

O'HARA TOWNSHIP

STANDARD SPECIFICATIONS

INSTALLATION OF SANITARY SEWERS, STORM SEWERS & APPURTENANCES

1. GENERAL: These Standard Specifications set forth the requirements relative to the installation of sanitary sewers and appurtenances. The Specifications are general in scope, are to be applied whenever possible or applicable, and will be referred to as "Standards" in the complete Specifications and other Construction Documents for any project if made a part of such Documents.

2. GENERAL SCOPE OF WORK: The work relative to the installation of sanitary sewers, storm sewers and appurtenances shall be done in accordance with these Standard Specifications and applicable Construction Plans and Documents. The Developer shall examine carefully these Specifications and all Construction Documents for information and guidance relative to the proper form and method for submission of Subdivision Plans and other pertinent details.

The work to be done under these Specifications, as shown on the Construction Plans and described herein, shall include the furnishing and/or installing of materials, equipment and appurtenances, except such materials as are to be furnished by the Developer and any other necessary work required for proper completion, operation and use of labor and such other items incidental to the execution of the work; all as intended or reasonably implied in the Construction Documents and these Specifications.

The work shall consist essentially and more specifically, of the furnishing of all materials, tools, equipment labor and other such items required for the installation of the sanitary sewers and all necessary sewer appurtenances; the work to include the providing of adequate protection prior to starting where required and immediate replanting in other areas, if approved, or replanting following completion of the work in the respective area; the removal of such pavement, sidewalks, riprap, landscaping barrier posts, fences and other obstructions as required for installation of the work, all excavation, including excavation below the bottom of the pipe and fittings, at all bell holes where joints are to be made, below the bottom of the pipe where rock is encountered, elsewhere as stipulated or indicated in order to allow placing of proper materials for bedding of the pipe; pumping, bailing or draining of all water, as required to permit proper execution of the work; construction and maintenance of all bridges required for traffic control; all sheeting, bracing, shoring and supporting of adjoining ground where necessary; all fencing, lighting, watching and protection of the site; all provisions necessary to maintain and protect existing structures; the unloading, hauling; distribution, laying and testing of the sewer pipe, fittings and appurtenances; the construction of manholes, encasement of pipe where required miscellaneous concrete work, and such other work; the connection to other sewers where required; the rearrangement of other conduits, ducts, gas lines or pipes where necessary, replacement of all damaged drains, sewers, and other structures; backfilling and tamping of all

trenches and excavated work; repairing and repaving of all riprap, walls, streets, walks and roadways; the repair of or replanting where required of all landscaping, plants, trees and sod removed during the course of the work; the removal of all surplus excavated material and rubbish; cleaning of the sites of work; maintenance of the streets and other surfaces over the trenches; and the proper completion and installation of all work and appurtenances in accordance with the Construction Documents and/or these Specifications.

All work shall conform, during its progress or on its completion, truly to the lines, levels and grades required, and shall be built in a thoroughly substantial and workmanlike manner, in accordance with the Plans, Specifications and directions given by the Engineer subject to such modifications and additions as shall be deemed necessary by the Engineer during its execution.

The Developer must be thoroughly experienced in this type of work, must be reputable and must recognize the fact that these projects will require utmost care in the execution of the work.

3. PERMITS: The Developer shall be responsible for all permits required for the installation and location of the sanitary sewers in the rights of way of roads and other thoroughfares. The Developer shall be responsible for compliance with all requirements relative thereto. The Developer shall be particularly cognizant of the requirements relative to road crossings.

4. DEVELOPER TO DO ALL ENGINEERING WORK: The Developer shall furnish an Engineer, and shall be responsible for the general layout of all sewers, for the maintenance of all monuments, bench marks and reference points, shall maintain these points until completion of the work and shall make all necessary extensions therefrom for all work. The Township reserves the right to check any or all such work under this construction. The Developer will be held responsible for the accuracy of such extensions, whether or not they are checked by the Township.

5. USE OF STREETS, PRIVATE OR PUBLIC PROPERTY: The operations of the Developer in public streets, public highways or alleys, as regulated more in detail later herein, shall be confined to as small a space as is practicable so as not to cause undue inconvenience to the public or abutting properties and shall be subject to the approval of the Engineer.

The operations shall be confined to the limits of rights of way over private property unless otherwise indicated and, if additional area is required, the Developer shall obtain the right to use adjacent or such property as required in writing. The Developer shall take cognizance of his responsibility to protect property on each side of the right of way.

6. MAINTENANCE TRAFFIC: During the progress of the work, as set forth in detail; later herein, the Developer shall accommodate both vehicular and foot traffic and shall provide free access to abutting property, fire hydrants, water and gas valves, and such other facilities. Street intersections may be blocked, but one half at a time, and the Developer shall lay

and maintain temporary driveways, bridges, and crossings, such as in the opinion of the Engineer are necessary to accommodate the public. In the event of the Developer's failure to comply with the foregoing provisions, the Township may, with or without notice, cause the same to be done and deduct the costs of such work from monies due or to become due the Developer; but the performance of such work by the Township or at its insistence shall serve in no way to release the Developer from his general or particular liability for the safety of the public or the work.

The Developer shall comply with all requirements relative to the maintenance of traffic, as stipulated by the State and County Highway Departments and the Township.

7. ORDERLY MAINTENANCE OF WORK: The Developer shall keep the work and all property occupied by him in a neat and orderly condition at all times, as set forth in detail later herein. Waste materials, rubbish and debris shall not be allowed to accumulate. The Developer's equipment, temporary buildings and excess materials shall be promptly removed as they become no longer needed for the progress of work. At the completion of the work, the premises shall be left rake clean, The newly constructed sewers, concrete chambers, flumes and manholes shall be cleared of all scaffolding, centering and debris of all sorts.

8. MAINTENANCE OF STREETS: The Developer shall clean and keep clean the streets, the work on public or private property occupied by him, free from waste or refuse resulting from his operations. Trucks hauling excavated material, cement, sand, stone or other loose materials from or to the site shall be tight, so that no spillage will occur on adjacent streets. Before trucks start away from the site, their loads shall be trimmed.

The Developer shall comply with all requirements relative to the maintenance of traffic, as stipulated by Township regulations.

9. MAINTENANCE OF EXISTING DRAINAGE: Drainage through existing sewers and drains shall be maintained at all times during construction and all gutters shall be kept open for drainage. Where existing sewers are encountered in the line of work which interfere with the construction, the flow in the sewers, including both dry weather flow and storm flows shall be maintained by either constructing a satisfactory flume or bypass sewer or by pumping.

10. INTERFERENCE WITHIN EXISTING IMPROVEMENTS: The Developer shall determine the exact location of all utilities affected by his work and shall give due notice to all whose tracks, poles, wires, pipes, conduits, governmental survey monuments, bench marks or other structures may be affected by his operations. Survey marks disturbed by the Developer must be replaced.

All public utilities, including building service connections whether indicated on the plans or not, which in the opinion of the Engineer, can be satisfactorily secured in place and maintained without interfering with the proper execution of the work, shall be taken care of by

the Developer, or at his insistence and expense by the utility concerned, in such a manner as to secure the safety of the public and said structures.

Whenever it becomes necessary to remove and replace any build service connections or other utility facility, the work shall be at the Developer's expense to meet the requirements of the utility concerned.

All damage as may occur to existing utilities as a result of the Developer's work shall be suitably repaired by the Developer.

11. EXCAVATION

A. Scope of Work

The work under this phase shall include the furnishing of all materials, labor, tools, and equipment necessary for the excavation and grading required for the proper execution the work. This work will include essentially, the providing of adequate protection for all lawns, trees, shrubs, landscape work, fences, utilities, sidewalks, and such other work and facilities; the removal of and safe storage of all landscaping where required and immediate replanting in another area, if approved, or replant following final completion of the work in the respective area; the removal of such pavement, sidewalks, riprap, landscaping, barrier posts, fences, existing structures and facilities, and other obstructions as required for the installation of the work; and loosening, loading, removing, transporting, and disposing of all existing structures and wet or dry materials necessary to be removed for the purpose of construction and grading on or off site; the storage of excavated materials; the realigning or relocating of existing sewers, piping and conduit; the construction of open drain ditches, surface and subsurface drainage facilities and such other facilities; stream alignment; the protection of all underground utility facilities; the disposal of excess materials and such other related work.

B. Materials of Excavation

The materials of excavation, where classification is necessary, shall be classified as earth excavation or as rock excavation and shall include whatever materials are encountered to the depths shown on the Drawings, or as directed by the Engineer. The following definitions shall apply to the materials of excavation.

1. EARTH EXCAVATION - Earth excavation shall include all clay, silt, loam, sand, gravel, slate, hard-pan pavements of all kinds, soft sandstone, loose stone, and all boulders measuring less than one-third cubic yard in volume.
2. ROCK EXCAVATION - Rock excavation shall include solid ledge rock, concrete or masonry structures or any other material which, in the opinion of the Engineer, requires for its removal drilling and blasting, and all boulders

exceeding one-third cubic yard in volume. No soft or disintegrated rock which can be removed with a pick or power operated excavator or shovel, no loose, shaken or previously blasted rock, no broken stone, in rock fillings or elsewhere, and no rock which can be removed with a pick or power operated excavator or shovel, no loose, shaken or previously blasted rock, no broken stone in rock fillings or elsewhere, and no rock which may fall into the trench from outside the limits of excavation shown on the Drawings will be measured or included under this classification.

C. Preparation of the Site

Prior to any excavation, the Developer shall properly prepare the right of way or site of the work.

The Developer shall first provide adequate protection for all, lawns, trees, shrubs, landscape work, fences, utilities and sidewalks that are to remain in place, and for such other existing similar growth, structures and facilities. Such protection shall be maintained so long as necessary to prevent damage due to the operation of the

All grass and sod shall be carefully removed from all lawns and stored, protected and relaid following backfill and taming of the excavated areas, providing it is in suitable growing condition. If the sod is not satisfactory for replanting, the Contractor shall seed the excavated areas in accordance with specifications set forth later herein. The Developer shall also remove all plant material, where required, store and replant the material following completion of the work or replace with suitable material. The plant material shall be examined six months after being planted, and all material not growing shall be replaced.

The clearing and grubbing operations shall be maintained a sufficient distance ahead of the excavating operation. The site shall be cleared of all dead trees outside the limits of the permanent sewer right of way.

The Developer shall remove all street and sidewalk pavement, curbing, riprap, barriers and such other obstacles as required for the proper execution of the work, and shall store and protect all materials that can be used in restoring the site to its original condition.

The amount of pavement and road surface to be removed shall depend on the width of the trench and the width and length of the pavement area for the construction of all structures and appurtenances. The width of the pavement removed along the normal trench for the installation of the pipe shall not exceed the width of the trench by more than twelve inches on each side of the trench. The width and length of the area of pavement removed for the construction of structures and sewer appurtenances shall not exceed the maximum linear dimensions of such structures by more than eighteen inches on each side. The Contractor shall use such methods, either drilling, chipping, or saw cutting as will assure the breaking of the pavement along straight lines. The face of the remaining pavement shall be approximately vertical.

D. Lines and Depths of Excavation

The trench excavation shall be of sufficient width and depth to provide adequate room for the construction or installation of the work and shall be to the lines and grades indicated on the Construction Plans. The trenches for pipe, sewers shall have widths at the spring lines of the pipe, so that there will be a minimum clearance of six inches between the outside of the pipe and the side of the trench, and where cradles are used, shall have a clear width between "Lines of Excavation" equal to the maximum width of the cradles of the sewers. The schedule of maximum trench width is shown on the standard detail sheet included with construction plans. The width shall not be exceeded from a point six inches above the grade of the top of the pipe to the bottom of the trench. Should the maximum width be exceeded, additional or alternate bedding, as approved by the Engineer, will be required at the Developer's expense.

The trench shall be excavated throughout its length to conform to the exterior of the pipe when granular bedding material is required. When granular bedding material is not required, the bottom of the trench shall be shaped by hand excavation to insure proper bedding of the pipe.

Bell holes of sufficient size shall be carefully excavated at proper intervals so that no part of the trench load on the sewer is supported by the bells, so that sewer joints can be made proper and in accordance with good practice.

In all cases, the bottom quadrant of the pipe shall be fully and uniformly supported. The full load on the pipe shall rest on the barrel of the pipe. Unauthorized excavation below the depth required shall be filled with approved bank-run gravel or sand, or concrete, as directed by the Engineer.

The excavation where an underdrain is necessary shall be carried to the depth and width required on the Construction Plans.

In cases where the bottom of the trench is found unsuitable as a foundation, it shall be further excavated and prepared by placement of sand or other approved material, or placement of a concrete cradle, as the Engineer may direct. Such authorized work shall be paid for as extra work.

Pipe laid in rock trenches obviously will always require a supplementary foundation to provide uniform support for the bearing surface of the pipe. The foundation shall be formed by placement in the bottom of the trench to a depth of six inches, a layer of sand or other approved Material.

The trench shall at all times during the progress of the work be excavated to the required width and depth for a distance of at least ten feet in advance of the end of the pipe in place, except that the trench in rock shall be opened 30 feet in advance. No trench shall be excavated more than one hundred and fifty feet in advance of the completed sewer without the written permission of the Engineer. Wherever a branch for a proposed sewer or extension of a sewer is built in rock,

the required trench shall be excavated a distance of not less than five feet beyond the end of the branch, in the direction of the proposed sewer or extension.

E. Excavated Materials - Handling

The excavated material shall be deposited in such a manner as to interfere as little as possible with the excavation of the whole work and its several parts, as to avoid obstructing driveways and sidewalks, and in such a manner that for each purpose the most suitable material shall be reserved.

The materials excavated from the trench and the materials of construction shall be so deposited and the work so conducted as to leave open and free for pedestrian traffic all roadways in the work area proper, all crosswalks, a space on each sidewalk not less than one-third the width of the sidewalk and not less than three feet in width, and for vehicular traffic a roadway not less than eight feet in width. The requirements of the County, State, or local governing officials, if in excess of the foregoing, shall control the operations. If all the excavated material cannot be stored on the street in such a manner as to maintain traffic movement, the surplus shall be removed from the work and stored, and the suitable material returned for backfilling. It is essential that the movement of traffic be unrestricted.

The work shall be done to allow accessibility to all fire hydrants, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls, at all times until the work is completed. The Developer shall keep all gutters clear or provide other satisfactory facilities for street drainage and shall not obstruct natural water courses, and shall, where necessary, provide temporary channels to allow the flow of all water either along or across the site of the work.

When instructed by the Engineer, the material removed from the first fifteen feet of trenches shall be removed by the Developer as soon as excavated, and the material subsequently excavated, if suitable for backfill, shall be placed in the trenches in which sewers have been built; and neither the excavated materials nor materials of construction shall be stored on roadways or sidewalks. This procedure will be necessary only where there is a possibility of interference with public travel.

During the progress of the work, the Developer shall maintain crosswalks sidewalks and roadways in satisfactory condition; and the work shall, at all times, be so conducted as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property along the line of the work.

F. Shoring

The Developer shall furnish, put in place, and maintain such sheathing, timber work, shoring, bracing and supports as may be required to protect adequately the work from the pressures of earth surrounding the excavation in order to protect life or property and as required by governing State Laws and Municipal Ordinances. Due care must be exercised to prevent voids outside the sheathing but if voids are found, they shall be immediately filled and rammed.

If the Engineer is of the opinion that sufficient or proper supports have not been provided, he may order additional supports constructed at the expense of the Developer and compliance with such orders shall not release the Developer from responsibility for these supports.

All the sheathing, bracing or shoring shall be removed unless required to be left in place to prevent damage due to settlement. The Engineer may order that timber used for sheathing and bracing be cut off at any specified elevation.

The Developer may, at his own expense, leave in place to be imbedded in the backfill of the trench, all sheathing and bracing in addition to that ordered by the Engineer or required by the Construction Plans if for the purpose of preventing injury to persons, corporations or property. No sheathing and bracing shall be left within four feet of the surface of the street without permission of the Engineer.

The sheathing and bracing not left in place shall be removed in such a manner as not to endanger the constructed sewer or other structures, utilities or property, whether public or private. The Developer shall eliminate all voids left or caused by the withdrawal of sheathing by immediately refilling with sand, by ramming with tools adapted to this purpose, by watering, or by other approved methods.

The right of the Engineer to order sheathing and bracing left in place shall not be construed as creating any obligation on their part to issue such orders, and the failure to exercise the right to do so shall not relieve the Developer from liability for damages to persons or property, occurring from upon the or upon the work of constructing the sewer, occasioned by negligence or otherwise growing out of the failure on the part of the Contractor to leave in Place in the trench sufficient sheathing and bracing to prevent any caving in or moving of the ground adjacent to the banks of the trench.

G. Pumping, Bailing and Drainage

The Developer shall remove by pumping, bailing or other means, any water which may accumulate or be found in the trenches or other excavations included in construction, and shall form all dams, flumes, or other works necessary to keep them entirely clear of water while the sewers and their foundations and other structures are being constructed. The Developer shall have sufficient pumping machinery available at all times on the site ready for immediate use.

All newly laid masonry shall be protected from injury resulting from dewatering work by use of canvas, tar paper or other approved methods.

The Developer may excavate, at his own expense, a trench from either or both ends of the sewers to a natural water course where such excavation will facilitate his work. If the excavation is ordered by the Engineer, it will be at the Developer's expense.

The water from the trenches and excavation shall be disposed of in such a manner as will not cause a public health nuisance or injure public or private property, work completed or in progress, surface of the streets, or cause interference with use of the area by the public. Where points of drainage discharge are in question, approval shall be obtained from the Engineer before such discharge is made.

The Developer shall lay vitrified clay, or PVC pipe, with open joints bedded in small gravel or stone, crushed fine, in the trench below the foundation of the sewer for subsoil drainage, when so ordered by the Engineer, the laying of these underdrains to be paid for by the Developer.

H. Blasting

All blasting will be permitted only after securing approval from the Engineer or authorized representative. No blasting shall be done adjacent to existing lines or structures which may be damaged through blasting operations, and under no circumstances shall blasting be done on the site during or for a period of at least forty-eight hours after concrete has been placed.

The blasting of rock within five feet of water or gas mains shall be done with light charges of explosive, and the utmost care shall be exercised to avoid disturbance of the main. All exposed sewers and special structures shall be carefully protected from the effects of blasts, and any damage to them, by blasting shall be promptly repaired by the Developer at his expense, and in no case shall blasting be done within twenty-five feet of newly laid sewer.

All shots shall be covered with cable or timer mats placed in accordance with governing regulations, and special care shall be exercised on the areas where high tension power lines are located. Prior to blasting, sufficient warning shall be given all persons in the vicinity and traffic shall be stopped at the proper distance from the site and controlled by watchmen.

The Developer shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men who have proper certificates or license. The handling and use of explosives shall be done strictly in accordance with the Specifications issued by the United States Bureau of Mines and with any Federal or State regulations now in effect or that might become effective in the future; and in compliance with the Local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner and in accordance with the Local and State laws; all vehicles and such storage places shall be marked clearly "Dangerous EXPLOSIVES", and shall be in care of a competent watchman at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the Engineer and applicable State agencies.

I. Utilities

The Developer shall carefully support and protect from injury all existing gas pipes, water pipes, steam pipes, electric conduits, sewers, drains, hydrants, valve boxes and other structures which do not have to be changed in their location. In case of injury or temporary removal, these facilities shall be restored to as satisfactory condition as that in which they were found. Where dead ends shall exist following removal of pipes, conduits or sewers, such ends shall be carefully plugged or bulkheaded with brick and mortar.

J. Barricades, Guards and Safety Provisions

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe for traffic or pedestrian use. All materials, piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades. and shall be protected by proper lights when visibility is poor. Whenever required, watchmen shall be provided to prevent accidents. Rules and Regulations of local State and County authorities regarding safety provisions shall be observed.

K. Protection of Existing Structures

Existing structures shall be carefully supported and protected from injury by the Developer at his own expense, and in case of injury they shall be restored by him without compensation therefore to as good condition as that in which they were found.

L. Drains, Culverts, Sewers and other Obstructions

Adequate provision shall be made for the flow of sewers, drains, culverts and watercourses encountered during the construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.

Where concrete gutter drains along State Highways or Municipal Roadways are disturbed, the entire gutter shall be reconstructed unless construction joints permit replacement only of the sections disturbed. All pipes and broken stone or gravel located under these gutters that are removed or disturbed shall be completely replaced. All this work shall be in complete accordance with the requirements of the State Highway Department and/or local governing officials.

M. Tunneling

Tunneling will not be allowed without the approval of the Engineer, and the method of tunneling and location of all shafts, portals and mechanical plant used in the tunneling operations shall also be subject to the approval of the Engineer.

All tunnels shall be equipped with a sufficient number of lights to insure proper work inspection. A supply of fresh air, sufficient for the safety and efficiency of workmen and engineers, shall be provided at all times throughout the length of any tunnel and especially at the headings. Additional lights and ventilation shall be supplied whenever directed by the Engineer. Headings are to be driven in both directions from the shafts, unless otherwise directed by the Engineer.

Where tunneling under hard surfaced roads is approved, the Contractor shall backfill the tunnel as specified herein. All tunnel liners shall be in accordance with the detailed specifications established when such methods are approved. Rock tunnels shall be driven using roof supports called for when such construction is indicated.

N. Drilling or Jacking of Casing

The installation of casing by drilling or jacking shall be carried on without disturbance of the embankment. All working operations of the Contractor, subcontractor and/or their agents or employees must be subordinate to the free and unobstructed use of the right of way for the passage of traffic without delay or danger to life, equipment or property. The Developer shall conduct his operations in such a manner that all work will be performed below road level, and standard clearances shall be maintained at all times.

The Developer shall inspect the location where pipe is to be drilled or jacked and familiarize himself with the condition under which the work will be performed and with all necessary detail as to the orderly prosecution of the work.

If in the opinion of the Engineer, the installation of the pipe is being conducted in an unsafe manner, the Developer will be required to stop work until agreements are reached between the Developer and the Engineer.

The Developer must be fully equipped and experienced in the installation of pipes by drilling or jacking. As evidence of his experience in this type of work the Developer shall submit to the Engineer specific information covering the successful installation by his company of at least five similar projects under heavy traffic. Any project involving the installation of less than twenty-four inch to thirty inch diameter pipe or length of less than forty feet will not be considered as satisfactory evidence of experience.

All drilling operations shall be conducted using an approved type of drilling equipment. The drilling machine shall be of the rotating auger type and shall be designed to permit the augers to operate inside of the casing being installed. The casing shall be installed at the same time as the hole is drilled, the cutting head being the only item of the drilling equipment being permitted beyond the forward end of the casing. The auger train shall be of the maximum size which will fit in the interior of the casing being installed. Drilling machines which operate in such manner as to permit the entire hole being drilled prior to the installation of the casing are not approved for this operation.

Jacking operations shall be done by means of a hydraulic jack. In this operation all material shall be removed from the casing by flushing, shoveling, or other approved method. A suitable drive block shall be inserted in the end of the casing to eliminate all damage to the casing end due to excessive pressures of the jack, and a cutting shoe shall be used on the forward end of the casing.

Prior to the beginning of the drilling or jacking operation, the Developer shall establish a grade for the casing and shall, to the maximum possible extent, insure that the grade is maintained during the entire operation.

The casing pipe used for the operation shall be black steel material having a yield strength of 35,000 p.s.i. All joints between sections of casing shall be made by continuous welding, and, if deemed necessary by the Engineer, a welding band shall be used to eliminate misalignment. The casing thickness shall be in accordance with the following:

Diameter of Casing	Wall Thickness
Up to 6 inches	1/4 inch
18 inch to 24 inch	3/8 inch
24 inch to 30 inch	1/2 inch

12. BACKFILL

A. General

The sewers and other work shall not be covered until inspected by the Engineer and approved as satisfactory work. If the work is found not satisfactory with respect to workmanship and materials, the Developer shall immediately remedy or remove and replace with new materials and proper construction that part rejected.

The Developer, unless otherwise indicated, shall backfill all trenches and excavations as soon as possible, allowing the proper degree of hardening of concrete, and the work shall be prosecuted continually after being commenced.

B. Materials of Backfill

All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, stones, or other material which, in the opinion of the Engineer, is unsuitable.

1. SAND BACKFILL - All sand used for backfill shall be a natural bank sand, graded from fine to coarse, not lumpy or frozen and free from slag, cinders, ashes, rubbish, or other material which, in the opinion of the Engineer, is objectionable or deleterious. It shall contain a total of less than 10% by weight of loam and clay, and all material must be capable of being passed through a 3/4 inch sieve.

2. GRAVEL BACKFILL - Gravel used for backfill shall consist of natural bank gravel having durable particles graded from fine to coarse in a reasonably uniform combination with no boulders or stones larger than 2 inches in size. It shall be free of slag, cinders, ashes, refuse, or other deleterious or objectionable materials. It shall not contain excessive amounts of loam or clay and shall not be lumpy or frozen. No more than 15% shall be finer than Number 200 sieve.
3. SCREENINGS BACKFILL - Screenings shall consist of the product obtained from crushing sound limestone or dolomite ledge rock and shall be free from shale, dust, excessive amounts of clay and other undesirable materials. All materials shall pass a ½ inch sieve and no more than 25% shall be finer than a Number 100 sieve.

The pipe shall be laid only on good firm earth or granular bedding material. As previously indicated, the bottom of the trench shall be shaped by manual excavation when bedding is not specified to insure full uniform support for the barrel of the pipe. When granular bedding material is required, sand, gravel, or screening is approved by the Engineer, shall be used and shall be placed from a depth of six inches below the bottom of tile exterior of the pipe to the spring line of the pipe, as indicated on the Plans or as otherwise required.

The materials used for backfilling trenches to a depth of at least two feet over the top of the pipe shall be clean earth sand, gravel, screenings or other approved material.

The remainder of the trench above an elevation two feet higher than the crown of the sewer shall be backfilled with the excavated material, provided that such materials which, in the opinion of the Engineer, are suitable for backfilling, except as indicated later herein. Where excavated material is indicated on the Drawings or specified for backfill, and there is a deficiency due to a rejection in part thereof, the Developer shall furnish the required amount of sand, gravel, or other approved material.

Where the excavation is made through pavements, curbs, driveways, parking areas, sidewalks, or other structures, or where these facilities are undercut by the excavation, the entire backfill to the subgrade of the facility and for a distance of three feet from each side, shall be made with sand, gravel, or other approved material. Where tunneling under roads is approved, the Developer shall backfill with a 1/3 mixture of cement and sand of dry consistency, thoroughly tamped. This work is to be included in the base bids and no additional payment shall be made therefore.

Backfill material to be used within two feet of manholes, catch basins, flush tanks, and other structures shall be made with sand, gravel, or other approved material.

Backfill material to be used within two feet of the pipes, where iron pipe is installed, shall be well compacted clay, sand, gravel, or other such material that is not injurious to iron pipe. No cinders, rubbish or other such materials shall be used.

Where sand, gravel, or screenings backfill is not indicated on the Drawings, or specified, and in the opinion of the Engineer, should be used in any part of the work, the Developer shall furnish and backfill with sand, gravel as directed, additional payment to be made therefore.

C. Method of Backfill

The trench shall first be backfilled with approved bedding material to a depth of six inches, if shown on the Construction Plan prior to the installation of the sewer. The bedding material shall be gravel and/or equal granular material, the material used not to be subject to floating where wet conditions exist. The bedding shall be Type B-1 or B-2 as indicated on the Plans, unless otherwise required. This material shall, be carefully placed and thoroughly consolidated so as to furnish a solid foundation for the bedding of the pipe.

Immediately subsequent to laying the pipe, the space between the pipe and the bottom and sides of the trench shall be thoroughly tamped with pipe rammers or tampers made for this purpose. The backfill shall then be carried to a depth of at least two feet above the crown of the sewer, with the material being placed in six inch layers, thoroughly tamped and compacted. The material shall be deposited carefully in the trench by hand shoveling to avoid injury to the sewer and shall be tamped with an appropriate tamper in such a manner as to avoid injury or movement of the completed sewer.

The remainder of the trench above an elevation of two feet higher than the crown of the sewer shall be backfilled with approved material, free of organic matter, no layer more than six inches thick, except as otherwise approved by the Engineer when granular materials are being utilized, and shall be mechanically rammed or tamped. No heavy truck shall be dropped into the trench until there is at least three feet of fill over the top of the sewer, and if rock is placed in the trench, all void spaces between the pieces of rock shall be filled with earth.

The tamping or ramming of each layer of backfill material shall be continued until it is thoroughly consolidated, after which another layer shall be spread and compacted in the same manner.

Wide trenches may be compacted by approved rollers once the backfill has been placed and compacted to a point at least two feet above the top of the pipe.

Where dry cement or concrete is required for backfilling the material shall be placed and thoroughly compacted to six inch to twelve inch layers with mechanical rammers.

Backfilling material placed within two feet of manholes, catch basins, flush tanks, and other structures shall be deposited uniformly around the sides in layers not exceeding six inches in depth, and solidly tamped in such a manner as to avoid impairing the structures or producing unequal pressures on them. All manholes are to be protected, if necessary, by an embankment at least three feet above the top of the sewer. The backfill under manholes or other structures which have been excavated below the levels shown on the Plans shall be made with sand, gravel, or concrete.

Where the crown of the sewer comes close to the surface of the ground or extends above it, the sewer shall be covered by an embankment at least three feet thick over the top and sides of the sewer, with side slopes at least one on one and one-half to the surface of the ground, unless otherwise shown on the Construction Plans. Where such slopes would extend into or obstruct a natural watercourse, street or private property, the Developer shall retain the slopes by rubble masonry walls, and where indicated, the sewer shall be covered to a depth of six inches with concrete and plastered with Portland Cement.

When sheathing is removed, all cavities remaining in or adjoining the trench shall be solidly filled and when the sheathing is left in place, all cavities behind such sheathing shall be solidly filled.

The Developer shall, in general, tamp all backfill by mechanical means in layers not to exceed six inches in thickness, except that, at the option of the Developer, the backfill two feet or more above the top of the pipe may be compacted by flooding, only if permitted by the Engineer.

The Developer shall comply fully with the requirements of the Pennsylvania Department of Highways and the County Department of Highways relative to backfill for all work along State and County Highways, and meet the requirements in excess of these Specifications. The Developer shall also comply fully with the requirements of the State and County Highway Departments relative to other conditions of operations and to the requirements of all local municipalities where local streets and highways are involved.

Where settlement is unimportant and/or where shown on the Drawings or specified, the Developer may backfill the trench from two feet above the pipe to the top of the trench with excavated material, and the backfill shall be machined, compacted and neatly rounded over the trench to sufficient height to allow for settlement to grade after consolidation. This condition will generally apply to work along untraveled portions of private rights of way and shall be approved by the Engineer prior to being put to use.

Backfilling shall not be done in freezing weather, except by permission of the Engineer, and it shall not be made with frozen material. No backfill shall be made where the material already in the trench is frozen.

No walking or working will be permitted on the completed pipe until the trench has been backfilled to a height of at least two feet over the top of the pipe, except as required for tamping or backfilling.

The final grade of the trench shall be even with the grade of the roadway or adjacent ground and shall be maintained during this Contract and for one year thereafter.

D. Compaction Facilities for Backfill

The Contractor shall furnish adequate facilities for the operation of the pneumatic rammers and shall provide a compressor plant of sufficient capacity to insure the continuous operation of at least one rammer for each thirty lineal feet of trench being backfilled. The rammers shall be in

satisfactory condition and an adequate number available prior to starting work. The equipment shall be maintained in approved condition throughout the operation and the pads and other mechanical parts on the rammers replaced or repaired immediately when necessary. The equipment shall allow maintenance of a working pressure of at least eighty pounds at the nozzle of each rammer.

The Engineer may require additional facilities, if in his opinion, the equipment is not adequate.

E. Temporary Surfacing

When the backfilling is completed, the Developer shall temporarily repave or resurface the openings in the pavements in such a manner that the roadway may be used for traffic, and maintain such work until permanent repaving is placed.

13. SEWER PIPE MATERIALS

A. General

The pipe materials shall be of good quality of the class and type indicated on the Construction Plans.

All pipe and fittings shall be manufactured in accordance with the latest applicable specifications as indicated herein. The Contractor shall submit such alternate bids as are required relative to the use of different types of pipe.

The initial shipment of each type of pipe shall be tested by qualified independent testing laboratory and certification of compliance with the Specifications furnished the Engineer for all projects wherein total length exceeds 1,500 feet. Manufacturers tests and certification of compliance shall be acceptable for projects less than 1,500 feet in length.

B. Applicable Specifications

1. VITRIFIED CLAY PIPE - All vitrified clay pipe required for sewer construction shall be of the best quality vitrified extra strength clay pipe of the hub and spigot pattern and shall be in accordance with the A.S.-T.M. Standard Specification for "Extra Strength and Standard Strength Clay Pipe and Perforated Clay Pipe", Designation: C 700-Latest Edition, or where the requirement is more stringent, the National Clay Pipe Institute Specification ER-4 Latest Edition. The Maximum laying strength that shall be permitted is 6 feet. In addition to the name of the manufacturer and the plant location, each length of pipe shall have the mark "E.S."

Joints shall be thoroughly and tightly caulked with oakum and sealed with a collar of newly mixed sand and Portland cement mortar. The use of precast bituminous joints will not be permitted.

2. CONCRETE SEWER PIPE - The Concrete sewer pipe shall be in accordance with the A.S.T.M. Standard Specifications for "Concrete Sewer Pipe," Designation C14-Latest Edition.
3. REINFORCED CONCRETE SEWER PIPE - The reinforced concrete sewer pipe shall be in accordance with A.S.T.M. Standard Specifications for "Reinforced Concrete Sewer Pipe," Designation C76- Latest Edition.
4. CAST IRON PIPE - The cast iron pipe and fittings shall be manufactured in accordance with the following Specifications:

Pipe - Bell and Spigot Ends, Mechanical Joint Ends, Single Ribber Gasket Ends and Plain Ends, ASA-A21.6 Class 22.

Mechanical Joint for Cast Iron for Cast Iron Pressure ripe and Fittings ASA-A21.11.

Single Rubber Gasket Joint for Cast Iron Pressure Pipe WWP 42 lb. - Bell-Tite or Tyton or approved equal.

The mechanical joints shall be furnished complete with standard accessories, including cast iron follower rings, high strength, cast iron bolts and nuts and plain rubber gaskets.

Where required for installation conditions, pipe and fittings shall have lugs cast on them for adequate tying the pipe and fittings together.

5. ASBESTOS-CEMENT SEWER PIPE - The asbestos-cement pipe shall be Transite or approved equal, as manufactured by the Johns Manville Company or approved equal for use as non-pressure lines for carrying sewage.

The pipe shall be available in five strength classes designated as Class 1500, 2400, 3300, 4000, and 5000 respectively and shall have standard nominal lengths of thirteen feet except that ten foot lengths are permissible in six inch and eight inch size in Class 1500, and shall be furnished with ring-tits couplings, as manufactured by Johns Manville Company or approved equal. Asbestos-cement fittings shall be manufactured in classes suitable for the class of pipe with which they will be used. Short lengths of 6'-6" shall be used for all connections to rigid structures in all classes up to twelve inches in size.

The wall and coupling thicknesses, as well as tolerances, shall be in accordance with the Specification DS-366-Latest Edit Transite Asbestos-Cement Sewer Pipe.

The pipe shall have a crushing strength for each respective size and class, when tested in accordance with A.S.T.M. three-edge bearing method, equivalent to that shown in the following table:

CRUSHING STRENGTH*

Nominal Pipe Size Inches	<u>Total Applied Load Per Linear Foot, Pounds</u>				
	Class 1500	Class 2400	Class 3300	Class 4000	Class 5000
6	1500	2400	3300	4000	5000
8	1500	2400	3300	4000	5000
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	1500	2400	3300	4000	5000
16	1500	2400	3300	4000	5000
18	—	2400	3300	4000	5000
20	—	2400	3300	4000	5000
24	—	2400	3300	4000	5000
30	—	—	3300	4000	5000
36	—	—	—	4000	5000

*Per A.S.T.M. 3-Edge Bearing Method

The uncombined calcium hydroxide, present in the sewer pipe and sleeves shall not be more than 2% when tested in accordance with Section 4.5 described in detail in material Specification DS-366- Latest Edition.

Each standard, random or short length of cement-asbestos pipe shall be subjected to an internal pressure of fifty pounds. The test shall be conducted by placing the pipe in a hydrostatic pressure testing machine with gaskets which seal the ends of the pipe. 1-11 air shall be removed and the pressure increased to fifty pounds.

6. STEEL PIPE - Steel pipe, where shown on the Construction Plan either for use as a sewer or casing, bored or jacked underneath roads or railroads, shall have wall thickness of 1/4 inch for sizes up to and including 16 inches, 3/8 inch for sizes from 18 inches up to and including 30 inches. The casting shall be black steel material and all joints shall be Welded. The pipe shall have yield strength of 35,000 P.S.I. The lines placed in the casing shall have the type of joints as indicated on the Plans.
7. ABS PLASTIC TRUSS PIPE - Truss pipe shall conform to the requirements of A.S.T.M. D-2680 and be installed in accordance with A.S.T.M. D-2321. Truss

pipe is defined as two (2) concentric thermoplastic tubes integrally braced across the annulus, and with resultant space filled with Portland cement concrete to provide continuous support between inner and outer tubes.

Truss pipe shall be extrusion formed from a thermoplastic material which shall be a virgin rigid ABS plastic conform to the requirements of A.S.T.M. D-1788; Type 1, Grade 1; Type 1, Grade 2; or Type IV, Grade 1; except that the minimum heat deflection temperature (A.S.T.M. D-648) shall be 180 F. (82.2 C).

Pipe Sizes

TABLE I

PIPE DIMENSIONS

<u>NOMINAL DIAMETER</u>	<u>OUTSIDE DIAMETER</u>			<u>AVERAGE INSIDE DIAMETER</u>
	<u>AVERAGE</u>	<u>TOLERANCE</u>	<u>MAXIMUM</u>	
<u>Inch</u> 8	<u>Inch</u> 9.41	<u>Inch</u> ±.04	<u>Inch</u> 9.51	<u>Inch</u> 7.75
10	11.75	±.04	11.37	9.75
12	14.07	±.00	14.22	11.75
15	17.62	±.07	17.80	14.75

Pipe shall be furnished in standard 12' - 6" lengths with a tolerance of -1 inch. Pipe intended to be straight shall have a maximum deviation from straightness of 1/16 in/ft. of length.

Pipe ends shall be square or perpendicular to the longitudinal axis as provided in Table II.

TABLE II

<u>NOMINAL DIAMETER</u>	<u>MAXIMUM ALLOWABLE GAP MEASUREMENT</u>
<u>Inch</u> 8	<u>Inch</u> 0.25
10	0.33
12	0.41
15	0.50

Pipe Joints and Connections

Pipe joints shall be made in accordance with the manufacturer's recommendations and instructions. All exposed ends shall be sealed with sealer material recommended by the manufacturer. Connections to manholes shall be made with a rubber gasket, water stop, or ring employed on the pipe.

Marking

Pipe shall be marked on the outside of the barrel in letters 3/8 inch (9.525 mm) in height and of bold type style. The marking shall indicate the name of the manufacturer or supplier, and the nominal diameter. Lettering shall be legible and permanent under normal conditions of handling and storage.

Fittings

All fittings shall be factory manufactured of equivalent material as the pipe installed. No field manufactured fittings will be permitted.

Solid Wall A.B.S. Pipe - Usable on 6" House Connections

The pipe wall shall be thermoplastic material as described in Section 4.1. A.S.T.M. Designation: D2680-Latest Edition with a standard dimension ratio (S.D.R.) of 35. All dimensions and tolerances shall be in accordance with manufacturer's specification.

Method of tests shall be in accordance with Section 8, A.S.T.M. D2680- Latest Edition.

The Developer shall comply with the Plumbing Code of Allegheny County in regard to material and method of installation.

Pipe shall be extrusion formed from a thermoplastic material which shall be a virgin rigid ABS plastic conforming to the requirements of A.S.T.M. D-2751.

Pipe shall be Extra Strength (F/Y 150) for all trench depths. Stiffness factor (F/Y) shall be determined in accordance with Section 8.3 of A.S.T.M. D-2680.

8. POLYVINYL CHLORIDE PIPE - Polyvinyl chloride pipe and fittings shall be of the best quality and shall conform to the requirements of A.S.T.M. Designations D-3033-Latest Edition-or D-3034-Latest Edition .. with a standard dimension ratio (SDR) of 35.

Pipe Inspection and Rejection

All pipe shall be subject to inspection at the factory, trench or other point of delivery by a competent inspector designated by the Engineer. The purpose of the inspection shall be to cull and reject pipe that, independent of the physical tests specified in A.S.T.M. Designations D-3033 - Latest Edition or D-3034 - Latest Edition, fails to conform to the requirements of these specifications.

Joining Materials

All joints shall conform in all respects to A.S.T.M. Specifications D-3033-Latest Edition or D-3044-Latest Edition. The assembly of joints shall be in accordance with A.S.T.M. Designation D-2855-Latest Edition and the pipe manufacturer's recommendations. The joints shall be subject to the approval of the Engineer. Before any construction begins the Developer shall inform the Engineer as to the type of joint that shall be used.

Fittings

The Pipe manufacturer shall provide manufactured fittings for all areas where fittings are required. No field made fittings shall be accepted.

Marking

Pipe - Each pipe shall be clearly marked, containing the manufacturer's name or trademark., nominal pipe size., the words "non-pressure" and the date of manufacture.

Fittings - Each fitting shall contain the manufacturer's name or trademark nominal size, and material designation "PVC".

14. LAYING OF PIPE

A. General

All pipe shall be laid to a uniform line and grade, socket ends up grade, with a firm and even bearing along the barrel of pipe, close joints, and smooth invert. The spigot end of the pipe is to be centered in and shoved right and secured against the bell or socket of the previous laid pipe. The interior of each pipe shall be cleaned of all excess joints and foreign material before the next pipe is laid.

No pipe shall be laid in water or when trench conditions or weather are unsuitable for such work, except when permitted by the Engineer. Under no circumstances shall any material be placed in the pipe either purposely for storage or other reasons, or inadvertently.

Branches for connections fitted with suitable stoppers shall be laid at the points and in the positions called for on the Drawings or as otherwise directed by the Engineer. Each branch shall be located by the Developer and its station recorded relative to the downstream manhole. During the process of laying the pipe, care shall be taken to protect both pipe and joint from disturbance, and the trench shall be kept free of water until the joints have set. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be protected with a close fitting stopper.

The Developer shall lay the sewer to line and grade by using a laser beam at all times unless other methods are approved by the Engineer. He shall use grade stakes spaced at 25 foot intervals. Complete cut sheets shall be furnished to the Engineer for his approval three working days prior to the beginning of construction of a section of a section of sewer.

B. Hand in Pipe and Accessories

The pipe, fittings and other accessories shall be hauled to the site from the point of delivery, and unloaded by means that will not result in any damage to the pipe, and under no circumstances, shall the pipe be dropped from the truck. The pipe and fittings shall always be handled with care to prevent damage when being transported, loaded or unloaded.

The pipe and fittings shall be unloaded and placed near where they are to be laid in the trench, with the bell or proper ends facing in the direction in which the work will proceed, exercising care and keeping the pipe and fittings free from dirt and foreign material.

The Developer shall provide proper tools, implements and facilities for handling and placing of the pipe. The pipe, fittings and other appurtenances shall be carefully lowered into the trench by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to the pipe or pipe coating where the type of materials require such handling. The pipe and fittings shall, under no circumstances, be dropped or rolled into the trench or dropped on the surface of the ground.

The Pipe and fittings shall be inspected for defects immediately before placing into the trench, and shall, in the case of cast iron pipe, be tapped with a light hammer to detect crack. Those pipes and fittings found unsatisfactory shall be rejected, a large cross mark painted red on these materials, and the materials removed. from the immediate site of the work. The pipe and fittings shall be thoroughly cleaned before lowering into the trench, and maintained clean.

C. Bedding of Pipe

All the pipe shall be installed on firm earth on granular bedding material as required by the Construction Plans or specified to allow proper bedding of the pipe. The type of bedding material shall be as specified and shall be in accordance with the Specification for back fill materials in Section 12-B of these Specifications.

In all cases, the bottom quadrant of the entire length of the pipe shall be fully and uniformly supported, except the bell, under which a recess shall be excavated to a sufficient depth to relieve the bell of any load and to allow ample space for making the joint.

If the excavation has been made too deep, granular bedding material shall be in the bottom of the trench, thoroughly rammed and a new bed made for the Pipe. The pipe shall not be raised by rating earth beneath the bottom. When the pipe has been bedded satisfactorily and the joint made, the recess under the bell shall be refilled with bedding materials, and enough earth or granular material placed and tamped on each side of the pipe to hold it securely in place, care being taken not to disturb the position of pipe during this process.

When a concrete cradle is required or has been specified, the cradle shall be at least six inches thick, unless otherwise directed, and in rock excavation shall be sufficient to fill the space around the pipe.

The concrete shall be deposited continuously and carefully tamped in such a manner as to avoid changing the position of the pipe to insure uniform support for the pipe, and to insure the placement of a uniform homogeneous cradle. The Developer shall take such precautions as are necessary to prevent floating of the sewer due to placement of the concrete cradle, including tying down or anchoring of the pipe prior to placement of the cradle. The concrete shall be Class B and shall have a compressive strength at 28 days of 3,000 pounds per square inch.

D. Jointing of Pipe

1. CLAY SEWER PIPE - The following procedures shall be followed in connection with the various types of joints:

Cement Grout Joints - The Contractor shall place under the hub of the last pipe, a suitable form of unbleached muslin of sufficient length to at least encase the lower 2/3 of the pipe. The spigot end of the pipe shall be inserted into the hub to its full depth and a gasket of jute or oakum shall be twisted and caulked into the joint, being thick enough to even up the inverts. The ends of the muslin shall be brought up around the pipe and tied with tie wire. The annular space then shall be filled with cement grout, thin enough to be forced through a hose and around and tightly into the joint. The muslin form shall remain in place, and before the grout has set the upper portion of the joint is then to be formed of cement mortar, well caulked into place. The inside joints of 24 inch or larger pipe shall be filled and caulked with cement mortar. Before any joints are made on the ground, the Contractor shall demonstrate to the Engineer, by pouring a sample joint, that the methods which he employs conform to the above specifications and will secure a watertight joint, and that the workmen he intends to use for this work are familiar with the requirements.

The cement grout and cement mortar used shall have the following composition by weight:

- 3 parts clean sharp sand
- 2 parts Portland cement
- 1 part Master Builder's Company Embeco or approved equal

To this shall be added only enough water to make a workable mix.

Cement-Mortar Joints - A gasket of hemp or yarn shall be rolled sufficiently thick to completely fill the annular space between the bell of one pipe and the spigot of another. A uniform width of joint shall be maintained in the annular space. This gasket shall be dipped in a cement grout composed of neat Portland cement and water, and is to be thoroughly soaked with the liquid. The gasket shall then be laid in the bell for the lower third of the circumference of the joint and covered with mortar. The spigot of the pipe shall then be inserted in the annular space around the entire circumference of the pipe.

Asphalt-Cement Joints - The joints shall be thoroughly caulked with a closely twisted gasket of dry hemp or jute, free from oil or grease, long enough to go around the pipe and of sufficient thickness to hold the pipes securely in their proper relative positions.

Subsequent to laying the pipe to its proper line and grade and placing and caulking of the hemp or jute and placing of a suitable runner, a bituminous joint compound shall be poured in the joint so that it shall run around the pipe, completely filling the annular space. The joint compound shall be heated to a temperature of 400 degrees Fahrenheit, or as specified by the manufacturer, in a suitable furnace and so that the material can be poured rapidly and smoothly.

In colder weather, when the compound is likely to cool too rapidly in running around a larger pipe, the lower half of the joint shall be poured first, from both sides, then the upper part of the joint shall be poured from the top.

In case the pipe joint is not complete filled, the unfilled part of the joint shall be poured again with hot material so as to form a complete water-tight joint. Whenever permitted, sections of two or three pipes may be joined at the side of the trench, provided the pipes are held firmly to correct alignment. In lowering the section so made into the trench, a piece of timber shall be run through the pipes to support their weight and prevent the joints or bells from being broken. The Developer shall pour as many joints as possible with the pipes in a vertical position. The joint on the inside of the pipe shall be carefully wiped and the pipe left smooth and clean throughout.

The joint compound shall melt and run freely at a temperature as low as 250 degrees Fahrenheit, shall adhere firmly to the surface of the pipe when set, shall be sufficiently elastic to permit a slight movement of the pipe without injury to the joints or breaking of adhesion of the compound to the pipes, and shall meet the following requirements:

	Minimum	Maximum
Specific Gravity at 25 C	1.45	1.55
Melting Point F	195.	205.
Penetration at 25 C	8.	15.
Adhesion at 25 C Lbs. Per Square Inch	150.	---
Total Bitumen	45%	55%
Total Inert Material	45%	55%

This compound shall not deteriorate when submerged in water or domestic sewage and shall form a tight joint when poured in pipe partly or entirely submerged in water. It shall show no deterioration when immersed for a period of five days in one percent solution of caustic potash. The compound shall be G-K Kaulktite, or approved equal.

2. CONCRETE SEWER PIPE - The joints for concrete pipe shall be bell and spigot or tongue and groove made in accordance with A.S.T.M. Specifications and prepared to receive endless rubber O rings or the Press Seal Gasket, or approved equal, to effect sealing of the joint.
3. CAST IRON PRESSURE PIPE - The following types Of joints will be considered for cast iron pressure pipe:

Lead Joints - The yarning or packing materials shall consist of one of the following:

- Molded or tubular rubber rings
- Asbestos rope
- Braided hemp
- Treated paper rope

All of the above materials shall be handled with care in order to prevent contamination and shall be dry when put- into place in the joint. The material

used shall be free of oil, tar or greasy substances.

The yarning or packing material shall be placed around the spigot of the pipe and shall be of proper dimensions to center the spigot in the bell. When the spigot is shoved home, the yarning material shall be driven tightly against the inside face of hub of the bell with suitable yarning tools.

When a single strand of yarning material is used, it shall have an overlap at the top of not more than two inches. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. The ends of the strands shall meet on opposite sides of the pipe and not on the top or at the bottom. Successive strands of yarning material shall be driven home separately.

For lead joints, a space of not less than 2-1/4 inches in depth shall be left in the bell in pipe having a nominal diameter of 20 inches or less; 2-1/2 inches in 24 inch, 30 inch and 36 inch pipe; and 3 inches in pipe larger than 36 inches.

The Developer shall then thoroughly clean and dry the joint and place a joint runner snugly against the bell and outside of the pipe. The pouring gate shall be built up with clay to a point at least one inch above the top of the joint space. The joint shall then be run full with one continuous pouring of lead. When the air temperature is below 40 degrees Fahrenheit, the bells and spigots of the pipe, valves and specials shall be heated to above 50 degrees Fahrenheit before the lead is poured.

Lead shall be heated in a melting pot kept in easy reach of the joint to be poured, so that the molten metal will not be chilled in being carried from the melting pot to the joint, and shall be brought to a proper temperature so that, when stirred, it will show a rapid change of color. Before pouring, all scum shall be removed. Spongy or imperfectly filled joints shall be burned out and repoured.

After lead has cooled to the temperature of the pipe, lead joints shall be caulked with pneumatic or hand tools operated by competent workmen until such joints are thoroughly compacted and watertight. The finished joint shall show a hard and even hammered surface overall. Care should be taken not to overstrain the bells during caulking.

The Developer shall yarn and pour all joints the same day as the pipe is laid, and no joints shall be made after dark unless approval is granted by the Engineer.

The lead for caulking purposes shall contain no less than 99.73 percent pure lead, and impurities shall not exceed the following limits:

Arsenic, Antimony and Tin, together	0.015
Copper	0.18
Zinc	0.002
Iron	0.002
Bismuth	0.25
Silver	0.02

The producer's name or identification mark shall be clearly cast or stamped upon each piece of lead.

Mechanical Joints - The joints on the mechanical joint pipe shall be made in accordance with the following procedure:

- A. The socket and plain end shall be washed with soapy water, and the gland and gasket slipped over the plain end of the pipe. The small slide of the gasket and the lip side of the gland shall be placed facing the bell.
- B. The gasket shall be painted with soapy water.
- C. The gasket shall be pushed into position so that it is evenly seated in the socket.
- D. The gland shall now be slid into position, the bolts inserted, and the nuts made finger tight.
- E. The bolts shall be brought to a uniform tightness with a ratchet wrench. The bolts, 180 degrees apart, shall be tightened alternately in order to bring the gland up evenly all around, the bolt at the bottom of the joint to be tightened first, the tightening continued in this manner.

Single Rubber Gasket Joints - The joints shall be made in accordance with the following procedure:

- A. The socket and plain end shall be washed or wiped with lubricant furnished by the manufacturer.
 - B. The gasket shall be washed with said lubricant and pushed into socket so that it is evenly seated.
 - C. The pipe shall be inserted into the gasket and shoved home by using a bar until the painted stripe on the end of the plain end is inside the socket.
4. ASBESTOS-CEMENT PIPE - The asbestos-cement pipe joints shall be made with couplings of the "Ring Tits" type, or approved equal, this coupling

consisting of an asbestos-cement sleeve and two rubber rings.

The machine ends of the pipe to be jointed, the inside of the sleeve and the two rubber rings shall be wiped clean immediately before jointing the pipe.

The assembly of the coupling shall be made as recommended by the manufacturer.

Following completion of the assembly of the coupling, the pipe ends within the coupling shall be separated 1/4 inch and the rubber ring location checked with a suitable gauge. Both rings for the full circumference of the pipe shall be not more or less from the coupling ends than the distance recommended by the manufacturer of the coupling. If these requirements are not met, the coupling shall be disassembled and reassembled in an acceptable manner.

The joints between asbestos-cement pipe and cast iron pipe and fittings shall be made by the use of lead, and the joint between asbestos-cement pipe and other types of pipe shall be the same as used throughout the remainder of the system.

The cutting of pipe for inserting into the bells of the Pipe and in accordance with the manufacturer's instructions.

In pipe sizes six (6) inches and less, the length of the pipe entering the bell of a fitting shall not exceed three (3) feet three (3) inches, and in sizes above six (6) inches the length of the pipe shall not exceed six (6) feet six (6) inches.

The lengths of pipe entering or passing through rigid structures shall not be greater than three (3) feet three (3) inches beyond the face of that structure when the pipe is six (6) inches or less in size, not more than six (6) feet six (6) inches for pipe larger than six (6) inches.

E. Plugging Ends, Branches and Specials

The ends of all pipe sewers, branches, laterals and other such points of terminus shall be closed with plugs equipped with a joint identical to the spigot end of the sewer pipe being used. All plugs shall be plugged and blocked so as to permit the making of the exfiltration test without leakage or movement of the plug and/or blocking. The installation shall withstand at least a 20 foot hydrostatic head. During the progress of the work, the open ends of all pipes and branches shall be temporarily closed with a properly designed wooden plug at such times as no work is active at that particular point.

F. Connections to Existing Sewer

Where a connection is to be made to an existing old sewer, a trench of proper width shall be excavated back a distance of six feet, to expose the existing sewer, and at least two-lengths of pipe removed and replaced with new pipe. There will be no additional payment for the replacement of the existing old sewer.

G. Tests of the Sewers

Each section of sewer between manholes shall be cleaned, tested and inspected.

The Contractor shall test each section of sewer between manholes to determine the tightness of the sewer joints, it being necessary to limit infiltration to a minimum.

The section of the sewer being tested shall be bulkheaded or plugged at the lower end of the sewer and at the inlet side of the upstream manhole. The Contractor shall fill the upstream manhole with water and shall maintain a column of water in the manhole at least four feet above the top of the sewer at the highest point of the section being tested. The test shall not start until thirty minutes after the pipe had been filled, in order to allow for absorption of water by the pipe, and the test shall last for one hour.

During periods that the ground water table is higher than the sewer, the water column in the manhole shall be at least four feet above the water table elevation.

The exfiltration of water, as determined by this test, shall not exceed 200 gallons per inch of diameter of pipe per mile per day when the pipe is subjected to a minimum head of four feet. The pipe will not be tested against a head greater than twenty feet of water, but must be satisfactory for up to a twenty foot head.

The Contractor must make all required tests immediately following the installation of the first 400 to 600 feet of sewer, in order to determine that the workmanship and materials are satisfactory before proceeding with any other work.

Where directed by the Engineer, the Contractor will conduct an air pressure test in lieu of the required water test. This test shall consist of sealing the ends of the sewer and applying a test pressure of 5 p.s.i. for a five minute period. The pressure gauge utilized for this test shall have a maximum range of zero to fifty p.s.i. The section of sewer being tested shall exhibit absolutely no drop in pressure during the test period.

If the leakage exceeds this amount, the Developer shall determine the cause of the leakage and make such repairs or replacements as found necessary and repeat the test, doing such work and repeating the test as often as necessary until the sewer is found to comply with the requirements of this hydrostatic test.

The complete sewer installation shall be tested for infiltration following the exfiltration tests of all sections as described above. The infiltration test shall be made during or immediately following periods of extended rain when the ground is completely saturated with water. The entire system shall sustain a maximum limit of five hundred gallons per inch of diameter per mile of pipe per day when tested for infiltration. The equipment for conducting infiltration tests shall be approved by the Engineer prior to use.

Each section of sewer between manholes shall show a full circle of light. All repairs shown necessary by tests and inspection are to be made by the Developer; all broken or cracked pipe is to be replaced, all deposits in the sewer are to be removed, and the sewer left true to line and grade and entirely clean.

15. MANHOLES

A. General

The manholes shall have concrete bases with concrete pipe walls or brick masonry walls, shall be provided with cast iron frames and covers and steps as specified under Item 16 of these Specifications, and shall be constructed in accordance with the details and dimensions of those shown on the Construction Plans. Unless otherwise indicated, all manholes shall be constructed of precast reinforced concrete risers and tops.

B. Materials

1. WATER - The water shall be clear and shall be free from oil, acid and injurious amounts of vegetable matter, alkalies, or other salts.
2. CEMENT AND AGGREGATE - The cement and aggregate to be used shall conform to the following:

Cement - All cement shall conform with ASTM Standard Specification for Portland Cement Designation C150-Latest Edition.

Aggregate - All aggregate shall conform to ASTM Standard Specification for concrete aggregates, Designation C33-Latest Edition and ASTM Standard Method of Test for Sieve or Screen Analysis of Fine and Coarse Aggregates, Designation C136-Latest Edition.

Fine Aggregates: All fine aggregates shall consist of clean, hard, durable, uncoated grains of natural sand.

Coarse Aggregates: All coarse aggregates shall consist of crushed limestone gravel or air cooled blast furnace slag. The nominal size of coarse aggregate under these Specifications shall be one inch.

3. LIME PUTTY - Lime putty may be made from hydraulic lime conforming to:
 - (a) ASTM Standard Specification for hydraulic hydrated lime for structural purposes, Designation C141-Latest Edition.
 - (b) ASTM Standard Specification for quicklime for structural purposes, Designation C5-Latest Edition.
 - (c) ASTM Standard Specification for normal finishing hydrated lime, Designation C6-Latest, Edition, Type N. The putty made from Type N - normal finishing hydrate shall have a plasticity figure of not less than 200 when soaked for a period of not less than 16 hours nor more than 24 hours.
4. CONCRETE - Concrete for bases, inverts and slabs shall be Class B and shall have a compressive strength of 3000 pounds per square inch in 28 days.
5. BRICK - All brick shall conform to the ASTM Standard Specification for sewer and manhole brick (made from clay or shale), Designation C32-Latest Edition, Grade MS. unless otherwise shown in the plans.
6. PRECAST CONCRETE SECTIONS - Concrete used in the manufacture of circular precast sections or pipe to be used for manholes shall be Class A and shall have a minimum compressive strength of p.s.i. 3,750 and shall be cured a minimum of seven days before shipment. The entire surface of all statically poured precast manhole sections shall be reinforced with not less than 6x6x10/10 gauge steel mesh: Base sections with more than two pipe holes exceeding 14 inches in size shall be reinforced with an additional pipe section.

Precast concrete sections shall be in accordance with ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops," Designation C478-Latest Edition.

The manhole steps shall be in accordance with Item 16 of these specifications, as previously indicated, 12 inches on centers, shall be 12 inches in width, and project not less than 5 inches from the wall, and shall be placed while the concrete is green. Should field grouting of steps be approved, such grouting shall be completed utilizing premixed grout material known as Embeco, as manufactured by Master Builders Company, or approved equal.

Cone section shall be designed to resist the effect of highway loadings. They shall be eccentric with the manhole steps installed on the straight side. The clear opening at the top of the manhole shall be 29 inches in diameter.

Inside diameter shall be not less than 48 inches.

All pipe openings in the base section shall be formed, at the time of fabrication of the manhole or shall be cut in the shop while the concrete is green. A 14" x 14" opening shall be the minimum size or an 8 inch pipe.

7. MORTAR - The mortar shall be mixed by volume in the proportion of one part Portland cement, one-fourth part well seasoned lime putty and two parts sand. The mortar shall be highly plastic with water retentivity.

When hydrated lime is used making up the lime putty, it shall be slaked and left to season not less than seventy-two hours before use. Where quick lime is used, it shall be slaked and left to season not less than fourteen days before use.

The materials shall be first mixed dry to a uniform color in a batch mixer or a tight mortar box, and then mixed thoroughly with water, which shall be added gradually until the required consistency is obtained.

Mortar shall be mixed in batches of such sizes as will be used immediately and any mortar which has set sufficiently to require retempering shall not be used.

C. Excavation

The excavation shall be made at least eighteen inches away from the exterior of the masonry. The excavation less than twenty-four inches from the exterior faces shall be backfilled with granulated slag, sand or other approved Material to a depth of within twelve inches of the surface of the ground, and the backfill shall be thoroughly compacted.

The portion of excavation more than twenty-four inches from the exterior of the masonry shall be backfilled with selected material and properly tamped in six inch layers with mechanical tampers.

The backfilling shall not be started until eighteen hours after construction of the masonry, but shall be completed before the end of forty-eight hours.

D. Concrete Base and Invert

1. GENERAL - The concrete work shall be done in accordance with the requirements set forth herein.
2. INSTALLATION - A base of plain concrete shall be poured that is a minimum of eight inches thick under the invert of the outlet sewer pipe. Concrete shall be poured to a height of three inches above the top of the inlet and outlet pipes outside the manhole. The latter concrete shall be poured, in the case of the brick manhole, after laying brick above the top of the inlet and

outlet pipe; and in the case of the precast manhole shall be poured monolithically with the base.

Whole pipe sections shall be first laid through the manhole area, to true grade for straight invert channels, and curved sewer sections shall be laid through curved invert channels, but junction invert channels will need to be formed by hand. The whole pipe sections thus used shall later have their tops broken out within and for the full 48 inch diameter of the manhole.

The inverts shall be shaped as indicated on the Construction Plans, with the sides of the invert made vertical from the spring line of the pipe to an inlet pipe, whichever is higher.

Sufficient pumps shall be provided to keep the excavation dewatered for twenty-four hours until the concrete has set up and there is no danger or leakage through the wet concrete.

3. PLACING OF CONCRETE - ADVERSE WEATHER CONDITIONS - All concrete following placement shall be protected during and immediately after a storm or rainfall by means of tarpaulins or other approved methods until the concrete is set.

During cold weather, when the air temperature is at or below 40 degrees Fahrenheit, or whenever it shall appear to the Owner's Engineer, from weather reports or otherwise, that the air temperature may fall below 40 degrees Fahrenheit within the 24 hour period next following the completion of the concrete pour, the Developer shall heat the mixing water and aggregates for the concrete at a temperature of at least 50 degrees Fahrenheit for not less than seventy-two hours after its placement and shall protect same from freezing for seventy-two hours immediately following the seventy-two hours of protection at 50 degrees Fahrenheit. Salt or other material to lower the freezing temperature of the concrete shall not be added to the mix; however, calcium chloride in complete solution may be added to the mixing water in amounts not exceeding two pounds per bag of cement.

No concrete shall be deposited on a frozen subgrade or subbase. Before placing concrete in cold weather, all forms, reinforcing and tearing strata shall be thoroughly heated so as to raise the temperature well above the freezing point.

After the concrete is placed, it shall be protected against freezing by means of a tight covering, and sufficient heat supplied around the concrete and the forms to maintain the temperature of the concrete above 50 degrees Fahrenheit for the period above stipulated. When heating concrete materials and water, sufficient heat shall be used so that the temperature of the concrete at the time

of placement shall be not less than 70 degrees nor more than 100 degrees Fahrenheit.

E. Brick Manhole falls

1. GENERAL - The brickwork shall be done in accordance with the details and dimensions shown on the Construction Plans and the procedures set forth herein.

All masonry units shall be protected from weather and damage in shipping and storage on the job.

The brick, upon delivery to the job, shall be stacked on suitable planking in allocation where they will be protected from splashing of mud, oil, and other deleterious material.

2. LAYING BRICK - The brick shall be thoroughly drenched with clean water immediately before being laid.

The brickwork shall be laid radially, be laid with shove joints completely filled with mortar, and the interior joints shall be not more than 1/4 inch in width and no joint more than 1/2 inch in width. Whole bricks shall be used except to effect closures and to fill in the outside portion of the radial joints. The brick shall be laid as headers, breaking all joints between courses, except that each seventh course shall be stretcher course. All interior joints shall be smooth with the brick.

The outside face of the brick walls shall be plastered with a 1/2 inch thick coating of mortar conforming to that specified herein. The inside walls shall be coated with one coat of Thoroseal, or approved equal.

F. Precast Concrete Manhole Walls

1. GENERAL - The manholes shall be constructed in accordance with the details and dimensions shown on the Construction Plans and described herein.

2. INSTALLATION

- A. Handling - All manhole sections shall be carefully handled during shipment and unloading. They shall not be rolled under any conditions. Any clipping of manhole joints shall be cause for rejection of the particular section.

- B. Setting - The precast base section shall be set on three concrete blocks so that the base edge is at the same elevation as the flow line of the outline

sewer. Field adjustments in pipe openings shall be done with a light hammer and cold chisel. A heavy sledge hammer will not be permitted for this use. The base shall be poured as described hereinbefore.

The wall section joints shall be thoroughly caulked with cement mortar, both inside and out.

All lifting holes shall be grouted after erection, using Embecco grout as manufactured by Master Builders Company, or equal. All mortar joints shall be troweled to insure resistance to moisture penetration. The interior surface of all concrete manholes shall be coated with one coat of Thoroseal, or approved equal.

- C. Inverts - The inverts shall be formed by bedding, split sections of terra cotta pipe on the concrete base, as hereinbefore described.

3. Drop Connections

In all junction manholes where the grade line of one sewer is considerably higher than that of the other, the drop connection shall be made as shown on the Construction Plans. Wye branch fittings shall be utilized for the drop connection where requested by the Engineer. Concrete for encasement shall be Class B, as described elsewhere under "Materials" in this section.

16. MISCELLANEOUS METAL PROJECTS

A. Manhole Frames and Covers

The manhole frames and castings shall be built to conform to the Construction Plans and shall meet the requirements of ASTM Standard Specifications for Gray Iron Castings, Designation A-48-Latest Edition, Class 30.

B. Manhole Steps

The manhole steps shall be made of forged or extruded aluminum, or of nodular iron, shall be of the dropped front type, and shall be in accordance with the details shown on the Construction Plans.

C. Placing Manhole Frame and Cover

The manhole ring shall be bolted to the top of the manhole with two 3/4 inch steel bolts and set in a bed of mortar at such level that when the cover is placed thereon, the top surfaces will conform with existing grades. The bolts shall be long enough to allow three inches of adjustment in the height of the frame and cover. The bolts shall be poured in place by the manufacturer of the precast manhole sections.

After installation of the frame, the bolts and nuts shall given two coats of bitumastic. Surfaces of contact between rings and covers shall be machined so no rattling occurs when vehicles pass over the cover. If rattling does occur, the cover shall be removed and remachined so as to eliminate the rattling.

D. Placing Manhole Steps

Steps shall be placed in the manhole wall in accordance with details shown of the Drawings. The center to center spacing shall be approximately twelve inches and they shall be in true vertical alignment unless otherwise shown. They shall project uniformly from the face of the wall five inches to the centerline of the step.

17. REPAIR, RESTORATION AND MAINTENANCE OF SURFACE PAVEMENT

A. General

The Developer shall restore, unless otherwise stipulated, all pavement, sidewalks, curbing, gutter, fences, poles, or other property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began, furnishing all labor and materials incidental thereto. In restoring pavement, sound granite blocks, sound brick or asphalt paving blocks may be reused. No permanent pavement shall be restored unless and until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement.

The paved surfaces shall be restored with new pavements and no permanent paving shall be placed within less than thirty days after backfilling, unless approved by the Engineer. The Developer shall construct an asphalt base beneath the hard-surfaced roads where indicated on the Construction Drawings or where required by the State or County Highway Departments.

All material and labor required for the maintenance of the trenches, surfaces and adjacent structures shall be supplied by the Developed for the period required by the Maintenance Bond.

B. Gutters

Gutters of dirt macadam telford or gravel roadways shall be paved where directed with cobbles, field or random stones of satisfactory quality, none of which shall be less than five inches in any dimension and all of which shall be at least eight inches in two dimensions. The stones shall be carefully laid by hand to line and grade, well bedded in fine gravel or sand thoroughly rammed. The joints shall be filled with sand. Should such pavement with its joints filled with Portland cement, grout or sand, settle or become displaced, or should there be any defective work of any kind, such work must be removed at once and replaced by the Developer in satisfactory manner without additional compensation. Concrete gutters shall be placed in accordance with the original design or as required by the Municipality.

When an open or covered cross gutter or pipe drainage channel exists in the surface of the roadway, which will be rendered useless by the construction of a storm inlet or other work by

the Developer, the Developer shall be required to remove the whole of it and lay or relay the pavement to the grade and surface designated by the Engineer.

C. Walks

Where a new sidewalk is required, the site shall be excavated and graded to the width directed, to a subgrade ten inches below and parallel to the top of the finished pavement. On the subgrade, a foundation of clean cinders and stone slag or gravel shall be placed, which shall be well consolidated by ramming. The base course shall be well watered during ramming, and the top surface shall be brought to a height of four inches, below and parallel to the finished surface, which shall have transverse grade 1/4 inch per foot upward from the curb. On this foundation shall be placed four inches of cement concrete, thoroughly compacted, which shall be cut by joints into blocks not larger than five foot square. One expansion joint shall be provided at intervals not exceeding thirty feet and shall contain 1/2 inch premolded expansion joint material. The surface shall be carefully floated and troweled to a smooth even surface. A drier made of equal parts of sand and cement, well mixed, shall be sprinkled in a dry state over the surface, and then floated or troweled. Joints shall be troweled with a small jointer and entire surface indented in a manner satisfactory to the Engineer. When the pavement is completed, it shall be kept covered for three days and shall be kept moist by sprinkling, if required by the Engineer and thoroughly protected against freezing.

Where stone walks are removed, they shall be replaced following the same procedure for subgrade and base as set forth in the preceding paragraph, and a concrete sub-base shall be constructed as shown on the Construction Plans, following which the stone shall be laid, which stone shall be similar in quality, color and texture to the existing stone walks.

Where bitumastic walks are removed, they shall be replaced, following the same procedure set forth under the preceding paragraph as relates to subgrade and bases and the walk shall be replaced in the same manner and with the same materials as the existing walks. The walks shall be excavated at least twelve inches beyond the edge of the trench or line of excavation, unless otherwise indicated and replaced for this width.

D. Curbs

The curbs shall be replaced with the same type originally installed, and the Specifications covering concrete work shall be followed as to materials and methods of doing work.

E. Roadways and Barriers

Where the Developer cuts across roads, he shall backfill with granulated slag properly tamped as promptly as possible, and shall maintain a crossing of grade at all times. He shall remove enough of the top stone and surfacing, at least twelve inches on each side of the trench where required to obtain support on each side of the trench for the new surfaces and shall repave according to the Township Standards. Where the trench is opened parallel to a paved area, the Developer shall restore any breaks or ragged edges on the paving as may be caused by his

operations.

No permanent paving shall be placed within less than thirty days after backfilling, unless approved by the Engineer. The Developer shall construct an asphalt base beneath the hard surfaced roads, where indicated on the Construction Drawings or where required by the Township.

The barriers shall be replaced in an approved manner, subject to the approval of the Owner under whose jurisdiction the property is maintained and the berms properly graded and finished.

18. RESTORATION OF LANDSCAPING

The Developer shall, in the preparation of the site, provide adequate protection for all lawns, trees, shrubs, and landscape work that are to remain in place or shall remove and preserve all topsoil within areas in which the lawns cannot be protected. Such protection or preservation shall be maintained so long as necessary to prevent damage or deterioration due to the operations of the Developer.

All landscape work and topsoil that must be removed shall be stored and protected and replanted following backfill and tamping of the excavated areas providing it is suitable for reuse. If such material is not suitable, it must be replaced.

All areas other than traveled roads and landscaped areas that are disturbed shall be graded and a ground cover of topsoil shall be placed so that erosion of said areas is kept to a minimum until natural vegetation flourishes and predominates.

A. Lawns

1. GENERAL - All lawns which are damaged due to the execution of this work shall be topsoiled to a depth of six (6) inches.
2. PREPARATION OF SUB-GRADE SOIL - The subgrade shall be established, uniformly sloped in the direction indicated, and be finished six inches (6") below the final grade. The subgrade shall be brought up to the proper elevation with clean, loamy earth properly placed and compacted.
3. PREPARATION OF SURFACE - All topsoil that was removed and preserved prior to excavation shall be used provided it is suitable for such use. Any additional topsoil to be furnished shall be fertile friable, natural topsoil, typical of topsoil of the locality. It shall be free from stone, without admixture of subsoil, plants, or roots, sticks or other extraneous matter, and shall not be used for operations while in muddy or frozen condition.

The topsoil shall be spread and brought to the finished grade, then leveled through the use of straight edges and finally rolled, but not compacted, the topsoil to have a depth of not less than six inches (6") after final compaction. The surface shall be rolled with a hundred pound roller-r. The surfaces, when finished and settled, shall conform to the finished grade and shall be free of hollows or other inequalities and from stones, sticks and other debris.

4. CLEAN UP OF UNDISTURBED ADJACENT AREAS - All areas adjacent to the disturbed area of work shall be cleaned of all rubbish, debris and other materials, following the completion of the fine grading and topsoiling.

Developer shall not be required to landscape, i.e., planting of grass or sodding; replacement of topsoil shall end the Developer's responsibility in compliance with these Specifications.

19. CLEAN UP

The Developer shall clean up the site of the work and the work itself upon its completion; remove all debris, old material and temporary work; and thoroughly flush all sewers and drains in a satisfactory manner.