

CLEARING AND GRUBBING

A. Description

This work shall consist of clearing, grubbing, snagging, removing from the ground, and disposing of trees, stumps, brush, shrubs, and other vegetation and debris occurring within the right-of-ways which interfere with excavation or embankment, or are considered otherwise objectionable, and includes the preservation from injury or defacement of all vegetation and objects designated to remain. Clearing is further defined as the cutting, dozing or other means of removing trees, logs, brush, shrubs, stumps and debris from the required work area. Grubbing is further defined as the removal of tree stumps and roots from below the ground surface. Snagging is further defined as the removal of loose debris, stumps, logs and fallen trees from an area without disturbing the existing sodded conditions.

B. General

The Contractor shall clear the channel and spoil deposit areas at least ½ mile in advance of the excavating operation with the following provisions, clarifications and exceptions applying:

1. All trees and brush shall be removed from within the limits of the channel. Unless otherwise noted on the plans or otherwise instructed by the Owner, the channel limits shall be defined as the area between the tops of channel side slopes.
2. All trees and brush shall be removed between the channel limits and outer edges of the spoil areas. Trees 6 inches in diameter or larger may be left in the right-of-ways provided they do not interfere with the construction operation.
3. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections.
4. The Owner reserves the right to order saved any tree or other vegetation during the course of construction at no increase in cost to the project.
5. The Contractor shall secure written permission of the landowner prior to removing any fruit trees.
6. The Contractor shall secure written approval of the landowner before removing merchantable timber or shade trees. Landowners shall have first call on all valuable timber. If the landowner does not wish to retain ownership, then the Owner shall have the option of claiming the timber. If neither the landowner nor the Owner choose to exercise this option, then the timber shall become the property of the Contractor.

Where the landowner or the Owner down the timber, both parties shall be given reasonable notice so that they may cut and remove the merchantable timber before the clearing operation, otherwise, all

timber will be treated as debris and disposed of as required by the Contractor.

7. The Contractor will clear, snag and grub that portion of the drain to be excavated.
8. On drain slopes that will not be disturbed by the excavation operation, the Contractor will clear, snag and grub.

Note: When authorized by the Owner, the Contractor may spray stumps 6 inches and over. Stumps under 6 inches and all brush shall be grubbed. Stumps shall be sprayed as specified under Spraying.

9. When called for on the plans, and where spoil is to be deposited on one side only, and access for maintenance purposes is not necessary, on the opposite side, the Contractor will be required to clear by cutting and grubbing a 12 foot wide maintenance strip on the opposite side. If access for maintenance purposes is not necessary, the Contractor shall be required to remove from the 12 foot wide strip only those diseased or dead trees in jeopardy of falling into the drain.
10. When trees and brush are cut off, they will be cut off as close to the ground as possible, but no higher than 2 inches.
11. The Contractor shall investigate for himself what trees, brush and other vegetation must be removed.

C. Selective Clearing and Grubbing

When bid as a separate item, the Contractor shall be required to selectively clear and grub the drain according to the plans. Fruit trees, trees, decorative shrubbery, and flowering plants may be designated on the plans to be removed (R), removed and relocated or replaced (RR), saved (S), or removed and salvaged (RS). Such designations are made for the convenience of the Contractor and are not intended to relieve him of the responsibility of securing the landowner's written permission to remove or to remove and relocate or replace or to save. Minor trees, brush and vegetation may not be shown on the plans. The Owner reserves the option to decide on their disposition during construction at no additional cost to the project. The Owner also reserves the right to change the designations (R, RR, S, RS) during construction at no additional cost to the project. The Contractor shall be required to verify all removals prior to conducting the work. All trees and brush, which are removed, shall be grubbed.

D. Spraying

Spraying shall be performed by the Contractor where required or permitted by the Owner. All costs shall be incidental to clearing and grubbing, and/or selective clearing and grubbing. Spraying shall be carried out in the following areas:

1. Unexcavated Channel Areas: When authorized by the Owner, the Contractor may spray stumps 6 inches and over. Stumps under 6 inches and all brush shall be grubbed. If stumps 6 inches and over are not sprayed, then they shall be grubbed.
2. Spoil Areas: Where 12 inches of cover can be maintained over the top of stumps, trees and brush shall be cleared but need not be grubbed or sprayed. Where 12 inches of cover cannot be maintained over the tops of stumps, all stumps and brush shall be grubbed with the exception that stumps 6 inches and over may be sprayed when authorized by the Owner.
3. Maintenance Strip: Clear, snag, and grub except that stumps 6 inches and over may be sprayed when authorized by the Owner.
4. Stumps will be basal sprayed with approved herbicides. The carrier mixed with the herbicide will be in accordance with the directions of the chemical manufacturer and will be colored with a suitable water soluble colored dye such as DuPont's "Rhodamine."
5. Spraying will be performed only by a properly trained and licensed sprayer. Spraying of stumps will be done as soon as possible after the cutting operation, but no later than 24 hours, and will be applied according to the spray manufacturer's recommendations.

E. Salvage

Where the Contractor is directed to "Remove and Salvage" he shall save all materials that may be of any value. It is the intent that salvage materials be saved for reuse by the Owner. The Contractor shall exercise care in removing such materials so that they are not damaged to the point where reuse is impossible. Where the Contractor has damaged materials designated for salvage, he shall be required to replace such materials at his own expense. Material replacement shall be subject to the approval of the Owner. All salvage materials shall be the property of the Owner. The Contractor shall use or dispose of such salvage as ordered. The Contractor shall be responsible for delivering the salvage materials to locations designated by the Owner.

F. Disposing of Unsalvaged Materials

All combustible debris shall be either burned and/or buried in compacted trenches with a minimum of 24 inches of cover or removed from the site and disposed of as approved by the Owner. Burning shall be in accordance with applicable laws regarding open fires. The Contractor is responsible for obtaining all necessary burning permits from local controlling units of government. No burning or piling shall be allowed within 200 feet of any overhead public utility line. When burning is permitted, and areas of organic soils are encountered, the combustible debris shall be either removed from the site or moved to areas of mineral soils before burning. The Contractor shall be responsible for any damage to life and/or property caused by fires resulting from his operations.

Tree stumps packed with soil that are grubbed intact with the entire tree may be placed in burning piles, provided there is sufficient other combustible material in the pile to assure a good burn. Otherwise, all noncombustible debris, cut-off stumps packed with soil, or the remains of any burning piles shall be either buried with at least 24 inches of cover or removed from the site. When burning is not permitted, all combustible debris shall be neatly piled and placed at intervals of not less than 100 feet. Adequate clearance (15 feet minimum) between the drain and debris piles shall be provided. When a property line falls within the drain top width, the debris piles shall be placed equally on both sides unless otherwise approved by the Owner.

Debris piles shall be kept reasonably free of soil and noncombustible debris. In wooded areas, when burning is not permitted, debris may be windrowed behind the spoil piles in a neat row with a minimum of 8 feet of clearance between the debris and the wooded areas, and between the debris and the spoil piles. Burning and/or burying will not be permitted within platted subdivisions.

The Contractor shall submit his schedule, methods of disposal, and location of disposal to the Owner for approval.

G. Protecting Plant Life

All vegetation which is required to be relocated, replaced or saved, shall be carefully protected from damage or injury during all construction operations. Any trees, shrubs or vegetation, that are not designated to be removed but are damaged by the Contractor's operations shall be repaired or replaced by the Contractor, at his own expense, as directed by the Owner.

H. Project Cleanup

Prior to final acceptance, the Contractor shall clean up and leave in a neat condition all of the premises which he has occupied or made use of during the construction period.

I. Measurement and Payment

The completed work as measured for clearing and grubbing will be paid for at the contract unit prices for the following contract pay items:

<u>Pay Item</u>	<u>Pay Unit</u>
Clearing & Grubbing	Lineal Feet(LF)
Selective Clearing & Grubbing	Lineal Feet(LF)

The length measured will be along the centerline of the drain. Payment for this work shall include, but not necessarily be limited to, clearing, grubbing, snagging, removal and disposal of vegetation and debris, stump spraying,

saving of salvage materials, protection and replacement of plant life to be saved, and project cleanup.

EXCAVATION

A. Description

This work shall consist of constructing earth grades by excavating soil or rock, and shall include the salvaging and stockpiling of selected material, disposing of surplus or unsuitable material, trimming the earth grade, and maintaining the work in a finished condition until acceptance. All work to excavate materials, which is not covered by separate items in the Contract, will be classified as Open Drain Excavation.

Soil notations and soil boring data, if shown on the plans, are for information only and shall not relieve the Contractor of his responsibility of investigating all local conditions before bidding.

B. Moving Fences

Where grading behind existing fences is required, sufficient fence shall be carefully removed and replaced. All materials which can be reused may be salvaged from the existing fence. Any additional materials required for resetting the fence shall be replaced by the Contractor using equal or better materials. All work to move, remove and/or replace fence which is not covered by a separate item in the Contract will be classified as Open Drain Excavation.

C. Removing and Salvaging Topsoil

Topsoil for seeding and sodding purposes shall be furnished by the Contractor as directed by the Owner. Topsoil for seeding or sodding may be required, where, in the opinion of the Owner, the existing topsoil is inadequate for insuring the growth of grass or sod. Topsoil may be furnished for the site or from sources located outside the site. This specification is intended to apply to topsoil secured within the site. The locations where topsoil is stripped and stockpiled shall be subject to the approval of the Owner.

Sufficient topsoil may be salvaged for seeding and sodding purposes as directed by the Owner. Before removing topsoil within the site, all vegetation of a height greater than 1 foot shall be reduced to a height of approximately 6 inches and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of.

Topsoil stockpiles shall be located and shaped so as to avoid placing around trunks and over root areas of trees to be preserved or in drainage courses.

The topsoil may be completely removed to the required depth from any designated area prior to the beginning of regular excavation or placement of spoil embankment in that area.

Equipment and methods of operations shall be such as to avoid the lifting of subsoil. If soil or weather conditions are unsuitable for the topsoil removal

operations, the Owner will order the operations suspended until conditions become favorable for resumption of the work.

Requirements for removal of topsoil from various portions of the right-of-way and borrow areas shall be as follows:

1. Peat, Muck, Organic Soil Areas: Topsoil shall not be removed.
2. Open Channels and Spoil Areas: Topsoil shall be only removed within construction limits where required by the Owner.

The topsoil may be stockpiled within the limits of the right-of-ways, outside the limits of construction, or used as directed by the Owner.

All work to remove and salvage topsoil which is not covered by a separate item in the Contract will be incidental to Open Drain Excavation or Sewer Construction.

D. Open Drain Excavation

The Contractor shall excavate the drain to the dimensions and cross sections specified in the plans. No change in grade or dimensions shall be made without permission of the Owner.

1. Tolerances: The Contractor shall closely adhere to proposed grades 300 feet below and above any bridge, culvert or rockford crossing. In no case shall the bottom grade be more than 0.5 feet below planned grade in these areas. Any excavations below this depth will be filled with approved size and type of rock as directed by the Owner. All costs shall be incidental to Open Drain Excavation.
2. Unstable Soils: It will be the Contractor's responsibility to have first constructed a pilot channel as specified below to the area of unstable soils. If the drain slopes do not become stabilized within a reasonable amount of time the Owner will specify the changes necessary to provide stability for the banks and grade. Any additional excavation or other work account of changes will be paid for at a price agreed upon in an executed Change Order before the changes are made.
3. Pilot Channels: When called for on the plans, or when wet or unstable soils are encountered, the initial construction of the drain shall be excavation of a pilot channel. The pilot channel shall be excavated at least 30 days in advance of completing final drain side slopes. The Owner shall determine when drain slopes have stabilized sufficiently to allow for final slope shaping. The pilot channel excavation shall have a bottom width of approximately $\frac{1}{2}$ the proposed final width (minimum 4 feet) with 1:1 side slopes and will be excavated to the proposed design grade.

The pilot channel will not be excavated upstream from any bridge requiring bridge protection work or replacement until the scheduled

work for such bridge has been completed, unless otherwise approved by the Owner.

4. Sediment Sumps: When called for on the plans, or at the Contractor's discretion, sediment sumps will be constructed at strategic locations to trap the sediments moving downstream during construction. When specified dimensions are not given on the plans, sumps will consist of overexcavating the drain grade by 1 to 2 feet with 1.5:1 side slopes. Sump bottom width shall be determined by the Owner during construction. The sumps will be at least 200 feet long, depending upon site conditions, but shall not be located within 300 feet of any crossing. If directed by the Owner, sediments accumulated during construction shall be removed from sumps periodically during construction and upon project completion.
5. Channel Parallel to Roadway: All excavation is to be taken from the side of the ditch opposite the roadbed where the channel runs parallel and adjacent to a road. However, the banks on the roadside are to be shaped to a 2:1 slope and all brush, roots, etc., removed. Where the roadside ditch slope is especially steep as sometimes occur, the Contractor may be ordered to cut the brush low and retain the present grass slope. At the option of the Genesee County Road Commission, and if right-of-way allows, dirt may be ordered placed on the opposite side of the road and leveled. In some cases, the roadway itself may be raised.

Where farm outlet roads occur along the side of the drain, excavation shall be placed on the opposite side of the farm road and leveled in order to save the present traveled surface. The 2:1 slope specified will be rigidly insisted upon, unless the Owner orders a lighter slope for short distances when the drain is close to farm buildings and bridges.

6. Spoil Banks: Excavated material shall be deposited only on the cleared right-of-way. Spoil material will be placed equally on each side of the drain, except where otherwise shown on the plans or directed by the Owner. In areas where the spoil was placed all on one side during previous drain excavations, the newly excavated soil shall be placed on the opposite side, except where otherwise shown on the plans or directed by the Owner. Old spoil banks shall be cleared and leveled as directed by the Owner, and as is necessary to facilitate the overall operation. Both old and new spoil banks shall be leveled as shown on the plans.

All old or newly excavated spoil deposited on or adjacent to improved or tillable farm land will be leveled to the average height above the ground as shown on the plans. Leveling will be done with suitable equipment in order that the landowner can work or till the spoil with normal farm equipment. The spoil will be uniformly sloped away from the channel. In wooded areas, old and new spoil banks will be piled, leveled and left in a condition suitable for travel by farm equipment.

When spoil is to be deposited on unstable organic soils, a 15 foot wide

berm will be maintained at all times during construction between the top edge of the drain and the excavated spoil.

All openings and tributaries entering the drains shall be left open for the free passage of water. Openings shall be left or made through the depositions at such places as the general ground drains. A minimum 3:1 bottom slope shall be provided for these openings and tributaries where they discharge into the drain. Approximately 2 square yards of plain riprap shall be placed in the opening bottom as directed by the Owner. Spoil shall be placed well away from existing tributary watercourses, drains and swales. Water shall not be trapped behind the leveled spoil in broad flat farm areas. In these cases, extra shaping of the spoil and the area behind it may be necessary.

No excavation material shall be deposited on any highway or within any highway right-of-way, except upon permission of the Owner or highway agency having authority.

Under no circumstances shall combustible brush or debris be covered or mixed with spoil material. A minimum of 12 inches of cover shall be placed over any cutoff stumps. The Contractor shall bury to a depth of 24 inches all rocks 12 inches in diameter and larger which are excavated from the drain.

7. Restricted Open Drain Excavation: In landscaped areas, (including, but not necessarily limited to subdivisions, parks, golf courses, etc.) all spoil shall be hauled away. All disturbed areas shall be restored to their original condition existing before construction. All work and costs associated with hauling spoil which are not covered by a separate item in the contract will be incidental to and classified as Open Drain Excavation.
8. Tributary Watercourses: When called for on the plans, and when directed by the Owner, major watercourses, side drains, and road ditches will be graded out as shown on the standard details. In some instances, road ditches may have to be realigned to avoid interference with the ends of the road culvert. The work associated with gradeouts and realignments of tributary watercourses shall be incidental to other items provided in the contract, i.e., clearing and grubbing, open drain excavation.
9. General Maintenance: The drain shall be maintained in such condition that the work will be well drained at all times. If it is necessary, in the prosecution of the work, to interrupt existing surface drainage, sewers or underdrainage, temporary drainage facilities shall be provided until the permanent drainage work is completed.

The grading shall be so conducted as to avoid unnecessarily removing or loosening any materials outside of the required slopes. Any such material which may be removed or loosened shall be replaced and thoroughly compacted.

All roots, stumps and other objectionable materials in the slopes and

bottom of the drain shall be removed, and any resulting holes backfilled with suitable material. All drains constructed on the project shall be maintained and kept free from debris until final acceptance.

E. Rock Excavation

Rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock and hardpan which cannot be excavated without continuous drilling and blasting or continuous use of a ripper or other special equipment. Hardpan is defined as cemented soil layers. The term hardpan shall not be applied to hard clay layers that are not cemented.

Where rock excavation is encountered within the grading limits, the surface of the rock shall be sufficiently exposed to permit adequate measurements to be taken before the rock excavation is started.

Where rock is encountered in the excavation, it shall be removed between channel lines to the cross section and elevation below earth grade, as shown on the plans or as authorized, with no rock projecting above the lines of the required cross section. All rock or boulders loosened in the excavation and overhanging ledges, either on or outside the required cross section, shall be removed.

Where rock excavation is encountered during construction and is not covered by a separate item in the contract, rock excavation will be paid for at a price agreed upon in an executed Change Order before the excavation is begun.

The Contractor is cautioned that the use of explosives will require special permits and insurance coverage which are to be secured and paid for by him. All costs shall be considered included in the contract item for Rock Excavation, or included in agreed upon prices in executed Change Orders.

F. Machine Grading

The work of machine grading shall consist of light grading of such character that, in general, the drain channel and spoil areas can be shaped by a blade grader or similar equipment.

The work shall include all necessary scarifying, plowing, disking, moving and shaping the earth to develop the cross section shown on plans. Drain shall be in close conformity with the line and grade as shown on the plans or as directed and must drain runoff waters to outlets shown on the plans or designated by the Owner.

All work to perform machine grading which is not covered by a separate item in the contract will be classified as Open Drain Excavation.

G. Rockford Crossing

Exact location of rockford crossings shall be determined in the field by the Owner during construction after consultations with the landowners. Field adjustments shall be made when, during the excavation operation, unstable

soils are encountered at the planned locations.

The ramps shall be no steeper than 8:1. The sides of the ramp shall be sloped at 1.5:1 unless otherwise specified. Upon completion, all exposed earth surfaces of the rockford shall be fertilized and seeded.

Rock used in construction of the rockford shall be Bayport Quarry #4 ballast limestone (majority in 1½" to 2" range) or an equal approved by the engineer.

The ramps shall be surfaced with 12 inches of rock. The bottom level portion of the rockford shall have rock to a depth of 24 inches.

H. Measurement and Payment

The completed work as measured for Excavation will be paid for at the contract unit prices for the following contract pay items:

<u>Pay Item</u>	<u>Pay Unit</u>
Open Drain Excavation _____ ft. Bottom	Lineal Feet(LF)
Restricted Open Drain Exc. _____ ft. Bottom	Lineal Feet(LF)
Rock Excavation	Cubic Yard(CY)
Machine Grading	Lineal Feet(LF)
Remove and Salvage Topsoil	Cubic Yards(CY)
Rockford Crossing	Each(Ea)

1. The length measured for Open Drain Excavation will be along the centerline of the Drain, excluding culvert lengths. Pay for the work shall normally include, but not necessarily be limited to, removing fences, removing and salvaging topsoil, excavation to the required earth grades, construction of pilot channels and sediment sumps, spoil banks, leveling, grading out of watercourses, and general drain maintenance during construction. All work to excavate materials which is not covered by separate items in the Contract will be classified and paid for as Open Drain Excavation.
2. The length for Restricted Open Drain Excavation shall be measured along the centerline of the Drain, excluding culvert lengths. The work included shall be similar to Open Drain Excavation, except that all spoil shall be hauled away. All work and costs associated with hauling of waste excavation shall be incidental to Restricted Open Drain Excavation.
3. Rock Excavation will be measured by the staked-section method with no allowance for overbreak.

4. Machine Grading will be measured by length along the drain centerline in lineal feet. Payment for the trimming of the earth grade to the specified tolerances is considered to have been included in the prices bid for Machine Grading.
5. Payment for work and materials required to build and maintain haul routes will be considered as having been included in the contract unit prices bid. Topsoil and frozen material removed to facilitate the Contractor's operations will not be paid for. The compaction of original ground, embankment, and cut sections will not be paid for separately but will be considered as included in the contract unit prices bid.
6. Rockford Crossings shall be bid and paid for on a lump sum basis for each crossing. Such payment will be considered full compensation for all excavation, labor and materials necessary in the performance of the work.

CULVERTS

A. Description

This work shall consist of relaying existing culverts and of constructing new culverts of the class or kind specified, of the required size, and shall include road surface removal, excavation, laying and jointing pipe, backfilling, and road base and surface replacement. The type and size of pipe culvert will be specified in the proposal or on the plans. Substitutions will not be allowed unless prior approval from the Owner is secured through execution of a Change Order.

B. Advance Notice and Permits

The Contractor shall notify the Owner and the highway or road agency having jurisdiction not less than 48 hours in advance of the time when he intends to cross any highway or road. Before beginning work on any highway crossing, the Contractor shall obtain written permission to cross from the highway or road agency. During the continuance of such crossing work, the Contractor shall erect and maintain barriers, warning lights and other protective devices as necessary, and shall furnish such watchman as may be needed to prevent an accident as a consequence of his work. All protective devices and procedures shall be in accordance with the prevailing rules and regulations of the highway or road agency having jurisdiction. In the absence of such rules and regulations, the Contractor shall be required to abide by the provisions of the current Michigan Manual of Uniform Traffic Control Devices.

The Contractor shall be liable for all accidents and damages caused by his neglect, or by the acts or neglect of his Subcontractors, agents, employees or workmen. The Contractor shall determine for himself what the requirements of the highway agency are for permits, insurance, bonds, barricading, backfilling, financial responsibility for imposed inspection fees, surface replacement or any other special requirements. The Contractor shall be required to pay all permit and inspection fees imposed by the highway or road agency having jurisdiction.

Where the requirements of the highway or road agency exceed the requirements specified herein, the requirements of the highway or road agency shall take precedence.

New culverts or culverts to be relaid will be placed by the Contractor according to the standard details and specifications of the highway agency having jurisdiction. Where required by the highway agency, such standard details and specifications shall supersede and replace the details shown on the plans and specifications covered herein.

C. Materials

1. Reinforced Concrete Culvert Pipe shall conform to the requirements of ASTM C-76 with the following exceptions and additions applying: Lift holes shall be cast or drilled. When elliptical reinforcement is used in

circular pipe, lift holes shall be cast in the pipe so that when properly installed, the lift holes will be on the top of the pipe and in line with the centerline of the culvert or sewer. After the pipes are installed, the lift holes shall be sealed with suitable concrete plugs. When S-stirrups are used, the centerline of the top and bottom of each end of each section of pipe shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of the walls. Markings shall be indented on the pipe section or painted thereon with waterproof paint. Circular pipe intended for use in pipe culverts jacked in place shall contain circular reinforcement.

The absorption test requirements of the concrete will be waived if the load required to produce the 0.01-inch crack exceeds by 20 percent or more the specified minimum load to produce the 0.01-inch crack.

2. Reinforced Concrete Elliptical Pipe shall conform to the requirements of ASTM C 507, except that the absorption test requirement of the concrete will be waived if the load required to produce the 0.01-inch crack exceeds by 20 percent or more the specified minimum load to produce the 0.01-inch crack.
3. Nonreinforced Concrete Circular Pipe, of the class specified, shall conform to the requirements of ASTM C 14, except that the required markings shall be made on the barrel of the pipe, near the socket, at the time of manufacture and shall be plainly legible at the time of delivery to the site of the work.
4. Corrugated Galvanized Steel Pipe with circular cross-section and reformed corrugated galvanized steel pipe with pipe-arch shape, shall conform to the requirements of AASHTO M 36, with the exceptions and additions specified herein. The Contractor shall furnish the Owner with 2 copies of a certification of compliance with the chemical requirements of the base metal as specified in the AASHTO Specification.
 - a. Testing: Corrugated steel pipe will be tested at the option of the Owner for weight of zinc coating of the metal. The weight of the zinc coating on any individual specimen shall meet the Single-Spot test requirement (1.80 oz./sq. ft. of sheet).

Testing for mechanical properties and for chemical analysis of the base metal will be at the option of the Owner.

When a chemical analysis of the base metal is required, it shall be made in accordance with ASTM E 30, E 281, and E 282, as applicable.

- b. Corrugation: The depth of the corrugations shall not under run the value specified by more than 5 percent. The pitch shall not exceed 2 3/4 inch, 3 1/4 inch, or 135mm for the 1/2 inch, 1 inch, and 26mm deep corrugations, respectively. The direction of the helical corrugations in pipe of 6 through 21 inch diameter shall

form an angle with the longitudinal axis not less than 45 degrees.

- c. Thickness Required: The nominal wall thickness required shall be as specified in the proposal or on the plans. Where such specification is lacking, culvert wall thickness shall be Class B wall thickness as specified in the current edition of the M.D.O.T. Standard Specification for Construction.

- 5. End Sections: Metal End Sections shall be fabricated in accordance with the details shown on the plans and shall be furnished complete with standard coupling band and connector section. They shall conform to AASHTO M 36, where applicable.

Precast Concrete End Sections shall be constructed of concrete and reinforcement conforming to the requirements of ASTM C 76, Class II. The concrete shall have an entrained air content of 6.0 ± 2.0 percent. Connections to pipe culverts shall be by means of standard tongue and groove joints.

- 6. Cold-Applied Pipe Joint Sealer: The bituminous material for sealing joints in concrete pipe used in culverts shall be of such consistency that it may be spread on the joints with a trowel when the temperature of the air is between 20°F and 100°F. The bituminous material shall adhere to the concrete or clay pipe so as to make a watertight seal and shall not flow, crack, or become brittle when exposed to the atmosphere.

The bituminous sealer shall meet the following specific requirements:

- Penetration, 25 C, 150 g.,
5 sec., with cone, dmm 175-300
- Loss on Heating, 163 C, 5 hr.,
50 g., percent1.50 max.
- Solubility in Trichloroethylene,.....70 min.
- Ash, percent 15-25
- Flow, centimeters, at 140°F 0 max.

The bituminous sealer shall be delivered to the project in suitable containers for handling and shall be sealed or otherwise protected from contamination. The container shall be marked as "Cold-Applied Pipe Joint Sealer" and shall show the brand name, net volume or weight, and the requirements for application.

- 7. Structural Plates for Field Assembly of Pipe, Pipe-Arches, and Arches: The plates, bolts, and nuts to be used in field assembled circular pipe, pipe-arches and arches shall meet all applicable requirements of

AASHTO M 167, except as otherwise specified herein.

The test for weight of spelter coating will be made in accordance with ASTM A 90. Testing for mechanical properties and chemical analysis of the base metal will be at the option of the Owner. When required, the chemical analysis of the base metal shall be made in accordance with ASTM E 30, E 281 and E 282, as applicable.

If the spelter coating as determined from the required sample is less than the specified average coating, 2 additional samples shall be taken from the same lot of plates. If the average weight of spelter coating as determined from the 3 samples is less than the average amount specified, or if any one specimen fails the single specimen minimum check limit (90 percent of the average coating), the lot sampled shall be rejected. Spelter coating shall be of first-class commercial quality, free from injurious defects, such as blisters, flux and uncoated spots.

All plates for which 3-ounce spelter is required shall be galvanized after fabrication. Plates equal to or thinner than nominal 0.168 inch thickness may be galvanized either before or after fabrication.

The plates shall be of such sizes that on assembly there will be no 4-lap seams. No part of any plate shall be without curvature. The plates shall be formed so that the dimensions of the completed structure shall not vary from the dimensions shown on the plans by more than 4 percent. All measurements shall be taken to the inside crests of the corrugations.

8. Precast Concrete Box Sections shall meet the requirements of ASTM C 789 or ASTM C 850, as applicable.

D. Construction Methods

1. Excavation and Culvert Bedding: When directed by the Owner, all unsound material underlying proposed culverts shall be removed and replaced with M.D.O.T. Granular Material Class II in layers not exceeding 6 inches in depth. Each layer shall be compacted to 95 percent of Maximum Unit Weight. The thickness of each layer of backfill may be increased to more than six (6) inches, provided the full depth of each layer of backfill is compacted to not less than the required percentage of maximum unit weight. Culvert beddings shall be constructed using Granular Material Class II in accordance with the details shown on the plans. Where rock or hardpan is encountered, the trench shall be excavated to a depth at least 4 inches below the grade established for the bottom of the pipe, and this excess depth shall be backfilled with Granular Material Class II to 95 % of maximum unit weight. Smooth transitions shall be excavated on the drain bottom width and side slopes upstream and downstream from culvert installations involving larger diameters or multiples.
2. Repair of Damaged Galvanized Surfaces: Special care will be taken in removing, salvaging, storing, handling or placing new culverts or culverts to be relayed so that they are not dented, scraped or the galvanized coating otherwise damaged. When placing larger diameter

or longer length culverts, suitable lift rings will be shop attached to facilitate handling. Lift holes cut in the C.S.P. will not be allowed. Saw cut ends of the C.S.P. shall be reasonably free from excessive jagged burrs or sharp spurs.

Surfaces on which the spelter coating has been damaged in transporting, handling, or installing shall be repaired by the Contractor without cost to the Owner. The damaged spelter shall be thoroughly cleaned by wire brushing and then painted with 2 coats of zinc-rich paint conforming to Federal Specification: Paint, High Zinc Dust Content, Galvanizing Repair (Ready Mixed Type), MIL-P-21035.

3. Laying and Jointing Pipe: All pipe shall be laid true to the lines and grades given, bells or grooves upgrade, ends fully and closely jointed, and each section shall have a full, firm bearing throughout its length. Reinforced concrete elliptical pipe shall be installed with the longer axis placed horizontally. Shop elongated corrugated steel pipe shall be installed with the longer axis placed vertically.

Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes on top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs.

Any pipe which shows signs of settlement or which is not in true alignment shall, upon the order of the Owner, be taken up and relayed.

4. Jointing Concrete Pipe with Cold-Applied Pipe Joint Sealer: Bell and spigot pipe or tongue and groove pipe shall be wiped clean and dry before applying the sealer to the pipe joint. Before the succeeding section of pipe is placed, the spigot end or tongue end of the pipe shall be completely covered with an excess of sealer, and then the pipe shall be laid to the established line and grade so that the inside surfaces of abutting pipe are flush. The joints shall then be completely filled with sealer so as to make a water tight seal. For 30-inch diameter and larger pipe, any excess material shall be removed from the inside of the pipe.
5. Jointing Corrugated Pipe - The separate sections of corrugated pipe shall be securely joined together with standard metal coupling bands. The bands may be two thicknesses lighter than the culvert, but not less than 0.64 inch (16 ga.). The standard band shall have the following minimum widths: 7 inches for sizes up to and including 18 inches, 12 inches for sizes 21 through 60 inches, and 24 inches for over 60 inches. Special coupling bands such as the hugger type or those used on re-rolled ends shall have widths generally corresponding to the above range variations. When joining sections of helical pipe, the ends of the joined sections shall be either rerolled to an annular configuration to receive the standard or hugger type bands or a special flanged band will be used. Dimpled type bands will not be allowed, nor will the use of annular or helical bands on helical pipe without prior written approval of the Owner. All helical corrugated steel pipe to be used on

public road crossings shall have both outer ends rerolled to an annular configuration to allow for future extensions. The pipe shall be laid with outside laps of circumferential joints, if any, pointing upgrade, and with no longitudinal joints in the lower quadrant.

6. Structural Plate Pipe and Structural Plate Pipe-Arch: The structure shall be assembled according to the manufacturer's instructions. Bolts shall be torqued to provide tight joints without exceeding a maximum torque of 300 foot-pounds and retaining a minimum of not less than 100 foot-pounds.

When the structure is to be erected in a trench, the width of the trench shall be sufficient to permit thorough compaction of the earth backfill.

The structure shall be bedded on an adequate foundation which has a uniform density and which has been shaped with a template to fit the lower plates. Where rock in either ledge or boulder formation is encountered, it shall be removed below grade and replaced with suitable materials in such manner as to provide a compacted earth cushion having a thickness under the pipe of not less than 12 inches unless otherwise specified. Where the foundation consists of soft, spongy, or other unstable soil, such soil under the pipe and for a width of at least 1 diameter on each side of the structure shall be removed and replaced with M.D.O.T. Granular Material Class II compacted by the Controlled Density Method.

7. Backfill:

- a. Granular Material Class II: Backfill shall be placed and compacted by the Controlled Density Method, except as modified herein. Backfill shall be placed evenly and alternately on both sides of the structure. In placing backfill around a structural plate pipe-arch, the material placed from the footing elevation to an elevation at least 12 inches above the top of the arch shall be placed by one of the methods described in Section 5.12 of the current M.D.O.T. Standard Specifications for Construction. Any additional material required to build the embankment to subgrade elevation shall also be placed by the controlled Density Method unless otherwise specified or authorized.
- b. Select Backfill: The backfill shall consist of suitable excavated material (excluding blue clay, peat, and muck) subject to the approval of the Owner. The backfill shall be placed in 1 foot layers with each layer compacted by approved mechanical methods to a density equivalent to the undisturbed soil. When required by the Owner, the backfill shall be surfaced with a minimum 6 inches thick gravel subject to the approval of the Owner. Select backfill and processed gravel surface shall be incidental to culvert placement.

When it is necessary to operate earth moving equipment or any other equipment over pipe culverts before the backfilling is completed, a cushion of earth at least 3 feet above the top of the pipe and for a width

of the equipment will be required to protect the pipe.

In any case, pipe that is broken, bent, or otherwise damaged by the Contractor's operations shall be removed and replaced with acceptable pipe without additional compensation.

Backfill over all culverts will be of sufficient depth to provide a minimum of 12 inches of cover for equivalent pipe sizes to and including 84 inches, 18 inches for equivalent pipe sizes to and including 102 inches, and 24 inches for 108 inches and larger. The backfilling shall be crowned and shaped to divert surface water runoff to prevent erosion over the end slopes.

8. End Sections: Where required, the ends of the culvert shall be protected, or end sections constructed in accordance with details shown on the plans. Steel end sections shall be attached to the ends of pipe by means of standard metal bands or other connecting devices as shown on the plans or as approved by the Owner.

Where designated on the plans, end section grates for culvert end sections shall be furnished and installed on the culvert end sections. The grates shall be fabricated from any grade of weldable hot-rolled steel bars, plain or deformed, of the diameter and configuration specified on the plans. They shall be securely fastened to the concrete end sections as called for on the plans.

9. Pipe Culverts Jacked in Place: This work shall consist of jacking into place a culvert pipe of the size and type shown on the plans or authorized by the Owner, without disturbing the roadbed or railroad above the pipe.

When reinforced concrete pipe is used, pipe with full circular reinforcement shall be used.

The culvert shall be jacked into place according to the required line and grade, established by the Owner.

The excavation ahead of the culvert shall be approximately 1 inch larger than the outside diameter of the pipe at the top and taper off towards the invert. The excavation shall not be carried ahead of the pipe far enough to cause caving of the earth. A steel cutting edge or shield may be attached to the front section of pipe to form and to cut the required opening for the pipe.

The approach trench shall be large enough to accommodate at least 1 section of pipe and the jacks and blocking. Two rails or sills shall be laid in the bottom of the trench to keep the pipe at the established line and grade. When jacking pipe under railroad tracks, sheeting and bracing plans of jacking pits shall be submitted for approval of the Railroad Company through the Owner. Excavation of the jacking pit shall not be started until such approval has been received.

Voids between the excavation and the pipe shall be filled using filler materials and placing methods as approved by the Owner.

Concrete pipe joints shall be protected from crushing due to jacking pressures. Upon completion of the jacking operations, joints shall be filed with mortar, wiped, and finished smooth. The joints shall be thoroughly wet before the mortar is placed.

10. Salvaging, Relaying and Extending Existing Culvert Pipe: Culvert pipe and end sections which are shown on the plans to be salvaged and relayed shall be placed in the same manner as specified for placing new pipe and end sections. However, the Owner reserves the option, upon existing backfill removal, to inspect the culvert pipe to be salvaged. If, in his opinion, the condition of the pipe is such that relaying is not feasible, then he may reject reuse of the pipe. In this event, the Owner shall designate the type and size of pipe to replace the rejected pipe. Any additional costs incurred by the Contractor on account of changes will be paid for at a price agreed upon in an executed Change Order before changes are made. The Owner reserves the right to request the Contractor to schedule early exposures of the existing pipe for inspection. Any existing pipe so damaged by the Contractor shall be replaced by him at his own expense. Pipe replaced shall be the same general size and type and shall be new pipe furnished in accordance with these specifications.

When existing culverts are to be extended, the Contractor shall, before ordering the new corrugated steel pipe extensions, field check the existing culvert to determine the exact size and type so that the new extension will be compatible and properly joined together. Any special banding techniques proposed by the Contractor shall have the prior approval of the Owner.

When existing round culverts are to be relayed, the inverts shall be rotated 180 degrees.

The Owner shall have the first option on claiming all culvert pipe removed from the drain. The pipe shall be delivered by the Contractor to the location designated by the Owner. All pipe not claimed by the Owner shall become the property of the Contractor, and shall be disposed of by him.

11. Road Surface and Shoulder Replacement: Road, street, and shoulder surfaces will be restored according to the requirements of the highway agency having jurisdiction. All cuts on concrete or asphalt pavements shall be neat straight cuts by a saw. Existing paved residential or access driveways will be restored to the new equivalent of the original condition. Unpaved residential streets and access driveways not falling under the jurisdiction of a highway or road agency will have a 6 inch processed gravel surface placed on them. Approaches to the crossings will not be steeper than a 10:1 slope.

Curb breaks shall be made at curb joints unless otherwise directed by the Owner. All pavement, curbs and curbs and gutters shall be replaced to the section and of the same materials as that removed in accordance with the Owner's established standards or in their absence,

to the Standards of the Michigan Department of Transportation. All costs shall be included in the unit price for Road Surface Replacement. Curb and gutter replacement shall only be paid for separately where a separate item for curb and gutter replacement has been established in the contract.

12. Cleanout: All old and new culverts shall be maintained and shall be kept free of accumulations of silt, debris, and other foreign matter.

13. Tile Outlets: With a minimum of 3 days notice to be given by the Contractor, landowners will locate and flag the location of all known tile outlets to be protected during the excavating operation. The Contractor will be responsible for leaving the tile outlets in good repair and in working order. When existing tile outlets are left in place, it may be necessary to shorten their length and recess them back into the newly shaped slope.

When called for on the plans or when directed by the Owner, new corrugated steel pipe tile outlets will be installed according to the standard details. The new corrugated steel pipe may be the same size as the existing tile outlet, provided an additional 1 percent slope can be obtained on the new corrugated steel, otherwise the size of the new corrugated steel pipe will be increased by 1 pipe size.

Interior lap seams on the new corrugated steel pipe will be placed in the direction of water flow. A suitable rodent guard shall be placed on the end of the new tile outlet.

When it is apparent a tile outlet is carrying human or animal waste materials from a home or barnyard area, Genesee County Health Department approval will be requested before reconnecting the outlet to the drain.

A pay item may be established with an arbitrary quantity for the purpose of applying the unit price to new corrugated steel pipe extensions. When no such pay item exists, the work of installing tile outlets shall be incidental to Open Drain Excavation.

E. Measurement and Payment

The completed work as measured for culverts will be paid for at the contract unit prices for the following contract pay items:

<u>Pay Item</u>	<u>Pay Unit</u>
___ " Corrugated Steel Pipe, ___"x___" corrug., ___ Ga	Lineal Feet(LF)
___ " x ___" Corrugated Steel Pipe Arch, ___" x ___" corrug., ___ Ga	Lineal Feet(LF)

___ " Corrugated Structural Plate Pipe, ___" x ___" corrug. , ___ Ga	Lineal Feet(LF)
___ " x ___" Corrugated Structural Plate Pipe Arch, ___" x ___" corrug., ___ Ga	Lineal Feet (LF)
___ " Reinforced Concrete Pipe C___, CL___	Lineal Feet (LF)
___ " x ___" Reinforced Concrete elliptical Culvert, HE___	Lineal Feet (LF)
___ ' x ___' Precast Concrete Box Culvert, C___	Lineal Feet (LF)
___ " Corrugated Steel Pipe End Section	Each(Ea)
___ " x ___" Corrugated Steel Pipe Arch End Section	Each(Ea)
___ " Corrugated Structural Plate Pipe End Section	Each(Ea)
___ " x ___" Corrugated Structural Plate Pipe Arch End Section	Each(Ea)
___ " Reinforced Concrete Pipe End Section	Each(Ea)
___ " x ___" Reinforced Concrete Elliptical End Section	Each(Ea)
___ Salvage & Relay ___" (Type) Culvert	Lineal Feet(LF)
___ Tile Outlets with Ratguard	Each(Ea)
___ Curb & Gutter Removal and/or Replacement	Lineal Feet (LF)
___ Road Surface Removal and/or Replacement	Square Yards(SY)
___ Shoulder Removal and/or Replacement	Square Yards(SY)

Payment for culverts shall include all labor, material, excavation, bedding, backfill, surface replacement, cleanup and all the work required for a complete job. Where specific items are listed separately in the proposal, they shall be paid for separately. Items not listed in the proposal shall be considered incidental work and merged into the unit price per foot of culvert.

Pipe Culverts, of the class or material and the diameter or size specified, will be measured by length in lineal feet, which will be determined by measuring the actual length of culvert but not including the length of end section as shown on the plans.

Corrugated Structural Plate Pipe and Corrugated Structural Plate Pipe Arch will be measured in place by length in lineal feet from end to end of the metal along the bottom of the pipe parallel to the centerline of the structure.

Culvert Bedding to replace unsound material underlying the proposed structure will be paid for separately at either the contract unit price or as provided by authorization in a Change Order.

Culvert Jacked in Place, of the size and type specified, will be measured by length in linear feet, which shall be determined by multiplying the number of units actually jacked by their commercial laying length.

Payment for excavation will not be paid for separately, but will be included in payment for installing culverts or for salvaging and relaying culverts.

Payment for backfill, Granular Material Class II Loose Measure (L.M.), will be measured in volume of loose material delivered to the site. The Contractor shall furnish delivery tickets at the time of delivery showing the quantities of Granular Material Class II delivered to the site. Payment for select backfill will not be paid for separately, but will be included in the payment for reinstalling culverts.

Road Surface Replacement and Shoulder Replacement shall be measured in place. Where replacement includes curb and gutter, replacement measurement shall be to the back of the curb. Replacement in excess of the quantities shown on the plans will be allowed only when adequately justified and authorized by the Owner.

SLOPE PROTECTION

A. Description

This work shall consist of all necessary excavation and disposal of excavated material, and of constructing, to the lines shown on the plans, a protective covering of the type shown on plans on a prepared foundation, including headers along the edges of the slope protection, when specified. Slope protection shall consist of the following types:

1. Plain Riprap
2. Heavy Riprap
3. Bag Riprap

B. Riprap

The materials shall meet the following requirements:

1. Concrete shall be Grade 30M, furnished and installed in accordance with current provisions of the MDOT Standard Specifications for Construction.
2. Steel Reinforcement shall be deformed bars meeting the requirements of ASTM A-615, A-616, or A-617 at the Contractor's option.
3. Stone for Plain Riprap shall be sound, tough, durable broken rock, free from structural defects or solid precast concrete blocks. Sound pieces of broken concrete may be used in place of stone when approved by the Owner. Individual stones or pieces of broken concrete shall measure at least 8 inches in one dimension and shall have a volume of not less than 1/3 cubic foot, except that smaller pieces may be used for filling spaces between the riprap stone. Broken concrete with projecting reinforcement or rounded boulders or cobblestones shall not be used.
4. Stone for Heavy Riprap shall be sound, tough, durable broken rock, free from structural defects, or solid precast concrete blocks. Sound pieces of broken concrete or concrete pavement may be used in place of stone when approved by the Owner. The volume of individual stone or pieces of broken concrete shall not be less than 1/2 cubic foot and shall average not less than 1 1/2 cubic feet and measure at least 16 inches in 1 dimension. Broken concrete pavement shall have a surface area of not less than 4 square feet, not more than 9 square feet and shall have a thickness of at least 8 inches.
5. Precast Concrete Blocks, if used, shall conform to the requirements of Section 8.19 of MDOT Standard Specifications for Construction, current edition.

6. Bag Riprap used shall be of at least 10 ounce burlap, properly sewn and each having a capacity of at least 1 cubic foot. The length of each bag will be approximately twice the width. Paper bags and prepacked riprap will not be permitted.

Concrete used in the bag riprap and the concrete header shall conform to Grad "30M" as defined in Section 7.01 of the MDOT Standard Specifications, or as approved by the Owner. The concrete shall be placed in the bags with a moisture content to produce a 1½" slump. Dry mix may be placed in the bags only with the Owner's approval.

C. Construction Methods

1. Preparation of Subgrade for Slope Protection: The subgrade shall be formed by trenching or filling to the required elevation for the bottom of riprap. The subgrade shall be thoroughly tamped or otherwise compacted to ensure its stability and trimmed to the necessary tolerances.
2. Plain Riprap: The bank on which the plain riprap is to be placed shall be trimmed to a uniform slope as shown on the plans.

The riprap shall commence in a trench below the toe of the slope, and shall progress upward, with each stone being laid by hand and firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with the surfaces in contact and with well broken joints. The riprap shall be thoroughly compacted as the construction progresses, and the finished surface of the riprap shall present an even, tight surface. The thickness of the riprap other than precast concrete blocks, shall not be less than 10 inches, measured perpendicular to the slope. Individual stones shall be laid with their 10 inch minimum dimensions perpendicular to the plane of the surface to be riprapped.

3. Heavy Riprap: The bank on which the heavy riprap is to be placed shall be trimmed to a uniform slope as shown on the plans.

Heavy Riprap shall be constructed in accordance with the requirements of plain riprap, except that the thickness of the riprap, other than precast concrete blocks, shall not be less than 16 inches measured perpendicular to the slope. Individual stones shall be laid with their 16-inch minimum dimensions perpendicular to the plane of the surface to be riprapped. When broken pavement is used, it shall be laid in 2 layers with staggered joints and all voids filled to the satisfaction of the Engineer.

4. Bag Riprap: The banks on which the bag riprap is to be placed shall be trimmed to a uniform slope as shown on the plans.

The bag riprap shall be placed in a circular wall, curved toward the center of the culvert with a .25:1 slope from bottom to top, wherever possible. The riprap must start 1 foot below the flow line of the

culverts. On the sloping banks of the drain, the headwall shall be trenched into the solid earth slope for a distance of 12 inches.

Number 4 deformed reinforcing steel bars, 2½ feet long, shall be driven into the riprap as it is placed at 15 inch intervals from bottom to top. The bars shall be lapped a minimum of 6 inches.

The backfill behind the riprap shall be thoroughly tamped and compacted.

All bag riprap headwalls shall be furnished with a reinforced concrete header as shown on the plans.

The placement of bag riprap in excess of the quantities shown on the plans will be allowed only when adequately justified and authorized by the Owner.

Filter fabric shall be installed behind the bag riprap headwalls. Product specifications for filter fabric shall be of the nonwoven polyester type such as Trevira or Spunbond 1120' or equal with a minimum thickness of 90 mils, a minimum permeability of 0.20 cm/sec and a minimum trapezoid strength of 60 pounds (ASTM D-2263). The installation shall be according to the manufacturer's recommendations. The filter fabric must be secured/anchored as shown on the plans. Upon completion of construction, the filter fabric shall not be exposed and shall have a minimum 6 inch soil cover.

Payment for material and installation of the filter fabric shall be included in the bid price for bag riprap.

D. Measurement and Payment

The completed work as measured for Slope Protection will be paid for at the contract unit prices from the following contract pay items:

<u>Pay Item</u>	<u>Pay Unit</u>
Plain Riprap	Square Yard (SY)
Heavy Riprap	Square Yard (SY)
Bag Riprap	Square Yard (SY)

Riprap will be paid for at the contract unit price per square yard, which price shall be payment in full for all excavation, trimming of bank and preparation of earth bed, furnishing and placing of riprap materials including reinforcing steel and reinforced concrete headers, and disposal of surplus materials.

TURF ESTABLISHMENT

A. Description

This work shall consist of preparing the foundation, topsoiling as required, fertilizing and mulching areas to be seeded, seeding or sodding, and watering as required.

The work of topsoiling consists of the preparation of the foundation and furnishing and placing the topsoil.

The work of fertilizing consists of furnishing and placing the fertilizer on areas to be seeded.

The work of seeding consists of preparing the topsoil surface and sowing the class of seed specified on all disturbed areas.

The work of mulching consists of furnishing, hauling, spreading, and anchoring, if required, mulch materials.

The work of sodding consists of preparing the topsoil surface, furnishing and placing the sod, and disposing of any surplus material.

The work of watering consists of furnishing and sprinkling earth beds and sodded areas at such times and locations and in such amounts as may be required by the Owner.

Friable is defined as a soil which is easily crumbled or pulverized.

Friable condition - soil in a "friable condition" is defined as a surface which is in a crumbled, pulverized, worked-up, loosened, or cultivated state; free of lumps and clods detrimental to seeding and sodding operations.

B. Materials

The materials shall meet the following requirements:

- A. Asphalt Emulsions Adhesive emulsions shall conform to the specific requirements for Asphalt emulsion SS-Ah, SS-As or RS-Am as specified in the current Standard Specifications for Construction of the M.D.O.T., except that when asphalt emulsion SS-Ah is used as the adhesive for anchoring mulch, diluting the emulsion will not be

permitted. Asphalt emulsions shall be made from an approved base asphalt having a negative spot. They shall be homogeneous and shall show no separation of asphalt after thorough mixing, within 30 days after delivery.

2. Mulching Materials for Seeding:

- a. Straw, hay, marsh hay, and excelsior used for mulches shall meet the approval of the Owner.
- b. Components for Latex-Base Adhesive for Mulching shall meet the following requirements:

- 1) Emulsion - The composition, by weight, of the latex emulsion polymer shall be 48% Styrene, 50% Butadiene, and 2% Additive; 42.0-46.0% solids; and a pH, as shipped, of 8.5 to 10.0. The emulsion shall not be allowed to freeze or to be exposed to sunlight for a prolonged period of time.
- 2) Modifying Agent - The modifying agent shall be a Cellulose Ether Powder having a viscosity of 60,000 to 90,000 cps in a 2% water solution at a temperature of 20C.
- 3) Preparation of Latex-Base Adhesive - The latex-base adhesive shall be proportioned in the ratio of 2 pounds of the modifying agent to each 55 gallons of undiluted styrene-butadiene emulsion and 9.0 parts by volume of water to 1 part by volume of styrene-butadiene emulsion.

The adhesive shall be prepared by thoroughly combining the modifying agent with 1/2 to 2/3 of the required amount of water. The remainder of the water shall then be added and the mixture combined and thoroughly mixed with the styrene-butadiene emulsion.

- c. Net for Mulching shall consist of a biodegradable mesh with openings not to exceed 1½ inches by 3 inches. The net shall be furnished in widths of not less than 35 inches.

Staples for holding the net in place shall not be less than 6 inches long and shall be made from No. 11 wire or other approved material.

- d. Excelsior in Mulch Blankets shall be made from fibers cut from sound, green timber. The blankets shall be made of a uniform web of interlocking fibers with a backing of fabric net on one side only. The fabric net shall have a mesh size not exceeding 1½ inches by 3 inches and shall be biodegradable.

The blanket shall be produced in the form of a tightly compressed roll not less than 35 inches in width, and shall have the fabric net on the outside of the fiber mat.

Roll weight when manufactured shall average 0.089 pounds per square foot, ± 10 percent. Weight of each roll at the time of manufacture shall be written or stenciled on roll wrapper, or on an attached tag. Average of entire shipment shall be approximately 0.089 pounds per square foot of area.

Devices used to hold blankets in place shall be of the material and design specified on the plans or in the proposal, or as approved by the Owner.

3. Seeding Mixtures shall meet the requirements for purity and germination as specified in the Proceedings of the Association of Official Seed Analysis, rules for Testing Seeds.

Deficiencies below the percentage specified for purity and germination will be evaluated for acceptability by the Owner.

Seeds shall be furnished in durable bags. On each bag of seed, the vendor shall attach a tag giving name, lot number, net weight of contents, purity and germination.

Seeding mixtures shall be composed of certified seed of the purity, germination, and proportions, be weight, as specified in the following table:

SEEDING MIXTURES

SEEDS	MINIMUM PURITY	MINIMUM GERMINATION	MIXTURE PROPORTIONS
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SEEDING - CLASS A

Perennial Rye	99%	90%	30%
Kentucky Blue Grass	90%	80%	30%
Creeping Red Fescue	95%	90%	40%

SEEDING - CLASS B

Perennial Rye	99%	90%	40%
Alsike	98%	90%	20%
Creeping Red Fescue	95%	90%	40%

Seeding classification will be based on the kind and rate of application of seeding mixtures as specified in the following table:

CLASSIFICATION	INTENDED USE LBS/ ACRE	SOWING RATE
Class A	Lawns, Landscaped Areas	200
Class B	Drain side slopes, watercourse grade outs, culvert end slopes, spoil areas	125

When seeding disturbed areas in landscaped sections and lawns, the Contractor shall use a commercially available lawn seed mixture to match the existing lawn grass type and apply it according to the seed suppliers recommendation. When a match cannot be obtained, the Contractor shall use the specified Class A mixture.

4. Chemical Fertilizer shall be a ready-mixed granular material containing equal amounts by weight of available Nitrogen (N), readily available Phosphoric Acid (P2O5) and total available Potash (K2O) mixed with

not less than 40 percent by weight of filler.

Chemical fertilizer shall be supplied in suitable bags, with the net weight of the contents and guaranteed analysis shown thereon, or in bulk with certification of the fertilizer analysis and net weight of the shipment. In addition to the above requirements, custom mixed fertilizers shall be furnished with certification of the weight of each commercial fertilizer used in the mixture, the guaranteed analysis of each commercial fertilizer used, and a guaranteed analysis of each shipment, expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P₂O₅) and total available Potash (K₂O) included in the mixture.

5. Sod:

- a. General: Sod shall be taken from soils similar to that upon which it is to be placed, except that sod from light sand will not be acceptable. The sod shall consist of a vigorous growing dense perennial grass turf sufficiently tough so that when a square A2 X A2 inches is cut to the required thickness and suspended by A corner, it will not tear apart. The sod shall be approved by the Owner in its original location before cutting operations are started.
- b. Class A Sod shall be of densely rooted blue grass, or other approved perennial grasses, reasonably free from all weeds. Merion Blue Grass will not be acceptable in excess of 20 percent of a blend or mixture. The sod shall be cut to a uniform thickness of not less than A inch, and an area of not less than ½ square yard.
- c. Class B Sod shall consist of a dense, well-rooted growth of perennial and desirable grasses other than Merion Blue Grass, and shall be indigenous to the general locality where it is to be used and shall be reasonably free from all weeds.

Before cutting the sod, the grass shall be cut to leave a maximum length of 3 to 4 inches above the surface of the ground. The sod shall be cut to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than A½ inches. The sod shall be cut in strips of a uniform

width, not less than 10 inches, and in lengths of not less than 18 inches.

- d. Pegs for Sodding shall be made of sound wood, at least 10 inches long, and shall have a cross-sectional area of approximately 0.75 square inches. In lighter soils, longer pegs may be required.

6. Topsoil:

Topsoil shall consist of the dark, organic, natural surface soil encountered on the project, exclusive of any peat or muck. Topsoil furnished from outside the grading limits shall be approved by Owner.

C. Construction Methods

A. Topsoil Surface:

- a. In areas possessing an adequate amount of existing topsoil, muck or peat, topsoil surface will not be required. Topsoil shall be placed where directed by the Owner.
- b. Preparation of Earth Bed: When topsoil is required by the Owner, the earth bed upon which the topsoil is to be placed shall be at the required grade and properly trimmed. Prior to placing the topsoil, the earth bed shall be in a friable condition for a depth of approximately 2 inches, including areas previously mulched or seeded for erosion control. Earth beds not in a friable condition just prior to placing the topsoil shall be harrowed with a disk, a spring tooth drag, a spike tooth drag, or other means meeting the approval of the Owner.

Areas to be sodded shall be graded uniform and parallel to the finished grade and cross section shown on the plans within the specified tolerances. The tops and bottoms of all slopes shall be rounded to blend into the natural ground or adjacent slopes.

- c. Placing Topsoil: The topsoil shall be spread on the prepared areas to a depth of 3 inches \pm 1 inch, unless otherwise shown on the plans or authorized by the Owner. After spreading, any large clods and lumps shall be broken with a pulverizer or by other effective means, and all stones and rocks over 2 inches in diameter, roots, litter or any foreign matter shall be raked up and disposed of by the Contractor. After the spreading is

completed, the topsoil shall be in a friable condition prior to seeding or sodding. Topsoil not in a friable condition just prior to seeding or sodding shall be harrowed with a disk, a spring tooth drag, a spike tooth drag, or other means meeting the approval of the Owner. The prepared topsoil surface shall be in reasonably close conformity to the lines, grades and cross sections shown on the plans.

- d. If there is an excess of topsoil from salvaging and stockpiling topsoil, the stockpiles of surplus topsoil shall be trimmed to present a neat appearance, as directed by the Owner. No topsoil shall be removed from site, unless directed in writing by the Owner. If the landowner request the contractor, the contractor shall provide the owner a copy of written authorization for removal. In no case shall topsoil required for restoration be removed from the site.
- e. Topsoil preparation shall be inspected and contractor shall obtain written acceptance from the owner prior to finishing the restoration.

2. Fertilizing:

For areas to be seeded, chemical fertilizer shall be evenly applied on the prepared topsoil surface at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients, in equal proportions of Nitrogen, Phosphoric Acid and Potash, or as directed by the Owner.

Fertilizer spread by drill or broadcast methods will be placed or worked into the soil to a depth of 1-2 inches. Granular fertilizer shall not be spread by the hydro-method.

Fertilizer manufactured to be applied by the hydo-method shall be constantly agitated while being applied and will not require discing and harrowing after being placed. Water soluble fertilizer mixed with seed shall be applied within two hours after seed has been added to the mixture.

3. Seeding:

- a. Sowing: The seed shall be sown following or in conjunction with the fertilizer and while the seed bed is in a friable condition. The seed shall be lightly raked into the surface and rolled once

with a light hand roller. The seeded areas shall be thoroughly watered with a fine spray in such a manner as not to wash out the seed. The Contractor shall use care in raking, not to destroy finish grade ,nor to destroy uniform distribution of seed.

Seeds shall not be sown through mulch. The seed mixture required shall be sown, or resown, at the rate specified, with either mechanical drills, broadcast, or hydro-seeder type equipment. The capability of the seeding equipment shall be adequate , as determined by the Owner, to effectively cover the area to be seeded.

The content of the hydroseeder tank shall be emptied within two hours after the seed is added to the tank. Seed which is allowed to remain mixed with the water for longer than two hours shall be rejected.

Areas which are sown will be visually inspected for uniformity of application. Areas in which visual inspection fails to reveal adequate distribution or growth(minimum of 75% germination) shall be resown by the Contractor at no additional cost to the Owner for a period of one year or at least one spring thru summer growing season.

Immediately after completion of the seeding operation, the seeded areas requiring mulching shall be mulched. Mulching shall be furnished at the locations designated by the Owner.

- b. Time of Seeding: Drain side slopes, watercourse grade-outs, and culvert end slopes will be fertilized and seeded daily as construction progresses, unless the Owner approves other times or methods. Daily seeding shall be performed any time ground is not frozen, except from October 15 to early spring. When other than daily seeding is approved or re-seeding is required, or when construction is completed in a nonseeding period, seeding will be allowed only from early spring to June 15, or from August 10 to October 15. If directed by the Owner, proper seedbed preparation will be required on seedings not done daily or on areas to be reseeded.

The Owner may also require that certain areas of the leveled spoil be fertilized and seeded daily upon completion of final spoil shaping.

Where the initial daily seeding does not produce an adequate catch of new grass, the area will be fertilized and reseeded to reduce the soil erosion potential. Costs for daily seeding are inclusive to pay item erosion control measures. The Owner shall inventory and determine those areas to be re-seeded.

Seed disturbed areas anytime ground is not froze, except from November 15 to early spring.

4. Mulching:

Areas to be mulched within the seasonal limitations for seeding, shall be seeded and fertilized prior to placing mulch. At other times, temporary mulching may be required for temporary erosion control.

- a. Straw, Hay, Marsh Hay, or Excelsior Mulch shall be spread over the surface to a uniform thickness at the rate per acre as specified on the plans or as directed by the Owner. Mulch may be spread by hand methods, blower or other mechanical means, provided a uniform covering is secured.

The mulch shall be loose enough to allow sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground reduce rate of water evaporation, and prevent or reduce water or wind erosion. Mulch shall be held in place by light disking, by using mulch adhesive, by using mulch net, or by placing excelsior mulch blankets. In areas where the selected mulch technique is providing inadequate protection, the Owner reserves the right to order another technique to be employed by the Contractor at no additional cost to the project. The Owner also reserves the right to restrict or disapprove the use of mulch adhesives in populated areas. Mulch which has become displaced shall be replaced at the Contractor's expense.

- b. Anchoring Straw, Hay and Excelsior Mulches:

- 1) Using Mulch Adhesives - Subject to the approval of the Owner, the mulch shall be held in place by a spray coating of adhesive material. The Contractor shall protect all traffic, signs, structures, and other objects from being marked or disfigured by the adhesive material.

Mulch adhesives shall be applied by spraying

simultaneously with the mulch or by spraying a surface application of adhesive immediately following mulching. The mulch adhesives shall be applied at the following minimum rates:

Asphalt emulsion Adhesive: A50 gallons/acre

Latex-Base Adhesive: 400 gallons/acre

- 2) Using Mulch Net - Where specified on the plans, or when directed by the Owner, the mulch shall be held in place by covering with net secured by staples. The net shall be spread over the mulch so that there is room for a workman to walk between adjacent widths of the net. The edges of the adjacent widths of net shall be pulled together and held in place by staples spaced not more than 3 feet apart along the edge of the net. Some of the mulch must be under the staples so that the net is not in direct contact with the ground. The staples shall be pushed into the ground so that the top of the staple is about ½ inch above the ground. The ends of each width of net shall be held in place by staples at each salvage edge and at the center of the net.

No traffic will be permitted over the net after it is placed and any torn or damaged net shall be replaced with undamaged material.

- c. Placing Excelsior Mulch Blankets - Excelsior mulch furnished in blankets shall be placed with the netting on top and the fibers in contact with the soil over the entire area. The blankets shall be butted snugly against each other and stapled at approximately 5 foot intervals along joints and edges. In ditches, blankets shall be unrolled in the direction of the flow of water, and on slopes, blankets shall be unrolled at right angles to the slope.
- d. Other mulch anchors may be used with the approval of the Owner and when applied per the manufacturer's specification.

5. Laying Sod:

The topsoil shall be in a friable condition prior to placing the sod. Topsoil not in a friable condition just prior to sodding shall be harrowed with a disk, a spring tooth drag, a spike tooth drag, or other means meeting the approval of the Owner. At time of placing, both

the sod and the topsoil shall be moist. Sod shall be laid within 24 hours after cutting and shall be properly protected until placed. The sod shall be carefully placed by hand in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. Pitchforks shall not be used to handle sod, and dumping from vehicles will not be permitted. The bottom edge of sodded areas shall extend at least 2 inches into the ground or ditch bottom. All other edges of sodded areas shall be turned into the ground and covered with a layer of earth or shoulder material in accordance with details shown on the plans. This material shall be thoroughly compacted so as to conduct the surface water over the edge of the sod. The transverse joints of sod strips shall be broken and the sod carefully laid to produce tight joints. When the sod may be displaced during sodding operations, the workmen shall work from ladders or treaded planks. The sod shall be firmly compacted by tamping immediately after it is placed. After tamping, the sod shall present a smooth, even surface, free from bumps and depressions. In general, Class A Sodding will be specified in urban areas and the finished surface shall present a lawn-like appearance.

On slopes steeper than 1 vertical to 3 horizontal, the sod shall be pegged with wooden pegs. The pegs shall be spaced not over 2 feet apart in any direction and shall be driven flush with the surface of the sod.

Frozen sod shall not be placed, nor shall any sod be placed on frozen soil.

6. Watering:

The Contractor shall thoroughly water the earth beds and sodded and seeded areas at such times and locations and in such amounts as may be required by the Owner. The seeded and sodded areas shall be maintained and patched as required by the Owner until final acceptance of the project by the Owner.

D. Measurement and Payment:

The completed work as measured for **TURF ESTABLISHMENT** will be paid for at the Contract unit prices for the following contract pay items:

<u>Pay Item</u>	<u>Pay Unit</u>
Topsoil Surface, ___ "	Square Yards (SY)
Chemical Fertilizer Nutrient (240 Lbs/ Acre)	Pound (Lb)
Class A Seeding (200 Lbs/ Acre)	Pound (Lb)
Class B Seeding (125 Lbs/ Acre)	Pound (Lb)
Mulch (2 Tons/ Acre)	Ton
Class ___ Sodding	Square Yards (SY)

Topsoil Surface, of the depth specified, will be measured by area in square yards in place. Topsoil spread to a greater depth than specified or directed will not be paid for separately but payment for the work will be considered as having been included as part of the contract unit price bid for Topsoil Surface. Topsoil Surface will be paid for as Topsoil Surface, except that where there is no separate contract item for Topsoil Surface, this work and materials required will be considered as having been included in the contract unit prices bid for Seeding or Sodding.

Chemical Fertilizer Nutrient will be measured in pounds of nutrients contained in the fertilizer applied. The following formula will be used to determine the pay weight of the Chemical Fertilizer Nutrient:

Total weight in pounds of fertilizer applied, multiplied by the sum of percentages of nutrients contained in the fertilizer used equals the pounds of Chemical Fertilizer Nutrients.

Receipts for the total amount of fertilizer used on the project will be made available to the Owner.

Seeding will be measured by weight in pounds of seed applied. The seed will be delivered to the site in tagged and labeled bags. Tags from the bags will be made available to the Owner. Tags will show the total quantity by weight and the percentage by weight of each variety in the mixture and the percentage of purity and germination of each variety. The seed will have been tested within 6 months prior to the date of seeding and will conform to the latest seed laws of the United States and of the State of Michigan.

For seedings requiring mulching, straw will be applied at the rate specified. Other suitable mulch materials shall be spread at comparable rates uniformly over the area immediately following seeding. The Contractor shall furnish tickets at the time of delivery showing the number of bales in each load, weight of each load, and any other such information as required by the Owner. The mulch shall be weighed on scales which have been approved by the Owner. Payment for Mulch will include furnishing, spreading, anchoring, spraying adhesives on mulch at the rate specified.

Sodding will be measured in place by area in square yards.

Topsoil, seed or sod which washes out shall be replaced by the Contractor after the required corrections are made on the area. The corrections and the replacement of the topsoil, seed or sod will be completed at the Contractor's expense.

DRAINAGE STRUCTURES

A. Description:

This work shall consist of constructing or reconstructing drainage structures of portland cement concrete (with or without steel reinforcement as provided), portland cement concrete block masonry, or brick masonry; furnishing and placing metal covers; and shall include excavation and backfilling.

1. Drainage Structures as used herein refers to Manholes and Catch Basins.
2. Cover as used herein refers to the metal frame and lid or grate of the details shown on the plans.

B. Materials:

The material shall meet the following requirements:

1. Concrete - Cast in place, site cast and dry mix concrete shall be in compliance with the requirements of Concrete Grade 30M of the Michigan Department of Transportation Standard Specifications for Construction, current edition.
2. Mortar and Grout - Mortar and Grout shall be in compliance with the requirements of Mortar Type II of the Michigan Department of Transportation Standard Specifications for Construction, current edition.
3. Steel Reinforcement - Steel Reinforcement shall be in compliance with the requirements of Section 8.05 of the Michigan Department of Transportation Standard Specifications for Construction, current edition.
4. Castings - Castings shall conform to the requirements of gray iron castings of AASHTO M 105. All exposed surfaces of castings shall be completely coated with coal tar pitch varnish to which sufficient oil shall have been added to make a smooth coating which shall be tough and tenacious when cold, and shall not be tacky or brittle, nor have any tendency to scale off. Castings used in the construction of manholes and catch basins shall be Class 30 gray iron castings, except cast iron steps which shall be Class 35.

5. Masonry Units - Brick and block used in the construction of manholes and catch basins shall be solid brick block units. Brick shall conform to the following nominal size limitations:

<u>Depth, in.</u>	<u>Width, in.</u>	<u>Length, In</u>
2-2½	3½-3¾	7½-8

All bricks for any structure shall be of one nominal size and shall not vary from the manufacturer's specified standard dimensions by more than ± 1/8 inch in any dimension.

- a. Concrete Brick - This brick shall conform to the requirements for concrete building brick of ASTM C 55, Grade S-11.
- b. Sand-Lime Brick - Sand lime brick for use in the construction of masonry structures shall conform to the requirements of ASTM C73, Grade SW, with the following addition: Maximum Water Absorption, 5 hour Boiling Test, Percent:
 - Average of 5 brick.....18
 - Individual brick..... 20
- c. Concrete Block for Drainage Structures- Concrete Block shall conform to ASTM C 139, with the following exceptions:
 - 1) Shape - The blocks shall be solid curved blocks with the inside and outside surfaces curved to the required radii. The blocks shall have a grooved or other approved type of joint at the ends. Curved blocks shall have the inside and outside surfaces parallel.
 - 2) Size - The nominal dimensions for length and height of the block shall be selected by the producer. The nominal dimension for width (thickness) shall be 6, 8, or 12 inches, as called for on the plans, within a tolerance of ± three (3) percent. where the specified wall thickness on the standard plans is twelve (12) inches, a multiple block wall of two 6-inch wide blocks is permitted. The blocks shall be designed for length so that only full length or half length blocks are required to lay the circular wall of any one course.

Blocks intended for use in the cones or tops of manholes or other structures shall have such shape as may be required to form the structure as shown on the plans with inside and outside joints not to exceed ¼ inch in thickness.

6. Precast Reinforced Concrete Units - Precast concrete units for tops, risers, and sump bases for manholes and catch basins shall be circular with

circular reinforcement and shall conform to ASTM C 478, with the following exceptions and additions:

The internal diameter of the units shall conform to the dimensions shown on the plans.

The unit for the top of the structure shall be of a design approved by the Engineer and shall be constructed so as to provide for the use of standard covers as called for on the plans. The joint with the vertical wall of the structure shall be of the same design as the joints in the circular pipe sections so as to have a uniform bearing on the full wall thickness of the pipe.

Riser sections may be cast with openings for one (1) or two (2) pipes. The hole for the pipe shall be cast with a diameter three (3) inches larger than the outside diameter of the pipe. The interior spacing between openings in a riser section shall not be less than six (6) inches. No holes for inlet or outlet pipes shall be made in precast units at the site of the work.

Openings for pipe inlets or outlets may be constructed in the riser sections of drainage structures by blocking out the openings when casting the sections, by scribing the openings in the green concrete and removing the green concrete from the openings, or by drilling out the openings from cured concrete with a water-cooled diamond bit.

Sump risers with base units shall be of the design shown on the plans.

C. Construction Methods:

1. Excavation - Excavation shall meet the same requirements as specified for excavation of the sewers connecting to the structure.
2. Concrete Construction - Construction shall be as specified under Structural Concrete Construction, 5.03, Michigan Department of Transportation, Standard Specifications for Construction, current edition. Castings of concrete during hot weather shall be limited by the temperature of the concrete at the time of placing. Concrete shall not cast when the temperature of the concrete is above 90° F.
3. Placing Brick and Block Masonry - Masonry with mortar shall not be placed in freezing weather, and any work which is damaged by frost shall be removed and replaced.
 - a. Brick - Before being laid all brick shall be thoroughly wetted and the surface allowed to dry only sufficiently to prevent slipping on the mortar.

Broken or chipped brick shall not be used on the faces of the structure.

The brick shall be laid in courses with full and close mortar joints. The courses shall be level throughout except where otherwise required. Adjoining courses shall break joints by half the length of a brick, as nearly as practicable, and at least one (1) course in every seven (7) shall be composed of headers. The length of pieces of brick used for making closures shall not be less than the width of a whole brick, and wherever practicable, closures shall be made with whole brick as headers.

Joints shall not be more than 1/2 inch in thickness unless otherwise provided, and shall be of a uniform thickness throughout the structure. All joints shall be struck and properly pointed and the exposed surfaces shall be true and smooth. where plaster coat is required, the joints shall be raked.

Before applying a plaster coat of mortar to a brick surface, the brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to provide for proper bonding of plaster coat.

- b. Concrete Block - The first course of blocks, as placed on the prepared base or footings, shall be on a full bed of mortar. All blocks shall be laid in courses with full and close mortar joints. The courses shall be level throughout except where otherwise necessary. Adjoining courses shall break joints by half the length of the block as nearly as practicable.

The joints shall be of a uniform thickness throughout the structure. All joints shall be struck and properly pointed and the exposed surfaces shall be true and smooth.

- 4. Precast Reinforced Concrete Units - Precast reinforced concrete units shall be constructed in accordance with the details shown on the plans. The joints shall be sealed as shown on the plans. The units shall be constructed on poured-in-place or precast concrete footings. Footings shall be supported by a compacted 6-inch granular subbase.

All structures that would require more than two (2) openings for pipe in any one riser section shall have the lower section of the structure from the footing to an elevation above such pipe built up with cast-in-place concrete, concrete block, or brick.

Precast concrete riser sections that do not require more than two (2) pipe openings in any one section may be used for the remainder of the riser sections. No openings for inlet or outlet pipes shall be made in precast units at the site of the work.

- 5. Steel Reinforcement - Steel reinforcement shall be installed as specified under Structural Concrete Construction, 5.03.07 of the Michigan Department of Transportation Standard Specifications for Construction, current edition.

6. Placing Castings - Casting shall be set to the required elevation in full mortar beds or otherwise secured as shown on the plans.
7. Inlet and Outlet Pipes - Pipe placed in the structure shall extend through the walls a sufficient distance to allow for connections. The space between the pipe and structure wall shall be sealed with mortar to prevent leakage.
8. Backfilling - The method of backfilling shall be as specified under Backfilling for the sewers connecting to the structure. Backfilling may begin immediately and progress with the construction of the drainage structure.
9. Curb and gutter and pavement surface shall be sawcut prior to removal. Curb and gutter, pavement and gravel surfaces in public right-of-way shall be replaced in accordance with the requirements of the road agency having jurisdiction. Curb and gutter pavement and gravel surfaces on private property shall be replaced with the materials and restored to a condition at least equal to that existing prior to construction.
10. Cleanout - All catch basins and manholes shall be maintained and shall be free of accumulations of silt, debris and other foreign matter at the time of final acceptance.

C. Measurement and Payment:

The completed work as measured for Drainage Structures will be paid for at the contract unit prices for the following contract items (pay items):

<u>Pay Item</u>	<u>Pay Unit</u>
___ ft. diam. Drainage Structures Manhole, Catch basin, 0 to 8 FT	Each
___ ft. diam. Additional Depth of Drainage Structure, Manhole, Catch basin, 8 to 15 ft.	Foot (Ft.)
___ ft. diam. Additional Depth of Drainage Structure, Manhole, Catch basin, more than 15 ft.	Foot (Ft.)
Drainage Structure Covers	Pound (Lb.)

Drainage Structures payment shall be for each unit complete with bases, sumps, risers, cones, and covers for all depths except where a separate pay item provided for payment of additional depth.

Drainage Structure will be measured vertically in feet, from the top of the base to the top of the masonry of the structure.

Drainage Structures eight (8) feet depth or less, of the diameter specified, and the upper eight (8) feet of drainage structures more than eight (8) feet in depth, or the diameter specified, will be measure as units.

Additional Depth of Drainage Structure, eight (8) feet to fifteen (15) feet, of the diameter specified, will be measured by the vertical foot, for that portion of all drainage structures more than eight (8) feet in depth to the top of the base.

Additional Depth of Drainage Structure, more than fifteen (15) feet, of the diameter specified, will be measured by the vertical foot, for that portion of all drainage structures more than fifteen (15) feet in depth to the top of the base.

Drainage Structure Covers, of the detail specified, will be measured by weight in pounds for the type of cover furnished in accordance with the table shown in 5.14 of the Michigan Department of Transportation Standard Specifications for Construction, current edition.

Where a cover is specified by a manufacturer's catalog designation, then the manufacturer's catalog weight in pounds for the cover specified shall be used.

Payment for Drainage Structures shall include all labor, material, excavation, dewatering, sheeting, tree removal, backfill, restoration, cleanup and all other work required for a complete job. Items not listed in the proposal shall be considered as incidental work and merged into the price for drainage structures.

Payment for the replacement of curb and gutter, pavement, or gravel surfaces adjacent to drainage structures is considered included in the payment for Drainage Structures, except where a separate pay item provides for payment for replacement of curb and gutter, pavement or gravel surface.

SEWERS

A. Description

This work shall consist of installing lines of sewer pipe, of the required class and the specified inside diameter, and shall include road surface removal, excavation, laying and jointing pipe, backfilling and road base surface replacement. The type and size of the pipe will be specified in the proposal or on the plans.

For any sewer, a higher strength or greater thickness of pipe may, upon the approval of the Owner, be substituted for the minimum strength or minimum thickness of pipe specified.

B. Materials

The materials shall meet the following requirements:

1. Reinforced Concrete Circular Pipe - Reinforced concrete pipe shall conform to the requirements of ASTM C-76 with the following exceptions and additions applying: Lift holes shall be cast or drilled. When elliptical reinforcement is used in circular pipe, lift holes shall be cast in the pipe so that when properly installed, the lift holes will be on the top of the pipe and in line with the centerline of the sewer. After the pipes are installed, the lift holes shall be sealed with suitable concrete plugs. When S-stirrups are used, the centerline of the top and bottom of each end of each section of pipe shall be clearly marked during the process of manufacture or immediately thereafter on the inside and the outside of the walls. Markings shall be indented on the pipe section or painted thereon with waterproof paint. Circular pipe intended for use in sewers jacked in place shall contain circular reinforcement.

The absorption test requirements of the concrete will be waived if the load required to produce the 0.01 inch crack exceeds by twenty (20) percent or more the specified minimum load to produce the 0.01 inch crack.

2. Reinforced Concrete Elliptical Pipe - Reinforced concrete elliptical pipe shall conform to the requirements of ASTM C 507, except that the absorption test requirement of the concrete will be waived if the load required to produce the 0.01 inch crack exceeds by twenty (20) percent or more the specified minimum load to produce the 0.01 inch crack.
3. Nonreinforced Concrete Circular Pipe - Nonreinforced concrete pipe, of the class specified, shall conform to the requirements of ASTM C 14, except that the required markings shall be made on the barrel of the pipe, near the socket, at the time of manufacture and shall be plainly legible at the time of delivery to the site of work.
4. Corrugated Galvanized Steel Pipe, Pipe Arch and Structural Plate - Corrugated galvanized steel pipe with circular cross-section and reformed corrugated galvanized steel pipe with pipe-arch shape and structural plate shall conform to the requirements specified in the section entitled Culverts.

5. Cold-Applied Pipe Joint Sealer - The bituminous material for sealing joints in concrete pipe shall be of such consistency that it may be spread on the joints with a trowel when the temperature of the air is between 20° F and 100° F. The bituminous material shall adhere to the concrete pipe so as to make a water-tight seal and shall not flow, crack or become brittle when exposed to the atmosphere.

The bituminous sealer shall meet the following specific requirements:

Penetration, 25 C, 150 g., 5 sec.,
with cone, dmm175 - 300

Loss on Heating, 163 C, 5 hr.,
50 g., percent1.50 max.

Solubility in Trichloroethylene,
percent70 min.

Ash percent15 - 25

Flow, centimeters, at 140° F . . .0 max.

The bituminous sealer shall be delivered to the project in suitable containers for handling and shall be sealed or otherwise protected from contamination. The container shall be marked as "Cold-Applied Pipe Joint Sealer" and shall show the brand name, net volume or weight, and the requirements for application.

6. Material Testing - All materials to be incorporated in the construction of sewers and appurtenances shall be subject to inspection and tests as specified by ASTM, AASHTO, ASA, or AWWA regulations. The Owner reserves the right to subject any material supplied for a particular project to an independent testing laboratory. Such tests, if scheduled, shall be paid for by the Owner. The results for such tests shall govern in material acceptance.

The Contractor will be required to supply the Owner with a certificate of testing or actual test results stating that the material to be used is in conformance with the specifications prior to using material for construction.

C. Construction Methods

1. Excavation

a. General:

- 1) Excavation shall include clearing the site of the work, the loosening, loading, removing, transporting and disposing of all materials, wet or dry, necessary to be removed to construct all sewers and appurtenances included in this Contract to the lines, grades and locations shown on the Contract Drawings. The Contractor must assume the risk of meeting the contract prices and shall include the cost of removal of quicksand, hardpan, boulders, clay, rubbish,

unforeseen obstacles, underground conduits, gas pipe, drain tile, telephone, ducts, tree roots, watermains, masonry structures, railroad tracks, pavements and sidewalks and the delay or damage occasioned by the same, whether these obstacles are shown on the Contract Drawings or not.

- 2) No claim for an amount of money beyond the contract Price of the work will be entertained or allowed on account of the character of the ground in which the trenches or other excavation is made.
- 3) The location of sewers, conduits and structures, as shown on the contract Drawings, have been selected to provide the least possible interference with or the crossing of existing utilities. The Owner reserves the right to make minor variations in the location of these items during the construction to meet any changed conditions discovered during the construction, and no extra payment will be allowed the Contractor for such shifts in alignment or grade.
- 4) The location of existing piping and underground utilities, such as gas mains, watermains, electric duct lines, telephone conduits, etc., as shown on the Contract Drawings, have been determined from the best available information, by actual surveys, or furnished and taken from the records of the parent utility companies and drawings of the existing facilities. However, the Owner does not assume responsibility for the possibility that during construction, utilities other than those shown may be encountered, or that actual location of those shown may be different from the locations designated on the Contract Drawings.
- 5) At the locations wherein detailed positions of these facilities become necessary to the new construction, the Contractor shall at his own expense, furnish all labor and tools to either verify and substantiate the record drawing location, or definitely establish the position of the facilities.
- 6) All concrete and asphalt surfaced pavements shall be sawed before removal.
- 7) Necessary arrangements shall be made by the Contractor with all persons, firms, corporations owing or using any poles, pipes, tracks, or conduits, etc., affected by the construction of this project, to maintain and protect such facilities during construction with the cost of any such protection paid by the Contractor and included in the Contract Price. In the event that any existing gas pipes, water pipes, conduits, sewers, tile drains or poles are blocked or interfered with by the excavation required on this project, the contractor shall maintain them in continuous operation, and restore them to the same condition as they were prior to the start of this Project, all at no additional compensation.
- 8) Excavated material shall not be placed on grass plots unless there is no other suitable place to put it. Excavated material shall be placed on pavements or sidewalks only on the written approval of the Owner.
- 9) Sidewalks and pavements must in no case be blocked or obstructed by excavated material, except on the authorization of the Owner, and then only when adequate provisions have been made for a satisfactory temporary passage of pedestrians and vehicles. Adequate bridging and planked crossings must be

provided and maintained across all open trenches for pedestrians and vehicles. Barriers, lights, flares and watchmen shall be provided and maintained by the Contractor at all trenches, excavations and embankments at no additional compensation.

- 10) The Contractor Price shall include the furnishing and installation of all temporary sheeting, shoring, timbering and bracing required to maintain the excavation in a condition to furnish safe working conditions and to permit the safe and efficient installation of all items of Contract work. The contractor shall further, at his own expense, shore up, or otherwise protect all fences, shrubs, buildings, walls, walks, curbs or other property adjacent to any excavation which might be disturbed during the progress of the work. The Contractor will be held liable for any damage which may result to neighboring property from excavation or construction operations.
- 11) Lumber used for sheeting may consist of any species which will satisfactorily stand driving. It shall be sawn or hewn with square corners, and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions, or other defects which might impair its strength or tightness. Minimum thickness shall be two (2) inch nominal. Lumber for bracing shall be No. 2 common yard lumber or timber in less than six (6) inch sizes, and common structural grade on timbers six (6) inches and over in thickness.
- 12) The sheeting and bracing shall be removed as the work progresses in such a manner as to prevent the caving in of the excavations. While being drawn, all vacancies left by the sheeting and bracing shall be carefully filled with fine sand and rammed by special tools, or puddled as directed by the Owner.
- 13) Sheeting, shoring, timbering and bracing for open trenches and excavations may be ordered left in place by the Owner when in its opinion such is necessary for the protection of the work, the public or the adjacent property. Any sheeting so ordered left in place will be paid for at a rate named in the Contract, or at a price agreed upon in a written Change Order prior to performing the work, said price to cover the furnishing, cutting, placing and bracing.
- 14) The Contract Price in the contract shall include the cost of all temporary supports and braces that may be necessary to secure a safe prosecution of the work until the permanent structure is complete; such temporary supports must in all cases be removed by the Contractor at his own expense or concurrently with the completion of the permanent structure.
- 15) The Contractor shall do all ditching, pumping, well pointing and bailing, build all drains and do all other work necessary to keep the excavation clear of ground water, sewage or storm water during the progress of the work, and until the finished work is safe from injury. Where the excavation is wet sand, and suitable construction conditions cannot be obtained by other methods, the Contractor shall install and operate, at no additional compensation, a pumping system connected with well points, so as to drain the same effectually. No masonry or pipe shall be laid in water, and water shall not be allowed to rise over masonry until concrete or mortar has set at least forty-eight (48) hours. All water pumped or drained from the work shall be

disposed of in a manner satisfactory to the Owner without damage to adjacent property or to other work under construction. Necessary precautions shall be taken to protect all construction against flooding. The Contractor shall supply water to home owners if wells go dry due to construction.

- 16) Whenever the excavation is carried beyond the lines and grades shown on the contract Drawings, or given by the Owner, the Contractor shall, at his own expense, refill all such excavated space with sand material and in such a manner as may be directed. Beneath and around concrete structures, space excavated without authority shall be thoroughly compacted when refilling, or if deemed necessary by the Owner, shall be refilled with concrete at the Contractor's expense.
- 17) Excavated material shall be deposited so as to interfere as little as possible with the excavation of the whole work or its several parts, and in such a manner that for each purpose the most suitable material may be placed in its final position, but not in a manner to interfere with the satisfactory carrying out of the work. Such material as cannot be placed in its final position in fills and embankments shall be removed to a temporary spoil bank, from which it shall later be taken and placed in embankments or fills.
- 18) Unsuitable and surplus excavated material not incorporated in the improvement shall be disposed of by the Contractor at his own expense unless otherwise designated. Topsoil shall be replaced on parcel from which it was removed. No material shall be removed without approval of Owner.
- 19) If private land is used by the Contractor as a spoil site, the Contractor shall obtain written permission from the Owner or agent of the land agreeing to its use for this purpose, and provide the project Owner with a certified copy of such agreement.

b. Trench Excavation:

- 1) The ground shall be excavated in open trenches of sufficient width and depth to provide ample room within the limits of the excavation, or lines of sheeting and bracing, for the proper construction of the sewer and its appurtenances as shown on the Contract Drawings and for removing any material which the Owner may deem unsuitable for foundation.
- 2) The excavation of the trench shall not advance more than 200 feet ahead of the completed masonry and pipe work, except where, in the opinion of the Owner, it is necessary to drain wet ground.
- 3) When trench excavation is carried ahead of contemplated masonry and pipe work, the elevation of the bottom of the trench shall be continually checked to the satisfaction of the Owner. Excavation made below that necessary for the proper installation of the sewers, masonry and appurtenances shall be refilled only with sand or fine gravel, or properly graded crushed rock, thoroughly compacted, all at the Contractor's expense.

- 4) In clay excavation the bottom of the trench shall be excavated to the minimum depth required below the bottom of the pipe barrel and this space refilled with a clean, low void granular bedding as noted on the Drawings. Refill shall be slightly rounded to provide as much bearing area as possible for the lower quarter of the pipe. Clay shall be interpreted to mean all soils other than rock, sand or gravel. The cost of this additional excavation and refill shall be merged in the unit bid and Contract Price for the pipe sewer. In sand and gravel excavation, the bottom of the excavation shall be slightly rounded to provide as much bearing area as possible for the lower quarter of the pipe.
- 5) When excessive ground water is encountered in the bottom of the non-dewatered system trench, the trench shall be excavated to a depth of six (6) inches below the bottom of the pipe barrel and this space refilled with a graded stone material satisfactory to the Owner. Refill shall be slightly rounded to provide as much bearing area as possible for the lower quarter of the pipe. The cost of this additional excavation and refill shall be merged in the unit bid and Contract Price for the pipe sewer. Any excavation that requires well pointing shall have the pipe bedded in stone. Excavation and stone bedding are incidental to construction.
- 6) Trench width and backfill requirements shown on the plans shall be strictly adhered to.

2. Tunnel Construction:

a. General

- 1) All work performed beneath existing structures, across railroad rights-of-way, and under pavements shall be performed in accordance with the requirements of the parties or agencies having jurisdiction over these locations. The Contractor shall contact the parties or agencies prior to starting work and shall meet all requirements of the parties or agencies in regard to methods of construction and the safety precautions to be taken in performing the tunnel work. All costs involved in meeting these requirements shall be paid for by the contractor and no additional compensation will be allowed.
- 2) When jacking under railroad tracks, sheeting and bracing plans of jacking pits shall be submitted for approval of the Railroad company through the Owner. Excavation of the jacking pit shall not be started until such approval has been received.
- 3) A suitable approach trench shall be opened adjacent to the toe of the slope of the embankment. The approach trench shall be long enough to accommodate the length of casing or jacking pipe to be placed, and wide enough to provide sufficient working room. Guide timbers or rails for keeping the casing or jacking pipe on line and grade shall be installed at the rear of the trench, and heavy timber backstop supports installed at the rear of the trench bearing or "pushing frame" shall be built and furnished to fit or match the end of the pipe to be jacked, so that the pressure of the jacks will be evenly distributed over the end of the pipe. Two (2) hydraulic jacks of sufficient power shall be used to apply pushing or jacking pressure. Excavation shall be carried on from inside the pipe, not to exceed six (6) inches ahead of the lead pipe.

Excavation at the top and sides may be approximately one (1) inch greater than the outside periphery of the pipe. Bottom excavation shall be accurately cut to line and grade. Adjoining sections of steel casing pipe shall be welded with continuous weld. Pipe shall be jacked upgrade where possible. Any undercutting at bore pit shall be stone filled.

- 4) Void spaces occurring between the excavation and the casing pipe, or between the excavation and the jacking pipe, shall be filled with grout.

b. Boring and Jacking

- 1) Excavation in casing made beneath existing structures, across railroad rights-of-way, existing pavements and sidewalks for the installation of sewer pipe shall be of sufficient size to permit the installation of the pipe and shall have a minimum diameter as shown on the following table.
- 2) The outer steel casing shall be of sufficient strength to meet the loading conditions of H-20 loading for pavements and Cooper E-72 loading for railroad tunnels. The casing shall also have a minimum wall thickness according to the following table:

<u>Inside Pipe Diameter</u>	<u>Minimum Casing Diameter In.</u>	<u>Minimum Reg. Thickness In</u>
6"	12" O.D.	.375
8"	20" O.D.	.375
10"	20" O.D.	.375
12"	24" O.D.	.375
15"	30" O.D.	.406
18"	36" O.D.	.469
21"	36" O.D.	.469
24"	42" O.D.	.500
27"	48" O.D.	.500

- 3) Casing shall begin a minimum of five (5) feet from edge of pavement on all county platted streets and local roads, a minimum of ten (10) feet from edge of pavement on all county primary and state trunk roads, and a minimum of thirty (30) feet from the edge of pavement on all expressways, measured at right angles to the pavement.
- 4) In unstable ground, the auger shall not proceed the casing pipe.

c. Jacking

Reinforced concrete pipe, with full circular reinforcement, shall be jacked into place according to the required line and grade. A steel cutting edge or shield may be attached to the front section of pipe to form and to cut the required opening for the pipe. Concrete pipe joints shall be protected from crushing due to jacking pressures. Upon completion of the jacking operations, joints shall be filled with mortar, wiped, and finished smooth. The joints shall be thoroughly wet before the mortar is placed.

3. Pipe Installation:

a. General

- 1) The Owner shall provide all line and grade stakes set on the natural ground surface as required for the Project. It shall be the Contractor's responsibility to transfer the line and grade to the bottom of the ditch. Three (3) batter boards, a top line and grade pole shall be used for this purpose unless some other method of checking the inner lower grade and line is approved. The Contractor must test the ditch or grade of the top line and sewer, and will be held responsible for the correct flow in completed sewers. In every case, the contractor must install on the batter lines an accurate line level to test the downward grade of the pipe in the direction of flow. The use of laser beams for grade and alignment is encouraged.
- 2) It shall be the Contractor's responsibility to protect the original line and grade stakes as set. Should the stakes become destroyed or damaged, the cost of their replacement will be borne by the Contractor.
- 3) The contractor shall provide and maintain on the work at all times a gauge rod of sufficient length to reach from the invert of the sewer pipe being laid to the top line strung on the three (3) batter boards. The gauge rod shall be graduated and numbered each foot of its entire length. The gauge rod shall be equipped with either a plumb line or two spirit levels and the utmost care used to insure a truly vertical gauge rod at the time a reading is taken and pipe is being set.
- 4) The junction of two (2) or more sewers shall be made in strict conformance with the Contract Drawings. The cost of all connections shall be included in the Contract Price for the new sewers unless otherwise specifically provided in the Contract.
- 5) New sewer connections with old existing sewers shall be made within a manhole.
- 6) Where no old manhole exists at the point of connection, a new manhole shall be constructed of the size and type shown on the Contract Drawings. Payment for such additional manholes will be made at the unit price in the Contract for new manholes, which price shall include all work necessary to make the connection.
- 7) When connections are made with sewers carrying water, special care must be taken that no part of the work is built under water, a flume or dam must be installed, and pumping maintained if necessary to keep the new work in the dry until completed and concrete or mortar has set up.
- 8) Openings provided in manholes for future sewer extensions shall consist of; (a) one (1) bell end of pipe of the size required extending only to the outside wall of manhole with a water-tight tile stopper; or (b) a brick and cement bulkhead placed in the manhole wall six (6) inches larger than outside diameter of stub

size at an elevation stated in the Contract Drawings. No separate payment shall be made for such stub, stopper or bulkhead and miscellaneous item of work covered in this paragraph. Such work shall be incidental to manhole construction.

b. Pipe Laying

- 1) Each pipe shall be laid on an even, firm bed, so that no uneven strain will come to any part of the pipe. Particular care shall be exercised to prevent the pipes bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each point as specified before. Each pipe shall be laid in conformity with the line and grade stakes and in the presence of the inspector. The bell-end of the pipe shall be laid up-grade.
- 2) The interior of the sewer shall, as the work progresses, be cleaned of all dirt, jointing material and superfluous materials of every description.
- 3) All pipe shall be completely shoved home. On pipe of the tongue and groove type, thirty (30) inch diameter and larger, pressure must be applied to the center of each pipe as it is laid by a winch and cable or other mechanical means properly set and operated to insure that the spigot is all the way home in the socket, and that the sewer joint is of uniform size throughout the circumference of the pipe.
- 4) Laying holes in pipe if used shall be tapered and shall be plugged before backfilling with a tapered concrete plug set in mortar or mastic.
- 5) Pipes laid in tunnel or casing pipe shall be supported on suitable blocks cut or grouted into position to place the invert of the sewer or drain at the slope and to the elevations indicated on the plans.

c. Pipe Joint:

Joints shall be sealed with cold applied sealer and shall have the spigot or tongue end of the pipe covered with the bituminous sealer for a depth of ½ inch or more before placing the pipe. After the pipe is brought to the proper line and grade and the sections brought close together, the remainder of the joint shall be completely filled with the bituminous joint sealer to form a water-tight joint. Any joint material inside the pipe shall be removed. Pipe with premolded bituminous-type joints shall be clean and dry at the time of jointing the pipe. The pipe joints shall be placed as specified by the manufacturer and as approved by the Owner. The premolded material shall form a water-tight joint with the inner surfaces of abutting sections flush.

d. Sewer Taps:

Connections to sewers owned by the county, municipality, or drain commission shall be made in accordance with the regulations of the owners, and where there is no conflict, the connections shall be as shown on the plans and the requirements of these specifications.

Connections to existing sewers having a plug or bulkhead shall be made with a water-tight joint. The plug or bulkhead shall be removed without damage to the pipe, and the material removed shall be disposed of. If there are no openings in the existing pipe or structures at the point of connection, an opening shall be cut or chipped in the pipe or structure sufficiently large to permit three (3) inches of mortar to be packed around the entering pipe and the mortar pointed up smooth and flush with the inner wall. Pipe passing through pipe or structure walls shall be cut at the end to conform with the shape of the inside of the wall and to be flush there with. On the outside of the pipe or structure, the entering pipe shall be encased with sufficient mortar to provide bearing under the pipe. Any existing pipe broken or cracked while making the connection shall be replaced incidental to making the connection.

e. Sewer Bulkheads:

Masonry bulkheads of the diameter specified shall be constructed at the location shown on the plans or authorized by the Owner.

4. Backfill

a. General

- 1) No sewers shall be backfilled above the top of the pipe until the sewer elevations, gradient, alignment, and the pipe joints have been checked, inspected and approved by the Owner. All pipe shall be held in place by cable and winch or other suitable method satisfactory to the Owner during backfill operations so that there will be no movement in the pipe joints.
- 2) Pipe bedding and trench backfill shall be as noted and detailed on the plans. Rocks, debris, trees, stumps or other rubbish shall not be used as backfill material.
- 3) Backfill material shall be placed in layers not to exceed twelve (12) inches in thickness unless the Contractor can demonstrate to the satisfaction of the Owner that he can consistently attain the specified density on thicker lifts.
- 4) Backfill for sewers within the limits of structures or traffic surfaces as shown on the plans, or as directed by the Owner, shall be Granular Material Class II and shall be compacted to ninety-five (95) percent of Maximum Unit Weight.
- 5) Backfill for sewers outside the limits of the roadbed shall be the suitable material excavated from the sewer trench. Backfill material placed within twelve (12)

inches of the pipe shall not contain stones larger than two (2) inch size. Sound earth, free from large stones and lumps, shall be carefully placed under and around the pipe in layers. Each layer shall be thoroughly compacted without displacing the pipe, until the pipe is completely covered to a depth of at least one (1) foot. The balance of the backfill shall be placed in layers and each layer thoroughly compacted by hand tamping or by approved mechanical methods.

5. Restoration of Disturbed Facilities:

a. General

When the work is completed on construction of sewers and appurtenances, all surplus material, earth, rubbish, etc., shall be removed from the site of the work. That portion of the surface of each street disturbed by construction under this Contract shall be left in as good condition as it was before commencement of the work, and it shall be promptly and regularly maintained in such condition during a period of two (2) years after the acceptance of the work. This work of maintenance shall apply only to items of materials and workmanship installed on the Project, and maintenance measures made necessary by the ordinary wear and tear occasioned by traffic shall not be the expense of the Contractor. However, any repairs required because of the unsatisfactory trench backfilling shall be at the expense of the contractor. Rough clean-up and grading shall proceed directly after completion of the trench backfill operation with final clean-up and grading following as soon as practicable.

b. Protection and Restoration of Property:

The Contractor shall be responsible for the preservation of and shall use every precaution necessary to prevent damage to all trees, fences, culverts, bridges, pavements, driveways, sidewalks, etc., to all water, sewer, gas or electric lines or appurtenances thereof, and to all other public or private property along or adjacent to the work. The Contractor shall notify the proper representatives of any public service corporation, any company or any individual not less than forty-eight (48) hours in advance of any work which might damage or interfere with the operation of their property. He shall be responsible for all damage or injury to property resulting from any act, omission, neglect, or misconduct, in the manner or method of executing the work or due to defective work or materials. when and where any damage or injury is done to public or private property by the Contractor, he shall restore at his expense such property to a condition similar or equal to that existing before such damage or injury was done, or he shall make good such damage or injury in an acceptable manner at no additional cost to the Contract.

c. Barricades and Warning Signs

Protection of the work, property and persons within the scope of this Project shall be in accordance with the Michigan Manual of Uniform Traffic Control Devices, current edition.

Where work is carried on, in or adjacent to any street, alley or public place,

the contractor shall, at his own expense, furnish and erect such barricades, fences, lights and danger signals, shall provide such watchmen and shall take necessary precautionary measures for the protection of persons or property and of the work. Barricades shall be painted white or yellow, so as to be visible at night. The paint shall be renewed as often as necessary to keep the barricades substantially covered. From sunset to sunrise the contractor shall furnish and maintain at least one (1) light at each barricade. A sufficient number of barricades shall be erected to keep vehicles from being driven on or into any work under construction. The Contractor shall furnish watchmen in sufficient numbers to protect any new work. Failure to comply with this requirement will result in the Owner shutting down the work until the Contractor shall have provided the necessary protection.

The Contractor will be held responsible for all damage to the work due to failure of barricades, signs, lights and watchmen to protect it, and whenever evidence of such damage is found prior to acceptance. The Owner may order the damaged portion immediately removed and replaced by the Contractor at his expense.

The Contractor's responsibility for the maintenance of barricades, signs and lights and for providing watchmen shall not cease until the project shall have been accepted by the Owner.

d. Pavements, Curbs and Curbs and Gutters:

- 1) In all streets or parts of streets or other areas that are paved or macadamized, and in all gravel surfaced areas, all backfilling within the zone of influence shall be compacted Granular Material Class II. After approval by the Owner of the backfill and sub-grade compaction, the pavement, curb and/or curb and gutter, and gravel surface shall be replaced. Backfill compaction shall be a minimum of ninety-five (95) percent of maximum unit weight.
- 2) All pavement, curbs and curbs and gutters shall be replaced to the section and of the same materials as that removed in accordance with the Owner's established standards or in their absence, to the Standards of the Michigan Department of Transportation.

e. Driveways and Sidewalks

- 1) The backfill and sub-grade for all driveway and sidewalk replacement shall be with Granular Material Class II in the same manner as that specified for pavements. All edges broken from driveways and sidewalks shall be sawed off at right angles to the driveway or sidewalk and after approval of Owner, replaced.
- 2) All driveways and sidewalks shall be replaced to the Section and of the same materials as that removed in accordance with the Owner's established standards for similar work.

6. Rock Excavation:

Rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock and hardpan which cannot be excavated without continuous drilling and blasting or continuous use of a ripper or other special equipment. Hardpan is defined as cemented soil layers. The term hardpan shall not be applied to hard clay layers that are not cemented.

Where rock excavation is encountered within the excavation limits, the surface of the rock shall be sufficiently exposed to permit adequate measurements to be taken before the rock excavation is started. Rock excavation will be measured by the staked-section method with no allowance for overbreak.

Where rock is encountered in the excavation, it shall be removed to the cross section and elevation as shown on the plans or as authorized, with no rock projecting above the lines of the required cross section. All rock or boulders loosened in the excavation, either on or outside the required cross section, shall be removed.

Where rock excavation is encountered during construction and is not covered by a separate item in the Contract, rock excavation will be paid for at a price agreed upon in an executed Change Order before the excavation is begun.

The Contractor is cautioned that the use of explosives will require special permits and insurance coverage which are to be secured and paid for by him. All costs shall be considered included in the Contract Item for Rock Excavation, or included in agreed upon prices in executed Change Orders.

7. Foundations, Strengthening:

When so designated on the Contract Drawings, or ordered by the Owner, excavated areas shall be strengthened for foundation purposes by furnishing and placing crushed rock or gravel refill, concrete cradle or encasement, timber cradles, timber poling or a combination of these materials.

After the excavation is opened and to grade, it will be examined by the Owner who will determine whether or not it is a satisfactory foundation for masonry or pipes, or if it is necessary to stabilize the base. Where deemed necessary by the Owner, a soil load test shall be made to determine the safe bearing capacity of the ground.

The cost of strengthening any foundation for pipe or masonry shall be merged into the unit price per foot for sewer.

D. Measurement and Payment:

The completed work as measured for sewers will be paid for at the contract unit prices for the following contract items (pay items):

<u>Pay Item</u>	<u>Pay Unit</u>
___ in. Sewer, Class ___, Trench Detail ___	Linear Foot(L.F.)
___ in. Reinforced Concrete Elliptical Sewer, Class ___, Trench Detail	Linear Foot(L.F.)
___ in. Corrugated Steel Sewer, Class ___ Trench Detail	Linear Foot(L.F.)
___ in. (type) Sewer in Steel Casing	Linear Foot(L.F.)
___ in. (type) Sewer in Jacked in Place	Linear Foot(L.F.)

Sewer, Reinforced Concrete Elliptical Sewer, and Corrugated Steel Sewer, of the diameter, class and trench detail specified, will be measured in place, by length in linear feet, from center to center of end manholes and catch basins, with no deductions in length for intermediate structures. Excavation and backfill material will not be measured separately, but shall be included as part of the item of sewer furnished and installed. Payment for sewers shall include all labor, material, excavation, dewatering, sheeting, tree removal, bedding, backfill, restoration, clean up and all other work required for a complete job. Topsoil surface, seeding, sodding, chemical fertilizer nutrient, and mulching shall be measured separately where such items are listed separately in the Proposal. Items not listed in the proposal shall be considered as incidental work and merged into the unit price per foot of sewer.

The measurement for sewer encased in a steel casing pipe shall be measured horizontally along the centerline of the sewer. The measurement shall be made from end of casing to end of casing as installed. In no case will sewer in casing pipe be paid for in addition to the quantity shown on the plans without prior written approval of the Owner. Sewer in casing pipe shall include the casing, pipe, the sewer pipe itself and all work necessary for a complete job.

Sewer Jacked in Place, of the size and type specified, will be measured by length in linear feet, which shall be determined by multiplying the number units actually jacked by their commercial laying length.