TOWN OF INDIAN HEAD
DESIGN MANUAL

Adopted
April 25, 2001

TOWN OF INDIAN HEAD
DESIGN MANUAL ~ 2001

I.0 GENERAL

A. Reference

All subsequent references to the Town or Town of Indian Head shall mean the Mayor and Council of Indian Head.

B. Purpose and Objectives

This Design Manual is intended to provide the Developers and consulting engineering community with the Town of Indian Head's requirements, references, standards and procedures. The Manual is intended to aid the designer during the preparation and presentation of engineering design for the Town of Indian Head. The Design Manual was developed in cooperation with the Planning Commission, Mayor and Council, Office of Planning and Zoning, and the Town's engineering and public works staff. It must be clearly understood that the criteria and/or requirements presented herein are considered by the Town to be minimum requirements and that additional requirements may be enforced as the Town deems appropriate on a case-by-case basis.

It is intended that the use of this Manual should help achieve the following objectives:

1. Uniformity of Approach - The Town desires its facilities to be designed with similar characteristics, configuration and features as much as is practical considering project requirements. It is hoped that this Manual will promote such uniformity.

2. Economy of Design and Schedule - By stating the Town's requirements and preferences at the outset, we hope to eliminate costly false starts and schedule slippages caused by the need to redesign.

3. Technical Quality Improvement - It is hoped that, by setting forth the Town's standards which reflect considerable experience, the overall quality of the design and construction will be improved.

4. Information - It is intended to eliminate unnecessary inefficiencies by answering designer's questions common to most designs.

C. Updates of Manual

Revisions to the Manual may be made from time to time, as the Town deems appropriate. As revisions are made, copies of the revisions, as well as the original Manual, will be available to interested parties at the Office of Planning and Zoning at a reasonable cost.

WATER SYSTEM DESIGN MANUAL

WATER SYSTEM DESIGN MANUAL

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1.0 GENERAL

1.1 Introduction

This chapter of the Indian Head Design Manual outlines the policies, minimum design criteria and design procedures for the preparation of feasibility reports and construction plans and specifications for Town-maintained and on-site water system improvements. Developers and/or Design Engineers shall check with the Town Office of Planning and Zoning to determine the availability of water at the site of a proposed subdivision.

1.1.1 Scope

a. Town-Maintained Facilities

The parts of the water supply system which are considered as the property and responsibility of the Town of Indian Head are the water mains, appurtenances and that portion of the water services which lie between the curbs. The water supply and distribution system for Indian Head is maintained by the Town of Indian Head.

b. On-Site Facilities

The parts of the water services which lie within private property are the responsibility of the owner and are constructed and maintained by the Owner.

1.1.2 Definitions

a. Service Connections: Water mains connecting the distribution mains to individual homes, buildings, or facilities for both consumptive use and fire protection.

b. Distribution Mains: Water mains connecting the transmission mains to the service connections. The distribution mains provide area-wide fire protection. Generally, the distribution mains will be in a grid or branched configuration.

c. Transmission Mains: Large diameter mains connecting the treatment plant with the distribution mains.

d. Average Day Demand: Average day demand is the volume of water used in the year divided by 365.

e. Average Day Rate (Average Day): Average day rate is the average day demand volume divided by a one-day period, expressed in gallons per minute (gpm) or million gallons per day (MGD).

f. Maximum Day Demand: Maximum day demand is the largest volume of water used in one day during the year.

g. Maximum Day Rate (Max. Day): Maximum day rate is the water used during the maximum day divided by a one-day time period expressed in gpm or MGD.

h. Peak Hour Demand: Peak hour demand is the largest volume of water used in one hour.

i. Peak Hour Rate (Peak Hour): Peak hour rate is the peak hour demand volume divided by 60 minutes, expressed in gpm; or multiplied by 24 hours, expressed as MGD.

j. AWWA: American Water Works Association.

k. Town: Mayor of Council of Indian Head.

2.0 DESIGN CRITERIA

2.1 General

For the Engineer's guidance, below are listed major elements constituting the design of a Water Main Utility Design project:

a. Pipe size and alignment

b. Profile, with all elevations

c. Property data (lot dimensions, all sides of affected properties, liber/folio number, owner)

d. Rights-of-way

e. Specifications and notes

f. Cost estimate

2.2 Demands

a. The sizing of major components of the Town water supply system such as major transmission mains, storage facilities, and booster pumping facilities, are the responsibility of the Town and beyond the scope of this manual. The Town may require developers to design these facilities as well as finance and construct them. Should this be the case, the Town must be consulted for specific design criteria.

b. The design engineer who is responsible for the extensions of distribution mains shall follow the guidelines in this manual for the derivation of design flows. The calculation of water demands will usually require extension of the average daily rate for the facility, application of a peaking factor to derive the maximum daily rate, then addition of the fire flow requirement.

c. Generally, the design engineer will be selecting distribution mains of 12-inch diameter and smaller, and often will be required to provide the minimum size mains, which are listed later in this Chapter.

2.2.1 Residential Demands

Studies have shown that the quantity of average daily water use and peaking factor for residential areas are related to lot size. This is due to increases in persons per dwelling unit, per capita consumption, and greater

lawn sprinkling as the lot sizes increase. The information in Appendix A shall be used to derive residential demands and peaking factors.

2.2.2 Commercial and Industrial Demands

The estimation of average daily water consumption and peaking factors for commercial demands are greatly dependent on the type of facility. With the exception of industries using process water, the fire demand generally is the major component of the design used to size distribution main extensions and service connections to buildings having sprinkler systems. The design engineer shall refer to the Charles County plumbing code for derivation of building design flows if the number of fixture units is known. If the type of business is known, but a specific fixture count is not known, use Appendix D to estimate water demand. For undeveloped land, use Appendix A to derive Commercial and Industrial water demand according to zoning.

2.2.3 Fire Flow Rates

Residential: [1]	
Single Family	1,000 gpm at 25 psi residual
Townhouses	1,500 gpm at 25 psi residual
Garden Type Apartments	2,000 gpm at 25 psi residual
High Rise Apartments	2,500 gpm at 25 psi residual
Commercial: [1]	
Regional Shopping Centers	3,000 gpm at 25 psi residual
Industrial: [1]	3,000 gpm at 25 psi residual
Institutions: [1]	
Hospitals	2,500 gpm at 25 psi residual
Schools	2,500 gpm at 25 psi residual
Office Building Complex: [1]	3,000 gpm at 25 psi residual

[1] Above fire flows to be used in the absence of site specific data from fire underwriters or construction plans which would permit a determination of fire flow requirements using insurance industry standards (Insurance Services Office -ISO). Consideration will be given to reducing the requirement where proposed construction includes sprinkler system; refer to current ISO recommendations.

2.3 Hydraulic Computations

2.3.1 General

The hydraulic design of water mains shall be in accordance with the requirements of the American Water Works Association *or* *Pipeline Design for Water and Wastewater*, ASCE, 1975, and the additional guidelines and criteria in this Chapter.

2.3.2 Design Flows and Residual Pressures

a. Service connections, distribution mains and transmission mains shall be sized based on the following design flow rates and residual pressures:

Maintain a minimum of 25 psi at ground level anywhere in the system under all conditions.

or

Normal working pressure 60 psi and not less than 35 psi residual pressure at the service connection during peak hourly rate.

.....Whichever is more critical.....

b. In some locations, the main size will be determined by the flow rate required to refill a storage facility which may be more critical than the above requirements. The Town will identify this requirement, if applicable.

2.3.3 Flow Velocities

Although the flow velocities and direction may vary considerably in distribution mains, there are upper and lower velocity bounds that indicate to the design engineer that design weaknesses may exist. The following are useful guidelines:

a. Velocities greater than 7 fps at design flow

This condition may produce large friction losses and high potential for valve and joint damage due to water hammer.

b. Velocities less than 0.5 fps at design flow

This condition indicates that the main may be oversized. Future maintenance problems may result from siltation at valves and there may be water quality degradation.

2.3.4 Hazen-Williams "C" and Minor Losses

a. The total head loss at the point of discharge for design flows shall be the sum of both friction and minor losses. The elevation difference between the source and discharge point shall be algebraically added to the total head losses.

b. Head losses for new pipes shall be computed using the nomograph in Appendix C and the following coefficients:

Type	Pipe Diameter	Hazen-Williams "C"
Service Connections		
Copper	3/4 inch - 3 inch	130
DIP	3 inch	100
Distribution Mains		
DIP	4 inch - 8 inch	100
DIP	10 inch - 12 inch	110
DIP	16 inch - 24 inch	120
Transmission Mains		
DIP	16 inch - 20 inch	120
DIP	24 inch and larger	130

c. Minor losses due to fittings and valves shall be included as equivalent lengths of pipe as shown in Appendix E or as fractional losses in velocity head as described in *Pipeline Design for Water and Wastewater*, ASCE, 1975, or other hydraulics texts.

2.4 Distribution System Layout and Sizing

2.4.1 General

Extensions of distribution mains will normally be on a grid basis with interconnecting nodes at street intersections.

2.4.2 Residential Subdivision (New and Existing)

The water distribution system for residential areas where fire protection is to be provided shall meet the following criteria:

a. Minimum size of water mains shall be 8-inch.

b. All water mains shall be looped, except where capped for future extension to adjoining property. A fire hydrant shall be placed at the end of the main and may be relocated at the time the main is extended, if approved by the Office of Planning and Zoning.

c. A fire hydrant shall be placed within ten (10) feet of the terminus of all dead end mains.

2.4.3 Commercial and Industrial Areas

The water distribution mains for Commercial and Industrial areas where fire protection is to be provided shall meet the following criteria:

a. Minimum size shall be 8-inches.

b. All water mains shall be looped, except where capped for future extension to adjoining property. A fire hydrant shall be placed at the end of the main and may be relocated at the time the main is extended, if approved by the Office of Planning and Zoning.

c. A fire hydrant shall be placed within 100 feet of the terminus of all dead end mains.

d. Where design flow rates exceed 1500 gpm, hydraulic computations shall be provided.

2.5 Service Connections

2.5.1 General

House connections for water shall be built to the meter vaults near the property line for all lots within a proposed development. All adjacent improved lots which are not a part of the proposed development, but which may be served by the water line, shall be shown on the contract drawings.

2.5.2 Location

On the plans, indicate service connections 15 feet from the property line on the high end of the lot or at a location desired by the homeowner if the lot is already developed. Meter vaults shall be placed near the property line and shall not be constructed in the curb or sidewalk. Remote readers shall be placed on the front exterior wall of house, easily accessible by Town personnel. No meters will be permitted inside the house.

2.5.3 Sizing

a. Service connections must be no smaller than 3/4 inches, the normal size for a residential dwelling. Twin house connections (3/4 inches each) may be permitted in group and semi-detached developments to serve two adjacent houses. The common service line to two homes must be 1 inch in size minimum. It is acceptable to have two meters in common vault to serve twin house connections.

b. For other than a residential dwelling, determine the water supply demand pursuant to the criteria in Section 2.2. The velocity in the service connection must not exceed 8 fps.

2.5.4 Cover

Cover over service lines must be a minimum of 3 feet 6 inches or as required by the Charles County Plumbing Code, whichever is greater.

2.5.5 Clearances

Water house services shall be placed 7 feet horizontally from sewer house connections and a minimum of 1 foot clear above the sewer house connection or as required by the Charles County Plumbing Code.

2.5.6 Materials

Piping material must be Type 'K' copper for residential service lines and ductile iron or copper for larger sizes.

2.5.7 Cross Connections

No cross connections where contamination can enter the potable water supply are permitted. No cooling water or condensate may be returned to the potable water supply line. All interconnections shall be approved by the Town and other appropriate reviewing authorities.

2.6 Appurtenances for Service Connections

2.6.1 Meters (Location)

a. In new and existing subdivisions with curb streets:

Locate on the property line or a minimum of 2 feet 6 inches behind the face of curb, but in no case shall the vaults for meters be located in the sidewalk.

b. In existing developed areas without curb streets:

Locate 3 feet from the property line in the public right-of-way, but not within sidewalks or paved areas.

c. In roads with a drainage ditch:

Locate 3 feet from the edge of the ditch between the ditch and the property line, but not within sidewalks or paved areas.

2.6.2 Meters (Sizing)

Meter types for Commercial, Industrial and Institutional applications shall be determined by the Town. The sizing and vault piping arrangement for Commercial, Industrial and Institutional meters shall be based on AWWA Manual M6, *Water Meters-Selection, Installation, Testing and Maintenance* and manufacturer's design charts. Meters shall be installed to record all water usage, including fire flow.

a. Valves

A valve or corporation cock shall be provided on the water main side of each meter installation.

b. Backflow Prevention Device

Reduced pressure backflow prevention devices shall be required on all services to commercial/industrial or individual facilities and shall be located immediately adjacent to the outlet side of the water meter, fully accessible. Refer to AWWA, *Cross Connection and Backflow Prevention* for additional design criteria.

2.6.3 Installation

Installation of all service connections and appurtenances shall be in accordance with latest AWWA standards or manufacturer's recommendations. Such requirement shall be noted in specifications and on contract drawings.

2.6.4 Booster Pumps

Booster Pumps are not permitted for any individual domestic or fire flow service.

2.7 Distribution Mains

2.7.1 Description

Distribution mains are 12 inches and smaller in diameter. For larger mains, design engineer should consult with the Town regarding special design criteria.

2.7.2 Location

a. In new subdivisions

Lay water mains 7 feet from the centerline of the road right-of-way, generally on the side of the road toward high ground (on opposite side of road from the sanitary sewer). Locate mains within the pavement area, wherever possible, no less than 5 feet from curb or proposed curb. Water mains shall not be located under curb or sidewalks, except where the water main crosses in a perpendicular fashion.

b. In existing developments with curbs

Generally, location must be the same as in new subdivisions. The location of other existing and proposed utilities must be fully considered.

c. In existing developments with pavement and no curbs

Generally, location must be the same as in new subdivisions. An alternative location with the approval of the Town will involve locating the main 2 feet outside the edge of pavement on the

opposite side of the road from the sanitary sewer, except that the main must not be laid under a future curb. The location of other existing and proposed utilities must be fully considered.

d. Where utilities are extended to accommodate development, they shall be extended across the full frontage of the property being serviced.

e. In parks and public rights-of-way, where location of a water main would require removal of trees, the design engineer shall obtain approval of the Town for tree removal.

f. Distribution mains may be designed on a curved alignment to reduce the number of bends. Along curves, the water main may be deflected at each joint within the limits given in the Appendix.

g. All water utility easements outside of road right-of-ways shall be 20 feet minimum width. No other utilities will be allowed in the water easement without the Town's written approval.

2.7.3 Size

a. Distribution Mains

Shall be 8-inch minimum size and shall be interconnected at all intersecting streets, with valves on all mains at the intersection. Where the required flow exceeds the capacity of an 8-inch main or of the existing system, larger mains will be required.

b. Distribution mains shall be sized to provide the required design flow rate and residual pressures as detailed herein.

c. Transmission Mains

Sizing shall be based on a computerized network analysis performed by the design engineer or as provided by the Town, if available.

2.7.4 Materials

a. All distribution and transmission mains and fittings shall be Ductile Iron, double cement lined (latest AWWA C-151) with standard mechanical joints or push-on joints. Other materials may be used if approved by the Town.

b. At bridge crossings, 16-inch and smaller ductile iron pipe shall have fiberglass insulation with vapor jacket wrapped by a full metal jacket for all exposed piping.

c. Expansion joints, insulated couplings and rollers shall be provided as required.

2.7.5 Installation

Installation of all service connections and appurtenances shall be in accordance with latest AWWA standards or manufacturer's recommendations. Such requirement shall be noted in specifications and on contract drawings.

2.7.6 Cover Over Pipe

a. Normal cover over water mains shall be 4 feet except at crossing over other utilities, where a minimal cover of 3 feet or a maximum cover of 9 feet may be allowed.

b. In new subdivisions

Cover shall be measured from finished grade of road or as specified by the Town. Roads shall be graded to subgrade before water mains are laid.

c. In existing or ungraded roads

Established grades of roads shall be obtained from the Town and are generally the proposed future finished grade. If such grades are not available, the design engineer shall submit proposed grades for approval by the Town. If established grade is at or below existing surface, cover shall be measured from established grade. If established grade is above existing surface, cover shall be measured from existing surface. In no case, however, shall the cover deviate from the minimum or maximum cover indicated in 2.7.6.

2.7.7 Clearances

a. Clearances shall be measured between outside of pipes.

b. Crossing Sanitary Sewer

Water main shall have minimum clearance of 18 inches above sewer. This vertical separation shall be maintained horizontally for a distance of 10 feet or as required by the Maryland Department of the Environment.

c. Parallel to Sanitary Sewer

A horizontal distance of at least 10 feet shall separate water main and sewers or as required by the Maryland Department of the Environment.

d. Crossing Other Utilities

Water mains shall have minimum clearance of eighteen inches where crossing utilities.

EXCEPTIONS: When specified clearance is not physically possible between sewer and water in a new subdivision or in locations where sewer is built along roads having existing water mains, the sewers shall be designed according to Sewer Design Standards of Charles County. If sewers already exist in a road, and water main cannot be built to specified clearances, ductile iron pipe with mechanical joints or other approved safety joints shall be used for the water mains. These installations shall be pressure tested to assure water tightness before backfilling. The Town shall be consulted to discuss the use of concrete encasement of the sewer and/or water main. The Developer or Engineer shall propose options to the Town for approval to ensure all possible measures are considered and implemented to avoid possible contamination of the water supply.

2.7.8 Structural Considerations

a. Buttresses and Anchors

Buttresses and anchors shall be required at all fittings which achieve a change in pipeline direction, such as tees, fire hydrants, bends and dead ends, thrust restraint is necessary. Buttresses and/or anchorage blocks are the two means of achieving thrust restraint. The design engineer shall decide what is appropriate for each particular situation based on an analysis of such factors as soil conditions, clearance requirements, constructability, future expansion and cost. Buttresses and Anchorage blocks are concrete placed against undisturbed soil designed for restraint of thrust forces in

pressurized piping systems. The Town reserves the right to require a soils analysis.

b. Restrained Joints

If the soils at the project site are unusually poor, or other factors such as cost, space limitations, or future construction so indicate, restrained pipe joints shall be designed. The joint restraint may be either harnesses or mechanical joints with retainer glands for mains up to 16-inch diameter. Restrained joint types for larger mains shall be approved by the Town prior to proceeding with design. The design shall account for test pressures, soil frictional resistance and effect of groundwater as a minimum. The Town reserves the right to require a soils analysis.

c. Jacking and Tunneling

Where mains are being designed to cross railroads, state highways, or other roads, on which service cannot be interrupted, the water main shall be installed in a sleeve, tunneled or jacked under the road. The sleeve size and material and the method of tunneling or jacking shall be approved by the owner of the road or the railroad being crossed.

The sleeve diameter shall be sufficient to permit the proper positioning of the water main within the sleeve. Water mains installed in sleeves shall have restrained joints throughout the length of the sleeve. The annular void between the main and the sleeve shall be completely filled with grout.

Water mains installed in sleeves shall be equipped with sufficient valves to shut-off all flow through the sleeved section. In the case of dead end main, one valve upstream will be sufficient; in other cases, a valve at each end is required.

d. Design Loads and Pipe Design

In cases where deemed necessary by the Town, the design engineer shall submit all calculations necessary to support the selection of the type and class of pipe indicated on the Contract Drawings.

The calculations may account for the following:

Vehicle or railroad loads (H-20, E-80, etc.);
Pipe loading factors (dead, live, impact);
Internal pressure (static, dynamic, surge);
Installation trench configuration.

e. Corrosion Protection

If soil tests or inspection of existing utilities in the project area reveals evidence of, or potential for, corrosion, the Town shall be notified of the condition. Should the Town deem it necessary, the design engineer shall design suitable galvanic and/or cathodic corrosion protection measures using AWWA *Controlling Corrosion Within Water Systems*, 1978. The Town reserves the right to require a soils analysis for corrositivity.

f. Deflection of Pipe

The maximum deflection allowed shall be as shown in Appendix B of this Manual.

2.8 Appurtenances for Service Mains

2.8.1 Valves

a. Size and Type

Mains 4-inches to 16-inches shall have valves of the same size as the main. Valves shall be resilient seat gate valves with non-rising stem. All valves 16-inches and larger shall have bevel gears and an enclosed gear case.

b. Location

Valves shall be installed on the loop or network at such places as to isolate the branch sections as may be necessary with a maximum spacing of 1500 feet. They shall be installed on all fire hydrant leads as close to the water main as is feasible. A valve shall be placed on all branch lines, regardless of size, near the main. Valves at intersections shall be placed on projection of road right-of-way lines. In no case shall the valve be placed in the sidewalk or less than ten feet (10') from another valve.

2.8.2 Tapping Sleeves and Valves

Where Used: Tapping sleeves and valves on ductile iron mains to serve as line valves shall be used for all connections 6-inches and larger to any existing main 12-inches or larger where more than 10 domestic services would be shut off during installation of a standard tee. The main being tapped may be the same size as the proposed main or tapping valve, but the tapping cutter shall be 1/4-inches or more undersized.

2.8.3 Fire Hydrants

a. Size and Type

Hydrants shall be a minimum of 6-inches. The engineer shall submit to the Town a scale map 1 inch = 200 feet showing area streets, water mains and proposed location of fire hydrants for the Town's use and for transmittal to the Fire Department. Fire hydrants shall be Mueller, Model A-423 or Kennedy Model K81. Each hydrant shall have one (1) 4½ inch diameter pump nozzle and two (2) 2½ inch hose nozzles, nozzle gaskets, 5¼ inch valve, 1½ inch pentagonal operating nut, open left. Both the hose nozzles and pumper nozzle shall have National Standard Thread. Hydrants shall be designed for 4½ foot bury and 6 inch mechanical joint inlet.

b. Location

Hydrants shall be located in a pattern approved by the Town Engineer or his duly authorized representative and shall be located so as to provide vehicular clearance from the street. Hydrants not at intersections shall be located in relation to property lines in order to avoid interference with future driveways.

c. Spacing

Hydrant spacing in residential areas composed of detached or semi-detached one- and two-family dwellings shall be at each street intersection and at 500-foot maximum intervals between intersections. Hydrant spacing in other residential areas and all other uses of property shall be at each street intersection and at 300-foot maximum intervals between street intersections.

2.8.4 Air and Vacuum Release Valves

a. The proper ventilation of distribution and transmission mains is often overlooked by design engineers. Trapped air pockets can significantly reduce the capacity of the mains as well as cause increased pumping heads and corresponding higher pumping costs. The following guidelines shall be used to locate air and vacuum release valves:

Peaks in profiles
Abrupt increase in downward slope
Abrupt decrease in upward slope
Long ascents - 1500 ft to 3000 ft intervals
Long descents - 1500 ft to 3000 ft intervals
Long horizontals - 1500 ft to 3000 ft intervals
Pumps - on the discharge side of pump having suction as close to the check valve as possible

b. In general, fire hydrants shall be placed at all high points along the main and at the terminus of dead end mains.

2.8.5 Valve Vaults

a. Mains 12-Inches and Smaller

For valves and for tapping sleeves and valves, use the Charles County Standard Roadway Valve Box.

b. Mains Larger than 12-Inches

For valves, except butterfly-type, use reinforced concrete vaults as approved by the Town. For tapping tees and valves, use concrete vaults as approved by the Town.

2.9 Testing and Disinfection

The contract documents shall provide for hydrostatic testing of newly laid mains as described in the Charles County Standard Specifications. Hydrostatic tests shall be performed for pressure retention and leakage. Disinfection shall be in accordance with AWWA C-651.

2.10 Abandonment Procedures

Abandoned service connections shall be cut and plugged at the service main, and the meters removed and salvaged if their condition permits reuse. Distribution mains that are to be abandoned shall be plugged at the point of abandonment and on each side of any existing valves, and the valves and hydrants removed and salvaged if their reuse appears practicable. Any necessary buttresses or anchorage required shall be designed in accordance with Charles County Standard Details.

2.11 Water Pumping and Treatment

A detailed presentation of design criteria for pumping and treatment facilities is beyond the scope of this manual. The Town will specify the exact requirements to be met by the design of these facilities.

2.12 Water Storage

2.12.1 General

A water system must be able to meet the peak hour demand during the maximum demand day to be effective. However, it is not economically feasible for domestic water systems to provide sufficient supply capacity to meet these peak demands. Therefore, to stabilize pressure and also to provide the necessary reserve capacity to meet peak demand period, it is the usual practice to provide storage reservoirs as an integral part of any distribution system.

During periods of peak demand, such as fire conditions, the required volumes of water that cannot be provided from the system's supply source are taken from the system's distribution storage. During periods of low demand, the excess water from the supply source returns to storage until the facilities are again full, completing the cycle.

The criteria used to determine the proper size of storage facilities can best be understood in terms of the functions which storage facilities are intended to perform. These functions may be summarized as follows:

a. To provide an equalizing reserve.

b. To provide a fire reserve.

c. To provide an emergency reserve.

2.12.2 Equalizing Storage

The equalizing reserve is the quantity of water needed to even out or "equalize" the system demands during a day's operation. By providing this reserve, the storage facilities make it possible to operate the treatment facilities and pumping stations at a relatively uniform rate. When the system demand is higher than the supply rate, water is withdrawn from the storage facilities. Conversely, when the system demand is below the supply rate, water is returned to storage to ensure that an adequate quantity is available for the next period of high demand. In general, systems which have an equalizing reserve equal to 20% of their maximum daily demand operate satisfactorily.

2.12.3 Fire Reserve

The size of the fire reserve is indirectly set by the Insurance Services Office (ISO), formerly known as the National Board of Fire Underwriters. This agency sets standards for the amount of fire flow that should be available at various points in a community.

2.12.4 Emergency Reserve

The emergency reserve is included as a safeguard against disruptions in the supply source, ruptured water mains, well-pump interruptions, or other circumstances which would exert an additional demand on the storage facilities. Normally, the quantity allotted for emergencies is 25% of the total effective storage volume.

2.13 Repaving of Roads

2.13.1 General

a. All Town construction contract specifications shall include a "patch-pave" requirement as follows:

Properly compacted borrow aggregate backfill shall be placed and compacted from 3 inches below the pipe to the bituminous pavement subgrade. The pavement replacement shall consist of a base course of asphaltic concrete of at least a thickness equivalent to the original pavement section, the original wearing course cut back two-feet on all edges of the excavation and a new asphaltic concrete wearing course of at least a thickness equivalent to the original wearing course. Other road pavement sections will receive

similar treatment. The base course shall be a minimum of 4-inches, and the wearing course shall be a minimum of 2-inches.

b. Patch-paving as outlined above is to be accomplished whether the roadway is to be re-paved or not.

c. House connection installations will require the same specifications for patch-paving.

d. All paving/repaving work will be accomplished in accordance with the Town Road Specifications or Design Manual. A "road cut" permit must be obtained from the Town when excavating within an existing Town maintained roadway.

2.13.2 Timing of Patch-paving and/or Repaving

a. Specifications will provide that patch-paving shall be accomplished immediately after backfilling and achieving specified compaction for connection and small extension contracts; and at no greater than seven (7) calendar day intervals for larger projects. Temporary "cold patch" shall be required for patches not immediately patch-paved. The Town must be consulted if immediate patch-paving cannot be accomplished. Cold patching must be maintained by the Developer to the Town's satisfaction. The placement of steel plates over trenching may be approved by the Town on a case-by-case basis.

b. Repaving shall be specified to be accomplished in one continuous effort to best assure economy and consistency of quality work.

2.13.3 Traffic Control

All water utility construction projects shall have an approved traffic control plan, using requirements of the *Manual on Uniform Traffic Control Devices*.

3.0 CONTRACT DRAWINGS AND DOCUMENTS

3.1 Reports

For mains larger than 12-inches, three copies of a preliminary report shall be submitted to the Town. The report shall include a sketch of the preliminary layout and a summary of the design data.

3.2 Design Computations

a. Design engineers shall submit three copies of design data and calculations for all water projects. The computations shall be in accordance with methods presented in this manual.

b. The design data and computations shall include: average and peak demands, fire demand, and future requirements.

c. Design computations for all special structures shall be submitted. Where information pertinent to design, such as borings, has been collected, this information shall be submitted to the Town. The locations of borings shall be shown on the plan sheets, and the boring logs shall be included in the Contract Documents. See Appendix F for Geo-Technical Requirements. In addition, the Town reserves the right to require borings and geotechnical information.

3.3 Specifications

Contract specifications shall utilize the Town of Indian Head Specifications or, in the absence of Town Specifications, the Charles County Specifications will apply.

3.4 Contract Drawings

3.4.1 Preparation

Water main contract drawings shall be prepared on drawings separate from drawings detailing the road design. Separate drawings shall be used for each street.

3.4.2 Plan

a. Scale: 1 inch = 50 feet.

b. Method of Indicating Location

Generally, water mains and structures shall be located in Plan by dimensions from property markers or other well defined physical features. However, in areas where physical features are not available, coordinates of structures and bearings of water mains based on the Maryland Coordinate System NAD 83/91 shall be used.

c. Fittings

A list of all valves and fittings required shall be shown on each drawing.

d. Contract drawings shall include the property line surveys and all lot dimensions of the land bordering water extensions and shall indicate the names of the present owners of such property with the recording reference number of the deed, lot numbers, house numbers, subdivision names and block numbers, as well as existing rights-of-way or easements. When rights-of-way must be obtained, a right-of-way drawing for each property shall be provided, accompanied by a written description of each right-of-way.

3.4.4 Profile

Profiles shall be shown for all water mains. Profile shall be on same sheet as the Plan.

a. Scale

Scale of all profiles shall be 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical. Water main profiles on straight streets shall be shown to correct scale. On curved streets, horizontal distances between structures shall be plotted using length of street centerline between radial projections to structures. The true length between structures shall be shown by figures.

b. Road Grades

Approved established grades shall be obtained from the Town. When such grades are not available, they shall be

established by the design engineer and submitted to the Town for approval.

The established grade (noted as top of curb or centerline) shall be shown. Where water main is located in present or proposed pavement or shoulders, the existing centerline grade of road shall be shown. Where water main is outside pavement or shoulders for a length greater than 50 feet, existing ground over water main shall be shown and labeled.

c. Water Main on Fill

Where water main is to be constructed on fill, a profile of the undisturbed earth (at water main location) shall be shown.

3.4.5 Other Utilities

Other existing and proposed utilities shall be shown accurately and clearly in Plan and Profile.

3.4.6 Location and Design Information

A Location Plan showing well known streets at a scale of 1 inch = 200 feet shall appear on the first drawing of each set of Contract Drawings. A schematic layout of the proposed extensions to the water system and adjacent existing lines shall be shown. The location of existing valves which must be shut off when the new line is connected must be shown. Existing and proposed fire hydrants shall also be shown.

3.4.7 Special Details

Structures or details not included in the Standard Details shall be detailed clearly on the Contract Drawings, preferably where the detail is located in Plan.

3.4.8 One (1) copy of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

3.5 Estimate of Project Costs

The engineer shall submit an estimate of project costs for each contract, including contingent items and a 50% contingency based on the total cost of the project.

APPENDICES

WATER SYSTEM DESIGN MANUAL

APPENDIX A

BASIS FOR RESIDENTIAL WATER DEMAND PROJECTIONS FOR UNDEVELOPED OR PARTIALLY DEVELOPED AREAS

Zoning	Projected Population per Acre	per Acre	Projected Dwelling Units 200 GPD/dwelling	Projected Demand Avg Per Acre Based on Factor	Maximum Day Peaking GPD/Acre	Day Demand
A	2.8		1.0	200	1.6	320
R-1	5.5		2.0	400	1.6	640
R-2	8.0		2.9	580	1.6	928
R-3	12.1		4.4	880	1.6	1408
R-4	40.0		14.5	2900	1.6	4640

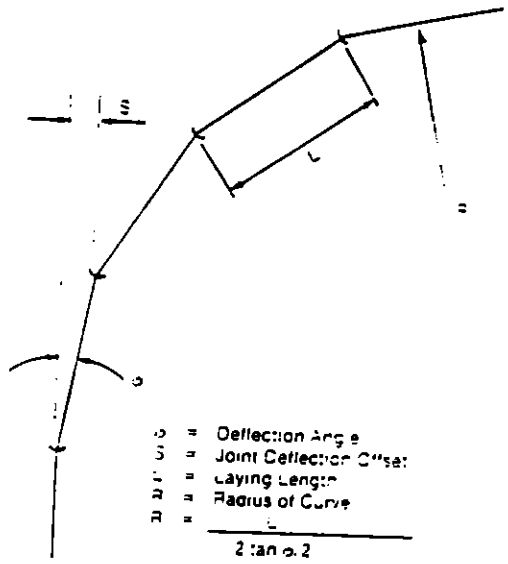
Zoning	Projected Flow per Acre Factor	Avg Day Peaking GPD/Acre	Maximum Day Demand
COMMERCIAL (COMM) B-0, B-1, B-2, 0S	*500	1.4	700
LIGHT INDUSTRIAL LI, LIP	*500	1.3	650
HEAVY INDUSTRIAL GI	*1000	1.1	1100

*Use Appendix D when the specific type of development is known. Use Charles County Plumbing Code when a specific fixture count is known.

Maximum Joint Deflection* Full-Length Pipe—Push-On Type Joint

Nominal Pipe Size in.	Deflection Angle—θ deg	Maximum Offset—S* in (m) 18 ft (5.5 m) L*	Maximum Offset—S* in (m) 20 ft (6.1 m) L*	Approx. Radius of Curve—R* Permissible in Succession of Joints ft (m) 18 ft (5.5 m) L*	Approx. Radius of Curve—R* Permissible in Succession of Joints ft (m) 20 ft (6.1 m) L*
3	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
4	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
6	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
8	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
10	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
12	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
14	5	19 (0.48)	21 (0.53)	[illegible]	230 (70)
16	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
18	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
20	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
24	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
30	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
36	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
42	3°	11 (0.28)	12 (0.30)	[illegible]	380 (115)
48	2½°	7½ (0.19)	8 (0.20)	[illegible]	570 (174)
54	2½°	7½ (0.19)	8 (0.20)	[illegible]	570 (174)
		5½ (0.14)	6 (0.15)	[illegible]	760 (232)

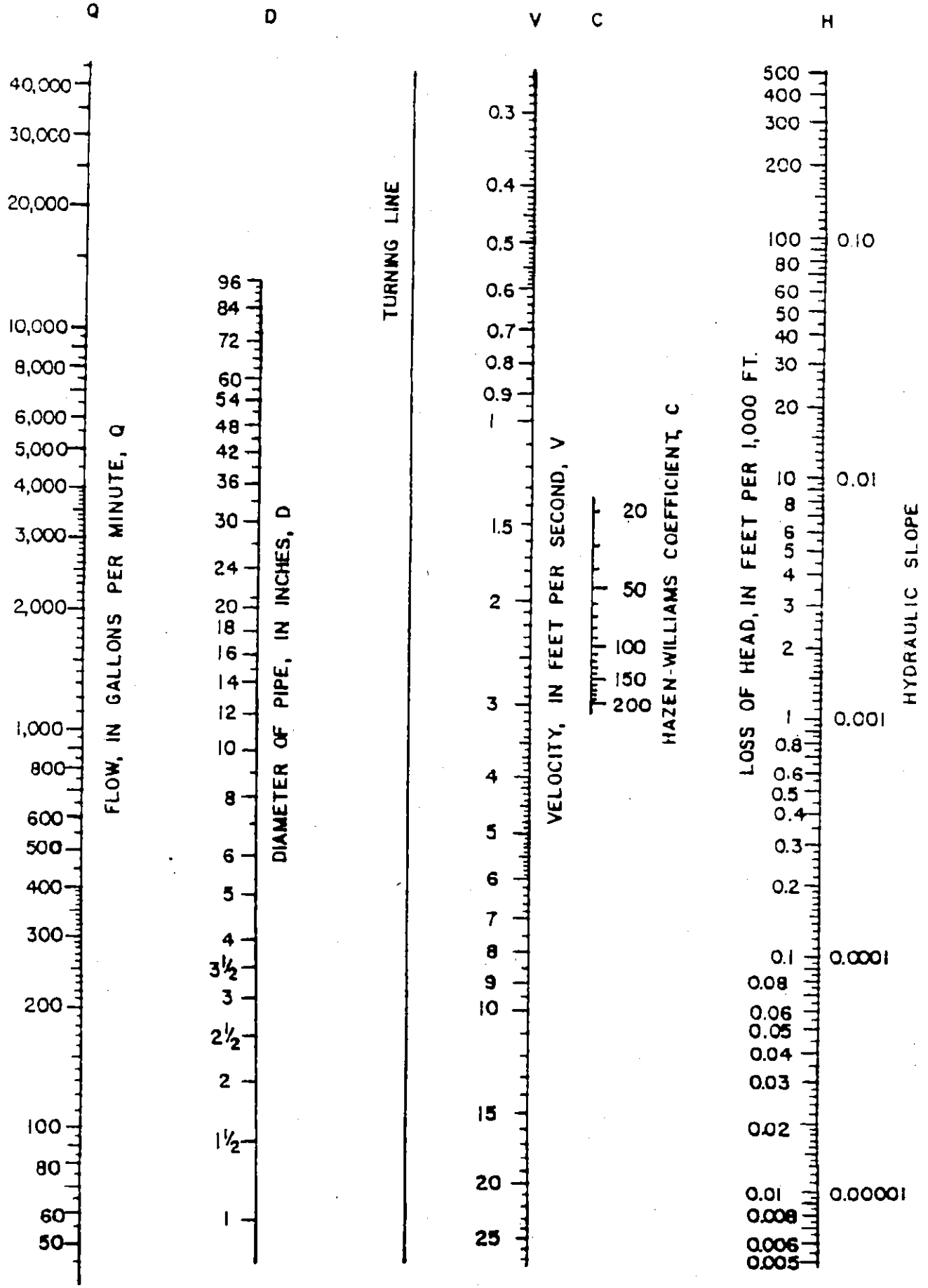
*For 14-in and larger push-on joints, maximum deflection angle may be larger than shown above. Consult manufacturer.
*See Figure 4



Maximum Joint Deflection Full-Length Pipe—Mechanical-Joint Pipe

Nominal Pipe Size in.	Deflection Angle—θ deg	Maximum Offset—S* in (m) 18 ft (5.5 m) L*	Maximum Offset—S* in (m) 20 ft (6.1 m) L*	Approx. Radius of Curve—R* Permissible in Succession of Joints ft (m) 18 ft (5.5 m) L*	Approx. Radius of Curve—R* Permissible in Succession of Joints ft (m) 20 ft (6.1 m) L*
3	8-18	31 (0.79)	35 (0.89)	[illegible]	140 (43)
4	8-18	31 (0.79)	35 (0.89)	[illegible]	140 (43)
6	7-07	27 (0.69)	30 (0.76)	[illegible]	160 (49)
8	5-21	20 (0.51)	22 (0.56)	[illegible]	220 (67)
10	5-21	20 (0.51)	22 (0.56)	[illegible]	220 (67)
12	5-21	20 (0.51)	22 (0.56)	[illegible]	220 (67)
14	3-35	13½ (0.34)	15 (0.38)	[illegible]	320 (98)
16	3-35	13½ (0.34)	15 (0.38)	[illegible]	320 (98)
18	3-00	11 (0.28)	12 (0.30)	[illegible]	380 (116)
20	3-00	11 (0.28)	12 (0.30)	[illegible]	380 (116)
24	2-23	9 (0.23)	10 (0.25)	[illegible]	550 (152)
30	2-23	9 (0.23)	10 (0.25)	[illegible]	550 (152)
36	2-05	8 (0.20)	9 (0.23)	[illegible]	550 (167)
42	2-00	7½ (0.19)	8 (0.20)	[illegible]	570 (174)
48	2-00	7½ (0.19)	8 (0.20)	[illegible]	570 (174)

APPENDIX C
HAZEN-WILLIAMS NOMOGRAPH



APPENDIX D

GUIDELINES FOR DEVELOPING WATER DEMAND PROJECTIONS FOR COMMERCIAL ESTABLISHMENTS OR PUBLIC BUILDINGS

Office Buildings	Gross Sq. Ft. x 0.09 =gpd
Medical Office Buildings	Gross Sq. Ft. x 0.62 = gpd
Warehouses	Gross Sq. Ft. x 0.03 = gpd
Retail Stores	Gross Sq. Ft. x 0.05 = gpd
Supermarkets	Gross Sq. Ft. x 0.20 = gpd
Drug Stores	Gross Sq. Ft. x 0.13 = gpd
Beauty Salons	Gross Sq. Ft. x 0.35 = gpd
Barber Shops	Gross Sq. Ft. x 0.20 = gpd
Department Store with Lunch Counter	Gross Sq. Ft. x 0.08 = gpd
Department Store without Lunch Counter	Gross Sq. Ft. x 0.04 = gpd
Banks	Gross Sq. Ft. x 0.04 = gpd
Service Stations	Gross Sq. Ft. x 0.18 = gpd
Laundries and Cleaners	Gross Sq. Ft. x 0.31 = gpd
Laundromats	Gross Sq. Ft. x 3.68 = gpd
Car Wash without Wastewater Recirculation Equipment	Gross Sq. Ft. x 4.90 = gpd
Hotels	Gross Sq. Ft. x 0.25 = gpd
Motels	Gross Sq. Ft. x 0.23 = gpd
Dry Goods Stores	Gross Sq. Ft. x 0.05 = gpd
Shopping Centers	Gross Sq. Ft. x 0.18 = gpd
Hospitals (per bed space)	350 Gallons/per bed space/day = gpd
Nursing homes (per bed space)	125 Gallons/per bed space/day = gpd
Restaurants (per seat)	25 Gallons/seat/day = gpd
Schools:	
Boarding	100 Gallons/per person/day = gpd
Day, without gyms, cafeterias or showers	15 Gallons/per person/day = gpd
Day, with gyms, cafeterias and showers	25 Gallons/per person/day = gpd
Day, with cafeterias but without gyms or showers	20 Gallons/per person/day = gpd

APPENDIX E

MINOR LOSSES OF HEAD IN EQUIVALENT LENGTHS

Nature of Resistance	Loss in Pipe Diameters
Angle Valve	
Open	170
Check Valve	
Swing Type, Open	80
Gate Valve	
Wide Open	7
1/4 Closed	40
1/2 Closed	200
3/4 Closed	850
Globe Valve	
Open	340
Standard Elbow	32
Long Swing Elbow	20
45-degree Elbow	15
Tee	
Flow Through Run	20
Flow Side to Run or Run to Side	
No Throat	65
With Throat	45
Lateral	45
Sudden Contraction	
d/D = 1/4	15
d/D = 1/2	12
d/D = 3/4	7
Sudden Enlargement	
d/D = 1/4	32
d/D = 1/2	20
d/D = 3/4	7

APPENDIX F

GEO-TECHNICAL REQUIREMENTS FOR UTILITY DESIGN AND CONSTRUCTION INSPECTION

PURPOSE

The following is intended to provide guidance to the engineer and contractor in their pursuit of the project and not to specifically dictate their activities.

DESIGN PHASE

Geotechnical services provided during water utilities design shall include the selection of boring and test pit locations, and the selection of sample types and intervals, the selection of field and laboratory test procedures, and the preparation of a geotechnical report. At a minimum, the report shall include the following:

1. Project overview.

2. Types of measures that will be needed to check stabilization of excavations and provide values of design parameters (lateral earth pressure distribution, allowable slopes).

3. Need for dewatering systems that may be needed and provide description of groundwater conditions over project limits of work.

4. Foundation preparation measures to be used.

5. Allowable bearing pressures, anticipated total and differential settlement, pipe bedding requirements, etc., to support design loads.

6. Backfill material characteristics required.

7. Estimated volumes of borrow.

8. The level of compaction needed to satisfy design criteria and methods of achieving this compaction through appropriate combinations of compaction equipment, water contents, and lift thicknesses.

9. Pavement design considerations.

10. Pavement reconstruction considerations - address need for road reconstruction around excavations.

11. The basis that will be used for field evaluation of material suitability, adequacy of compaction, acceptability of shoring, etc.

12. The potential sources and magnitudes of uncertainty in geotechnical conditions.

13. Guideline construction specification with respect to geotechnical requirements.

14. Potential for encountering sink holes and mitigation measures for avoidance.

15. Soil boring logs within area of construction and stormwater management facilities.

16. Impact on nearby wells and springs and mitigation measures.

CONSTRUCTION PHASE - FIELD IMPLEMENTATION OF GEOTECHNICAL REPORT RECOMMENDATIONS

Implementation of geotechnical report recommendations and design requirements is critical to satisfactory completion of the project. The following guidelines are to be followed by the project inspector.

1. The design phase geotechnical engineer should be involved during construction. (Depending on the size of the project, this involvement could range from telephone consultation to on-site inspections. However, geotechnical expertise should be available during construction.)

2. A qualified testing laboratory should be engaged.

3. The geotechnical report prepared during design should be provided to the inspector prior to construction. Both the inspector's office and field personnel should be familiar with all aspects of the report, including, but not necessarily limited to the following:

    a. Existing conditions.
    b. Feasibility of using materials from trench for backfill.
    c. Appropriate compaction methods for excavated materials.
    d. Procedures for selecting and approving borrow sites.
    e. Appropriate compaction methods for borrow materials.
    f. Recommendations for when select materials should be used.
    g. Appropriate methods for compaction of select materials.
    h. Appropriate methods for monitoring 'c', 'e', and 'g' above:
        (1) Sampling.
        (2) Laboratory testing.
        (3) Field testing.
    i. Location of sink hole prone areas and mitigation measures for avoidance.

    The inspection personnel must have a sound working understanding of the geotechnical report in order to effectively implement its recommendations. Therefore, this responsibility should be clearly defined in the scope of services for inspection.

4. In consultation with the design geotechnical consultant, the resident inspector should develop a written plan for implementation of the recommendations of the geotechnical report. This plan should include the following:

a. Identification of the person responsible for insuring adherence to geotechnical report recommendations in the field. Because immediate field decisions are usually required at some time during construction, this person should be well grounded in the subject of backfill materials, methods and compaction, and at least knowledgeable enough to recognize field conditions that do not conform with the geotechnical report and to seek necessary assistance.

b. Establishment of general criteria for use by the field representative in meeting the requirements of the geotechnical report:
   (1) Frequency of standard Proctor determinations.
   (2) Frequency of soil density determinations.
   (3) Criteria for using visual characteristics and soil consistency for spot determinations of backfill material suitability without consulting geotechnical experts.
   (4) Criteria for using visual characteristics and soil consistency for spot determinations of compaction suitability without soil density determinations.

c. Establishment of procedures for detailed record-keeping using a daily inspection report form. This form would require that each of the following be addressed:
   (1) Conditions encountered.
   (2) Help sought from supervisors, geotechnical engineer, etc.
   (3) Location of field tests.
   (4) Weather conditions.
   (5) Notations on visual and manual observations.
   (6) Exceptions to geotechnical report recommendations (field decisions).

AS-BUILT DRAWING

I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

ENGINEER DATE P.E. NO.

	AS-BUILT DRAWING STATEMENT	

STORMWATER MANAGEMENT DESIGN MANUAL

STORMWATER MANAGEMENT DESIGN MANUAL

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1.0 STORMWATER MANAGEMENT CRITERIA

1.1 Definitions

a. APPLICANT

Any person, firm or governmental agency who executes the necessary forms to procure official approval of a proposed plan for a project or a permit to carry out construction of a project.

b. CAPITAL IMPROVEMENT PROJECT

A project under consideration and, in fact, planned for implementation by the Town of Indian Head and included in the Town's short- (1 year) or long-term (5-6 years) budget.

c. CHANNELIZATION

The purposeful alteration by a man of a natural stream cross-section, slope or location.

d. DEVELOPER

A person, firm or governmental agency undertaking or proposing the construction of a structure, a project consisting of interrelated structures or other construction, and who primary financial responsibility for the proposal.

e. DITCH

A man-made channel with a well defined cross-section and side slopes of 6:1 or steeper.

f. DRAINAGE AREA

The area of land that contributes storm runoff by virtue of its topography to a specific point under consideration.

g. ENGINEER

Any professional engineer duly registered by the State of Maryland to practice Professional Engineering.

h. EROSION

The process by which the ground surface is worn away by the action of wind and/or water.

i. FLOOD CONTROL

A system of structural measures to protect flood hazard areas from flooding, and in the case of dams, significantly reduce the magnitude and frequency of "natural" flood flows.

j. FLOOD PLAIN

That area which, after total development in its watershed, would be inundated by water runoff from a storm equivalent to the heaviest rainfall that occurs, on average, once every 100 years.

k. FLOOD PLAIN MANAGEMENT

A program of identifying areas prone to flooding and providing regulation for the use of those areas by a number of possible alternatives, including building codes, land use regulations, public acquisition and design practices.

l. FLOODWAY

That portion of the natural floodplain that must remain free of fill and other obstructions to safely pass a 100-year flood.

m. FREEBOARD

A vertical tolerance above the estimated water level to allow for wave and variance in the estimate.

n. NRCS

Natural Resources Conservation Service (Formerly Soil Conservation Service).

o. RETENTION

The difference between total precipitation and total runoff.

p. RUNOFF

That portion of rainfall which immediately flows from point of impact to a stream via the ground surface.

q. SEDIMENT

Soils or surface materials transported by wind or surface water as a product or result of erosion.

r. SWALE

A broad and flat channel---6:1 side slopes or flatter---that normally carry small amounts of runoff.

1.2 Design Requirements

1.2.1 Minimum Requirements: "The Maryland Stormwater Design Manual, Volumes I and II", prepared by the Center for Watershed Protection for the Maryland Department of the Environment, shall be hereby adopted for use as the design guidelines for stormwater management facilities in the Town of Indian Head, except as amended herein. Specific amendments, additions or deletions to the aforementioned manual are as follows:

a. The Developer/Engineer is required to demonstrate that downstream roads, bridges and public utilities are adequately protected from the Extreme Flood Volume (Qf) storm. The investigation shall extend to the first downstream tributary of equal or greater drainage area or to any downstream dam, highway, or natural point of restricted stream flow. Generally, no control is needed if development is excluded from the 100-year floodplain and downstream conveyance is adequate. Based on the analysis provided, the Town will determine if control of the Extreme Flood Volume (Qf) is needed for a particular development.

b. To prevent an increase in the frequency and magnitude of out-of-bank flooding generated by developments, the post-development ten-year, 24-hour storm peak discharge (Qp_{10}) shall be prevented from exceeding the pre-development peak discharge rate.

c. Where pipe is used for the principal spillway, only concrete pipe with "O-ring" gaskets (ASTM C-361) shall be used to create watertight joints and shall be inspected during installation by the Town or its duly authorized agent.

d. Vegetated open channel systems are subject to the limitations as stated in the "Storm Drainage Design Manual." Wet swales are prohibited for use as a Best Management Practices (BMP).

e. An orifice diameter of less than 3" for channel Protection Storage volume (CP_s) is not permitted.

f. Stormwater credits for disconnection of rooftop runoff will not be considered.

g. Credits for using open-grass channels to reduce runoff volume and pollutants will generally not be permitted. The use of curb and gutter along roadways are generally required, as provided for in the "Streets and Roads Design Manual." The use of and associated credits for using roadside open-grass channels will only be considered with approval by the Planning Commission when considering "Planned Unit Developments" (PUD's) for approval.

1.2.2 Flood Hazard Management Act: Where applicable, stormwater management and development plans must be consistent with adopted and approved watershed management plans or flood management plans as approved by the Maryland Department of the Environment, in accordance with the Flood Hazard Management Act of 1976 (Section 8-9-01 et seq, Natural Resources Article.

1.2.3 Protection of Citizens: When the Town of Indian Head finds it necessary to protect the citizens of Indian Head and their real property, the developer may be required to provide stormwater controls beyond those outlined in this section.

1.3 Stormwater Management Measures

1.3.1 Stormwater management measures are required to satisfy the minimum quantity and quality control requirements. The stormwater best management practices and design guidelines to be used in developing a stormwater management plan must be consistent with the Maryland Stormwater Design Manual, hereby adopted as part of the Town of Indian Head Design Manual.

Generally, the State Manual addresses the following major areas:

a. Unified Stormwater Sizing Criteria for water quality, recharge, channel protection, overbank flood control and extreme flood management. Acceptable BMP groups are:

1. Stormwater Ponds.

2. Stormwater Wetlands.

3. Filtering Systems.

4. Open-Channel Practices.

5. Non-Structural Practices.

6. Infiltration.

b. Performance Criteria for Urban BMP Design. The performance criteria for the groups of structural BMP's are based on the following factors:

1. General Feasibility.

2. Conveyance.

3. Pretreatment.

4. Treatment Geometry.

5. Landscaping.

6. Maintenance.

c. Guide to BMP Selection and Location. Comparative matrices that evaluate BMP's from the standpoint of the following factors:

1. Watershed Factors.

2. Terrain Factors.

3. Stormwater Treatment Suitability.

4. Physical Feasibility Factors.

5. Community and Environmental Factors.

6. Locational and Permitting Considerations.

d. Stormwater Credits for Innovative Site Planning. Potential credits for designing progressive planning techniques includes:

1. Conservation of Natural Areas.

2. Disconnection of Non-Rooftop Runoff.

3. Stream Buffers.

4. Grass Channels.

5. Environmentally Sensitive Development.

2.0 GENERAL ENGINEERING STANDARDS

2.1 Natural Resource Conservation Service

Because many of the control structures may require Natural Resources Conservation Service (NRCS) approval, and to be consistent in the design and review of all projects, the design methods and criteria of the NRCS outlined below are required for all types of stormwater management facilities. Any additions, deletions and/or changes to the Design Standards will be detailed in the NRCS Newsletter, which is issued periodically.

2.2 Hydrology

2.2.1 Runoff Curve Number

a. Use the NRCS runoff curve number (RCN) method.

b. Use tabular forms for all hydrology computations.

c. Do not use TR-55 Figures 2-1, 2-3 and Exhibits 4-1, 4-1A, 4-111 to determine discharge or its related parameters.

d. RCN's must be based on <u>good</u> hydrologic condition.

Pasture is grazed area. Meadow is the ungrazed equivalent. A hay field is considered to be meadow.

2.2.2 Use of TR-20 for Hydrology

The use of TR-20 for hydrology is permitted with the following restrictions:

a. Round RCN values to the nearest whole number. Round T_c values to two decimal places.

b. Rainfall table must be 0.1 hour table or 0.25 hour table.

c. Submit input and output with full hydrographs.

2.3 Time of Concentration

Use the NRCS "Overland Flow" method. Round off the times of concentration (except in TR-20 routings), using the conventional method of routing, to the nearest T_c hour for which hydrographs are provided in TR-55.

2.4 Soils

2.4.1 Soil Types: Soil maps detailing soil types are available at the Natural Resource Conservation Service. Use hydrologic soil groups approved for use in Frederick County by the Natural Resource Conservation Service, as contained in the Storm Drainage Design Manual.

2.4.2 Adjustments for Grading: Soil permeability is very sensitive to disturbance and compaction. Therefore, on sites where substantial grading will occur, the soils classification will be adjusted as follows:

Existing Soil Type	Post-grading Soil Type
A	B
B	C
C	C
D	D

2.5 Rainfall Depths

Frequency	Inches per 24 Hours
1-Year	2.5
2-Year	3.1
5-Year	4.0
10-Year	5.0
25-Year	5.4
100-Year	7.0

2.6 Borings and Test Pits

2.6.1 Minimum Number of Borings and/or Test Pits: A minimum of two borings or test pits are required at the location of each stormwater management facility. In the case of sites using ponds, enough borings shall be obtained to provide a clear picture of subsurface soils in the pond and embankment area. In any case, the Town reserves the right to require additional borings.

2.6.2 Minimum Boring or Test Pit Depth: The minimum boring or test pit depth shall be to groundwater or five feet below the bottom of the storage device, whichever is greater, or to refusal. In any case, the Town reserves the right to require additional borings or test pits.

2.6.3 Boring or Test Pit Data Required

a. Bearing strength (number of blows) - required for ponds only;

b. Unified soil classification for each strata;

c. Groundwater at completion and at 24 hours minimum; and

d. U.S.C.S. soil textural classification for each strata.

2.6.4 Boring or Test Pit Logs: Show boring or test pit logs on the plans for stormwater management facilities.

3.0 STORMWATER MANAGEMENT PRACTICE FOR QUALITY CONTROL (POLLUTANT REMOVAL) IN SMALL DRAINAGE AREAS

3.1 Design Guidelines

The design of such systems shall be as described in the Maryland Stormwater Design Manual, by the Center for Watershed Protection or manual approved by the Town of Indian Head.

3.2 Runoff Volume

A 1.0 inch runoff event shall be used for computing peak discharge for water quality storm.

3.3 Water Quality Volume

To compute the water quality volume, refer to the method (adapted from Clayton and Schueler, 1996) as described in the Maryland Stormwater Design Manual.

4.0 WET (RETENTION) PONDS, EXTENDED DETENTION PONDS, AND DRY (DETENTION) PONDS

4.1 Off-Site Design Criteria

When off-site detention or retention structures are used, the criteria identified in the Maryland Stormwater Design Manual must be used and as follows:

a. The contributory drainage area for off-site ponds must be less than 400 acres, unless a larger drainage area is approved by the Maryland Department of the Environment.

b. Design off-site ponds to provide a permanent pool of water or, as a minimum, a 24-hour detention period for releasing the volume of runoff from a 1-year frequency storm. (A permanent dewatering device on the low-flow pipe may be used to extend detention.)

c. Do not locate off-site ponds so as to discharge to Class III Natural Trout Waters identified in COMAR 10.50.01.021, except as authorized by the Administration in permits issued pursuant to Natural Resources Article, Section 8-803.

4.2 Hydraulics

Detailed hydraulic design calculations are required for all facilities. Present the stage-discharge data in tabular and graphical form with all supporting computations, clearly indicating orifice, pipe and weir flows. Also present the elevation-storage data in both tabular and graphical forms.

4.3 NRCS Small Pond Design Criteria

All small-pond designs (wet or dry) must meet or exceed the NRCS Design Standards, current version. Excavated ponds have the same freeboard requirements as embankment structures, as outlined in NRCS 378.

4.4 Cutoff Trench

4.4.1 Where Required: Cutoff trenches are required in any pond embankment having any storage above existing ground. When a public road fill is used as a pond embankment, a cutoff trench may not be required.

4.4.2 Specification: The cutoff trench must have a 4-foot (minimum) bottom width, a 4-foot (minimum) depth below the barrel pipe and/or existing ground, and 1:1 side slopes. The trench must extend along the embankment between points where

the proposed top of embankment intersects existing ground. Material for the cutoff trench fill must be Unified Soil Classification SC or CL and must be compacted to 95% of AASHTO Specifications T-99 or its ASTM equivalent.

4.5 Impervious Core

4.5.1 When Required: An impervious core is required in addition to a cutoff trench on all retention ponds which are designed to retain a permanent pool of water.

4.5.2 Specifications: The top of the core must be at the riser crest elevation, be a minimum of 4 feet wide, and have 1:1 side slopes extending to existing ground. The impervious core must extend along the entire length of proposed embankment to 1 foot past where the core top meets existing ground. Construct the core of the same material as the cutoff trench fill and compact to 95% of AASHTO Specification T-99 or its ASTM equivalent.

4.6 Emergency Spillway

Provide an emergency spillway for all impoundments, unless mutually waived by the Town of Indian Head and the Natural Resource Conservation Service. The Town may consider designs which utilize the emergency spillway for storm frequencies greater than the 25-year storm, provided the level section and exit channel are armored and flow is conveyed to an adequate outfall. Emergency spillway gabion lining must begin at the centerline of emergency spillway level section and extend through the outfall channel. Size the capacity for NRCS 378 criteria and design according to the NRCS Engineering Manual. Token emergency spillways (where principal spillway carries 100-year discharge) require only 1 foot of freeboard from emergency spillway crest to settled top of dam.

4.7 Anti-Seep Collar and Phreatic Line

4.7.1 Basis for Design: Base anti-seep collar design on the following:

a. If a pond will have an emergency spillway and will use a metal riser with a concentric trash rack and anti-vortex device for a principal spillway, use either the riser crest or the computed 10-year high water elevation in the pond (whichever is greater) for the start of the phreatic line.

b. If a pond will not have an emergency spillway, use the 100-year computer high water elevation.

c. If a pond will have any other principal spillway (such as a standard or modified headwall or a concrete box drop inlet, etc.) and will have an

emergency spillway, use the crest of the emergency spillway elevation for the start of the phreatic line.

4.7.2 Placement of Collars: Place anti-seep collars along the barrel a minimum of two feet from pipe joints. This shall be included as a note with the anti-seep collar detail. Contain the anti-seep collars as much as practical within the saturated zone under the phreatic line, which extends downward at a 4:1 slope from the elevation specified above on the backslope of the embankment. Anti-seep collars may not be required where a public road is used as the pond embankment if mutually waived by the Town of Indian Head and the NRCS.

4.8 Outlet Protection

Place velocity dissipation devices at the outfall of all detention or retention structures and along the length of any outfall channel as necessary to provide a non-erosive velocity of flow from the structure to a water course. Construct outfall channels of riprap or Class IV gabions.

4.9 Downstream Analysis

4.9.1 Submission: If required by the Town of Indian Head, the developer must submit to the Town an analysis of the impacts of stormwater flows downstream in the watershed.

4.9.2 Hydrologic and Hydraulic Calculations: Include in the analysis hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications of the proposed development on a dam, highway, structure or other point established by the Town, but at a minimum downstream of a tributary of the following size:

a. The first downstream tributary whose drainage area equals or exceeds the contributing area to the pond; or

b. The first downstream tributary whose peak discharge exceeds the largest designed release rate of the pond.

4.9.3 Modifying Designed Release Rate: Modify the designed release rate of the structure when any increase in flooding or stream channel erosion would result at the downstream dam, highway, structure, or other point selected by the Town. The release rate of the structure must:

a. Be reduced to a level which will prevent any increase in flooding or stream channel erosion at the downstream control point;

b. Be not less than the 1-year pre-development peak discharge rate;

c. Meet the requirements of Section 1.1.

4.9.4 Waiving Use of Detention or Retention Structures: The Burgess and Commissioners may waive the use of detention or retention structures when the characteristics of the receiving stream or the site are such that detention of flows are contrary to accepted engineering practice or detrimental to the environment.

4.90.5 Dambreach Analysis: When directed by the Town of Indian Head or the NRCS, the Engineer must provide a dambreach analysis based on NRCS publications TR-66 and National Engineering Manual 210-V Circular No. 1, dated July 14, 1980. The County permits use of the maximum breach discharge at each of the downstream sections if the Engineer desires. However, in critical situations, the attenuation modeled by the normal TR-66 procedure may provide more accurate results. Continue analysis to the point at which:

a. Breach discharge is less than the 100-year discharge; or

b. Where a stream crossing causes significant ponding; or

c. When the County or NRCS permits ending the study.

4.9.6 100-Year Floodplain Study: Is required if so directed by the Town of Indian Head.

4.10 Fencing of Facilities

The Planning Commission reserves the right to require fencing around stormwater management facilities. In some cases, depending on depth of the water impounded and/or the steepness of the interior slopes, fencing may be required. The Planning Commission also reserves the right to approve the materials, design and height of the fence, if the Planning Commission determines that a fence is required.*

4.11 Access and Swing Gates

Provide an 18-foot minimum access gate when access is perpendicular to the gate. Provide a 24-foot gate when access is skewed. For all ponds, provide a swing gate at the public road right-of-way to prevent unauthorized vehicles from using the access road. See MD SHA for specifications to be placed on plan if fence is required.

4.12 Embankment Slopes

Slopes must never be steeper than 4:1 inside the facility without fencing and no steeper than 2:1 outside the facility. Interior slopes may be steepened to 2:1 if the facility is fenced in accordance with Section 4.11. The interior and exterior embankment slopes must total at least 5:1.

4.13 Filter Cloth

Use filter cloth under riprap and under gabions. The type of filter fabric must be specified on the plans and must be approved by the Town of Indian Head.

4.14 Synthetic Lining for Stormwater Management Structures

Synthetic linings shall be Geosynthetic Clay Liner, such as Bentomat Claymax or 30 mil poly liner. The Town reserves the right to approve the type of liner product submitted by the Developer for use.

4.15 Gabion Baskets and Mattress

Construct gabion baskets and mattress in accordance with Maryland Department of the Environment standards. Plans must specify use of Class IV, PVC-coated wire baskets for gabions. A preferred option to gabions is the use of imbricated riprap.

4.16 Riser

If a circular riser is used, situate so as to provide a minimum of 1 foot and a maximum of 2 feet clearance between the bottom of the anti-vortex device and the proposed ground. If the rise type does not require an anti-vortex device, the top of the riser must be a maximum of 2 feet above the proposed ground. Provide trash racks for low-flow pipes and for risers not having an anti-vortex device. Refer to SCS 378 Standards for design criteria.

4.17 Construction Specifications

4.17.1 Authority: Construct all stormwater management facilities in accordance with the NRCS Maryland Construction Specifications for Ponds, contained in the November 1992 NRCS 378 Standards, with modifications and additions.

4.18 Construction Drawings

Show the following information on the final construction drawings submitted to the Town of Indian Head and the NRCS for review and approval. (Scales may be changed after approval by the Department of Public Works. Use larger scales when necessary to show detail clearly.)

a. Facilities shall be presented on standard 24" x 36" mylar film (reproducible stick-ons are permitted);

b. Location and drainage area map (Scale 1" = 200' min.) showing the contributing drainage area, soil types, and the time of concentration paths.

c. Plan view of the pond and dam (Scale 1" =50' min.) with 2-foot contours, showing incoming drains and channels, pilot channel, riser, barrel, outlet protection, emergency spillway, property lines and owners, embankment stations, fence, access road and ramp, flood easements, and utility easements.

d. Profile along the centerline of the dam (Scale 1" = 50' horizontal, 1" = 5' vertical min.) showing top of dam as constructed and after settlement, emergency and principal spillway, cutoff trench, existing ground, proposed ground line within pond, and stationing.

e. Profile through the principal spillway (Scale 1" = 20' horizontal, 1" = 5' vertical min.) showing existing and proposed ground, cutoff trench, riser, low-flow pipe, barrel, outlet protection, phreatic line, anti-seep collars, constructed and settled top of dam, pipe inverts, design stormwater surface elevations and emergency spillway crest elevation. Indicate sizes, types, length, gages, slopes, flows and velocities.

f. Cross-section and profile of the emergency spillway (Scale 1" = 20' horizontal, 1" = 5' vertical min.) showing existing and proposed ground, inlet, control and outlet sections (labeled with lengths and elevations), slopes, discharge and velocity, limits of stabilization, labeled if token spillway;

g. Elevations, dimensions, and details of earthwork, cutoff trench, riser, barrel, pilot channels, welding detail, anti-seep collars, trash rack and anti-vortex device, outlet treatment, and soil boring locations.

h. The following certifications (place on Sheet 1 of the Construction Drawing): Engineer's, Developer's, and As-Built (Professional Engineers licensed in Maryland must sign and seal all construction drawings and "As-Built" drawings.)

i. Construction specifications from NRCS 378;

j. Structure classification, storage-height product, watershed area to pond, level of management provided by pond (1, 2, 10, 25 and 100 year), height and top width of embankment, allowable release rates for design storms, peak inflow and outflow from pond (1, 2, 10, 25 and 100 year), design high-water elevations (1, 2, 10, 25 and 100-year) and associated storage volumes (Ac.-ft.).

l. One (1) copy of the As-Built Drawings on mylar plan sheets with the statement and the Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

m. Three (3) copies of the final plans shall be submitted to the Office of Planning and Zoning for use by the Town.

APPENDICES

STORMWATER MANAGEMENT DESIGN MANUAL

RAINFALL-RUNOFF DEPTHS IN INCHES

RCN	DESIGN STORM YEAR AND RAINFALL INCHES						
	1 yr. 2.5"	2 yr. 3.1"	5 yr. 4.0	10 yr. 5.0	25 yr. 5.4	50 yr. 6.1	100 7.0
60	0.17	0.37	0.76	1.30	1.54	1.99	2.61
61	0.20	0.40	0.81	1.37	1.61	2.07	2.72
62	0.22	0.44	0.86	1.44	1.68	2.16	2.85
63	0.25	0.47	0.92	1.51	1.76	2.25	2.97
64	0.26	0.51	0.97	1.58	1.84	2.33	3.09
65	0.30	0.55	1.03	1.65	1.92	2.42	3.19
66	0.33	0.60	1.09	1.73	2.01	2.51	3.29
67	0.36	0.64	1.15	1.81	2.09	2.61	3.39
68	0.38	0.68	1.20	1.88	2.16	2.70	3.49
69	0.42	0.72	1.27	1.96	2.25	2.79	3.59
70	0.45	0.77	1.33	2.04	2.33	2.88	3.69
71	0.49	0.82	1.39	2.11	2.42	2.98	3.79
72	0.53	0.87	1.46	2.19	2.51	3.08	3.89
73	0.57	0.92	1.53	2.28	2.60	3.17	3.99
74	0.61	0.97	1.60	2.37	2.69	3.28	4.09
75	0.65	1.02	1.67	2.44	2.77	3.36	4.19
76	0.69	1.08	1.74	2.54	2.87	3.47	4.29
77	0.74	1.14	1.81	2.62	2.96	3.56	4.39
78	0.79	1.20	1.89	2.72	3.06	3.67	4.49
79	0.84	1.26	1.96	2.80	3.15	3.77	4.59

Reference: "SCS-TR-55"

RAINFALL-RUNOFF DEPTHS IN INCHES

RCN	DESIGN STORM YEAR AND RAINFALL INCHES						
	1 yr. 2.5"	2 yr 3.1"	5 yr 4.0"	10 yr. 5.0"	25 yr. 5.4"	50 yr. 6.1"	100 yr. 7.0"
80	0.89	1.33	2.04	2.89	3.25	3.87	4.69
81	0.94	1.39	2.12	2.98	3.34	3.97	4.80
82	0.99	1.46	2.20	3.08	3.44	4.07	4.91
83	1.06	1.53	2.29	3.17	3.54	4.18	5.02
84	1.12	1.60	2.37	3.27	3.64	4.29	5.14
85	1.18	1.68	2.46	3.37	3.74	4.40	5.26
86	1.24	1.74	2.54	3.46	3.83	4.50	5.36
87	1.31	1.83	2.64	3.57	3.95	4.61	5.48
88	1.38	1.90	2.72	3.66	4.05	4.72	5.58
89	1.46	1.99	2.82	3.77	4.16	4.95	5.83
90	1.53	2.08	2.92	3.88	4.26	4.95	5.83
91	1.61	2.16	3.02	3.99	4.37	5.05	5.94
92	1.69	2.26	3.12	4.09	4.48	5.17	6.06
93	1.78	2.35	3.22	4.20	4.59	5.28	6.17
94	1.87	2.44	3.32	4.30	4.70	5.39	6.28
95	1.97	2.54	3.42	4.41	4.81	5.50	6.40
96	2.07	2.66	3.55	4.54	4.94	5.64	6.53
97	2.17	2.77	3.66	4.66	5.06	5.75	6.64
98	2.27	2.87	3.77	4.77	5.17	5.87	6.77

Reference: "SCS-TR-55"

TABULAR DISCHARGES FOR TYPE II STORM DISTRIBUTIONS
CSM/INCH

TIME OF CONCENTRATION = 0.1 hours
Hydrograph Time in Hours

T_x	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	24	51	299	991	796	477	233	152	132	121	111	85	74	70	68	65	52	48	39	33	29	24	18	14
0.25	20	38	66	140	327	626	686	546	364	236	169	137	117	97	83	75	66	52	41	35	30	24	18	14
0.50	15	27	36	63	67	133	288	482	580	543	429	310	222	168	136	110	81	63	47	38	32	26	19	15
0.75	12	20	25	29	34	42	65	125	245	392	496	515	452	360	273	206	127	80	53	42	35	27	19	15
1.00	9	15	19	21	24	28	32	41	63	115	209	328	427	470	451	389	245	121	64	47	38	29	20	16
1.50	6	10	12	13	14	16	17	19	22	25	29	38	56	92	154	236	410	360	133	66	47	33	21	16
2.00	3	6	7	8	9	10	11	12	13	14	16	18	20	23	27	34	74	244	371	142	68	38	23	17
2.50	2	4	4	5	5	6	7	7	8	9	10	11	12	13	15	16	21	61	243	343	150	48	26	19
3.00	1	2	2	3	3	4	4	4	5	5	6	7	7	8	9	10	12	17	50	239	321	74	29	20
3.50	0	1	1	1	1	2	2	2	3	3	4	4	4	5	6	6	7	10	17	59	304	159	33	21
4.00	0	0	0	0	0	1	1	1	1	2	2	2	2	3	1	4	5	6	10	18	67	298	39	23

TIME OF CONCENTRATION = 0.2 hours
Hydrograph Time in Hours

T_x	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	23	47	208	509	796	641	624	245	170	138	121	104	85	75	71	68	56	49	40	34	29	24	18	14
0.25	18	34	49	91	196	419	603	627	486	341	235	173	138	114	96	83	70	55	43	36	31	25	18	15
0.50	14	24	32	37	50	87	181	341	490	545	497	397	296	219	167	133	92	67	49	39	33	26	19	15
0.75	11	18	23	26	30	36	49	84	161	284	409	491	481	422	340	263	157	89	56	43	36	27	19	15
1.00	9	14	18	20	22	25	29	35	48	79	143	240	347	426	452	427	299	147	69	49	39	29	20	16
1.50	5	9	11	12	13	14	16	18	20	23	26	32	43	67	110	176	330	399	159	72	50	33	22	17
2.00	3	6	7	7	8	9	10	11	12	13	15	16	18	21	24	29	56	192	363	168	75	40	24	18
2.50	1	3	4	5	5	6	6	7	7	8	9	10	11	12	13	15	19	33	200	337	174	51	26	19
3.00	0	2	2	2	3	3	4	4	5	5	6	6	7	8	8	9	11	15	40	203	316	82	29	20
3.50	0	0	1	1	1	2	2	2	2	3	3	4	4	5	5	6	7	9	16	46	300	100	34	22
4.00	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	1	4	6	9	16	53	286	41	24

TIME OF CONCENTRATION = 0.3 hours
Hydrograph Time in Hours

T_L	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	21	43	141	324	586	658	535	372	251	184	148	124	102	86	77	71	61	51	41	34	30	24	18	14
0.25	17	31	63	67	134	279	461	559	530	428	318	234	179	143	116	97	76	59	45	37	32	25	18	15
0.50	13	22	29	34	42	65	124	238	378	479	499	447	363	281	216	168	110	74	51	41	34	26	19	15
0.75	10	17	21	24	27	32	41	63	114	203	316	413	457	443	389	319	198	105	60	45	37	28	20	15
1.00	8	13	16	18	20	23	26	31	40	60	103	176	269	358	415	426	344	182	77	51	41	30	20	16
1.50	5	8	10	11	12	13	15	16	18	21	24	28	36	52	82	132	272	382	192	81	52	34	22	17
2.00	3	5	6	7	8	8	9	10	11	12	14	15	17	19	21	25	44	151	351	198	85	41	24	18
2.50	1	3	4	4	5	5	6	6	7	8	8	9	10	11	12	14	17	28	162	328	200	54	27	19
3.00	1	1	2	2	3	3	3	4	4	5	5	6	6	7	8	9	10	14	33	169	309	94	30	20
3.50	0	0	1	1	1	1	2	2	2	3	3	3	4	4	5	5	6	9	14	38	172	294	35	22
4.00	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	4	5	9	15	43	281	42	24

TIME OF CONCENTRATION = 0.4 hours
Hydrograph Time in Hours

T_L	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	20	39	103	224	419	558	575	451	331	247	190	155	127	105	90	80	66	53	42	35	30	24	18	14
0.25	15	28	38	54	98	196	343	461	508	464	380	295	228	180	145	119	87	64	47	38	32	26	19	15
0.50	12	20	26	30	37	53	92	172	286	395	462	453	402	332	266	211	137	84	54	42	35	27	19	15
0.75	10	16	19	22	25	29	36	51	85	150	242	338	407	429	406	356	241	128	65	47	38	29	20	16
1.00	8	12	15	17	19	21	24	28	34	49	78	132	208	292	362	403	368	220	88	55	42	30	21	16
1.50	5	8	9	10	11	12	14	15	17	19	22	25	31	43	65	102	220	365	224	93	56	35	22	17
2.00	3	5	6	6	7	8	9	9	10	11	13	14	16	17	20	23	37	119	338	225	99	43	24	18
2.50	2	3	3	4	4	5	5	6	6	7	8	9	10	11	12	13	16	25	132	311	225	58	27	19
3.00	2	1	2	2	2	3	3	3	4	4	5	5	6	7	7	8	10	13	28	140	300	107	31	21
3.50	1	0	1	1	1	1	1	2	2	2	3	3	3	4	4	5	6	8	13	32	146	286	36	22
4.00	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	5	8	14	36	275	44	24

TIME OF CONCENTRATION = 0.5 hours
Hydrograph Time in Hours

T_1	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	18	36	80	166	301	433	496	474	395	309	242	194	158	130	109	94	75	57	43	36	31	25	18	15
0.25	15	26	37	52	94	172	277	372	425	424	383	326	270	221	182	150	107	73	49	39	33	26	19	15
0.50	12	20	25	30	38	58	101	169	252	327	374	385	366	329	285	241	169	103	59	44	36	27	19	15
0.75	9	15	19	22	25	30	41	63	103	162	229	292	335	354	348	325	255	157	77	50	39	29	20	16
1.00	7	12	15	17	19	21	25	31	43	66	103	153	210	264	304	327	317	231	109	61	44	31	21	16
1.50	5	8	9	10	11	12	14	15	17	20	24	31	43	61	92	129	214	295	224	115	65	36	23	17
2.00	3	5	6	6	7	8	9	10	11	12	13	14	16	19	23	30	58	143	271	216	120	46	25	18
2.50	2	3	3	4	4	5	5	6	7	7	8	9	10	11	12	14	18	39	150	253	209	71	28	19
3.00	0	1	2	2	2	3	3	4	4	4	5	5	6	7	7	8	10	15	48	154	239	126	32	21
3.50	0	0	1	1	1	1	2	2	2	2	3	3	4	4	5	5	6	8	16	56	155	227	38	23
4.00	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	3	4	5	9	19	63	217	52	25

TIME OF CONCENTRATION = 0.12 hours
Hydrograph Time in Hours

T_1	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	15	29	57	98	163	248	329	375	388	369	325	276	232	195	165	142	107	76	51	39	33	26	19	15
0.25	12	21	29	39	61	100	158	227	291	336	355	348	321	285	247	212	156	103	62	44	36	27	19	15
0.50	10	16	21	24	29	41	63	100	150	208	263	305	327	329	314	288	226	147	79	52	40	29	20	16
0.75	8	13	16	18	20	24	30	43	65	98	142	192	239	278	301	311	286	208	107	63	45	31	21	16
1.00	6	10	13	14	15	17	20	24	31	44	65	95	138	177	220	256	294	264	149	81	53	33	21	16
1.50	4	6	8	9	10	11	12	13	14	16	19	23	31	42	60	83	147	269	248	152	85	40	23	17
2.00	2	4	5	5	6	7	7	8	9	10	11	12	14	16	18	23	39	97	251	235	153	56	26	19
2.50	1	2	3	3	4	4	4	5	5	6	7	7	8	9	10	11	15	28	107	218	236	91	29	20
3.00	0	1	1	2	2	2	2	3	3	4	4	5	5	6	6	7	8	12	33	113	225	153	34	22
3.50	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5	7	13	39	117	215	44	24
4.00	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	3	4	7	15	45	207	61	26

TIME OF CONCENTRATION = 1.0 hours
Hydrograph Time in Hours

T_L	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	13	24	45	66	107	155	211	258	301	313	316	301	277	247	217	188	146	102	64	46	36	27	19	15
0.25	10	18	24	32	45	68	102	146	191	238	272	293	299	293	275	252	200	139	81	54	41	29	20	16
0.50	8	14	17	20	24	32	46	68	99	136	170	219	251	274	284	283	256	187	105	65	47	33	21	16
0.75	7	11	13	15	17	20	25	33	46	67	94	128	165	202	233	256	273	236	140	82	55	33	21	16
1.00	5	9	11	12	13	15	17	20	25	33	46	65	90	121	154	187	240	262	183	107	66	37	22	17
1.50	3	5	7	7	8	9	10	11	12	14	16	19	24	31	43	58	103	185	244	181	110	48	24	18
2.00	2	3	4	4	5	6	6	7	8	8	9	10	11	13	15	18	29	69	182	230	178	70	27	19
2.50	1	2	2	3	3	3	4	4	5	5	6	6	7	8	9	10	12	21	77	178	219	114	31	21
3.00	0	1	1	1	1	2	2	2	3	3	3	4	4	5	5	6	7	10	25	83	210	172	39	22
3.50	0	0	0	0	1	1	1	1	1	2	2	2	2	3	3	3	4	6	11	29	88	202	52	25
4.00	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	4	6	12	33	195	77	28

TIME OF CONCENTRATION = 1.21 hours
Hydrograph Time in Hours

T_L	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	11	21	37	51	79	107	147	187	219	249	264	271	267	256	241	219	177	128	81	56	42	29	20	16
0.25	9	15	21	27	36	53	74	103	137	172	205	231	249	259	259	253	223	167	102	67	48	31	21	16
0.50	7	12	15	17	21	27	37	51	72	98	128	160	190	216	235	247	251	209	130	82	56	34	21	16
0.75	6	9	12	13	15	17	21	27	36	50	69	93	120	149	177	202	235	242	165	103	67	38	22	17
1.00	4	7	9	10	11	13	14	17	21	27	36	49	66	88	113	139	190	236	200	130	83	43	23	17
1.50	3	5	6	6	7	8	8	9	10	12	14	16	20	25	33	44	76	142	223	195	131	58	26	18
2.00	1	3	3	4	4	5	5	6	6	7	8	9	10	11	13	15	24	52	143	212	169	86	29	20
2.50	1	1	2	2	2	3	3	3	4	4	5	5	6	7	7	8	10	17	58	143	201	132	35	21
3.00	0	1	1	1	1	1	2	2	2	2	3	3	3	4	4	5	6	9	20	64	143	196	45	23
3.50	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	4	5	9	23	68	190	62	26
4.00	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	3	5	10	26	164	91	30

TIME OF CONCENTRATION = 1.5 hours
Hydrograph Time in Hours

T_1	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	10	18	31	42	57	81	105	133	164	192	209	227	235	236	236	225	201	153	99	68	50	32	20	16
0.25	8	13	17	22	30	41	57	76	99	125	153	178	199	215	225	230	224	188	122	82	58	36	21	16
0.50	6	10	13	15	18	22	30	40	54	72	94	118	143	167	188	204	224	214	152	99	68	39	22	17
0.75	5	8	10	11	11	15	18	22	29	39	52	69	89	111	134	157	194	219	182	122	82	44	23	17
1.00	4	6	8	9	10	11	12	14	17	22	29	38	50	66	84	105	148	198	214	150	100	50	24	18
1.50	2	4	5	5	6	7	7	8	9	10	12	14	17	21	26	34	58	109	191	204	149	70	28	19
2.00	1	2	3	3	4	4	4	5	5	6	7	8	8	10	11	13	19	40	112	184	197	102	33	20
2.50	0	1	1	2	2	2	3	3	3	4	4	5	5	6	6	7	9	14	45	114	190	147	40	22
3.00	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5	7	16	49	115	184	53	25
3.50	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	4	8	18	53	178	74	28
4.00	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	4	8	21	174	105	34

TIME OF CONCENTRATION = 2.0 hours
Hydrograph Time in Hours

T_1	11.0	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0	16.0	18.0	20.0
0	7	14	22	30	38	49	64	80	95	114	133	152	165	175	184	192	190	176	129	93	68	41	23	17
0.25	6	10	13	17	22	28	37	47	61	75	91	108	126	143	157	168	185	189	153	109	79	46	24	17
0.50	5	8	10	11	13	17	21	27	35	45	57	71	86	103	119	135	162	186	172	129	92	52	26	18
0.75	4	6	8	8	10	11	13	16	21	26	34	43	55	67	82	97	129	166	183	149	109	59	27	18
1.00	3	5	6	7	7	8	9	11	13	16	20	26	33	42	52	64	92	136	180	167	127	68	29	19
1.50	1	3	3	4	4	5	5	6	7	8	9	10	12	15	18	23	37	68	135	175	163	93	34	21
2.00	1	1	2	2	3	3	3	4	4	5	5	6	6	7	8	10	14	26	71	133	170	127	42	23
2.50	0	1	1	1	1	1	2	2	2	3	3	3	4	4	5	5	7	11	29	74	132	166	53	26
3.00	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	3	4	5	12	32	76	162	71	30
3.50	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	3	6	13	35	158	95	35
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	3	6	14	80	155	43

AS-BUILT DRAWING

I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

ENGINEER DATE P.E. NO.

	AS-BUILT DRAWING STATEMENT	

STREETS AND ROADS DESIGN MANUAL

STREETS AND ROADS DESIGN MANUAL

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Major Arterial
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As-Built Drawing Statement

1.0 GENERAL

1.1 Definitions

a. In these Standards, the terms "roads and streets" identifies any public highway, thoroughfare, road, street, cul-de-sac, or service road. The term "highways" identifies traffic ways under the jurisdiction of the Maryland State Highway Administration.

b. Service Road: A local access road to provide a means of egress and ingress to a non-residential development for the purpose of limiting access directly onto a collector or arterial roadway.

c. Local Road or Street: The local street comprises all facilities not in use of the higher order systems. It is intended to carry the least amount of traffic at the lowest speed and provide the safest and most desirable environment for a residential neighborhood, with the maximum number of homes fronting the street. The local street provides access to land adjacent to the collector network and serves travel over relatively short distances.

d. Minor Collector Road or Street: This is the highest order of street that could be classified as residential. This class of street is necessary to carry traffic from one neighborhood to another or from the neighborhood to streets connecting to other areas in the community. Direct access to homes is discouraged onto collector roads.

e. Minor Arterial: This classification of roadway generally provides for movement of vehicles larger in number than collectors and local roads. Providing access to abutting land is a minor function. This classification of roadway receives volumes of traffic from collectors and provides inter- and intra-county access throughout the municipality and county.

f. Intermediate Arterial: This is the highest order of street or road. This classification of roadway carries the highest volume of traffic through the municipalities and county.

g. (ADT) Average Daily Traffic: The total volume of traffic during a given time period (in whole days), greater than one day and less than one year, divided by the number of days in that time period.

h. Peak-Hour Traffic: The volume of traffic during the hour of day with the highest volume. For design purposes, this should represent the 30th highest hourly volume of the year, or 30 HV, and generally represents 15% - 25% of the ADT.

i. Design Speed: The maximum safe speed that can be maintained over a specified section of road or street when conditions are so favorable that the design features of the road govern.

j. Capacity: The maximum hourly rate of traffic at which persons or vehicles can reasonably be expected to traverse a point or uniform section of road during a given time period under prevailing roadway and traffic conditions.

k. Stopping Sight Distance: The length of roadway ahead visible to the driver. Stopping sight distance is the sum of two distances: the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied; and the distance required to stop the vehicle from the instant the brake application begins. These are referred to as brake reaction distance and braking distance, respectively.

l. Passing Sight Distance: The length needed to safely complete normal passing maneuvers, generally determined for a single vehicle passing a single vehicle. The minimum passing sight distance for two-lane roads is determined as the sum of the four distances:

    1. Distance traversed during perception and reaction time during the initial acceleration to the point of encroachment on the left lane.

    2. Distance traveled while the passing vehicle occupies the left lane.

    3. Distance between the passing vehicle at the end of its maneuver and the opposing vehicle.

    4. Distance traversed by an opposing vehicle for two-thirds of the time the passing vehicle occupies the left lane, or 2/3 of "2" above.

m. AASHTO: American Association of State Highway and Transportation Officials.

n. Alley: A public right-of-way which affords only a secondary means of access to abutting properties.

1.2 Responsibility for Design and Construction

a. Indian Head roads and streets in or related to new development are designed by Developers or their consulting engineers. Town projects are designed by either the Town or consulting engineers.

b. Construction of roads and streets in or related to new development is the responsibility of the Developer. These projects are constructed by either a contractor hired by the Developer or the Developer's own forces.

c. The Developer shall provide the Town with a minimum one-year warranty from the date of acceptance of the improvements by the Town for all work constructed by the Developer. The Town shall withhold all of the contingency portion of the surety associated with road work (i.e. paving, curb and gutter, sidewalk) until the warranty period expires.

d. The Town will not accept the road improvements until all construction is complete, final paving is installed, build-out is complete, and there is no longer a need to use the completed road for construction traffic. No construction traffic will be permitted on streets that have been accepted by the Town.

1.3 Authorization Permits

a. Where intersections occur with roadways under the jurisdiction of the Maryland State Highway Administration, Charles County, or other political districts, a permit from the office involved authorizing the proposed construction must be filed with the Town before plans will be approved.

b. Where permits are required from other agencies, such as the Natural Resources Conservation Service, Maryland Department of the Environment or Army Corps of Engineers, a signed permit from those agencies having authorization over the project must be filed with the Town before plans will be approved.

1.4 Planning Guidelines

The designation or classification of the road, street or alley shall be designed as stipulated in the Town's Comprehensive Plan or as dictated by the Town. The design standards of roads and streets as shown herein shall be used.

1.5 Existing Streets

Each street abutting or affecting the design of a subdivision or land development which is not already classified in the comprehensive plan shall be classified to its function, design and use by the Town at the request of the applicant or during plan review. The classification of existing streets shall include the hierarchy noted above or classification of higher order, as determined by the Town.

2.0 DESIGN

2.1 Preliminary Considerations

The design of roads and streets includes general layout, curb and gutters, signage, sidewalk, alignment, grades, grading, paving widths, paving material, and drainage facilities. Sufficient rights-of-way should be set aside in the early stages of layout to provide for future increases in pavement widths and roadside improvements when practical. When determining alignments and grades of roads and streets, the designer must consider the requirements for utilities, including adequate storm drainage, and he must take into account any unusual aspects of the design, such as railroad crossings, floodplain crossings, intersection improvements with State or County roads and traffic signals.

2.2 Layout of Intersections

a. Centerlines of traffic ways shall continue through intersections without offsets and shall intersect as nearly as possible at right angles. Where various conditions make a right angle intersection impracticable, the minimum deflection angle between the centerline of a street and the centerline of any other street shall be 70 degrees.

b. There must be an unobstructed sight distance along all approaches at an intersection across their included corners for a distance sufficient to allow operators of vehicles to accelerate, slow down, or stop. The design is commonly called the intersection sight triangle. All intersections should be designed with angle of intersection at 90 degrees. AASHTO's discussion of intersection sight distance shall predominate, but is too long to be included here. Since local residential access streets will inherently be low speed roads, then one can plan on only having to satisfy AASHTO's requirement for 30 mph situations. Stopped intersections of local roads shall have a minimum sight distance of 150 feet. AASHTO's guidelines, as discussed in *A Policy on Geometric Design of Highways and Street*, latest edition, Chapters 5, 6, and 7, will govern except as modified in this design manual.

c. At the intersection of two (2) closed section streets, consideration must be given to the radius of the return. A minimum curb radius of 25 feet should be provided with 30 feet minimum at the intersection with State or County highways.

d. At an intersection of an alley and a street, the standard radius of the return shall be 10 feet to face of curb. Where the distance on the street between the face of the curb and property line is less than 10 feet, that distance shall become the return radius.

e. Where alleys intersect at 90 degree angles, the fillet triangle formed shall have legs of 15 feet. At intersections other than 90 degrees, the fillet triangles shall be subject to approval by the Town.

f. The cut-back of property lines at intersections shall be governed by the following criteria:

1. At an intersection of roadways (other than alleys), the cut-back of the property line normally shall be a chord connecting the points on the property lines directly opposite the Point of Curvature (P.C.) and Point of Tangency (P.T.) of the curb return or edge of pavement return. In any case, the minimum distance from the property line Point of Intersection (P.I.) at an intersection and the property line chord points shall be a minimum of 10 feet.

2. At an intersection of an alley and a street, the property line shall not be cut-back.

3. At an intersection of alleys, the property line shall conform with the pavement fillet.

g. A clear zone should be established that is free of all opaque obstructions greater than 3.0 feet high above the curb elevation. Such objects typically include: buildings, cut slopes, hedges, trees, bushes, or tall crops. The triangular dimensions of the zone allow for the desired sight lines. This triangle shall have a minimum of 70 feet dimension on the edge of the pavement on both legs. This design requires elimination of parking within the sight triangle. Street signs, fire hydrants, and utility poles typically can be located within a sight triangle, as long as they are not clustered and do not contribute to sight limitation.

h. Intersections shall be no less than 250 feet apart between roadway centerlines. (Local streets only.)

i. Refer to Table 2 in the Appendix for separation guidelines.

j. In certain situations, the design and construction of turning lanes or acceleration/deceleration lanes at intersections may be required to facilitate the movement of traffic through an intersection and improve traffic capacity and level of service. The Planning Commission reserves the right to require additional lanes of roadway for this purpose and to require

the Planning Commission as to the necessity for and the geometric requirements for additional turning lanes.

2.3 Horizontal Curves

a. Where road and street centerlines change direction by more than one degree (1°), they shall be connected by a horizontal curve with a radius to insure a minimum horizontal sight distance, as shown in Table 1. Minimum radii of horizontal curves shall be limited as directed by the Table's minimum radius. The minimum radius of a horizontal curve shall be 100 feet.

b. Property lines which change direction through angles less than one degree (1°) need not have a horizontal curve introduced at the break, unless otherwise directed by the Town.

c. Horizontal curve data shall be computed by the arc definition of a circular curve. A tangent of at least 100 feet shall be used between reverse curves. Horizontal alignments using compound curves shall be avoided.

2.4 Superelevation

Horizontal curves of road and streets in subdivisions, commercial and industrial areas, regardless of classification, shall not be superelevated.

2.5 Cul-de-Sacs; Tee Turn-Arounds; Driveways

2.5.1 Cul-de-Sacs

a. Generally, all residential parcels should be accessible from two directions. This usually reduces total vehicle miles of travel and improves emergency vehicle access. However, the most efficient subdivision of certain tracts (considering shape and terrain) may work best by locating limited numbers of lots along dead-end streets.

b. A 400-foot length shall be the maximum for cul-de-sacs. The minimum right-of-way radius for a traditional circular cul-de-sac is 50 feet. No eyebrow cul-de-sacs shall be permitted. The minimum length of a cul-de-sac shall be 350 feet from the centerline of the intersecting street to cul-de-sac curb. The minimum outside pavement/curb radius is 40 feet. Larger cul-de-sacs will be required in subdivisions with very large lots with sufficient lot width to allow curb parking around the cul-de-sac. The curb parking creates the

need for larger pavement/curb radii to accommodate the parking, while providing sufficient turning radius for large trucks and fire apparatus. Oversized cul-de-sacs will also be required for school bus access, as determined necessary by staff at the preliminary plan stage. The minimum diameter of the right-of-way for over-sized cul-de-sacs, when required by the Town, shall be 150 feet.

c. When outside curb (pavement) radii of 40 feet or greater are used, they create large expanses of pavement which may be unsightly. The use of center islands may be considered to reduce this paved area, if care is given to keeping adequate maneuver space around the island. A minimum pavement driving width of 20 feet is required around the island. The use and design of islands will be at the discretion of the Planning Commission. All islands, when approved by the Town, will be rolled curbed.

d. In addition to the traditional circular cul-de-sac, an offset cul-de-sac may be provided. Generally, offset cul-de-sacs are used to overcome environment, topographic and property constraints.

e. At the connector between the cul-de-sac right-of-way, a transition radius is required. This radius should be at least 50 feet, to avoid an unsightly sidewalk layout and to provide smooth turning movements into and out of the cul-de-sac. Also, a more constant curb to right-of-way line dimension is achieved.

2.5.2 Tee Turn-Arounds

Tee Turn-Arounds will <u>not</u> be permitted as temporary or permanent facilities.

2.5.3 Driveways

Layout of driveway entrances shall conform with the applicable Typical Driveway Entrance Detail, shown in the Appendix.

2.6 Design Speed

Designation of a design speed is suspended here because other design elements serve to "limit" speeds in residential areas. Wherever possible in the other sections, an effort to design for 30 mph or less has been considered. Lower design speeds must be considered as progressively more difficult terrain is encountered.

The Developer or his Engineer shall submit with each project a proposed mechanism or method(s) for reducing traffic speed on the roadways being designed, particularly in residential areas. The mechanism or method(s) to achieve the desired result of reducing traffic speeds may consist of one or more different approaches.

2.7 Minimum Centerline Radius of Curves

The minimum centerline values for design of streets and roads are provided in Table 1. These values relate to mid-block horizontal centerline curves and not to intersection radii. When a street makes a right angle or 90 degree turn, a much shorter centerline radius, such as 50-feet centerline, will apply.

2.8 Minimum Tangent Between Reverse Curves

A minimum tangent of 100 feet at curves and intersections is needed between reverse curves to facilitate steering and control. Refer to Table 1 for minimum lengths for various roadway classifications.

2.9 On-Street Parking

a. Off-street parking requirements are addressed in the zoning and subdivision regulations. However, the adequacy of street widths is tied to available off-street parking and the need to provide on-street parking capability when off-street parking is not sufficient. The pavement widths provided in Table 1, and as shown in the Standard Details in the Appendix of this manual, provide the opportunity for on-street parking.

b. Studies have shown curb parking to be a primary factor in accidents on all types of streets. The number of children killed and injured each year as a result of entering the street from behind parked cars is particularly tragic. For these reasons, every development must meet off-street parking requirements so as to minimize curb parking.

c. Angle parking along the curbs of local streets should never be allowed. When traffic lanes are used for parking and parking maneuvers, the accident potential is much higher than with parallel parking. Therefore, all such bays and lots allowing any parking other than parallel, should be physically separated from the roadway and confined by barrier curbing beyond the street and the sidewalks.

2.10 Driveway Aprons

a. Because they are deceptively simple in appearance, driveway aprons often do not receive the design consideration that they merit. Common deficiencies include:

1. Inadequate radii at intersection with street;

2. Excessive grades and grade changes (breakover angles);

3. Inadequate width and depth of paving;

4. Inadequate sight-distance due to landscaping;

5. Poor drainage characteristics.

b. The typical residential driveway apron should be designed for passenger car operation only. The driveway radius or flare should be designed with consideration given to both the driveway and road width. Refer to the Standard Details in the Appendix of this manual for a typical driveway apron design.

2.11 Minimum Tangent Length Approaching Intersection

It is desirable to provide a tangent section of roadway approaching intersections, when the street leg has minimum or near-minimum radius curve. However, curving collector streets need not have tangents approaching intersections with local streets, if the collector radius is 1,000 feet or greater.

2.12 Drainage Structures

a. Inlets or catch basins should not be located within the corner radius or within 6 feet of either end. Clearance is needed to keep the area relatively dry and to allow space for street lights, name signs, utility poles, etc. Grate design should provide for safety of bicycle traffic.

b. Special considerations should be given to the middle of the curb return at the upper end of the intersection of two streets in a downhill condition. A small area of ponding in the gutter can be created due to the gutter slope. Detailed spot elevations must be provided to show that all drainage will flow to the appropriate storm drain inlet.

2.13 Traffic Control

All signs will be placed by the Town at the expense of the Developer, according to the *Manual of Uniform Traffic Control Design* (MUTCD). All intersections of Town roads and streets with other private or public streets, with the exception of State and County roads, are under the jurisdiction of the Town of Indian Head. Intersections at State facilities are under Maryland State Highway Administration jurisdiction. On Town roads and streets, the curbs shall be painted 7.5 feet on each side of a hydrant and along the curbed radius to a point 20 feet beyond the end of the radius in each direction. Centerline road markings will be required on all roads and streets except local roads. Stop lines will be required on all roads and streets at stop signs. Crosswalks will be required as dictated by the Planning Commission.

2.14 Commercial Driveway Entrances

a. The minimum width of a commercial driveway access shall be 30 feet.

b. Median-divided entrance roads are permitted; however, they must meet a minimum 100-foot depth. The median width may range from 4 feet to 10 feet. The minimum drive-aisle width shall be 14 feet. Any other non-standard design (channelization, right-in, right-out, angled entrances, etc.) must be approved by the Town on a case-by-case basis.

c. In all cases, the minimum curb return of radius shall be 25 feet and shall have curbed edge protection. Larger radii are recommended for larger design vehicles.

d. For all commercial driveways having access to higher volume, higher classified roads, the Town can require that acceleration/deceleration lanes and bypass lanes with additional right-of-way be provided. When required by the Town, a sufficient bypass lane design shall include, as a minimum onto a collector road, a 150 feet departure taper, a 150 feet bypass, a 100 feet transition, and a 150 feet merge taper. When access is onto a minor or major arterial, a 300 feet departure taper, a 300 feet bypass, a 200 feet transition, and a 300 feet merge taper shall apply. The bypass lane shall be a full width lane equal to or greater than the travel lane width.

2.15 Grades

2.15.1 Roadways

a. The minimum allowable grade of roadways shall be 0.50%.

b. The maximum grades of roadways shall be as shown in Table 1.

c. To meet the criteria for cul-de-sacs, the grades across the circular portions of cul-de-sacs shall be flattened when necessary: the grade along the centerline extended across the circular portion of any cul-de-sac shall not exceed a mean of 6%.

d. At an intersection of two roadways, the normal typical section of the priority traffic way shall continue through the intersection without break. The crown of the other traffic way shall be warped from its normal section to connect to the edge of the priority traffic way. Where two traffic ways of equal importance intersect, one shall be considered as a priority traffic way in order to accomplish the foregoing connection, except where the design engineer is unable to determine satisfactorily either one of the intersecting traffic ways as a priority traffic way. In this case, the Town shall be consulted.

2.15.2 Intersections with State Roads

Approach grades to Maryland State Highway Administration shall be governed by the State Highway Administration.

2.16 Vertical Curves

a. To avoid an abrupt change in vertical alignment when passing from one grade to another, a vertical curve shall be used at the grade intersection whenever the algebraic difference in the percents of a grade is 0.25 or greater.

b. Elevations on vertical curves shall be computed by the parabolic curve formula, except for rehabilitated streets when it becomes impractical, due to the use of other curves. The elevations of other curves may be scaled when the profile is plotted on a scale of 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical.

c. The minimum length of a vertical curve may include a compound curve, but not a reverse curve, and shall not be less than 100 feet.

d. The parabolic curve is used almost exclusively in connecting grade tangents because of the convenient manner in which the vertical offsets can be computed. Figure 1 in the Appendix provides the Standard Landing Requirements for Local and Collector Streets. A typical symmetrical vertical curve is shown below.

PARABOLIC VERTICAL CURVE

P.V.C. . . . . .Point of Vertical Curvature
P.V.I. . . . . Point of Vertical Intersection
P.V.T. . . . . .Point of Vertical Tangency
E. . . . . .External Distance - in feet
L. . . . . .Length of Curve - in feet
g_1 . . . . . .Grade from which stationing starts (in %)
l. . . . . ..1/2 or half the Length of Curve
y. . . . . .Offset in feet
x. . . . . .Any Distance from P.V.C. in feet
g_2 . . . . . .Grade toward which station heads (in %)

To design the curve for use in profile drawings, first the minimum allowable length of curve must be established. This minimum length is: K (a constant) multiplied by the absolute value of the algebraic difference of the two grades (in percent). Per AASHTO for a design speed of 30 mph in a crest (1) condition K = 30 and a sag (2) condition K = 40. For other design speeds, refer to Table 1.

(1) A vertical crest is the same as a hill or high point, with the extensions of the two tangents forming an angle point up.

(2) A vertical sag is the same as a valley or low point, with the extensions of the two tangents forming an angle pointing down.

Other equations that may be helpful are as follows:

Lmin = K x (gl - g2) = Minimum Vertical Curve Lengths

$$E = \frac{(g1 - g2) \cdot L}{800}$$ = Vertical Offset at P.V.I.

$$r = \frac{g1 - g2}{L(\text{in stations})}$$ = Rate of Grade Change

$$y = \frac{r}{2} x^2 + glx + \text{Elevation P.V.C.}$$ = Vertical Offset of any point X Station from the P.V.C.

In order to determine the high (low) point along the curve, use the equation

$$X \text{ (in stations)} = \frac{-gl}{r}$$

e. An effort shall be made to avoid the placing of horizontal curves along crest vertical curves. Where such design is unavoidable, the sight distance of the vertical curve shall not be less than the horizontal curve sight distance, and the limits of the horizontal curve shall extend beyond the limits of the vertical curve.

2.17 Private Streets

a. In apartment and townhouse developments, driveways connecting to buildings and parking areas are privately owned and maintained. These streets will not be accepted into the Town's public road network. All streets leading to courts and parking areas within townhouse areas, apartments and condominiums shall be private streets.

b. The reason a developer utilizes private streets is to minimize his right-of-way or geometric design requirements. Both of those reductions can cause problems for the public agency that may eventually have to take over the private street system. All private streets shall be a minimum of 14 feet in width for one-way traffic flow and 24 feet for two-way traffic flow. Sidewalks are required along private streets.

2.18 Underdrains

To drain free water from subgrades in excavated areas, underdrains shall be incorporated into the design of new roadways wherever there is a possibility of water undermining the traffic way subgrade. See Standard Details 387.01 and 387.11 of the *State Highway Administration for Construction Methods*.

2.19 Guard Rail

a. Guard rail shall be erected on roadways at points of extreme hazard to a vehicle leaving the traveled portion of the traffic way. Generally, this potential hazard develops at fills over 8 feet in vertical depth from the edge of the curb or right-of-way to the toe of the slope. Guard rail shall be placed behind the curb and sidewalk.

b. Where roadway construction ends in fill areas, temporary barricade posts shall be erected.

c. For guard rail details, refer to the *State Highway Administration Construction Details* series 660.

2.20 Sidewalks and Curb and Gutters

Concrete or brick sidewalks and curb and gutters may be required on both sides of all new roadways, regardless of classification. Refer to the Standard Details in the Appendix of this manual for Construction Details and Location. Generally, curb and gutter shall be required fronting all residential lots which have a width less than 100 feet and fronting all commerical or industrial lots.

2.21 Cross Sections and Quantities

a. Cross sections for roadways shall be taken at least every 50 feet and at all noticeable terrain breaks. The centerline and profile grade line shall be stationed correspondingly.

b. The design engineer shall provide quantity estimates to the Town. These estimates shall include all quantities for grading, paving, curb and gutter, excavation, embankment, etc., and shall be tabulated as directed by the Town.

2.22 Traffic Impact Studies

2.22.1 Purpose

a. Whenever a proposed project will generate one hundred (100) new vehicle trips in the peak direction (inbound or outbound) during the site peak traffic hour, the applicant shall perform a traffic impact study. Based on this study, certain improvements may be identified to provide safe and efficient access to the development.

b. In addition, a traffic impact study shall be prepared whenever either one of the following conditions exist within the impact study area:

1. Current traffic problems exist in the local area, such as a high-accident location, confusing intersection, or a congested intersection which directly affects access to the development.

2. The ability of the existing roadway system to handle increased traffic or the feasibility of improving the roadway system to handle increased traffic is limited, as determined by the Town.

3. Study is required as a condition of all annexation and rezoning applications.

2.22.2 Traffic Impact Study

2.22.2.1 Area of Traffic Impact Study

The traffic impact study area shall be based on the characteristics of the surrounding area. The intersections to be included in the study shall be adjacent to the site or have direct impact upon the access to the site. Intersection and study areas shall be determined by the Town during a scoping session, to be attended by the Town staff, State and County representatives, and the Developer's Engineer responsible for preparing the Study. The Town shall be called upon to resolve any disputes between the municipality and the traffic engineer.

2.22.2.2 Preparation by Transportation Engineer Required

Traffic impact studies shall be prepared under the supervision of qualified and experienced transportation engineers with specific training in traffic and transportation engineering and at least 2 years of experience related to preparing traffic studies for existing or proposed developments.

2.22.2.3 Horizon Year

The traffic forecasts shall be prepared for the anticipated opening year of the development, assuming full buildout and occupancy. This year shall be referred to as the horizon year in the remainder of this section.

2.22.2.4 Non-Site Traffic Estimates

Estimates of non-site traffic shall be made and will consist of through traffic and traffic generated by all other developments within the study area for which preliminary or final plans have been approved. Non-site traffic may be estimated using any one of the following three methods: "Build-up" technique; area transportation plan data or modeled volumes; and trends or growth rates.

2.22.2.5 Warrants

The traffic impact study shall include a warrant analysis at each intersection (as determined in 2.22.2.1) in accordance with the warrants requirements in the *Manual on Uniform Traffic Control Devices*, latest edition. The traffic impact study shall include an accident history record at each intersection and the 85th percentile speed of all vehicles on the approaches to each intersection.

2.22.2.6 Trip Generated Rates Required

The traffic impact study report shall include a table showing the categories and quantities of land uses, with the corresponding trip generation rates or equations (with justification for selection of one or the other), and resulting number of trips. The trip generation rates used must be either from the latest edition of Trip Generation by ITE or from a local study of corresponding land uses and quantities. All sources must be referenced in the study.

2.22.2.7 Consideration of Pass-By Trips

If pass-by trips or shared trips are a major consideration for the land use in question, studies and interviews at similar land uses must be conducted or referenced.

2.22.2.8 Rate Sums

Any significant difference between the sums of single-use rates and proposed mixed-use estimates must be justified in the study report.

2.22.2.9 Explanations Required

The reasoning and data used in developing a trip generation rate for special/unusually generators must be justified and explained in the report.

2.22.2.10 Definition of Influence Area

a. Prior to trip distribution of site-generated trips, an influence area must be defined which contains eighty percent (80%) or more of the trip ends that will be attracted to the development. A market study can be used to establish the limits of an influence area, if available. If no market study is available, an influence area should be estimated based on a

reasonable documented estimate. The influence area can also be based on a reasonable maximum convenient travel time to the site or delineating area boundaries based on locations of competing developments.

b. Other methods, such as using trip data from an existing development with similar characteristics or using an existing origin-destination survey of trips within the area, can be used in place of the influence area to delineate the boundaries of the impact.

2.22.2.11 Estimates of Trip Distribution Required

a. Trip distribution can be estimated using any one of the following three methods:

1. analogy

2. trip distribution model

3. surrogate data

b. Whichever method is used, trip distribution must be estimated and analyzed for the horizon year. A multi-use development may require more than one distribution and coinciding assignment for each phase (for example, residential and retail phases on the same site). Consideration must also be given to whether inbound and outbound trips will have similar distributions.

2.22.2.12 Trip Assignments

a. Assignments must be made considering logical routings, available roadway capacities, left turns at critical intersections, and projected (and perceived) minimum travel times. In addition, multiple paths should often be assigned between origins and destinations to achieve realistic estimates, rather than assigning all of the trips to the route with the shortest travel time. The assignments must be carried through the external site access points and in large projects (those producing five hundred (500) or more additional peak direction trips to or from the site during the development's peak hour) through the internal roadways. When the site has more than one access driveway, logical

routing and possibly multiple paths should be used to obtain realistic driveway volumes. The assignment should reflect conditions at the time of the analysis. Assignments can be accomplished either manually or with applicable computer models.

b. If a thorough analysis is required to account for pass-by trips, the following procedure should be used:

1. Determine the percentage of pass-by trips in the total trips generated.

2. Estimate a trip distribution for the pass-by trips.

3. Perform two separate trip assignments, based on the new and pass-by trip distributions.

4. Combine the pass-by and new trip assignment.

c. Upon completion of the initial site traffic assignment, the results should be reviewed to see if the volumes appear logical, given characteristics of the road system and trip distribution. Adjustments should be made if the initial results do not appear to be logical or reasonable.

2.22.2.13 Total Traffic Impacts

Traffic estimates for any site with current traffic activity must reflect not only new traffic associated with the site's redevelopment but also the trips subtracted from the traffic stream because of removal of a land use. The traffic impact report should clearly depict the total traffic estimate and its components.

2.22.2.14 Capacity Analysis

a. Capacity analysis must be performed at each of the major street and project site access intersection locations (signalized and unsignalized) within the study area. In addition, analyses must be completed for roadway segments deemed sensitive to site traffic within the study area. These may include such segments as weaving sections, ramps, internal site roadways, parking facility access points, and reservoirs for vehicles queuing off-site and on-site. Other locations may be deemed appropriate depending on the situation.

b. The recommended level-of-service analysis procedures detailed in the most recent edition of the *Highway Capacity Manual* must be followed. The Town of Indian Head considers the overall level-of-service ratings A, B, and C to be acceptable for signalized intersections; level-of-service D, E or F is considered to be unacceptable. Refer to the Appendix for Level of Service Criteria.

c. The operational analyses in the Highway Capacity Manual should be used for analyzing existing conditions, traffic impacts, access requirements, or other future conditions for which traffic, geometric, and control parameters can be established.

2.22.2.15 Required Levels-of-Service

The recommendations of the traffic impact study shall provide safe and efficient movement of traffic to and from and within and past the proposed development, while minimizing the impact to non-site trips. The current levels of service must be maintained if they are C, not allowed to deteriorate to worse than C if they are currently A or B, and improved to C if they are D, E or F.

2.22.2.16 Documentation Required

a. A traffic impact study report shall be prepared to document the purpose, procedures, findings, conclusions, and recommendations of the study.

1. The documentation for a traffic impact study shall include, at a minimum:

a.) Study purpose and objectives.

b.) Description of the site and study area.

c.) Existing conditions in the area of the development.

d.) Recorded or approved nearby development.

e.) Trip generation, trip distribution, and modal split.

f.) Project future traffic volumes.

g.) An assessment of the change in roadway operating conditions resulting from the development traffic.

h.) Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level-of-service.

b. The analysis shall be presented in a straight forward and logical sequence. It shall lead the reader step-by-step through the various stages of the process and resulting conclusions and recommendations.

c. The recommendations shall specify the time period within which the improvements should be made (particularly if the improvements are associated with various phases of the development construction), and any monitoring of operating conditions and improvements that may be required.

d. Data shall be presented in tables, graphs, maps, and diagrams wherever possible for clarity and ease of review.

e. To facilitate examination by the Town, an executive summary of one or two pages shall be provided, concisely summarizing the purpose, conclusions, and recommendations.

f. The report documentation outlined above provides a framework for site traffic access/impact study reports. Some studies will be easily documented using this outline. However, the specific issues to be addressed, local study requirements, and the study results may warrant additional sections.

2.22.3 Improvements

2.22.3.1 Responsibility for Improvements

The applicant shall be responsible for the improvements required to provide safe and convenient ingress and egress to the development site.

2.22.3.2 Coordination with Municipal Requirements

The applicant shall be responsible for other improvements as may be agreed to with Indian Head or which are required by any municipal adequate public facilities, impact fee, or other ordinance and which improvements shall be installed or paid for by the applicant.

3.0 CONTRACT DRAWINGS AND DOCUMENTS TO BE SUBMITTED TO TOWN

3.1 Contract Drawings

3.1.1 General

a. Roadway layouts shall be prepared on sheets separate from other utilities. These drawings shall be made on standard size tracing mylar film, with titling as required by the Town, and shall be rendered in black ink.

b. On all Road and Street projects, including improvements to existing roads and where a subdivision abuts on only one side of the road, cross sections shall be taken in the field. Maximum distance between cross sections shall be 50 feet, with intermediate cross sections taken as needed to show a true picture of the topography. The cross sections shall extend to a point sufficient to determine the slope and other easements.

c. The cross sections shall be plotted on standard cross section paper 10 x 10 graduations to the inch. The scale for plotting the cross sections shall be 1 inch = 10 feet both vertical and horizontal. The original ground line and the proposed road section shall be shown.

d. The plan shall be drawn to a scale of 1 inch = 50 feet or larger. The profile shall be drawn to a horizontal scale of 1 inch = 50 feet or larger and a vertical scale of 1 inch = 5 feet.

e. Drawing numbers of other utilities (water, storm drainage, etc.) being prepared for the development at the same time shall be shown on the plan portion of the roadway drawings.

f. A location map drawn to a scale of 1 inch = 500 feet shall appear on the first drawing of the traffic way drawings. In remote areas, an additional location map on a small scale, such as 1 inch = 2000 feet, shall be required so that existing roadways may be used for orientation reference.

g. The applicant shall submit ten (10) copies of all plans for review by the Town. Signature blocks shall be provided for signature by: Natural Resource Conservation Service; Town of Indian Head Planning Commission; Town of Indian Head Engineer; Charles County Dept. of Public Works for Sewer and Storm Water Management only.

h. Three (3) copies of final plans shall be submitted to the Office of Planning and Zoning for use by the Town in updating the Town's maps.

i. One (1) copy of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

3.1.2 Plan

3.1.2.1 Street Names

The names of all roadways shall be clearly lettered either along the street centerline or along one property line, whichever location is more convenient; however, all names on each drawing shall be placed in the same relative position.

3.1.2.2 Widths of Right-of-Way, Pavement and Easements

Widths of existing and proposed rights-of-way and pavements for each traffic way shall be shown with dimensioning. Slope easement where established and utility easements and rights-of-way which intersect traffic way rights-of-way shall be shown with dimensioning.

3.1.2.3 Topography

The location of all structures above the subgrade shall be shown, all topography, including poles, trees, fences, hedges, property markers, buildings and other structures. This topography shall be carried at least 100 feet beyond right-of-way lines, 200 feet beyond the ends of roadways or beyond approval limits, and 200 feet in each direction from an intersection. When shown, all measurements for utility

structures, poles, trees, fences and hedges shall be dimensioned from the roadway centerline.

3.1.2.4 Coordinates, Bearings, and Ties

a. Bearings of roadway centerlines and coordinates of centerline P.C.s and P.T.s and of intersecting traffic way centerline P.I.s shall be shown along the respective centerlines.

b. In addition to the above requirements, al P.I.s, P.C.s, P.T.s and other points that are needed to re-establish the centerline of the traffic way shall be referenced to permanent features or guarded hub stakes that will not be disturbed prior to the completion of all work.

c. The location and description of all reference points and the distance or angles to the centerline control points shall be shown on all Roads and Street drawings.

3.1.2.5 Horizontal Curve Information

Centerline curve information for each horizontal curve shall be tabulated on the plan in the following manner:

_ = ____° ____' ____" (Angle of intersection)
D = ____° ____' ____" (Degree of curve)
R = ____.____' (Centerline radius)
T = ____.____' (Tangent Length)
L = ____.____' (Length of curve)

_, or Delta, is the external angle of intersection of the tangents at the P.I.

3.1.2.6 Stationing

a. Stationing along the centerlines of tangents shall be in even 100 feet stations, indicated by a small circle and the station number. Stationing along horizontal curves shall be indicated in like manner.

b. P.C.s and P.T.s of horizontal curves shall also be indicated by a small circle on the centerline and their stations shown to the nearest hundredth of a foot.

c. Stations of P.C.s and P.T.s of curbs on circular portions of cul-de-sacs shall be shown on the plan.

d. P.I.s of intersecting traffic way centerlines shall be indicated by a small double circle at the centerline intersection, and the equality to the nearest hundredth of a foot shall be lettered thereunder.

3.1.2.7 Match Lines

Traffic way plan portions shall be continued from one sheet to the next with match lines. In addition, the last 200' of each section of a traffic way plan shall be repeated on the next adjacent section.

3.1.2.8 P.I.s of Curb Lines

The points of intersection of curb lines shall be indicated by small linked crosses and shall be identified thereunder as N.E., N.W., S.W., or S.E.

3.1.2.9 Direction of Drainage

a. Arrows approximately 1/2 inch long shall be drawn around all curb returns and at all critical drainage points to indicate the direction of surface water flow in ditches or gutters.

b. Wherever the slope of a gutter is reversed from the traffic way slope, a note to that effect shall appear on the plan.

c. When an inlet adjacent to a curb return is to be set to such an elevation that it serves as the low point along the curb return, and the grades of the intersecting traffic ways are such that a true picture of the top curb grade in the inlet area is not feasible on the profile, then a note shall appear on the plan stating that the top curb grades in the inlet area shall be set in the field to locate the sump at the inlet.

3.1.2.10 Storm Drainage

a. The design engineer shall indicate on the traffic way plans all of the proposed storm drainage system in the right-of-way. The storm drainage shall be shown schematically by a single dashed line, with inlets and drainage structures and direction of flow indicated.

b. If the storm drain system is of minor nature with no other utilities involved, the design engineer may include the storm drain plans on the roadway contract. For instructions on storm drainage, see Section on Storm Drains, Design Manual.

3.1.3 Profiles

3.1.3.1 Centerline Grade

a. The Centerline Grade submitted for approval shall be shown and designated "C_L GRADE." On profiles where the grades are warped, or less than 1 percent slope, spot elevations will be required to clarify the proper grade and direction of slope desired by the Engineer.

b. Circles, as shown in the Standard Symbols, shall be used on profile grade lines to designate vertical curve P.V.C.s, P.V.R.C.s, and P.V.T.s and P.I.s of intersecting top curb lines or centerlines. All percents of grades shall be shown to two decimal places.

3.1.3.2 Previously Established Top of Curb Grade and Centerline Grade

Where a grade line shown on a drawing is taken from a previously established grade, it shall be designated as "ESTABLISHED TOP OF CURB GRADE" or "ESTABLISHED C_L GRADE." The date established and the design drawing number of such previously established grades

shall be noted on the profile. On existing pavement, grades shall be field surveyed.

3.1.3.3 Existing Ground Profiles at Centerlines and Property Lines

The profile of the existing ground along the centerline of a proposed roadway and the profile of the existing ground line along property lines shall be shown by dashed ink lines. The existing ground profiles shall be so labeled, and the date and datum of the field survey shall be indicated.

3.1.3.4 Vertical Curves

A vertical curve shall be shown on profiles as a smooth curve between tangents. The correct templates for given vertical curves will be tangent at the P.V.C. and P.V.T. and will pass through the computed middle ordinate elevation at the P.I. Computation of the middle ordinate will be required, except where difficult to compute at unusual intersection situations.

3.1.3.5 Top of Curb Grades for Cul-de-Sacs

Top of curb grades for cul-de-sacs shall be shown independently as profiles running linearly around the perimeter of the cul-de-sac including the approach returns. An additional 100 feet overlap on each end of the linear profile shall be shown.

3.1.3.6 Stationing and Elevations

a. Stations of all points of intersection of curb lines and pavement edges shall be determined at right angles to the centerline. Therefore, a face of curb line shall not be extended to intersect a centerline at a skew in order to establish a station.

b. Throughout profiles, elevations shall usually be shown for each 50 feet station with additional elevations every 25 feet throughout horizontal and vertical curves. Stationing shall be in ink at these points on the profile.

c. Elevations on tangents shall be computed; elevations on vertical curves shall be computed. Elevations shall be shown to the hundredths of a foot.

3.1.3.7 Extension of Profiles

a. At any point where a proposed traffic way is an extension of an existing traffic way, the profile of the existing centerline or top curb shall be shown for at least another 200 feet and the heights of the curb face note. All roadway profiles shall be extended a sufficient distance to define clearly the situation, and this distance shall never be less than 200 feet beyond the approval limits requested, except in the case of a profile terminating at a tee intersection. These profiles shall be independent and shown apart from the proposed top curb profile or profiles.

b. Where profiles must be broken and continued on the same or other sheets, a minimum of 200 feet of profile shall be repeated.

3.1.4 Typical Sections

Typical sections of each type of proposed roadway (i.e. paving width and/or right-of-way width) to be constructed shall be shown once on each set of construction drawings. These sections shall conform with the typical sections shown in the Standard Road and Street Details in the Appendix of this manual.

3.1.5 Pavement Markings, Signage, Traffic Signals, Street Lights

Plans and details of all pavement markings, signage, street lights, and traffic signals shall be provided. The Developer shall procure and install all signs at the Developer's expense in conformance with the plans prepared by the Developer and approved by the Town. Pavement markings shall be installed by the Developer in accordance with the approved plans and this Design Manual.

3.2 Contract Specifications

Proposed work not covered by Indian Head Standard Specifications for Construction shall be covered in the Charles County Specifications.

3.3 Estimate of Quantities and Prices

The design engineer shall furnish estimates of all quantities and prices, including a 50% contingency.

3.4 Design Calculations

The design engineer shall submit three copies of design calculations made in connection with the project. The calculations shall be submitted along with the contract drawings.

APPENDICES

STREETS AND ROADS

TABLE 1

Road Classification	Alley	Private Road	Local	Minor Collector	Minor Arterial	Intermediate Arterial	Service Road
* Minimum R-O-W Width	20'	20'	60'	70'	80'	100'	40'
Minimum Pavement Width	14' (One-Way)	24' (Two-Way)	18'	24' with curb 22' w/o curb	36' with curb 24' w/o curb	48'	24'
** Curb Required	No	No	Per P.C .	Per P.C .	Per P.C .	Yes	No
Closed Storm Drainage Required	No	No	Yes with Curbs	Yes with Curbs	Yes with Curbs	Yes	No
** Sidewalks Required	No	No	Yes with Curbs	Yes with Curbs	Yes with Curbs	Yes	No
Minimum Stopping Sight Distance	150'	150'	150'	200'	275'	350'	200'
Minimum Passing Sight Distance	700'	700'	700'	800'	1000'	1400'	800'
Design Speed	25 mph	25 mph	30 mph	35 mph	40 mph	50 mph	35 mph
Minimum Horizontal Centerline Radius of Road	100'	100'	100'	350'	600'	700'	350'
Minimum Tangent Between Reverse Horizontal Curves	100'	100'	100'	100'	100'	100'	100'
Minimum 'K' Values for Crest Vertical Curves	30'	30'	30'	45'	55'	85'	45'
Minimum 'K' Values for Sag Vertical Curves	40'	40'	40'	50'	55'	75'	50'
Minimum Roadway Grade	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Maximum Roadway Grade	10%	10%	10%	7% (6% across Cul-de-sac)	5%	5%	7%

Per P.C. means Per Planning Commission requirements.

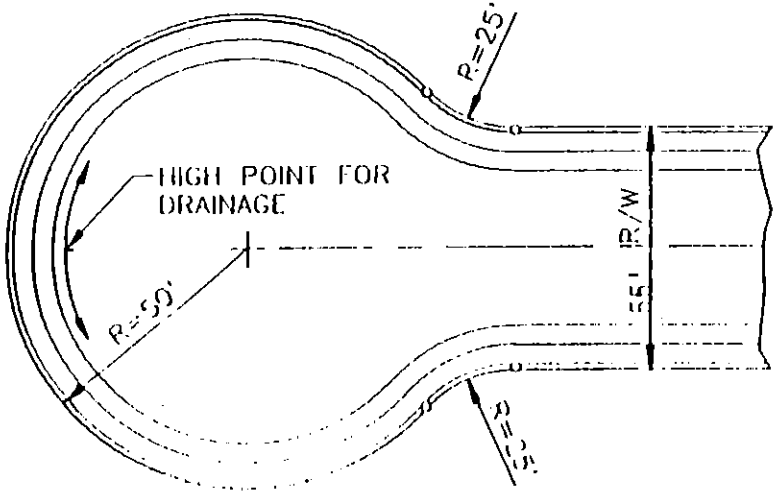
* Additional right-of-way width may be required for turning, bypass, and acceleration/deceleration lanes.

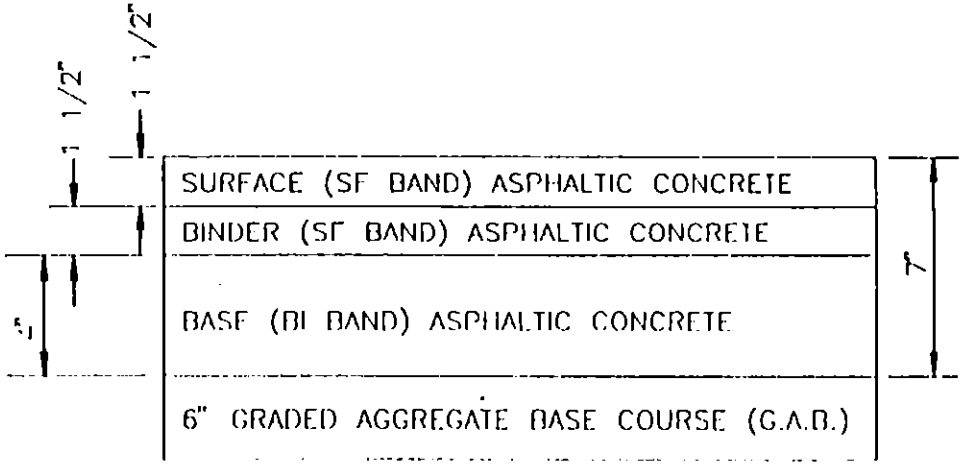
** Curb and sidewalks shall be placed on both sides, when required.

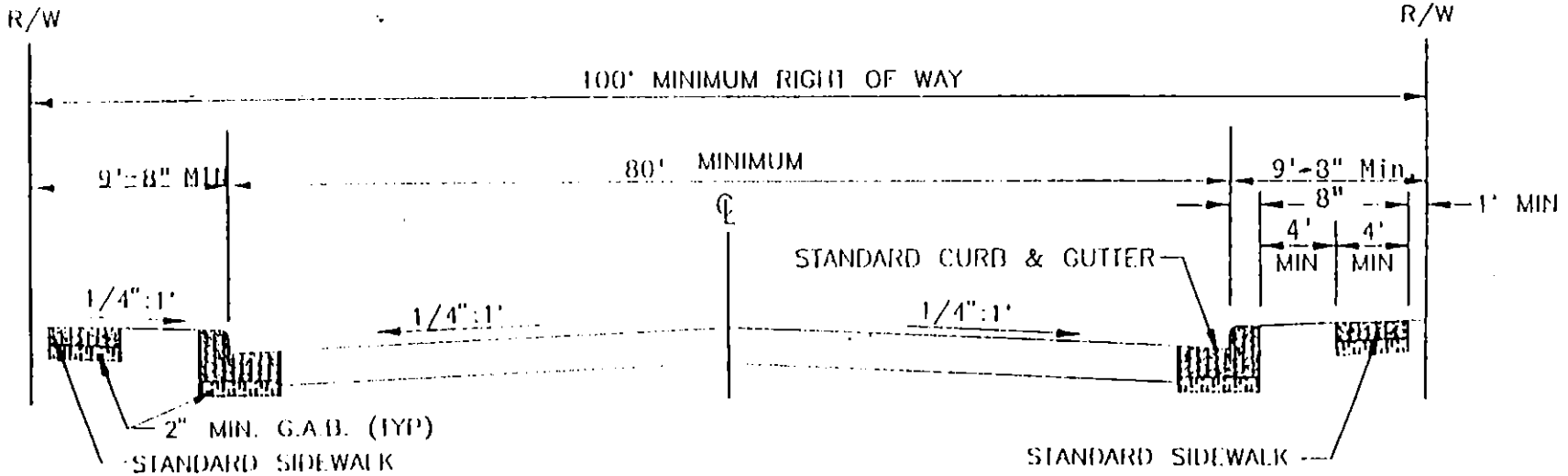
TABLE 2

MINIMUM SEPARATION GUIDELINES

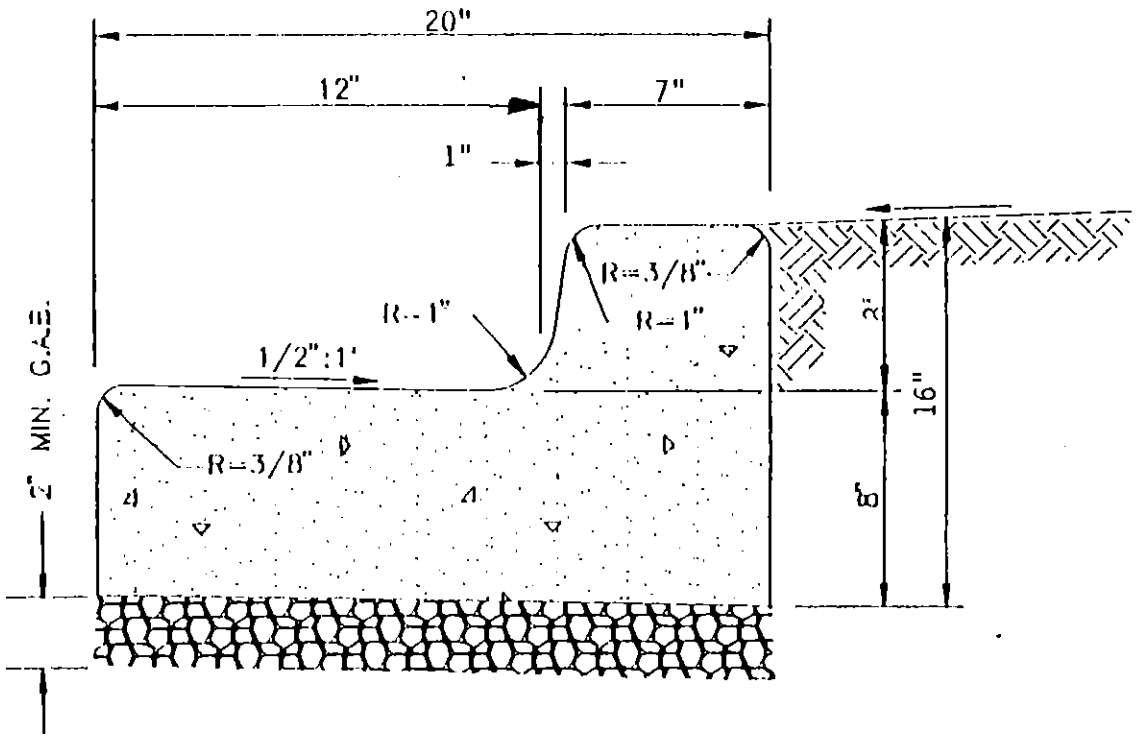
Minimum Distance Between a:	On a Local Street (feet)	On a Collector Street (feet)	On a Arterial Street (feet)
Local street and a local street	250	300	500
Local street and a collector street	250	400	500
Local street and an arterial street	250	400	500
Collector street and a local street	250	400	500
Collector street and a collector street	300	400	500
Collector street and an arterial street	400	500	750
Arterial street and a local street	300	400	750
Arterial street and a collector street	400	500	750
Arterial street and an arterial street	500	600	1200
Private driveway and local street	50	N/A	N/A
Private driveway and collector street	50	N/A	N/A
Private driveway and arterial street	75	N/A	N/A
Commercial entrance and local street	75	75	N/A
Commercial entrance and collector street	100	100	N/A
Commercial entrance and arterial street	125	125	N/A







TYPICAL CUL-DE-SAC



COMBINATION CURB AND GUTTER

STREET

Town of Indian Head, Design Manual 2001 5.8.2006

Supplemental Standard for Brick Sidewalk & Walkways

For all public brick sidewalk & walkway instillations in Indian Head the attached aggregate & stone dust standard is to be used. This brick sidewalk/walkway standard was provided by the City of Hagerstown which has successfully used this detail for the brick plaza in its Public Square since the renovation project of 1996. This ten year old instillation has held up very well to the freeze/thaw process and heavy use (pedestrian, civic activities, and routine service truck parking). A copy of the two page standard is attached.

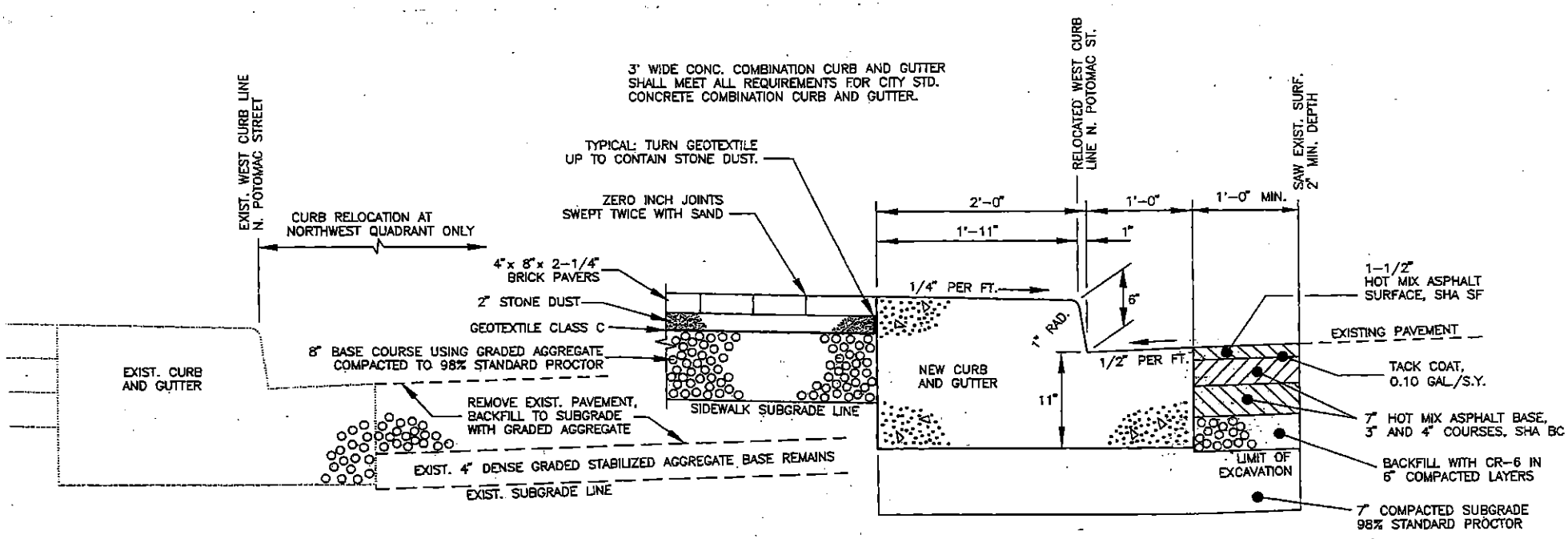
For all practical purposes the aggregate & stone dust standard is as "solid" as a concrete/brick instillation. Yet, it does flex in desirable ways that concrete simply cannot. This standard is also much better than the sand base standard of a century ago. Though the sand base tended to be durable, and much better than a concrete base instillation, it has proven to be not as durable as the aggregate & stone dust base. The sand base standard needs maintenance of the base over time otherwise sections tend to sink resulting in an uneven surface.

The 1975 brick-in-concrete instillation in Hagerstown's Public Square failed because it was too ridged. The failure, which began within 10 years, was due to the overly rigid concrete instillation of brick pavers on a concrete base, mortared in concrete. Entire sections had to be replaced because of serious cracking and settlement issues resulting in a dangerous tripping hazard (the bricks would not settle back to the original level as winter ended). The replacement sections resulted in a less attractive appearance as they were all too obvious due to the fresh mortar and slight color differentiation of the new bricks

For additional information contact Hagerstown's City Engineer, currently Rodney Tissue, at 301.739.8577 128.

Note: As a Hagerstown native who worked on downtown revitalization during the 1975 project, and was Mayor during the design and construction of the 1996 replacement I have substantial first hand knowledge of the significant difference in the two standards.

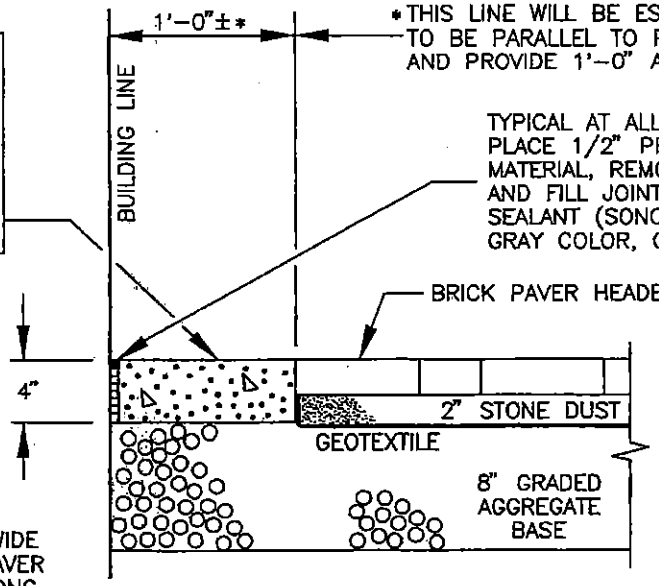
Steven T. Sager,
Town Manager



CURB AND GUTTER, BRICK SIDEWALK AND PAVEMENT REPAIR DETAIL

SCALE: 1" = 1'-0"

1.0' WIDE CONC. CONTAINMENT BAND AT BUILDING LINE SHALL MEET ALL REQUIREMENTS FOR CITY STANDARD CONC. SIDEWALK. 1.0' WIDE CONC. BAND SHALL BE MEASURED AND PAID FOR UNDER THE ITEM FOR CITY STANDARD 4" CONCRETE SIDEWALK.



*THIS LINE WILL BE ESTABLISHED IN THE FIELD TO BE PARALLEL TO PROPOSED PLANTER CURBS AND PROVIDE 1'-0" APPROXIMATE STRIP WIDTH.

TYPICAL AT ALL VISIBLE EXPANSION JOINTS: PLACE 1/2" PREFORMED EXPANSION JOINT MATERIAL, REMOVE TOP 1/2" OF MATERIAL AND FILL JOINT WITH GUN-GRADE JOINT SEALANT (SONOLASTIC NP 2, ALUMINUM GRAY COLOR, OR AN APPROVED EQUAL).

BRICK PAVER HEADER BAND

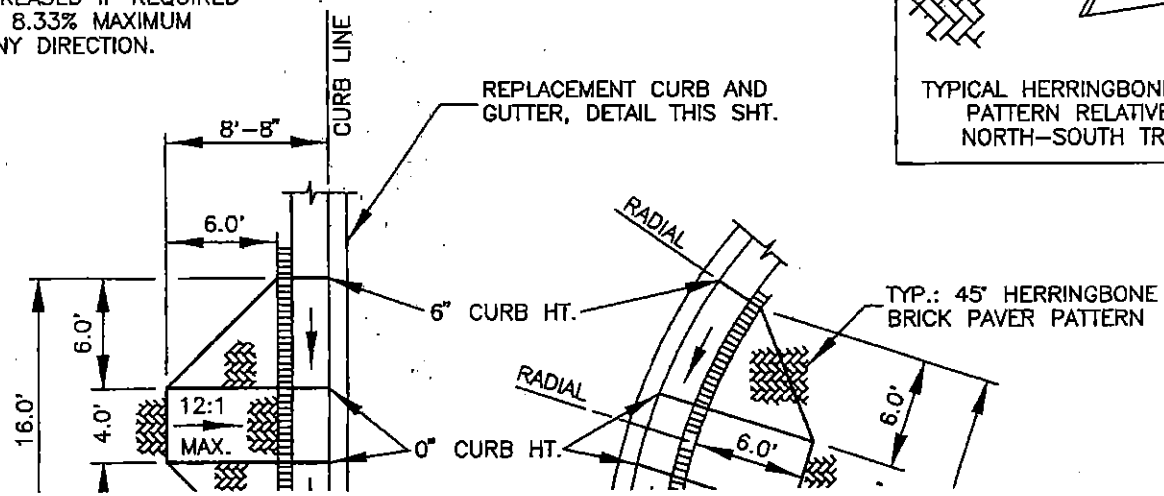
NOTE: CONSTRUCT SIMILAR 1'-0" WIDE CONC. BAND WHERE NEW BRICK PAVER SIDEWALK ADJOINS CITY STD. 4" CONC. SIDEWALK AT SQUARE BUILDING LINES.

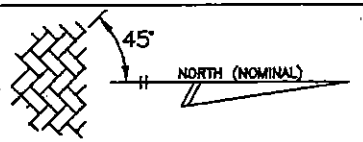
CONCRETE CONTAINMENT BAND DETAIL

SCALE: 1" = 1'-0"

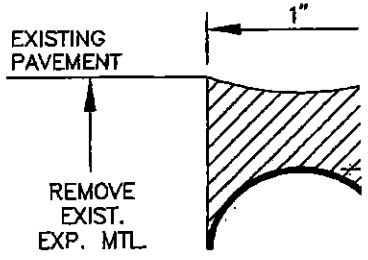
EXISTING SIDEWALK: (TY
CITY STD. 4" CONC. SIDEWALI
OR
4" BRICK PAVER/MORTAI
4" CONC. BASE AND 4"
OR
8" CONC., 4" CR-6 (2' WID
ALL CONCRETE HAS #66-1

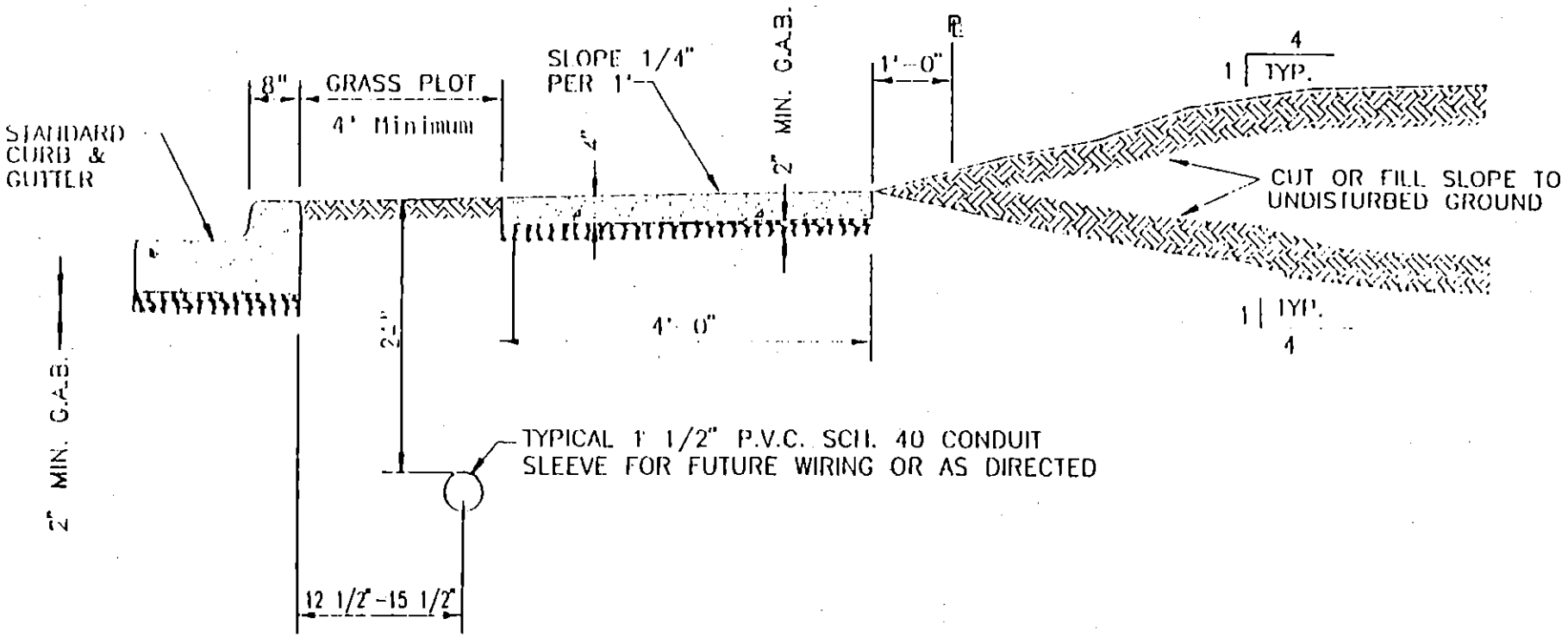
NOTE: RAMP LENGTH AND/OR WIDTH WILL BE INCREASED IF REQUIRED TO MAINTAIN 8.33% MAXIMUM GRADE IN ANY DIRECTION.





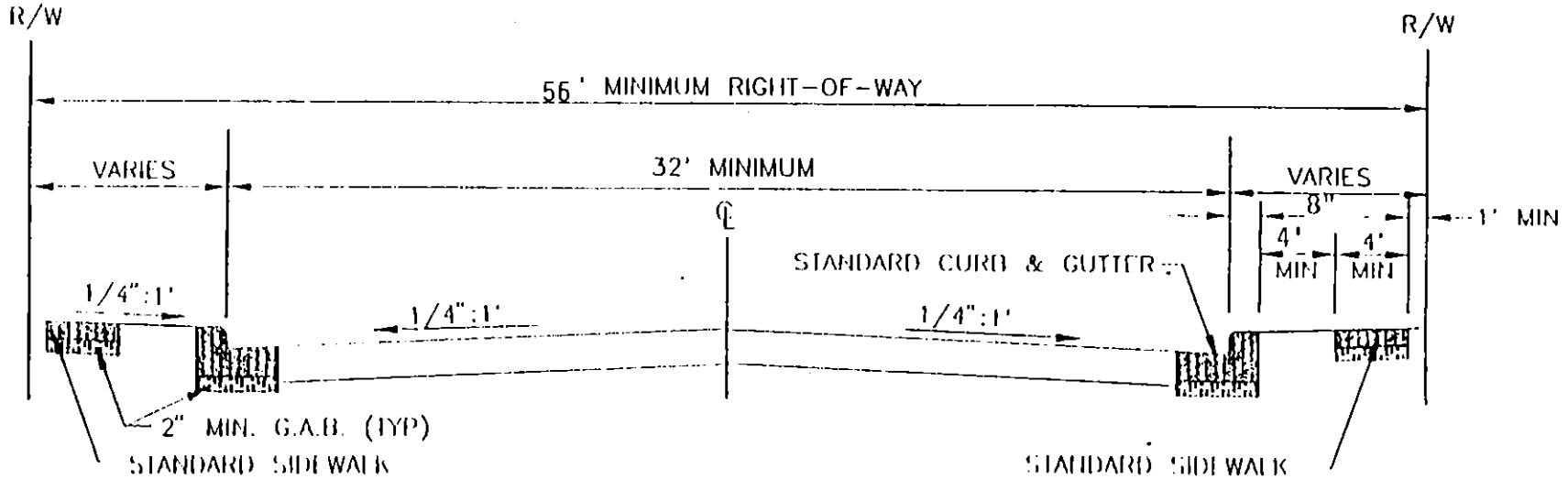
TYPICAL HERRINGBONE PAVER PATTERN RELATIVE TO NORTH-SOUTH TRAVEL

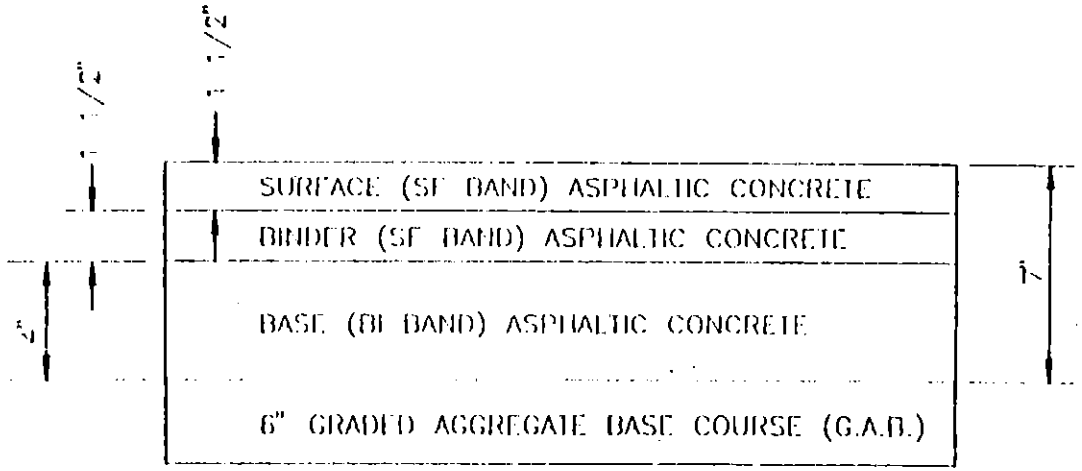




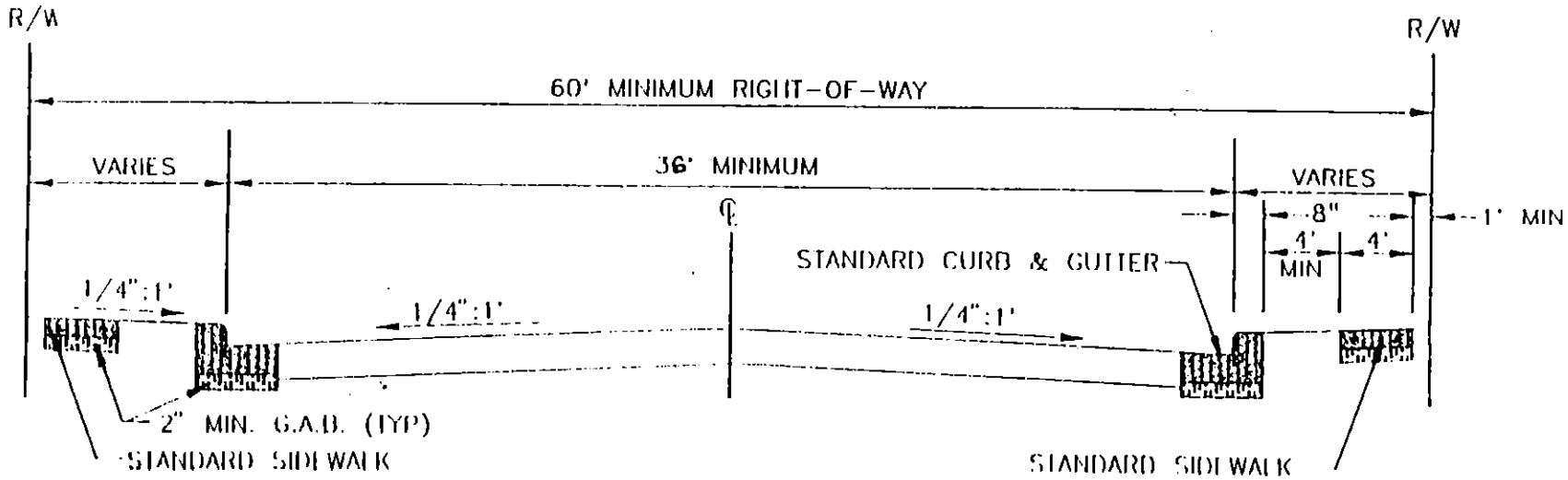
TYPICAL SIDEWALK INSTALLATION

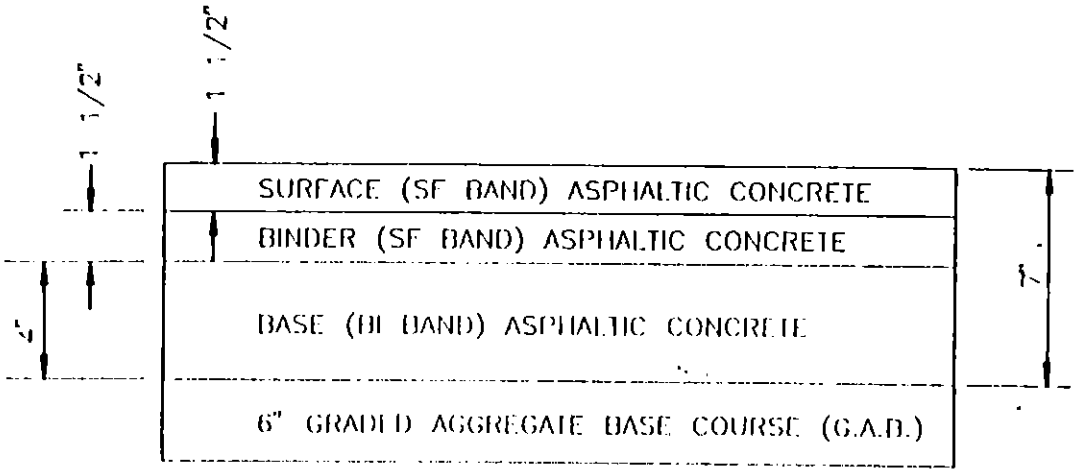
STREET



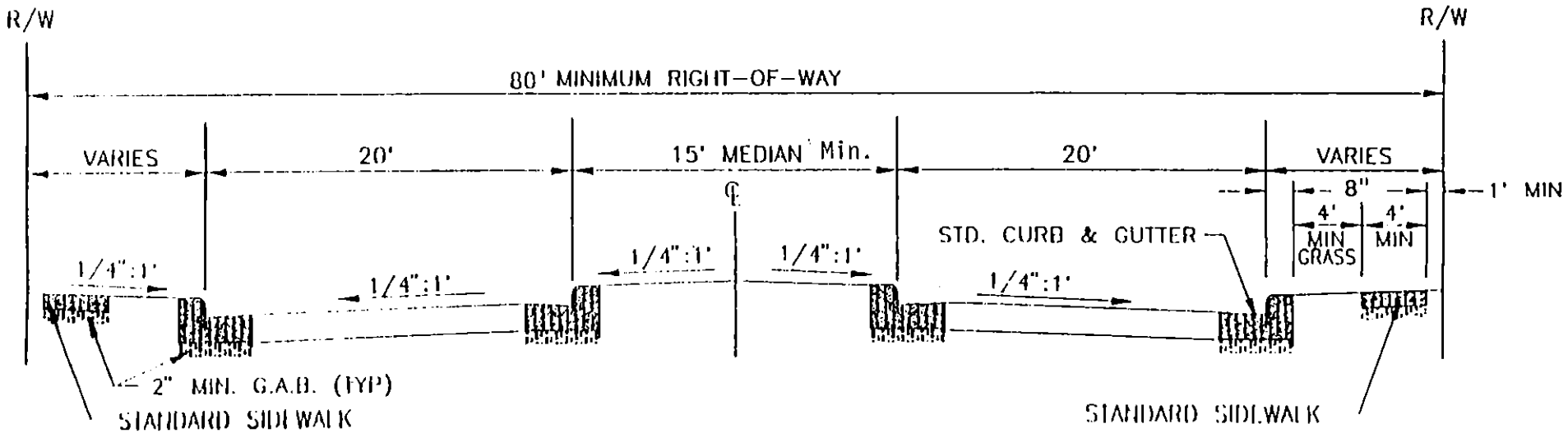


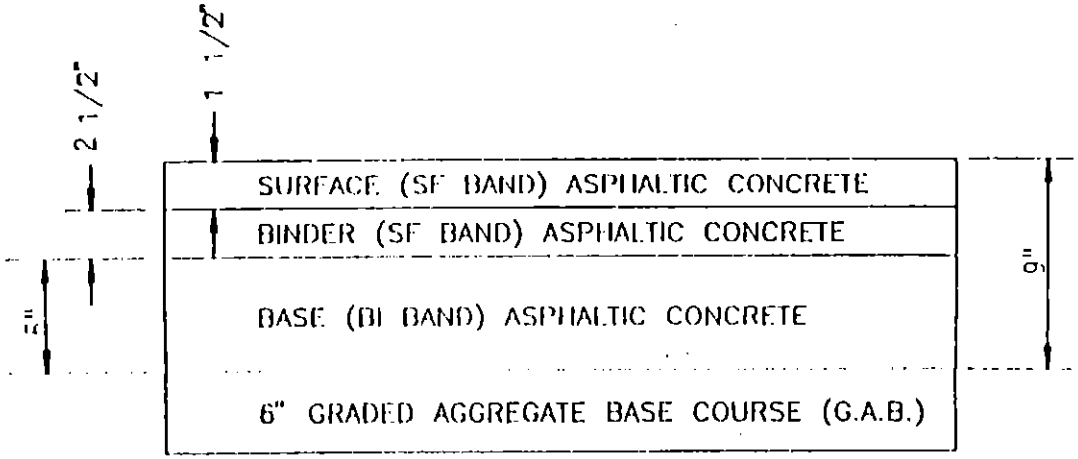
LOCAL STREET



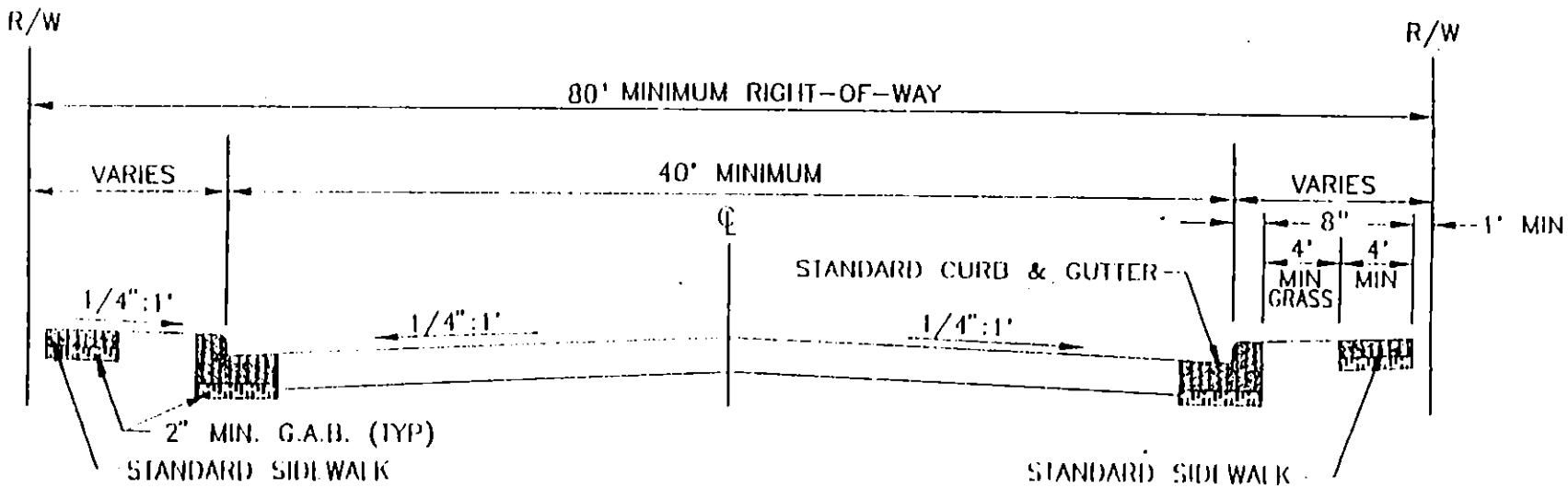


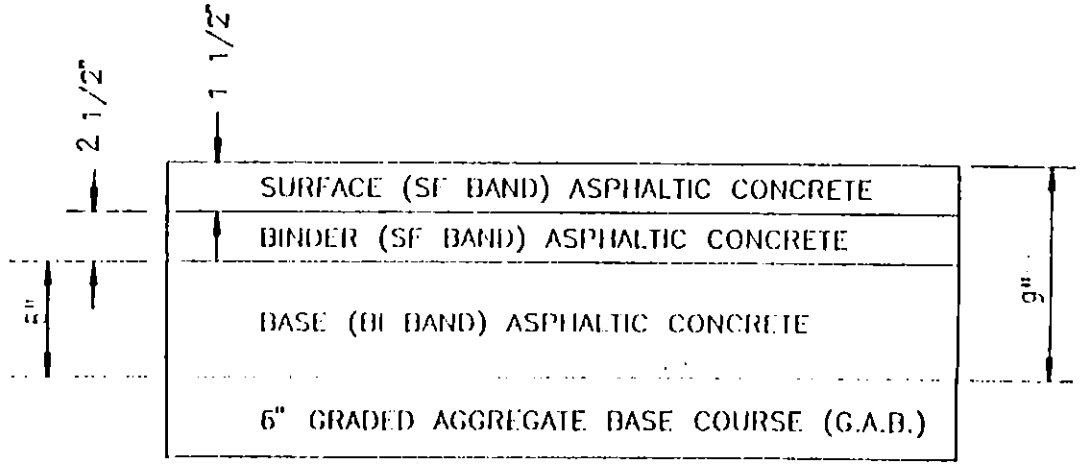
COLLECTOR STREET



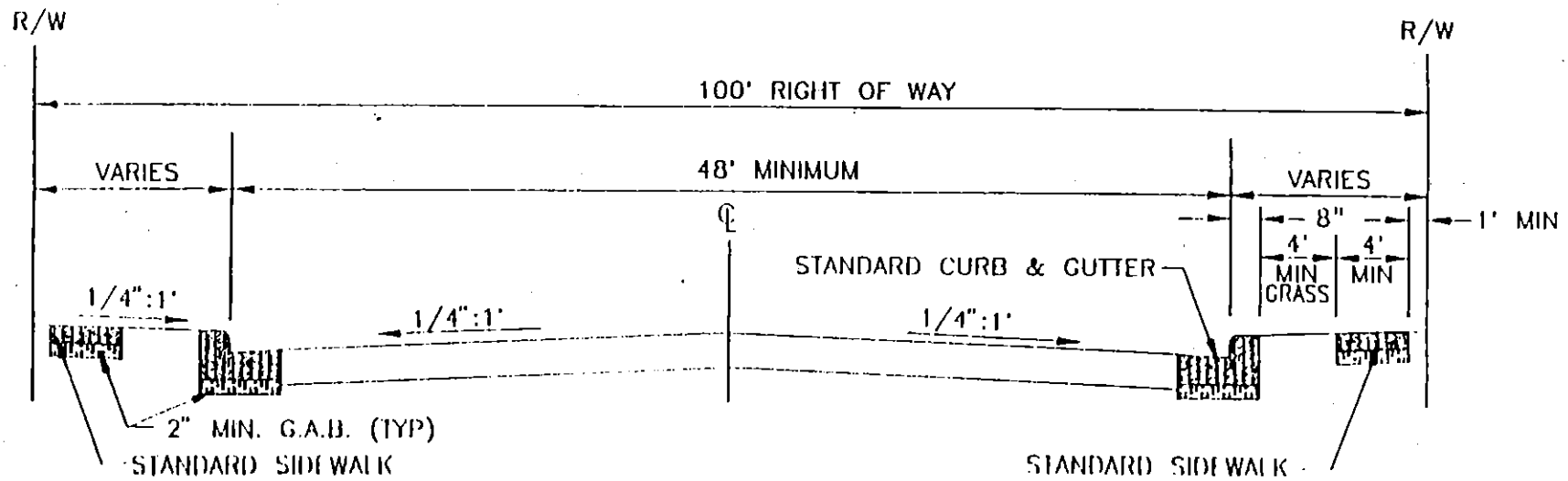


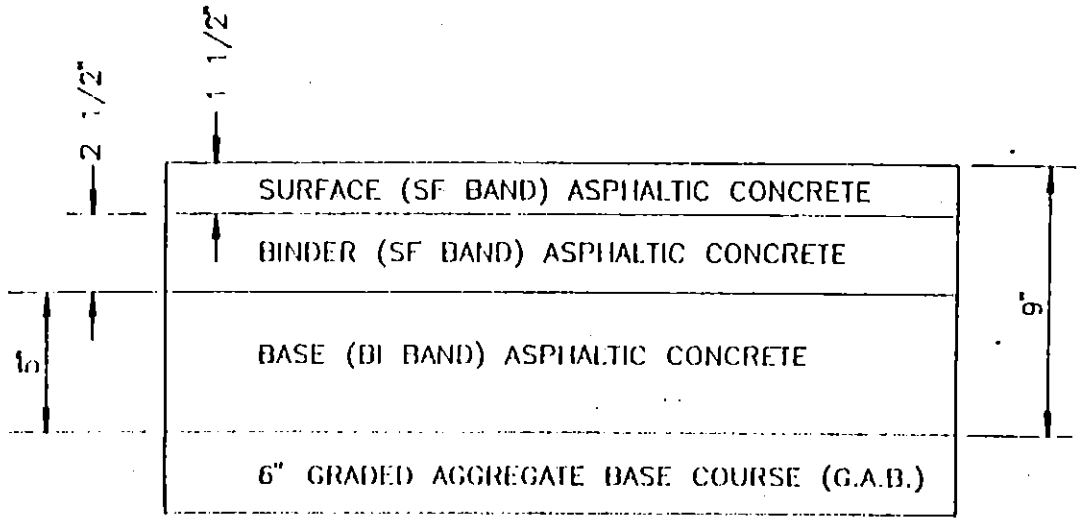
ALTERNATE MINOR ARTERIAL WITH MEDIAN



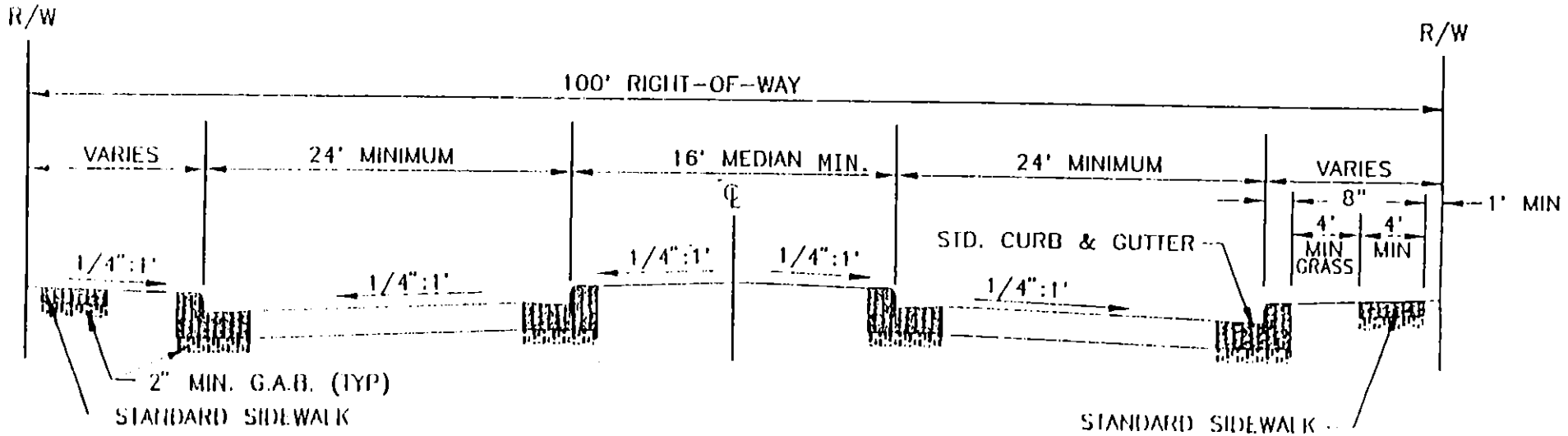


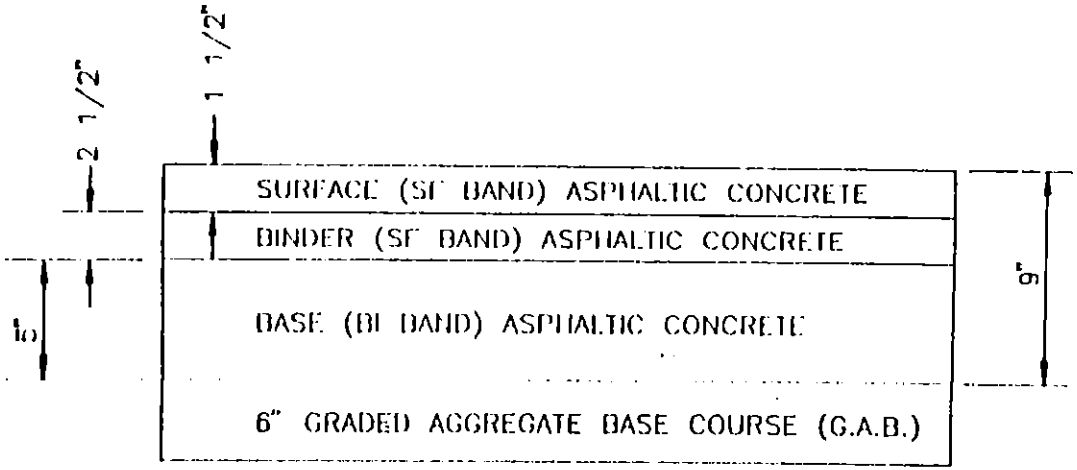
MINOR ARTERIAL



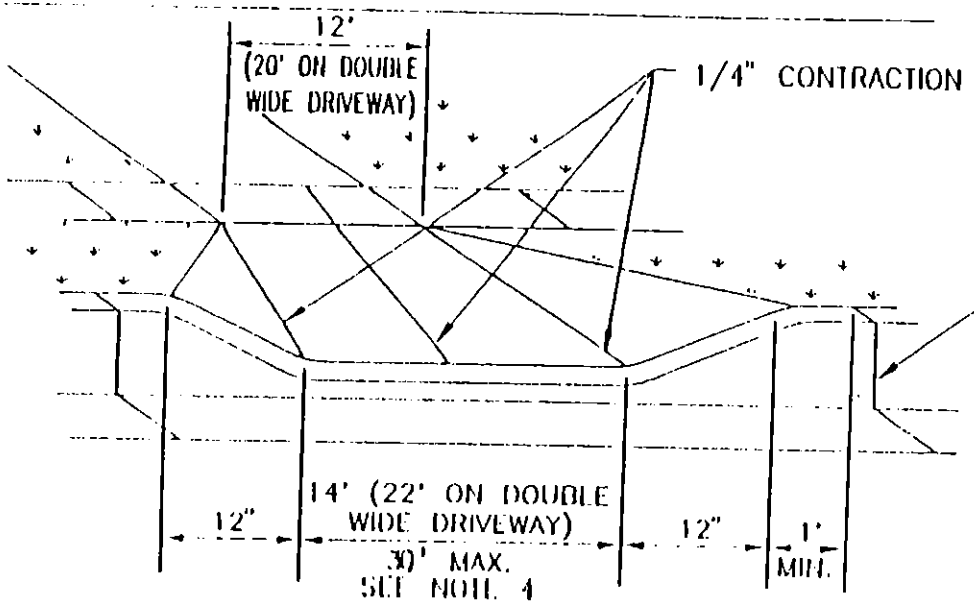


MAJOR ARTERIAL



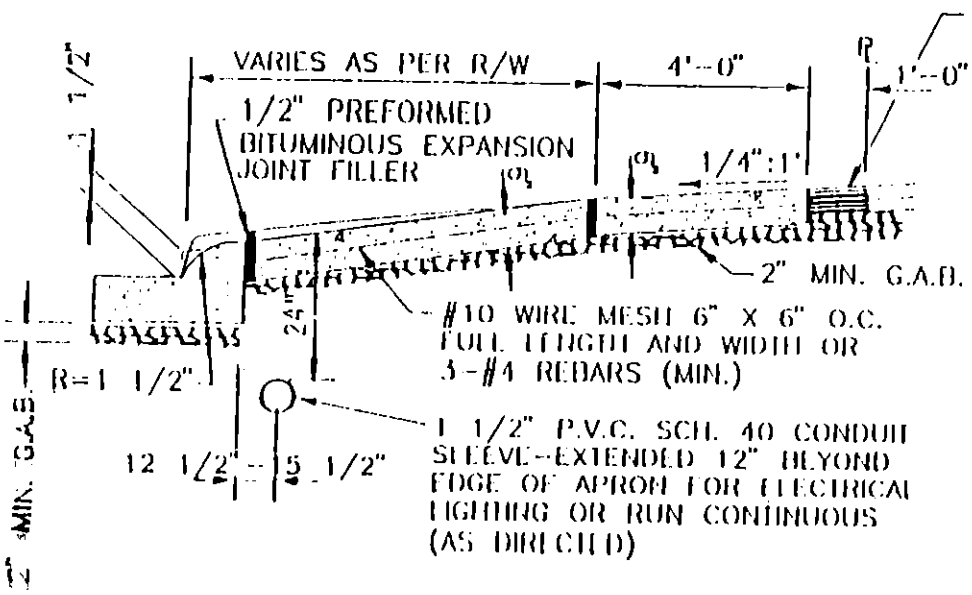


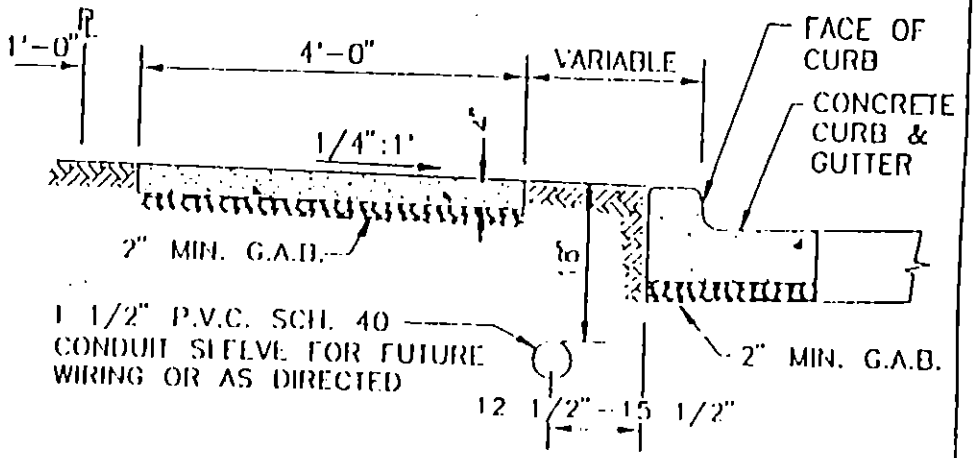
ALTERNATE MAJOR ARTERIAL WITH MEDIAN



NOTES:

1. SCORE 1/4" DUMMY CONTRACTION JOINTS AT 4'-0" INTERVALS.
2. CONSTRUCT 1/2" BIT. EXPANSION JOINTS AT 20'-0" (MAX.) INTERVALS.
3. CONCRETE SHALL BE SPRAYED WITH LIQUID CURING COMPOUND.
4. 30' MAXIMUM WIDTH IS SUBJECT TO APPROVAL ON A CASE BY CASE BASIS AND FOR COMMERCIAL USE.
5. CONCRETE TO BE MSHA MIX NO. 2.





TYPICAL DRIVEWAY-CURB DETAIL AND TYPICAL SIDEWALK LOCATION FOR RESIDENTIAL AND COMMERCIAL ENTRANCES

AS-BUILT DRAWING

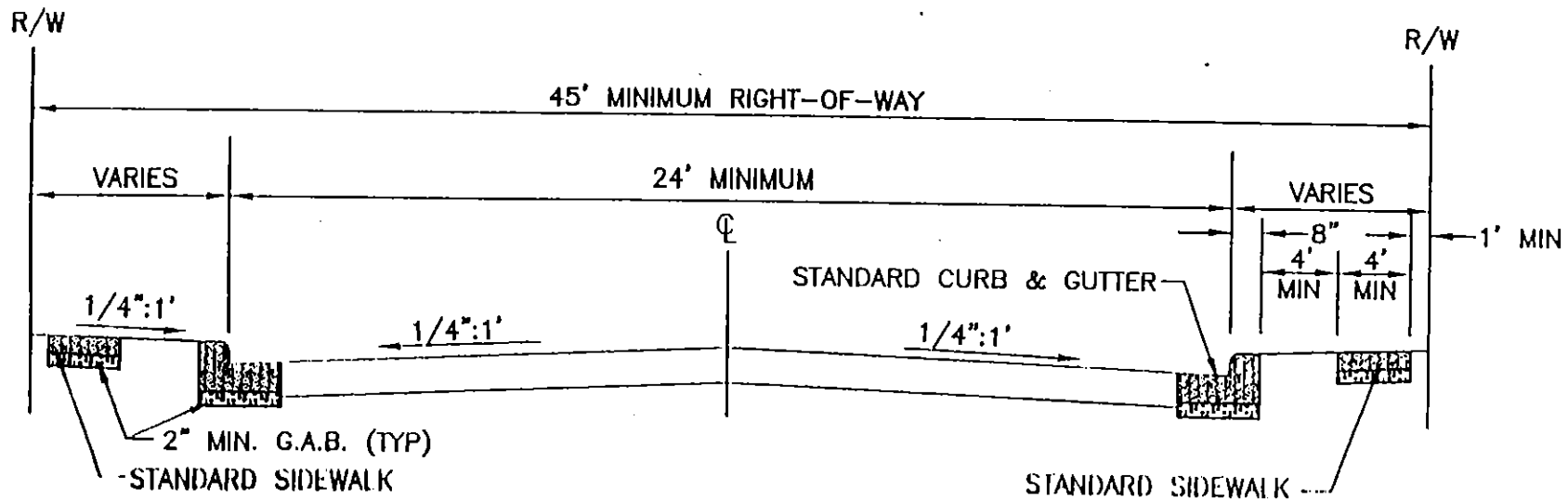
I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

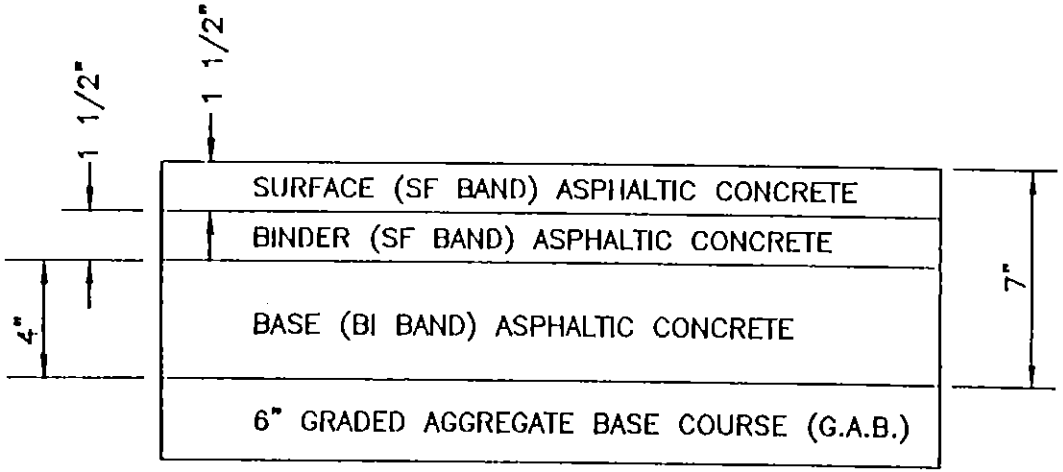
(- -)

ENGINEER (DATE) P.E. NO.

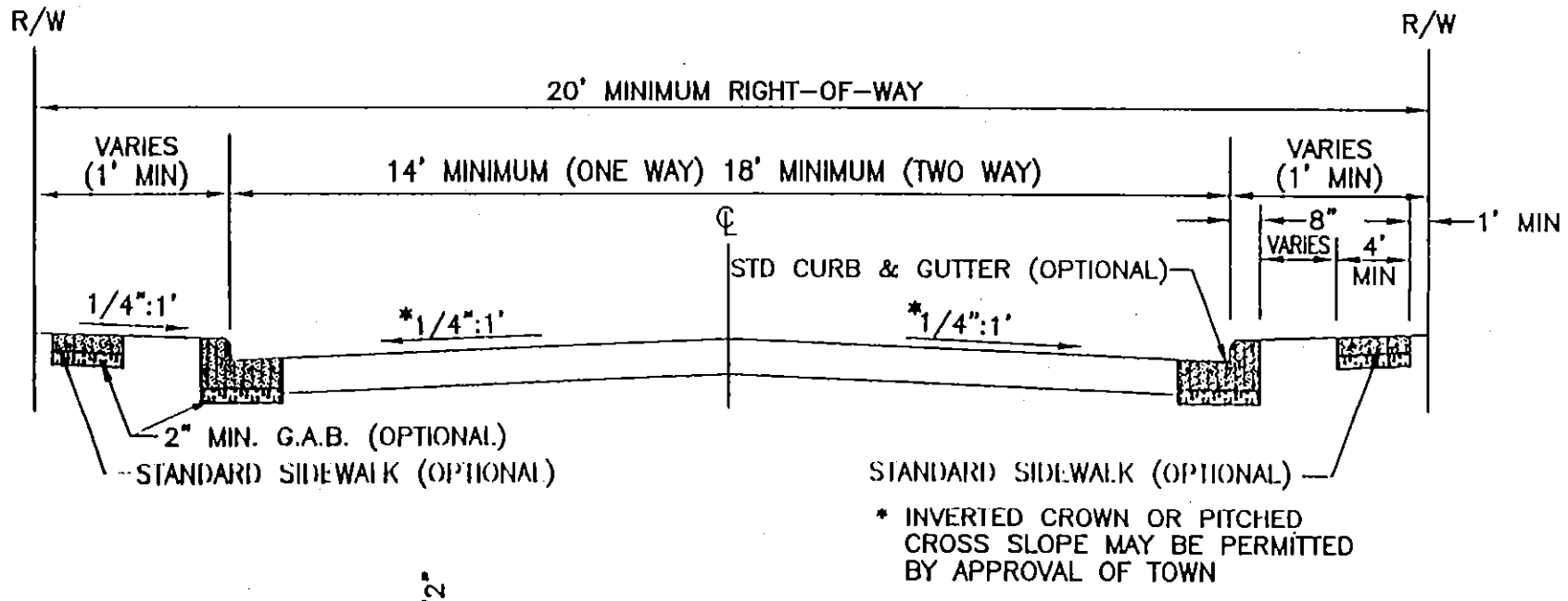
GENERAL

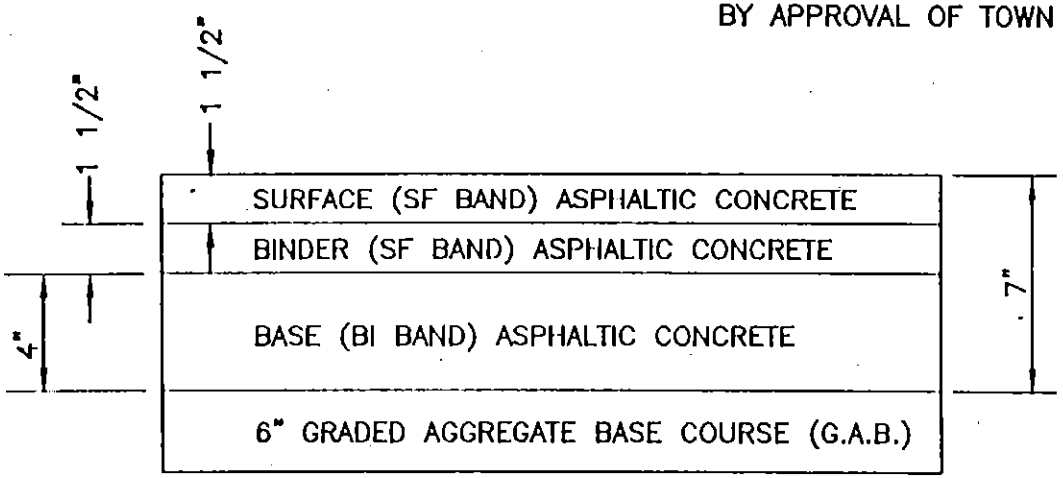
AS-BUILT DRAWING STATEMENT





PRIVATE ROAD


R/W
R/W
20' MINIMUM RIGHT-OF-WAY
VARIES (1' MIN)
14' MINIMUM (ONE WAY) 18' MINIMUM (TWO WAY)
VARIES (1' MIN)
8" VARIES
4' MIN
1' MIN
℄
STD CURB & GUTTER (OPTIONAL)
1/4":1'
*1/4":1'
*1/4":1'
2" MIN. G.A.B. (OPTIONAL)
STANDARD SIDEWALK (OPTIONAL)
STANDARD SIDEWALK (OPTIONAL)
* INVERTED CROWN OR PITCHED CROSS SLOPE MAY BE PERMITTED BY APPROVAL OF TOWN


1 1/2"
1 1/2"
SURFACE (SF BAND) ASPHALTIC CONCRETE
BINDER (SF BAND) ASPHALTIC CONCRETE
BASE (BI BAND) ASPHALTIC CONCRETE
6" GRADED AGGREGATE BASE COURSE (G.A.B.)
4"
7"

ALLEY

Table 3
Level of Service Characteristics

Service (L.O.S.)	UNSIGNALIZED INTERSECTION		SIGNALIZED INTERSECTION	
	Stopped Delay Per Vehicle (Sec)	Expected Delay To Minor Street Traffic	Stopped Delay Per Vehicle (Sec)	Expected Problems To Intersection
A	≤ 5.0	little or no delay	≤ 5.0	very low delay
B	5.1 - 10.0	short traffic delays	5.1 to 15.5	short delay
C	10.1 - 20.0	average traffic delays	15.1 to 25.0	number of vehicles stopping is significant
D	20.1 - 30.0	long traffic delays	25.1 to 40.0	influence of congestion becomes more noticeable
E	30.1 - 45.0	very long traffic delays	40.1 to 60	limit of acceptable delay
F	≥ 45.1	extreme delays - usually warrants improvement to the intersection	≥ 60.1	oversaturated and unacceptable

Source - Highway Capacity Manual : Special Report 209. Transportation Research Board, National Research Council, Washington, DC, 1994
L.O.S. - Level of Service

LEVEL OF SERVICE CRITERIA

From an operations perspective, the traffic volume passing through an intersection is normally more critical than the volume at a mid-block location. Traffic congestion is more likely experienced where traffic must stop at a traffic signal or stop sign than where it can otherwise flow freely in mid-block. A road which narrows or vehicles turning into or out of on-street parking spaces, or buses stopping to pick up or discharge passengers can slow traffic in mid-block.

The degree of traffic congestion at an intersection can be ranked according to six Levels of Service ranging from A, which is free flowing traffic, to F, which is a forced movement. The six levels as they apply to non-signalized intersections are described in detail below. In this study, the methodology used in determining intersection Levels of Service is the method prescribed in the Highway Capacity Manual, Special Report No. 209 Third Edition, Updated 1994 published by the Transportation Research Board and its software (Highway Capacity Software - HCS) developed by the Federal Highway Administration. In this manual, signalized intersection capacity is evaluated in terms of the ratio demand flow rate to capacity (V/C ratio), while Level of Service (LOS) is evaluated on the basis of average stop delay per vehicle (sec/vehicle). For unsignalized intersections, Levels of Service are evaluated in terms of delay. The generally accepted industry standard is that levels of service A, B, or C are acceptable, D is marginal, and E and F are unacceptable.

Several quantitative methods exist for objectively determining Levels of Service at stop sign-controlled intersections. The 1994 Highway Capacity Manual method was used to calculate levels of service at those intersections where turning movement counts were taken.

Signalized Intersections

Level of service for signalized intersections is defined in terms of delay. Delay indicates the degree of driver discomfort, frustration, fuel consumption, and lost travel time. Specifically, level-of-service criteria are stated in terms of the average stopped delay per vehicle for a 60-minute analysis period.

Delay may be measured in the field, or may be estimated using procedures presented in the 1985 Highway Capacity Manual. Delay is a complex measure and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the volume/capacity (v/c) ratio for the lane group or approach in question.

Level of Service A describes operations with very low delay, i.e., less than 5.0 sec per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level of Service B describes operations with delay in the range of 5.1 to 15.0 sec per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.

Level of Service C describes operations with delay in the range of 15.1 to 25.0 sec per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level of Service D describes operations with delay in the range of 25.1 to 40.0 sec per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combinations of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level of Service E describes operations with delay in the range of 40.1 to 60.0 sec per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.

Level of Service F describes operations with delay in excess of 60.0 sec per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Unsignalized Intersections

Level of service criteria for this methodology are defined as the total elapsed time from when a vehicle stops at the end of the queue until the vehicle departs from the stop line; this time includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position.

The average total delay for any particular minor movement is a function of the service rate or capacity of the approach and the degree of saturation. Levels of service range from "A" to "F" and are defined below:

A Little or no delay is expected at an intersection where the delay is equal to or less than 5 seconds per vehicle.

B Short traffic delays may be expected at levels of service B, where the delay is greater than 5 seconds but less than or equal to 10 seconds per vehicle.

C Average traffic delays may be expected at a level of service C, where the delay is greater than 10 seconds but less than or equal to 20 seconds per vehicle.

D Long traffic delays are encountered at an intersection with level of service D, where the delay is greater than 20 seconds but less than or equal to 30 seconds per vehicle.

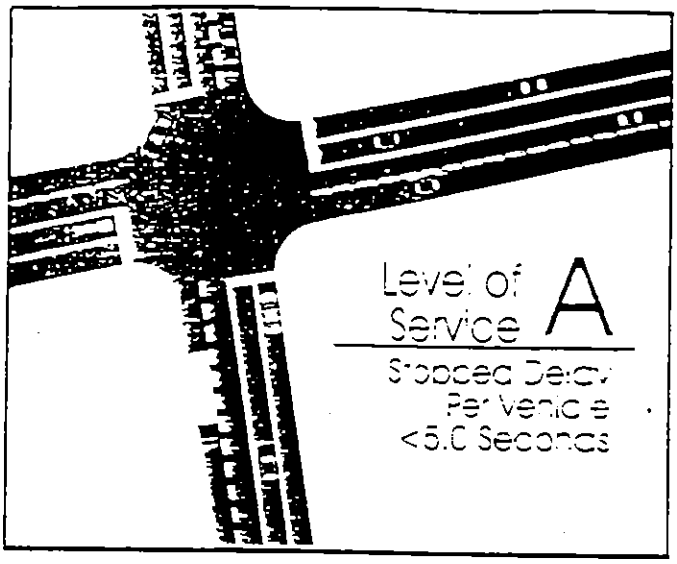
E Very long delays are encountered at an intersection where the level of service is E, as the delay is greater than 30 seconds but less than or equal to 45 seconds per vehicle.

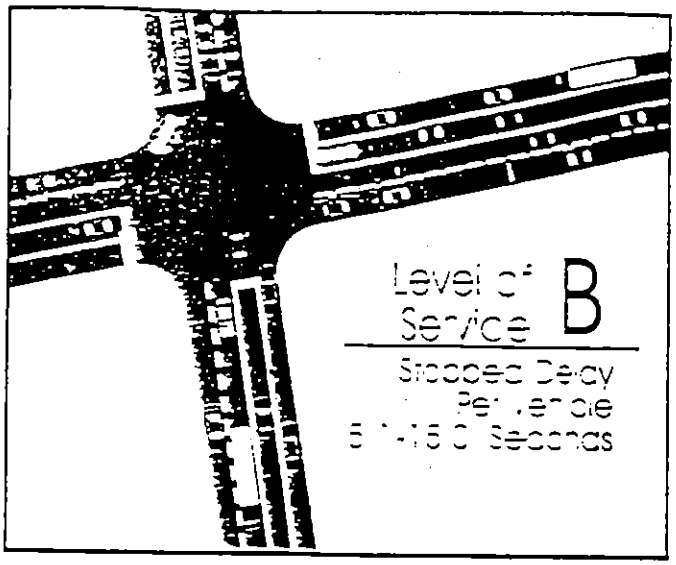
F When demand capacity exceeds the capacity of the lane, extreme delays will be encountered with queuing, which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvements to the intersection

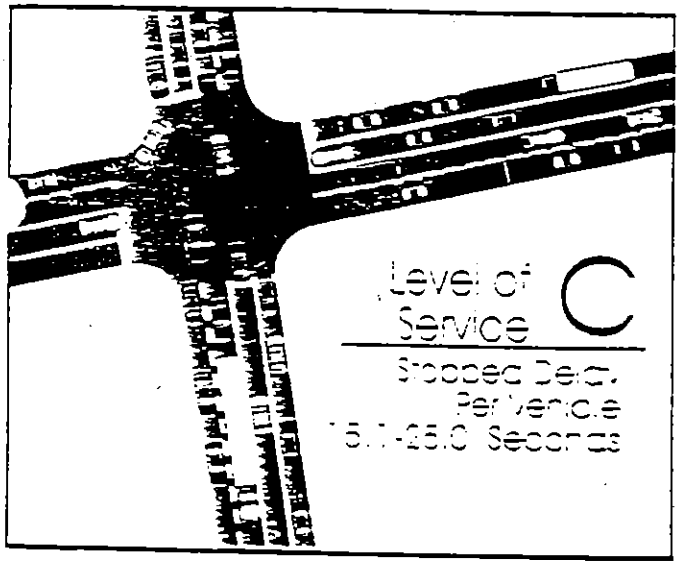
Table3 shows a summary of the criteria for signalized and unsignalized intersection levels-of-service while Exhibit 2 graphically illustrates this.

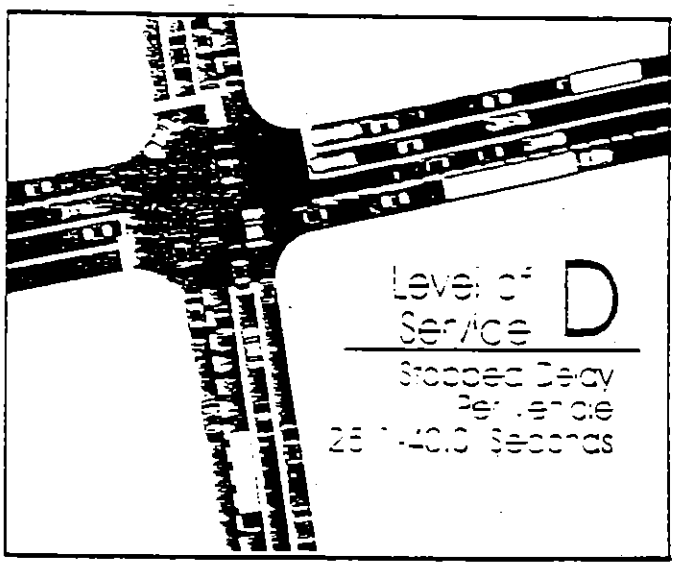
Signalized Intersections Levels of Service

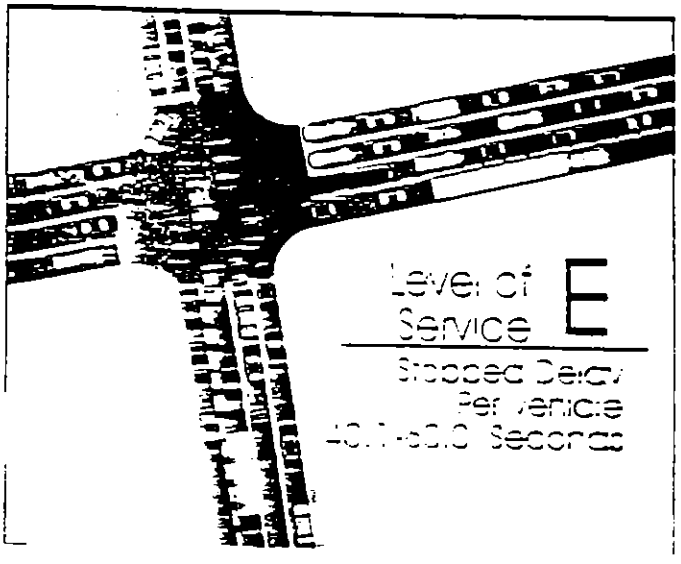
BASED ON "HIGHWAY CAPACITY MANUAL", SPECIAL REPORT 209, TRANSPORTATION RESEARCH BOARD, 1994

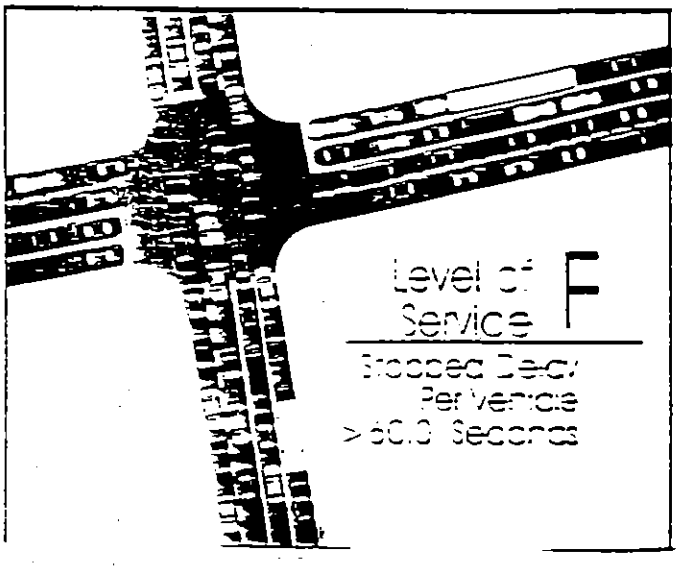












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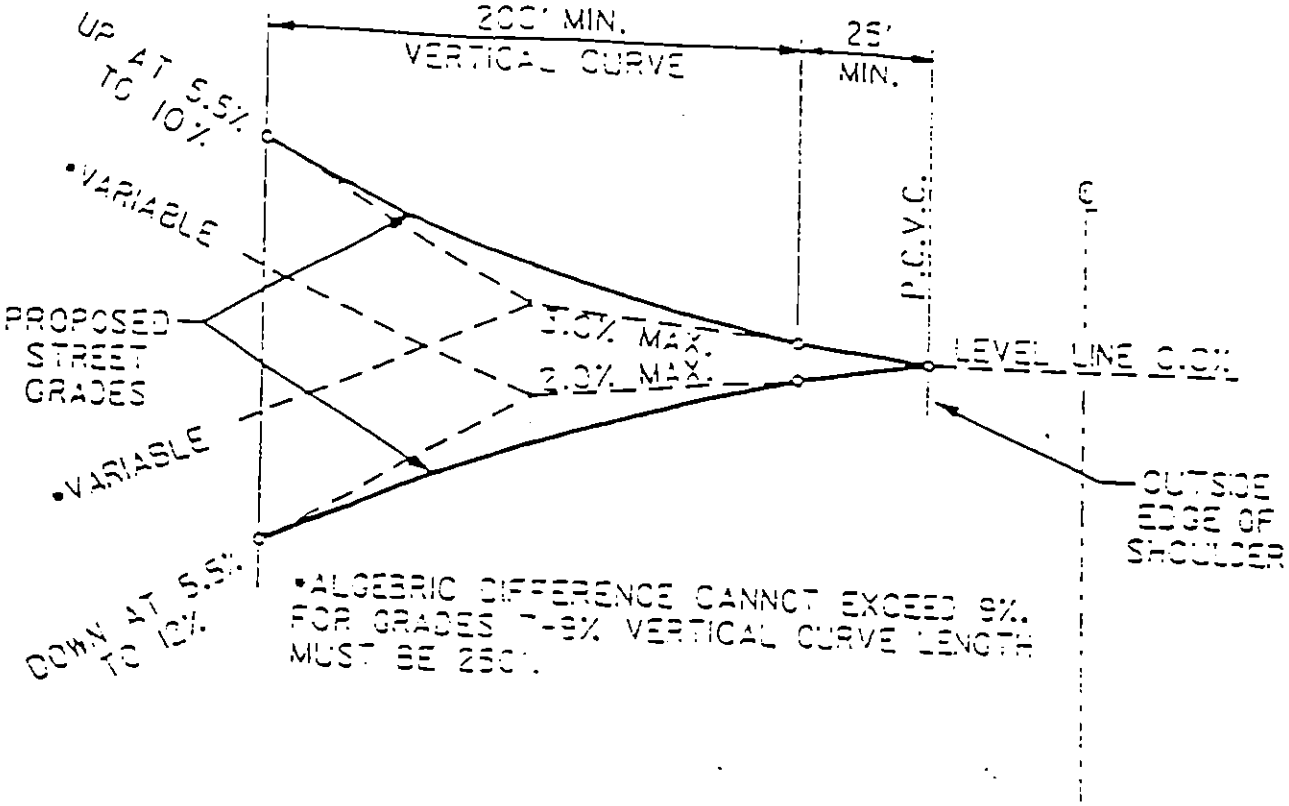

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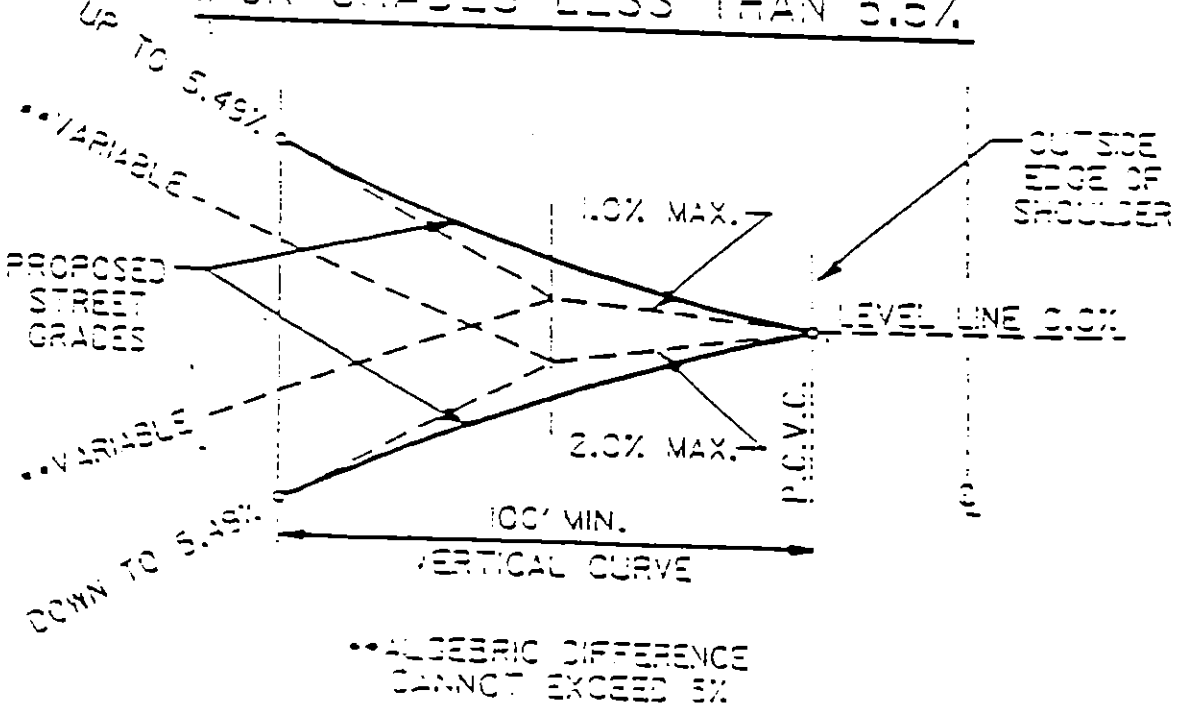

Figure 1 — STANDARD GRADING REQUIREMENTS FOR LOCAL AND COLLECTOR STREETS

AS-BUILT DRAWING

I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

ENGINEER DATE P.E. NO.

	AS-BUILT DRAWING STATEMENT	

SEWER SYSTEM DESIGN MANUAL

SEWER SYSTEM DESIGN MANUAL
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1.0 SEWER SYSTEMS

1.1 General

This chapter of the Indian Head Design Manual outlines the policies, minimum design criteria and design procedures for the preparation of feasibility reports and construction plans and specifications for Town-maintained and on-site sewer system improvements. Developers and/or Design Engineers shall check with the Town Office of Planning and Zoning to determine the availability of sewer at the site of a proposed subdivision.

1.1.1 Scope

a. Town-Maintained Facilities

The parts of the sewer system which are considered as the property and responsibility of the Town of Indian Head are the sewer mains, pump stations, appurtenances and that portion of the sewer services which lie between the Town's rights-of-way. The sewer collection and treatment system for Indian Head is maintained by the Town of Indian Head.

b. On-Site Facilities

The parts of the sewer services which lie within private property are the responsibility of the owner and are constructed and maintained by the Owner. Construction of private sewer facilities are generally governed by the Charles County Plumbing code.

1.1.2 Definitions

a. Collector sewer: A sewer constructed within developments which transports sewage to an interceptor sewer.

b. Interceptor sewer: A sewer designed to collect sewage from several developments and transports wastes to a treatment plant.

c. House or building connection (SHC): A sewer which connects a house or other building to a collector sewer. The portion within the public right-of-way is owned and maintained by the Town. The portion beyond the right-of-way is owned and maintained by the property owner.

d. Force main: A sewer which conveys sewage from a pumping station to a treatment plant at a higher elevation or to a higher elevation in the sewer from which gravity flow may resume.

e. Manhole: A structure providing access to buried sewer, valve, conduit, etc.

f. Average Daily Flow: The arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flow from the service area. The average daily commercial, industrial and other flows shall be based on the period in which these flows are generated.

g. Peaking Flow: The average daily domestic flow peaked in accordance with the curve entitled "Diagram for Converting Average Daily Domestic Flow to Peak Flow" (in the Appendix).

Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with a factor determined by evaluation of historical data for the commercial or industrial facilities and the periods in which these flows are generated.

The average daily domestic flow, average daily commercial flow, and average daily industrial flow may be peaked individually or combined and then peaked using the curve (in the appendix) as dictated by the evaluation of the sources and periods in which the flows are generated.

Whenever forced flow applies, peak flow shall be equivalent to the pumping rate.

h. Infiltration and Inflow: For design purpose, the upper limit of allowable infiltration and inflow within the areas of the project is 400 gallons per acre per day (gpad). Additional allowance for infiltration and inflow may be made upon verification of evidence or approval of operation data.

i. Design Hydraulic flow: Design Hydraulic flow = Peak Flow + Peak Commercial flow + Peak Industrial Flow + Infiltration and Inflow Allowance.

j. Design Professional: An individual, partnership, or corporation licensed under the laws of the State of Maryland to practice as an engineer, architect, landscape architect, land surveyor or property line surveyor who is preparing contract drawings and documents for a construction project in Indian Head. It shall be the responsibility of the design professional to

ensure that the various elements of the project are prepared by appropriately licensed practitioners.

k. Design Engineer: An individual, partnership, or corporation, or an employee thereof, practicing as a licensed engineer in the State of Maryland, who is preparing contract drawings and documents for a construction project in Indian Head. The term "responsible licensed engineer" shall mean Registered Professional Engineer, as authorized to practice under the laws of the State of Maryland..

l. Developer: An individual, partnership or corporation (or agent thereof) that undertakes the preparation of a subdivision plat and/or a site development plan the public and private improvements involved therein.

m. Approval: Specific examination and acceptance by a duly authorized representative of the Town of Indian Head.

2.0 DESIGN CRITERIA

2.1 General

For the Engineer's guidance, below are listed major elements constituting the design of a Sewer Utility Design project:

a. Pipe size and alignment

b. Profile, with all elevations

c. Pump station site plan, mechanical, electrical, architectural and electrical elevations, plan views and details

d. Property data (lot dimensions, all sides of affected properties, liber/folio number, owner)

e. Rights-of-way

f. Specifications and notes

g. Cost estimate

2.2 Determination of Design Flows

a. The sizing of major components of the Town sewer system such as treatment facilities, are the responsibility of the Town and beyond the scope of this manual. The Town may require developers to design these facilities as well as finance and construct them. Should this be the case, the Town must be consulted for specific design criteria.

b. The design engineer who is responsible for the extensions of sewer mains shall follow the guidelines in this manual for the derivation of design flows. The calculation of sewer flows will usually require extension of the average daily flow for the facility, application of a peaking factor to derive the peak flow, then addition for inflow and infiltration.

c. Generally, the design engineer will be selecting sewer mains of 12-inch diameter and smaller, and often will be required to provide the minimum 8-inch size mains.

2.2.1 Collector Sewers

a. Design Period

A sewage delivery system shall ordinarily be designed to provide for the projected population at ultimate buildout for the contributing drainage area to the facility. Whenever cost-effectiveness permits, the construction may be programmed in stages to accommodate the needs, subject to the approval of the Town Council of Indian Head.

b. Existing Development

In developed areas, the basis for flow projection shall be the actual number of single-family homes, apartment units, various types of businesses, etc. present in the drainage area, as determined by field count. An allowance shall be made for undeveloped areas as described below. For each residential dwelling unit, sewage flows of 250 gallons per day for the average daily flow shall be used.

c. Future Development

In small undeveloped areas, the basis for flow projection shall be the maximum number of residential units per acre according to current zoning regulations. This applies to residential or mixed residential/commercial zones. It shall be assumed that each residential unit shall contribute 250 GPD average daily sewage flow. In the case of small undeveloped portions of commercial or industrial zones, design flows shall be based on the land use consistent with current zoning regulations which would provide the most likely maximum sewage flow. In the absence of specific sewer flows, the design engineer shall use 500 Gallons/Acre/Day for commercial and light industrial zoned lands for the average daily flow. Heavy Industrial lands shall be assigned 1,000 Gallons/Acre/Day.

In large undeveloped areas, the average daily flow for a given zoning classification shall be as given above

.

d. Average Daily Flow

The average daily flow for collector sewers is based on the population and land use inventories and projections described above. Appendices B and C are compilations of average daily flow generation rates for various types of establishments. The flow from each existing establishment shall be based on Appendix B when the number of persons using a facility can be determined or on Appendix C when only the gross area of the facility can

be determined. The average daily flow shall be the sum of the flows projected for the existing or ultimate land use of each lot or parcel in the drainage basin. In the case of largely undeveloped drainage basins, the average daily flow shall be based on criteria in 2.2.1.(c).

Average daily flows given in 2.2.1.(c) for industrial facilities are for domestic-type flows only. Flows generated by industrial processes must be determined on a case-by-case basis.

e. Peak Flows

Peak domestic flow is the average daily domestic flow peaked in accordance with the curve entitled "Diagram for Converting Average Daily Domestic flow to Peak Flow" in the Appendix.

Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with a factor determined by evaluation of historical data for the commercial or industrial facilities and the periods in which these flows are generated. If historic peaking data for these facilities is unavailable, the average daily domestic flow, average daily commercial flow, and average daily industrial flow may be combined and then peaked using the curve in the Appendix.

If it can be established that the peak of the industrial waste flow (and other non-domestic flows) does not occur during peak domestic flow, a percentage (based upon engineer's field observation and judgment) of the peak industrial waste flow (and other non-domestic flow) shall be added.

f. Infiltration and Inflow

In areas where a sewer is being designed to replace an existing sewer with existing SHC's, a minimum infiltration rate of 400 gallons/acre of drainage basin per day shall be used. A higher rate of infiltration may be justified if there is evidence of poor soil conditions, high groundwater table, or deteriorated SHC's.

In areas where the sewer will serve future development, the infiltration rate should be determined on a case-by-case basis. Factors affecting this determination include the proposed sewer elevation relative to the normal groundwater elevation and the soil types present. The infiltration rate selected for design of new sewers shall be 100 gpd/in-dia/mile.

New clear water connections such as downspouts, catch basins, cellar drains or sump pump drains to sanitary sewers are strictly prohibited.

g. Design Hydraulic Flow

The design hydraulic flow shall be the sum of the peak flows determined as described in Section 2.2.1 (e), the infiltration rate determined as described in Section 2.2.1 (f), and any industrial flows.

2.2.2 Interceptor Sewers

a. Design Hydraulic Flow

Determination of design hydraulic flows for interceptor sewers shall be generally as outlined for collector sewers. Peak flows generated by ultimate development allowed by zoning regulations shall be provided for. Interceptors which will carry the flows from a significant number of older collectors may have infiltration rates far in excess of 400 gallons/acre/day. The design engineer may be required by the Town to perform flow monitoring in the existing sewer to determine actual flows and remaining capacity if actual flow data is not available by the Town. In all cases, the design hydraulic flows shall be approved by the Town of Indian Head prior to proceeding with sewer design.

2.3 Hydraulic Criteria

2.3.1 Collector Sewers

a. Size

The size of the sewer shall be sufficient to carry the previously discussed design hydraulic flow with the hydraulic gradient coincident with or slightly below the crown of the pipe. Size shall be determined by the relationship $Q = av$, where:
Q = quantity of sewage in cfs (design flow)
a = required cross section area of conduit in sq. ft.
v = velocity in feet per second

The minimum size sewer shall be 8-inch inside diameter.

b. Velocity

Velocity shall be determined by the Manning formula:

$$v = \frac{1.486}{n} r^{2/3} s^{1/2}$$

n = coefficient of roughness as indicated in table (see Appendix E)
s = slope in feet per foot
r = hydraulic radius - area divided by wetted perimeter

Minimum velocities of 2.5 feet per second shall be provided. Minimum velocities shall be determined based upon present average sewage flow.

Where velocities greater than 15 ft/sec are attained, provision shall be made to protect against erosion and displacement by shock. If practical, suitable drop manholes shall be provided to reduce steep slopes so as to limit the velocities in pipes between manholes. When drop manholes are impractical for reduction of velocity, the sewer shall be of ductile iron or other abrasion resistant material as approved by the Town of Indian Head.

2.3.2 Interceptor Sewers

a. Size

Interceptor sewers shall be sized to carry the design hydraulic flow when two-thirds full (i.e. the hydraulic grade line will be d/D - 0.67). The minimum size shall be 8 inches inside diameter.

b. Velocity

Velocities in interceptor sewers shall be as presented for collector sewers.

2.4 System Layout Criteria

2.4.1 Collector Sewers

a. Horizontal Layout

1. General

Collector sewers shall be laid on tangents only. All changes of direction and connections to other collector sewers shall be accomplished at manholes. In laying out the sewer, the design engineer shall take into full account such factors as environmental impact, maintenance of traffic, maintenance of existing utility services, constructability, and system maintenance.

2. In New Subdivisions

In new subdivisions, collector sewers shall be located seven feet from the centerline of the street right-of-way, generally on the side of the street toward low ground and on the opposite side of street centerline from the water main. Collector sewers shall be located within the pavement area wherever possible, no less than five feet from the face of the existing or proposed curb. Where it is not feasible for manholes to be located within the pavements, they shall be located wholly within the grass plot or wholly within the grass plot between the curb and sidewalk or wholly within the sidewalk.

3. In Existing Developments with Curbs

In existing developments with curbs, sewer location shall generally be the same as in new subdivisions. The location of other existing and proposed utilities shall be fully considered.

4. In Existing Developments with Pavement and No Curbs

In existing developments without curbs, collector sewers shall generally be located four feet outside of the edge of pavement, except that the sewer shall not be located under a future curb. The location of other existing and proposed utilities shall be fully considered.

5. In Parks and Public Rights-of-Way

Where location of sewer would require removal of or damage to trees within parks or public rights-of-way, design engineers shall obtain approval of the Town of Indian Head for sewer alignment and trees to be removed.

6. Easements

All sewer utility easements shall be 25 feet minimum width. No other utilities will be allowed in the sewer utility without the Town of Indian Head's permission.

b. Profile Layout

1. Grades

Grades shall be such as to require the least excavation while satisfying minimum and maximum velocity requirements, clearances, and depth requirements discussed hereinafter. All collector sewers shall be on tangent grades with required breaks in grade accomplished at manholes. Minimum slopes shall be 0.4 ft/100 ft.

Terminal sewer collection lines shall be at a minimum 1% grade.

2. Changing Size

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method is to match the crown of the sewers or to place the 0.8 depth point of both sewers at the same elevation. Generally, sewers should not decrease in size in the downstream direction.

3. Depth

In developed areas, sewer inverts shall be a minimum of 2.5 feet + h below cellar elevations, where h = length of house lateral connection between the sewer and the point of connection to the existing house sewage system, or stack, multiplied by the required house connection slope. For houses without cellars, sewers shall be a minimum of 2.5 feet + h below first floor elevations. In all cases, sewer depth shall be sufficient to meet criteria established for house connection, depth, grade and clearance.

For unimproved lots, maximum sewer depth as controlled by adjacent lots shall generally not exceed 12 feet. Where lots can be expected to be filled to the level of the established grade, depth as regulated by adjacent house connections shall normally not exceed eight feet. Greater depth may be required to clear future storm drains. In all cases, depth shall be sufficient to meet criteria established for house connection depth, grade and clearance.

Sewers at stream crossings shall be constructed with a minimum of three feet of cover between pipe and stream invert. At all stream crossings the design engineer shall consider such items as flotation,

stream meandering and scouring and infiltration and shall include such protective measures in the design as encasement, riprap, special pipe, and joints as may be deemed necessary by the Town.

4. Gravity Service Not to be Provided

Sewer project plans shall clearly label any improved lots for which gravity service is not to be provided. Any recommendation for not providing gravity service is to be documented, with the reasons therefore, by the A/E to the Town for decision. For lots where it is determined that gravity service is not available and the Town approves the use of grinder pumps, a note shall be placed on the drawings as follows: "A grinder pump is required for sewer service to this lot."

5. Test Borings

Soils investigations (test borings and/or test pits) may be required by the Town as a pre-requisite and approval of the plans, if the Town suspects possible sinkhole activity in the area, to locate existing utilities or other reasons as the Town warrants.

c. Clearances of Other Utilities

1. Interactive Considerations

In general, existing utilities have prior right to maintain their location. The existence and location of such utilities must be considered when designing new sewers. Clearance shall be measured between outside of pipes. Design engineers shall investigate clearance between sewer and other utilities, both existing and future.

(a) Parallel Installation

A horizontal distance of at least 10 feet shall separate water mains and sewers. The distance shall be measured edge to edge. In cases where a 10-foot separation is not practical, deviation may be allowed on a case-by-case basis subject to town and State approval if supported by data from the design engineer. Such deviation may allow closer installation, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of

the water main is at least 18 inches above the top of the sewer.

(b). Crossings

Where water mains and sanitary sewers, building drains or storm drains must cross, there shall be a vertical separation of 18 inches between the bottom of the water main and the top of the sanitary sewer, building or storm drain. This vertical separation must be maintained horizontally for a distance of 10 feet. The 10-foot distance is to be measured as a perpendicular distance from the sewer, building or storm drain to the water line.

(c). Exceptions

When it is impossible to obtain the proper horizontal or vertical separation as stipulated above, both the water and sewer lines shall be constructed of ductile iron with mechanical joints. Other types of pipe and joints with equal or greater integrity may be used at the discretion of the Town. Where a water main must cross under a sewer, additional protection of the water main shall be provided. The Town shall be consulted to discuss the use of double casing or concrete encasement of the sewer and/or water main.

2. Separation of Utilities and Sewer Manholes

No utilities shall pass through any part of a sewer manhole.

3. Clearances at Other Utilities

Sewers shall have a minimum of 12 inches clearance from drains, gas mains, and other unspecified utilities. If 12 inches cannot be maintained at crossings, provide encasement of sewer for the width of 10 feet on each side of the crossing.

d. Appurtenances

1. Manholes

Manhole details are shown in the Town's Standard Details. The designer shall use these standards as required to meet the design

situation and shall designate the type of each manhole on the contract drawings. Maximum spacing for manholes shall be 400 feet. Line manholes shall generally be used at all changes of pipe size, grade, alignment, or connections of two or more sewers. A minimum drop of 0.10' shall be used at line manholes. Generally, a drop pipe should be provided where the difference between the crown of the effluent sewer and the invert of the influent sewer exceeds 2 feet, subject to the limitations of standard fittings. Concrete encasement should be provided to support the drop pipe. The minimum diameter of manholes shall be 4.0 feet. Larger diameters are preferable. The size of manhole entrance shall be 2.0 feet or larger in diameter. The thickness of manhole walls shall not be less than 8 inches for the upper 12 feet of depth and shall increase 4 inches for each additional 12 feet of depth. The flow channel through manholes shall be made to slope and conform in shape to the sewers.

e. Structural Considerations

1. Soil Conditions - Foundations

Where extremely poor soil conditions, such as running sand, material with high organic content, etc. are anticipated, design engineers shall secure soil samples and discuss the analysis of the samples with the Town. In all cases, a proper foundation shall be provided for pipes.

2. Grades - Anchors

Sewers designed on slope of 20 percent or greater shall have anchorages as follows (consult the Town for details):

20% - 34%	36' center to center (max.)
35% - 50%	24' center to center (max.)
50% +	16' center to center (max.)

3. Underdrains

Where there is evidence of spring heads or a high groundwater table in the area of the proposed sewer, underdrain shall be provided. Underdrains shall be extra strength concrete sewer pipe (CSPX), or pipes of equal strength, and need to be shown on the drawings.

4. Depth and Loading

Minimum and maximum permissible depths and loadings for pipes of the various types and classes shall be in accordance with manufacturer's recommendations and bedding requirements. Manufacturer's data shall be submitted as part of the Engineering report. Ductile iron pipe shall be used where depth is less than 4 feet or greater than 20 feet. PVC pipe, SDR 35 may be used for depths of 4 feet to 10 feet. PVC pipe SDR 26 may be used for depths of 10 feet - 20 feet.

5. Pipeline Materials

The materials allowed for sewer construction, together with their Mannings 'n' are listed below. The choice of materials is at the engineer's discretion, subject to the Town's approval, provided allowable maximum velocities and structural loading criteria are met. Fittings that are necessary for wye branches, etc. shall be approved by the Town. Only one type and description of pipe shall be used between two manholes.

Pipe Type (abbreviation)	'n' Coefficient	Range of Diameters
Ductile Iron (DIP)	0.013	6" & larger
Reinforced Concrete (RCP)	0.013	12" & larger
Concrete Sewer Pipe (Extra Strength) (CSPX)	0.013	6" & larger
Polyvinyl Chloride (PVC)	0.010	6" & larger
Reinforced Concrete Cylinder (RCCP)	0.013	16" & larger

Design engineers shall consider the effect of industrial waste on sewer pipe. Several industrial wastes, such as sulfuric acid, are known to cause deterioration of concrete pipe. Wherever harmful wastes cannot be prohibited from sewers or diluted prior to entry, the use of liner plates or other pipe protection shall be required for concrete pipe. In addition to consideration of industrial wastes, the design engineer shall also consider other local conditions, such as septicity, exceptionally heavy loadings and abrasion due to high flow velocities, in selecting pipe materials.

Use Ductile Iron Pipe (DIP) under the following conditions:
- Where sewer depths are 4 feet or less.
- Where sewer depths exceed 20 feet.

- In interceptor sewer applications where maintenance is perceived to be a problem
- Creek or stream crossing (alternative to DIP is concrete encasement of PVC 10 feet either side of stream bank).
- Off road areas where maintenance is not achievable or where individual homeowners may be severely affected by repair efforts

f. Venting

The design engineer shall indicate method of proposed ventilation of gravity sewers.

g. Testing

Sewer mains shall be tested in accordance with the Town's specifications, using air testing procedures. All manholes are to be vacuum tested.

(6) Jacking and Tunneling

Where mains are being designed to cross railroads, state highways or other roads on which service cannot be interrupted, the sewer main shall be installed in a sleeve, tunneled or jacked under the road. The sleeve size and material and the method of tunneling or jacking shall be approved by the owner of the road or the railroad being crossed.

The sleeve diameter shall be sufficient to permit the proper positioning of the sewer main within the sleeve. The annular void between the main the sleeve shall be completely filled with grout, sand or as shown in the Standard Details.

2.4.2 Interceptor Sewers

a. Horizontal Layout

Interceptor sewers generally follow streams or the valley of a drainage area. They shall be located so as to best serve the drainage area. Special caution is required to insure the proper location of manholes for future connection of collecting sewers and ease of maintenance by the Town.

Sewers shall be laid with straight horizontal alignment between manholes. Where the sewer is planned in a Town road right-of-way or a park, layout shall be as described for collector sewers.

b. Profile Layout

Grade requirements shall generally be as described for collector sewers. The depth of interceptor sewers is not directly controlled by lot and house elevations. The depth of interceptor sewers shall be sufficient to allow connection of all existing and foreseeable future collector sewers within the drainage basin served. In general, sewer elevation should be three feet lower than the stream bed and have six feet of cover where possible.

Where interceptor sewers cross streams, the requirements of Section 2.4.1.e.5. shall be met, except that concrete encasement shall be required in all cases and will extend 20 feet each way from the stream bank.

c. Clearances at Other Utilities

The requirements for horizontal and vertical clearances between interceptor sewers and other utilities shall be the same as those for collector sewers.

d. Appurtenances

Manhole requirements for interceptor sewers shall be the same as those for collector sewers, with the following modifications. Manholes will be required where collector sewers join the interceptor. Precast concrete manholes constructed shall meet the standard ASTM C478 criteria.

e. Structural Considerations

Structural considerations shall be the same as for collector sewers.

2.5 Grinder Pumps/Pressure Sewer Systems

2.5.1 Purpose

The purpose of this section is to provide a Policy and Procedural Guide for Alternate Wastewater Systems. The following is for Grinder Pump/Pressure Sewer Systems to serve existing or proposed development.

2.5.2 Policy

a. Determination of Use

Grinder Pumps/Pressure Sewer Systems will not be considered as a method of providing sewer service that could otherwise be furnished by conventional gravity system (including pumping stations) at a reasonable cost. A final determination on the use of grinder pumps will be made by the Town Council. An economic analysis, based on a total present worth, must be submitted by the developer or design engineer for use by the Town in making the final decision.

b. Temporary Use

Grinder Pumps/Pressure Sewer Systems are not normally to be used on an interim or temporary basis in anticipation of conventional facilities installed in the future.

c. Ownership and Maintenance

The property owner will own and maintain all grinder pumps, regardless if installed by the Town, Developer, or by property owner. The property owner will be responsible for electrical costs to operate the pumping units.

d. Only grinder pumps from Environment One Corporation shall be used in Indian Head. Low pressure sewer mains shall be sized according to the design manual offered by the grinder pump manufacturer. The Town shall be consulted on specific design and construction standards for the grinder pump and low pressure sewer mains, if approved for use by the Town Council.

2.6 Sewer House Connections

2.6.1 Location

The Town-owned portion of house connections shall be built to the property line for all lots within proposed developments. All adjacent improved lots which are not a part of the proposed development but which may be served by the sewer line shall be shown on the contract drawings. Connections for these lots shall be shown, where and as directed by the Town. Where sewers are at sufficient depth to require drop house connections, design engineers shall discuss house connection location with the Town. No twin sewer house connections shall be allowed.

2.6.2 Size

Connections to large buildings such as apartments or commercial/industrial properties shall be designed and sized in accordance with the criteria previously presented for collector sewers. The minimum connection size for home and smaller buildings shall be six inches diameter.

2.6.3 Materials

House and building connections shall comply with ASTM 3034, SDR 35 PVC; ASTM F789, T-1 PVC; or AWWA C151 DIP.

2.6.4 Appurtenances

Cleanouts shall be provided on all building connections at the property line. Cleanouts shall be as shown in the Standard Details. All cleanouts must be installed vertically to be accepted by the Town. This cleanout is to be used on all systems regardless of the air test requirements. No solvent weld joints will be allowed.

2.6.5 Grades

House and building connections shall be two percent minimum grade, unless otherwise approved by the Town. The maximum grade shall be five percent. A one percent minimum grade may be allowed by the Town with adequate justification from the Developer and approved by the Town. Minimum cover at property line shall be four feet. Where storm drains have not been designed or have not been installed, house connections shall have a minimum cover within the street right-of-way of 6.5 feet.

2.6.5 Clearance

a. Crossing Water Main

Clearance shall be measured between outside of pipes. Sewer house and building connections crossing water mains (existing or future) shall be a minimum of 12 inches clear below water mains. Sewer house and building connections crossing above water mains shall be encased in concrete 10 feet each side of water main or constructed of ductile iron pipe (push-on or mechanical joints).

b. Parallel to Water House Service

Sewer house and building connections shall ordinarily be not less than 10 feet horizontally from water house service and a minimum of one foot clear below water house services. If Town approves placing sewer house or building connections above water house service, such connection shall be ductile iron pipe (push-on joints or mechanical joints).

c. Crossing Storm Drains and Other Utilities

Sewer house and building connections crossing storm drains and other utilities (existing or future) shall have a minimum clearance of six inches from these utilities.

2.6.7 Structural Considerations

Minimum and maximum permissible depths shall be in accordance with those of collector sewers.

Where poor soil has required the use of ductile iron pipe collector sewers or ductile iron pipe (DIP), house and building connections of the same material shall be used.

2.7 Repaving of Roads

2.7.1 General

a. All Town construction contract specifications shall include a "patch-pave" requirement as follows:

Properly compacted borrow aggregate backfill shall be placed and compacted from 3 inches below the pipe to the bituminous pavement subgrade. The pavement replacement shall consist of a base course of asphaltic concrete of at least a thickness equivalent to the original pavement section, the original wearing course cut back two feet on all edges of the excavation and a new asphaltic concrete wearing course of at least a thickness equivalent to the original wearing course. Other road pavement sections will receive similar treatment. The base course shall be a minimum of 4 inches, and the wearing course shall be a minimum of 2 inches.

b. Patch-paving as outlined above is to be accomplished whether the roadway is to be re-paved or not.

c. House connection installations will require the same specifications for patch-paving.

d. All paving/re-paving work will be accomplished in accordance with the Town Road Specifications or Design Manual. A 'road cut' permit must be obtained from the Town when excavating within an existing Town maintained roadway.

2.7.2 Timing of Patch-paving and/or Re-paving

a. Specifications will provide that patch-paving shall be accomplished immediately after backfilling and achieving specified compaction for connection and small extension contracts and at no greater than seven (7) calendar day intervals for larger projects. Temporary "cold patch" shall be required for patches not immediately patch-paved. The Town must be consulted if immediate patch-paving cannot be accomplished. Cold patching must be maintained by the developer to the Town's satisfaction. The placement of steel plates over trenching may be approved by the Town on a case-by-case basis.

b. Re-paving shall be specified to be accomplished in one continuous effort to best assure economy and consistency of quality work.

2.7.3 Traffic Control

All water utility construction projects shall have an approved traffic control plan, using requirements of the *Manual on Uniform Traffic Control Devices*.

3.0 SEWAGE PUMPING STATIONS

3.1 General

These design standards are intended to facilitate engineering of sewage pumping stations to meet the service needs of users and the operational responsibilities of the Town. The sewage pumping station design standards include criteria and design guidelines. This section includes the criteria and guidelines for designing sewage pumping stations within the limits of applicability for these design standards.

The design standards generally apply to sewage pumping stations up to 3.0 MGD capacity. Not included within the group of sewage pumping stations covered by this section are several special applications: individual user pumping installation, lift stations, and sewage pumping stations with capacity in excess of 3.0 MGD.

The design engineer shall check with the Town to determine the applicability of these design standards to planned sewage pumping stations. It is the responsibility of the design engineer for blending all applicable criteria and guidelines for sewage pumping stations incorporated into the Town of Indian Head Sewage System.

3.2. Design

3.2.1 Design Criteria

Sewage pumping stations must satisfy the criteria relating to regulations of agencies having jurisdiction, design flow rate, hydraulic conditions and site characteristics.

1. Applicable Regulations

Sewage pumping stations shall conform to the Design Guidelines for Sewerage Facilities, 1978 edition or latest as published by the Department of the Environment, State of Maryland. Town of Indian Head Office of Planning and Zoning land use regulations shall be considered in the selection and development of sewage pumping station sites. Buildings shall comply with BOCA requirements and permitting requirements of the Town of Indian Head. Other regulations governing facilities and construction shall be adhered to. These will include the Occupational Safety and Health Administration, National Electric Code, Charles County Plumbing Code and others.

2. Flow

The design flow for sewage pumping stations shall consider existing and project peak flow rates and sewage composition.

a. Planning Period

Sewage pumping station discharge flow rates shall, at a minimum, accommodate a 20-year planning horizon. In circumstances where the status of a planning pumping station is interim, the planning period for establishing flow rate may be shorter. For all but interim pumping stations, consideration shall be given to future upgrading flexibility necessary to accommodate flows beyond the normal 20-year planning horizon. This is especially important for larger (more than 200 GPM) sewage pumping stations.

b. Existing and Projected Flow Rates

Sewage pumping stations shall be designed to pump the flow for existing and future users. In developed areas population shall be determined by house count and non-domestic user inventory, with allowances made for remaining undeveloped tributary areas. Population densities and per capita flows shall be as established by Facility Plans or, in their absence, in agreement with the Water and Sewer Master Plan or instruction of the Town.

c. Composition

Sewage composition can vary widely, depending upon the proportion of design flow generated by non-domestic users. Non-domestic user sewage composition shall be investigated. Adequate consideration and necessary provisions shall be taken to ensure that sewage pumping station equipment and materials are suitable for the anticipated composition of sewage. Consultation with the Town is required in the event that sewage composition affects standard material and equipment requirements.

3. Hydraulics

A complete analysis of each sewage pumping station is required. An investigation and analysis of the sewage pumping station and force main

system to consider features of configuration and operation shall be conducted. Sewage pumping stations shall be designed to operate at the appropriate discharge head and flow rate.

a. Pump/System Curve

System curve characteristics shall be determined by the Williams-Hazen formula for piping headlosses. The pump/system curve shall be shown on the drawings.

b. Water Hammer

The potential impact of water hammer shall be evaluated. If the combined effects of static head and water hammer do not exceed the weakest piping system component working pressure, no special provisions need to be included to control water hammer. Where the maximum water hammer pressure exceeds the weakest piping system component working pressure, strengthen those elements affected, or select an appropriate device to control water hammer. The decision to strengthen piping system components instead of utilizing a water hammer control device shall be based upon life cycle cost economic comparison.

4. Siting

Sewage pumping station site selection is dependent on a number of factors. Topography, access, availability of power supply, floodplain, land use, esthetic concern, overflow potential and impact to the environment shall collectively be considered in the process of site selection.

a. Topography

Sewers tributary to sewage pumping stations commonly dominate site selection. Adjacent drainage areas potentially served by the sewage pumping station must also be considered. Sewage pumping station site selection shall also be compatible with suitable access and soil capability with respect to landgrading in conjunction with site development.

b. Access

All sewage pumping stations shall be sited to permit access by all weather surface roads. Access road and parking or working areas within the pump station must be paved with bituminous or concrete

pavement. The depth of pavement shall be dictated by the Town of Indian Head.

c. Floodplain

Sewage pumping stations shall be sited to remain operational and permit access during a 100-year return frequency flood.

d. Land Use

Sewage pumping station sites should be selected to occupy vacant land. In new subdivisions the sewage pumping station site shall occupy an area at least equivalent in size to the minimum allowable lot size. In existing subdivisions site size shall meet the minimum allowable lot size if possible. Pump station sites wherever possible must conform to land use regulations such as building restriction lines. Special exceptions and variances may be required.

e. Esthetics

Natural screening and remoteness of site should be provided by site selection wherever possible. Where pump stations are sited in proximity to developed areas, predominate wind direction for potential odor dispersion and building aspect for generator exhaust and ventilation fan noises shall be considered.

f. Overflow

Sewage overflow at sewage pumping stations is not permitted. Sewage pumping station sites shall be selected to permit site development which will preclude on-site overflows.

3.2.2. Guidelines

To the extent practical, sewage pumping station designs shall conform to the guidelines given. The guidelines shall be applied to design situations in a careful and thoughtful fashion.

1. Selection of Sewage Pumping Station Type

The type of sewage pumping station required by the Town will be governed by station capacity in terms of flow rate and horsepower. Sewage pumping stations will be custom built-in-place wet well/dry well

type, engineered package wet well/dry well type, engineered package submersible type, or engineered package wet well mounted suction lift type subject to the limitations set forth.

a. Custom Built-In-Place Wet Well/Dry Well Sewage Pumping Station

This type of sewage pumping station will be designed for installation with design flows above 1.5 MGD. Custom built-in-place stations shall be engineered to meet the requirements of these guidelines.

b. Package Sewage Pumping Station

This type of sewage pumping station will be utilized for design flows of 1.5 MGD and less. Depending upon flow rate and motor horsepower, the packaged pump stations will be wet well/dry well configuration, submersible configuration, or wet well mounted suction lift station. Packaged sewage pumping stations shall be engineered to meet the requirements of these guidelines.

(1) Submersible

Submersible sewage pumps with guide rail and pump discharge elbow assemblies installed in the wet well shall be used for small sewage pumping stations. Submersible type sewage pumping stations shall be used at locations where design flow does not exceed 200 GPM and motor horsepower is 10 or less. If either motor horsepower or design flow limitations for submersible type sewage pumping stations are exceeded, other types shall be used.

(2) Dry Well/Wet Well

Dry Well/wet well sewage pumping stations may be used where flows are in excess of 200 GPM or where a submersible station would require a motor greater than 10 horsepower.

(3) Wet Well Mounted Suction Lift Station

This type may be used where flows are in excess of 200 GPM or where a submersible station would require a motor greater than 10 horsepower. Suction lift stations generally

are only to be used where the depth of wet well is less than 15 feet.

c. Other Configurations

In special circumstances due to extraordinary sewage composition, rehabilitation of an existing installation or other reasons, the Town shall be consulted to determine the acceptability of other configurations before sewage pumping station design begins.

2. Site Improvements

Sewage pump stations must be developed with the necessary improvements to ensure adequate and reasonable access, security, drainage and maintainability.

a. Access Road

All sewage pumping stations must provide complete vehicular access.

(1) Duty and Section

Access roads should be designed to accommodate all types of vehicles at low speeds from passenger automobiles up to large tanker trucks. An all weather surface with cross section design adequate to support the vehicular loads anticipated should be designed for local soil conditions. Access roads shall be signed for local soil conditions. Access roads shall be a minimum 12 foot wide single lane with 2 percent cross slope to provide surface drainage. Two foot wide shoulders on each side of the road surface shall be included with a cross slope of 6 percent. Swales, pilot ditches and culverts as necessary shall be provided to ensure adequate storm drainage for a 10-year return frequency rainfall event. Grading and slope stabilization in conjunction with access road design shall be compatible with local soil conditions. In no case shall the depth of bituminous pavement be less than 6 inches.

(2) Geometry

Horizontal access road geometry shall permit vehicular movement such that vehicle tires can remain on road and shoulders at all curves. Turning flares shall be provided at the intersection with traveled roads. Vertical access road geometry shall provide smooth grade transitions and adequate site angles at intersections with traveled roads. Access road grades should be limited to 8 percent, but in no case may exceed 12 percent. Access roads shall satisfy all horizontal and vertical geometry requirements for vehicles in size up to large unit trucks.

(3) Security

Access roads longer than 75 feet in length shall include a padlocked entrance chain between pipe bollards across the access road. The chain and pipe bollards shall be set back a minimum of 5 feet from the right-of-way line. Consideration may be given to access road entrance chain and pipe bollards for access roads less than 75 feet in length.

b. Sewage Pumping Stations

All sewage pumping station sites shall be improved with paved surfaces, security fences, site lighting and screening. Certain locations and attendant conditions may require other improvements which may consist of storm drainage systems or more extensive security provisions.

(1) Perimeter Fence

All sewage pumping stations must have a 6 foot high chain link fence surrounding the parking area, building, wet well, dry well and vaults. In areas particularly subject to vandalism, higher fences and electronic security systems should be considered on a case-by-case basis. Full width fence gates, up to fourteen feet wide, with padlocked astrigal shall be located to suit entry and exit of the pump station site. All exposed fencing materials shall be black vinyl coated.

(2) Paving and Other Surfaces

Sufficient bituminous paved surfaces, within the sewage pumping station perimeter fence, shall be provided to enable maneuvering and turning of vehicles in size up to unit trucks. The paving section composition shall consist of band SN surface course, an underlying band BF and a CR-6 crushed stone base course, all of a composite thickness necessary to support all anticipated wheel loads in consideration of local soil conditions. The remaining surfaces inside the perimeter fence not occupied by structures shall be covered with a compacted course of washed SRC-2A stone of thickness equal to bituminous concrete site paving and underlain by a CR-6 crushed stone base course of thickness equivalent to the paved surface base course.

(3) Grading

Sewage pumping station grades for paved areas shall prevent local ponding, provide positive drainage away from structures and generally be limited to no greater than 4 percent slopes. Stone surfaces around paved areas shall provide proper site drainage at slopes 10 percent or less. Landgrading outside of the sewage pump station perimeter fence shall not exceed 3 to 1 slopes, and 4 to 1 slope maximums are desirable. Lesser slopes wherever possible are preferred. Site grading design shall be compatible with slope stability for soils encountered. Slope stabilization shall be appropriate for the degree of slope and soil conditions.

(4) Landscaping

All sewage station sites shall be screened as appropriate for surrounding development.

Landscaping materials should be aesthetically pleasing and require minimal maintenance.

(5) Lighting

Exterior lights shall be wall mounted on the pump station building, high pressure sodium type controlled by a photocell.

c. Structures

All structures shall be protected from 100-year return frequency floods. Structure foundation design shall be based upon geotechnical evaluation of underlying bearing stratum. The design engineer shall include the geotechnical report and boring report in the project specifications.

(1) Building

Sewage pumping station electrical, control and standby power systems are to be housed in an at-grade brick and block building with wood roof trusses and shingles. Prefabricated concrete buildings may be used only if approved by the Town. The building shall be sized to afford reasonable access to and removal of all components housed within. Details of construction shall follow the architectural, structural, mechanical and electrical standard design. All buildings shall be designed to comply with BOCA Building Code.

The control room shall be heated with an electric unit heater to automatically maintain 68° F during the winter. The control room shall be ventilated to eliminate heat buildup during the summer. An exhaust fan shall be provided and controlled by a thermostat.

(2) Pumping Station

Sewage pumping equipment will be located in a below grade concrete structure of the type indicated for the capacity planned. The pumping station concrete structure(s) shall extend at least 6 inches above finished grade.

(3) Vaults

Precast concrete vaults for emergency station bypass pumping connections and valves shall be provided for package sewage pumping stations. Valve vaults for submersible sewage pumping stations shall be segmented and contain emergency connection couplings and valves in one compartment and all pump discharge check valves, isolation valves, gauges and flushing connection control valve in a separate compartment. Submersible sewage pumping station vaults shall extend 6 inches above grade and shall have hatches and ladders with spring-loaded extension poles to access valves and emergency connection couplings. Vault dewatering when required will be accomplished with portable pumps. Vaults normally will be surrounded with bituminous concrete paving.

3. Sewage Pumping Station Feature

Sewage pumping station structures, equipment systems, piping, controls and accessory systems must be engineered according to these guidelines to form a cohesive design integrating the intended service and operational characteristics stipulated. To fulfill the intent of these guidelines, the designer must exercise judgment to use the special knowledge relating to project site characteristics and conditions of service (head, flow, force main, etc.) particular to the sewage pumping station design under development.

a. Wet Well

Wet wells shall be as hazard free as possible and of corrosion resistant materials.

(1) Structure

Sewage pumping station wet wells shall be constructed of reinforced concrete. Package sewage pump station wet wells shall have cast-in-place base slabs and top slabs with precast riser sections. Custom built-in-place sewage pump station wet wells shall be compartmented and constructed entirely of cast-in-place reinforced concrete. The structural design of cast-in-place concrete is the responsibility of the design engineer. Wet wells shall have an interior epoxy paint finish and exterior elastomeric membrane water-

proofing in accordance with Technical specifications. Wet wells shall be adequately designed to prevent floatation. Wet well size and depth shall be as required to accommodate the influent sewer, pump suction submergence as recommended by Hydraulic Institute Standards or in the case of submersible pumps complete pump submergence. The required working volume and preferred intervals between sewer and control elevations shall be determined as follows:

(a) Working Volume (in Gal.) = $\frac{TQ}{4}$

Where T = minimum time between motor starts or 7 minutes, whichever is greater

Q = discharge rate of one pump in operation in GPM

Working Volume = lead pump on - lead pump off

(b) Minimum inside width - 6 feet

(c) Minimum elevation difference between influent sewer invert and high water alarm - 6 inches

(d) Minimum elevation difference between control elevations - 6 inches

(2) Access

Package pump station wet well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch shall be 36 by 30 inches minimum size and as large as necessary to allow removal of equipment from the wet well. An aluminum ladder with extendible springloaded aluminum safety poles at the top shall be provided to permit safe entry. Structures 20 feet in height or more shall be equipped with removable intermediate landings as required to obtain less than 20 foot intervals. The ladder landing on the wet well floor shall be flat. Custom built-in-place wet well personnel access shall be stairs, minimum of 36 inches wide. Provisions should be made for wet well access openings large enough for equipment removal.

(3) Wet Well Work Platform

Package pump station wet wells shall have an intermediate platform completely covering the wet well. The work platform shall be constructed of aluminum grating sections and grating supports of structural aluminum shapes fastened to the wall. Custom built-in-place pump station wet wells shall have an aluminum perimeter platform with handrail over the wet well and screening channel. Seven feet minimum of headroom over work platforms is desirable. Care shall be taken to locate removable grating sections consistent wit equipment placement and removal requirements. All fixed grating shall be bolted down as detailed. All fasteners to be stainless steel.

(4) Debris Removal

All sewage pumping stations will have bar racks for debris removal. Package sewage pumping stations will have manually cleaned static bar racks attached to the wet well wall and work platform. Static bar racks shall be of welded aluminum and stainless steel construction with a welded aluminum debris basket to accept bar rack strippings. The debris basket shall be removable and should be easily hoisted through the open access hatch above. Custom built-in-place sewage pump stations shall have a special debris screening channel and bypass channel upstream of the segmented wet well. Aluminum stop gate guides shall be cast into the channel walls for insertion of flow isolating aluminum stop gates. The debris screening channel shall be fitted with a mechanical bar rack of the front cleaning design with no moving parts below the sewage in the channel. Strippings from the mechanical bar rack shall be shredded or ground and returned to the channel without need for further handling at the sewage pumping station. Mechanical bar rack sizing shall be based upon maximum through bar velocity of 3 feet per second. Maximum clear opening between bars shall be 1-1/4 inches for all bar racks. Bar rack headloss shall not cause any reduction in influent sewer flow velocity.

(5) Invert Slope

Wet wells shall have sloping sides to form a hopper at the bottom of the wet well. Package sewage pumping stations shall have grout fill slopes of 1 horizontal to 1.75 vertical. Custom built-in-place sewage pumping station wet wells shall have side slopes of 1 horizontal to 1 vertical if possible. The flat portion of the wet well floor shall be sufficient in area to accommodate equipment mounting, ladder landings and recommended pump suction hydraulic pump suction hydraulic conditions as outlined by Hydraulic Institute standards.

(6) Level Control

Wet well liquid levels are controlled by a solid state submersible level transducer with D152 controller from Consolidated Electric with back up float switches. Other types of controllers may be required, depending on the complexity and control logic the Town requires. These systems within the wet well shall be located to minimize the turbulent influence of flow into the wet well on the control of liquid level. Float staffs shall be readily removable from the wet well work platform.

(7) Odor Control

Odor control method selection will be offered by the design engineer for approval by the Town. The Town reserves the right to require a different method if deemed appropriate. It should be assumed that a pump station with a greater than two-hour force main detention time will produce both H_2S and NMOC levels greater than 5 ppm and require odor control.

(8) Lighting

Wet wells shall be provided with wall mounted explosion proof incandescent light fixtures with guard and globe. One fixture shall be installed above the grating and one fixture below the grating. A waterproof switch shall be installed to operate the lights.

(9) Ventilation

Wet wells shall be provided with a separate ventilating system and shall be sized to provide a minimum of 30 complete air changes per hour. In addition to manual control, time clock operation of fans shall be provided to allow a minimum of 2 complete air changes per hour. Ventilation shall be accomplished by the introduction of fresh air into the wet well under positive pressure. If the fan is installed outdoors, the fan housing shall be weatherproof construction. The entrance hatch to the wet well shall be provided with a switch to energize the fan whenever the hatch is open.

(10) Dewatering

Package sewage pumping station wet well dewatering shall be accomplished by means of a portable submersible pump. Suitable grating openings and wet well floor space shall be provided for this purpose. Custom built-in-place sewage pumping station wet wells shall have individual valued drains to a common station drain sump. The drain sump shall be duplex solids handling pumps with valved discharge piping to at least two of the wet well compartments.

b. Dry Wells

Below grade dry wells shall be designed to provide suitable environments for operating and maintaining pumping equipment and piping systems. Configuration of dry well components shall promote safe access and adequate space for equipment and valve maintenance. Hazards must be avoided.

(1) Structure

Sewage pumping station dry wells shall be constructed of reinforced concrete. Package sewage pump station dry wells shall have segmented precast concrete base, riser, access tube and top slab sections as necessary on a cast-in-place structural concrete base slab foundation. Custom built-in-place sewage pump station dry wells shall be constructed integral with the wet well and above grade building structures. The structural design of all cast-in-

place concrete is the responsibility of the design engineer. Dry well exteriors shall be waterproofed with elastomeric membrance as specified in the Technical Specifications. Dry well interiors shall have a smooth, easy to clean special coating finish as specified in the Technical Specifications. Dry well depth and size shall be adequate to provide proper wet well suction and spaces for maintenance and removal of all equipment.

(2) Access

Package pump station dry well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch and precast access tube riser shall be of sufficient size to permit the removal of an assembled sewage pump or any other station component, if larger. Minimum hatch size shall be 36 inches by 30 inches. An aluminum ladder with extendible spring loaded safety poles at the top shall be provided to permit safe precast concrete dry well entry. Structures 20 feet or more in height shall be equipped with removable intermediate landings as required to obtain less than 20 foot intervals. The ladder landing area shall be sufficiently clear to permit easy ladder use and equipment removal. Custom built-in-place dry well personnel access shall be stairs, minimum of 36 inches wide. Additional grating, plate or concrete covered access openings shall be provided directly above each pump.

(3) Lighting

Precast concrete dry wells shall have wall mounted vapor-proof incandescent lights. Cast-in-place concrete dry wells shall have lighting systems specifically designed to provide illumination best suited for the dry well layout which may include suspended, wall, or ceiling mounted; incandescent, fluorescent, or other types of fixtures. Dry well lighting shall be at levels adequate for routine service inspections and maintenance activities. Portable supplemental lighting will be utilized for unusual or non-routine maintenance activities.

(4) Ventilation

Dry wells shall be provided with a separate ventilating system and shall be sized to provide 10 air changes per hour. In addition to manual control, time clock operation of the ventilating fans shall be provided. Ventilation shall be accomplished by the introduction of fresh air into the dry well under positive pressure. Precast dry well ventilating fans shall be continuously energized whenever the access hatch is open.

(5) Heating

Thermostatically controlled electric unit heaters shall be provided to maintain a minimum of 55 degrees.

(6) Humidity Control

Precast dry wells shall have small wall mounted dehumidifier units piped to drain in the dry well sump. Cast-in-place concrete concrete dry well dehumidifiers shall be considered on a case-by-case basis.

(7) Sump Pump

Precast dry wells shall have a simplex sump pump with minimum discharge capability as specified in the Technical Specifications. Cast-in-place concrete dry wells shall have duplex submersible sump pumps located in a common station drain sump. Duplex sump pumps shall each have capacity to handle anticipated maximum station drain system flow. Sump pumps shall discharge into the wet well. All dry wells shall be provided with a float switch emergency alarm system to protect the dry well from flooding in the event of sump pump failure. Each sump pump shall have dual check valves installed on the discharge piping to protect the dry well from siphoning from the wet well.

c. Pumping and Piping System

All sewage pumping stations shall have multiple pumping units. Sewage pumping stations shall be capable of delivering the design flow rate with the largest pumping unit of service. Sewage

pumping station design shall permit individual pump maintenance while maintaining the station in operation. Suction and discharge piping must be supported rigidly at or near the pump connections.

(1) Piping

The minimum size for sewage piping (except surge relief valve discharge piping) shall be 4 inch. Pump suction piping velocity should be within the range of 2-1/2 to 5 feet per second. Pump discharge piping shall be sized to provide velocities in the range of 2-1/2 to 10 feet per second. Pump suctions should have free and smooth unobstructed bellmouth openings in the wet well. Individual pump suctions are required for each pump. Flooded pump suction is desired under all normal conditions of operation. Pump suction piping design and installation shall not permit the accumulation of air in the suction piping or induce excessive turbulence in the pump suction area. Long radius suction piping bends to be used whenever possible. Packaged sewage pumping stations shall have adequate piping and fittings to permit station bypass pumping with portable above grade pumps. All sewage pumps shall be provided with casing drains with ball valve shut-offs installed either on the pump suction elbow or on the suction line between the pump and suction isolation valve. Take-off nipples shall be schedule 80 stainless steel. Pipe nipples must not be installed in a tapped hole in piping. Use either a welded-on thread-o-let connection or service saddle.

(2) Valves

Each sewage pump shall have isolation valves to permit the removal or maintenance of the pumps without affecting the operation of remaining pumps. Isolation valves 10 inches and smaller shall be non-lubricated plug valves. 4 to 6 inch plug valves shall be quarter turn to open. Larger plug valves shall have geared operators with handwheels. Isolation valves larger than 10 inches shall be solid wedge, non-rising stem type gate valves with handwheel operators. Plug valves shall be positioned so that when closed, the valve body is isolated from the actively flowing portion of the piping system. Each pump shall have a swing check valve to prevent backflow through in operative pumps. In

accordance with the criteria for water hammer control, check valves shall be of the type and strength required to eliminate water hammer damage. Plug valves shall be 100% port opening.

(3) Bypass Arrangement

As mentioned in Paragraph (1) above, sewage pumping stations shall have additional pipe, valves, fittings and couplings as necessary to permit bypassing of the station pumping units from a vault separate from the pumping station. This vault should be provided with a gravity drain discharging into the wet well. A valve should be provided in the drain line. This system shall also permit the recirculation of pump discharge back into the wet well for the purpose of scouring solids from the wet well and pumping them into the force main. The emergency pump around piping connections shall be accessible from grade. Submersible sewage pumping stations with a discharge head of 100 feet or greater must have an on-site manhole upstream of the wet well to serve as an emergency wet well for portable pump use. Care should be taken to locate this manhole, when required, out of traffic areas.

(4) Flowmetering

Dedicated pump discharge flowmetering and chart recording devices shall be provided for all custom built-in-place stations and those package stations designated by the Town. Where dedicated flowmetering equipment is not provided, provisions shall be made for utilizing portable flowmetering devices. The Town utilizes ultrasonic flowmetering instruments which normally require a location with limited influence of valves, bends and fittings. For the devices employed by the Town, five upstream and three downstream pipe diameters of straight pipe are usually sufficient. Additional length of straight piping is desirable.

(5) Pumping Units

Sewage pumps shall be 4 inch minimum size. All sewage pumps shall rotate counterclockwise as viewed into the impeller eye. Sewage pumps shall be centrifugal non-clog

solids handling pumps capable of passing a 3 inch sphere. Pump motors shall operate on 460 volt, 3 phase, 60 cycle electrical service. Pump motor horsepower shall be sufficient to prevent motor overload under all possible conditions. Sewage pumps and motors shall be suitable for continuous duty.

(a) Submersible Sewage Pumps

Pump volute, impeller and motor housing shall be of cast iron construction. The pump volute casing and impeller shall be fitted with replaceable stainless steel wear rings to maintain sealing efficiency between the pump volute and impeller. The motor shaft shall be heat-treated high strength alloy steel or high strength stainless tell having a tapered end with keyway to receive the impeller. All nuts, bolts and screws shall be stainless steel. The motor shall be sealed form the pump by independent double mechanical seals. The upper mechanical seal shall run in an oil chamber and the lower mechanical seal shall run in the pumped liquid. All mating surfaces where watertight sealing is required shall be machined and fitted with a rubber O-ring. The machining of mating surfaces shall provide metal to metal bearing on sealing surfaces without crushing the O-ring.

(b) Dry Well Sewage Pumps

Pumps shall be of the vertical biltogether design. Pump volute, impeller, support base, suction elbows, seal housing/motor adapter and motor housing shall be of cast iron construction. The pumps volute an impeller shall be fitted with replaceable stainless steel wear rings to maintain sealing efficiency between the pump volute and impeller. The motor adapter shall have jacking screws to permit adjustment of the wear ring clearances. The pump/motor shaft shall be stainless steel with straight fit impeller and with keyway. All nuts, bolts, and screws exposed to sewage shall be stainless steel. The pumps shall have double mechanical shaft seals, water lubricated. All mating

surfaces shall be machined and sealed with gaskets or rubber o-rings. Where rubber o-ring seals are used, metal mating surfaces shall provide metal to metal bearing without crushing the o-ring.

(6) Pump Starters and Controls

Sewage pumping stations must be suitable for unattended automatic operation. As a result, the pump starting and stopping must be affected by equipment that is direct, reliable and easily understood by operating personnel. Pump starters shall be single speed, full voltage, non-reversing type.

(7) Pump Removal

From time to time sewage pump removal is required for periodic maintenance or overhaul. Dedicated lifting devices for pump removal will be provided for custom built-in-place sewage pumping stations. A motorized trolley hoist positioned over pump access openings shall be furnished. Package sewage pumping stations will not have dedicated lifting devices. Pump removal will be accomplished by a truck mounted boom hoist positioned over access openings. Submersible sewage pumps shall feature stainless steel guide rails and automatic cast iron discharge connection elbow system permanently installed in the wet well. Package wet well/dry well sewage pumping stations shall be furnished with a sufficient number of lifting eyes in the dry well top slab which can be used to assist in safe positioning of the pumps under the dry well access tube for a direct lift.

(8) Gauges

Pressure gauges where required shall be direct reading 4-1/2 inch dial, 1/2 inch connection in accordance with Town specifications.

d. Emergency Station Operations

To ensure that utility power failures do not cause sewer system overflows, provisions to maintain sewage pump station operation with a standby power supply shall be made. The design engineer

shall evaluate the following methods of dealing with utility power failures and select the method most appropriate for the project.

(1) Dual Feed Power Supply

Dual feed power supply shall be provided for the station if available from the power company.

(2) On-Site Power Generation

Where dual feed power supply is not available from the power company, a diesel engine driven emergency electric generator shall be provided. The unit shall be sized to allow both pumps to operate at the same time. Automatic transfer switch shall be provided to switch to emergency power on a power failure or a drop in any phase voltage to 70 percent of line voltage. A 275 gallon minimum aboveground diesel oil tank shall be provided in the generator room for fuel storage.

e. Miscellaneous

(1) Water System

Where water is available, a metered connection from the existing water system shall be made and water for the purposes of flushing and sewage pumping station washdown shall be provided. A 50 foot length of hose with spray nozzle, hose bib and interior backflow preventer shall be provided at a minimum. A water supply system shall be provided for all custom built-in-place sewage pumping stations. If there is no existing water supply system, a well and hydropneumatic tank shall be installed at custom built-in-place stations.

(2) Electrical Service

The electric service shall be 277/480V-3 phase - 4W. The service shall be sized to allow all station fixtures, equipment, and both pumps to operate together.

(3) Convenience Receptacles

120 volt, 1 phase receptacles with GFI shall be provided within the pump station buildings. One duplex outdoor weatherproof outlet shall be provided for the odor control unit and one duplex weatherproof outlet shall be provided for portable tools, lights, etc.

A weatherproof 480 volt, 3 phase, 100 amp receptacle will be provided on the building wall exterior to allow use of a portable emergency pump.

(4) Portable Generator Connection

Pump station buildings shall have a through wall 4 inch diameter pipe sleeve with capped ends to permit the passage of temporary power cables. Power from a portable generator can be delivered to the automatic transfer switch at the emergency generator connection lugs for stations so equipped, or at the station main breaker if emergency generator is not provided.

(5) Coatings and Painting

In general, all exposed construction materials and equipment shall be field painted or have some other form of field applied protective coating. Stainless steel, aluminum, PVC, brick and factory finished items are excluded. Painting unfinished materials shall be in accordance with the specification. Paint and other coatings shall be utilized as necessary to prevent corrosion, extend wear or promote easy to clean surfaces. Paint and coating systems used at sewage pumping stations must exhibit superior durability.

(6) Testing

The installation of mechanical and electrical equipment in accordance with these design standards requires, upon completion and prior to final inspection, testing to insure the standards are met and to maintain quality control. Electrical testing procedures as outlined in Appendix will apply to all electrical equipment. Vibration testing procedures as outline in Appendix will apply to all motor or engine-driven equipment. Load bank testing procedures

as outlined in Appendix will apply to all standby generators.

(7) Autodialer

All pump stations must be equipped with an autodialer with telephone service to allow for telemetry. A Raco Verbatim shall be supplied at a minimum. Additional or substitute telemetry systems may be required as is deemed warranted by the Town at the time of the design of the pump station.

(8) Final Inspection Checklist

Prior to sewage pumping station acceptance as part of the Town of Indian Head Sewage System, a thorough inspection and operational check of the station is required in the presence of a representative of the Town. A typical final inspection test procedure and checklist is attached to the specification. Each sewage pumping station design shall be submitted with an inspection test procedure and checklist tailored to the station.

4. Vibration

The pump station designer is directed to include vibration design and installation requirements in the Specifications.

4.0 CONTRACT DRAWINGS AND DOCUMENTS

4.1 Reports

For sewer mains larger than 8-inches, three copies of a preliminary report shall be submitted to the Town. The report shall include a sketch of the preliminary layout and a summary of the design data.

4.2 Design Computations

1. Design engineers shall submit three copies of design data and calculations for all sewer projects. The computations shall be in accordance with methods presented in this manual.

2. The design data and computations shall include: average, peak, inflow and infiltration, and future requirements.

3. Design computations for all special structures shall be submitted. Where information pertinent to design, such as borings, has been collected, this information shall be submitted to the Town. The locations of borings shall be shown on the plan sheets, and the boring logs shall be included in the Contract Documents. In addition, the Town reserves the right to require borings and geotechnical information.

4.3 Specifications

Contract specifications shall utilize the Town of Indian Head Specifications or, in the absence of Town Specifications, the Frederick County Specifications will apply.

4.4 Contract Drawings

4.4.1 Preparation

Sewer main Contract Drawings shall be prepared on drawings separate from drawings detailing the road design. Separate drawings shall be used for each street.

4.4.2 Plan

a. Scale: 1 inch = 50 feet.

b. Method of Indicating Location

Generally, sewer mains and structures shall be located in Plan by dimensions from property markers or other well defined physical features. However, in areas where physical features are not available, coordinates of structures and bearings of sewer mains based on the Maryland Coordinate System NAD 83/91 shall be used.

c. Fittings

A list of all fittings required shall be shown on each drawing.

d. Contract Drawings shall include the property line surveys and all lot dimensions of the land bordering sewer extensions and shall indicate the names of the present owners of such property with the recording reference number of the deed, lot numbers, house numbers, subdivision names and block numbers, as well as existing rights-of-way or easements. When rights-of-way must be obtained, a right-of-way drawing for each property shall be provided, accompanied by a written description of each right-of-way.

4.4.4 Profile

Profiles shall be shown for all sewer mains. Profile shall be on same sheet as the Plan.

a. Scale

Scale of all profiles shall be 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical. Sewer main profiles on straight streets shall be shown to correct scale. On curved streets, horizontal distances between structures shall be plotted, using length of street centerline between radial projections to structures. The true length between structures shall be shown by figures.

b. Road Grades

Approved established grades shall be obtained from the Town. When such grades are not available, they shall be established by the design engineer and submitted to the Town for approval.

The established grade (noted as top of curb or centerline) shall be shown. Where sewer main is located in present or proposed pavement or shoulders, the existing centerline grade of road shall be shown. Where sewer mains is outside pavement or shoulders for a length greater than 50 feet, existing ground over sewer main shall be shown and labeled.

c. Sewer Main on Fill

Where sewer main is to be constructed on fill, a profile of the undisturbed earth (at sewer main location) shall be shown.

4.4.5 Pump Stations

Sufficient details, plan views and elevations shall be shown for all pump stations, including architectural, mechanical, civil or site, electrical and structural plans and details. The scale of elevations and details shall be 1/4" = 1'-0". Slightly larger or smaller scale views may be used if more appropriate. Site plans should be shown at 1" = 10' or 1" = 20' scale.

4.4.6 Grinder Pumps

Grinder Pump locations shall be clearly shown on the plan view, with a table or chart identifying the depth, type, size and other pertinent details. The plan view shall clearly shown the location of the electrical cables and alarms, breakers and appropriate details.

4.4.7 Other Utilities

Other existing and proposed utilities shall be shown accurately and clearly in Plan and Profile.

4.4.8 Location and Design Information

A Location Plan, showing well known streets, at a scale of 1 inch = 200 feet shall appear on the first drawing of each set of Contract Drawings. A schematic layout of the proposed extensions to the sewer system and adjacent existing lines shall be shown.

4.4.9 Special Details

Structures of details not included in the Standard Details shall be detailed clearly on the Contract Drawings, preferably where the detail is located in Plan.

4.4.10 One (1) copy of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

APPENDICES

SEWER SYSTEM DESIGN MANUAL

APPENDIX A

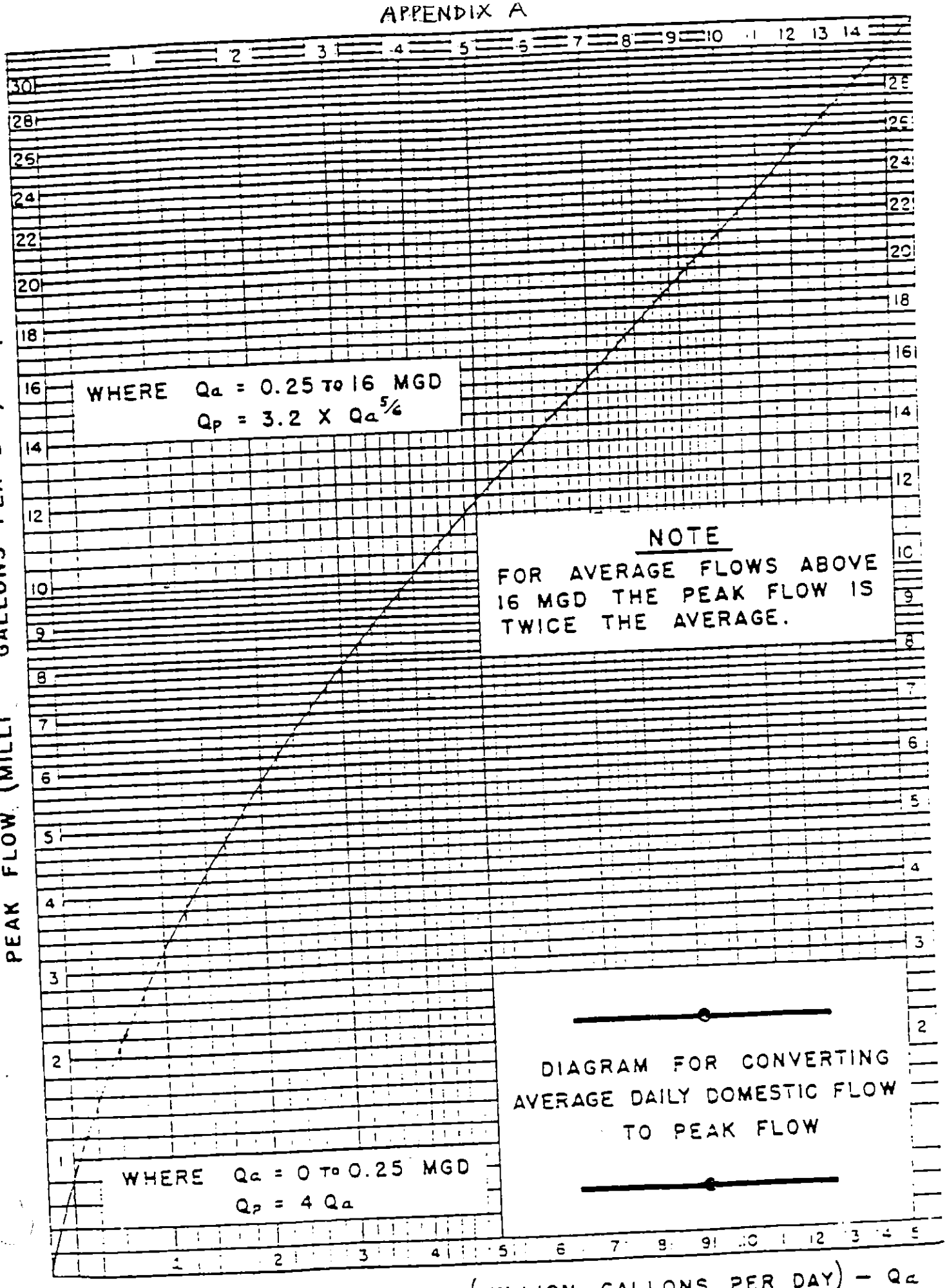


DIAGRAM FOR CONVERTING AVERAGE DAILY DOMESTIC FLOW TO PEAK FLOW

APPENDIX B

FLOW PROJECTION BASED UPON GALLONS PER PERSON PER DAY

Type of Establishment	Gallons per Person per Day (Unless otherwise noted)
Cottages and small dwellings with seasonal occupancy	50
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Dwellings:	
Boarding houses	50
additional for non-resident boarders	10
Luxury residences and estates	150
Multiple family dwellings (apartments)	60
Rooming houses	40
Single family dwellings	75-100
Factories (gallons per person, per shift, exclusive of industrial wastes)	35
Hospitals (per bed space)	350
Hotels with private baths (2 persons per room)	60
Hotels without private baths	50
Institutions other than hospitals (per bed space)	125
Laundries, self-service (gallons per wash, i.e., per customer)	50
Mobile home parks (per space)	250
Motels with bath, toilet and kitchen wastes (per bed space)	50
Motels (per bed space)	40
Picnic Parks (toilet wastes only) (per picnicker)	5
Picnic Parks with bathhouses, showers and flush toilets	10
Restaurants (per seat)	25
Restaurants (toilet and kitchen wastes per patron)	10
Restaurants (kitchen wastes per meal served)	3
Restaurants, additional for bars and cocktail lounges	2
Schools:	
Boarding	100
Day, without gyms, cafeterias or showers	15
Day, with gyms, cafeteria and showers	25
Day, with cafeteria, without gyms or showers	20
Service stations (per vehicle served)	10
Swimming pools and bathhouses	10
Theaters:	
Movie (per auditorium seat)	1
Drive-in (per car space)	5
Travel Trailer Parks without individual water and sewer hookups (per space)	50
Travel Trailer Parks with individual water and sewer hookups (per space)	100
Workers:	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	15

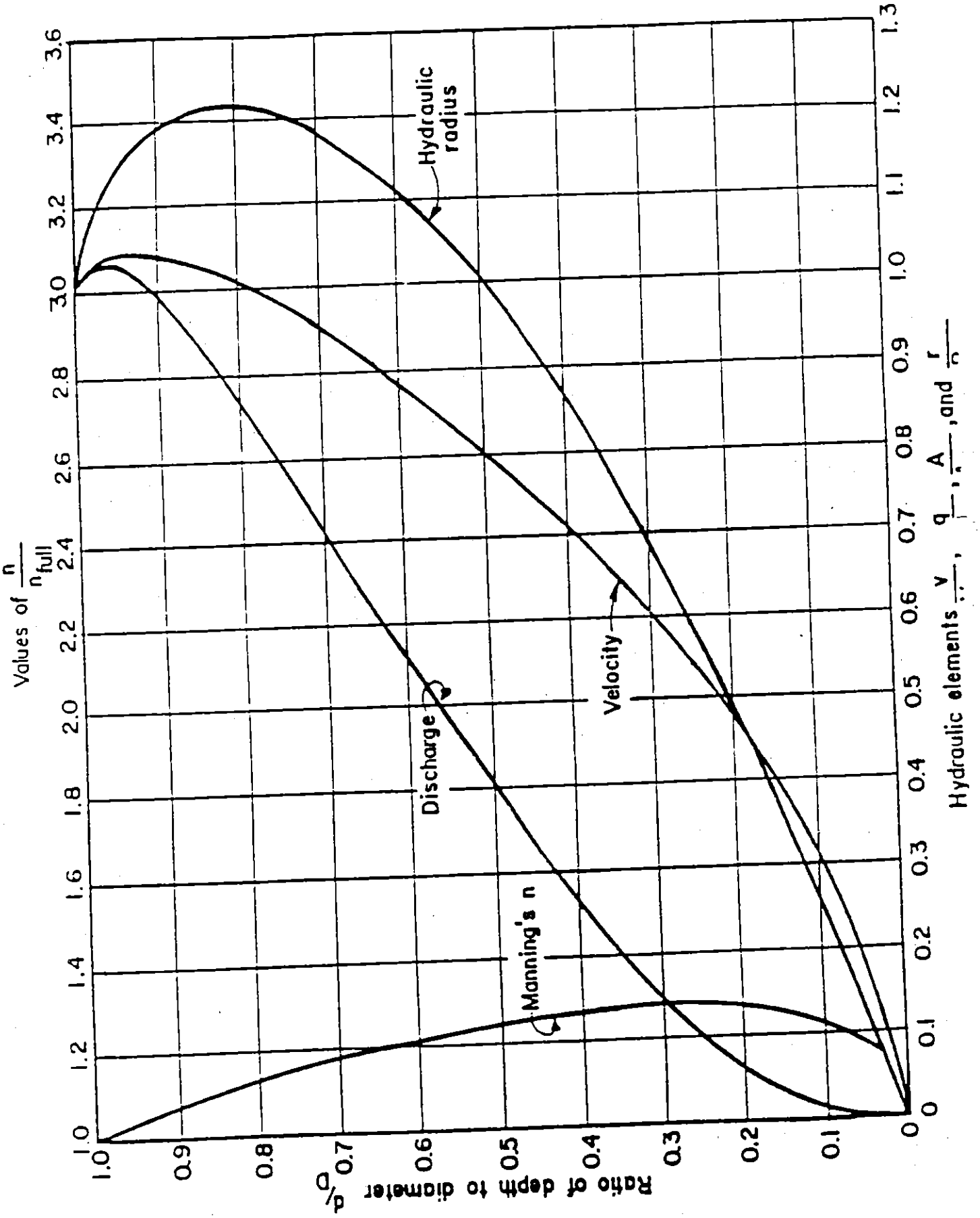
From State of Maryland "Design Guidelines for Sewer Facilities"

APPENDIX C

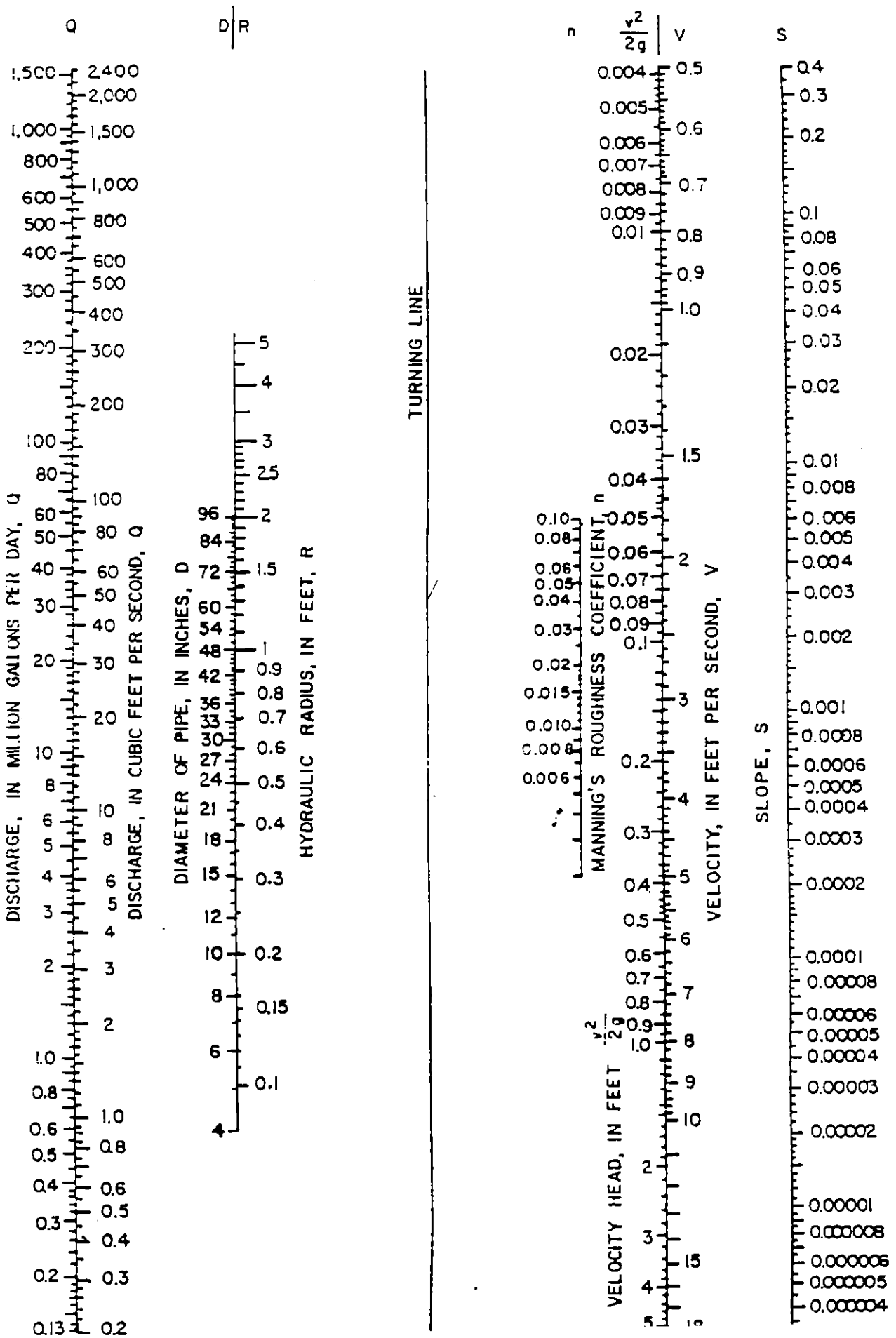
GUIDING FACTORS FOR FLOW PROJECTION RELATED WITH COMMERCIAL ESTABLISHMENTS, PUBLIC SERVICE BUILDINGS OR DWELLING UNITS

Office Buildings	Gross Sq. Ft. x 0.09 = gpd
Medical Office Buildings	Gross Sq. Ft. x 0.62 = gpd
Warehouses	Gross Sq. Ft. x 0.03 = gpd
Retail Stores	Gross Sq. Ft. x 0.05 = gpd
Supermarkets	Gross Sq. Ft. x 0.20 = gpd
Drug Stores	Gross Sq. Ft. x 0.13 = gpd
Beauty Salons	Gross Sq. Ft. x 0.35 = gpd
Barber Shops	Gross Sq. Ft. x 0.20 = gpd
Department Store with Lunch Counter	Gross Sq. Ft. x 0.08 = gpd
Department Store without Lunch Counter	Gross Sq. Ft. x 0.04 = gpd
Banks	Gross Sq. Ft. x 0.04 = gpd
Service Stations	Gross Sq. Ft. x 0.18 = gpd
Laundries and Cleaners	Gross Sq. Ft. x 0.31 = gpd
Laundromats	Gross Sq. Ft. x 3.68 = gpd
Car Wash without Wastewater Recirculation Equipment	Gross Sq. Ft. x 4.90 = gpd
Hotels	Gross Sq. Ft. x 0.25 = gpd
Motels	Gross Sq. Ft. x 0.23 = gpd
Dry Goods Stores	Gross Sq. Ft. x 0.05 = gpd
Shopping Centers	Gross Sq. Ft. x 0.18 = gpd

APPENDIX D
HYDRAULIC ELEMENTS GRAPH



APPENDIX E
MANNING EQUATION NOMOGRAPH



JOB NAME _____ SUBDIVISION _____

PREPARED BY _____ DATE _____

CHECKED BY _____ DATE _____

SHEET _____ OF _____

SEWER DESIGN

AREA SYMBOL		AREA ACRES			POPULATION DENSITY		POPULATION		AVG. DOMESTIC FLOW M.G.D.		AVG. COMMERCIAL FLOW M.G.D.		AVG. INDUSTRIAL FLOW M.G.D.		PEAK DOM. COMM. FLOW M.G.D.		PEAK INDUSTRIAL FLOW M.G.D.		INFILTRATION M.G.D.	DESIGN FLOW M.G.D.		RUNOFF COEFF.	TENTATIVE SIZE INCHES	VELOCITY F.P.S.	
FROM	TO	DOM.	COMM.	IND.	PRES.	ULT.	PRES.	ULT.	PRES.	ULT.	PRES.	ULT.	PRES.	ULT.	PRES.	ULT.	PRES.	ULT.		PRES.	ULT.			PRES. AVG.	ULT. PEAK
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

STANDARD SANITARY SEWER DESIGN

FLOW TABULATION FORM

APPENDIX F

FLOW TABULATION FORM

GEO-TECHNICAL REQUIREMENTS FOR UTILITY DESIGN AND CONSTRUCTION INSPECTION

PURPOSE

The following is intended to provide guidance to the engineer and contractor in their pursuit of the project and not to specifically dictate their activities.

DESIGN PHASE

Geotechnical services provided during water utilities design shall include the selection of boring and test pit locations, and the selection of sample types and intervals, the selection of field and laboratory test procedures, and the preparation of a geotechnical report. At a minimum, the report shall include the following:

1. Project overview.
2. Types of measures that will be needed to check stabilization of excavations and provide values of design parameters (lateral earth pressure distribution, allowable slopes).
3. Need for dewatering systems that may be needed and provide description of groundwater conditions over project limits of work.
4. Foundation preparation measures to be used.
5. Allowable bearing pressures, anticipated total and differential settlement, pipe bedding requirements, etc., to support design loads.
6. Backfill material characteristics required.
7. Estimated volumes of borrow.
8. The level of compaction needed to satisfy design criteria and methods of achieving this compaction through appropriate combinations of compaction equipment, water contents, and lift thicknesses.
9. Pavement design considerations.
10. Pavement reconstruction considerations - address need for road reconstruction around excavations.
11. The basis that will be used for field evaluation of material suitability, adequacy of compaction, acceptability of shoring, etc.
12. The potential sources and magnitudes of uncertainty in geotechnical conditions.
13. Guideline construction specification with respect to geotechnical requirements.

14. Potential for encountering sink holes and mitigation measures for avoidance.

15. Soil boring logs within area of construction and stormwater management facilities.

16. Impact on nearby wells and springs and mitigation measures.

CONSTRUCTION PHASE - FIELD IMPLEMENTATION OF GEOTECHNICAL REPORT RECOMMENDATIONS

Implementation of geotechnical report recommendations and design requirements is critical to satisfactory completion of the project. The following guidelines are to be followed by the project inspector.

1. The design phase geotechnical engineer should be involved during construction. (Depending on the size of the project, this involvement could range from telephone consultation to on-site inspections. However, geotechnical expertise should be available during construction.)

2. A qualified testing laboratory should be engaged.

3. The geotechnical report prepared during design should be provided to the inspector prior to construction. Both the inspector's office and field personnel should be familiar with all aspects of the report, including, but not necessarily limited to the following:

    a. Existing conditions.
    b. Feasibility of using materials from trench for backfill.
    c. Appropriate compaction methods for excavated materials.
    d. Procedures for selecting and approving borrow sites.
    e. Appropriate compaction methods for borrow materials.
    f. Recommendations for when select materials should be used.
    g. Appropriate methods for compaction of select materials.
    h. Appropriate methods for monitoring 'c', 'e', and 'g' above:
        (1) Sampling.
        (2) Laboratory testing.
        (3) Field testing.
    i. Location of sink hole prone areas and mitigation measures for avoidance.

    The inspection personnel must have a sound working understanding of the geotechnical report in order to effectively implement its recommendations. Therefore, this responsibility should be clearly defined in the scope of services for inspection.

4. In consultation with the design geotechnical consultant, the resident inspector should develop a written plan for implementation of the recommendations of the geotechnical report. This plan should include the following:
    a. Identification of the person responsible for insuring adherence to geotechnical report recommendations in the field. Because immediate field decisions are usually required at some time during construction, this person should be well grounded in the subject of backfill materials, methods and compaction, and at least knowledgeable enough to recognize field conditions that do not conform with the geotechnical report and to seek necessary assistance.

b. Establishment of general criteria for use by the field representative in meeting the requirements of the geotechnical report:

(1) Frequency of standard Proctor determinations.

(2) Frequency of soil density determinations.

(3) Criteria for using visual characteristics and soil consistency for spot determinations of backfill material suitability without consulting geotechnical experts.

(4) Criteria for using visual characteristics and soil consistency for spot determinations of compaction suitability without soil density determinations.

c. Establishment of procedures for detailed record-keeping using a daily inspection report form. This form would require that each of the following be addressed:

(1) Conditions encountered.

(2) Help sought from supervisors, geotechnical engineer, etc.

(3) Location of field tests.

(4) Weather conditions.

(5) Notations on visual and manual observations.

(6) Exceptions to geotechnical report recommendations (field decisions).

STORM DRAINAGE DESIGN MANUAL

STORM DRAINAGE DESIGN MANUAL

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1.0 INTRODUCTION

1.1 Purpose of Storm Drainage Design Manual

This manual is intended to provide acceptable criteria, methods, and a framework within which the goals of storm drainage systems may be achieved in effective and efficient ways.

1.2 Laws, Ordinances and Policies

It shall be the responsibility of the developer to be aware of all applicable laws, ordinances and policies associated with the storm water field for projects under design and construction. This design manual is not intended to supersede the laws and regulations of the Natural Resources Conservation Service, the Maryland Department of the Environment, or the State Highway Administration for storm drainage within the State Highway Administration right-of-way.

1.3 Easements, Ownership and Maintenance

It is the Town's policy to require that all storm drainage facilities, whether natural or improved, surface or subsurface, including storm water management facilities, to be within an easement, right-of-way or Town owned lands.

a. Subsurface drainage facilities which convey drainage flow from a public right-of-way shall be enclosed within a drainage easement or Town owned lands.

b. Surface drainage facilities which convey drainage flow from a public right-of-way shall be enclosed within a drainage easement or Town owned lands.

c. Surface drainage facilities conveying storm water from upstream lots comprising a total area of less than one acre will not be required to provide a drainage easement, but the construction plans or the site development plans for the development shall show a drainage swale or underground pipe system which will accommodate the flow.

d. For natural drainage systems, the 100-year floodplain shall be enclosed by a "100-year floodplain and drainage easement" or Town owned lands, which shall be defined by bearings, distances and coordinate values; be tied to

property lines; and show the floodplain elevations at all bearing changes and at intervals not exceeding 200 feet between bearing changes.

e. Storm water management practices which are to be maintained by the Town shall be enclosed within a drainage easement or Town owned lands, which shall include a 10' minimum access surrounding the facility.

f. For improved channels, the 100-year floodplain shall be enclosed by a 100-year floodplain and drainage easement extending beyond the floodplain on both sides of the channel for purposes of access and maintenance.

1. For channels having a top width of 30 feet or less, the easement or right-of-way on one side of the channel shall extend beyond the 100-year floodplain to a line a minimum distance of 10 feet outside of the floodplain. On the opposite side of the channel, the easement or right-of-way shall extend beyond the 100-year floodplain to a line a minimum distance of 20 feet outside of the floodplain. The wider easement or right-of-way shall be located continuously on the same side of the channel between intersecting public roads, but may switch sides of the channel on the opposite side of a public road.

2. For channels having a top width in excess of 30 feet, the wider easement or right-of-way criteria shall apply to both sides of the channel.

g. Discharge and Drainage Easements: Discharge easements for the major drainage system will normally not be required from downstream property owners unless the point of discharge has been significantly altered in location or the size of the drainage basin has been significantly increased in area. Drainage easements for the major drainage system will normally not be required from upstream property owners unless one or more of the following conditions occurs:

1. The point at which the flow crosses the property lines is significantly altered in location. The developer will also be required to construct all facilities to direct storm water runoff to the new point of entry.

2. There is existing development upstream with an closed-conduit channel system and the hydraulic grade line or energy grade line at the next upstream structure is raised above its original or recomputed value.

3. There is existing development upstream with an open-channel system and the hydraulic grade line in the open channel at the property line is raised above its original or recomputed value.

4. There is undeveloped land upstream and a proposed project improvement, other than a bridge or culvert, would raise the hydraulic grade line at the property line above the 100-year floodplain based on the existing natural upstream channel and the ultimate runoff of the fully developed watershed. A flowage easement will be required only if the backwater or headwater at the property line exceeds the previously defined 100-year floodplain by one foot for a bridge or for a culvert. In no case shall an increase be allowed at the property line, with or without a flowage easement, if it causes flooding or increased flooding of existing structures.

h. All existing or proposed surface drainage facilities such as swales, streams, storm water management facilities, unpaved and paved channels, etc., located within privately owned easements will be the legal responsibility of the property owner for operation and maintenance.

i. Surface drainage from an area comprising one acre or more shall be intercepted at the point where the drainage area is equal to or less than one acre and conveyed to a suitable point of outfall via an underground storm drain pipe properly designed to accommodate the drainage expected from ultimate development. Recognizing that it may not be possible or feasible, due to topography or underground impediments, to convey storm drainage the full length to an acceptable stream or other outfall via an underground pipe, the terminal length of the system may consist of an open swale or ditch properly lined to prevent erosion. Should the terminal end of the conveyance system be required to be an open swale or ditch, as determined by the Town, the length of the open swale or ditch shall be the minimum needed to overcome topographic, underground impediments or other physical constraints.

2.0 SUBMITTALS

2.1 General Submission Requirements

2.1.1 Introduction

The Office of Planning and Zoning administers the review and approval process for all subdivision and land development projects and Capital Improvement Projects. Current information concerning applications, review fees, numbers of copies, etc., should be obtained from the Town Office of Planning and Zoning.

In many cases, storm drainage facilities will be presented on roadway, site development, and other plans which include other improvements. If this occurs, the requirements for the storm drainage facilities shall be coordinated with the requirements for other improvements.

2.1.2 Design Computations

Appropriate hydrologic, hydraulic, geometric, structural, and other design computations, together with the environmental inventory and assessment, shall accompany all submissions for storm drainage improvements. If an appropriate form or table is not presented in the Design Manual, a suitable engineering style of computation shall be followed.

Complete sets of hydrologic and hydraulic design computations shall be included with all submission, review and record copies of plans involving storm drainage facilities. The materials may be included at the original size of the various computation tables and forms or they may be combined in sequence and reproduced on 24 inch x 36 inch sheets to match the size of the plan sheets. These items need not be included in sets of plans for bidding or construction purposes. In addition to those bound into the plans, two (2) copies or more, if required, of all storm drainage design computations shall be submitted in separate binders which will fit in a standard letter or legal sized file.

2.1.3 Specifications

All storm drainage construction shall meet or exceed the following specifications as appropriate:

a. State Highway Administration Specifications for Materials, Highway, Bridges, and Incidental Structures, latest edition for all work within the State Highway Administration's right-of-way.

b. 1994 Maryland Standards and Specification for Soil Erosion and Sediment Control or most current edition for all work within the Town Boundaries.

c. Charles County Plumbing Code, latest edition for work on private property.

d. Walkersville Standard Details and Specifications for Construction, latest edition for all work within the Town Boundaries and outside of County, State or Federal land.

Specifications for items not covered in these specifications shall be submitted to the Town for review and approval. Whenever a conflict exists between the standards mentioned herein, the most stringent requirement(s) will apply.

2.1.4 Quantities and Cost Estimates

In conjunction with other required public improvements, design engineers shall submit a tabulated estimate of all quantities and costs, including contingent items, for all storm drainage facilities, soil erosion and sediment control measures, and storm water management facilities. The Office of Planning and Zoning should be consulted for information relating to the latest format for both development and Capital Improvement Projects.

2.1.5 Easement Plats and Transmittal Sheets

Where storm drainage facilities will occur in areas outside of public roads and highways or easements to be shown on the project final subdivision plat, supplementary easement plats will be required.

2.2 Specific Plan Requirements

2.2.1 Introduction

The purpose of this section is to indicate the specific requirements for storm drainage facilities, soil erosion and sediment control measures, and storm water management facilities as shown in the various plan submissions. The Town's Subdivision Regulations provide requirements for plan submissions which shall include storm drainage facilities, easements, if applicable.

2.2.2 Drainage Area Map

Off-site drainage area maps shall be prepared from the largest practical and available scale topographic maps. On-site drainage area maps shall be prepared at the scale of project preliminary or site development plan. Preliminary drainage area maps shall be revised to reflect final design conditions if they are to be utilized for the final drainage area map.

The entire area under consideration shall be subdivided into areas tributary to entry or design point. Each tributary area shall be delineated by bold, dashed lines along its ridges. Sufficient flow arrows shall be shown to clearly indicate high points, direction of surface runoff, direction of gutter or channel flow and points of concentration. Final drainage area maps shall show all paths of drainage at street intersections, gutters and side road ditches.

2.2.3 Construction Plans

a. Construction plans involving storm drainage shall include, at a minimum, the following:

Grading Plans

Road Plans

Site Development Plans

Soil Erosion and Sediment Control Plans

Storm Water Management Plans

Storm Drainage Profiles

Detail Sheets

Structure and Pipe Schedule

Final Drainage Area Maps

Storm Drainage Plan-Profiles

1. Grading Plans: Separate grading plans may be required by the Office of Planning and Zoning if a road or site development

plan is insufficient or too complex to portray area grading. These plans are normally prepared at the same scale as the preliminary or site development plan. They should show existing and proposed grades, contours, temporary or permanent drainage, existing features and be coordinated with the Soil Erosion and Sediment Control Plan.

2. Road Plans: These plans shall show the location and geometrics of the storm drainage system and its horizontal relationships with property lines, easements, public roads, and other existing and proposed improvements. This plan shall also show the drainage system identification, size, structure schedule and flow directions.

3. Site Development Plans: Site development plan requirements are delineated by the subdivision and land development regulations. Insofar as storm drainage is concerned, they fulfill essentially the same function as roadway plans. Additionally, they are often utilized to indicate the 100-year floodplains, grading, soil erosion and sediment control, if separate plans are not to be prepared. Floodplains shall be determined.

4. Soil Erosion and Sediment Control Plans: These plans are usually prepared on a reproducible copy of the preliminary grading or site development plan and hence have the same scale as these plans. They shall show the location and geometrics of the erosion and sediment control measures and the horizontal relationships of them with property lines, easements, public roads, and other existing and proposed improvements. This plan should also show necessary seeding and other specifications, construction sequences, details, watersheds being served by sediment basins, and certifications. The Natural Resources Conservation Service should be consulted for the latest requirements.

5. Storm Water Management Plans: These plans are utilized if other plans are not appropriate to show the storm water management facilities. A reproducible copy of the preliminary grading or site development plan may often be utilized for this plan. This plan serves the function of all plans for the horizontal location of the improvements. In addition, this plan shall also show necessary specifications,

special details or structures, watersheds being served, maintenance responsibilities, and certifications.

6. Storm Drainage Profiles: Storm drainage profiles are utilized in conjunction with some type of plan which shows the horizontal aspects of the storm drainage facility. Storm drain profiles shall show the existing and proposed grade of closed conduits, the conduit size, type, class, length, slope, upstream and downstream invert elevations, structure invert development and designations, design discharge, full-flow velocity and part-full velocity, if the last was computed. In addition, the profiles shall state and show graphically the locations of the hydraulic grade line as specified. For open channels essentially the same information shall be shown except that both the water surface and energy grade line profiles shall be stated and shown graphically. Approximately 400 feet upstream and downstream of the water course shall be shown.

7. Detail Sheets: If other types of plans or profiles are insufficient, detail sheets may be necessary. They contain architectural, structural, and other elements of any special details. They are prepared to an architectural scale, usually 3/8 inch = 1 foot for simple details and as large as 3 inches = 1 foot for highly complicated details. They shall clearly present all information necessary for the fabrication or construction of the item. For significant structures subsurface exploration data, design standards, loadings, foundation pressures and design stresses shall be given. Major material categories or specifications shall also be given.

8. Final Drainage Area Maps: These represent a refinement of the preliminary drainage area maps.

9. Storm Drainage Plan-Profiles: This special type of plan is utilized if the drainage facility is the major improvement. Scales will be similar to those for road plan-profiles. These plans shall contain essentially the same information contained in the previously described plan types and the separate storm drainage profiles.

10. Structure Schedule and Pipe Schedule.

11. Three (3) copies of the final plans shall be submitted to the Office of Planning and Zoning for use by the Town in updating the Town's system maps.

12. One (1) copy of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, shall be submitted to the Office of Planning and Zoning within thirty (30) days of completion and acceptance of the work by the Town and on computer or GIS diskette in a format approved by the Office of Planning and Zoning.

2.2.4 Final 100-Year Floodplain Determination

In addition to the necessary computations, the following shall be submitted:

a. Channel and floodplain cross-sections plotted on full cross section paper (1 inch = 20 feet or 50 feet horizontal, and 1 inch = 5 feet vertical) or presented as computer plotter output. Indicate Manning n factor for each subsection of cross section.

b. Channel profile (1 inch = 100 feet horizontal and 1 inch = 10 feet vertical, or 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical) plotted on full cross section paper or computer plotter output with the channel meander used as the horizontal length and showing the tops of channel banks, water surface, energy grade line, and distribution of flow and average velocities for overbanks and channel, if available.

2.2.5 Final Subdivision Plat

For storm drainage, the plat shall show drainage easements, 100-year floodplain limits and elevations, maintenance responsibilities and dedication statements.

2.2.6 Capital Improvement Projects

Capital Improvement Projects shall meet the same general criteria as the developer projects and shall meet the site specific project scope of services.

2.3 Review and Approval

Storm drainage submissions will be reviewed by the following agencies for compliance with the given requirements:

a. Town Office of Planning and Zoning for compliance with the Subdivision and Land Development Regulations and for compliance with the following:

1. Subdivision and Land Development Regulations

2. Design Manual

3. Grading Permit

4. Storm water management inspection schedule, reports and requirements during construction

5. Storm water management maintenance and maintenance agreement

b. Other Town or Charles County agencies for compliance with the subdivision and land development regulations.

c. Natural Resources Conservation Service and Maryland Department of the Environment, as appropriate, for compliance with *1994, Maryland Standard Specifications for Soil Erosion and Sediment Control* and NRCS criteria for the design of dams and ponds for storm water management.

d. Department of Transportation, State Highway Administration for compliance with its design practices, criteria and specifications for construction within its rights-of-way for an access permit.

e. Maryland Department of the Environment for issuance of a permit involving construction in a major floodplain or a major dam and reservoir where drainage area is 200 acres or greater for Class I and Class II waterways and 100 acres for Class III and Class IV waterways.

f. U.S. Department of Housing and Urban Development, Federal Insurance Administration for compliance with its criteria and regulations for floodplain delineation for Federal Flood Insurance.

g. U.S. Army Corps of Engineers for permit.

3.0 STORM DRAIN DESIGN STANDARDS

3.1 Criteria and Procedures

The criteria and procedures for design shall be consistent with approved environmental practices and existing laws and regulations which are concerned with storm water runoff. They are also intended to be compatible with the Natural Resources Conservation Service, Maryland Department of the Environment, and the requirements of other State and County agencies as they pertain to the Town of Indian Head.

3.2 Topographic and Land Use Maps

Topographic maps shall be obtained from the Office of Planning and Zoning, if available. If additional or supplemental topography or planimetric mapping is needed, the Developer shall be responsible to secure the information. Zoning and approved land use maps are available from the Office of Planning and Zoning.

3.3 Drainage Problems not Covered Herein

When a specific drainage problem is encountered which is not covered in the Section, it will be the responsibility of the Engineer to furnish the Office of Planning and Zoning with calculations and other data supporting his design.

4.0 HYDROLOGY

4.1 Rational Method

The rational method may be used for homogeneous drainage basins of 100 acres or less for closed storm drain systems. For drainage basins greater than 100 acres, but less than 500 acres, it may be used for determination of peak runoff only. Ultimate conditions shall be determined based on current zoning. Existing and pre-developed conditions shall be determined based on 1" = 200' scale or large topography and field recommendations. The rational method may not be used for storm water management design, culvert or bridge crossings. With the rational method, the peak discharge at any point may be determined by the formula:

$$Q = CIA$$

In this formula:

Q = the peak discharge in cfs
C = the runoff coefficient
I = the average rainfall intensity in inches per hour
A = the drainage area in acres

For clarity: in/hr x acres = 1.008 cu ft/sec

4.2 Hydrograph Methods

The size of the drainage area shall be limited to 500 acres maximum and shall be homogenous with respect to the time of concentration and land use. The latest version of Natural Resources Conservation Service (NRCS) TR-55 "Urban hydrology for Small Watersheds" may be used for small watersheds. The latest version of NRCS TR-20 "Computer Program for Project Formulation-Hydrology" may be used for areas greater than 500 acres.

4.3 Rainfall Intensity (I)

Use the NRCS Type II rainfall distribution for a 24-hour storm and antecedent moisture condition II.

4.4 Time of Concentration (T_c)

4.4.1 How Determined: The time of concentration consists of the sum of the inlet time and the time of flow in the system from the most hydraulically distant point in the drainage area to the point under consideration. Inlet time includes time for establishment of flow and time in swales, ditches, gutters, etc. An acceptable

average value of the inlet time as a function of percentage impervious area may be obtained from the following relationship:

$T_i = 15.0 - PI/8$

in which T_i is the inlet time in minutes and PI is the percent impervious area within the inlet area under investigation.

4.4.2 By Zoning Classification

a. Minimum Inlet Time: Shall be 5 minutes regardless of zoning classifications.

b. Maximum Inlet Time: For zoning classifications with an allowable percent impervious area greater than 50%, the maximum allowable inlet time shall be 7 minutes.

4.5 Runoff Coefficients (C)

The runoff coefficient is a factor which relates the runoff rate to the rainfall intensity. This coefficient is dimensionless and takes into account the percent impervious, soil type, and slope of contributing drainage area.

Average values of runoff coefficients are shown in Table 2 for various land uses. A composite "C" value for the drainage area under consideration is computed in an area-weighted average of the individual runoff coefficient of the various sub-areas of the watershed.

4.6 Special Considerations

4.6.1 Partial Area Contribution

In some watersheds, particularly if there are large amounts of impervious areas near the downstream portions of the basin, the peak rate of runoff may be realized when only these areas are contributing. Because the design intensity will be based on their shorter time of concentration, rather than the longer time of concentration for the entire watershed, the discharge may be greater than when the entire watershed contributes at a reduced intensity and runoff coefficient.

4.6.2 Apparent Reduction in Peak Discharge

In many watersheds, particularly where the mainstream channel is in a natural condition and there are not significant tributaries, the intensity values associated with time of concentration based on the travel time in the mainstream will decrease faster than the total area of the watershed increases. This results in a decrease in the product of I times A and, hence, the peak runoff shall not be decreased, but the greatest upstream value of peak runoff shall be used until a point is reached for which the peak runoff rate again increases.

4.7 Watershed Modeling

4.7.1 Soil Conservation Service TR-20

The NRCS's Technical Release No. 20 "Computer Program for Project Formulation-Hydrology" is a valid approach to hydrologic modeling of watersheds and should be considered when any of the following conditions exist:

a. Watersheds are larger than 500 acres.

b. There are many sub-area with different runoff characteristics.

c. Reservoirs and dams are either existing or proposed.

d. Historical storm events need to be analyzed.

e. A complete flood hydrograph is desired.

4.7.2 NRCS's Tabular Method

Smaller watersheds may be analyzed using the NRCS's Tabular Method as described in Technical Release No. 55, "Urban Hydrology for Small Watersheds."

4.7.3 Other Models: Other hydrologic computer programs may be used with prior approval of the Office of Planning and Zoning. A user's manual and complete input data and printout must be submitted for each project.

5.0 HYDRAULICS

5.1 Closed Conduit Flow

5.1.1 Size of Drains: Shall be established as follows:

$Q = a\ v$ where:

Q = Quantity of flow in cfs.

a = Required area of conduit in square feet

v = velocity in feet per second

5.1.2 Velocity: Shall be determined by the Manning Formula:

$$v = \frac{1.486}{n} r^{2/3} s^{1/2}$$ where:

n = coefficient of roughness

r = hydraulic radius in feet = $\frac{\text{cross-sectional area}}{\text{wetted perimeter}}$

s = slope of hydraulic gradient in feet per foot

5.1.3 Minimum and Maximum Velocities: The minimum velocity shall be 2 fps, and the maximum velocity shall be based on boundary surface material and shall not exceed 25 fps.

5.1.4 Manning's Coefficient (n): The selection of a friction coefficient involves a consideration of not only the initial but also the future conditions of the boundary surface material. Also hydraulic conditions such as velocity and disturbing influences such as joints, alignment, variations in cross-sections, etc. will affect selection. Design values for man-made conduits are given in Table 3.

5.1.5 Hydraulic Gradient: The hydraulic gradient is a line connecting points to which water will rise in manholes and inlets, etc. throughout the system during the particular design flow. The hydraulic gradient shall begin at the downstream end of the proposed drainage system. Where a proposed drainage system is connected to an existing system, the hydraulic gradient

at the point of junction shall be determined from existing plans on file with the Office of Planning and Zoning.

Where there are no record drawings available which indicate the elevation of the existing hydraulic gradient, it shall be the Engineer's responsibility to determine this elevation.

Closed conduit design shall be based on the hydraulic grade line method with pipes assumed to be flowing full. The losses are applied through the structures. The losses are identified and applied as follows:

a. Loss at entrance

$$h_e = Ke \frac{V^2}{2g}$$

b. Loss due to bends

$$hb = K_b \frac{V^2}{2g}$$

c. Loss at Junctions

The controlling angle is used to calculate the loss at the structure.

d. Loss for the length of the pipe.

One equation that can be used is:

$$h_L = 2.87\ n^2 \frac{LV2}{{}_d4/3}$$

5.2 Open Channel Flow

5.2.1 Size of Required Waterway

The waterway area required shall be determined from the relationship:

$$Q = AV \text{ and Mannings Formula } V - \frac{1.486}{n} r^{2/3}{}_{1/2}$$

5.2.2 Minimum and Maximum Velocities

Minimum velocities for improved channels shall be 3 fps. The maximum velocities will be controlled by the erodibility of the lining. The maximum velocity shall not normally exceed 25 fps for non-erodible lining. For allowable velocities in erodible and non-erodible channels, see Table 5.

5.2.3 Manning Coefficients (n)

Design values for man-made channels are well established and are given in Table 3. Natural channels are subject to more variants and present a complex problem. For an extensive treatment of natural channels, the Engineer is referred to Chow, V.T. "Open Channel Hydraulics."

5.2.4 Water Surface Profiles

a. Improved Sections: The solution of the Manning equation often involves a trial-and-error process. However, numerous tables, graphs and capacity charts are available for a variety of channel slopes to facilitate computation, and any of these expedients resulting in sufficient accuracy may be used for design.

b. Natural and Irregular Sections: Streams and channels with irregular and varying "n" coefficients are usually analyzed by the following methods:

1. Standard Step Method: For sample computations, the designer is referred to King, H.W. "Handbook of Hydraulic" and Chow, V.T. "Open Channel Hydraulics."

2. U.S. Army Corps of Engineer Computer Program HEC-2 may be used for design without documentation, providing a complete listing of all input data, including cross-sections, is furnished along with the complete printout.

5.3 Energy Dissipators and End Treatment

5.3.1 Determination of Maximum Outlet Velocity

In all cases, the partial depth velocity shall be checked to determine the maximum outlet velocity to be used in the design of the end treatment.

5.3.2 Drop Structures

One of the most effective means of dissipating energy in channels is the drop structure (abrupt or steeply sloping). Whichever method is employed, sufficient data is to be furnished to support the design.

5.3.3 Stone-Filled Wire Baskets (Gabions)

Wire baskets of various sizes offer an effective means of dissipating velocities at the ends of structures and/or to construct checks or drops in channels. The Engineer is referred to Federal Highway Administration Hydraulic Design Series Nos. 11 and 15 for more specific design criteria. Sizing the stone is critical and will require design and analysis of the velocities for various states of flow. Wire baskets shall be vinyl coated.

5.4 Culverts

5.4.1 Losses Through Culverts

The determination of losses through culverts is well documented in various texts. The Engineer is referred to the FHWA Hydraulic Design Series Nos. 5 and 10 and the U.S. Army Corps of Engineers Computer Program HEC-2 for specifics concerning the design of these structures.

5.5 Bridges

5.5.1 Losses Through Bridges

The determination of losses or the amount of backwater produced through a bridge is complex, and the Engineer is referred to FHWA Hydraulic Design Series No. 1, "Hydraulics of Bridge Waterways" and the U.S. Army Corps of Engineers Computer Program HEC-2 for specifics concerning the design of these structures.

The minimum freeboard between the underside of the superstructure and the design high water shall be 2 feet, based on the 100-year frequency storm with ultimate development using current zoning.

5.6 Reservoir Routing

5.6.1 Drainage Areas Less Than 2,000 Acres

These shall be designed in accordance with the NRCS criteria established in Technical Release No. 55, Engineering Memorandum No. 378, and Engineering Memorandum No. 2.

5.6.2 Drainage Areas Greater Than 2,000 Acres

The design method shall be approved by the Office of Planning and Zoning.

6.0 COLLECTION AND CLOSED SYSTEM DESIGN

6.1 Specific Design Criteria

6.1.1 Design Storm Criteria

a. Minor drainage systems with flows of less than 10 c.f.s. shall be designed for the 10-year storm as a minimum, except as required in 6.1.1.(b) (c) (d) and Section 7.0.

b. When a closed conduit system is installed to replace an open swale drainage system serving drainage areas of 25 acres or more and/or having a 10-year discharge of 100 cfs or more, the system shall be designed for the 100-year storm.

c. Culverts and/or bridges which are in the 100-year floodplain shall pass the 100-year design storm. The ultimate conditions 100-year storm shall not have more than a one-foot increase in backwater above the existing conditions. A one-foot freeboard is required for the ultimate conditions 100-year storm.

d. The following minimum storm frequency criteria must be met for storm drain systems and culverts:

1.	Cul-de-Sac Street	10 year
2.	Local Road	10 year
3.	Collector Road	25 year
4.	Arterial Road	50 year

In the event the Town believes that a greater year storm frequency should prevail for the design of storm drain systems due to concerns over excessive private or public property damage, disruption of public services, flood damage, or other undesirable impacts that may result from implementing the minimum criteria described herein, the Town, at its sole discretion and with the approval of the Planning Commission, may require more stringent criteria be followed in the design.

The roads cannot be flooded on the above storm frequency. The water surface elevation should be a minimum of one-foot below the outside edge of the shoulder.

e. The inlet spacing shall be based on the 2-year ultimate condition storm and an eight foot (8') maximum spread onto the pavement measured from the face of the curb.

6.1.2 Basic Equations

a. $Q = A_1V_1 \quad = A_2V2$

Q = Discharge in cfs

A = Cross-sectional area in ft^2

V = Velocity in fps

The subscripts designate different channel or conduit sections.

b. $V = \frac{1.49}{n} \quad R^{2/3} S^{1/2}$

V = velocity in fps

n = Manning coefficient

R = Hydraulics radius in ft.

S = Friction slope in ft/ft.

c. For pipes flowing full

$V = \frac{0.59}{n} D^{2/3} S^{1/2}$

6.1.3 Minimum and Maximum Velocities

a. The minimum velocity in storm drains shall be 2 fps.

b. The maximum velocity in storm drains shall be 25 fps.

6.2 Hydraulic Design Criteria

6.2.1 Hydraulic Grade Line Method

Closed conduit systems shall be designed by the hydraulic grade line method which assumes pipes to be flowing full. In this method, structure losses are approximated by nearly constant functions of velocity head of the incoming or outgoing flow. The losses are applied through a structure.

The hydraulic grade line in a structure or access point shall be below the top of the grade or curb's opening for the design storm and at or below the curb for the 100-year storm.

6.2.2 Future Extensions

Consideration shall be given to possible future extensions of the system.

6.3 Gutter and Street Flow

6.3.1 Flow Spread Requirements

Maximum permissible spread for flow in a curbed street shall be eight feet (8') for the two-year ultimate condition storm event.

Computations shall be based on the following equation:

$$\frac{Q_n}{{}_y 8/3 \; {}_S 1/2} = 0.56 \, Z$$

Q = discharge in cfs

Z = the reciprocal of the pavement cross slope or side slope in ft/ft
For example, for 1/4"/ft or 2.08% cross-slope, Z = 48)

n = Manning coefficient (normally 0.015 for pavement)

S = gutter slope in ft/ft

y = depth of flow in feet

6.3.2 Gutter Capacity

The gutter capacity cannot be exceeded; i.e., the curbs cannot be overtopped for the 100-year storm.

6.4 Inlet Design

6.4.1 Type of Inlet

State Highway Administration (SHA) Standard COG or COS inlets must be used where curbs are either existing or proposed. Grated inlets shall be SHA WR bicycle safe grates and shall generally be used only in pavement swales such as occur in parking lots and alleys or yard areas.

6.4.2 Where Required

Inlets shall be constructed in all sumps, regardless of flow volume, and at all intersections where flow exceeds 2 c.f.s. or the spread onto the pavement exceeds eight feet (8') and at intermediate points along street where criteria for gutter capacity will be exceeded. Pipes shall have a capacity equal to or greater than design flows, and inlets shall intercept a minimum of 85 percent of the design flow. Any carry-over flow must be accounted for at the next downstream inlet and shown on the Engineer's calculations.

6.4.3 Weep Holes or other temporary measures shall be installed in the catch basins for interception of runoff from the street until the final hot mix asphalt surface coarse has been installed or at the direction of the Town or Sediment Control Inspector.

6.5 Closed Conduit Design

6.5.1 Manholes

a. Where used: Shall be used at all change in pipe size and where there is a change in direction.

b. Spacing: Maximum spacing of manholes shall be 400 feet.

c. Alignment: The horizontal alignment of pipe shall be straight line between access points and perpendicular to the road centerline if the pipe crosses the road, wherever feasible. At all inlets, manholes,

etc., the invert of the pipe's upgrade shall be a minimum of 0.1 foot above the invert of the pipe downgrade.

6.5.2 Clearance with Other Utilities

For drains nearly parallel to other utilities, a minimum physical horizontal clearance of 5 feet shall be maintained. A minimum physical vertical clearance of 18 inches shall be maintained. Clearances less than this must be approved by the Office of Planning and Zoning.

6.5.3 Minimum Cover

Minimum cover for pipe in roadway shall be 18 inches, measured from the top of the pipe to the finished grade.

6.5.4 Size of Drains

Closed conduit systems shall be sized pursuant with the preceding hydraulic criteria, and the minimum pipe size shall be 15-inch diameter or equivalent.

6.5.5 Materials

All storm drain pipe shall be reinforced concrete pipe, Class III minimum, and required to meet State Highway Administration bedding conditions. Pipe joints shall be sealed with o-ring rubber gaskets.

The following minimum construction methods shall apply:

a. Backfill under the haunches of the pipe shall be hand-placed and tamped.

b. The backfill shall be placed in 6-inch layers equally on each side of the pipe and shall be thoroughly compacted to a minimum of 95% Modified Proctor Density in pavement areas and 90% in unpaved areas.

6.5.6 Foundations

In all cases, adequate bedding conditions shall be provided for drains. The Engineer shall detail on the Plans acceptable methods for supporting drains on unstable soil or fresh fill. Soil borings shall be taken if it is presumed that rock exists in the area or the suitability of material must be determined in order to adequately design the facility. A minimum of 3 inches of gravel bedding shall be placed below the pipe and bedded in gravel up to the spring line of the pipe.

6.5.7 Pipe Loadings

a. Foundation Designs in Specific Locations: Borings will be required for foundation designs in locations where the quantity of runoff requires a 72-inch diameter pipe or larger waterway area. The Engineer shall be governed by the analysis and recommendations of the Soils Engineer for foundation or pipe bedding designs.

b. Pipe Depths and Widths: In locations where the width of pipe trenches exceeds the standard maximum trench width, the loading on the pipe equals a projecting condition, and the design shall be based on positive projecting pipe loadings.

c. For Designs not Included Herein: The design of pipes and/or conduit shall be in accordance with the method presented in ASCE "Design and Construction of Sanitary and Storm Sewers", Chapter 9, Structural Requirements.

7.0 OPEN CHANNEL DESIGN

7.1 Swales, Roadside and Shoulder Ditches

These and other minor waterways having a design flow of less than 10 cfs shall be designed based on a 10-year storm frequency except as required in Section 6.1. All other open channels, improved or natural, shall be designed based on a minimum 50-year storm frequency or consistent with the criteria described in Section 6.1.1(d). Open swales or ditches shall not be used to convey storm water from a drainage area greater than one acre in surface area unless an open swale or ditch is necessary at the terminal end of the system to transition to an acceptable outfall, as discussed in Section 1.3(i).

7.2 Waterway Depth

Maximum waterway depth for all improved channels shall be two (2) feet.

7.3 Freeboard

Generally, freeboard shall be 30 percent of the design depth. This is an approximation. The minimum freeboard shall be 1.0 foot.

7.4 Velocities

a. For non-erodible linings the maximum velocity shall be 25 fps and the minimum velocity shall be 3 fps.

b. For vegetative and natural linings, see Table 5.

7.5 Open Channel Design Criteria

a. The design storm will be based on ultimate development.

b. The time of concentration will be based on:

1. the replacement of hydraulically inadequate bridges and/or culverts upstream of the project or within the project.

2. ultimate development.

c. Manning's coefficient based on

1. existing conditions unless changes in the coefficient are included in the proposed project.

2. the highest seasonal variation of the coefficient.

d. For improved channels, the profile and velocities of the natural stream shall be examined, both upstream and downstream of the proposed development for the following locations:

1. at the beginning and end of the improvement for all projects,

2. five (5) feet for all projects,

3. two hundred (200) feet for projects with drainage areas less than 50 acres,

4. five hundred (500) feet for projects with drainage areas between 50 and 200 acres,

5. one thousand (1000) feet for projects with drainage areas greater than two hundred (200) acres.

e. Riprap for energy dissipators and for bend locations shall be sized for the 100-year storm velocity.

f. If the headwall or bridge height above the channel bottom exceeds five (5) feet, or is within three (3) feet of a sidewalk, then channels which do not require a safety fence shall be provided with guard rails, or other safety device.

g. In non-erodible channels, the flat bottom may be sloped one to two percent to the center to define a low-flow channel.

h. The waterway depth based on the design storm shall be two (2) feet or less for all improved channels.

i. All open channels shall be lined with two feet (2') of clay or synthetic liner to reduce the possibility of creating or exacerbating sinkhole activity.

j. The minimum longitudinal slope of open drainage swales shall be 1.0 percent.

8.0 CULVERTS

8.1 Guardrails, Fences and Pipe Rails

Safety devices shall be required at all headwalls, as deemed appropriate by the Planning Commission.

8.2 Structural Borings

Structural borings to determine character and bearing capability of in-site material underlying foundations shall be provided for all single cell or pipe culverts of an opening size greater than twenty (20) square feet.

For the purpose of this design manual, a culvert shall be defined as a structure under a roadway or other embankment, open at each end, placed for the purpose of conveying a natural stream, waterway, or storm drainage.

8.3 Culvert versus Bridge

In general, the Town of Indian Head will only approve culverts for stream crossings. If the Developer or his Engineer believes that only a bridge structure will satisfy the hydraulic, environmental and other prevailing criteria, the Engineer shall submit written analysis comparing the use of culvert and bridge. The analysis should include capital costs, maintenance costs, traffic maintenance, soil conditions, rights-of-way, and hydraulics and environmental impacts.

8.4 Inlet Protection

The inlet of all culverts shall be provided with a headwall or some other acceptable means of terminating the pipe and protecting the culvert from erosion.

8.5 Outlet Protection

It shall be the Engineer's responsibility to determine the need for erosion protection at the culvert due to excessive velocities. Outlet velocities shall be compared to stream velocities at the site under consideration to determine the need for erosion protection. The Engineer shall furnish data which supports the lack thereof for erosion protection.

8.6 Structural Design

The structural design of reinforced concrete box culverts shall be in accordance with the "Standard Specifications for Highways and Bridges", adopted by AASHTO. Culverts shall be sized using FHWA Design Series 5 and 10 and the U.S. Army Corp of Engineer's Computer Program HEC-2.

8.7 Minimum Freeboard

The minimum freeboard between the underside of the superstructure and the design storm water surface elevation shall be one (1) foot. The headwater of the structure shall be as close to the existing water surface elevation as possible. In trout streams, one culvert shall be one (1) foot lower than the final grade elevation.

8.8 Minimum Length

The minimum length of the culvert shall be based on providing for a 1/4 inch per foot graded area eight feet (8') behind the curb or two feet (2') behind the sidewalk, whichever is greater, and a side slope of 3:1 from this point.

9.0 BRIDGES

9.1 General

Bridge design is too broad a subject to be treated herein. However, the following guidelines are to be considered.

9.1.1 Where Used

Bridges shall be used for those cases where:

The quantity of flow to be passed is too great for a culvert;

Obstructions on the floodplain are to be avoided; or

Preservation of natural stream conditions is warranted.

9.1.2 Minimizing Lateral Forces

To minimize lateral forces on the structures, water must pass beneath the bridge without a standing headwater pool as is normal for a culvert. This requires the superstructure to be raised higher than that of a comparable box culvert.

9.1.3 Problems for Waterway Openings

Two of the foremost problems with bridge construction for waterway openings are the protection of the substructure from scour and erosion and the minimization of waterway obstruction. The placing of abutments and piers in the deepest flowing parts of the stream is prohibited.

9.1.4 Additional Considerations

a. To minimize accumulation of debris, stream crossings shall have as few supports in the waterway opening as possible, and all should be avoided if the flow is super-critical.

b. Embankments and grading around the substructure of a bridge shall be protected where necessary with either cast-in-place concrete slope protection or other acceptable methods.

c. The entire substructure of a bridge should be fitted in with the natural layout of the channel in such a way that hydraulic disruption is minimized.

d. The leading and trailing edges of piers in the stream should be either rounded or wedge-shaped to pass the water with a minimum of resistance and reduce possible scour from eddy currents.

e. Bridge design shall be in accordance with the "Standard Specifications for Highway Bridges", adapted by AASHTO officials, current State Highway Administration practices, and the current Maryland Department of the Environment regulations. Plans shall show all pertinent structural data such as design loadings, pressures and allowable stresses.

9.1.5 Piers and Abutments

The depths of bridge piers and abutment footings shall be established with respect to the character of the foundation materials and the possibility of undermining as determined from structural borings and soundings.

9.1.6 Footings

Except where solid rock is encountered, or in other special cases, footings which are exposed to the erosive action of stream currents, preferably shall be founded at a depth of not less than 8 feet below the stream bed. The above preferred minimum depths shall be increased as conditions may require. Footings not exposed to the action of stream currents shall be founded on a firm foundation and below the frost line.

10.0 ENERGY DISSIPATORS AND CHANNEL PROTECTION

10.1 Drop Structures

One of the most effective means of dissipating energy. Sufficient data must be furnished to support design.

10.2 Gabions

Wire baskets of various sizes offer an effective means of dissipating velocities at the ends of structures and/or to construct checks or drops in channels. Gabion wire baskets shall be vinyl coated in all cases.

10.3 Riprap

Stone may be used to dissipate velocities at the ends of structures and to line channels. The stone is to be sized for the design storm's velocity.

APPENDICES

STORM DRAINAGE DESIGN

TABLE 1

HYDROLOGIC SOIL GROUPS
FOR FREDERICK COUNTY

Soil	Group
Athol	B
Augusta	C
Bermudian	B
Birdsboro	B
Bowmansville	D
Braddock	B
Brandywine	C
Bucks	B
Captina	C
Cardiff	B
Catoctin	C
Chalfont	D
Chandler	C
Chester	B
Chewacla	C
Clymer	B
Colbert	D
Conestoga	B
Congaree	B
Croton	D
Dekalb	B
Dullield	B
Edgemont	B
Elioak	B
Elk	B
Fauquier	B
Glenelg	B
Grenville	C
Hagerstown	B
Highfield	B
Huntington	B
Lantz	D

Soil	Group
Legore	C
Lehigh	C
Lindside	C
Linganore	C
Manor	B
Melvin	D
Montalto	B
Myersville	B
Norton	B
Penn	C
Raritan	B
Readington	C
Roanoke	D
Rohrersville	D
Rowland	C
Sequatchie	B
Thurmont	B
Urbana	B
Watchung	D
Waynesboro	B
Wehadkee	D
Worsham	D

TABLE 2

RATIONAL FORMULA COEFFIENCIENTS

SEE FOLLOWING PAGES

PART 3 Rational Formula Coefficients for SCS Hydrologic Soil Groups (A, B, C, D)

Urban Uses

1) Storm Frequencies of Less Than 25 Years
2) Storm Frequencies of 25 Years and Greater

Land Use	Treatment/ Practice	Hydrologic Condition	A			B			C			D		
			0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Paved Areas & Impervious surfaces			0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97
Open Space-lawns etc.			0.08 0.11	0.12 0.15	0.15 0.19	0.11 0.15	0.16 0.20	0.21 0.26	0.14 0.19	0.19 0.24	0.24 0.32	0.20 0.25	0.24 0.29	0.28 0.37
Industrial			0.67 0.85	0.68 0.85	0.68 0.86	0.68 0.85	0.68 0.86	0.69 0.86	0.68 0.86	0.69 0.86	0.69 0.87	0.69 0.86	0.69 0.86	0.70 0.88
Commercial			0.71 0.88	0.71 0.88	0.72 0.89	0.71 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.90	0.72 0.89	0.72 0.89	0.72 0.90
Residental														
	Lot Size 1/8 acre		0.25 0.33	0.28 0.37	0.31 0.40	0.27 0.35	0.30 0.39	0.35 0.44	0.30 0.38	0.33 0.42	0.38 0.49	0.33 0.41	0.36 0.45	0.42 0.54
	Lot Size 1/4 acre		0.22 0.30	0.26 0.34	0.29 0.37	0.24 0.33	0.29 0.37	0.33 0.42	0.27 0.36	0.31 0.40	0.36 0.47	0.30 0.38	0.34 0.42	0.40 0.52
	Lot Size 1/3 acre		0.19 0.28	0.23 0.32	0.26 0.35	0.22 0.30	0.26 0.35	0.30 0.39	0.25 0.33	0.29 0.38	0.34 0.45	0.28 0.36	0.32 0.40	0.39 0.50
	Lot Size 1/2 acre		0.16 0.25	0.20 0.29	0.24 0.32	0.19 0.28	0.23 0.32	0.28 0.36	0.22 0.31	0.27 0.35	0.32 0.42	0.26 0.34	0.30 0.38	0.37 0.48
	Lot Size 1 acre		0.14 0.22	0.19 0.26	0.22 0.29	0.17 0.24	0.21 0.28	0.26 0.34	0.20 0.28	0.25 0.32	0.31 0.40	0.24 0.31	0.29 0.35	0.35 0.46

PART 2B Rational Formula Coefficients - SCS Hydrologic Soil Groups (A, B, C, D)

Agricultural Land Uses

1) Storm Frequencies of Less Than 25 Years
2) Storm Frequencies of 25 Years or Greater

Land Use	Treatment/ Practice	Hydrologic Condition	A			B			C			D		
			0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Small Grain	Contoured	poor	0.21	0.26	0.30	0.38	0.42	0.46	0.55	0.59	0.62	0.63	0.65	0.67
			0.33	0.38	0.42	0.53	0.57	0.61	0.69	0.72	0.75	0.75	0.77	0.78
		good	0.17	0.22	0.27	0.33	0.38	0.42	0.54	0.58	0.61	0.62	0.65	0.67
			0.29	0.34	0.38	0.50	0.54	0.58	0.67	0.70	0.73	0.74	0.76	0.77
	Contoured and terraced	poor	0.18	0.22	0.26	0.32	0.36	0.40	0.52	0.55	0.58	0.56	0.59	0.61
			0.30	0.34	0.37	0.46	0.50	0.53	0.65	0.68	0.71	0.70	0.72	0.73
		good	0.16	0.20	0.24	0.31	0.35	0.38	0.45	0.48	0.50	0.55	0.58	0.60
			0.28	0.32	0.35	0.44	0.48	0.51	0.62	0.64	0.66	0.68	0.70	0.71
Closed-seeded legumes or rotation meadow	Straight row	poor	0.25	0.30	0.35	0.44	0.48	0.52	0.62	0.65	0.68	0.73	0.76	0.78
			0.37	0.42	0.46	0.60	0.64	0.67	0.74	0.77	0.80	0.83	0.85	0.86
		good	0.15	0.19	0.23	0.31	0.35	0.38	0.55	0.58	0.60	0.63	0.65	0.66
			0.20	0.24	0.28	0.47	0.50	0.53	0.67	0.70	0.72	0.75	0.77	0.78
	Contoured	poor	0.23	0.28	0.32	0.41	0.45	0.49	0.57	0.60	0.63	0.62	0.65	0.67
			0.35	0.40	0.44	0.56	0.60	0.63	0.70	0.73	0.76	0.74	0.77	0.79
		good	0.14	0.18	0.21	0.30	0.34	0.37	0.45	0.48	0.51	0.58	0.60	0.61
			0.24	0.28	0.31	0.42	0.46	0.49	0.61	0.64	0.66	0.71	0.73	0.74
	Contoured and terraced	poor	0.21	0.26	0.30	0.34	0.38	0.42	0.51	0.54	0.57	0.58	0.60	0.61
			0.33	0.38	0.42	0.50	0.54	0.57	0.67	0.70	0.72	0.71	0.73	0.74
		good	0.07	0.10	0.13	0.28	0.32	0.35	0.44	0.47	0.49	0.52	0.54	0.56
			0.20	0.24	0.28	0.40	0.44	0.47	0.61	0.63	0.65	0.68	0.70	0.71

PART 2A Rational Formula Coefficients - SCS Hydrologic Soil Groups (A, B, C, D)

Agricultural Land Uses

1) Storm Frequencies of Less Than 25 Years
2) Storm Frequencies of 25 Years or Greater

Land Use	Treatment/ Practice	Hydrologic Condition	A			B			C			D		
			0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Fallow	Straight row		0.41	0.48	0.53	0.60	0.66	0.71	0.72	0.78	0.82	0.84	0.88	0.91
			0.57	0.64	0.69	0.70	0.76	0.80	0.83	0.88	0.91	0.95	0.97	0.98
Row Crops	Straight row	poor	0.31	0.36	0.39	0.54	0.58	0.62	0.70	0.74	0.77	0.75	0.78	0.80
			0.45	0.50	0.54	0.65	0.70	0.73	0.82	0.86	0.88	0.86	0.88	0.89
		good	0.24	0.30	0.35	0.43	0.48	0.52	0.61	0.65	0.68	0.73	0.76	0.78
			0.38	0.44	0.49	0.60	0.64	0.67	0.75	0.77	0.79	0.83	0.85	0.86
	Contoured	poor	0.28	0.34	0.39	0.51	0.55	0.59	0.61	0.65	0.68	0.70	0.74	0.77
			0.43	0.48	0.52	0.64	0.68	0.71	0.73	0.76	0.78	0.84	0.86	0.88
		good	0.21	0.26	0.30	0.41	0.45	0.49	0.55	0.59	0.63	0.63	0.66	0.68
			0.33	0.38	0.42	0.56	0.60	0.64	0.69	0.72	0.74	0.74	0.76	0.77
	Contoured and terraced	poor	0.26	0.30	0.34	0.38	0.42	0.46	0.50	0.54	0.57	0.56	0.59	0.61
			0.38	0.42	0.46	0.52	0.57	0.62	0.66	0.70	0.74	0.69	0.72	0.74
		good	0.20	0.24	0.27	0.31	0.35	0.39	0.45	0.48	0.51	0.55	0.58	0.60
			0.34	0.37	0.40	0.45	0.49	0.53	0.61	0.64	0.67	0.68	0.70	0.72
Small grain	Straight row	poor	0.24	0.28	0.32	0.43	0.47	0.51	0.62	0.65	0.68	0.72	0.74	0.76
			0.37	0.40	0.43	0.59	0.63	0.66	0.73	0.76	0.78	0.84	0.86	0.87
		good	0.23	0.26	0.29	0.42	0.45	0.48	0.57	0.60	0.62	0.71	0.73	0.75
			0.35	0.38	0.41	0.57	0.60	0.63	0.70	0.73	0.75	0.83	0.85	0.86

Part 1 Rational Formula Coefficients for SCS Hydrologic Soil Groups (A, B, C, D)

Rural Land Uses

1) Storm Frequencies of Less Than 25 Years
2) Storm Frequencies of 25 Years or Greater

Land Use	Treatment/ Practice	Hydrologic Condition	A			B			C			D		
			0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Pasture or range		poor	0.23	0.25	0.26	0.31	0.33	0.34	0.37	0.38	0.39	0.40	0.41	0.42
			0.27	0.29	0.31	0.36	0.37	0.39	0.42	0.43	0.44	0.45	0.46	0.47
		fair	0.12	0.13	0.15	0.24	0.25	0.27	0.31	0.33	0.34	0.36	0.37	0.38
			0.15	0.17	0.19	0.28	0.30	0.32	0.36	0.37	0.39	0.40	0.41	0.43
		good	0.07	0.09	0.10	0.18	0.20	0.22	0.27	0.29	0.31	0.32	0.34	0.35
			0.09	0.11	0.13	0.22	0.24	0.26	0.32	0.33	0.35	0.37	0.38	0.40
	Contoured	poor	0.11	0.12	0.14	0.22	0.24	0.26	0.33	0.34	0.36	0.39	0.40	0.41
			0.13	0.16	0.18	0.26	0.28	0.30	0.37	0.39	0.40	0.44	0.45	0.46
		fair	0.06	0.07	0.08	0.17	0.19	0.21	0.28	0.30	0.31	0.35	0.36	0.37
			0.07	0.08	0.10	0.21	0.23	0.25	0.32	0.34	0.36	0.39	0.41	0.42
		good	0.03	0.04	0.06	0.11	0.12	0.14	0.24	0.26	0.28	0.31	0.33	0.34
			0.05	0.06	0.08	0.13	0.14	0.15	0.28	0.30	0.32	0.36	0.37	0.39
Meadow			0.06	0.08	0.10	0.10	0.14	0.19	0.12	0.17	0.22	0.15	0.20	0.25
			0.08	0.11	0.14	0.13	0.18	0.22	0.16	0.20	0.26	0.21	0.25	0.32
Wooded		poor	0.10	0.12	0.13	0.13	0.15	0.20	0.16	0.19	0.25	0.18	0.22	0.26
			0.12	0.14	0.16	0.16	0.19	0.23	0.19	0.23	0.28	0.22	0.27	0.33
		fair	0.06	0.08	0.09	0.10	0.13	0.18	0.11	0.15	0.20	0.13	0.18	0.23
			0.08	0.10	0.12	0.13	0.17	0.21	0.15	0.18	0.24	0.18	0.22	0.29
		good	0.05	0.07	0.08	0.08	0.11	0.15	0.10	0.13	0.17	0.12	0.15	0.21
			0.06	0.09	0.11	0.11	0.15	0.18	0.13	0.17	0.21	0.15	0.19	0.25

Gutters, Ditches and Channels	Value of "n"
Concrete or bituminous lined channels	0.013
Bituminous concrete paving with concrete gutter	0.015
Grass gutters & ditches, flow greater than 6"	.040
Grass gutters & ditches, flow less than 6"	.060
Gabions	0.030
Rip-Rap	Ref. to Chart SHA-61.1-405.1
Channels not maintained, uncut weeds & brush	.08 - .12
Earth gutters and ditches	.025
Ditches in rock	.037
Seed and Mulch	.030
Soil Stabilization Matting	.030
Natural Stream channels	.035 - .150

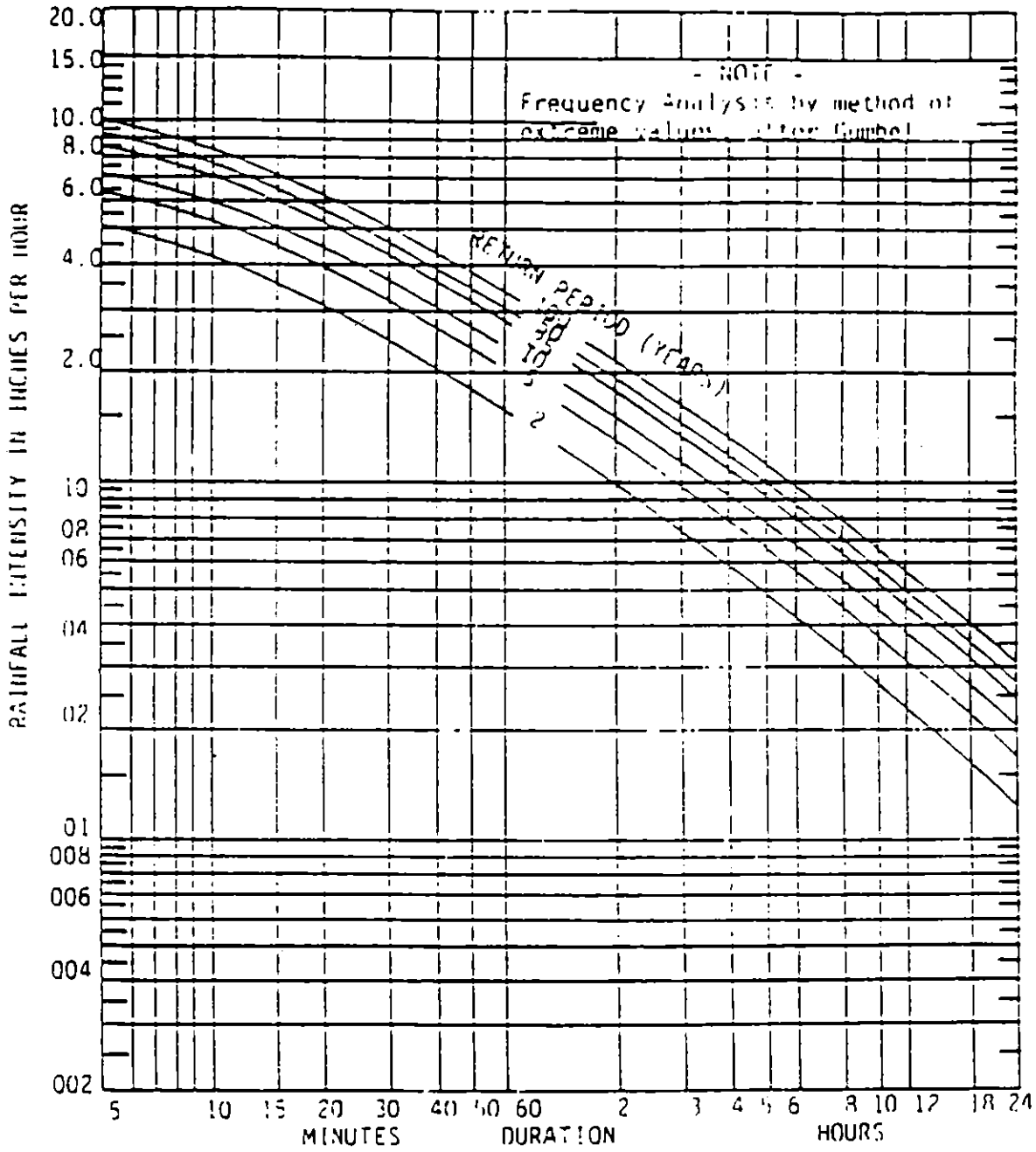
ENTRANCE LOSS COEFFICIENTS

Type of Structure and Design of Entrance	Coefficient K_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Pipe or Pipe-Arch, Corrugated Metal	
Projecting from fill, (no headwall)	0.9
Headwall or headwall and wingalls	
Square-edge	0.5
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrell dimension	0.2
Wingwalls at 30 to 75 to barrell	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrell dimension	0.2
Wingwalls at 10 to 25 to barrell	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7

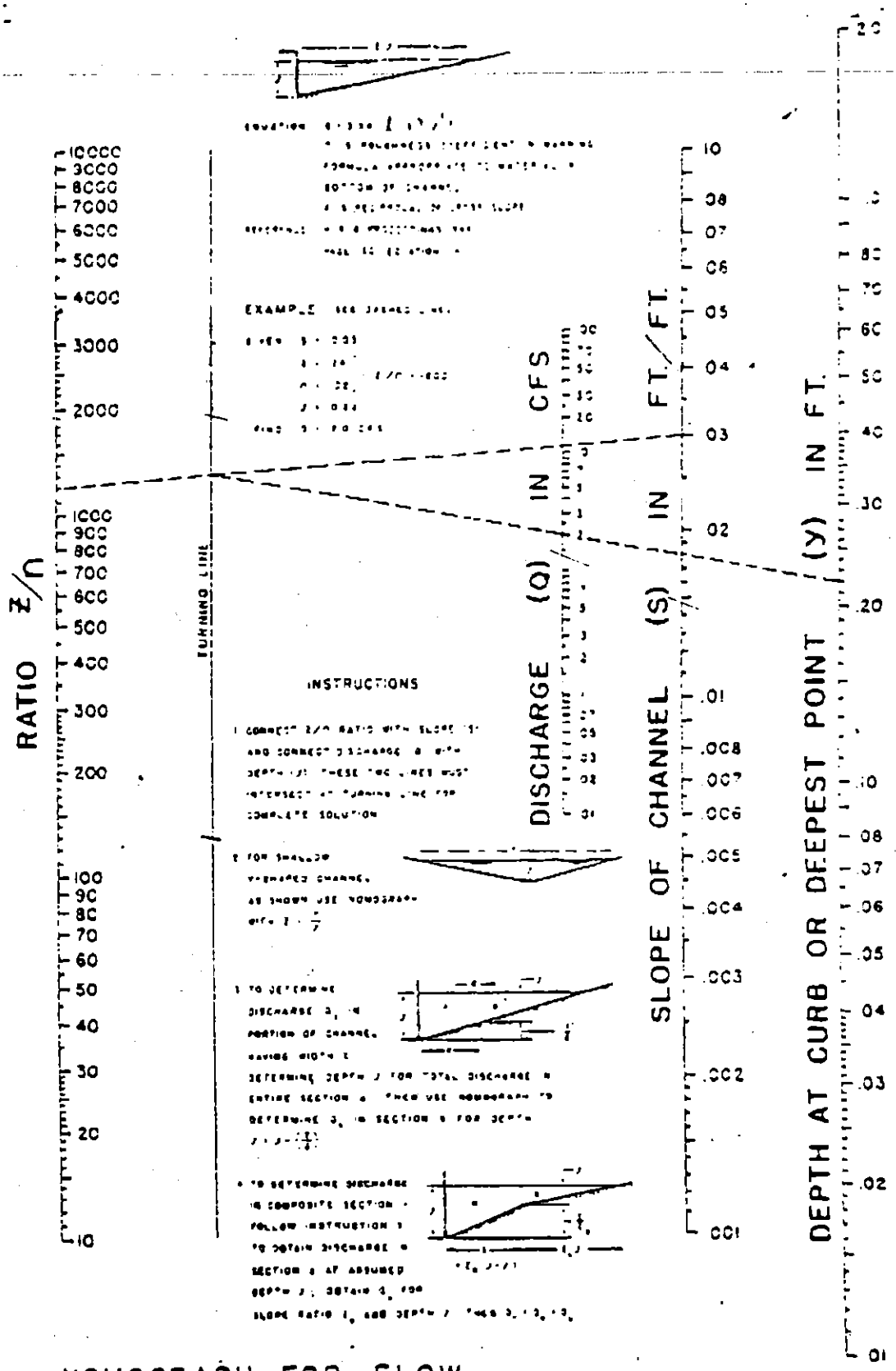
*NOTE: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to headwall in both inlet and outlet control.

LIMITING VELOCITIES FOR DITCHES AND CHANNELS

Type of Lining	Allowable velocity Feet per second	
Earth, without vegetation	1-3	USE SOIL STABILIZATION MATTING OVER SEED AND MULCH FOR CONSTRUCTION ITEMS
Seed and Mulch	2.5	
Grains, stiff stemmed grasses	2-3	
Bunch grass	2-4	
Solid Sodding	4	
Stiff clay or clay and gravel	3-5	
Fine gravel	5	
Well-established grasses, short pliant blades	5	
Soil Stabilization matting over seed and mulch	5	
Shale and Rock	5.6	
Course gravel	6	
Riprap	Refer to Chart SHA 61.1-405.1	
Concrete Channel	No Max.	



INTENSITY DURATION FREQUENCY CURVES



NOMOGRAPH FOR FLOW
IN TRIANGULAR CHANNELS

RUNOFF CURVE NUMBERS

RURAL AREAS

	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Wooded:				
Poor - No mulch, small trees or brush	45	66	77	83
Fair - Grazed, some mulch	36	60	73	79
Good - Protected from grazing, Heavy mulch and shrubs cover soil	25	55	70	77
Pasture: (Native or improved grassland reserved for grazing)				
Poor - Heavily grazed, Plant cover on less than 50% of area	68	79	86	89
Fair - Not heavily grazed, Plant cover on 50% to 75% of area	49	69	79	84
Good - Lightly grazed, Plant cover on more than 75% of area	39	61	74	80
Meadow: (Grass grown for hay crop)	30	58	71	78
Cultivated:				
Fallow: (Plowed, no crop planted)	77	86	91	94
Row Crop: (Corn, soybeans, tomatoes, etc. spaced about 3 1/2' apart)	72	81	88	91
Small Grain: (Wheat, oats, barley, etc.)	65	76	84	88
Water Surfaces	100	100	100	100

Source - Ref. #9 Appendix 2

SHA-61.1 - 401.2A

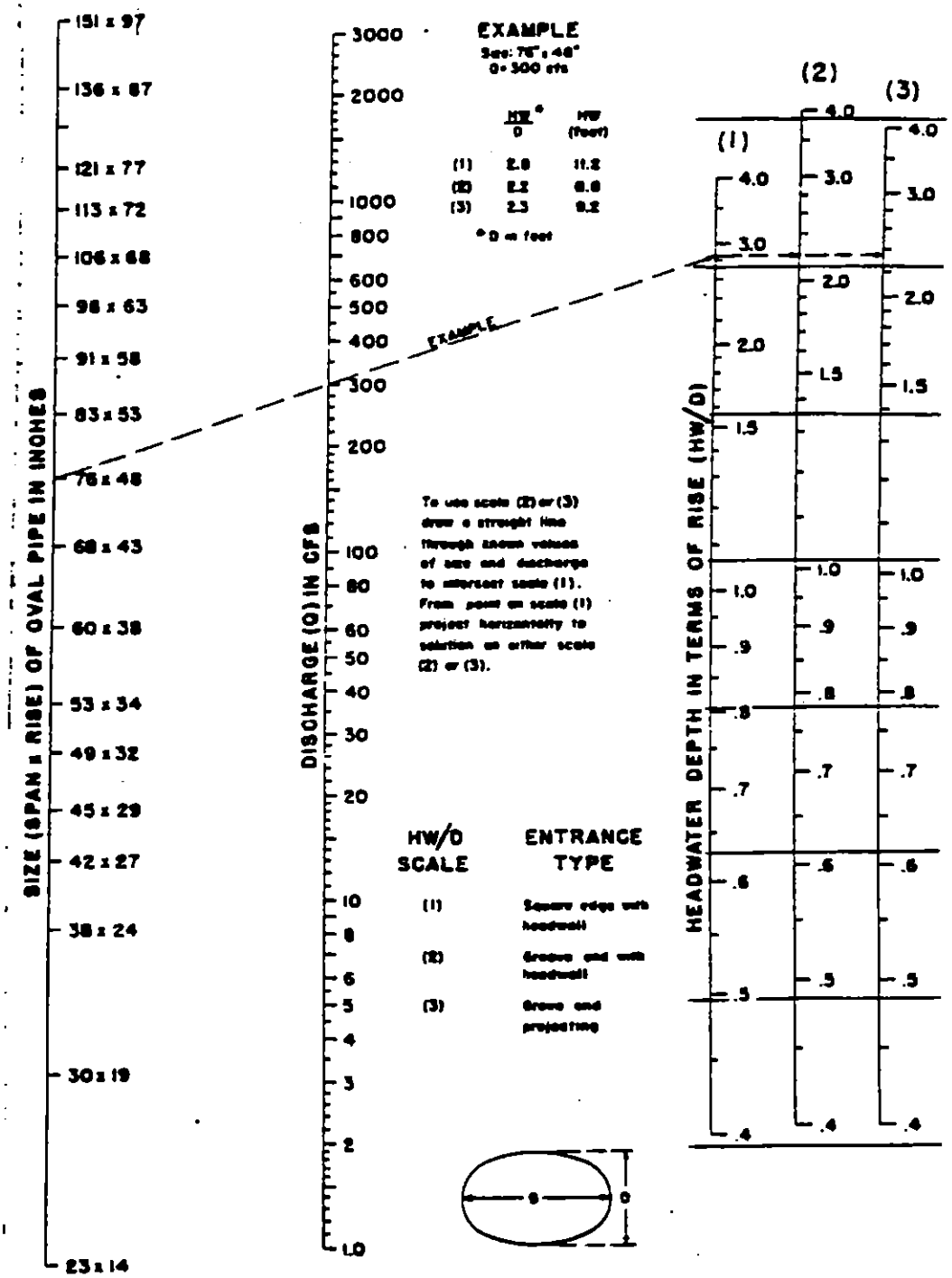
RUNOFF CURVE NUMBERS

URBAN AREAS

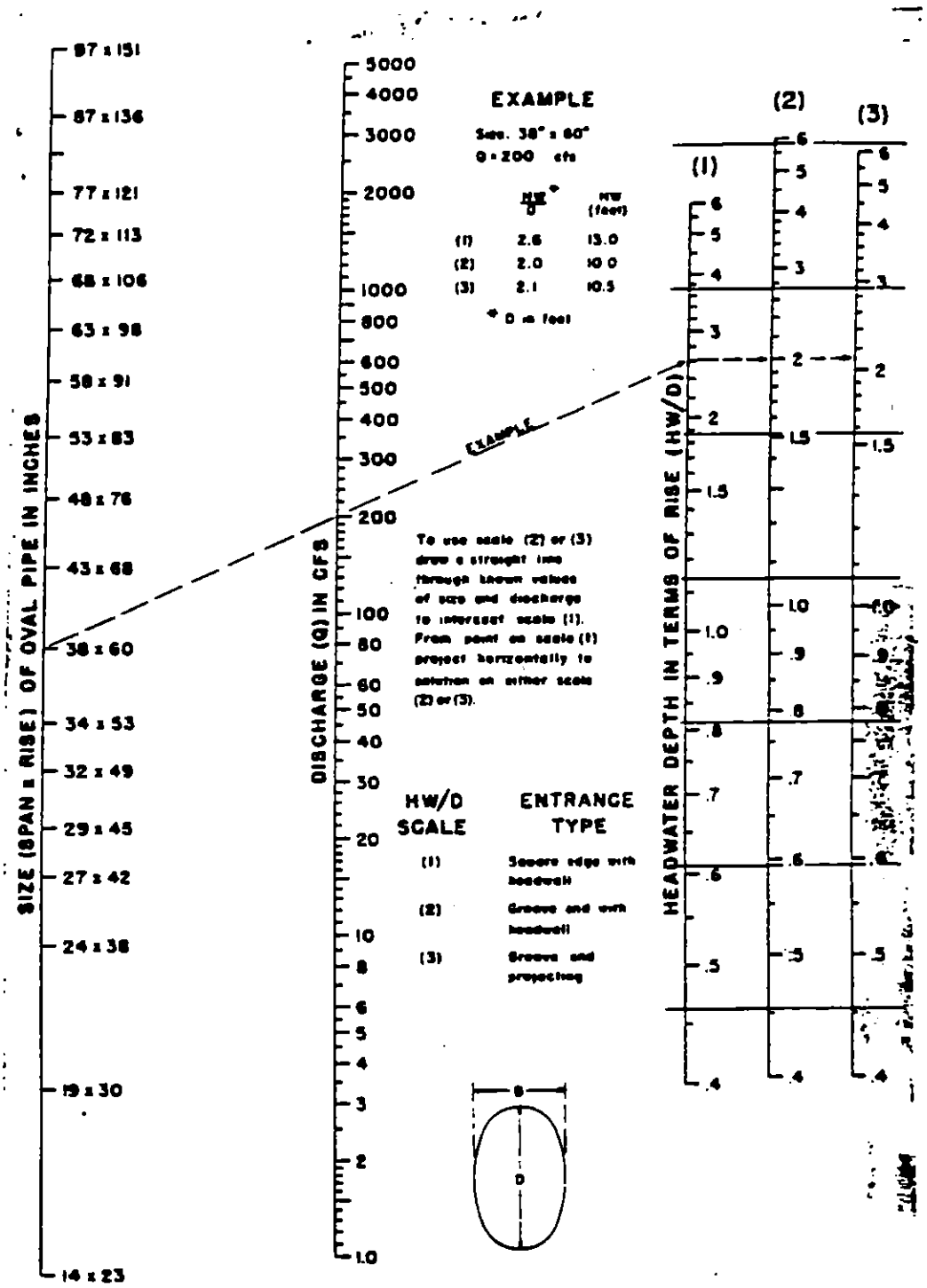
	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Open Spaces, Lawns, Parks, Golf courses, Cemeteries				
Grass covers 75% or more of area	39	61	74	80
Grass covers 50% to 75% or area	49	69	79	84
Paved Areas, Roofs	98	98	98	98
Streets and Roads				
Paved, Curb and Gutter	98	98	98	98
Hard Surfaced (Includes R/W)	74	84	90	92
Gravel	76	85	89	91
Dirt (Includes R/W)	72	82	87	89
Residential Development				
Row Houses or Town Houses	80	85	90	95
1/8 acre lots Average 65% impervious	77	85	90	92
1/4 acre lots Average 38% impervious	61	75	83	87
1/3 acre lots Average 30% impervious	57	72	81	86
1/2 acre lots Average 25% impervious	54	70	80	85
1 acre lots Average 20% impervious	51	68	79	84
2 acre lots	47	66	77	81
Newly Graded area, no vegetation	81	89	93	95
Commercial and Business Areas 85% impervious	89	92	94	95
Industrial Areas 72% impervious	81	88	91	93

Source - Ref. # 26 Appendix 2

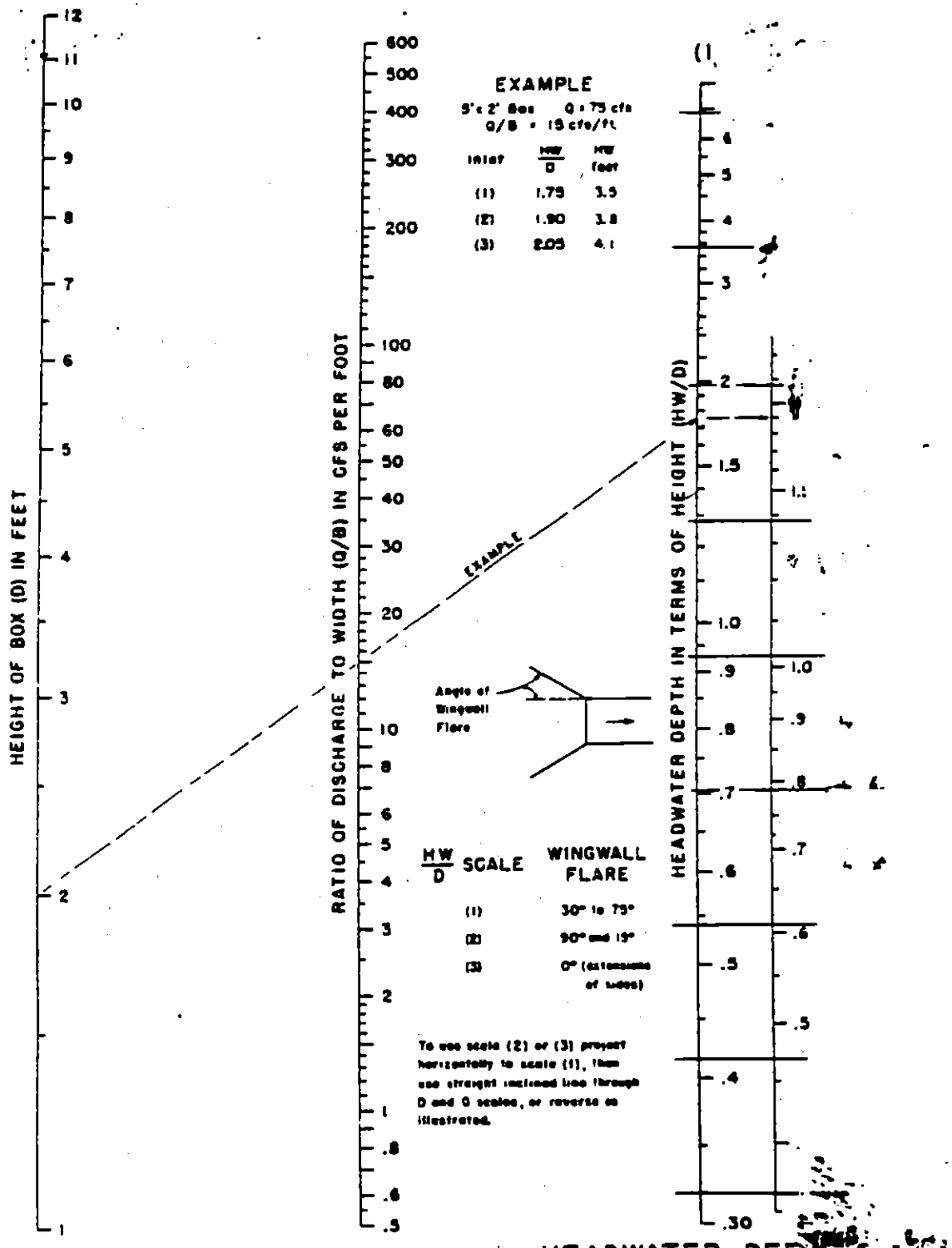
SHA-61.1 401.2B



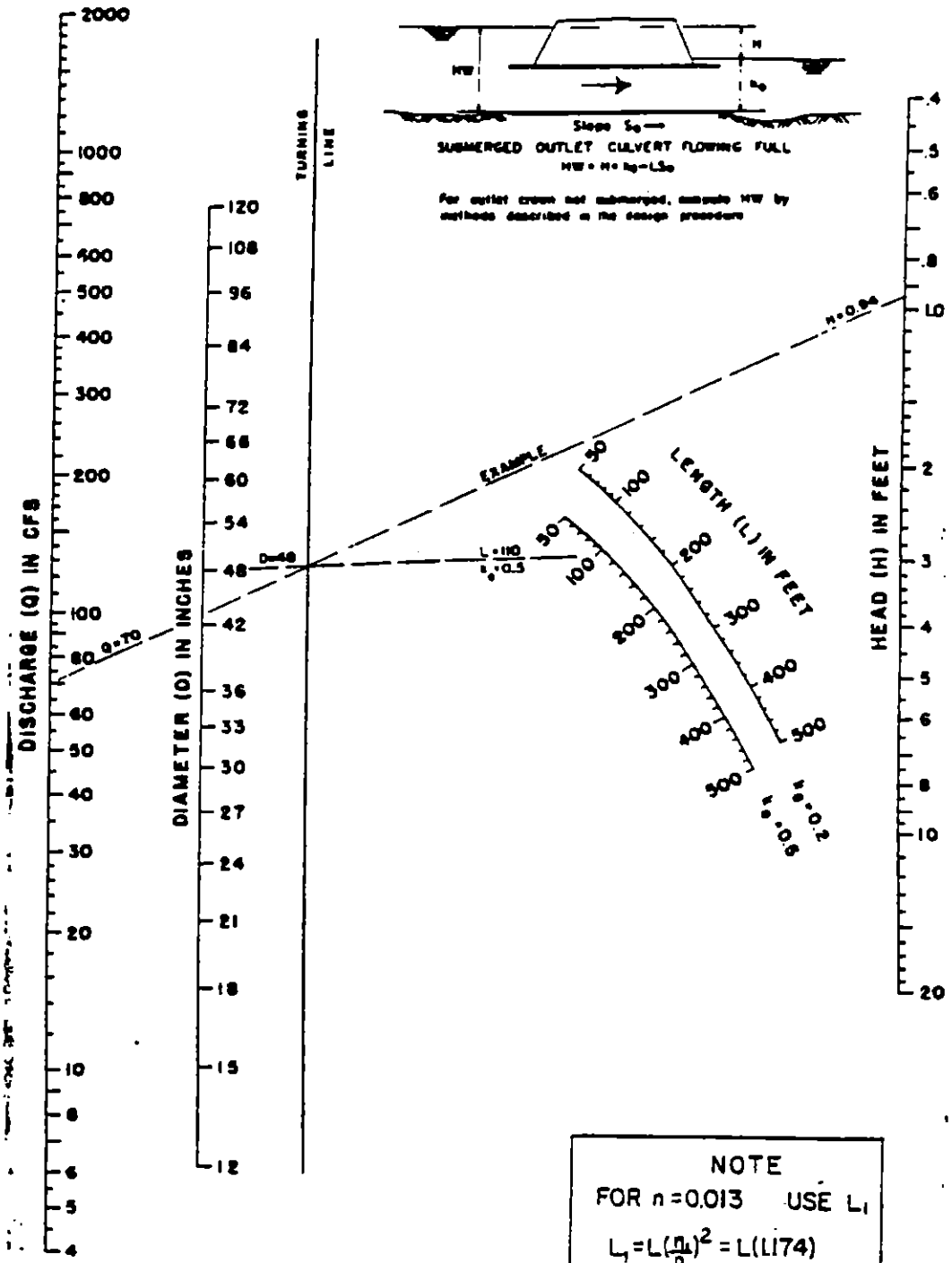
HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL



HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS VERTICAL WITH INLET CONTROL



HEADWATER DEP
FOR BOX CULVE
WITH INLET CON

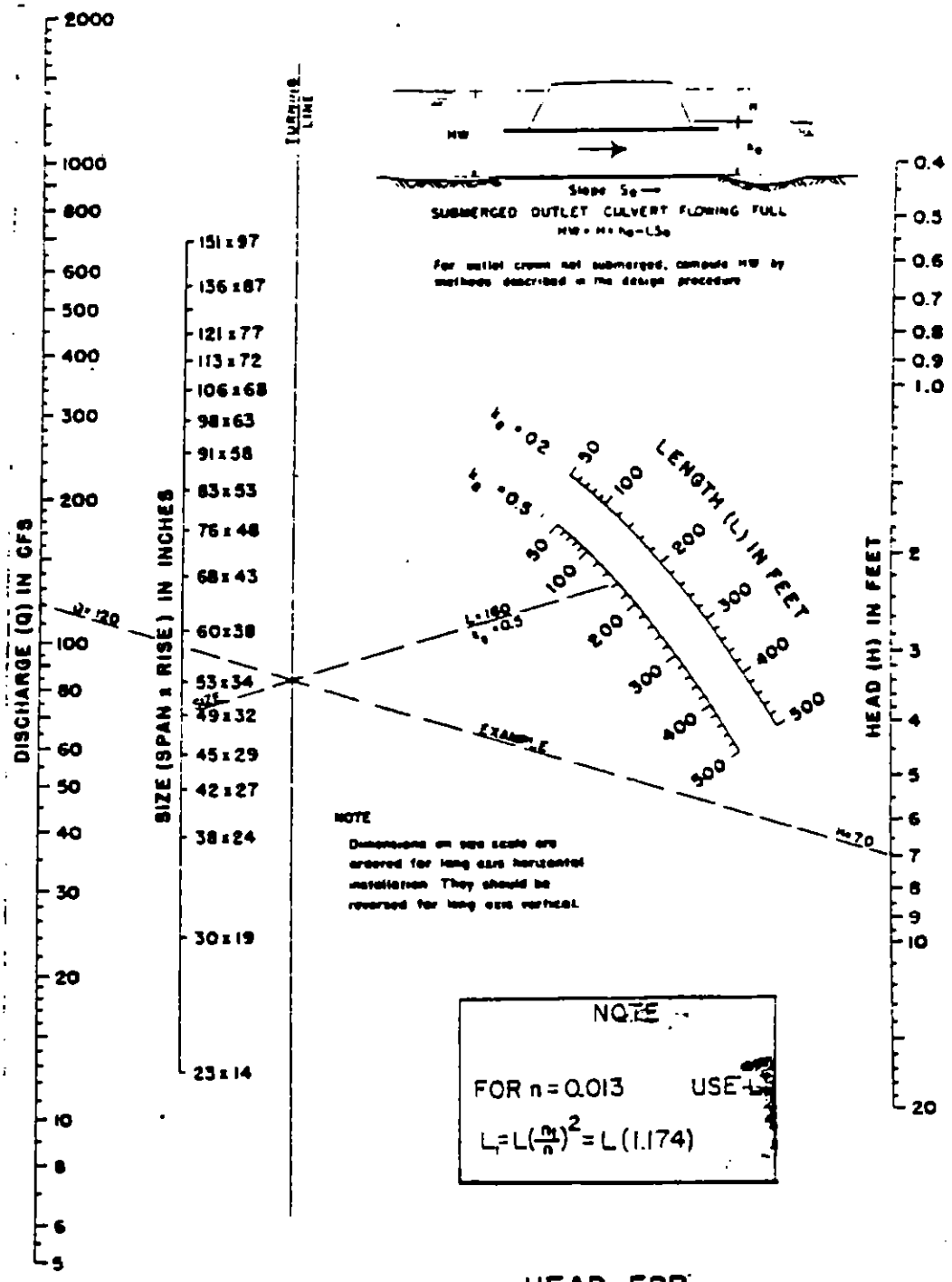


NOTE

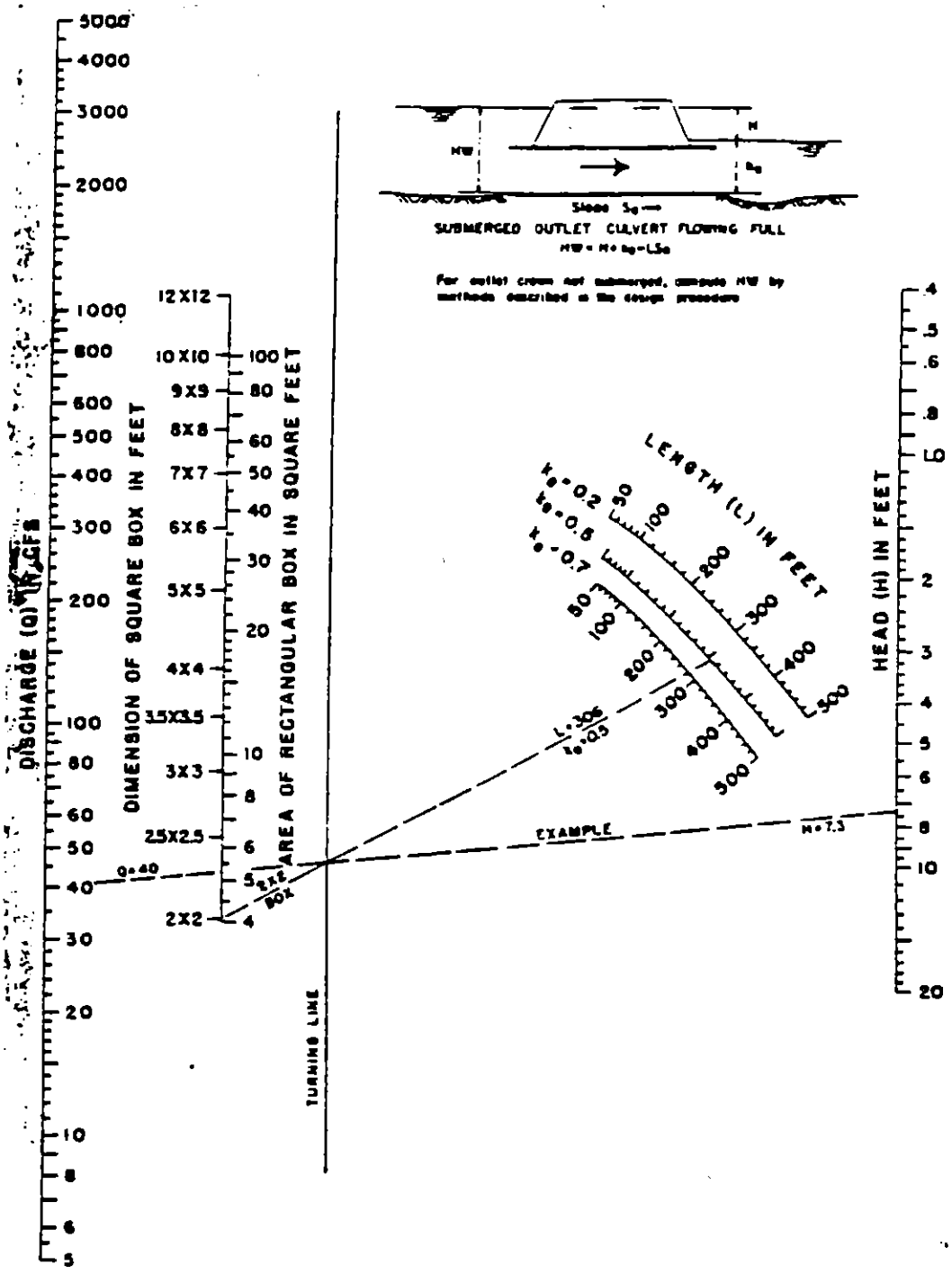
FOR $n = 0.013$ USE L_1

$L_1 = L\left(\frac{n_1}{n}\right)^2 = L(1.174)$

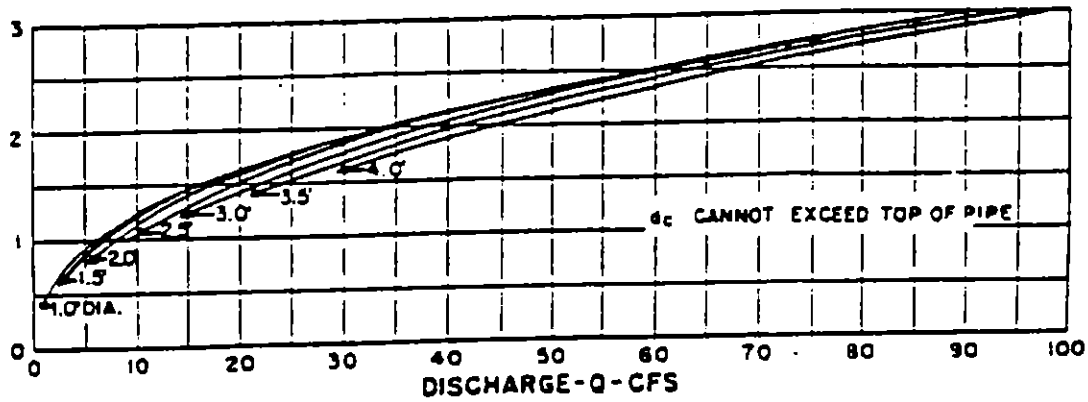
HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012

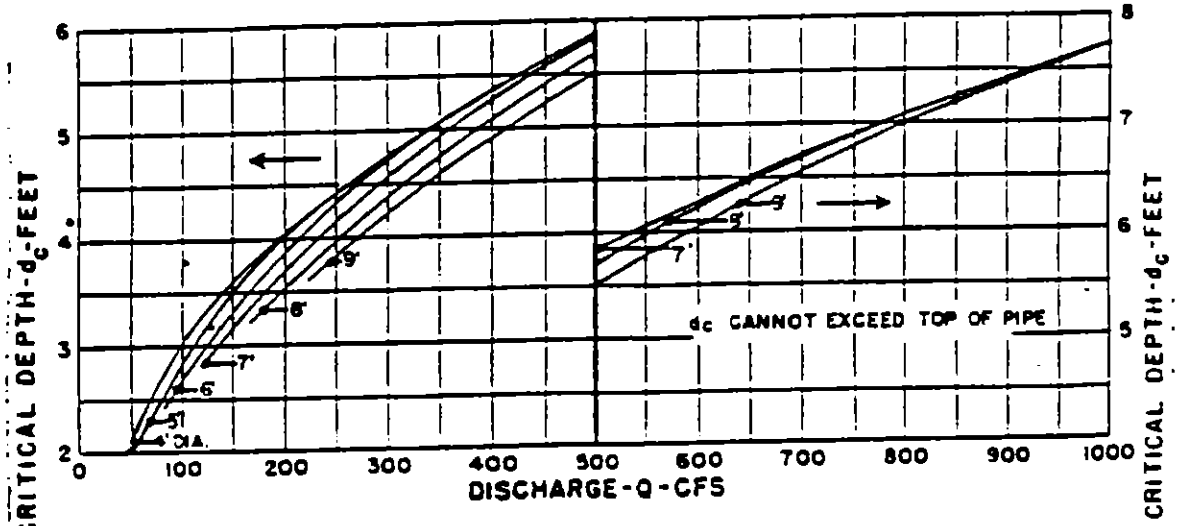


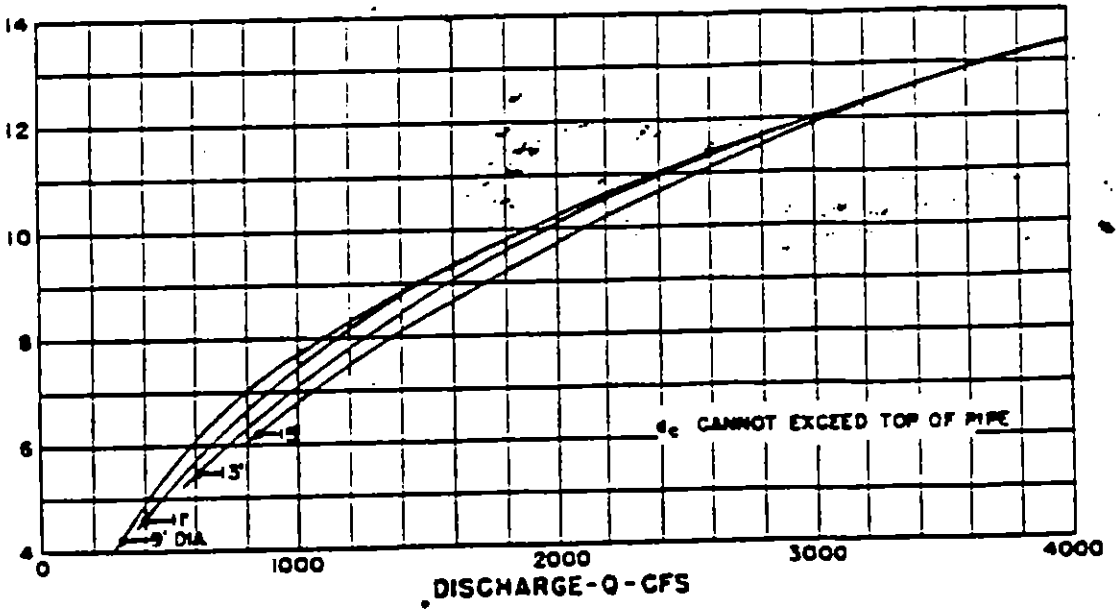
HEAD FOR
OVAL CONCRETE PIPE CULVERTS
LONG AXIS HORIZONTAL OR VERTICAL
FLOWING FULL
n = 0.012



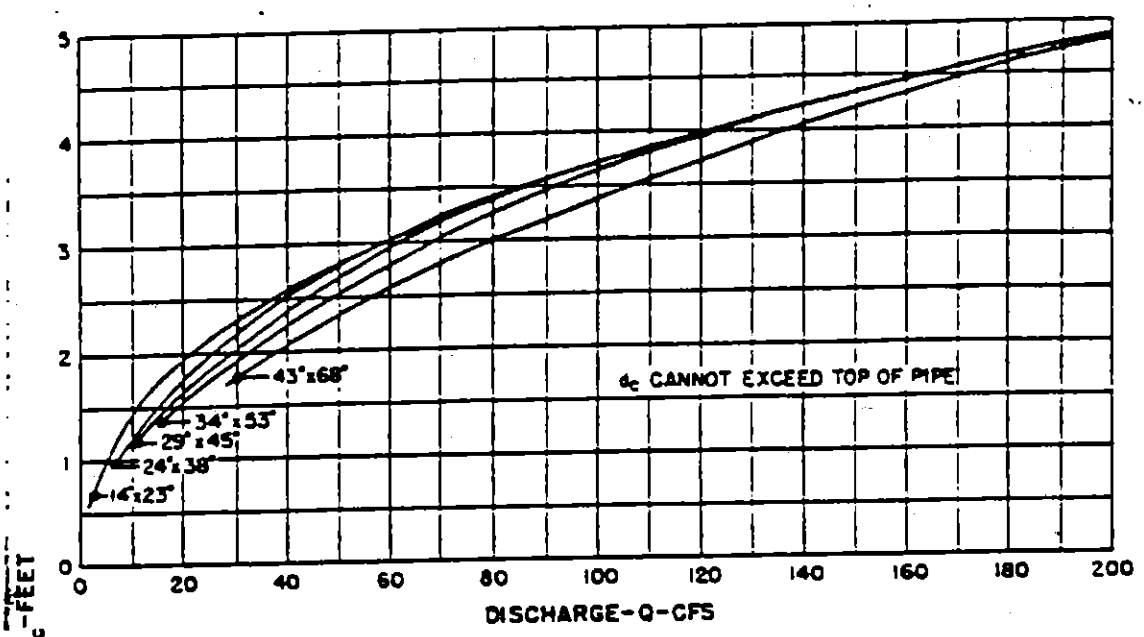
HEAD FOR CONCRETE BOX CULVERTS FLOWING FULL n = 0.012

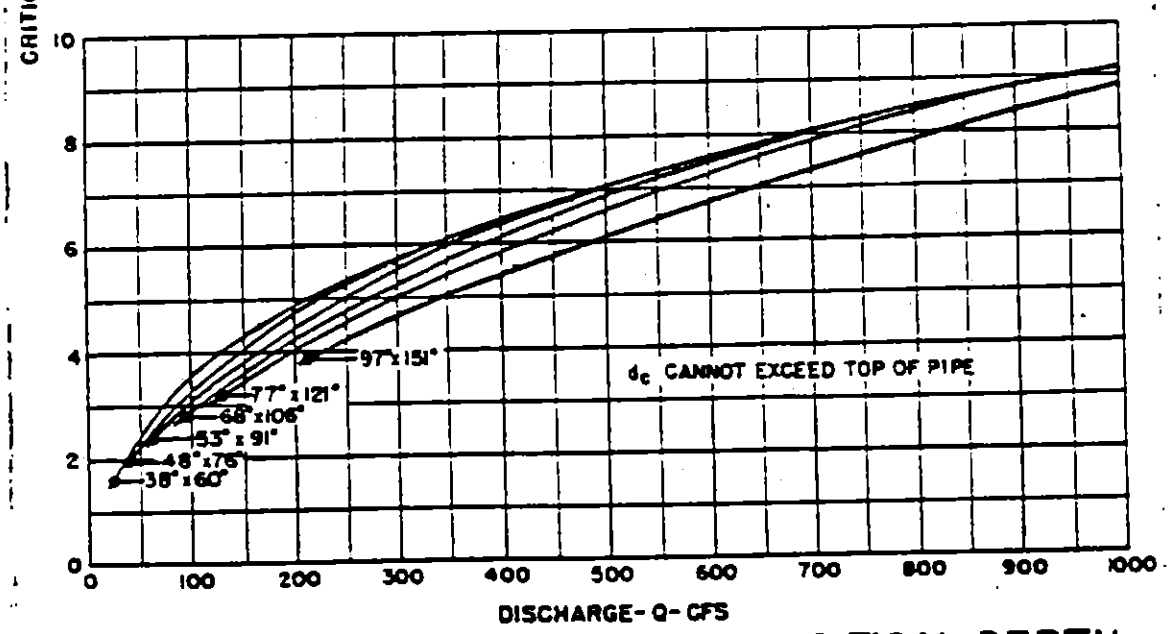




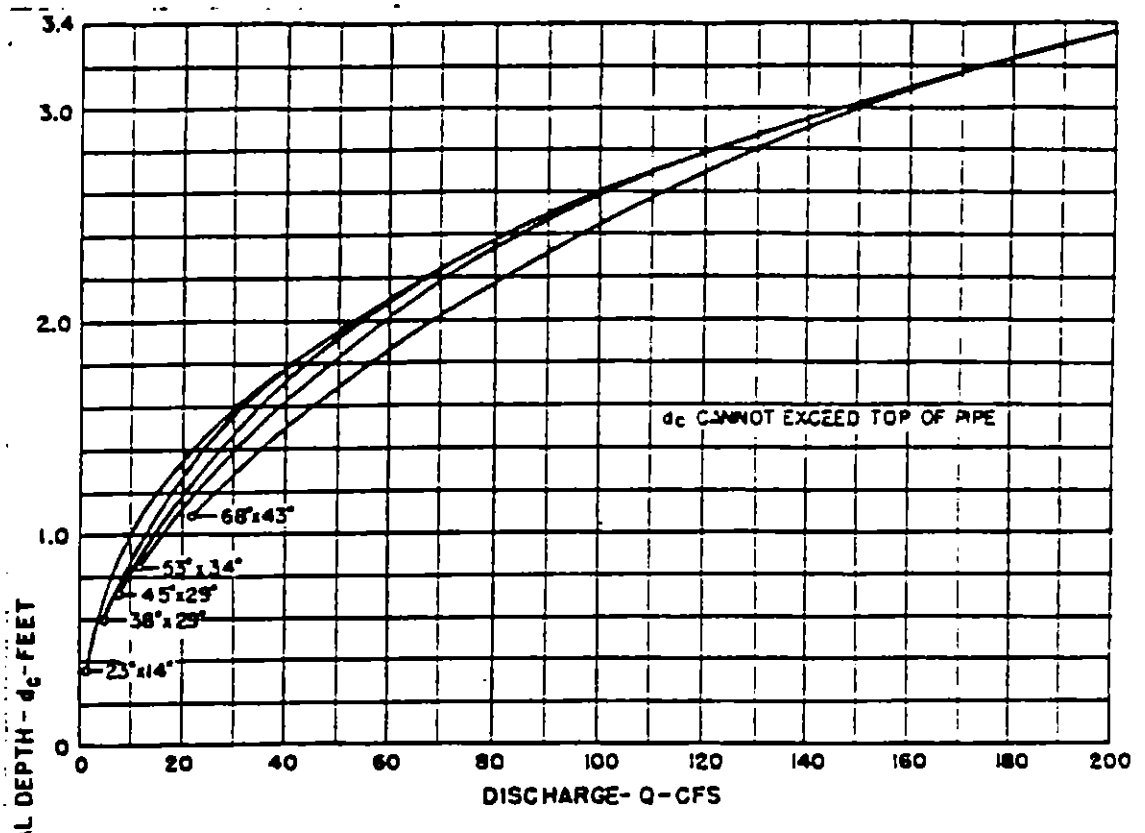


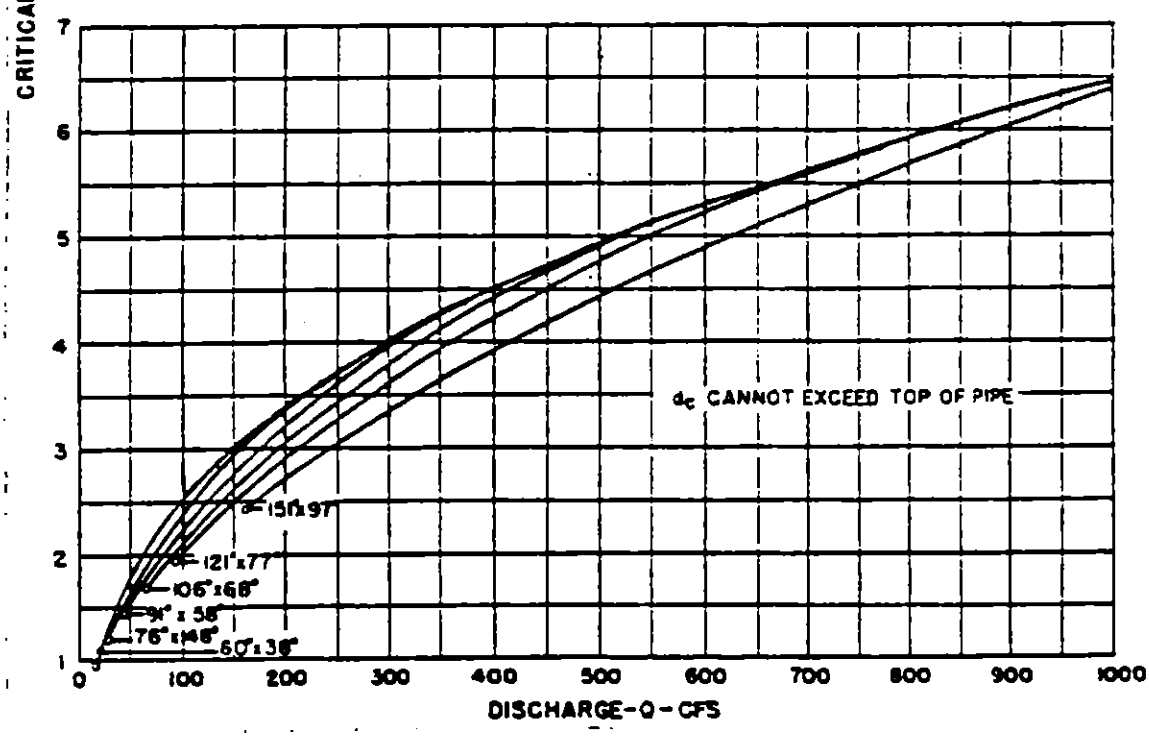
CRITICAL DEPTH
CIRCULAR PIPE





CRITICAL DEPTH
OVAL CONCRETE PIPE
LONG AXIS VERTICAL





CRITICAL DEPTH
OVAL CONCRETE PIPE
LONG AXIS HORIZONTAL

BASIC DATA - CIRCULAR PIPE

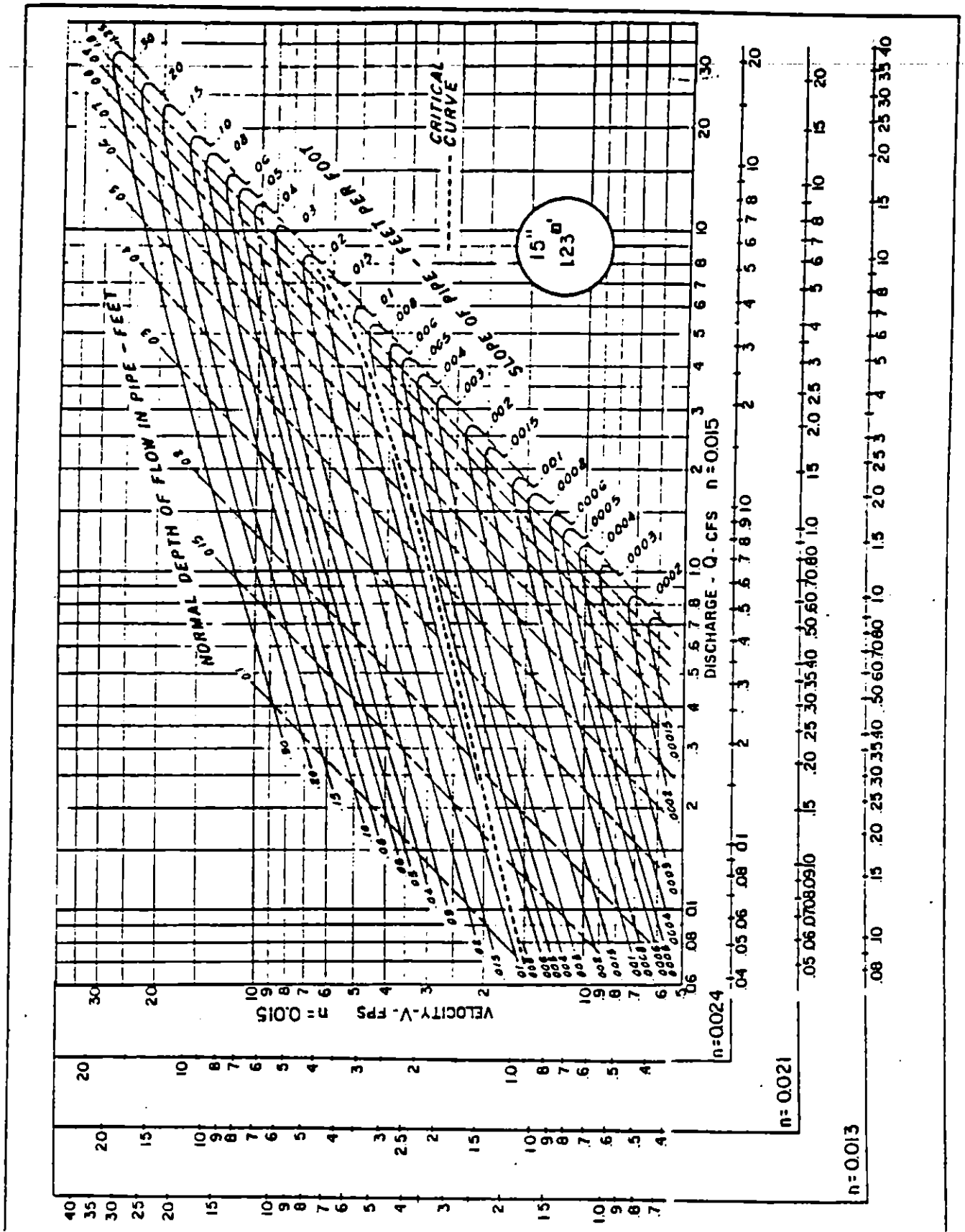
NOMINAL SIZE	INSIDE DIAMETER	AREA	PERIMETER	CONCRETE PIPE MINIMUM WALL THICKNESS			REMARKS
				AASHO M-170 CLASS IV OR V		CLASS IV ONLY	
				WALL B	WALL C		
INCHES	FEET	SQ. FT.	FEET	INCHES	INCHES	INCHES	
12	1.00	0.79	3.14	2	-		*
15	1.25	1.23	3.93	2 1/4	-		*
18	1.50	1.77	4.71	2 1/2	-		*
21	1.75	2.41	5.50	2 3/4	-		*
24	2.00	3.14	6.28	3	3 3/4		*
27	2.25	3.97	7.07	3 1/4	4		*
30	2.50	4.91	7.85	3 1/2	4 1/4		*
33	2.75	5.94	8.63	3 3/4	4 1/2		*
36	3.00	7.07	9.43	4	4 3/4		*
42	3.50	9.62	11.00	4 1/2	5 1/4		*
48	4.00	12.57	12.57	5	5 3/4		*
54	4.50	15.90	14.14	5 1/2	6 1/4		*
60	5.00	19.64	15.71	6	6 3/4		*
66	5.50	23.76	17.28	6 1/2	7 1/4		*
72	6.00	28.27	18.85	7	7 3/4		*
78	6.50	33.18	20.42	7 1/2	8 1/4*		
84	7.00	38.49	21.99	8	8 3/4*		*
90	7.50	44.18	23.56	8 1/2	9 1/4	8 1/2	*
96	8.00	50.27	25.13	9	9 3/4	8 1/2	*
102	8.50	56.75	26.70	9 1/2	10 1/4	9	
108	9.00	63.62	28.27	10	10 3/4	9	
120	10.00	78.54	31.42	-	-	10	
126	10.50	86.59	32.99	-	-	10 1/2	
132	11.00	95.03	34.56	-	-	11	
138	11.50	103.87	35.13	-	-	11 1/2	
144	12.00	113.10	37.70	-	-	12	

* DESIGN CHARTS ARE AVAILABLE FOR THESE PIPE SIZES

BASIC DATA - REINFORCED CONCRETE ELLIPTICAL PIPE SHA-61.1-441.0-1

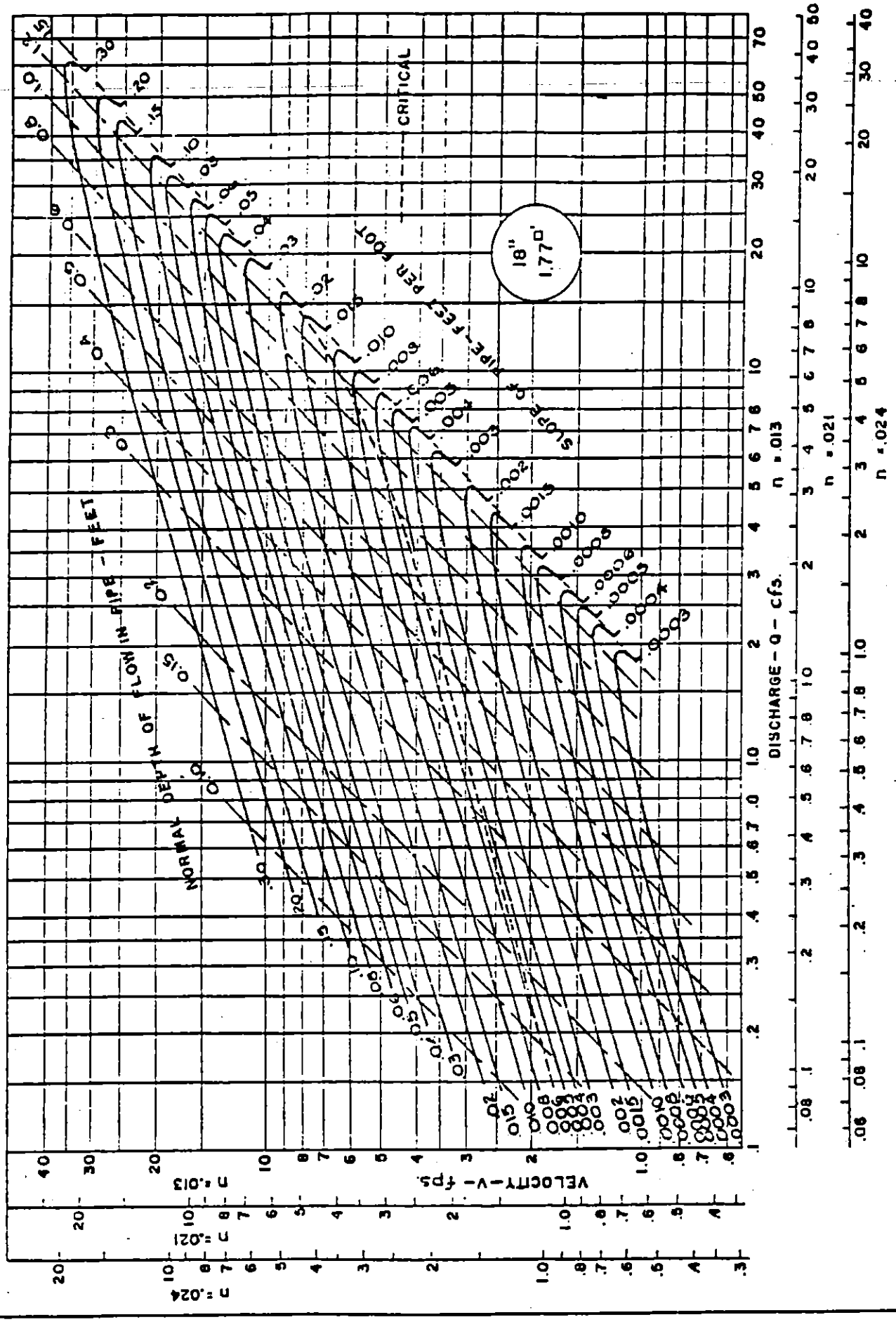
SIZE SPAN x RISE	APPROXIMATE EQUIVALENT ROUND SIZE (DIAMETER)	AREA	PERIMETER	MINIMUM WALL THICKNESS	REMARKS
INCHES	INCHES	SQ. FT.	FEET	INCHES	
23 x 14	18	1.8	4.92	2 3/4	
30 x 19	24	3.3	6.50	3 1/4	*
34 x 22	27	4.1	7.42	3 1/2	*
38 x 24	30	5.1	8.23	3 3/4	*
42 x 27	33	6.3	9.15	3 3/4	*
45 x 29	36	7.4	9.81	4 1/2	*
49 x 32	39	8.8	10.73	4 3/4	*
53 x 34	42	10.2	11.54	5	*
60 x 38	48	12.9	13.00	5 1/2	*
68 x 43	54	16.6	14.73	6	*
76 x 48	60	20.5	16.46	6 1/2	*
83 x 53	66	24.8	18.03	7	*
91 x 58	72	29.5	19.76	7 1/2	*
98 x 63	78	34.6	21.34	8	*
106 x 68	84	40.1	23.07	8 1/2	
113 x 72	90	46.1	24.54	9	
121 x 77	96	52.4	26.26	9 1/2	
128 x 82	102	59.2	27.85	9 3/4	
136 x 87	108	66.4	29.57	10	
143 x 92	114	74.0	31.15	10 1/2	
151 x 97	120	82.0	32.88	11	
106 x 106	132	99.2	36.04	12	
180 x 116	144	118.6	39.24	13	

*DESIGN CHARTS ARE AVAILABLE FOR THESE PIPE SIZES



PIPE FLOW CHART 15- INCH DIAMETER

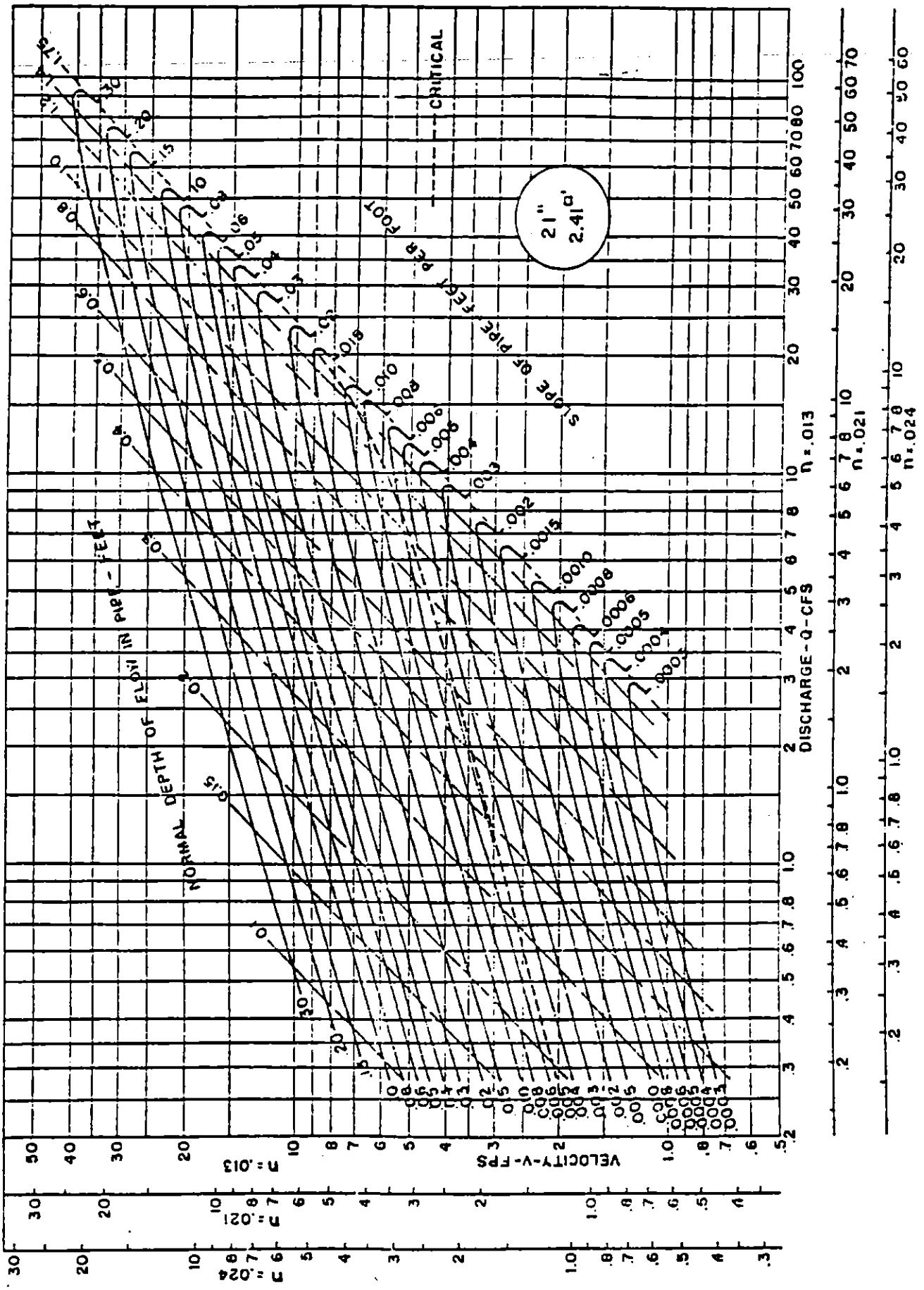
MARYLAND STATE HIGHWAY ADMINISTRATION 9/78 SHA-61.1-440.15



PIPE FLOW CHART 18- INCH DIAMETER

IV-3-8-5

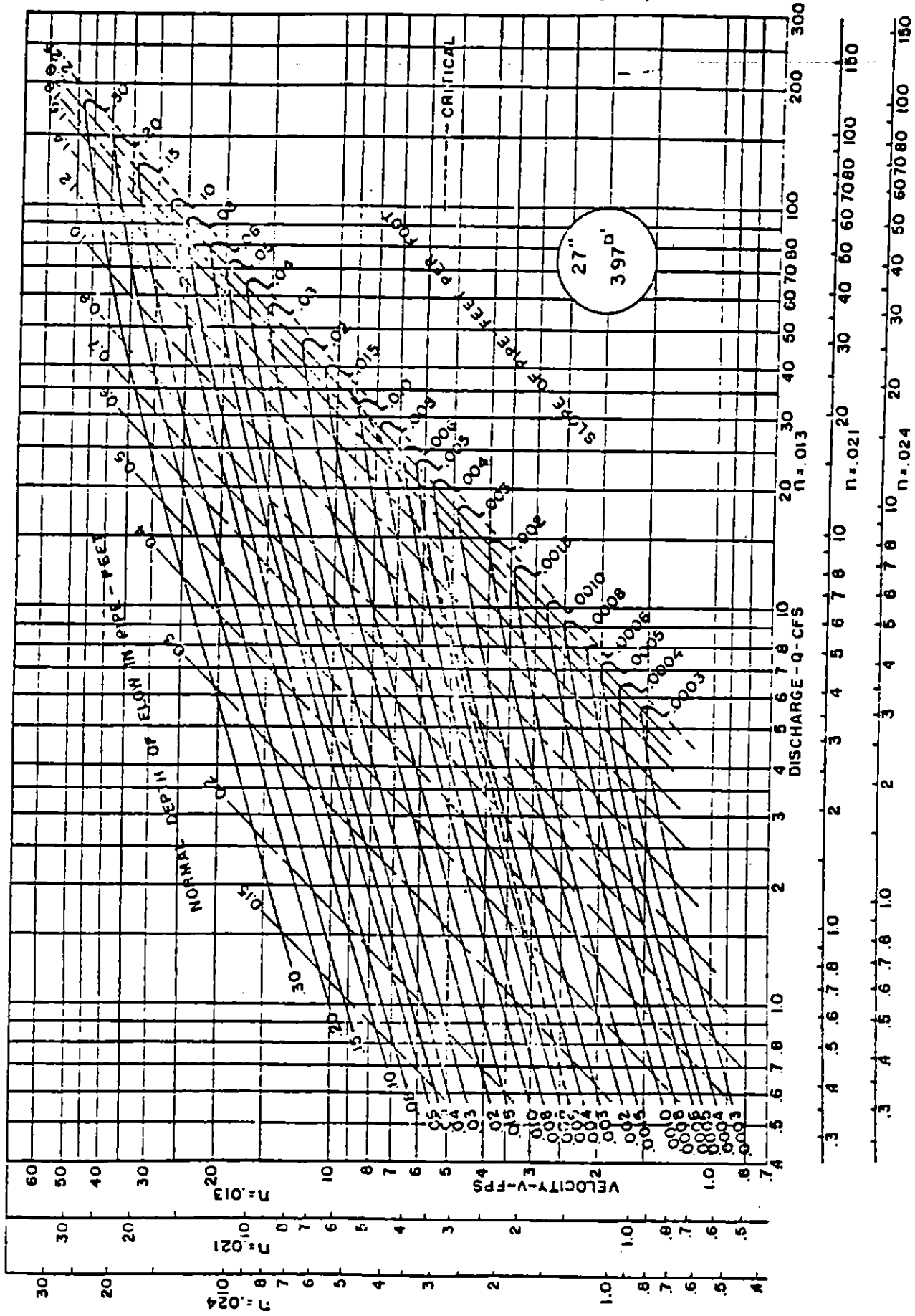
MARYLAND STATE HIGHWAY ADMINISTRATION S/GL SHA-611-440.18



PIPE FLOW CHART 21" DIAMETER

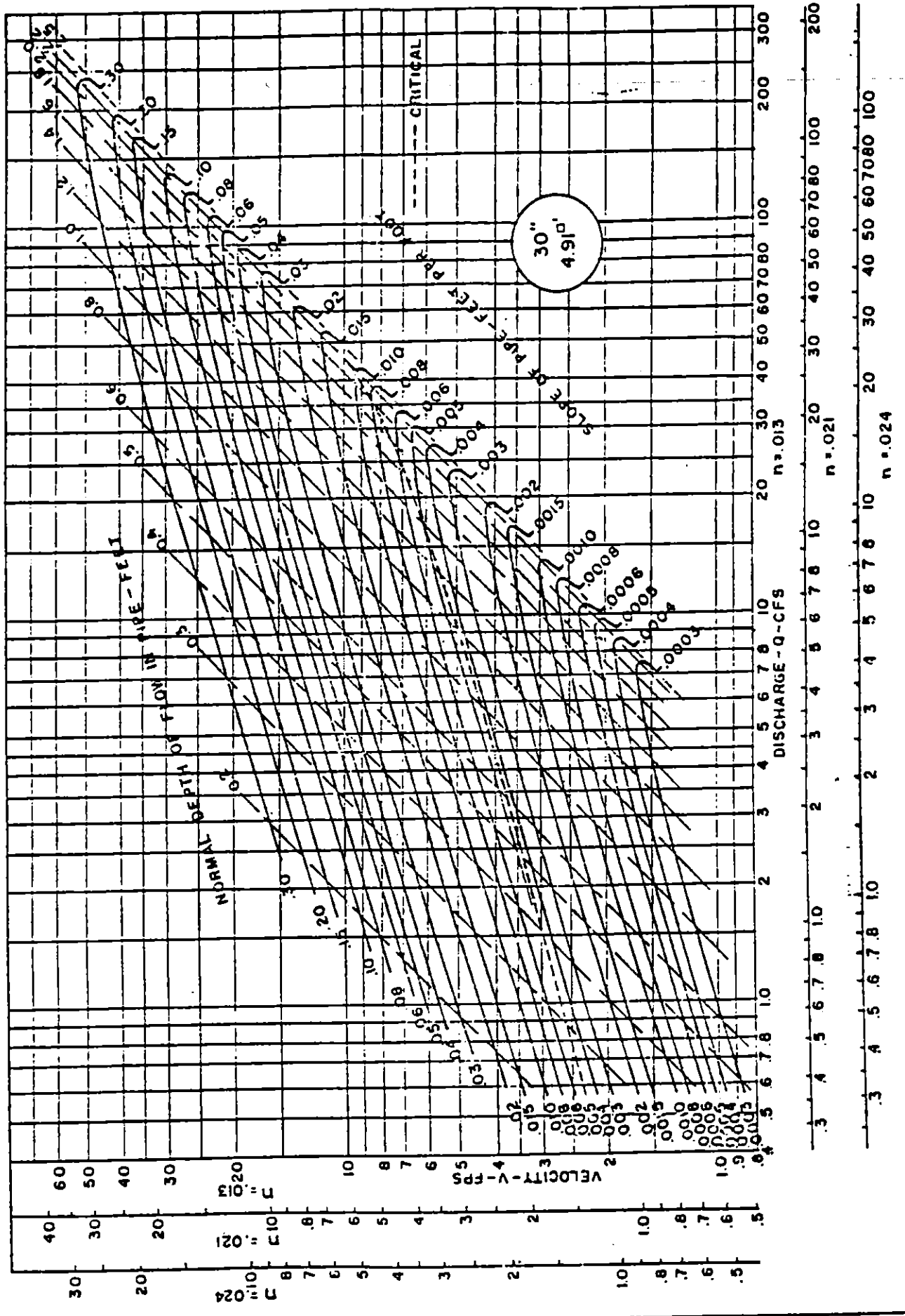
IV-3-8-6

MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-611-440 21



PIPE FLOW CHART 27" DIAMETER

MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-611-440 27



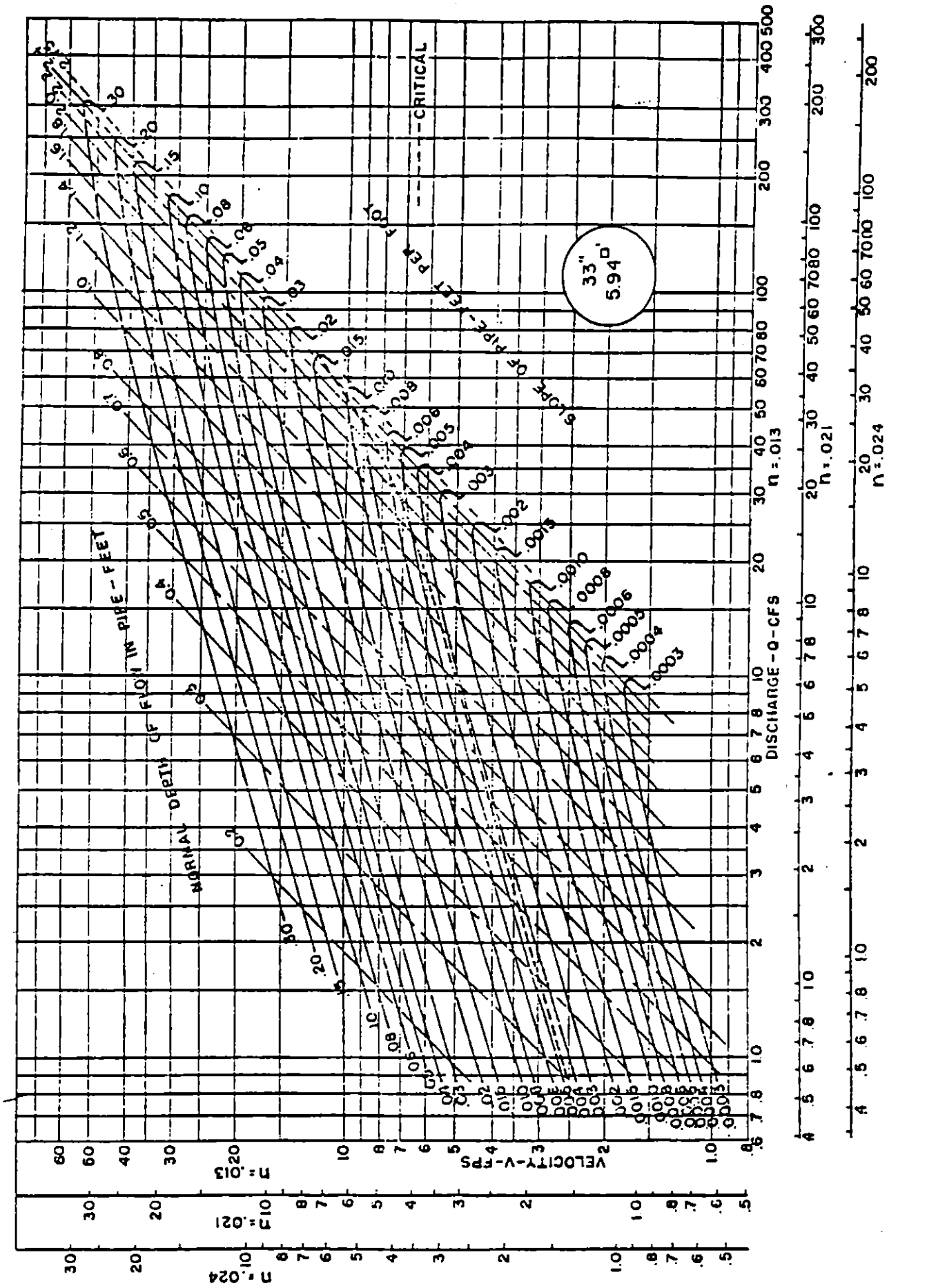
PIPE FLOW CHART 30" DIAMETER

IV-3-U-9

MARYLAND STATE HIGHWAY ADMINISTRATION

6/61

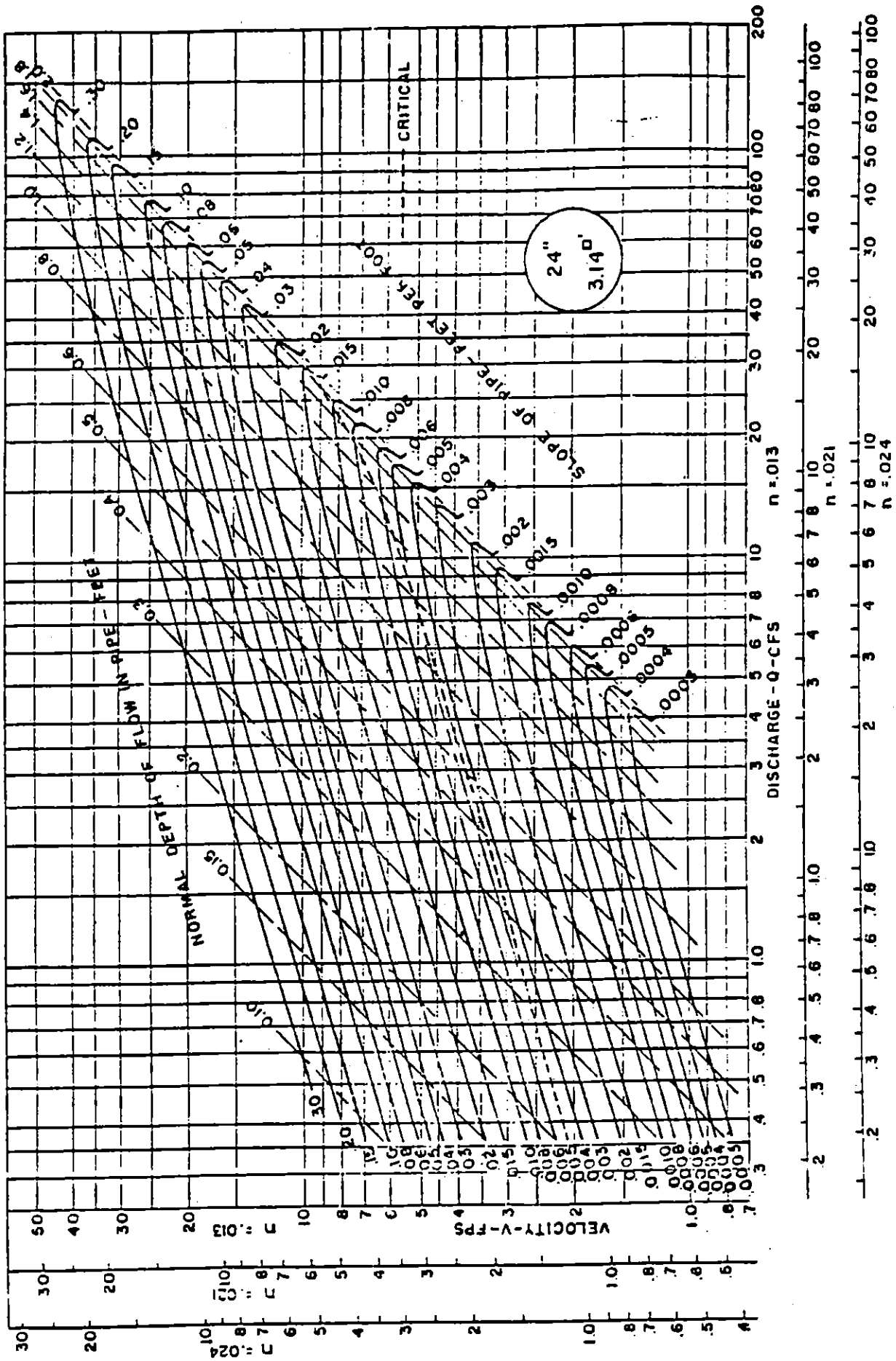
SHA-61.1-440.30



PIPE FLOW CHART 33" DIAMETER

IV-3-8-10

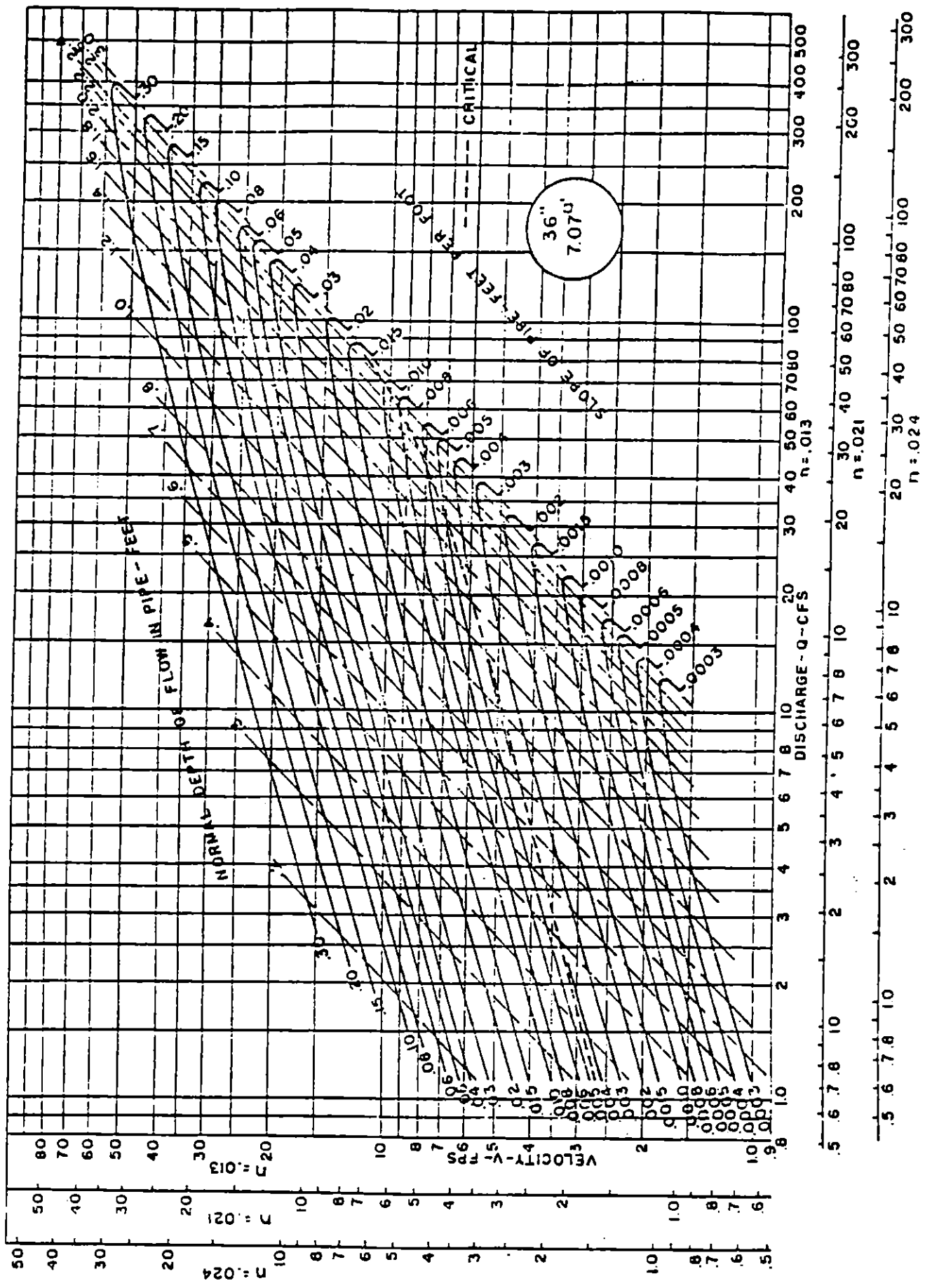
MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-611-44033



PIPE FLOW CHART 24" DIAMETER

IV-3-8-7.

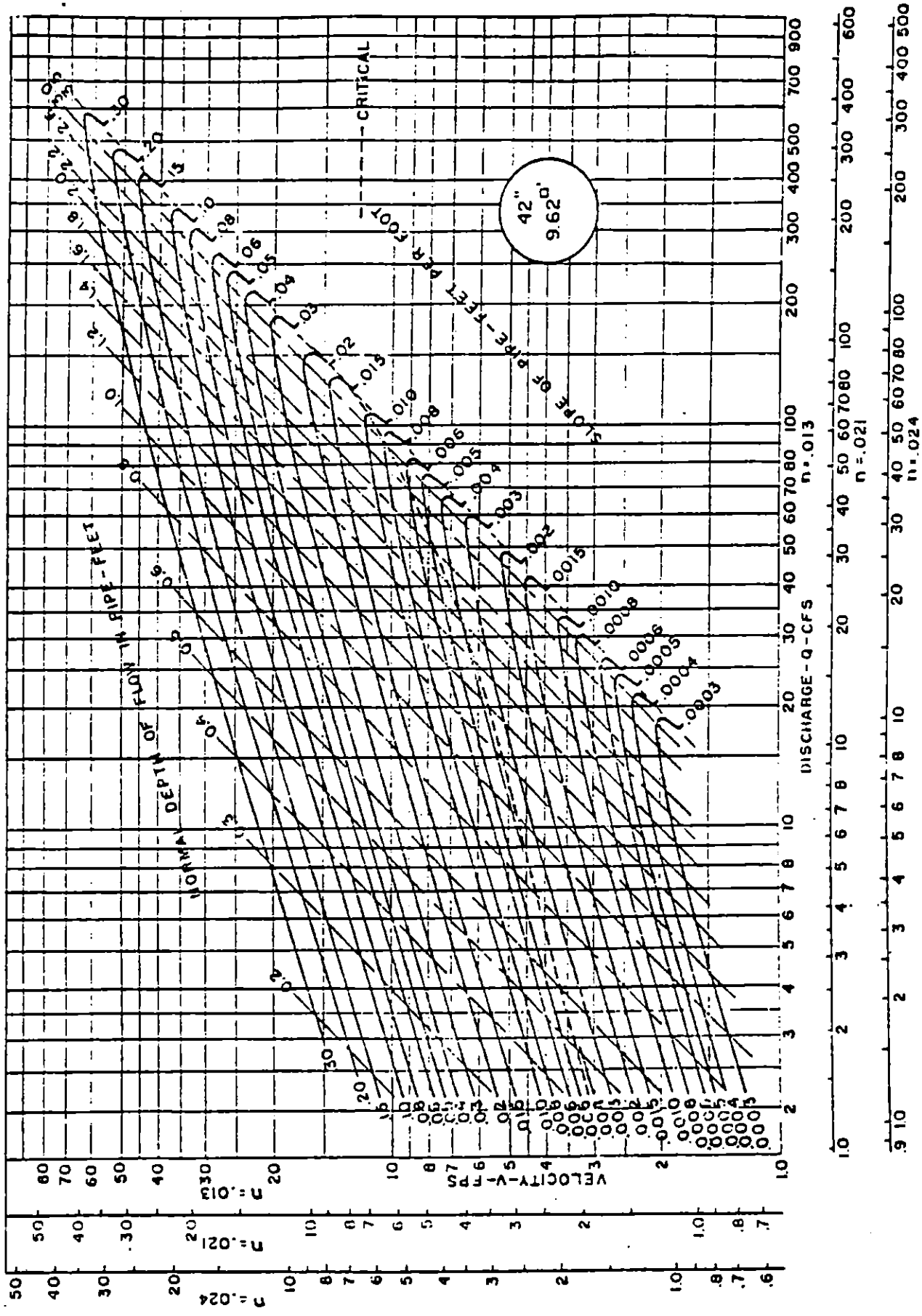
MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-61.1 - 440.24



PIPE FLOW CHART 36" DIAMETER

IV-3-8-11

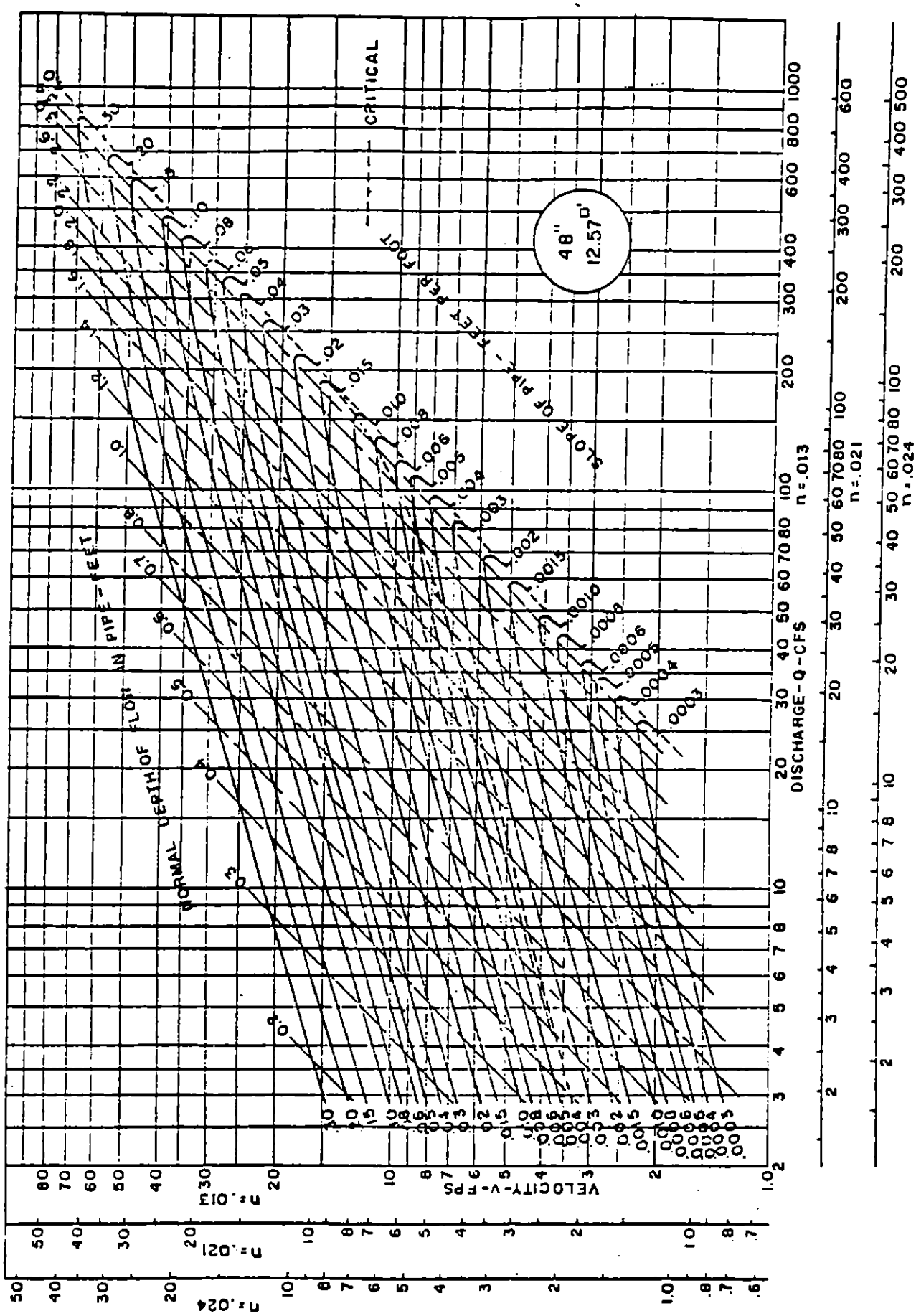
MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-611-440.36



PIPE FLOW CHART 42" DIAMETER

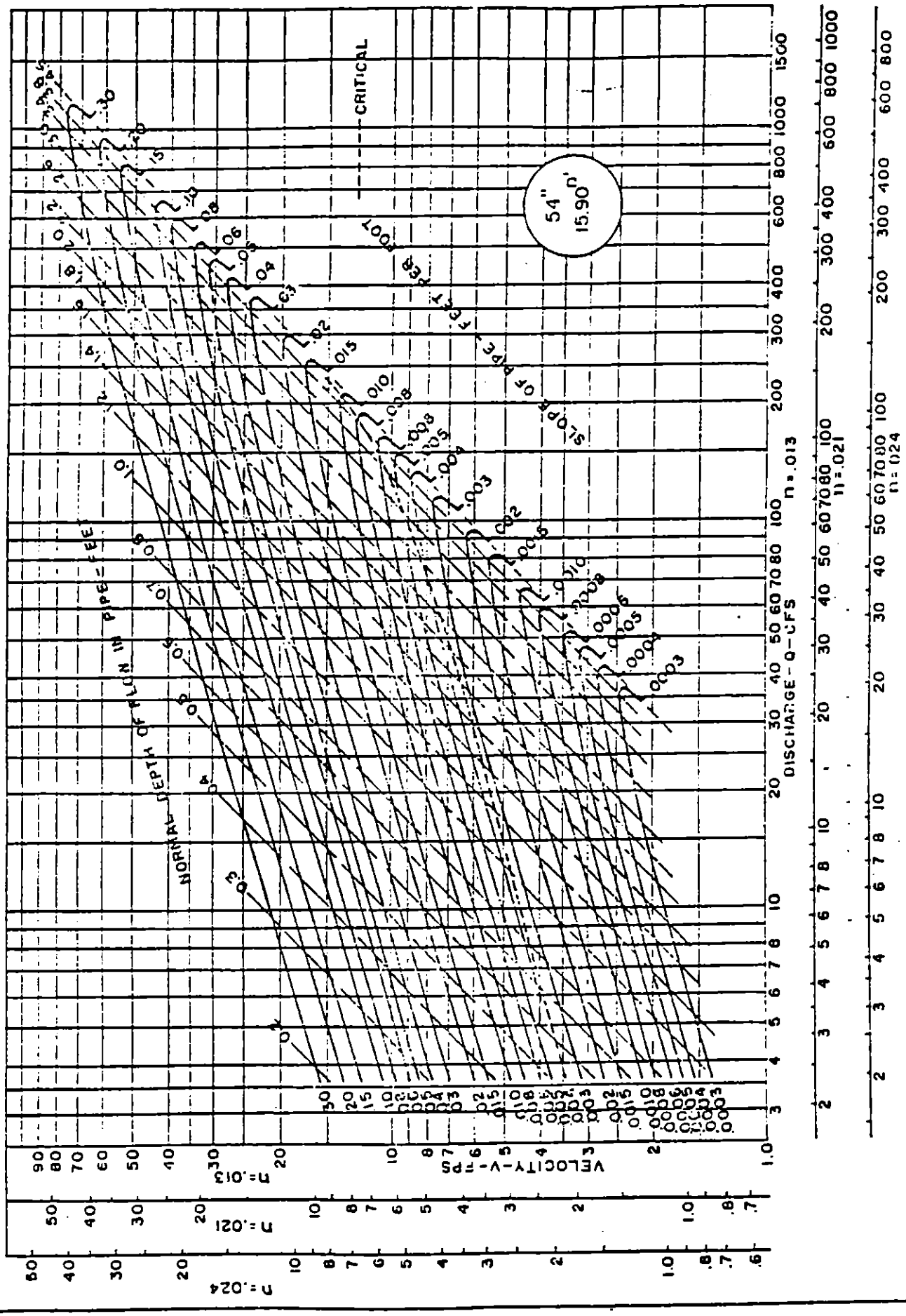
Tv 3-8-12

MARYLAND STATE HIGHWAY ADMINISTRATION 8/61 SHA-GU 440-62



PIPE FLOW CHART 48" DIAMETER

IV-3-a-13



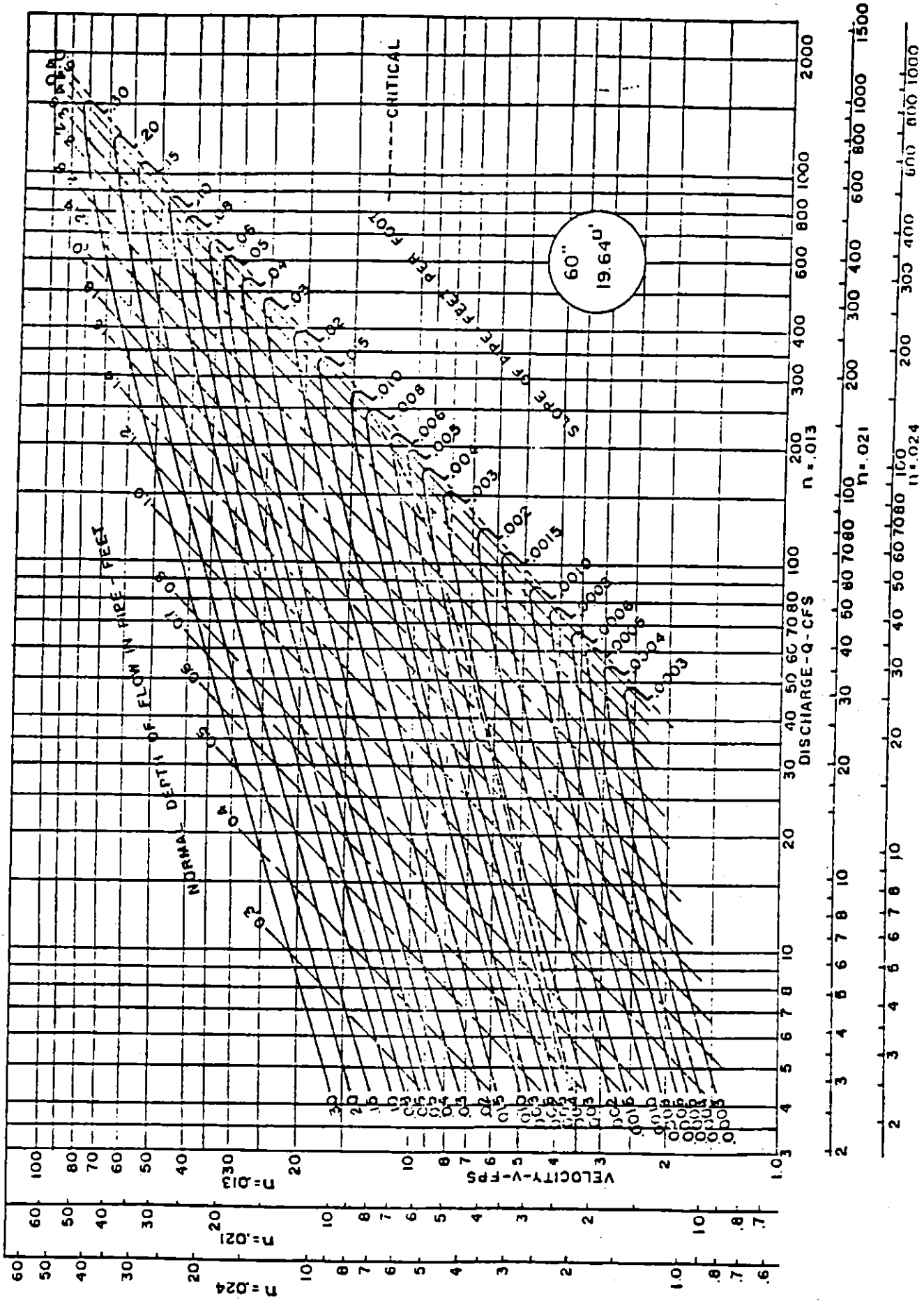
PIPE FLOW CHART 54" DIAMETER

IV-3-d-14

MARYLAND STATE HIGHWAY ADMINISTRATION

8/61

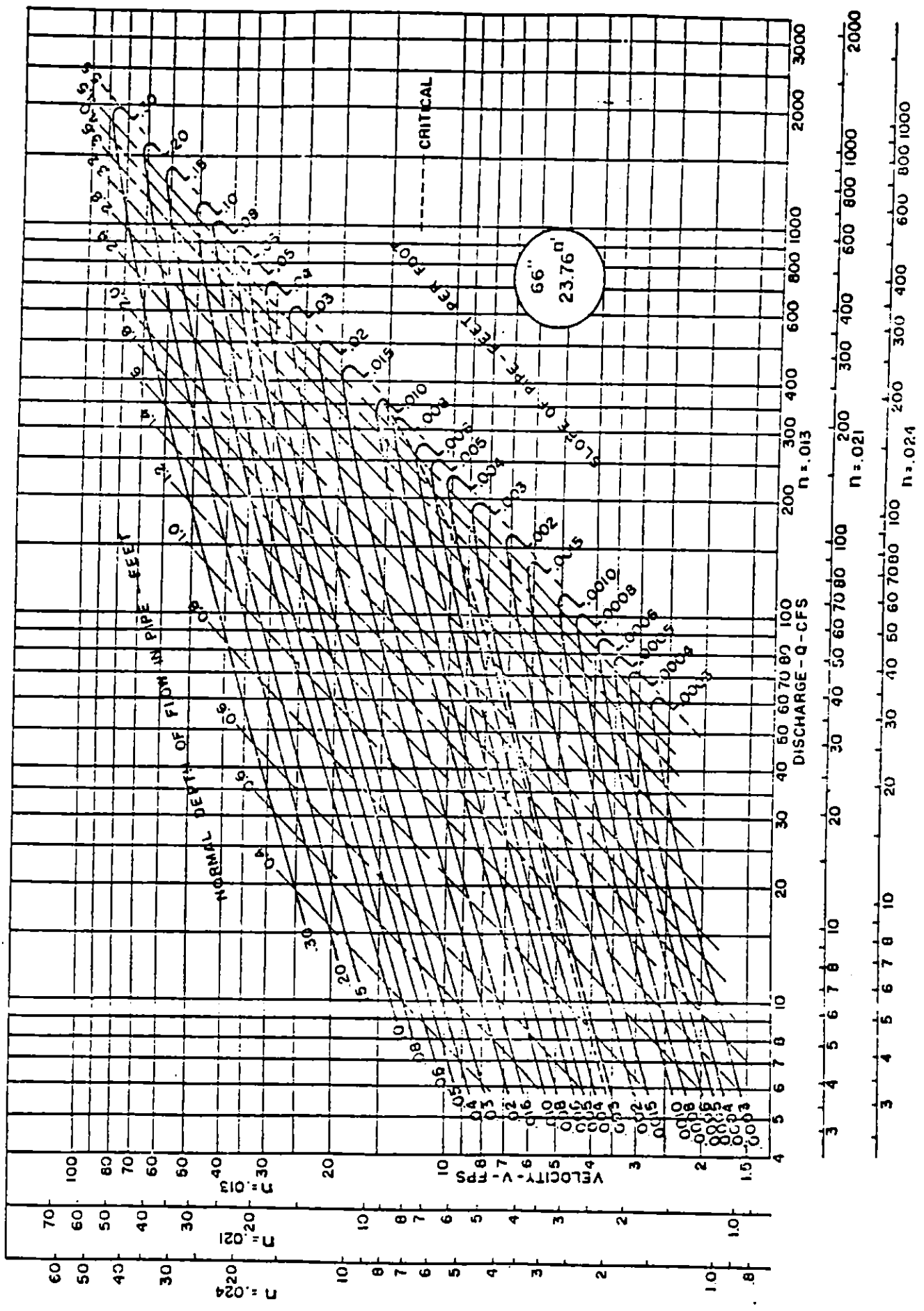
SHA-61.1-44054



PIPE FLOW CHART 60" DIAMETER

IV-3-8-15

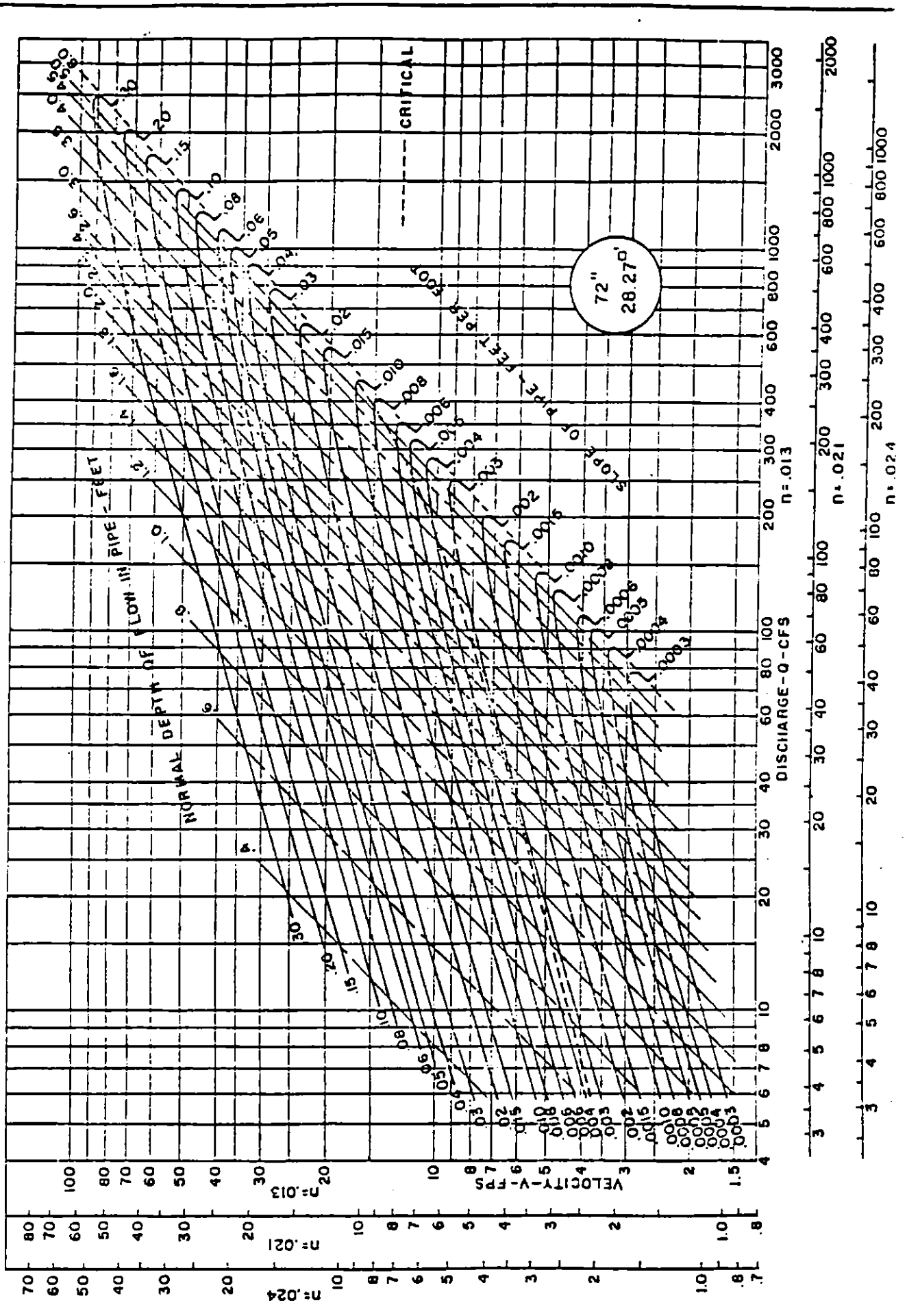
MARYLAND STATE HIGHWAY ADMINISTRATION



PIPE FLOW CHART 66" DIAMETER

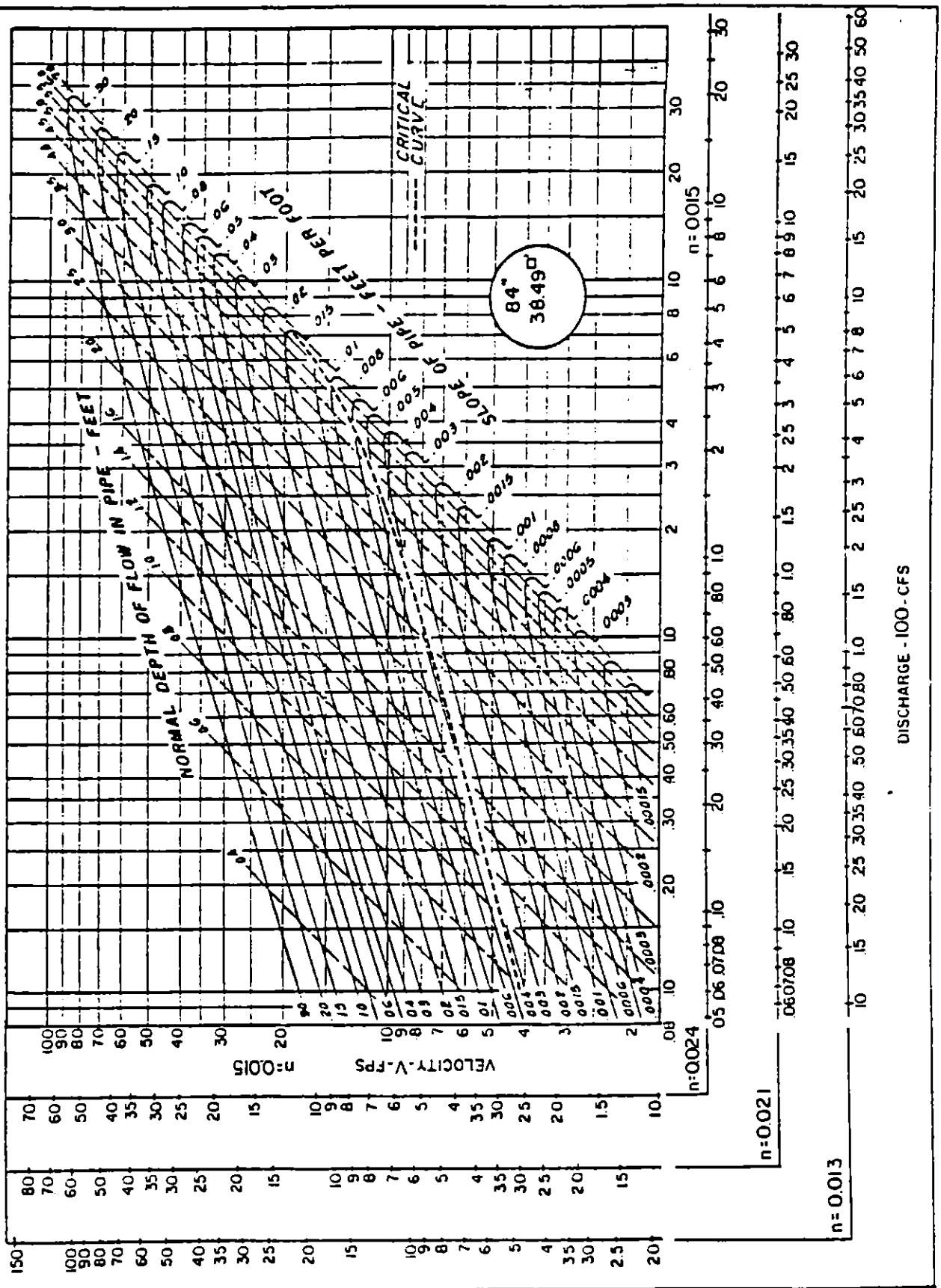
IV-3-8-16

MARYLAND STATE HIGHWAY ADMINISTRATION



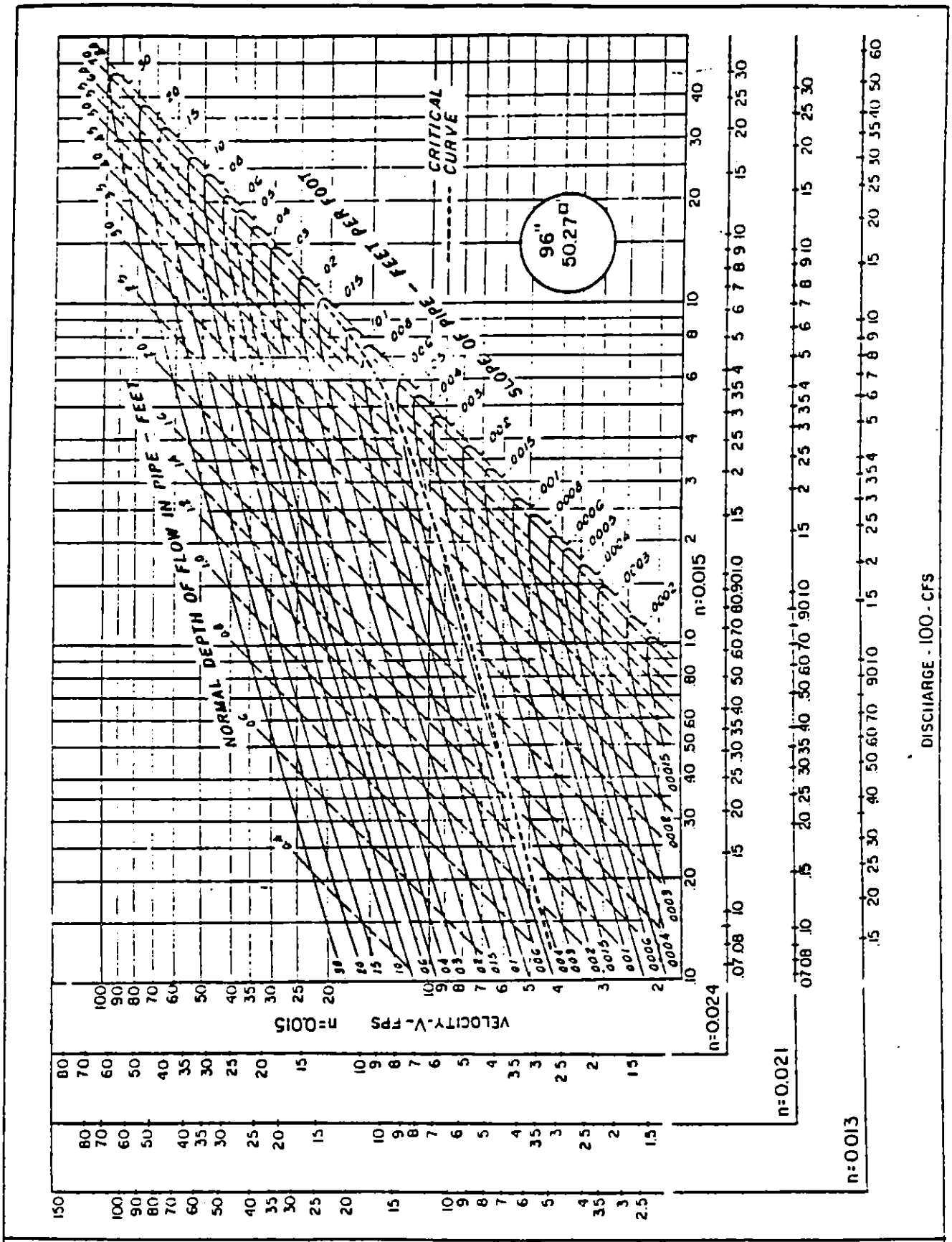
PIPE FLOW CHART 72" DIAMETER

IV-3-8-17



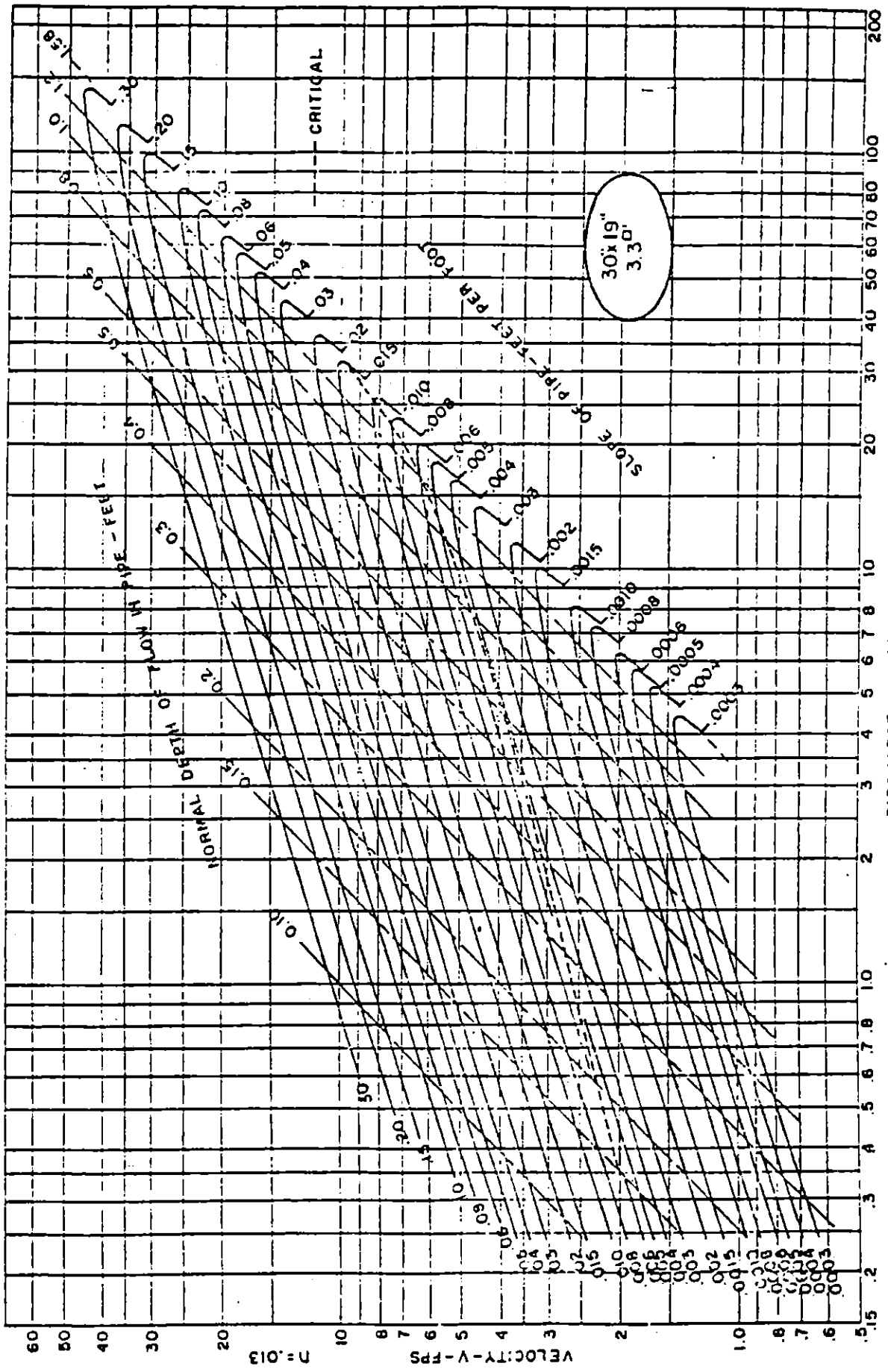
PIPE FLOW CHART - 84 INCH DIAMETER

MARYLAND STATE HIGHWAY ADMINISTRATION 9/78 SHA-61.1-440.84



PIPE FLOW CHART 96-INCH DIAMETER

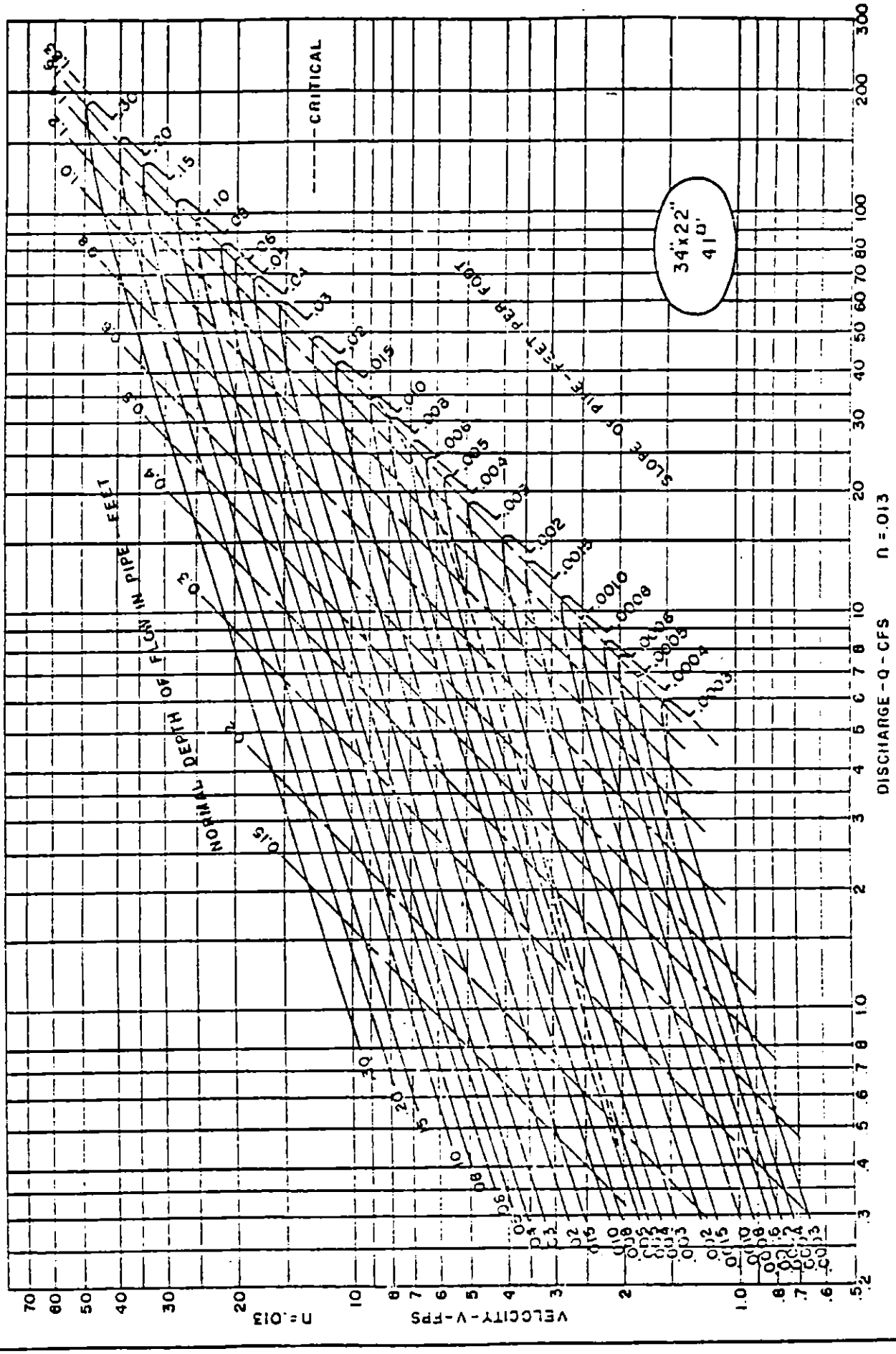
MARYLAND STATE HIGHWAY ADMINISTRATION 9/78 SHA-61.1-440.96



PIPE FLOW CHART, 30"x19" CONCRETE ELLIPTICAL PIPE

IV-3-9-2

MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-611-44130-19

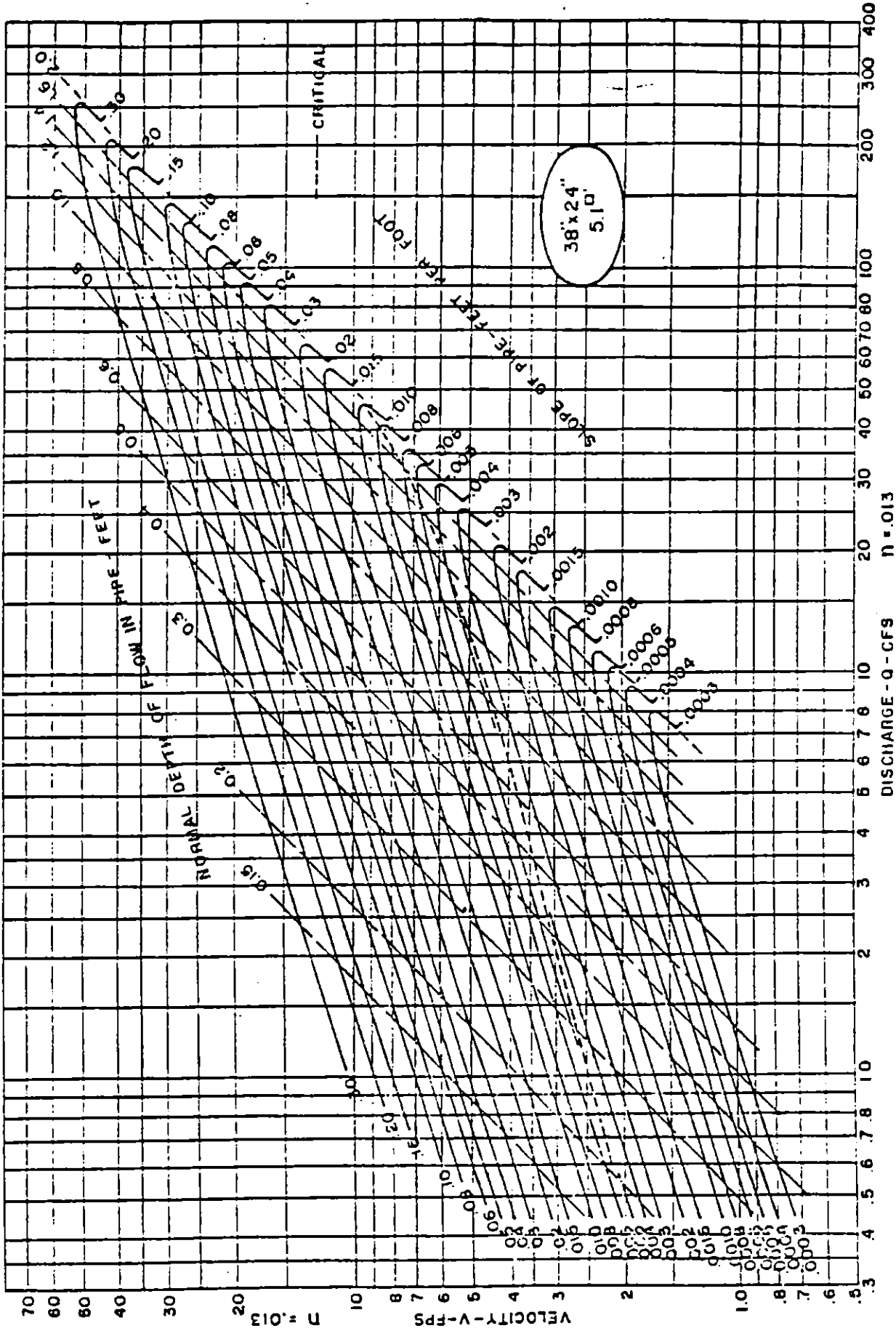


PIPE FLOW CHART, 34"x22" CONCRETE ELLIPTICAL PIPE

IV-3-9-3

MARYLAND STATE HIGHWAY ADMINISTRATION 12/61

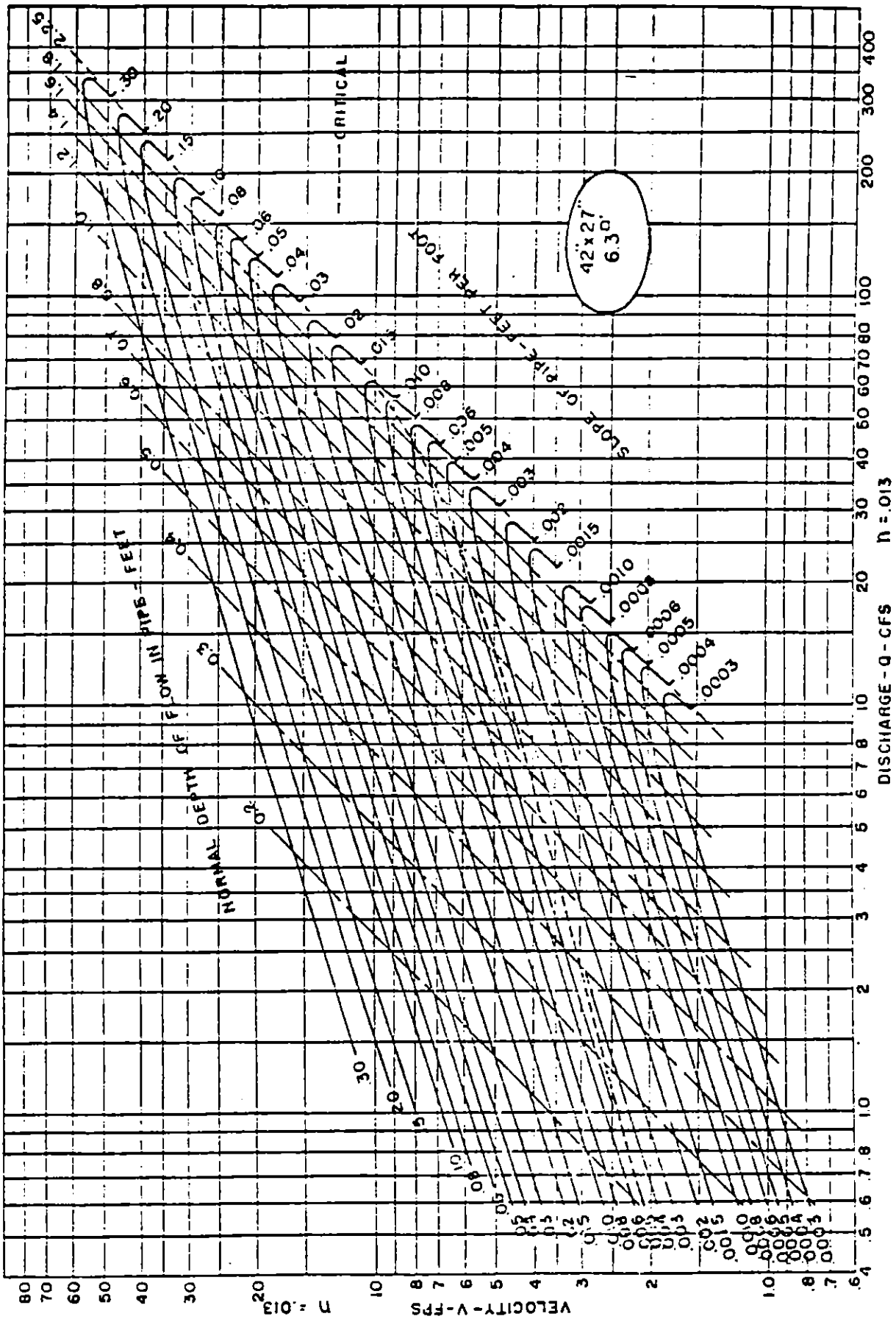
SHA-611-44134-22



PIPE FLOW CHART, 38"x24" CONCRETE ELLIPTICAL PIPE

IV-3-9-4

MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA SL 44 38-24

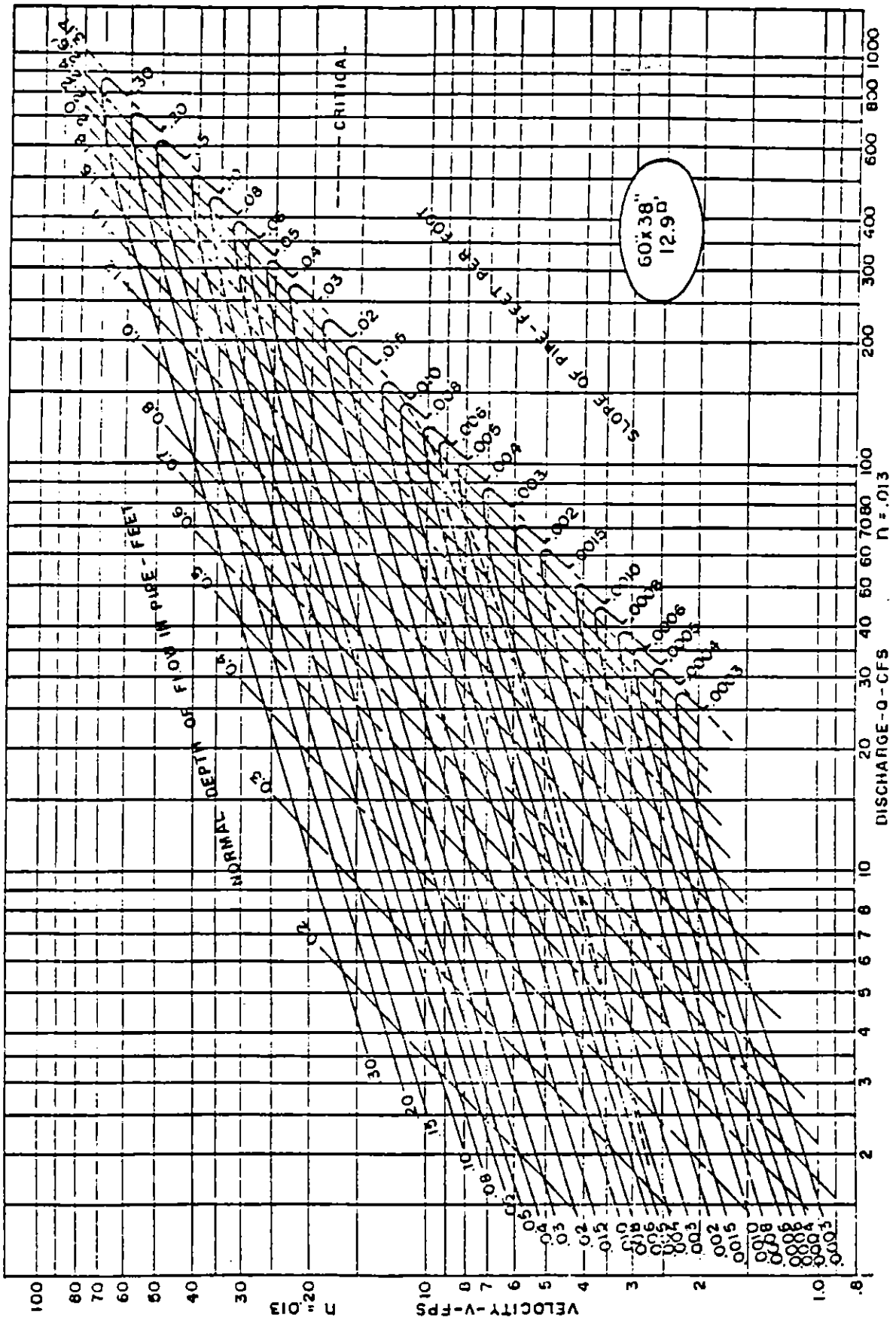


PIPE FLOW CHART, 42"x27" CONCRETE ELLIPTICAL PIPE

IV-3-9-5

MARYLAND STATE HIGHWAY ADMINISTRATION 12/61

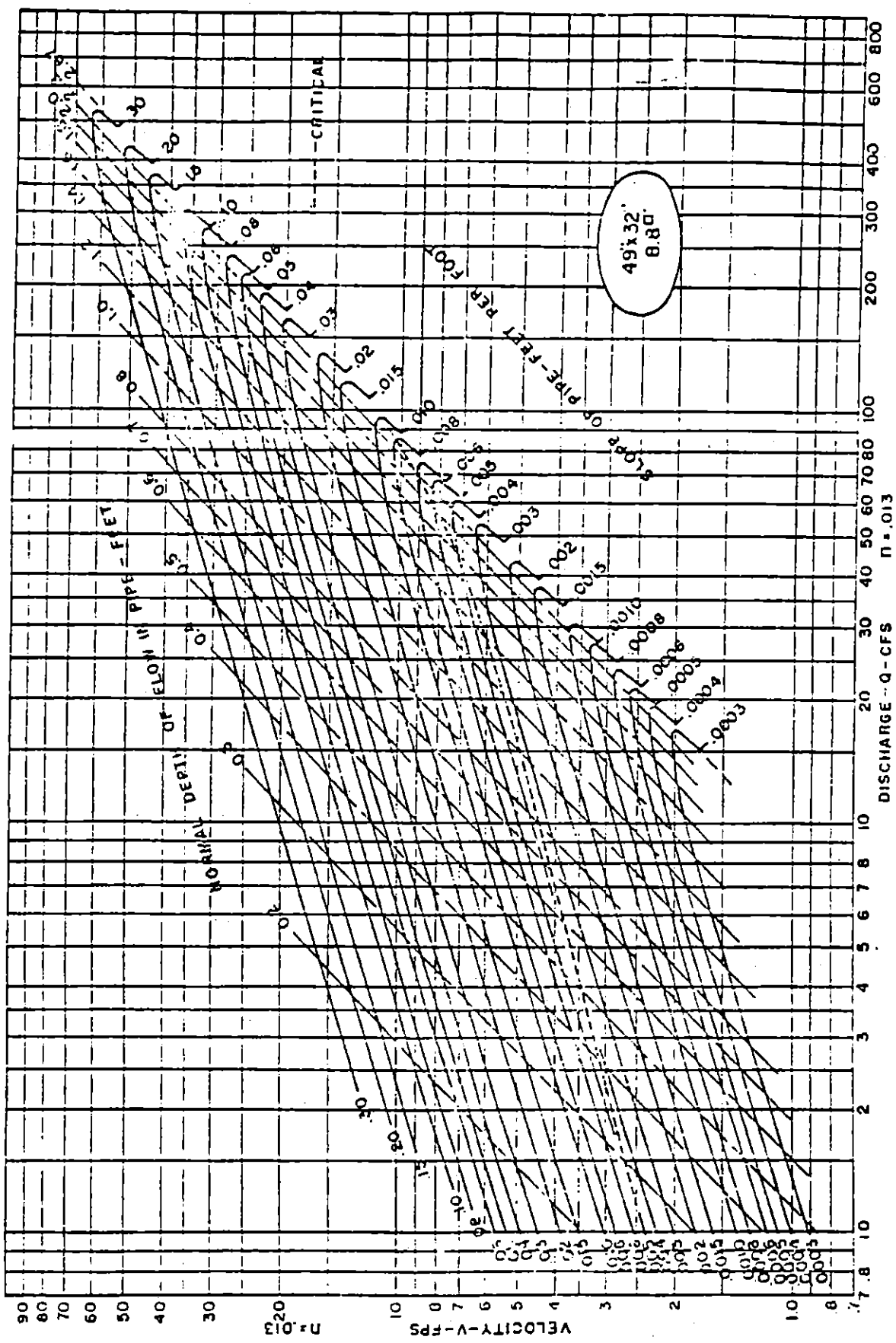
SHA-61.1-441.42-27



PIPE FLOW CHART, 60"x38" CONCRETE ELLIPTICAL PIPE

IV-3-9-9

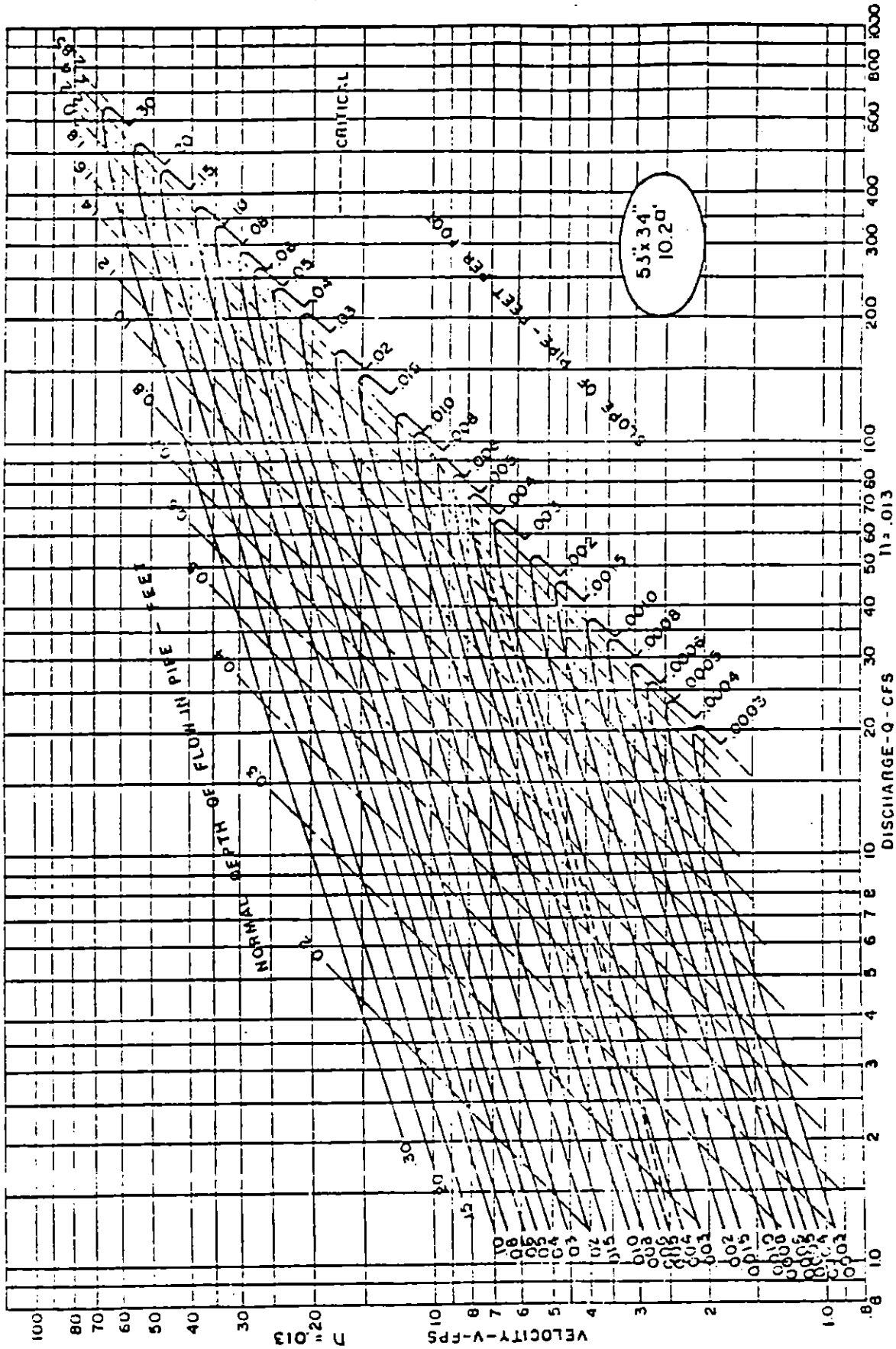
MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-611-441.60-38



PIPE FLOW CHART, 49"x32" CONCRETE ELLIPTICAL PIPE

IV-3-9-7

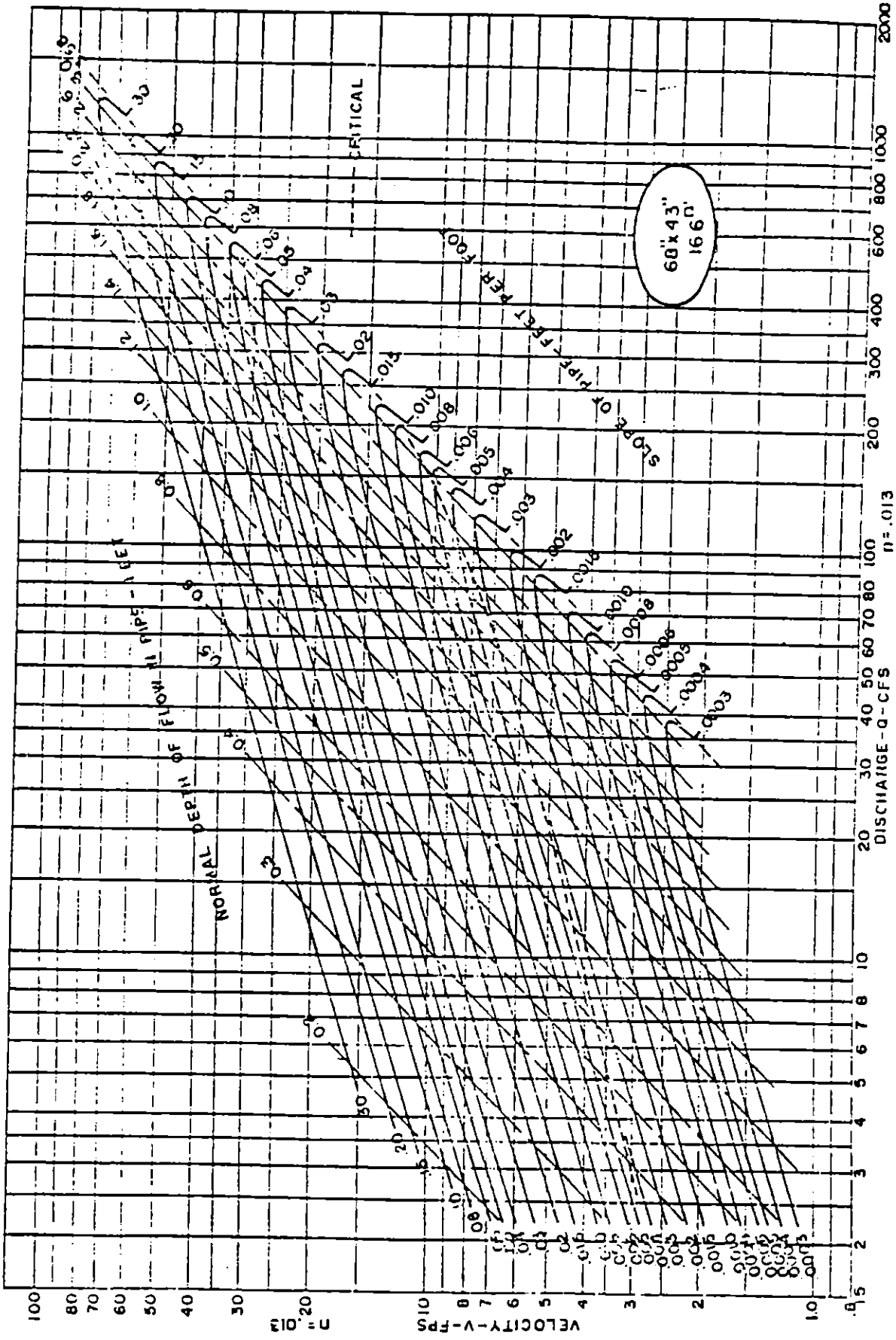
MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-61.1-441.49-32



PIPE FLOW CHART, 53"x34" CONCRETE ELLIPTICAL PIPE

IV-3-9-8

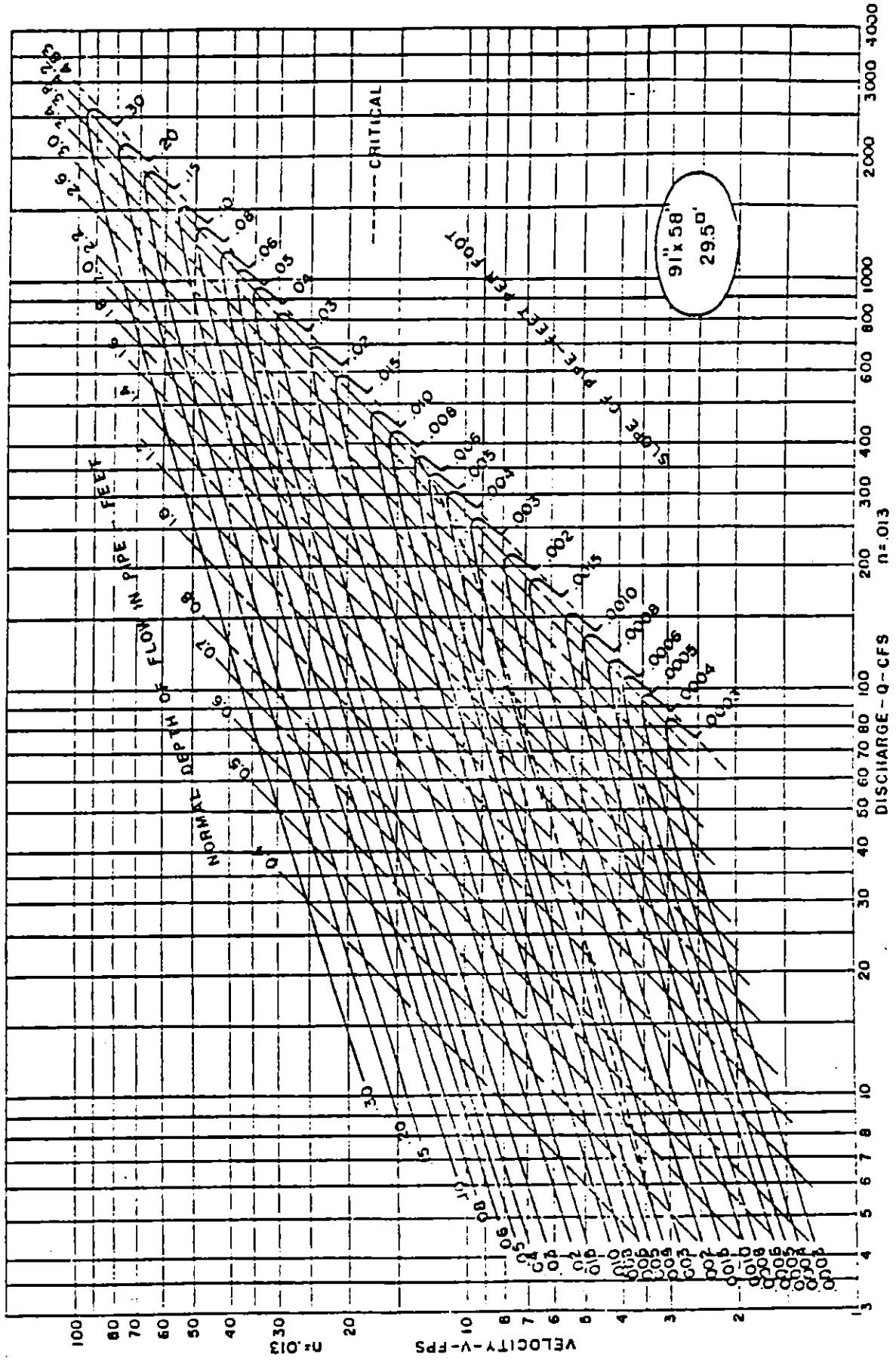
MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-61.1-44 53-34



PIPE FLOW CHART, 68"x43" CONCRETE ELLIPTICAL PIPE

IV-3-9-10

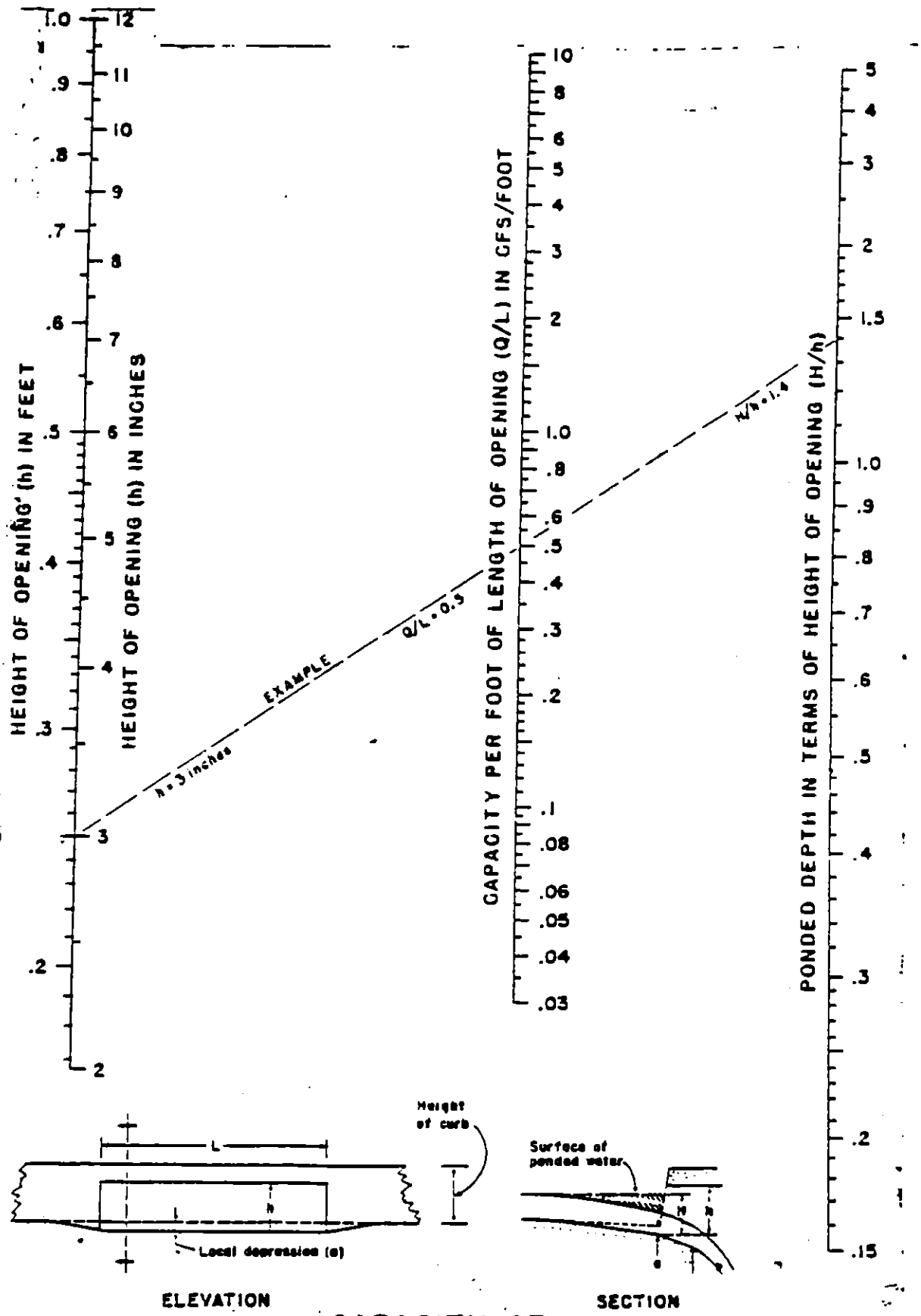
MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-61.1-441.68-43



PIPE FLOW CHART, 91"x58" CONCRETE ELLIPTICAL PIPE

IV-3-9-13

MARYLAND STATE HIGHWAY ADMINISTRATION 12/61 SHA-611-44191-58



CAPACITY OF CURB OPENING INLET AT LOW POINT IN GRADE

MARYLAND STATE HIGHWAY ADMINISTRATION 7/50 SHA-61.1-431.1

AS-BUILT DRAWING

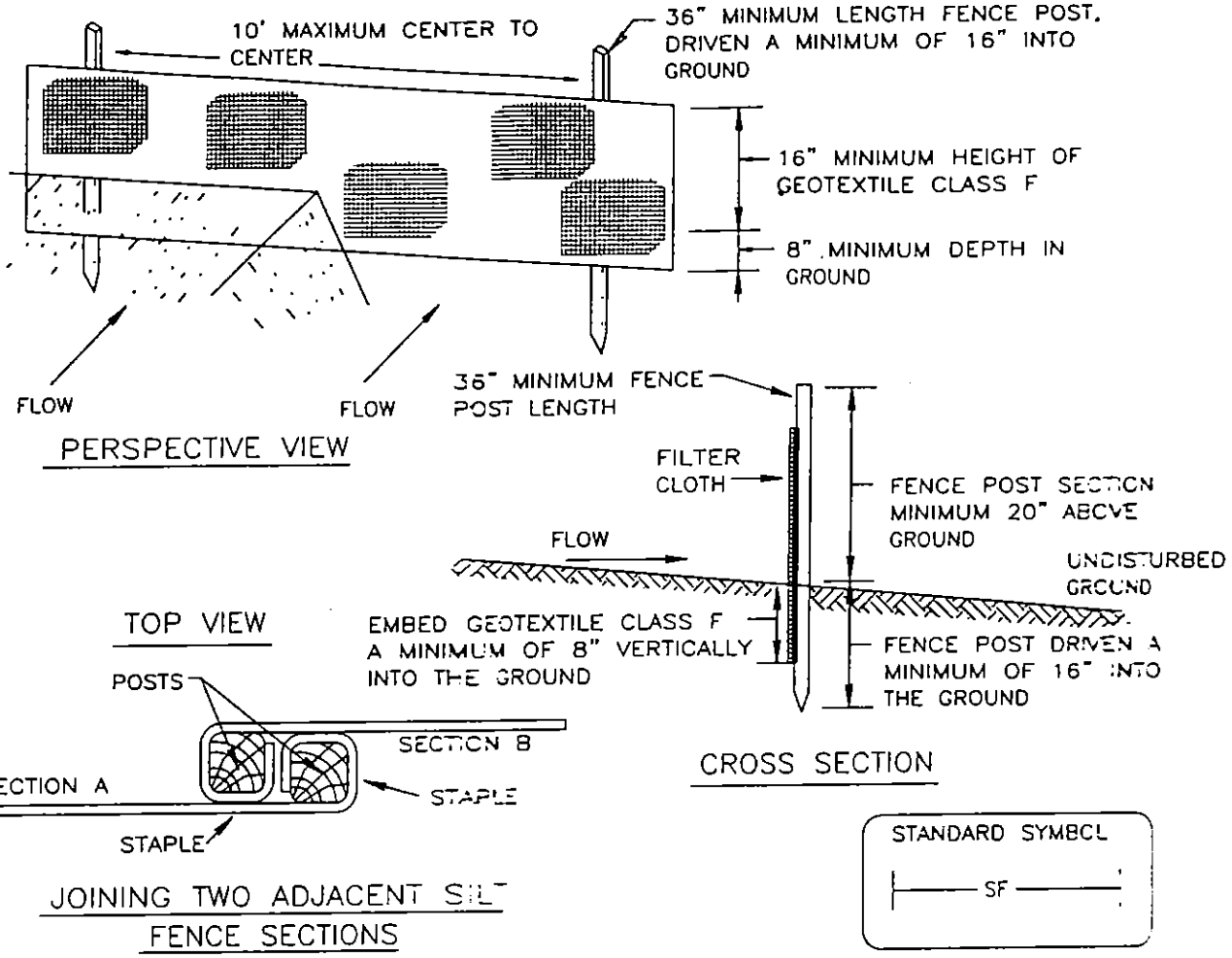
I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

ENGINEER DATE P.E. NO.

AS-BUILT DRAWING STATEMENT

STANDARD DETAILS

SEDIMENT AND EROSION CONTROL



Construction Specifications

1. FENCE POSTS SHALL BE A MINIMUM OF 36" LONG DRIVEN 16" MINIMUM INTO THE GROUND. WOOD POSTS SHALL BE 1 1/2x1 1/2" SQUARE MINIMUM CUT OR 1 3/4" DIAMETER MINIMUM ROUND AND SHALL BE OF SOUND QUALITY HARDWOOD. STEEL POSTS WILL BE STANDARD T OR U SECTION WEIGHING NOT LESS THAN 1.00 POUND PER LINEAR FOOT.
2. GEOTEXTILE SHALL BE FASTENED SECURELY TO EACH FENCE POST WITH WIRE TIES OR STAPLES AT THE TOP AND MIDSECTION AND SHALL MEET THE FOLLOWING REQUIREMENTS FOR GEOTEXTILE CLASS F:

TENSILE STRENGTH	50 LBS/IN (MIN	TEST: MSMT 509
TENSILE MODULUS	20 LBS/IN (MIN)	TEST: MSMT 509
FLOW RATE	0.3 GAL FT/MIN (MAX)	TEST: MSMT 322
FILTERING EFFICIENCY	75% (MIN)	TEST: MSMT 322

3. WHERE ENDS OF GEOTEXTILE FABRIC COME TOGETHER, THEY SHALL BE OVERLAPPED, FOLDED AND STAPLED TO PREVENT SEDIMENT BYPASS.
4. SILT FENCE SHALL BE INSPECTED AFTER EACH RAINFALL EVENT AND MAINTAINED WHEN BULGES OCCUR OR WHEN SEDIMENT ACCUMULATION REACHES 50% OF THE FABRIC HEIGHT.

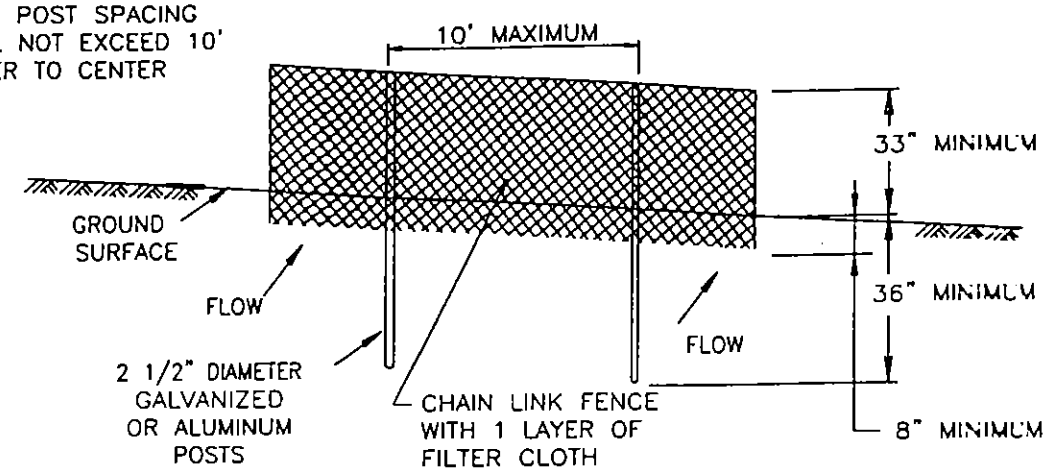
SILT FENCE DESIGN CRITERIA

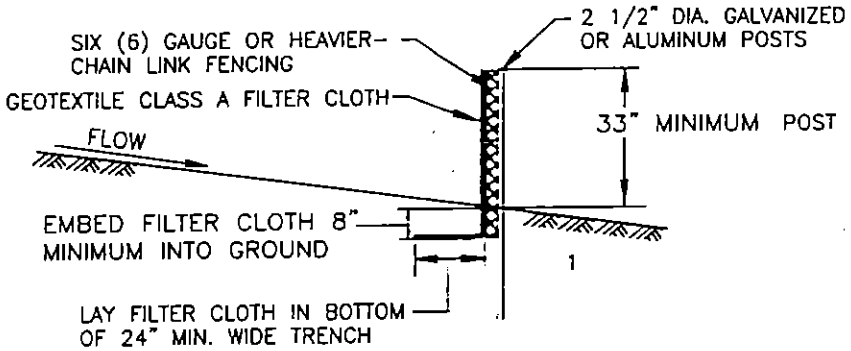
SLOPE STEEPNESS	SLOPE LENGTH (MAX)	SILT FENCE LENGTH (MAX)
FLATTER THAN 50:1	UNLIMITED	UNLIMITED
50: 1 TO 10:1	125 FEET	1000 FEET
10:1 TO 5:1	100 FEET	750 FEET
5:1 TO 3:1	60 FEET	500 FEET
3:1 TO 2:1	40 FEET	250 FEET
2:1 AND STEEPER	20 FEET	125 FEET

NOTE: IN AREAS OF LESS THAN 2% SLOPE AND SANDY SOILS (USDA GENERAL CLASSIFICATION SYSTEM, SOIL CLASS A) MAXIMUM SLOPE LENGTH AND SILT FENCE LENGTH WILL BE UNLIMITED. IN THESE AREAS A SILT FENCE MAY BE THE ONLY PERIMETER CONTROL REQUIRED.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	PAGE E - 15 - 3	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION
TOWN OF INDIAN HEAD	SILT FENCE	

NOTE: FENCE POST SPACING SHALL NOT EXCEED 10' CENTER TO CENTER





STANDARD SYMBOL

SSF

Construction Specifications

1. Fencing shall be 42" in height and constructed in accordance with the latest Maryland State Highway (SHA) Details for Chain Link Fencing. The SHA specification for a 6' fence shall be used, substituting 42" fabric and 6' length posts.

2. The posts do not need to be set in concrete.

3. Chain link fence shall be fastened securely to the fence posts with wire ties. The lower tension wire, brace and truss rods, drive anchors and post caps are not required except on the ends of the fence.

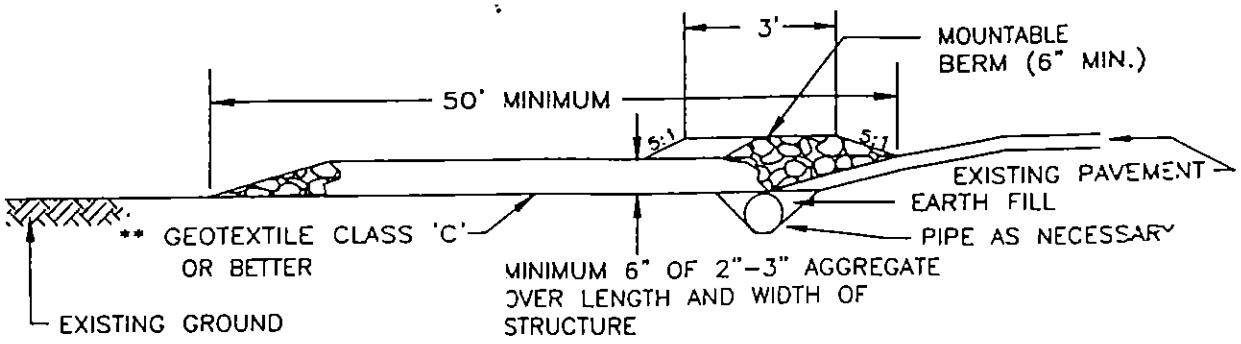
4. Filter cloth shall be fastened securely to the chain link fence with ties spaced every 24" at the top and mid section.

5. Filter cloth shall be embedded a minimum of 8" into the ground.

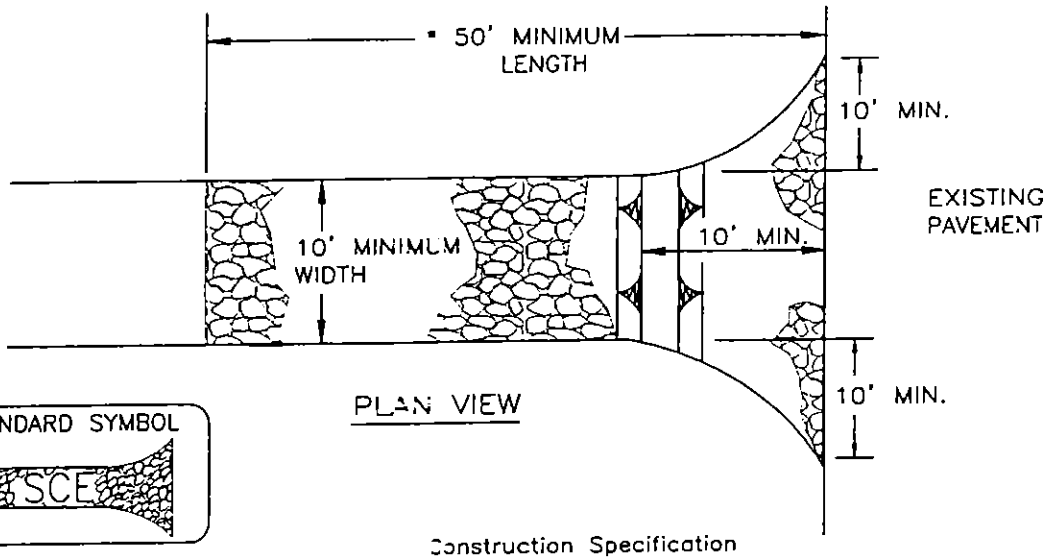
6. When two sections of filter cloth adjoin each other, they shall be overlapped by 6" and folded.

7. Maintenance shall be performed as needed and silt buildups removed when "bulges" develop in the silt fence, or when silt reaches 50% of fence height

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	H - 26 - 3 MODIFIED	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION
TOWN OF INDIAN HEAD	SUPER SILT FENCE	

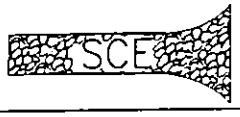


PROFILE



PLAN VIEW

STANDARD SYMBOL



Construction Specification

1. Length – minimum of 50' (*30' for single residence lot).

2. Width – 10' minimum, should be flared at the existing road to provide a turning radius.

3. Geotextile fabric (filter cloth) shall be placed over the existing ground prior to placing stone. **The plan approval authority may not require single family residences to use geotextile.

4. Stone – crushed aggregate (2" to 3") or reclaimed or recycled concrete equivalent shall be placed at least 6" deep over the length and width of the entrance.

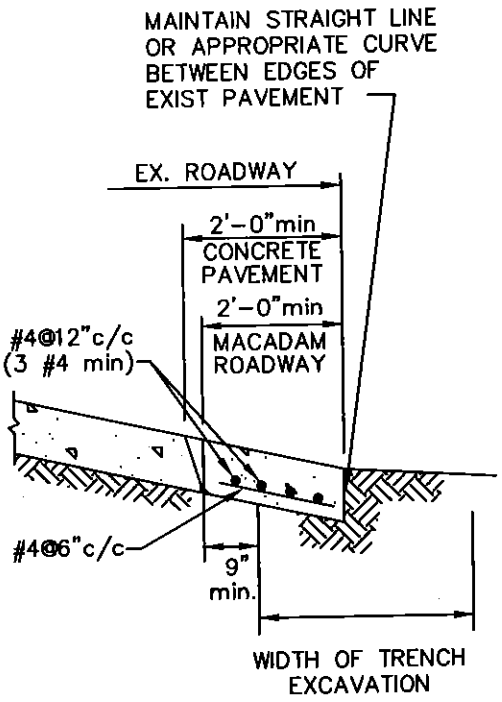
5. Surface Water – all surface water flowing to or diverted toward construction entrances shall be piped through the entrance, maintaining positive drainage. Pipe installed through the stabilized construction entrance shall be protected with a mountable berm with 5:1 slopes and a minimum of 6" of stone over the pipe. Pipe has to be sized according to the drainage. When the SCE is located at a high spot and has no drainage to convey a pipe will not be necessary. Pipe should be sized according to the amount of runoff to be conveyed. A 6" minimum will be required.

6. Location – A stabilized construction entrance shall be located at every point where construction traffic enters or leaves a construction site. Vehicles leaving the site must travel over the entire length of the stabilized construction entrance.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	PAGE F - 17 - 3	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION
TOWN OF INDIAN HEAD	STABILIZED CONSTRUCTION ENTRANCE	

CIVIL

FOR BITUMINOUS SURFACE OR MACADAM SEE ADJACENT DETAILS



EDGE OF PAVING REPAIR
(TYPICAL)

GENERAL NOTES

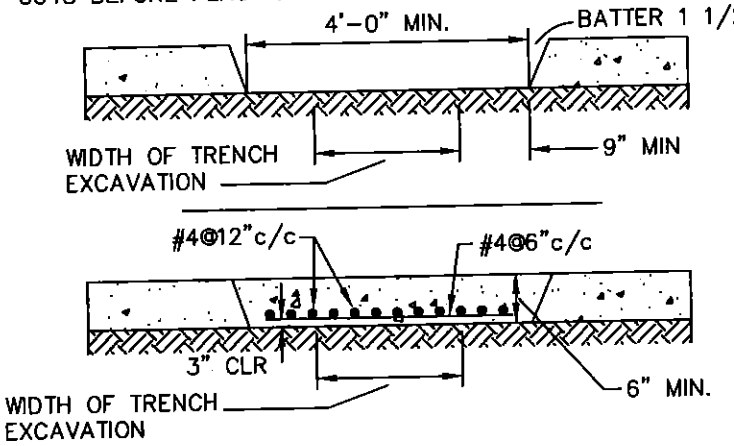
1. ALL CONCRETE SHALL BE 4000 PSI @ 28 DAYS. CEMENT SHALL BE HIGH EARLY STRENGTH. (TYPE III)
2. BITUMINOUS CONCRETE SHALL BE IN ACCORDANCE W/ MSHA SPECIFICATION.
3. PRIOR TO PLACING BITUMINOUS SURFACING ALL UTILITY STRUCTURES SHALL BE BROUGHT TO GRADE. BACKFILL AROUND UTILITY STRUCTURES SHALL BE MADE WITH 3000 PSI. CONCRETE.

ALL EXPOSED EDGES OF EXISTING BITUMINOUS SURFACE COUSE AND SURFACE OF CONCRETE BASE SHALL BE PRIMED BEFORE THE BITUMINOUS MIXTURE IS PLACED.

CONCRETE PAVEMENT

CLEAN AND WET EDGES OF CUTS BEFORE PLACING CONC.

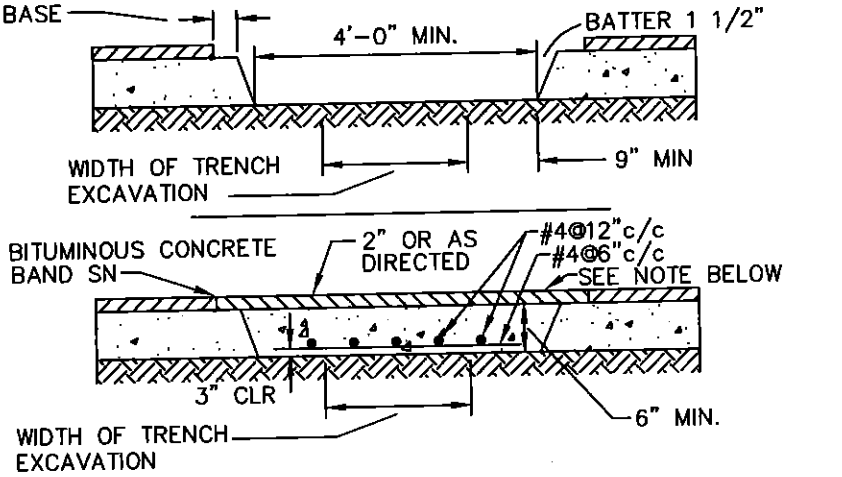
COMPACT AND DAMPEN SUBGRADE BEFORE PLACING BARS



BITUMINOUS CONCRETE SUBSURFACE COURSE ROADWAY OVER CONCRETE BASE

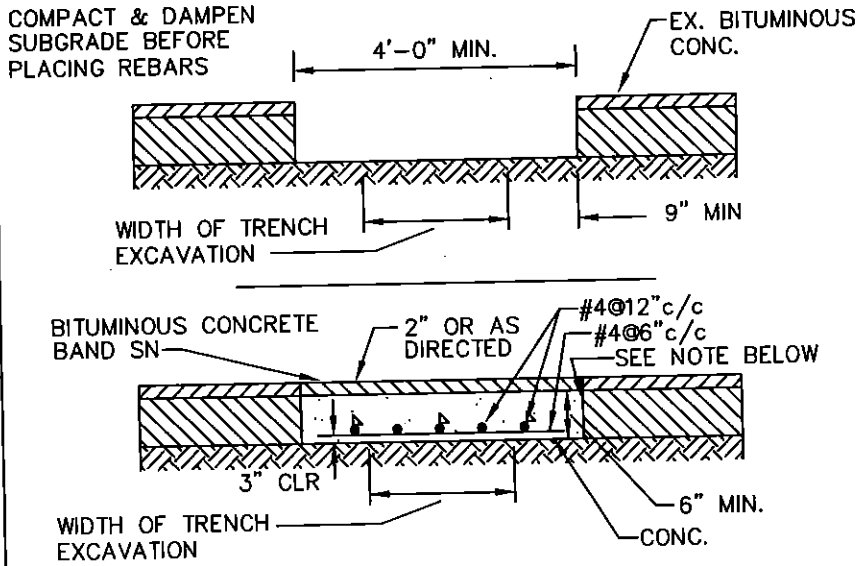
CUT BITUMINOUS SURFACE BACK 3" FROM EDGE OF BASE

COMPACT AND DAMPEN SUBGRADE BEFORE PLACING BARS

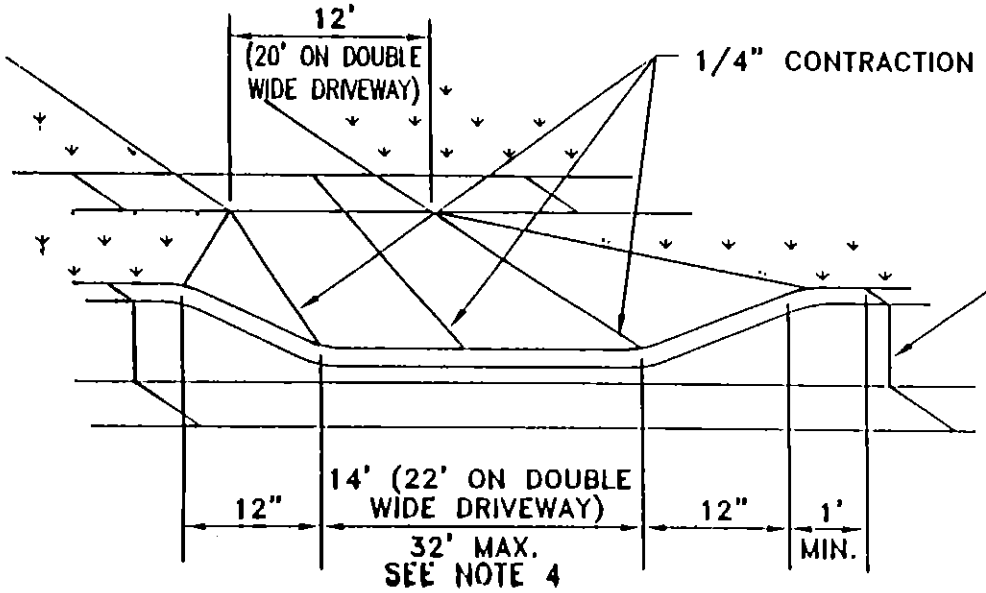


MACADAM ROADWAY

COMPACT & DAMPEN SUBGRADE BEFORE PLACING REBARS

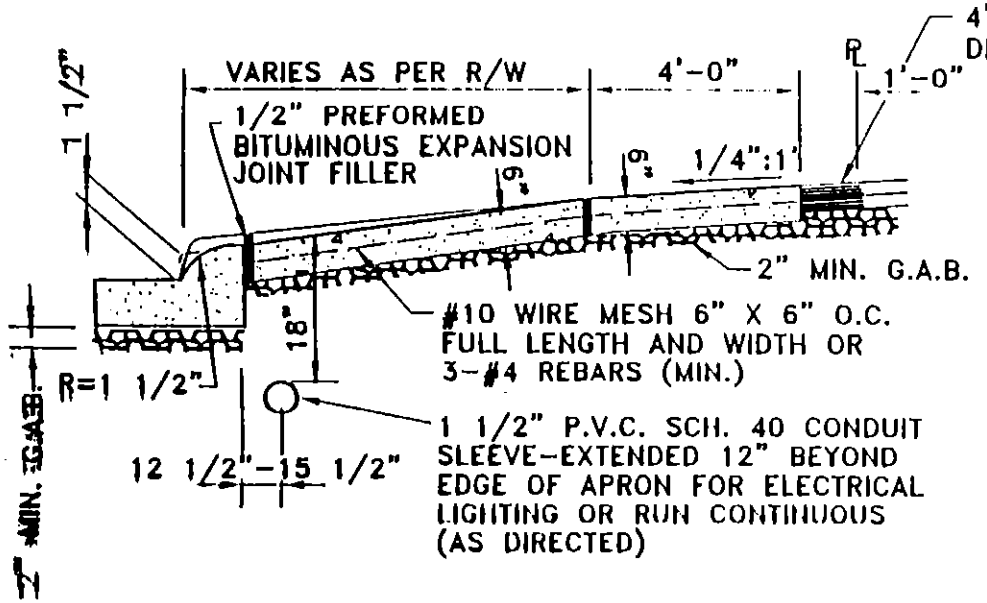


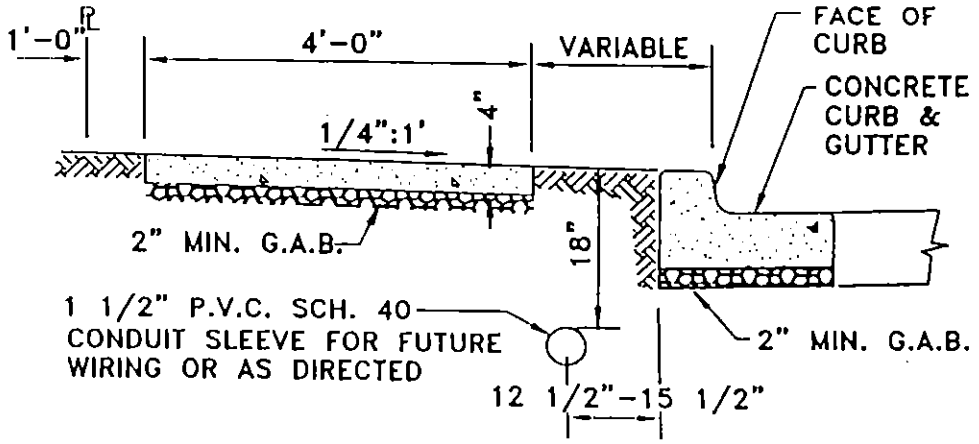
TOWN OF INDIAN HEAD	METHOD OF CUTTING & REPAIRING ROADWAYS IN AREAS WITHOUT JURISDICTIONAL REQUIREMENTS	



NOTES:

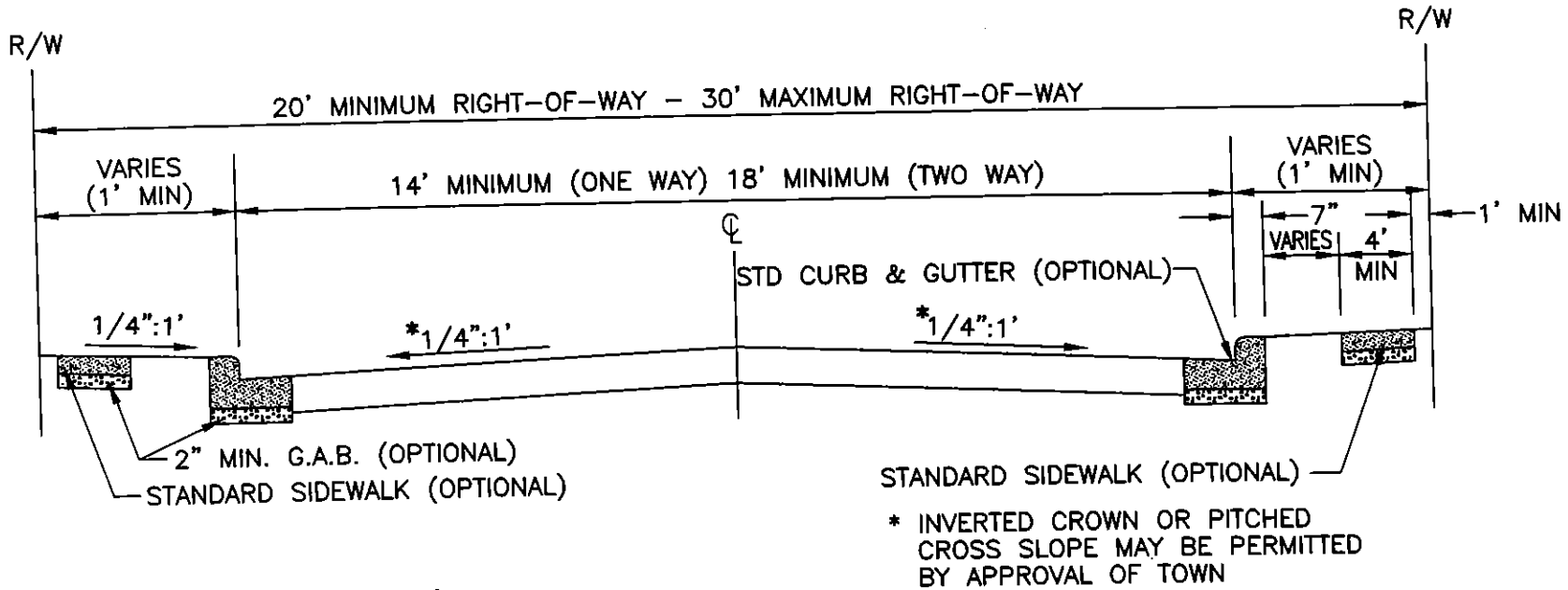
1. SCORE 1/4" DUMMY CONTRACTION JOINTS AT 4'-0" INTERVALS.
2. CONSTRUCT 1/2" BIT. EXPANSION JOINTS AT 20'-0" (MAX.) INTERVALS.
3. CONCRETE SHALL BE SPRAYED WITH LIQUID CURING COMPOUND.
4. 32' MAXIMUM WIDTH IS SUBJECT TO APPROVAL ON A CASE BY CASE BASIS AND FOR COMMERCIAL USE.
5. CONCRETE TO BE MSHA MIX NO. 2.

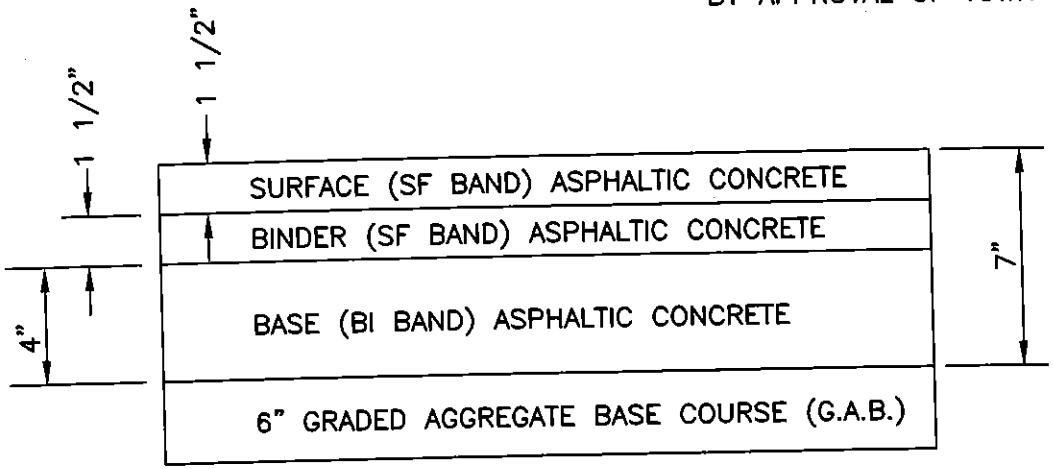




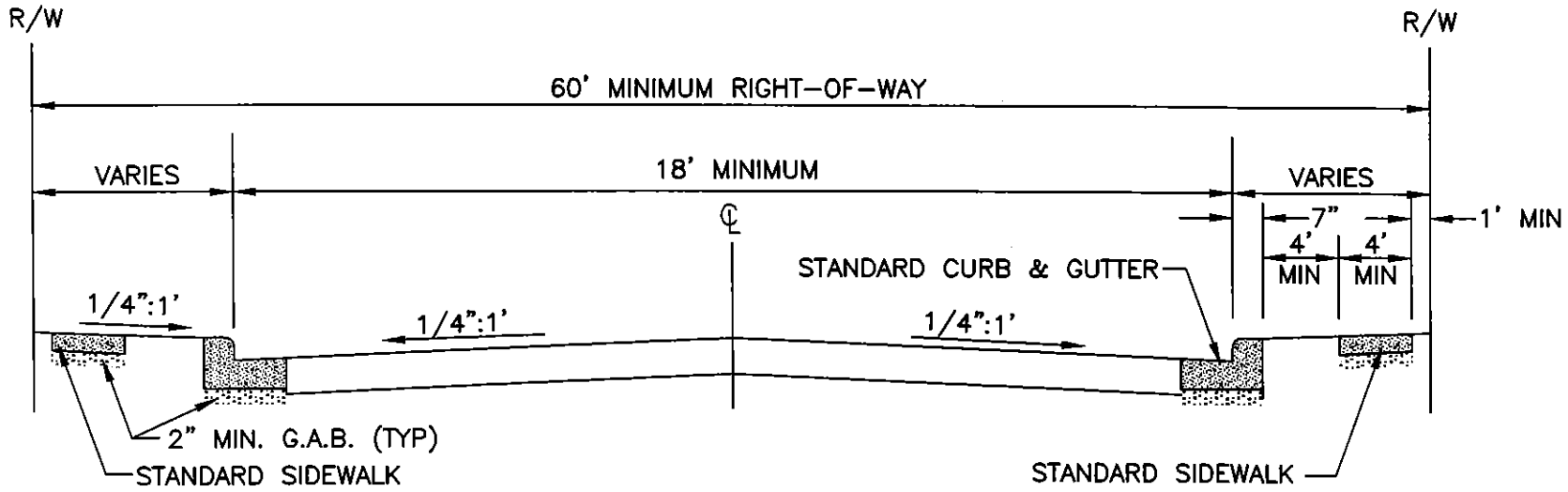
TOWN OF INDIAN HEAD

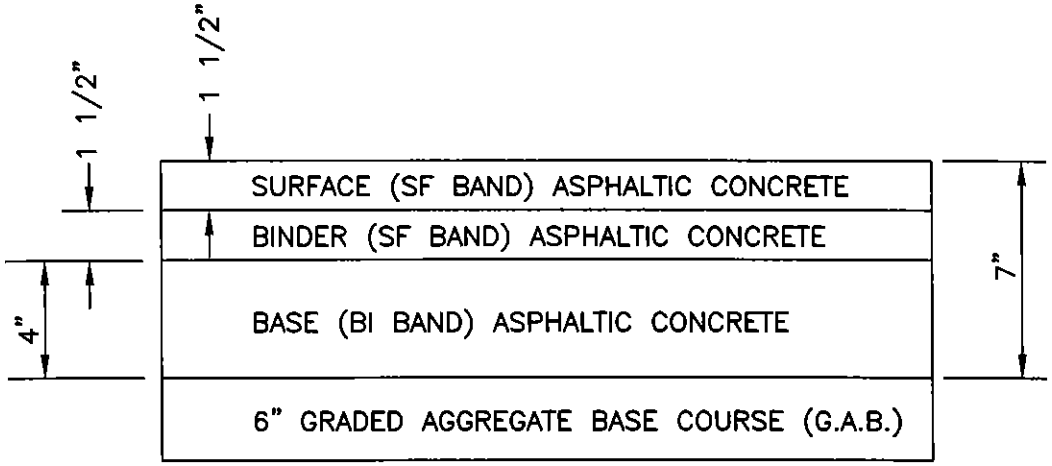
TYPICAL DRIVEWAY-CURB DETAIL AND TYPICAL SIDEWALK LOCATION FOR RESIDENTIAL AND COMMERCIAL ENTRANCES



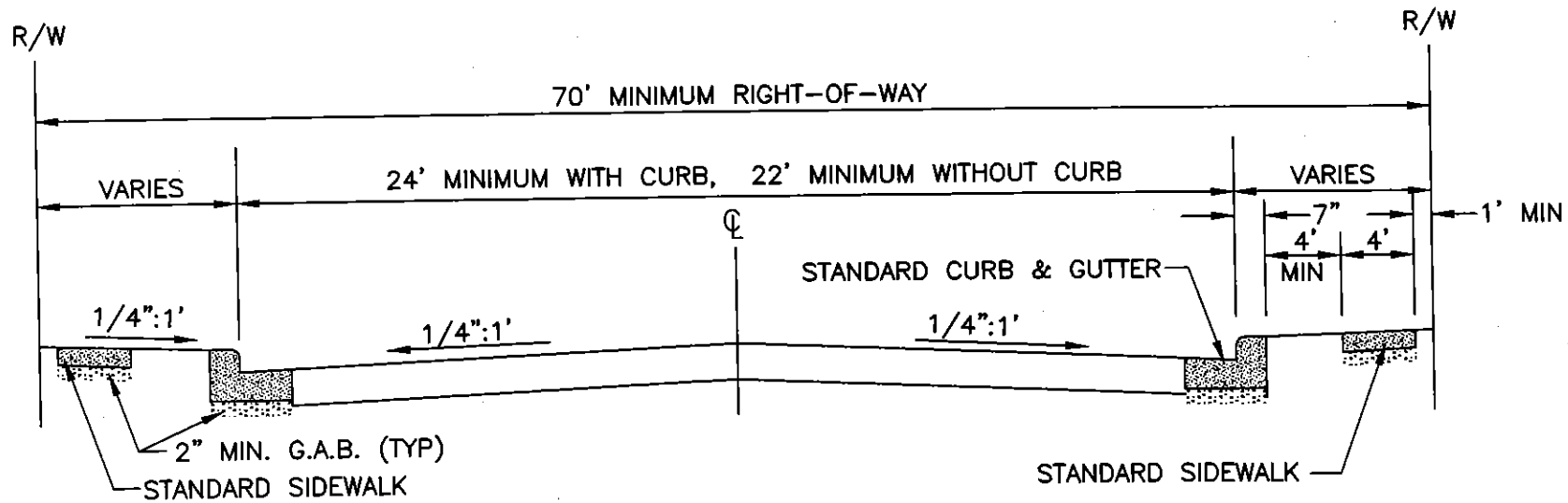


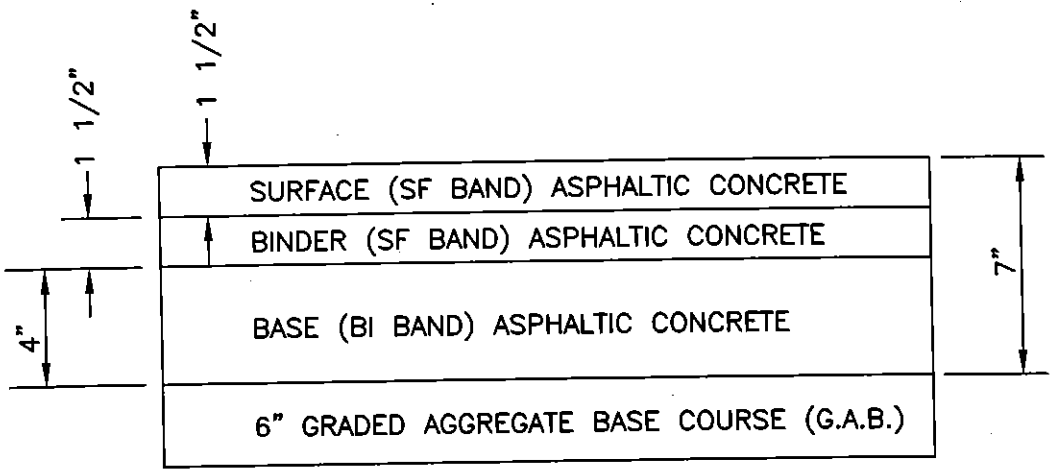
TOWN OF INDIAN HEAD	ALLEY	



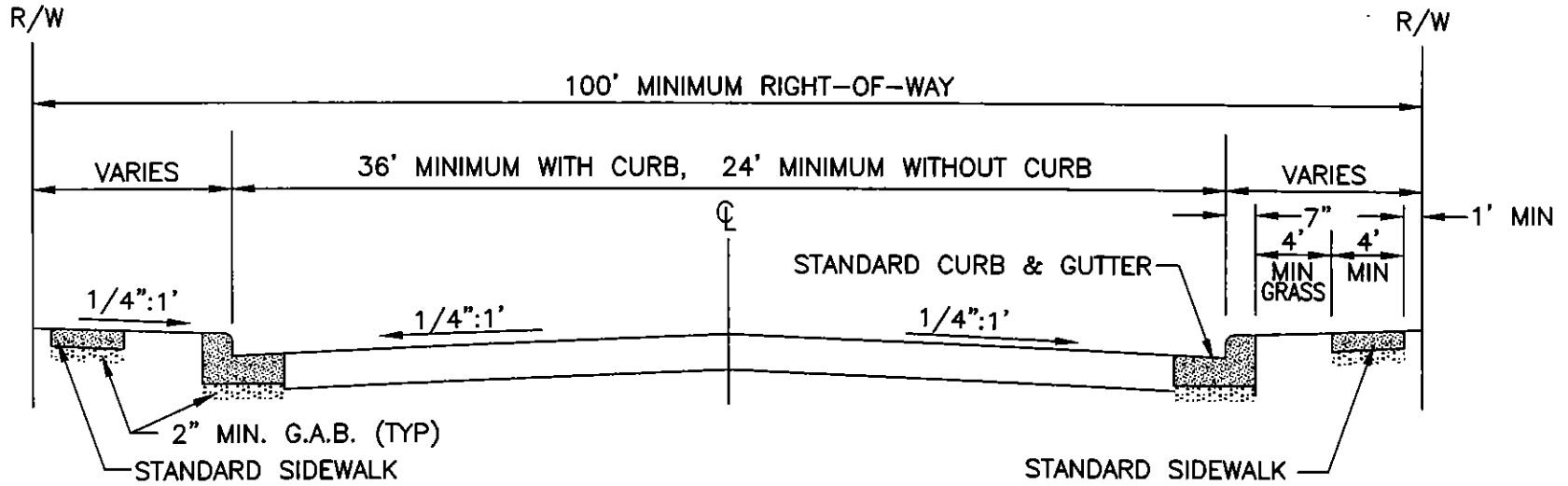


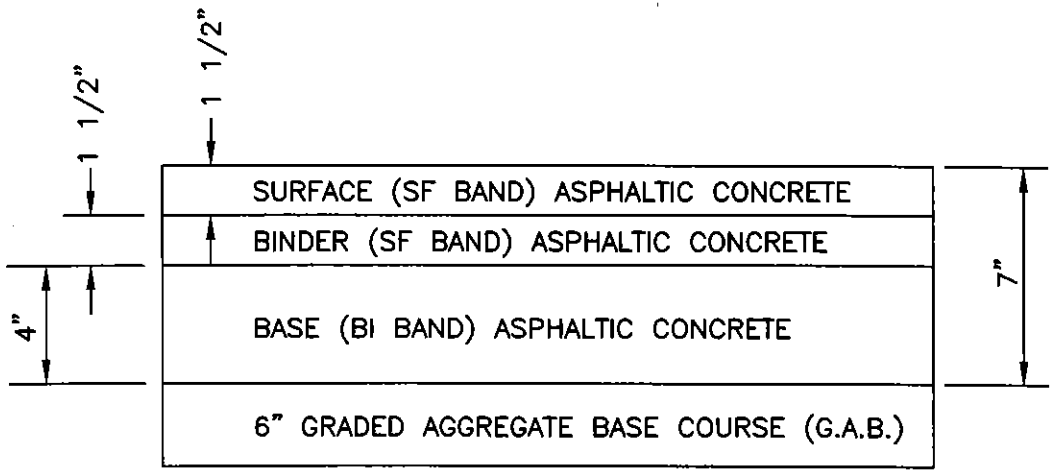
TOWN OF INDIAN HEAD	LOCAL STREET	



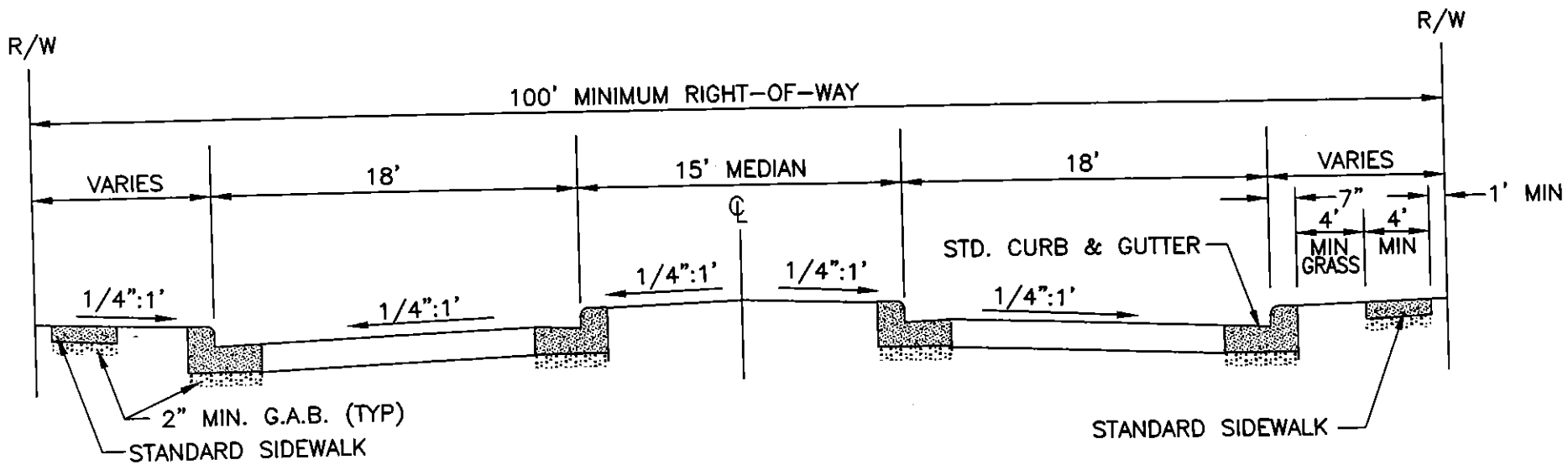


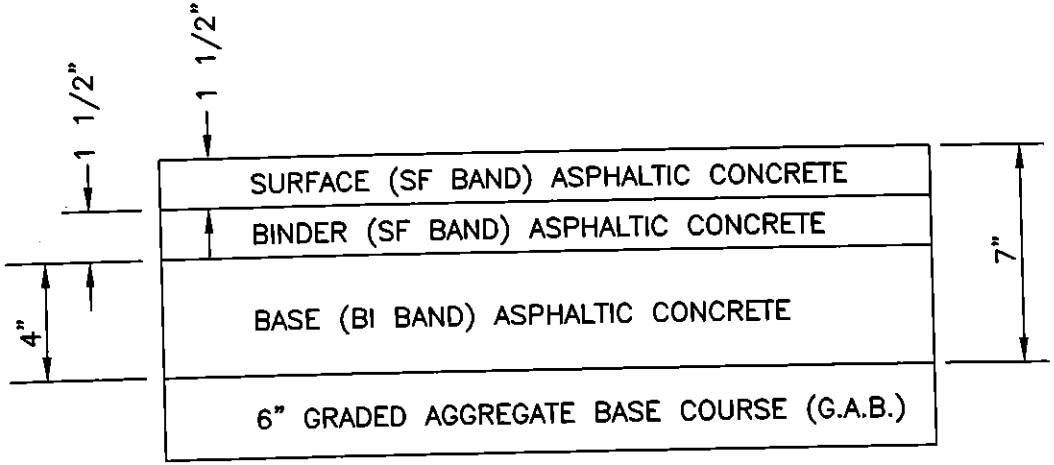
TOWN OF INDIAN HEAD	MINOR COLLECTOR STREET	



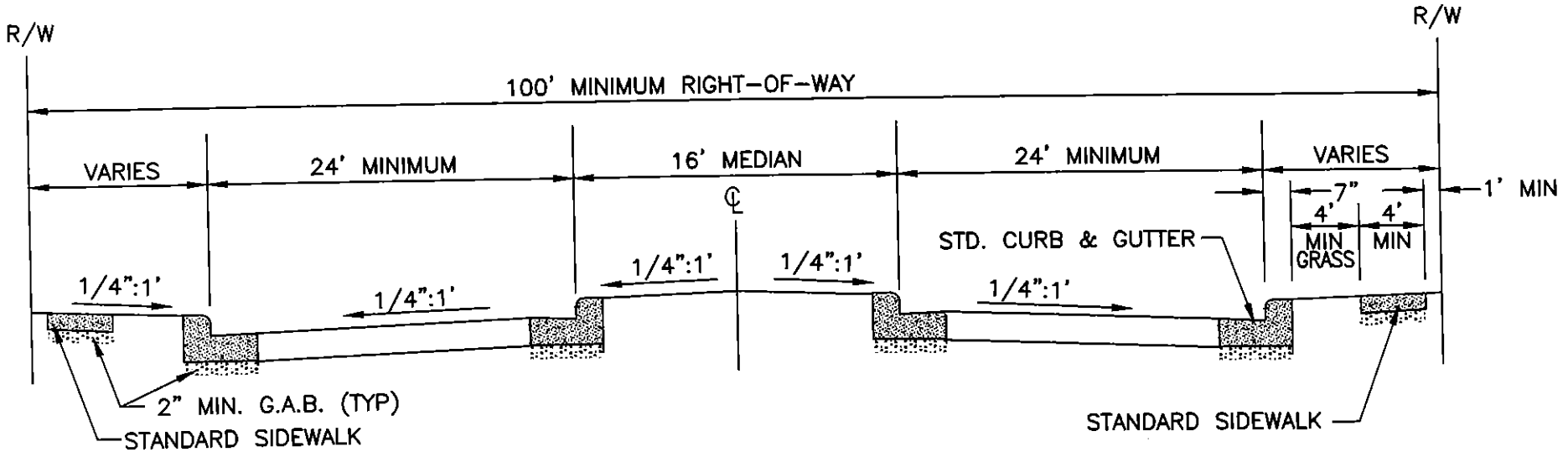


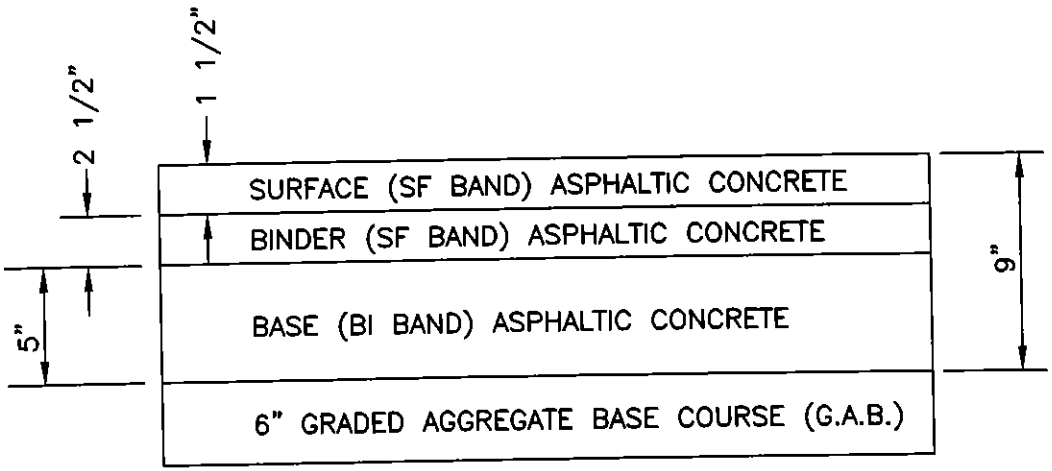
TOWN OF INDIAN HEAD	**MINOR ARTERIAL**	



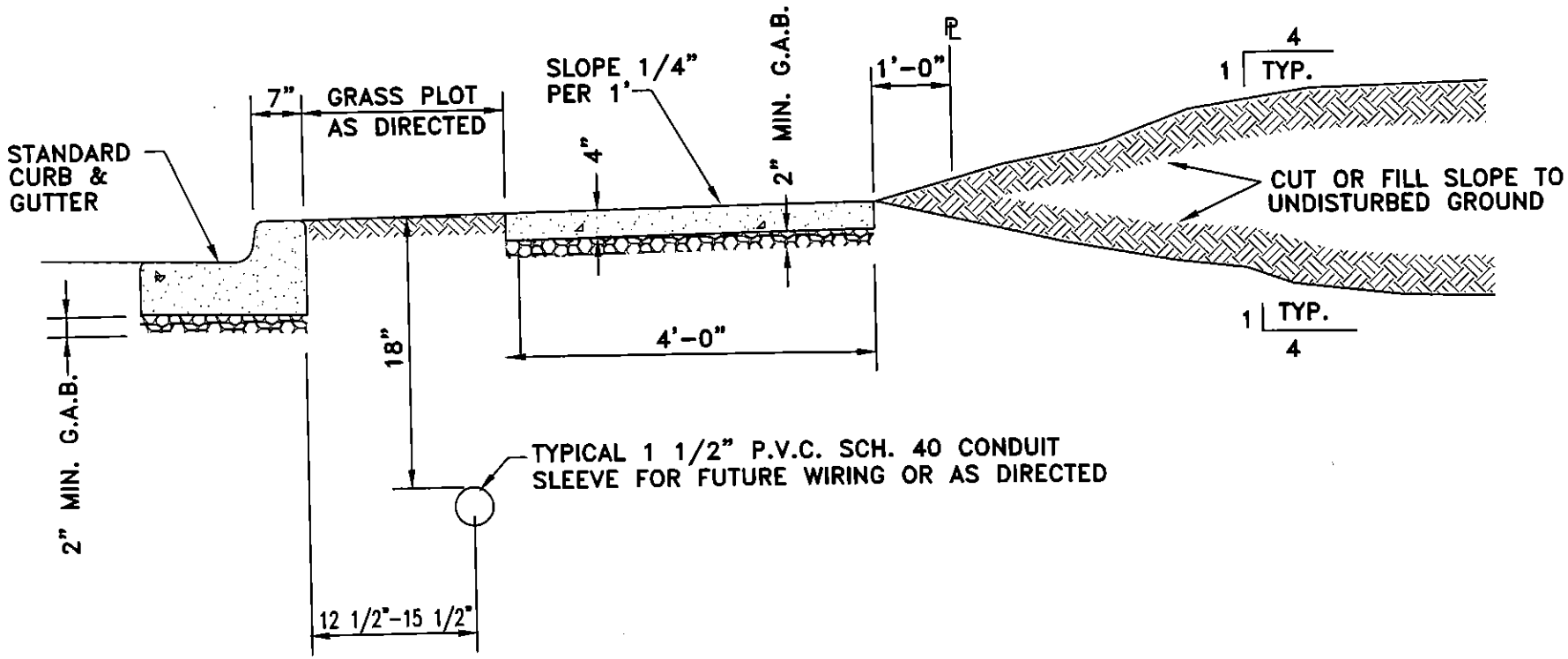


TOWN OF INDIAN HEAD	**ALTERNATE MINOR ARTERIAL WITH MEDIAN**	

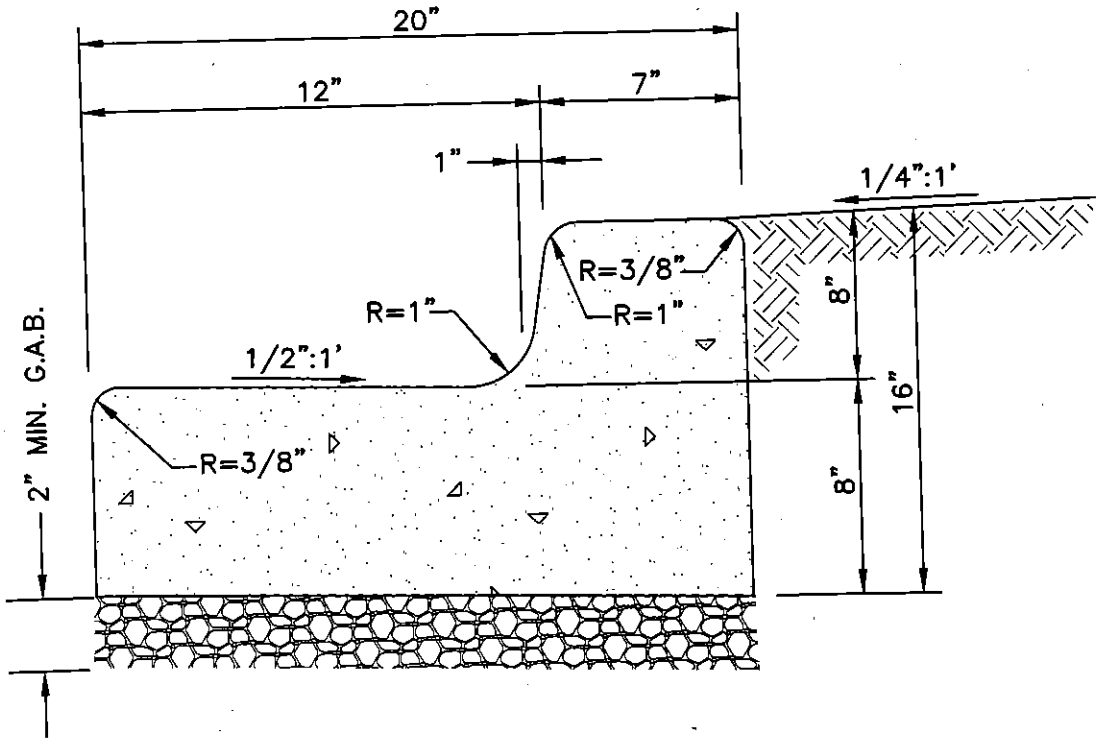




TOWN OF INDIAN HEAD	**ALTERNATE INTERMEDIATE ARTERIAL WITH MEDIAN**	



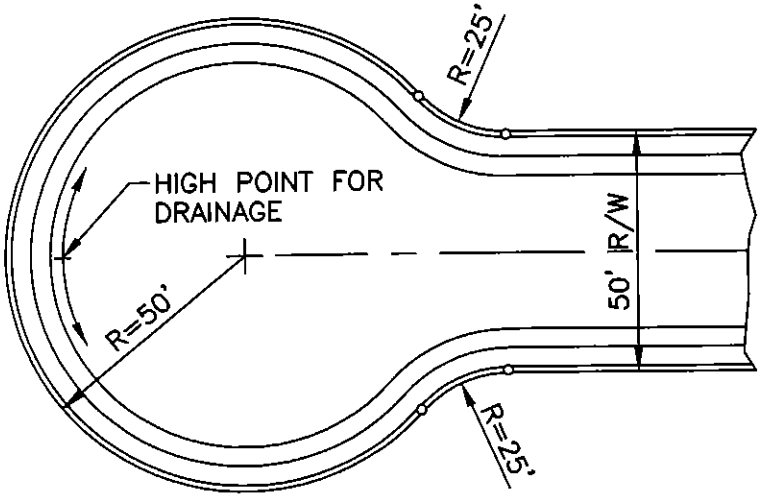
TOWN OF INDIAN HEAD	**TYPICAL SIDEWALK INSTALLATION** STREET	

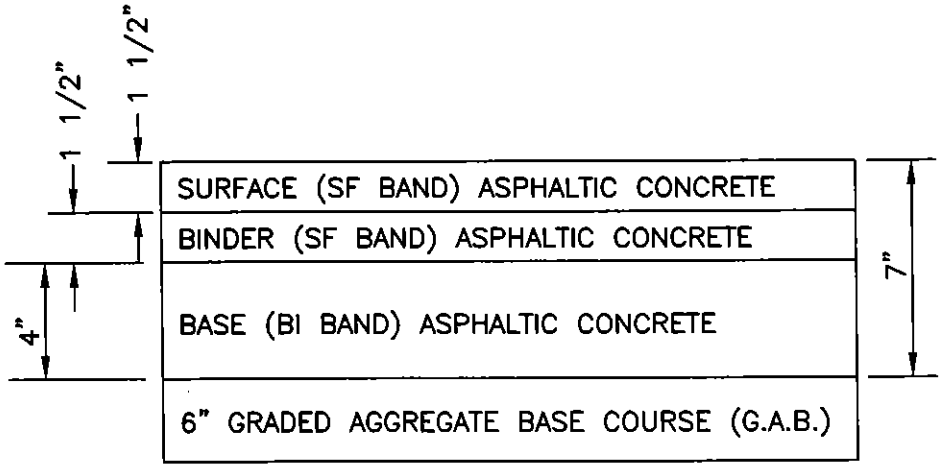


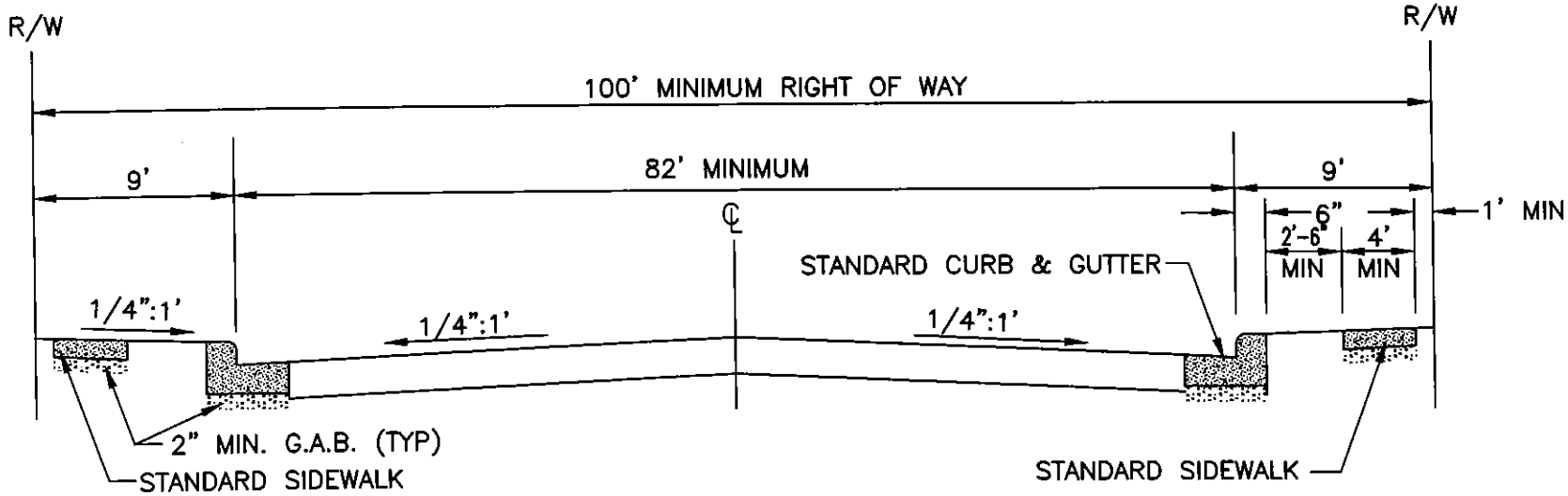
TOWN OF INDIAN HEAD

COMBINATION CURB AND GUTTER

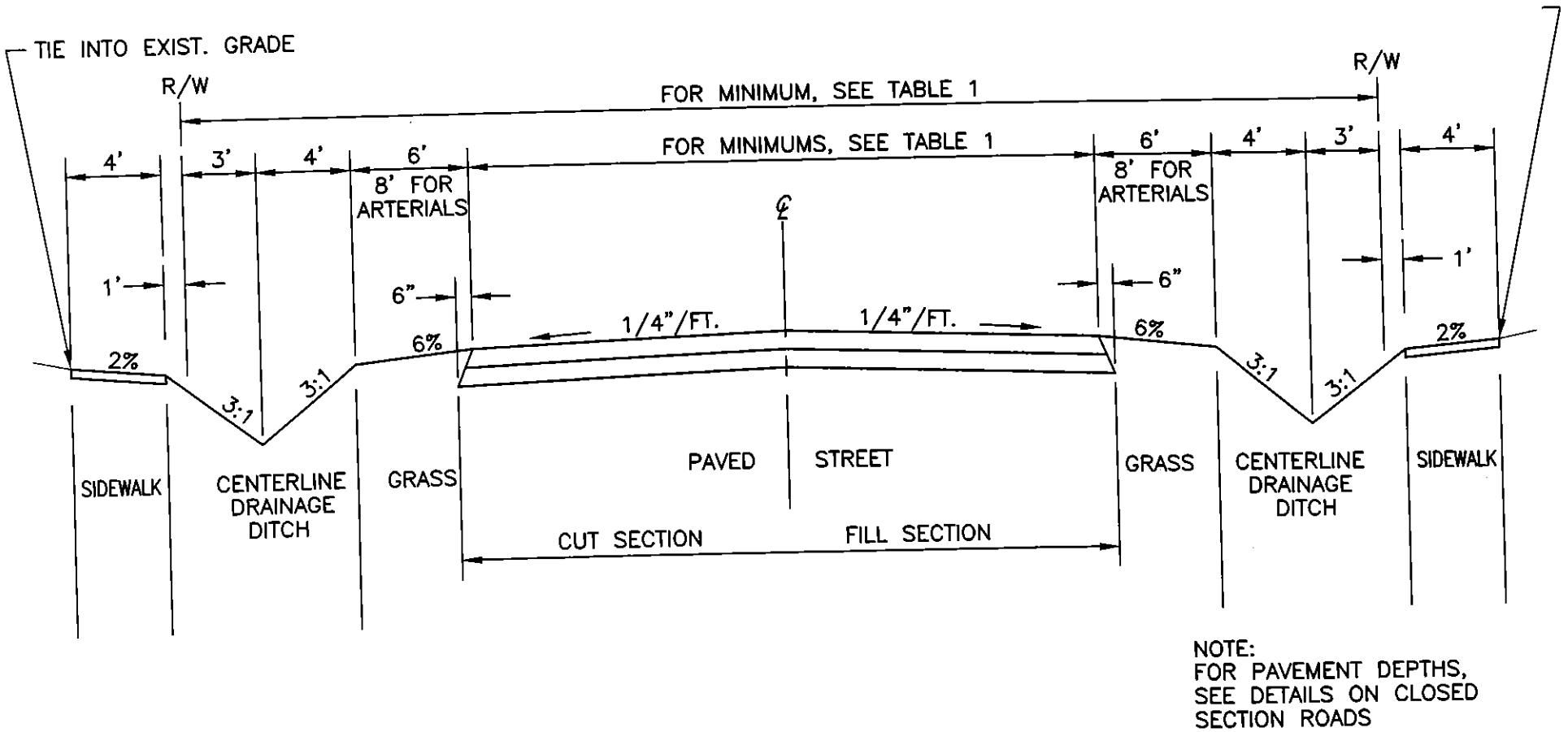
STREET







TOWN OF INDIAN HEAD	TYPICAL CUL-DE-SAC	



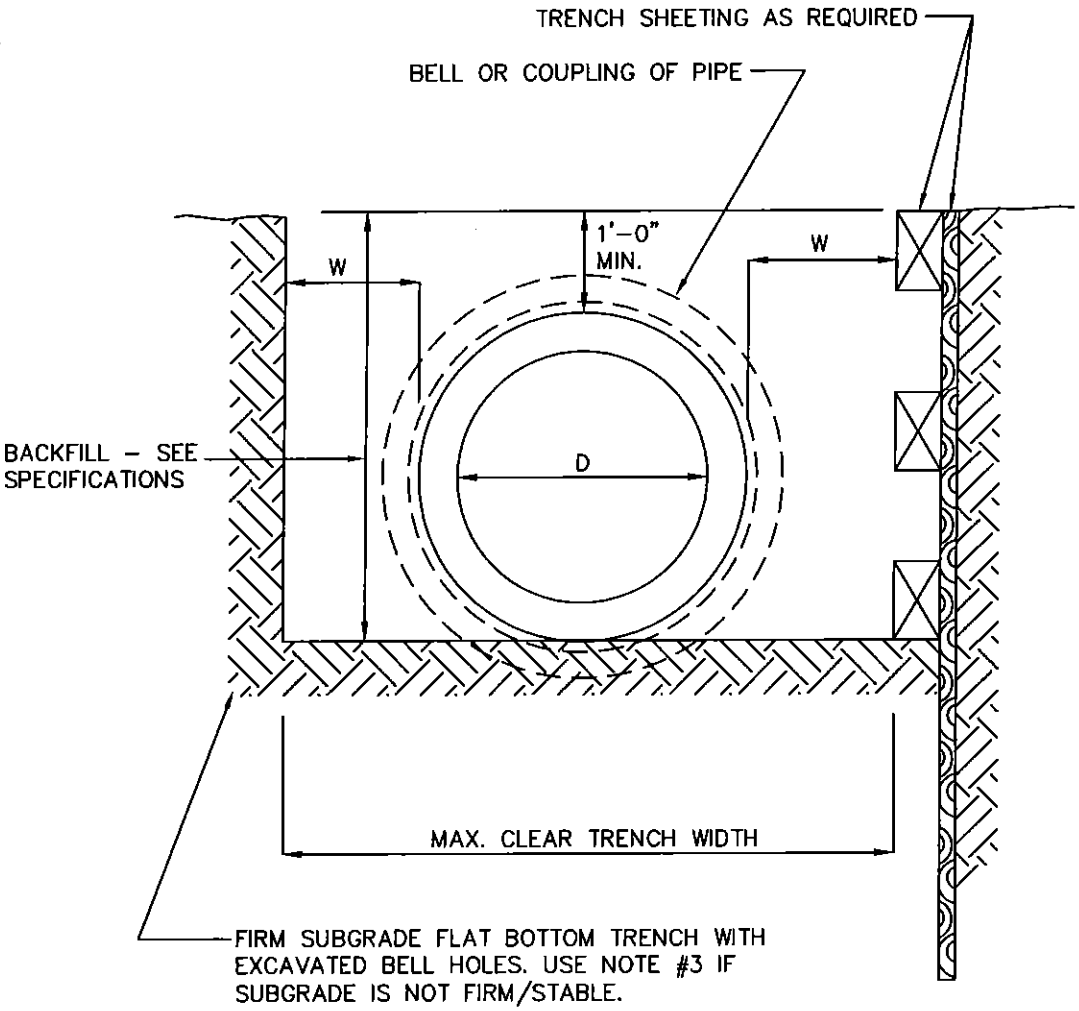
NOTE:
FOR PAVEMENT DEPTHS, SEE DETAILS ON CLOSED SECTION ROADS

TOWN OF INDIAN HEAD

TYPICAL SECTIONS OPEN SECTION ROADS

WATER

D	W
3"&4"	12"
6"	11"
8"	10"
10"	9"
12"	8"
15"	8"
16"&18"	8"
20"&21"	8"
24"	12"



NOTES:

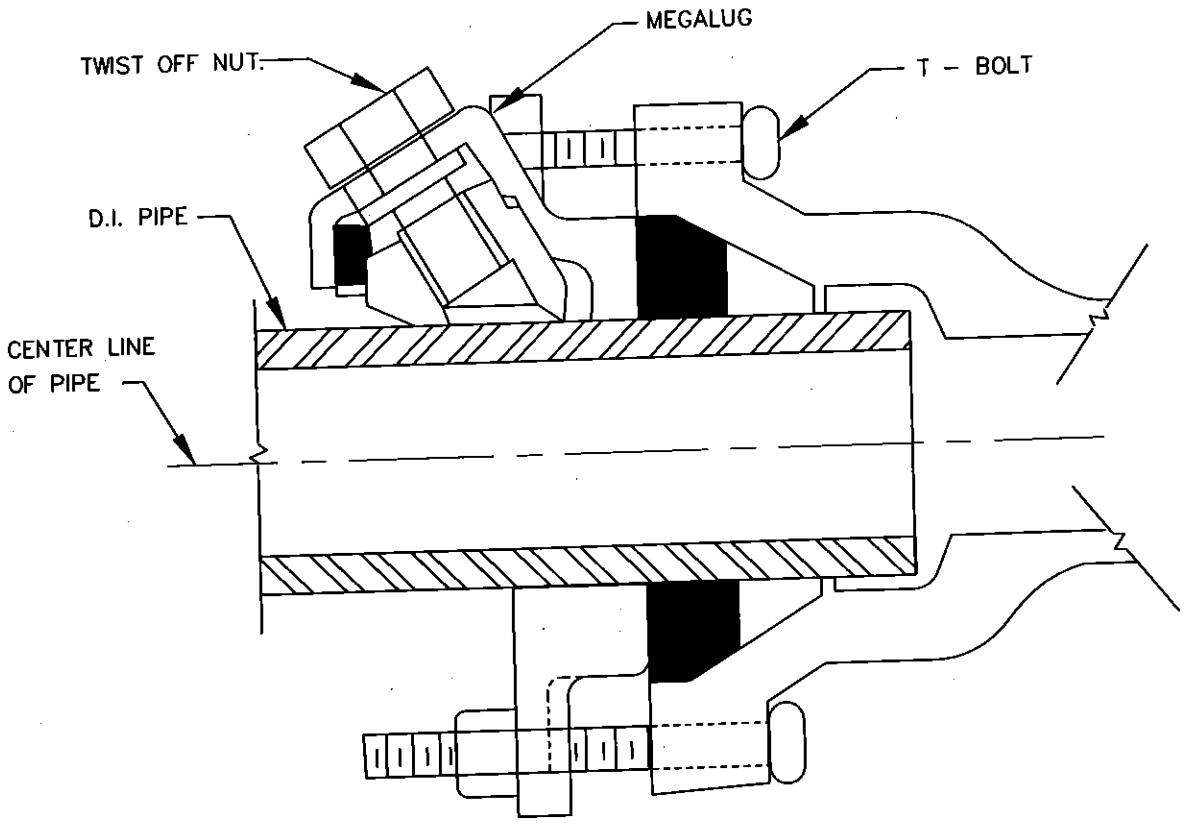
1. SEE DETAIL M/2.04 FOR GRANULAR BEDDING REQUIREMENTS FOR DUCTILE IRON PIPE LARGER THAN 24" DIAMETER.

2. MAXIMUM CLEAR TRENCH WIDTH SHALL BE 2W PLUS THE OUTSIDE DIAMETER OF THE PIPE.

3. IF BEDDING IS REQUIRED, PROVIDE 6 INCHES OF ASTM C33 NO. 67 CRUSHED OR WASHED STONE.

4. IF DUCTILE IRON IS UTILIZED FOR SANITARY SEWER, THEN APPROVED BEDDING IS REQUIRED TO THE TOP OF THE PIPE.

TOWN OF INDIAN HEAD	TRENCH WIDTHS FOR DUCTILE IRON WATER MAIN	



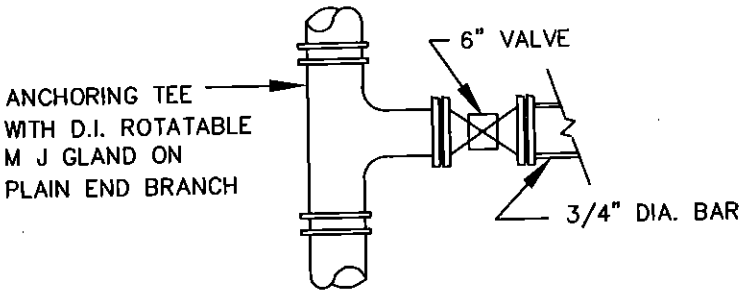
SPECIFICATIONS

NOMIAL PIPE SIZE (INCHES)	NUMBER OF MEGALUGS	TOTAL PRESSURE (PSI)	NUMBER OF T BOLTS
3	2	350	4
4	2	350	4
6	3	350	6
8	4	350	6
10	6	350	8
12	8	350	8
14	10	350	10
16	12	350	12
18	12	250	12
20	14	250	14
24	16	250	16
30	20	250	20

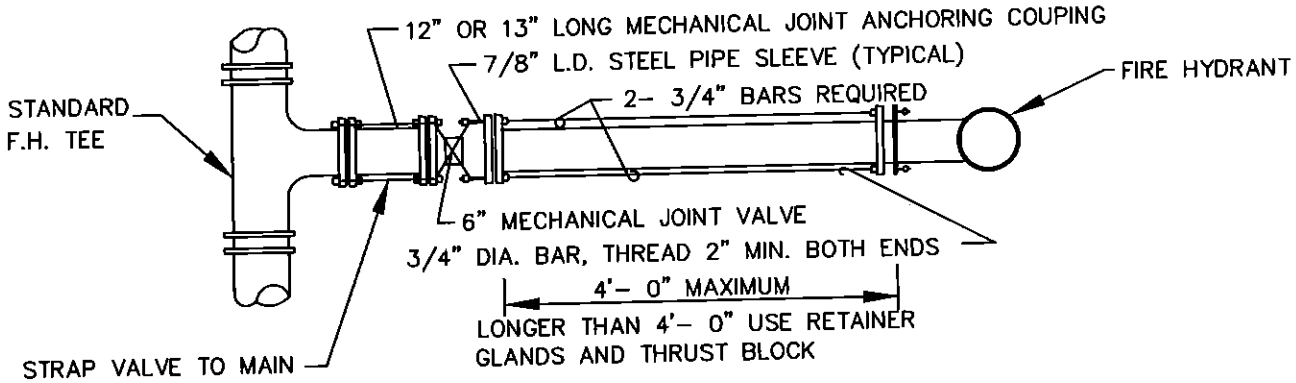
NOTES:

1. MECHANICAL JOINT FITTINGS ONLY.
2. MEGALUG™ OF EBAA IRON, INC. FOR INSTALLATION ON DUCTILE IRON PIPE ONLY.
3. INSTALLATIONS SHALL BE AS PER MANUFACTURER'S RECOMMENDATIONS.
4. TOTAL PRESSURE EQUAL TO OPERATING PRESSURE + SURGE PRESSURE.

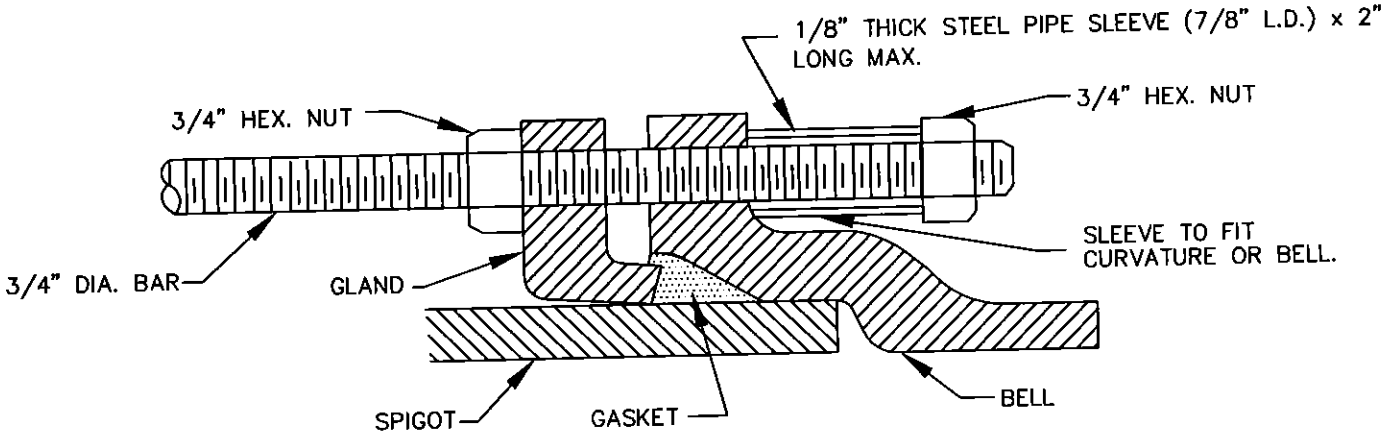
TOWN OF INDIAN HEAD	MEGALUG MECHANICAL JOINT RESTRAINING DETAIL	



OPTION TO USE OF ANCHORING COUPLING



PLAN

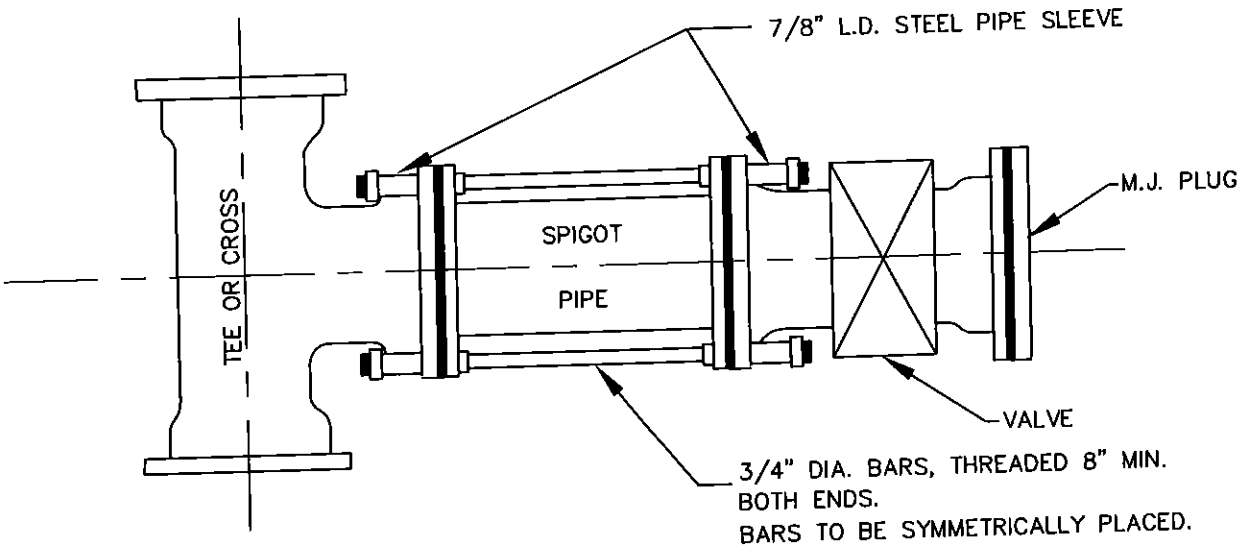


CROSS SECTION
SLEEVE AND BAR ASSEMBLY

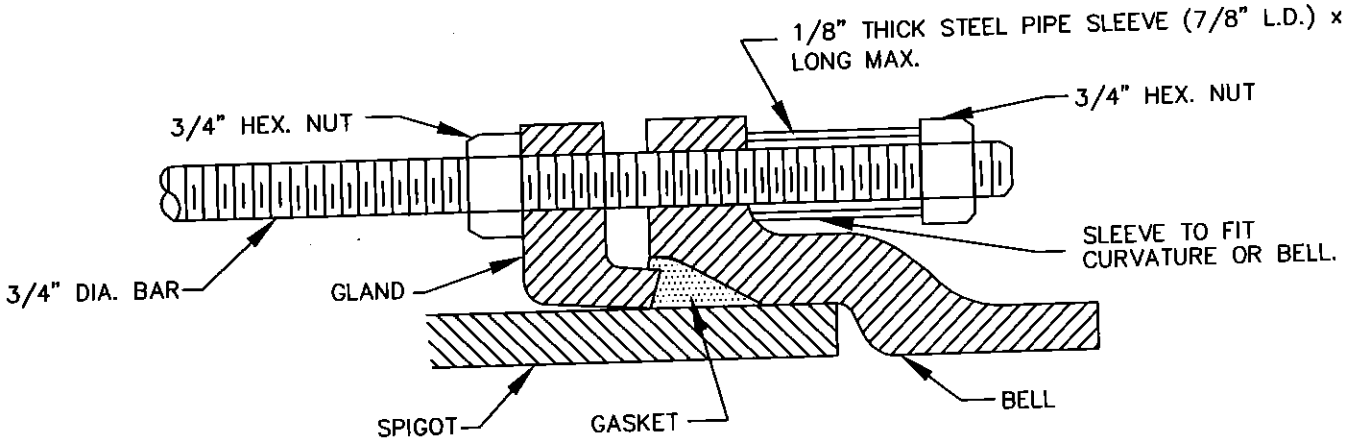
NOTES:

1. USE MECHANICAL JOINT FITTINGS ONLY.
2. PAINT BARS AND APPURTENANCES WITH 2 COATS OF BITUMINUOUS PAINT.

TOWN OF INDIAN HEAD	METHODS OF STRAPPING FIRE HYDRANT TO MAIN	



PLAN



CROSS SECTION

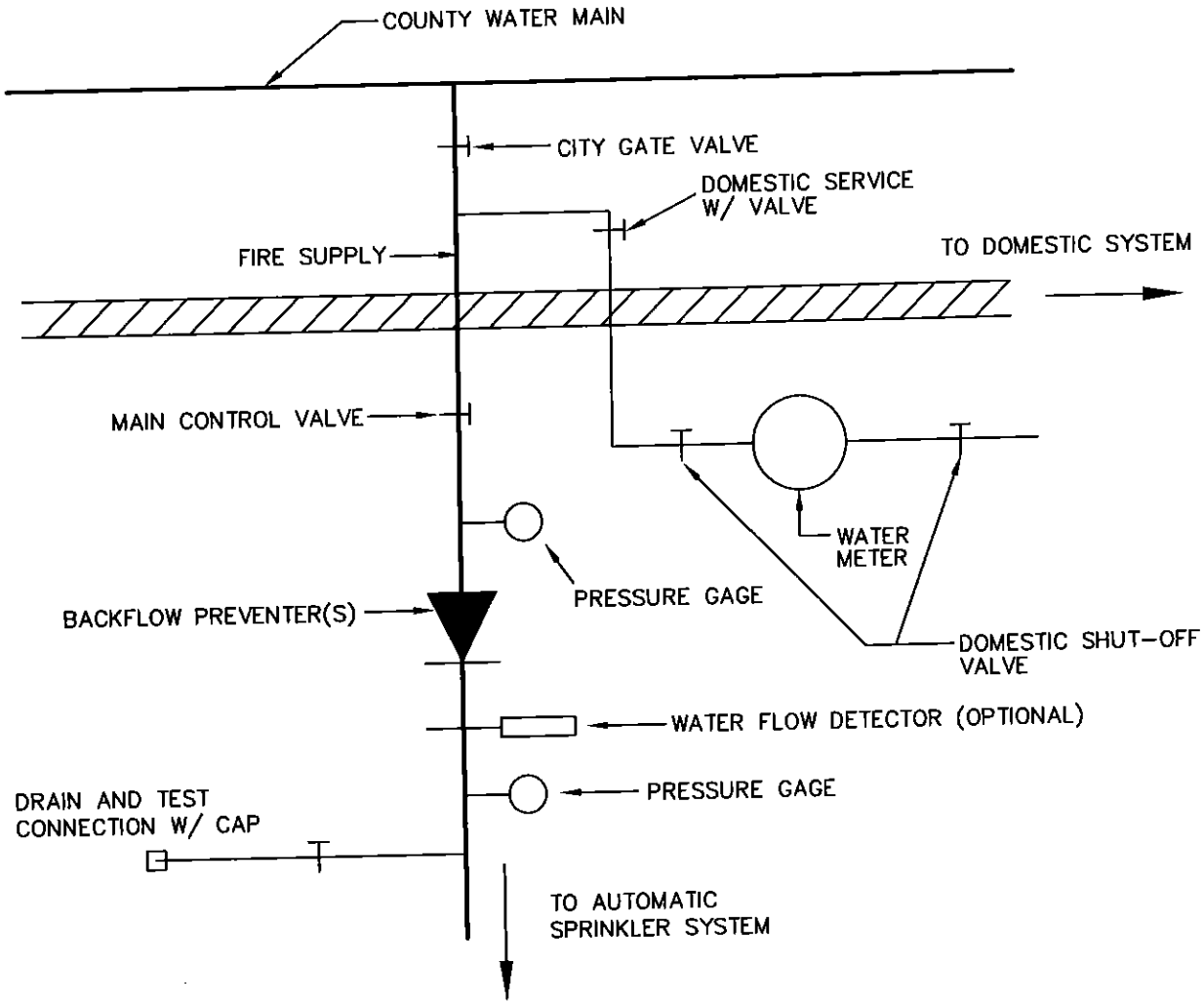
SLEEVE AND BAR ASSEMBLY

NOTES:

1. USE MECHANICAL JOINT FITTINGS ONLY.
2. APPLY TWO COATS OF BITUMINOUS PAINT TO BARS AND APPURTENANCES.

VALVE SIZE	NUMBER OF 3/4" DIA. BARS REQUIRED	MAX. LENGHT OF SPIGOT PIPE
3"	2	24"
4"	2	24"
6"	2	27"
8"	2	27"
10"	4	27"
12"	6	27"
16"	8	36"
20"	12	36"
24"	16	36"
30"	20	42"

TOWN OF INDIAN HEAD	METHOD OF STRAPPING VALVE TO MAIN	



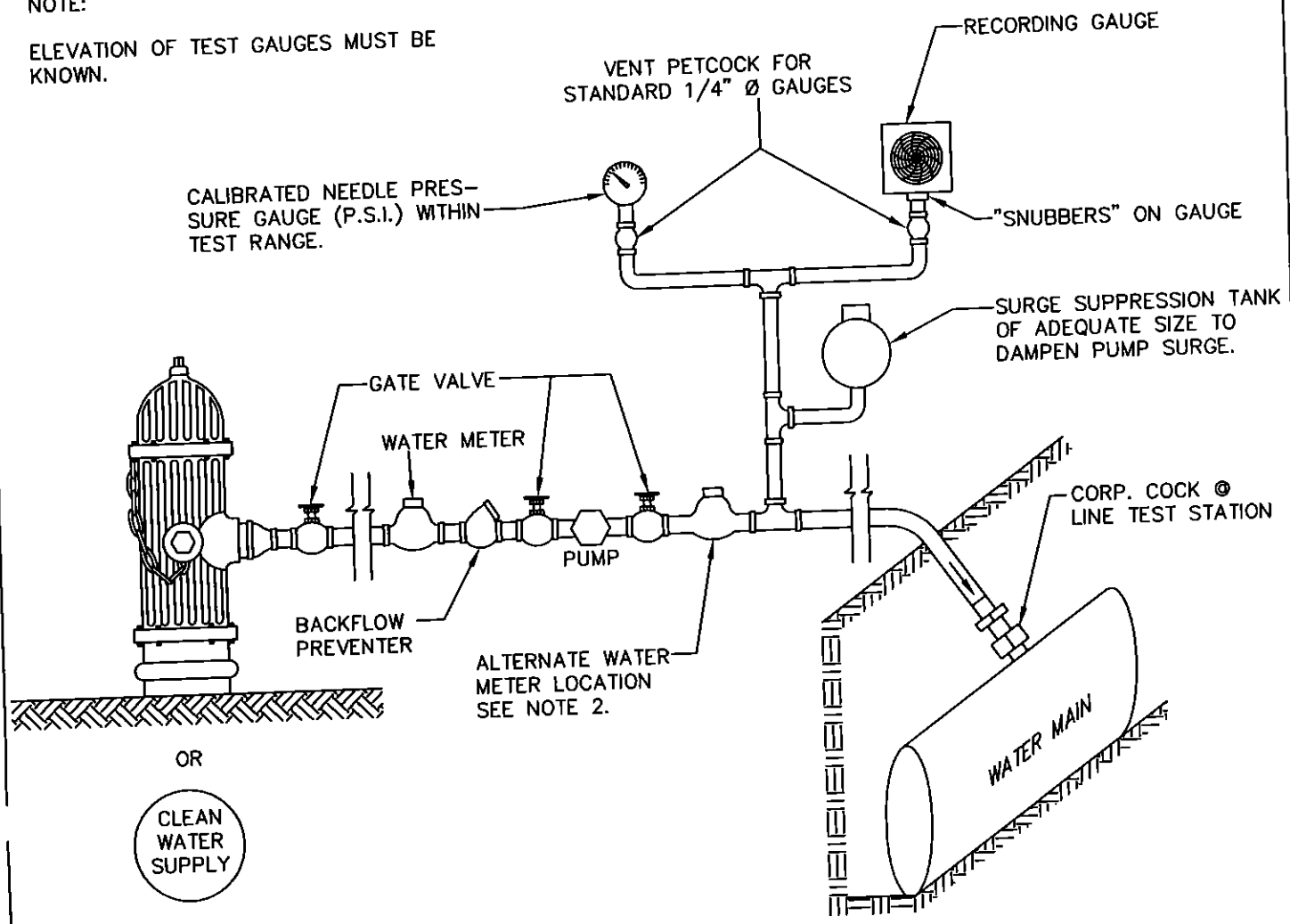
NOTES:

1. BACKFLOW PREVENTER(S) FOR WATER FIRE SPRINKLER SYSTEMS SHALL BE:
   A) 3/4 INCH TO 2 INCH = WATTS 007QT (ASSE 1015) OR COUNTY APPROVED EQUAL
   B) 2 1/2 INCH AND ABOVE = WATTES 709 ONSY (ASSE 1015) OR COUNTY APPROVED EQUAL.
2. INSTALL A DRAIN FOR THE BACKFLOW PREVENTER(S).
3. BACKFLOW PREVENTER(S) FOR IRRIGATION SYSTEMS SHALL BE:
   A) 1/2 INCH - 3 INCH = WATTES 009QT (ASSE 1013) OR COUNTY APPROVED EQUAL.
   B) 3 1/2 INCH AND ABOVE = WATTS 909QT (ASSE 1013) OR COUNTY APPROVED EQUAL.

TOWN OF INDIAN HEAD	SPRINKLER AND DOMESTIC SYSTEM CONNECTION (COMMERCIAL/INDUSTRIAL)	

NOTE:

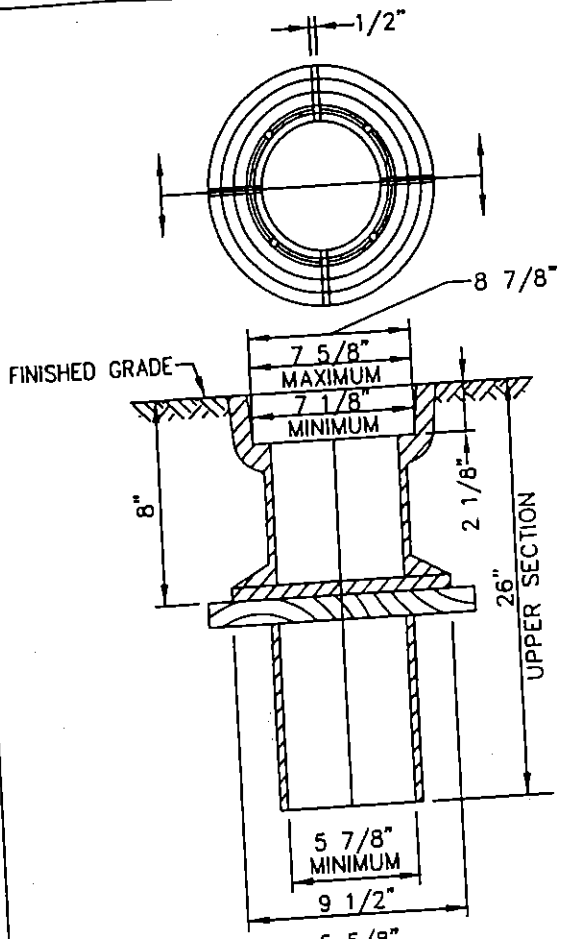
ELEVATION OF TEST GAUGES MUST BE KNOWN.

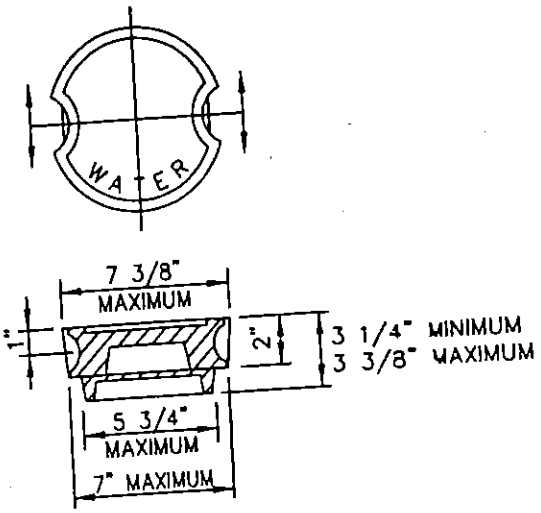


NOTES:

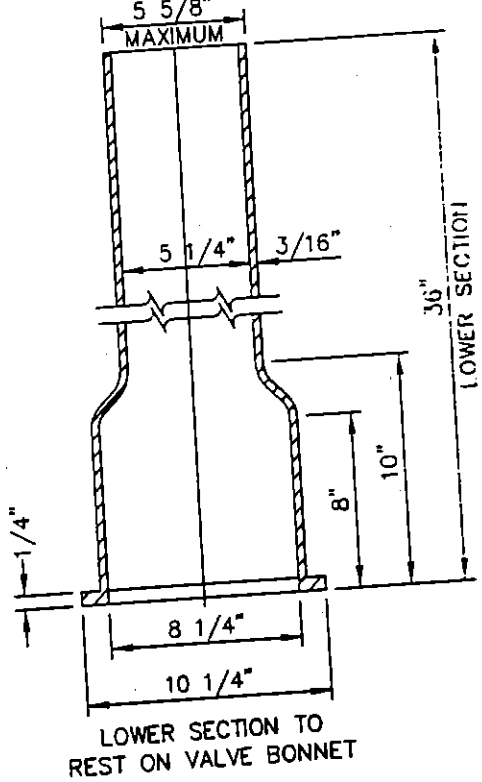
1. ALL LINES, FITTINGS AND TEST APPURTENANCES SHALL BE CAPABLE OF WITHSTANDING MAXIMUM TEST PRESSURE.
2. WHEN TEST PRESSURE IS LESS THAN PRESSURE RANGE OF METER, INSTALL METER AT ALTERNATE LOCATION SHOWN.
3. PROVIDE ADEQUATE PROTECTION TO ALL LINES, FITTINGS AND TEST APPURTENANCES WHEN TESTING DURING FREEZING WEATHER.
4. PUMP MUST BE CAPABLE OF PRESSURE WITHIN TEST RANGE (PROVIDE FOR PRESSURE RELIEF ON PUMP).
5. TEST CORPORATION COCK TO BE UTILIZED AS A SERVICE CONNECTIION AFTER TESTING.
6. COUNTY METER REQUIRED WHEN USING COUNTY WATER FOR TESTING, FLUSHING, OR OTHER CONSTRUCTION NEEDS.
7. REFER TO CHARLES COUNTY WATER SPECIFICATIONS FOR SPECIFIC TESTING CRITERIA.

TOWN OF INDIAN HEAD	METHOD OF TESTING WATER MAINS	





COVER

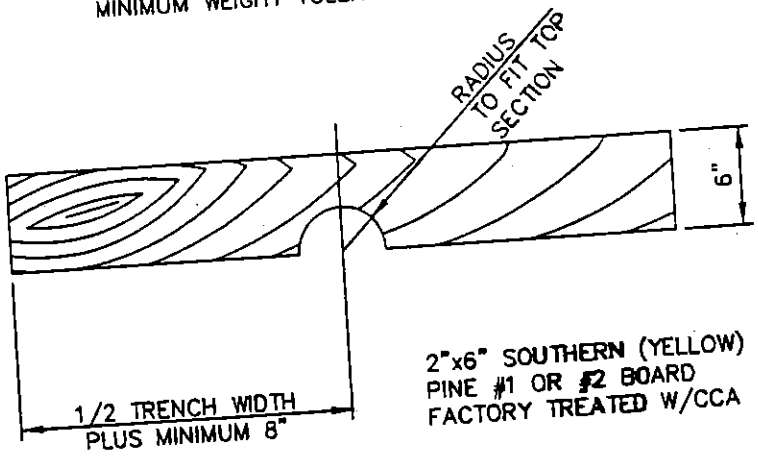


LOWER SECTION TO
REST ON VALVE BONNET

UPPER & LOWER VALVE BOX
SECTION

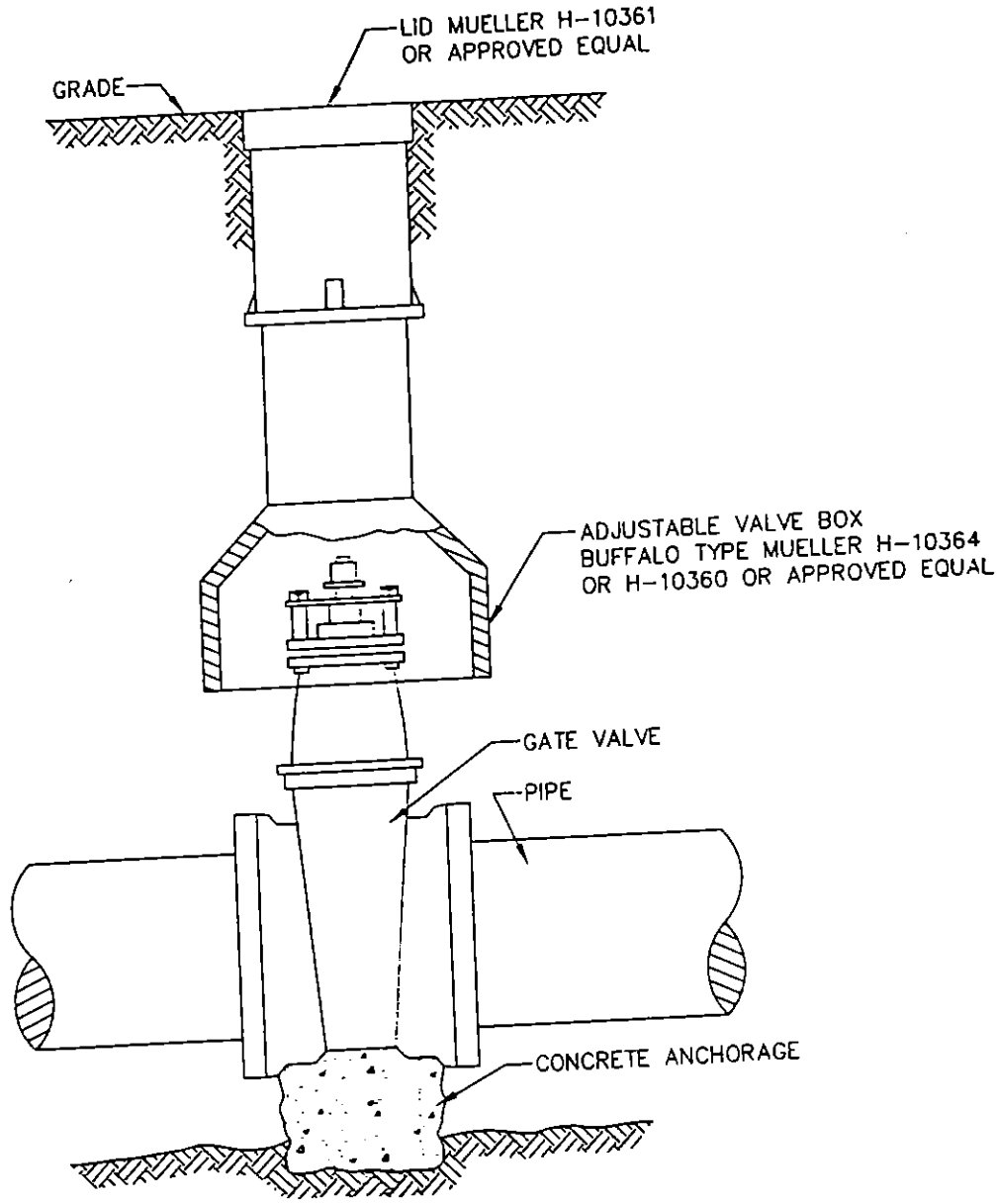
NOTE: ALL SECTIONS SHOWN TO BE GRAY.
IRON CASTINGS, CLASS NO. 25 ASTM A-48.
(FOR USE ONLY WHEN W-3.00 CANNOT BE UTILIZED)

WEIGHTS:
LID - 15 LBS.
TOP SECTION - 52 LBS.
BOTTOM SECTION - 48 LBS.
TOTAL - 115 LBS.
MINIMUM WEIGHT TOLERANCE 5%



2"x6" SOUTHERN (YELLOW)
PINE #1 OR #2 BOARD
FACTORY TREATED W/CCA

	ADJUSTABLE VALVE BOX ROUND HEAD SLIDING TYPE	TOWN OF INDIAN HEAD

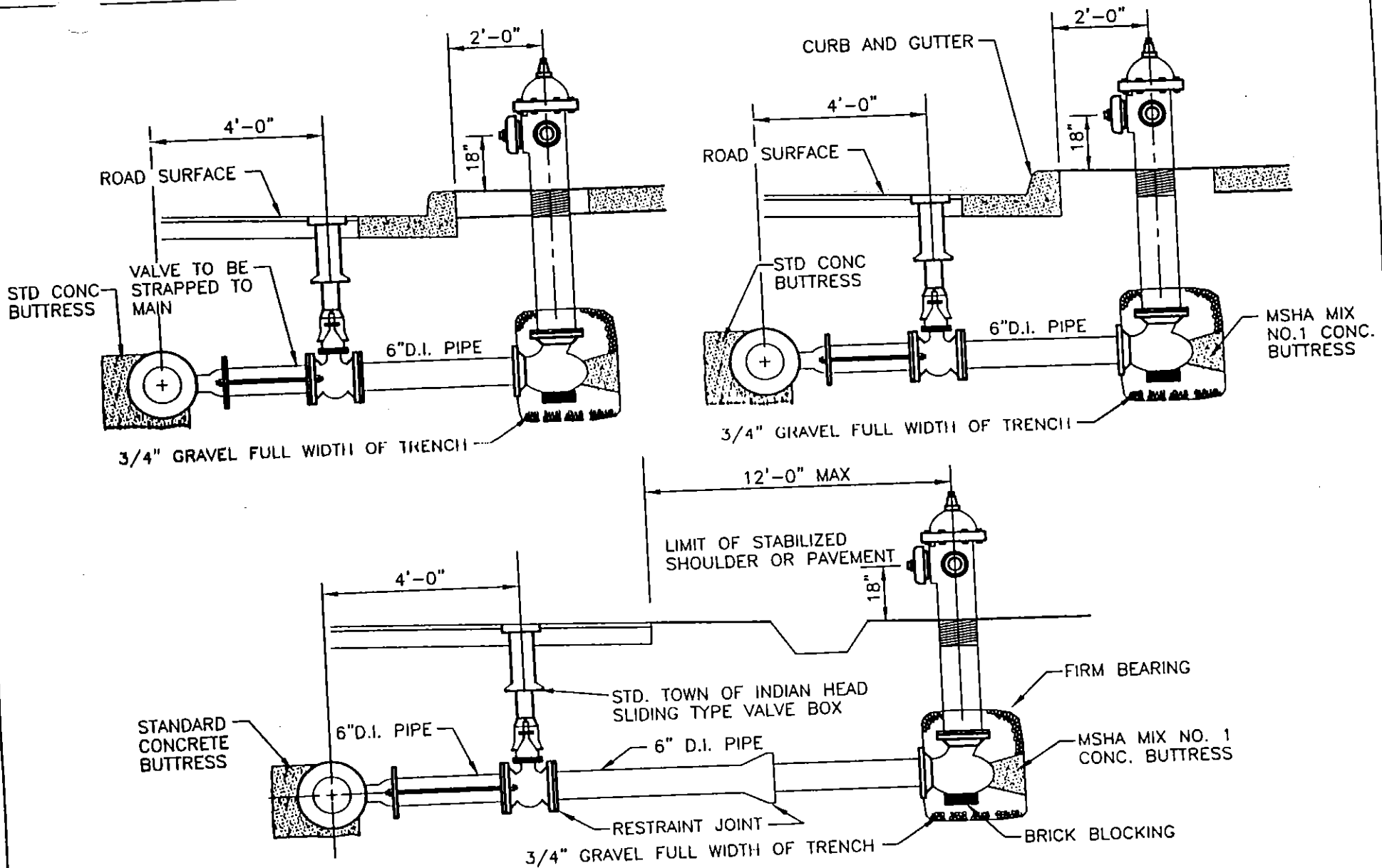


NOTES:

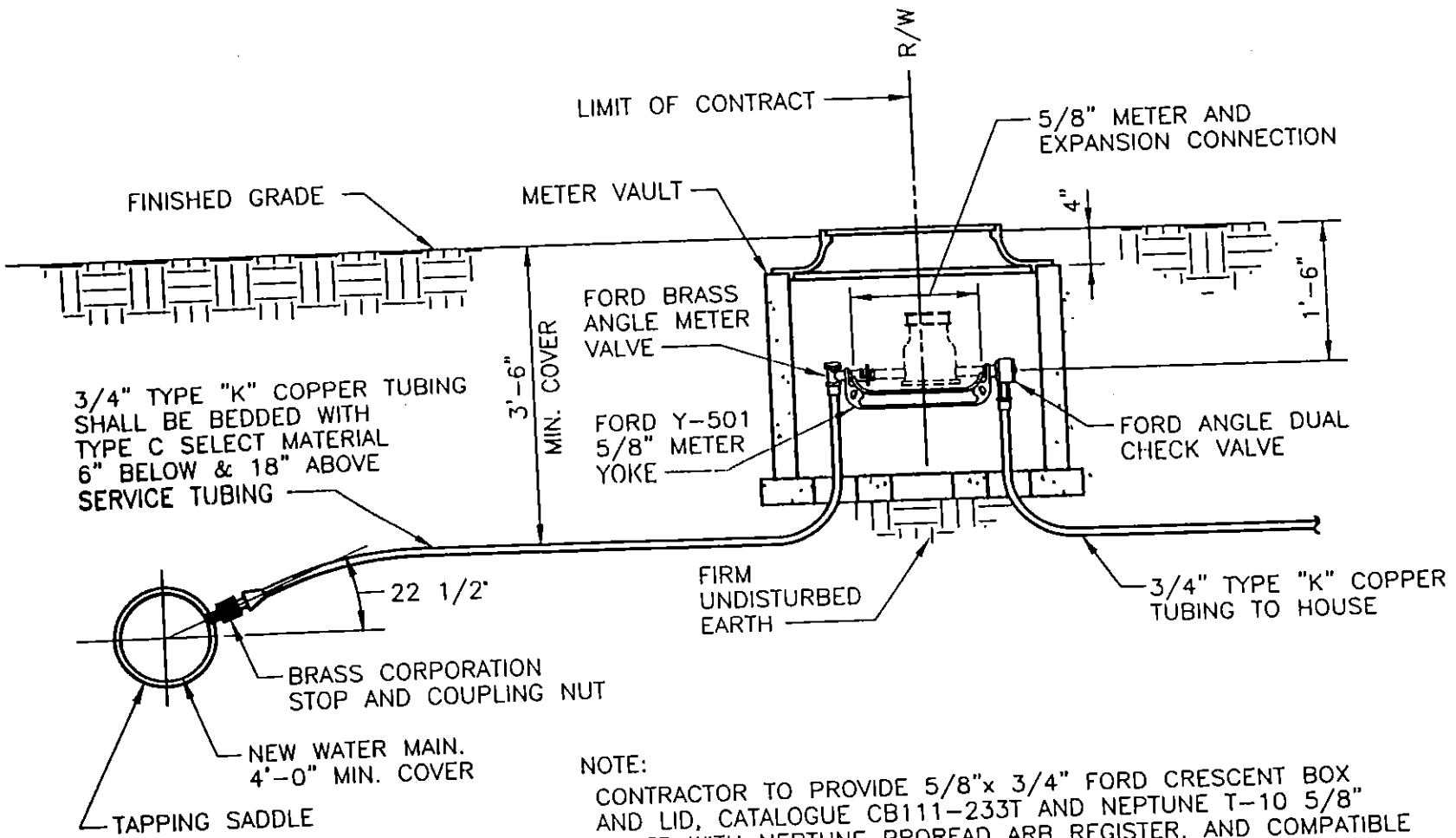
(1) ALL VALVES SHALL BE RESILENT WEDGE ONLY AWWA C-509.

(2) APPROVED VALVES ARE: KENNEDY KEN-SEAL II, U.S. PIPE METROSEAL 250, MUELLER SERIES A-2360, AND WATEROUS SERIES 500 FOR 12 INCH AND BELOW, AND 16 INCH SHALL BE U.S PIPE METROSEAL 250.

TOWN OF INDIAN HEAD	GATE VALVE AND BOX 16" AND BELOW	

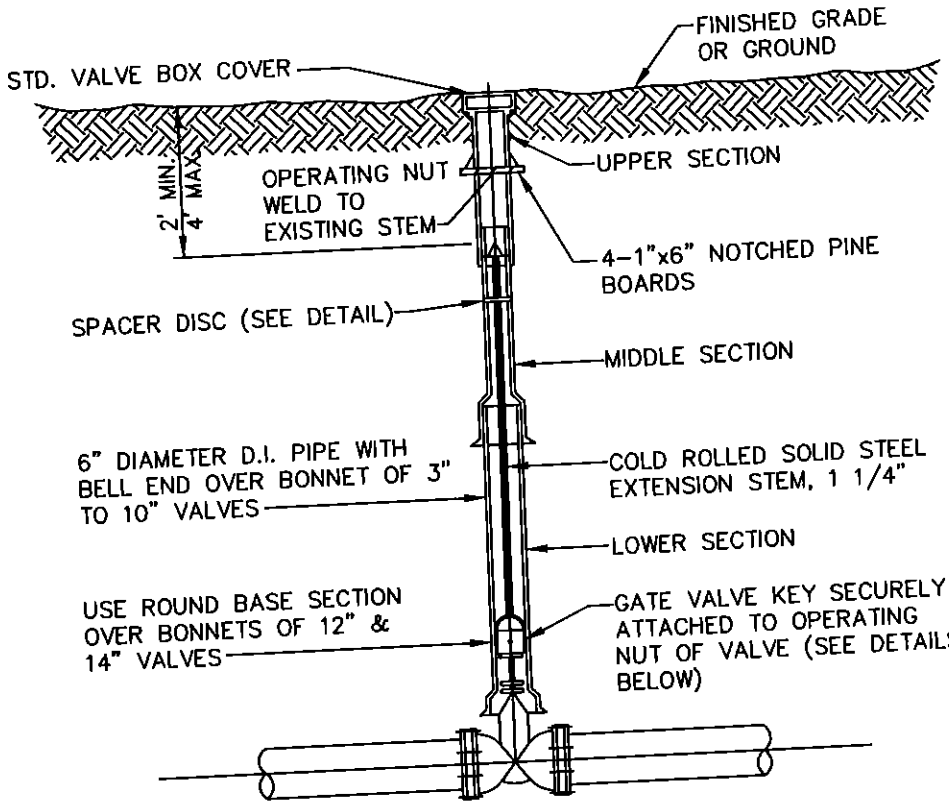


TOWN OF INDIAN HEAD	FIRE HYDRANT SETTING DETAIL	

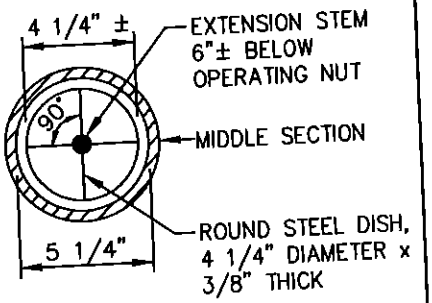


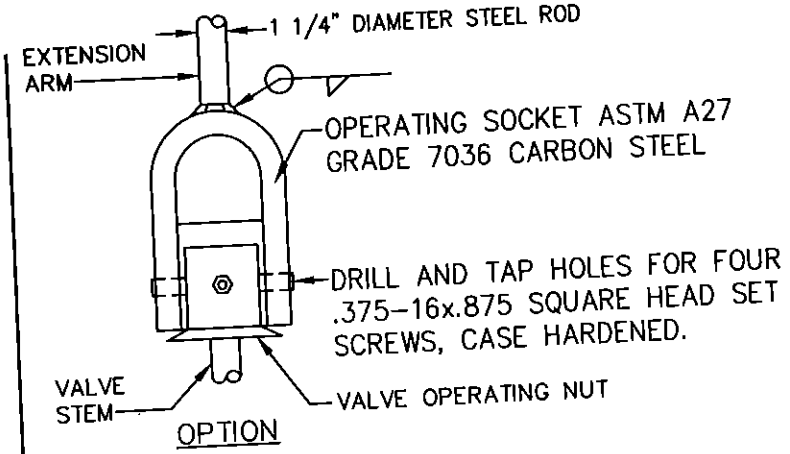
NOTE:
CONTRACTOR TO PROVIDE 5/8"x 3/4" FORD CRESCENT BOX AND LID, CATALOGUE CB111-233T AND NEPTUNE T-10 5/8" METER WITH NEPTUNE PROREAD ARB REGISTER, AND COMPATIBLE PIT MOUNT RECEPTACLE FOR EACH METER.

TOWN OF INDIAN HEAD	**STD. DOMESTIC SERVICE INSTALLATION**	

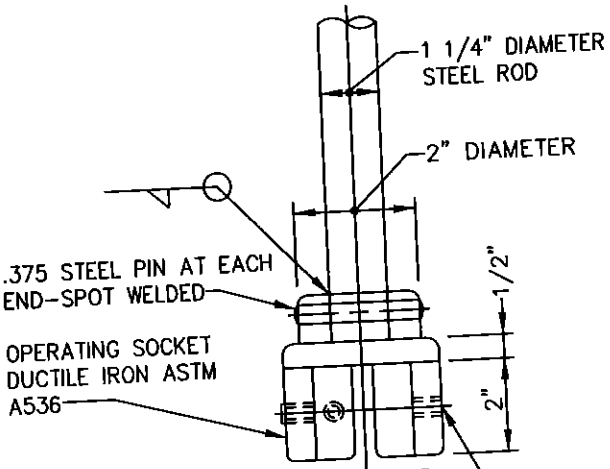


GATE VALVE





OPTION



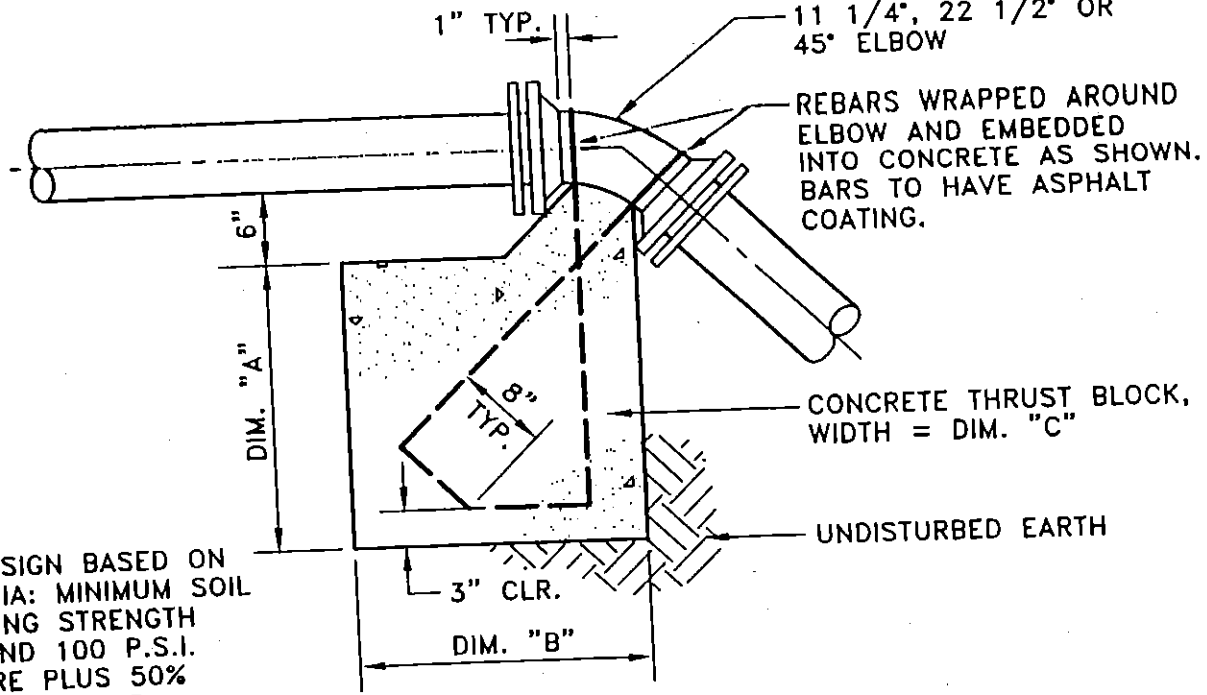
STANDARD

NOTES:

1. EXTENSION STEM TO BE SECURELY WELDED TO GATE VALVE KEY. STEM MATERIAL COMPOSITION SHALL COMPLY WITH ASTM A108.
2. LENGTH OF STEM TO BE SUCH THAT OPERATING NUT WILL BE LOCATED AS PRESCRIBED ABOVE.
3. WELD STEEL DISH 4 1/4" DIAMETER x 3/8" THICKTO EXTENSION STEM TO INSURE OPERATING NUT IS CENTRALLY LOCATED WITHIN VALVE BOX.
4. PAINT EXTENSION STEM WITH 2 - COATS OF BITUMINOUS COATING.
5. USE THIS DETAIL WHEN DISTANCE FROM TOP OF OPERATING NUT OF VALVE TO FINISHED GRADE OR GROUND EXCEEDS 4'-0".

TOWN OF INDIAN HEAD	**EXTENSION STEMS AND VALVE BOXES**	

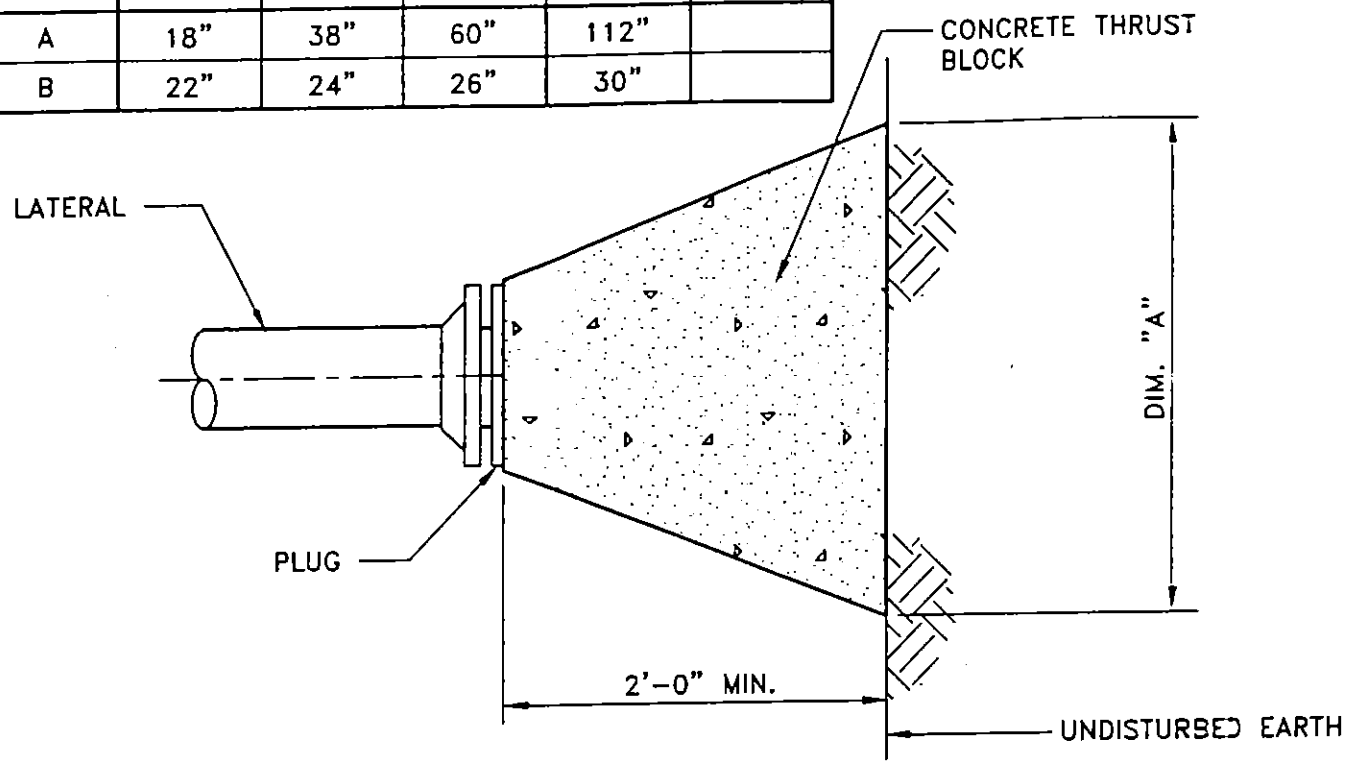
VERTICAL ELBOW DIMENSION SCHEDULE									
DIM.	6"-11 1/4°	8"-11 1/4°	12"-11 1/4°	6"-22 1/2°	8"-22 1/2°	12"-22 1/2°	6"-45°	8"-45°	12"-45°
A	12"	18"	36"	18"	36"	54"	36"	48"	54"
B	18"	24"	36"	24"	36"	48"	36"	48"	54"
C	18"	24"	24"	24"	24"	30"	24"	30"	48"
REBAR	#4	#4	#6	#4	#4	#6	#4	#4	#6



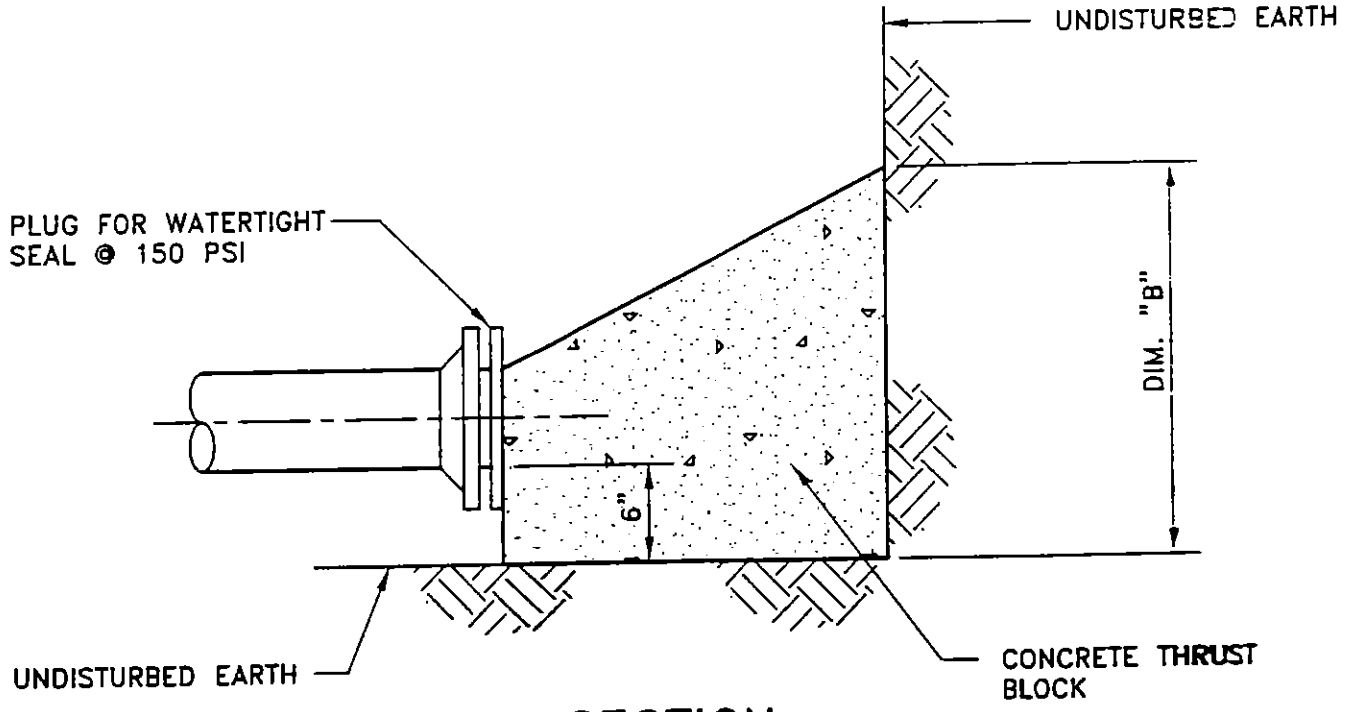
THRUST BLOCK DESIGN BASED ON FOLLOWING CRITERIA: MINIMUM SOIL HORIZONTAL BEARING STRENGTH OF 3000 P.S.F. AND 100 P.S.I. WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE

TOWN OF INDIAN HEAD	VERTICAL RESTRAINT THRUST BLOCKING FOR 11 1/4°, 22 1/2°, AND 45° ELBOWS	

THRUST BLOCK DIMENSION SCHEDULE (PLUG)					
DIM.	LATERAL SIZE				
	4"	6"	8"	12"	
A	18"	38"	60"	112"	
B	22"	24"	26"	30"	



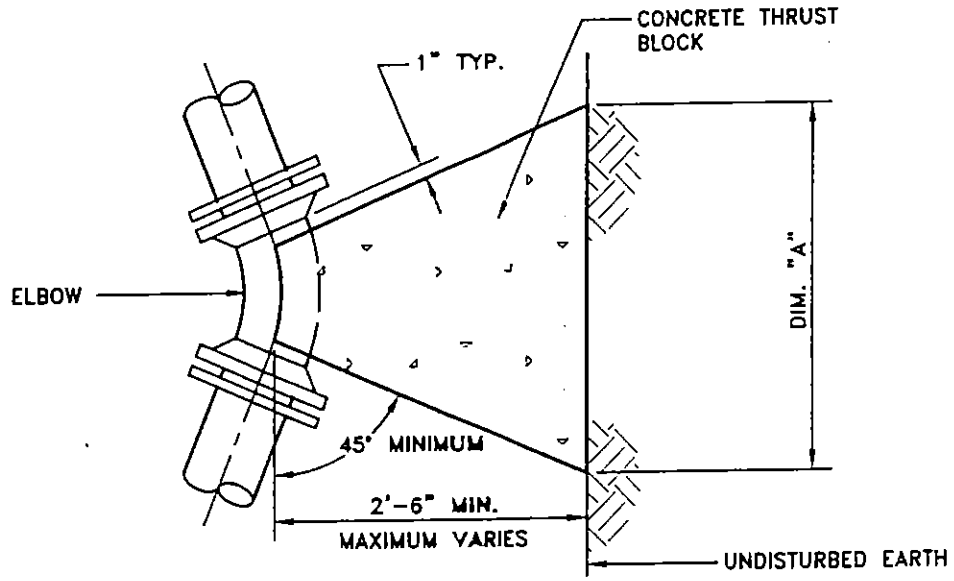
PLAN



SECTION

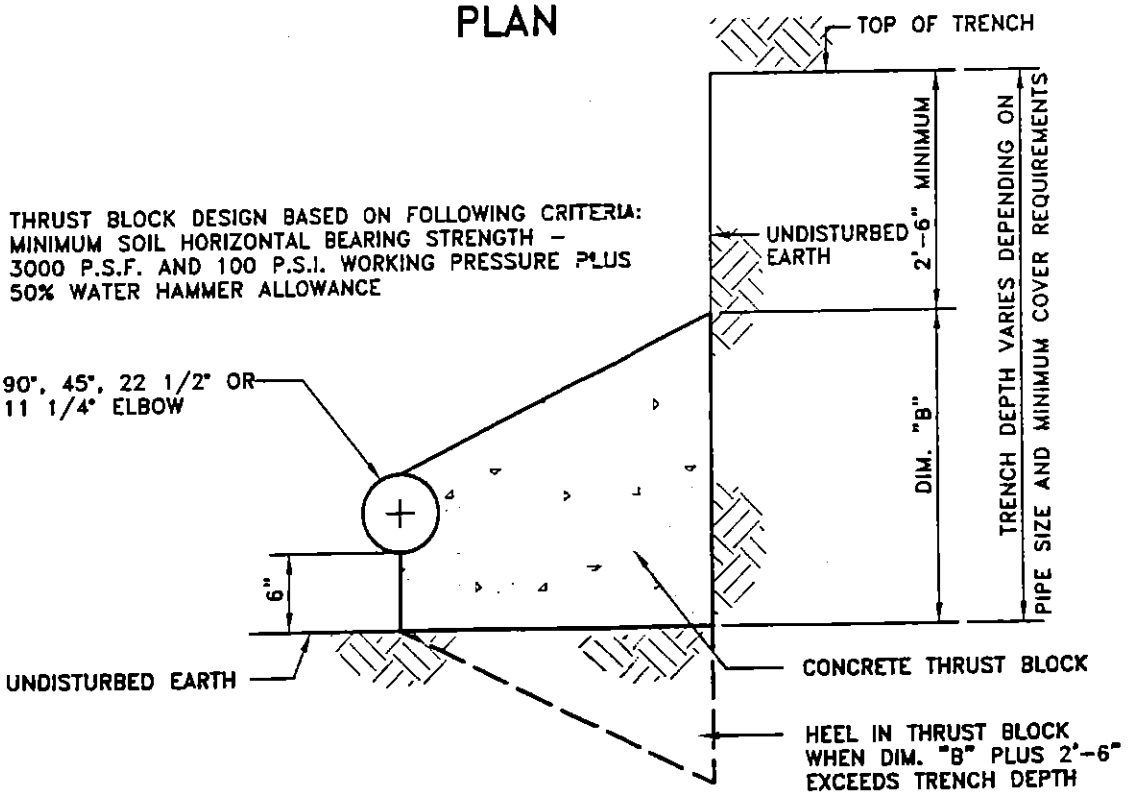
TOWN OF INDIAN HEAD	HORIZ. RESTRAINT THRUST BLOCKING — PLUGS AND PLUGGED CROSSES	

THRUST BLOCK DIMENSION SCHEDULE (ELBOW)					
PIPE DIAM.	DIM.	ELBOW DEFLECTION ANGLE			
		11 1/4°	22 1/2°	45°	90°
6"	A	8"	14"	28"	52"
	B	24"	24"	24"	24"
8"	A	12"	24"	46"	86"
	B	26"	26"	26"	26"
12"	A	22"	44"	86"	160"
	B	30"	30"	30"	30"



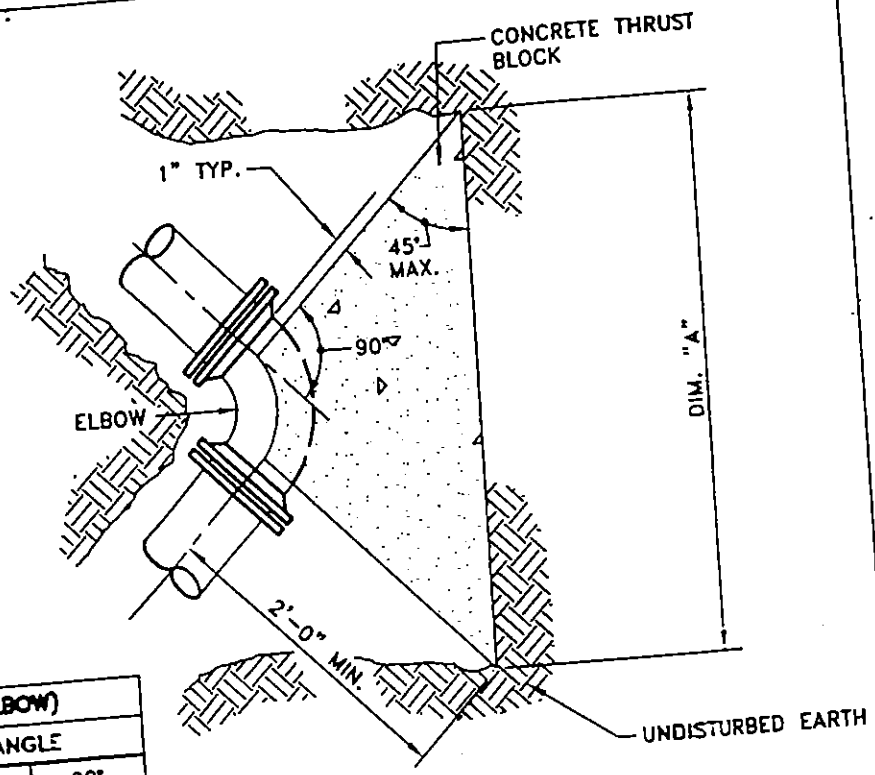
PLAN

THRUST BLOCK DESIGN BASED ON FOLLOWING CRITERIA:
MINIMUM SOIL HORIZONTAL BEARING STRENGTH – 3000 P.S.F. AND 100 P.S.I. WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE



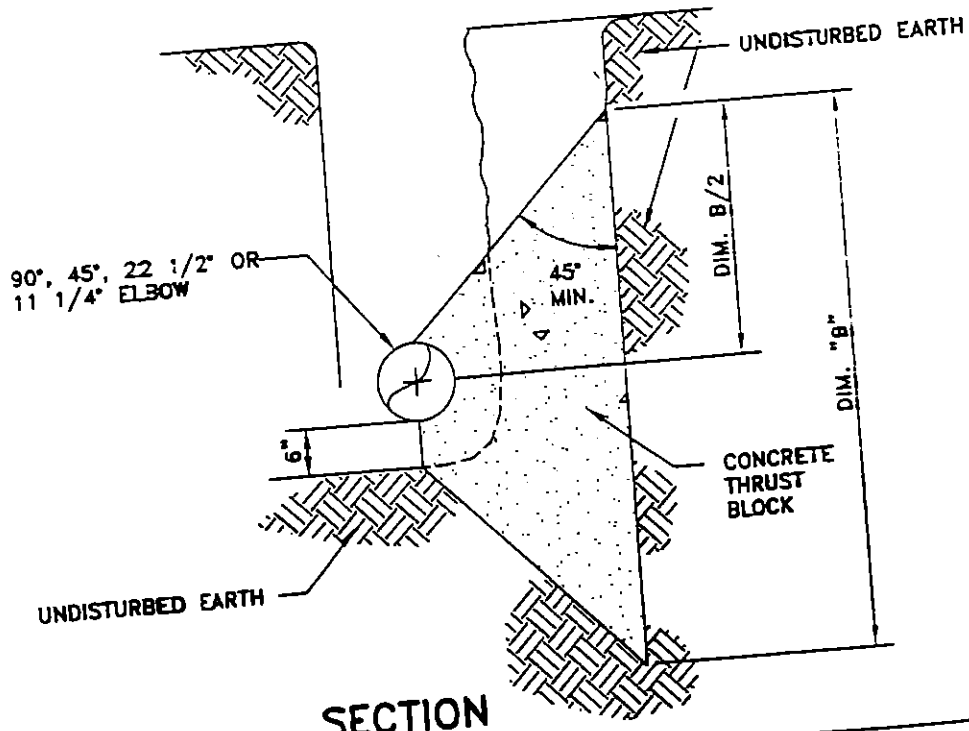
SECTION

TOWN OF INDIAN HEAD	HORIZONTAL RESTRAINT THRUST BLOCKING – ELBOWS	



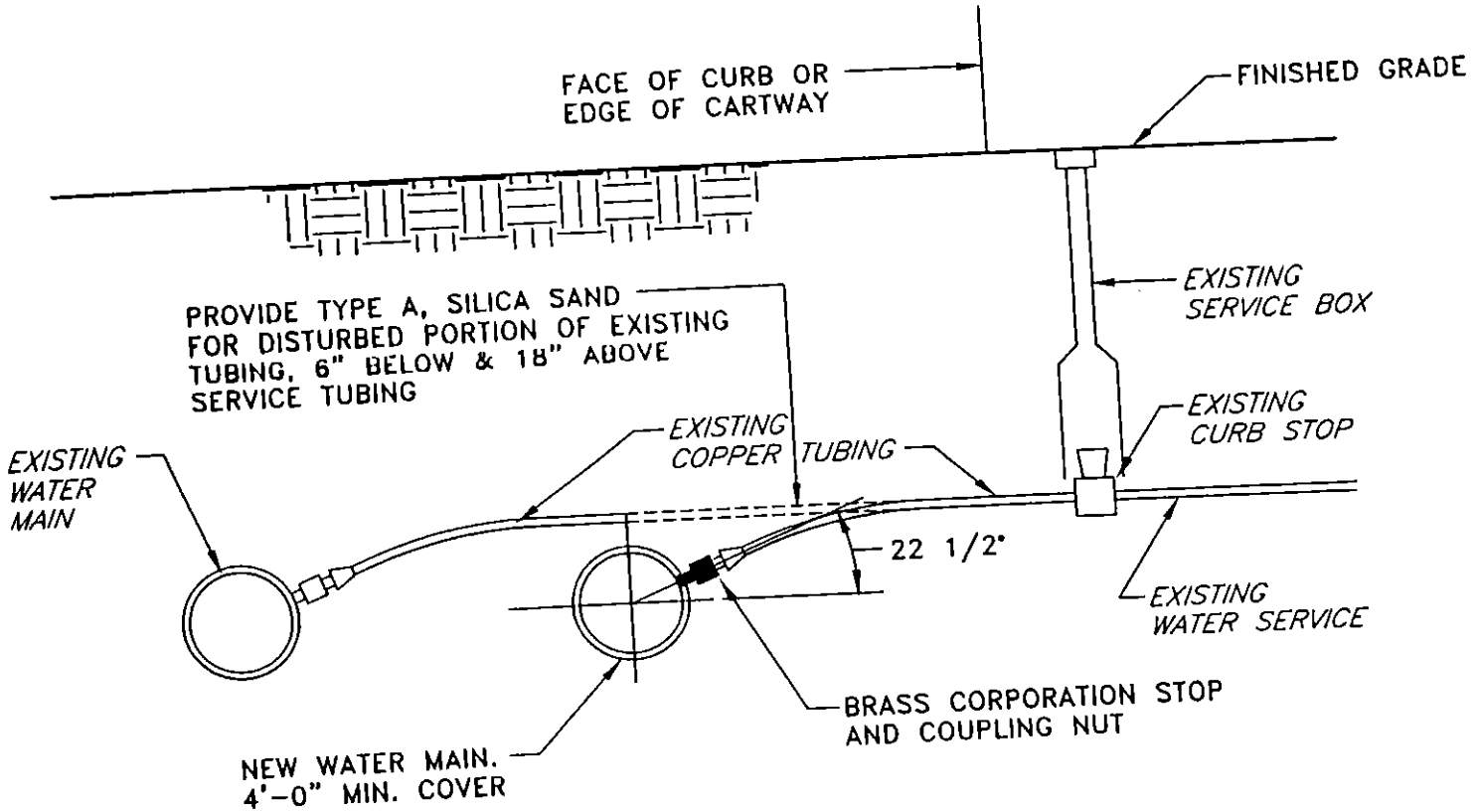
PLAN

THRUST BLOCK DIMENSION SCHEDULE (ELBOW)					
PIPE DIAM.	DIM.	ELBOW DEFLECTION ANGLE			
		11 1/4°	22 1/2°	45°	90°
6"	A	18"	24"	30"	42"
	B	12"	18"	24"	30"
8"	A	24"	24"	42"	60"
	B	12"	24"	30"	36"
12"	A	30"	42"	54"	90"
	B	24"	30"	36"	48"

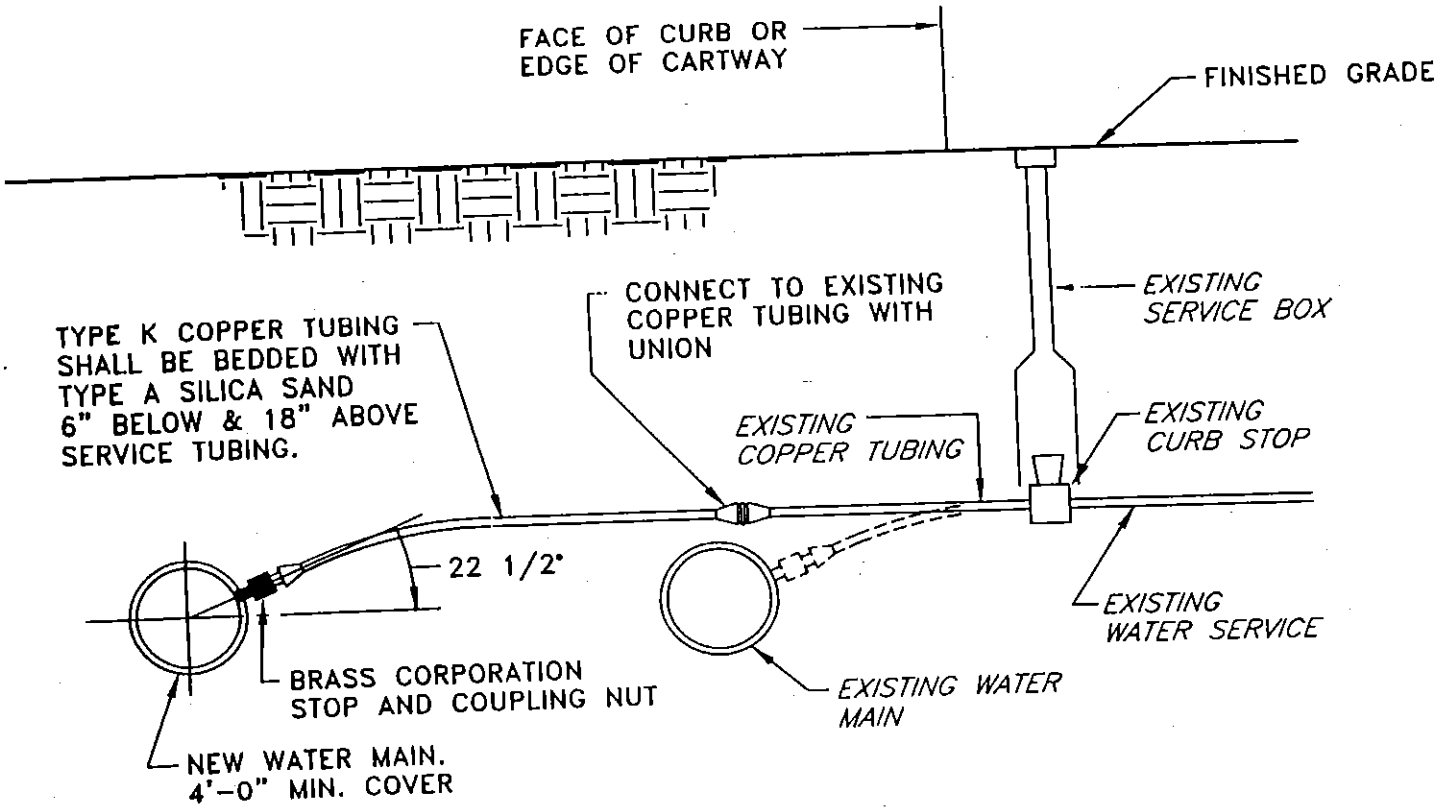


SECTION

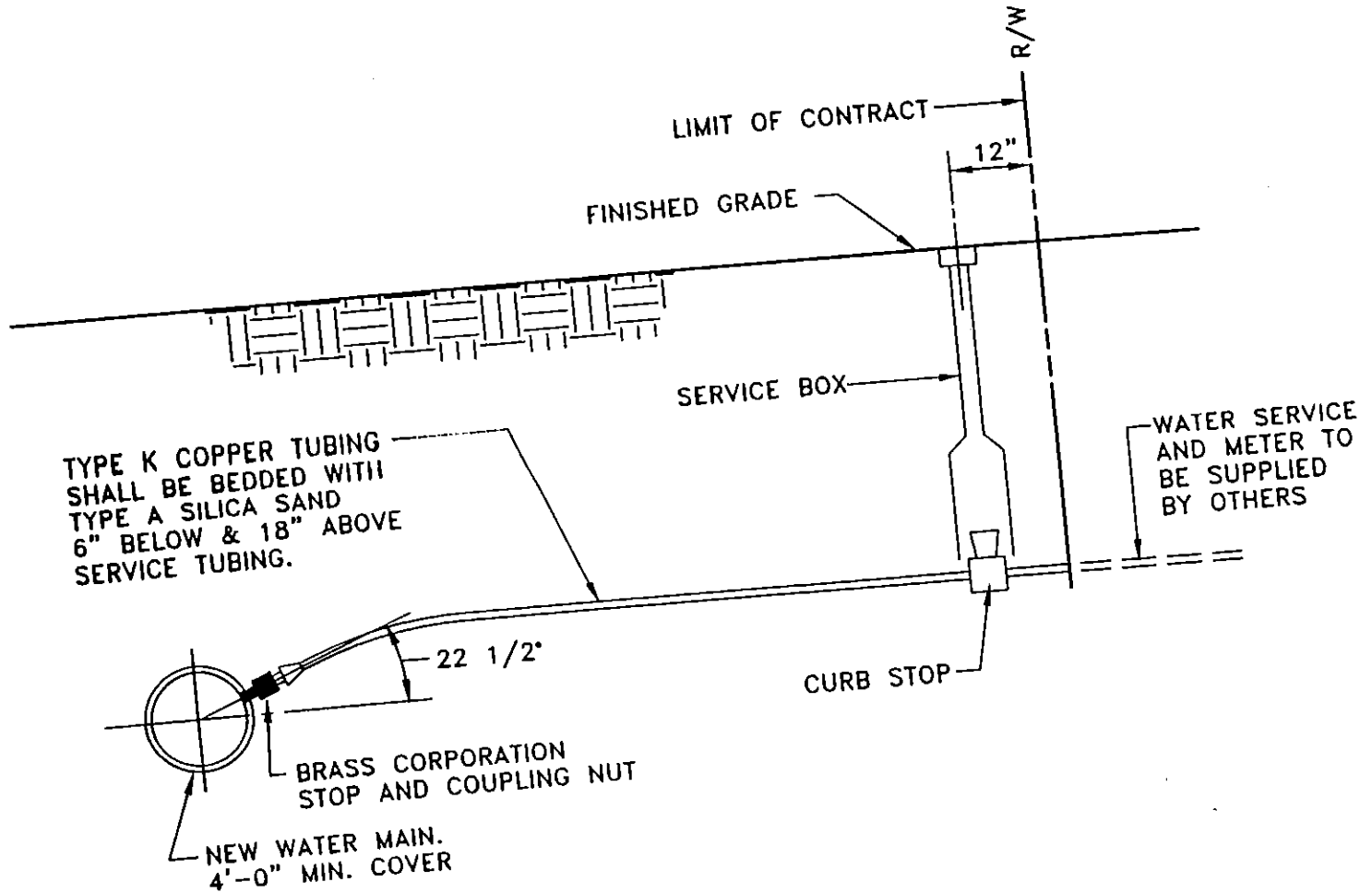
TOWN OF INDIAN HEAD	HORIZONTAL RESTRAINT THRUST BLOCKING DETAIL ELBOWS	



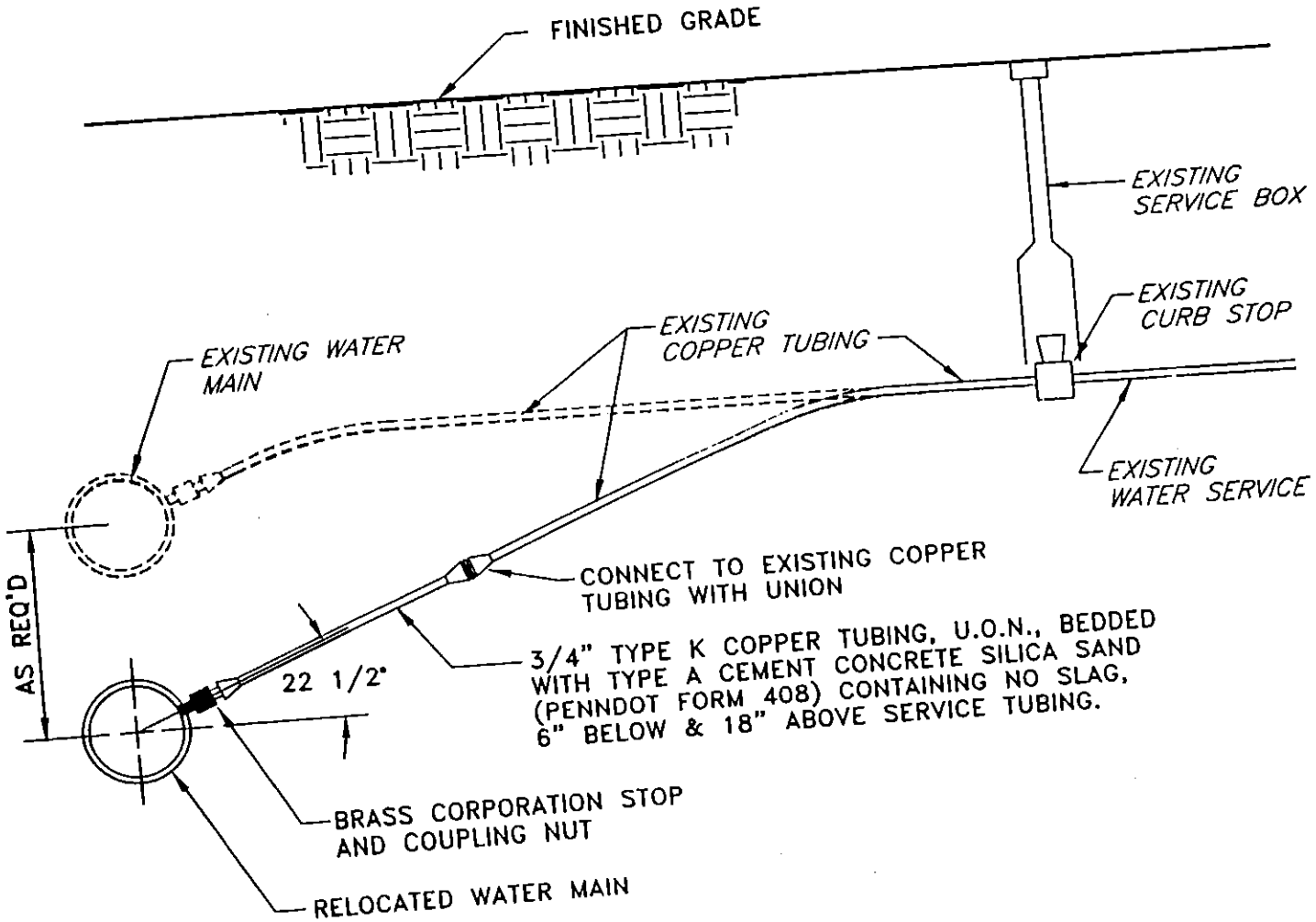
TOWN OF INDIAN HEAD	STD. INSTALLATION FOR EXIST. COPPER SERVICE TYPE 1	



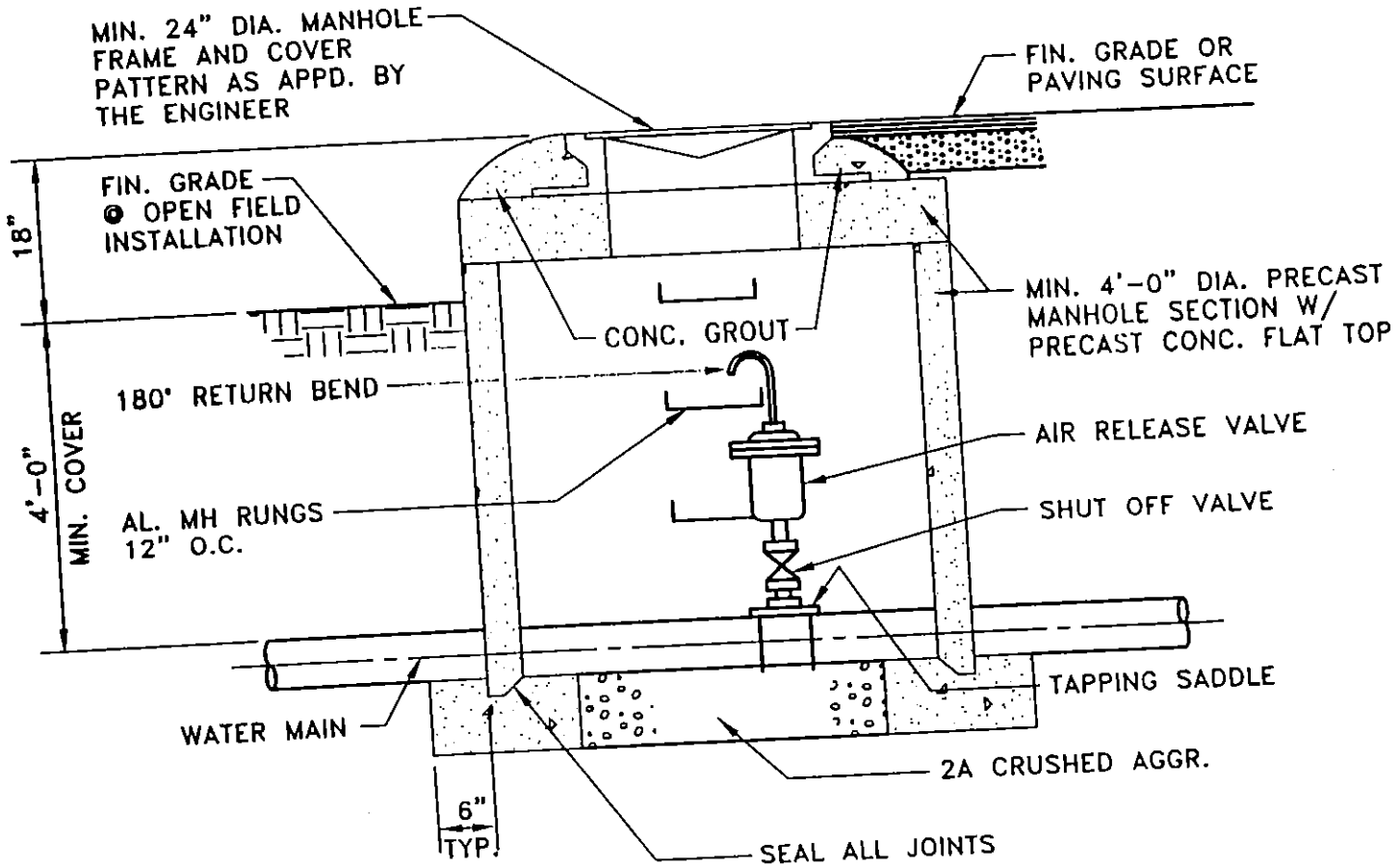
TOWN OF INDIAN HEAD	STD. INSTALLATION FOR EXIST. COPPER SERVICE TYPE II	



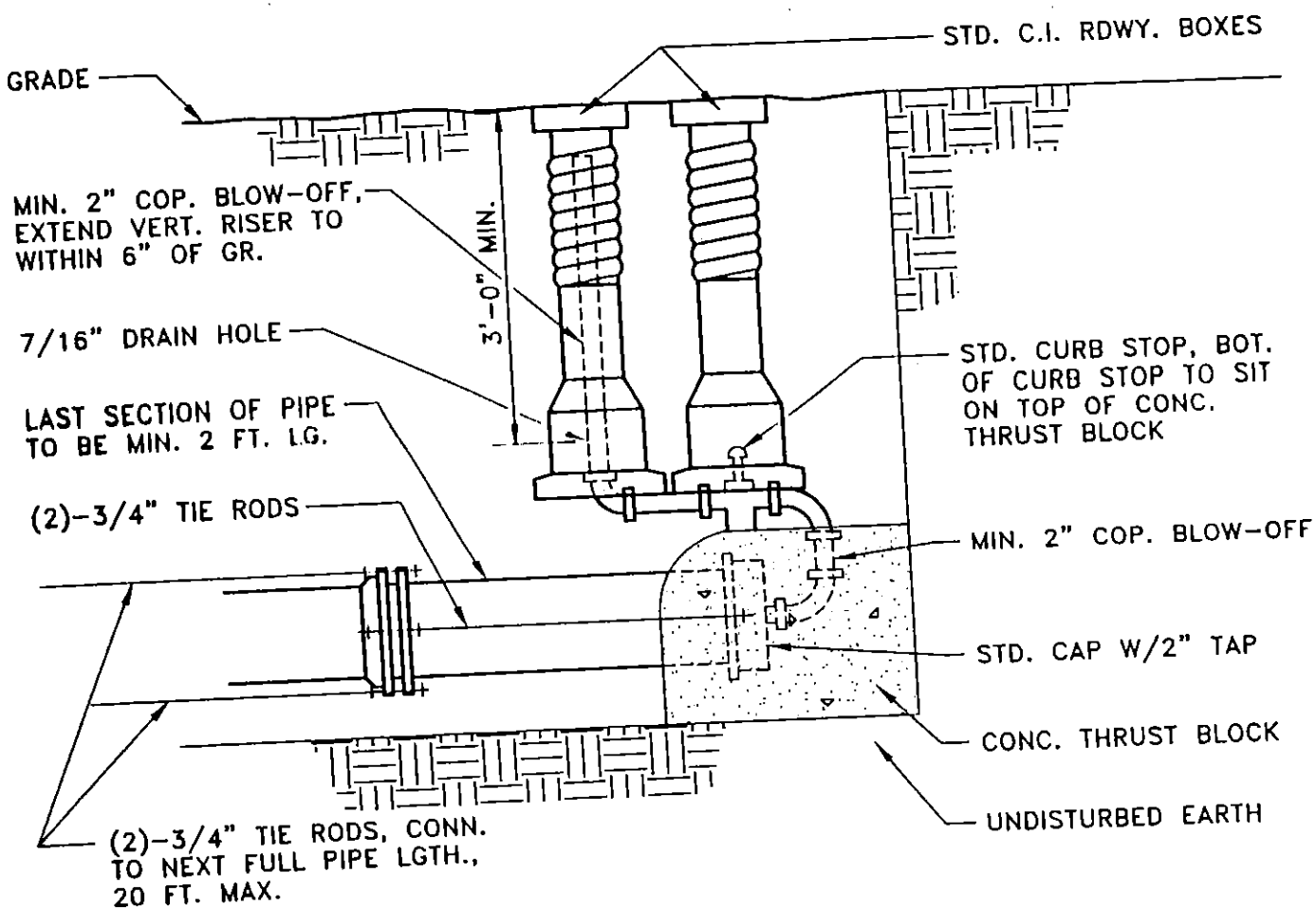
TOWN OF INDIAN HEAD	STD. DOMESTIC SERVICE INSTALLATION	



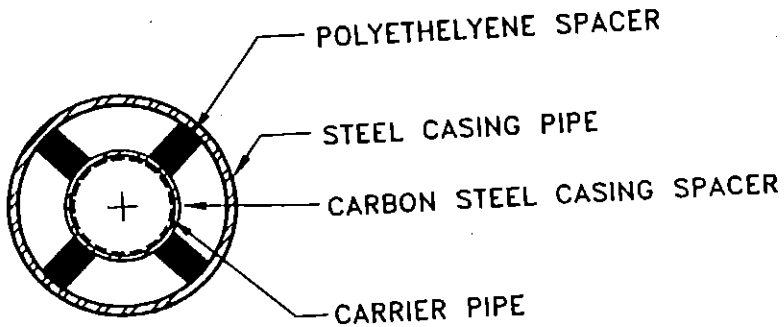
TOWN OF INDIAN HEAD	**WATER SERVICE RELOCATION (LOWERING EX. WATER MAIN)**	



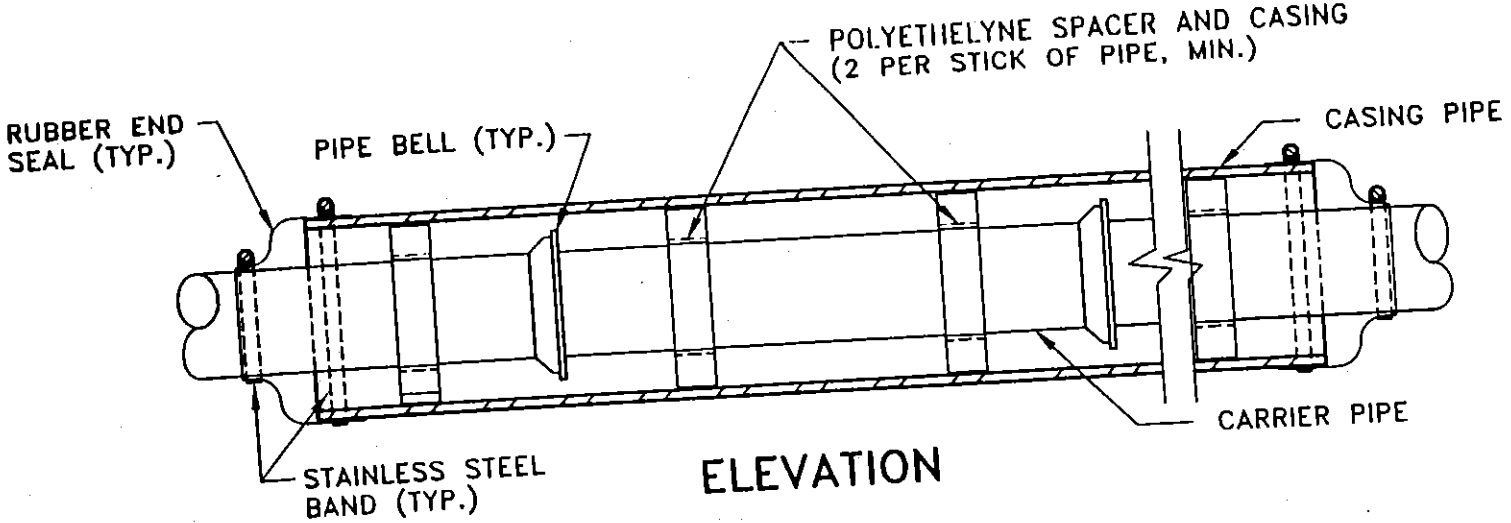
TOWN OF INDIAN HEAD	AIR RELEASE VALVE AND MANHOLE	



TOWN OF INDIAN HEAD	CAP AND BLOW-OFF	

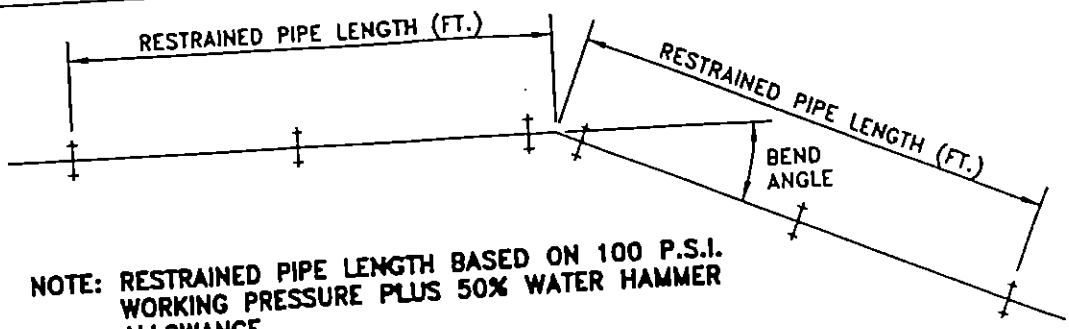


SECTION



ELEVATION

TOWN OF INDIAN HEAD	CASING CRADLE DETAIL	



NOTE: RESTRAINED PIPE LENGTH BASED ON 100 P.S.I. WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE.

HORIZONTAL RESTRAINED PIPE LENGTH SCHEDULE					
PIPE DIAMETER	HORIZONTAL ELBOW DEFLECTION ANGLE				
	90°	45°	22 1/2°	11 1/4°	DEAD ENDS
4"	13.2'	3.2'	2.6'	1.3'	
6"	18.3'	7.6'	3.6'	1.8'	
8"	24.0'	9.9'	4.8'	2.4'	
10"	28.6'	11.9'	5.7'	2.8'	
12"	33.4'	13.9'	6.7'	3.3'	
14"	38.1'	15.8'	7.6'	3.7'	
16"	42.4'	17.6'	8.4'	4.2'	
18"	47.0'	19.4'	9.3'	4.6'	
20"	51.0'	21.1'	10.2'	5.0'	
24"	58.5'	24.2'	11.6'	5.7'	
30"	69.2'	28.6'	13.8'	6.8'	
36"	79.0'	32.7'	15.7'	7.8'	
42"	87.3'	36.1'	17.4'	8.6'	

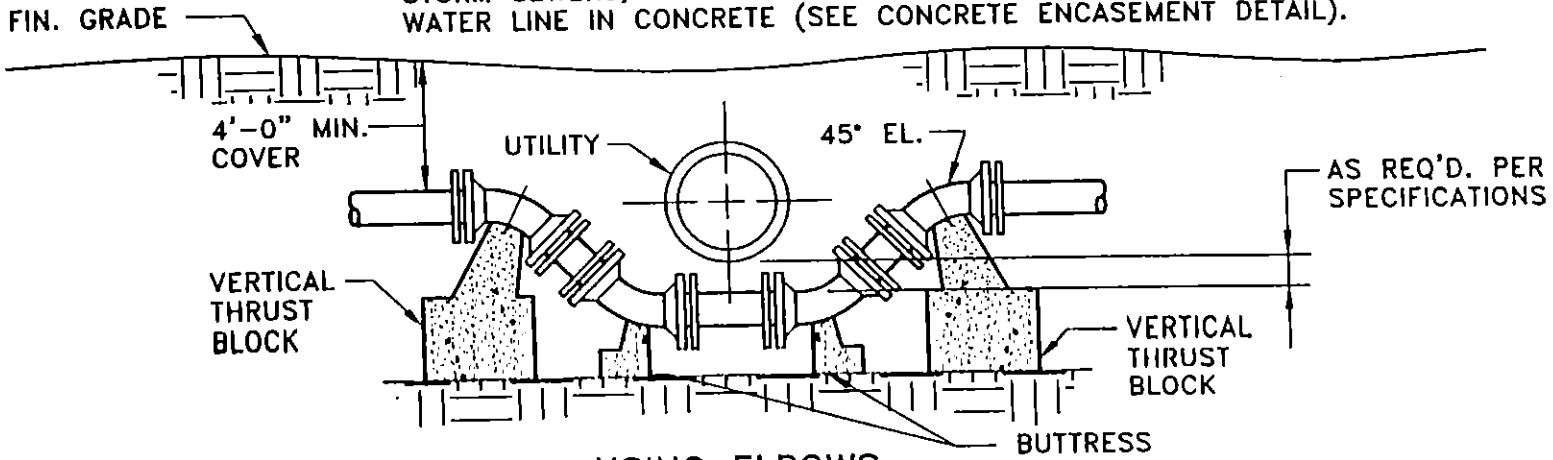
* ADD 12% TO LENGTH IF PIPE IS POLYETHYLENE ENCASED.

VERTICAL RESTRAINED PIPE LENGTH SCHEDULE			
PIPE DIAMETER	VERTICAL ELBOW DEFLECTION ANGLE		
	45°	22 1/2°	11 1/4°
4"	16.5'	9.4'	5.0'
6"	23.3'	13.2'	7.0'
8"	29.3'	16.9'	9.0'
10"	35.7'	20.2'	10.7'
12"	41.4'	23.4'	12.4'
14"	46.8'	26.4'	14.0'
16"	52.1'	29.4'	15.6'
18"	57.3	32.2'	17.1'
20"	62.2'	35.0'	18.5'
24"	71.6'	40.2'	21.2'
30"	84.3'	47.2'	24.9'
36"	95.7'	53.4'	28.1'
42"	105.5'	58.8'	31.0'

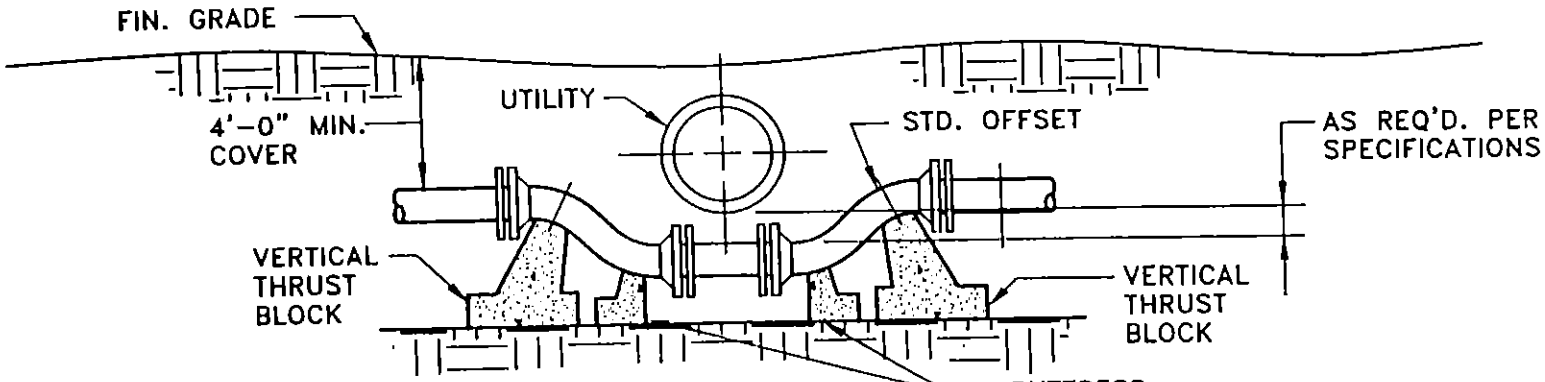
* ADD 12% TO LENGTH IF PIPE IS POLYETHYLENE ENCASED.

TOWN OF INDIAN HEAD	RESTRAINED PIPE LENGTH SCHEDULE	

NOTE: ALL VERTICAL THRUST BLOCKS MUST BE APPROVED BY THE ENGINEER.
WHERE FIELD CONDITIONS WARRANT THAT A VERTICAL CLEARANCE OF 1'-6" CANNOT BE MAINTAINED BETWEEN THE WATER LINE AND SANITARY OR STORM SEWERS, AND WHERE APPROVED BY THE ENGINEER, ENCASE THE WATER LINE IN CONCRETE (SEE CONCRETE ENCASEMENT DETAIL).

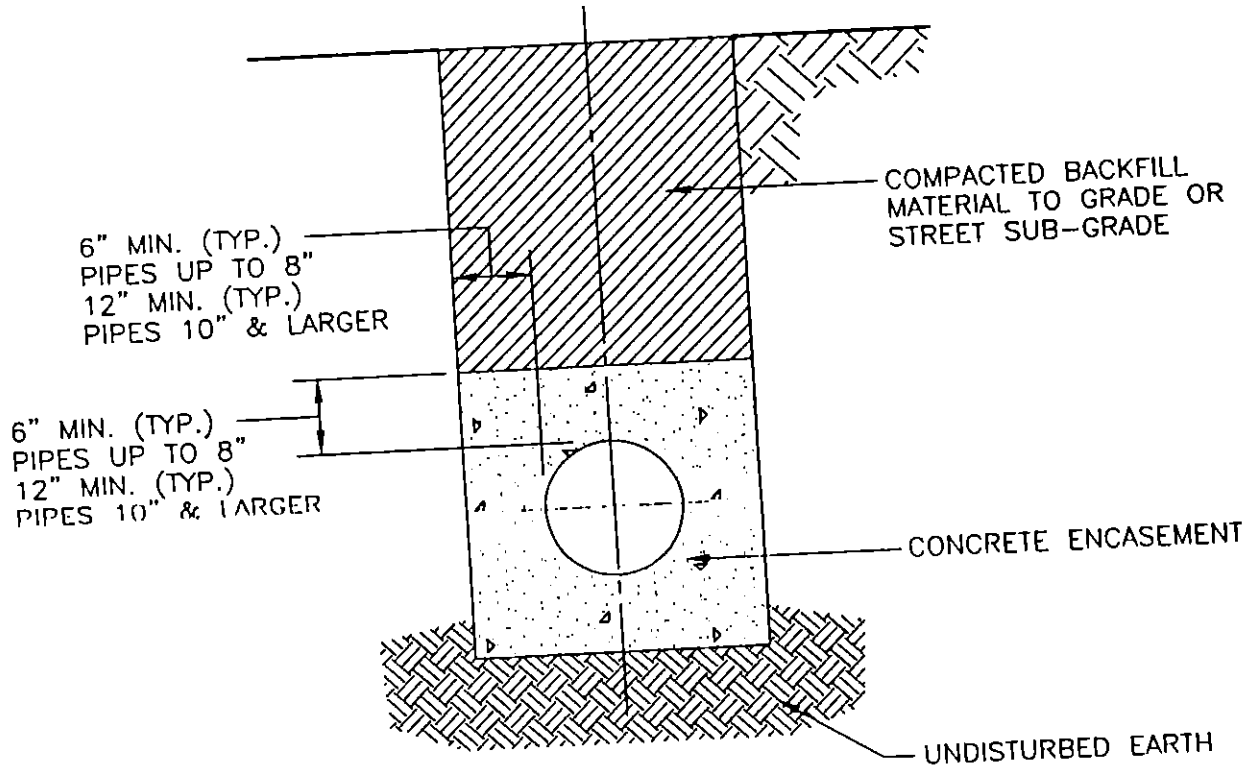


USING ELBOWS

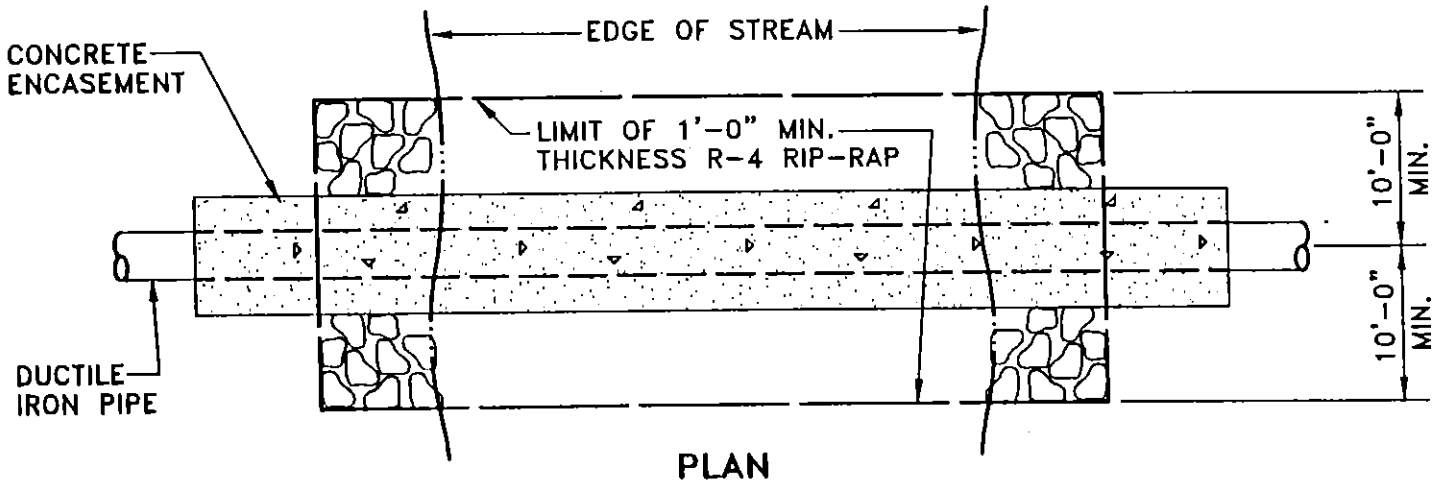


USING STD. OFFSETS

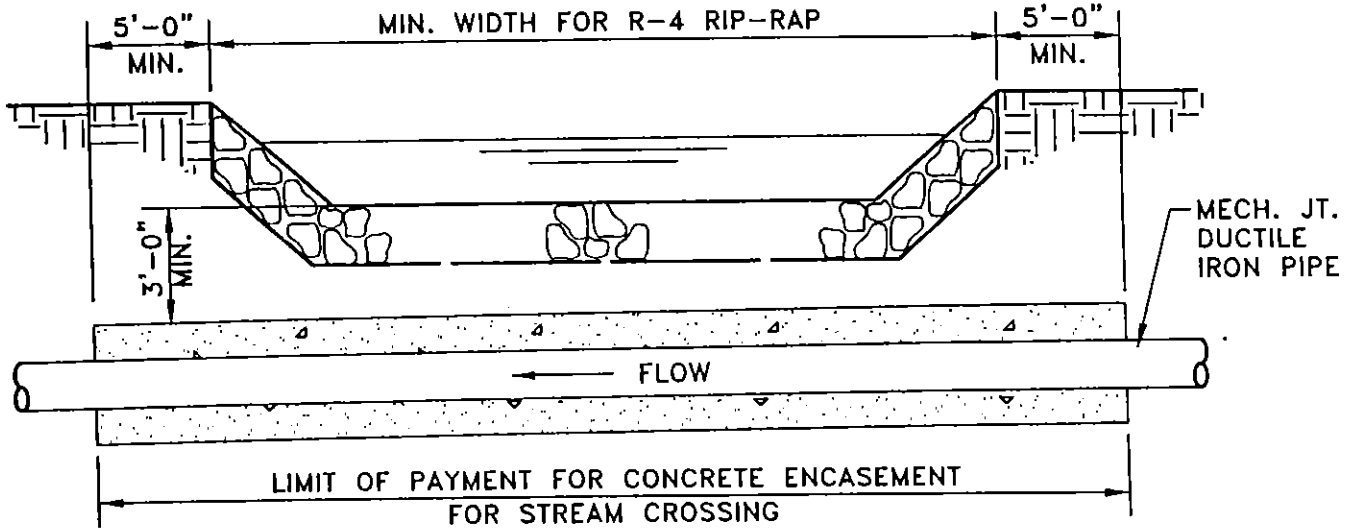
TOWN OF INDIAN HEAD	WATER MAIN CROSSING UTILITY DETAIL (USING FITTINGS)	



TOWN OF INDIAN HEAD	**CONCRETE ENCASEMENT DETAIL**	

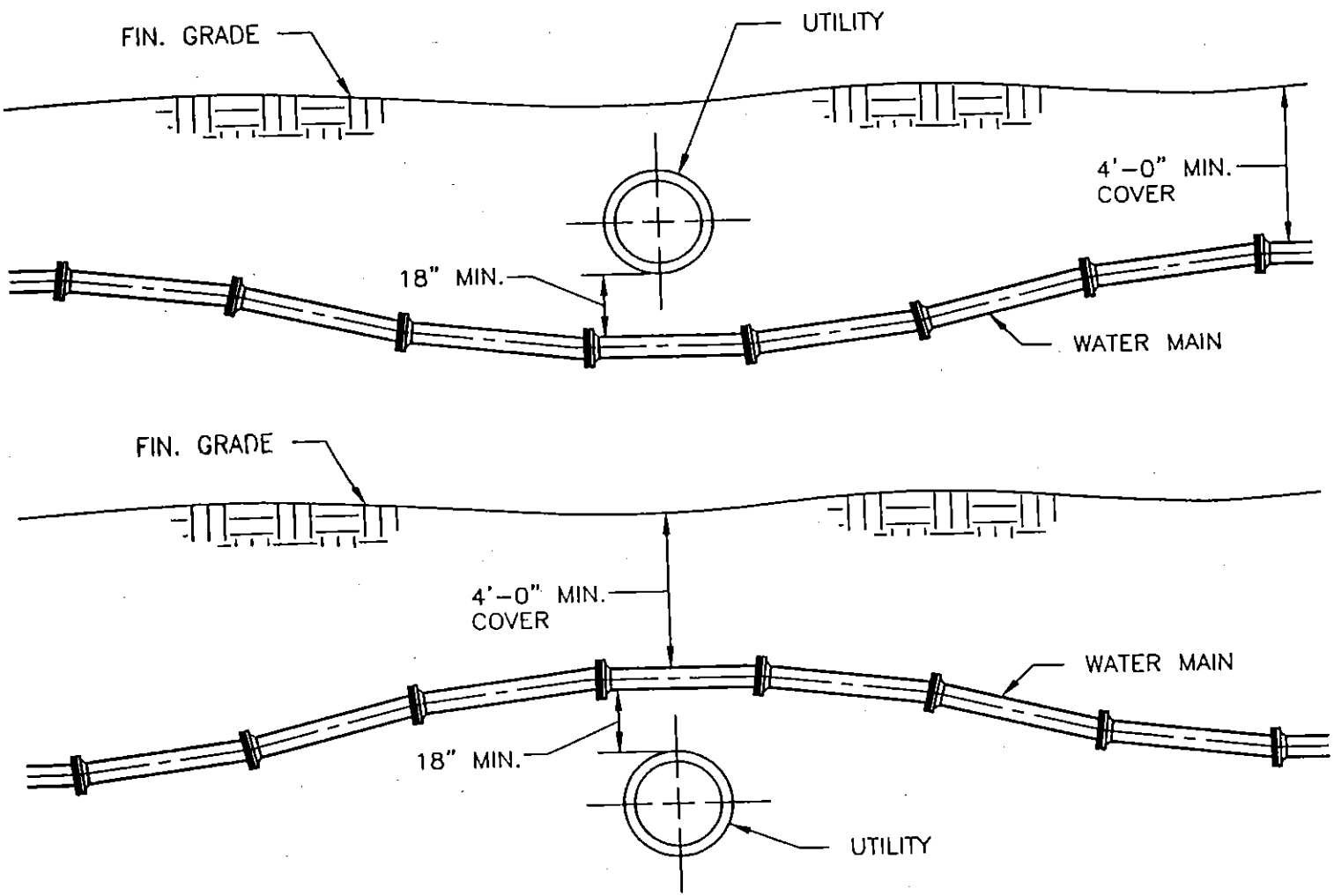


PLAN



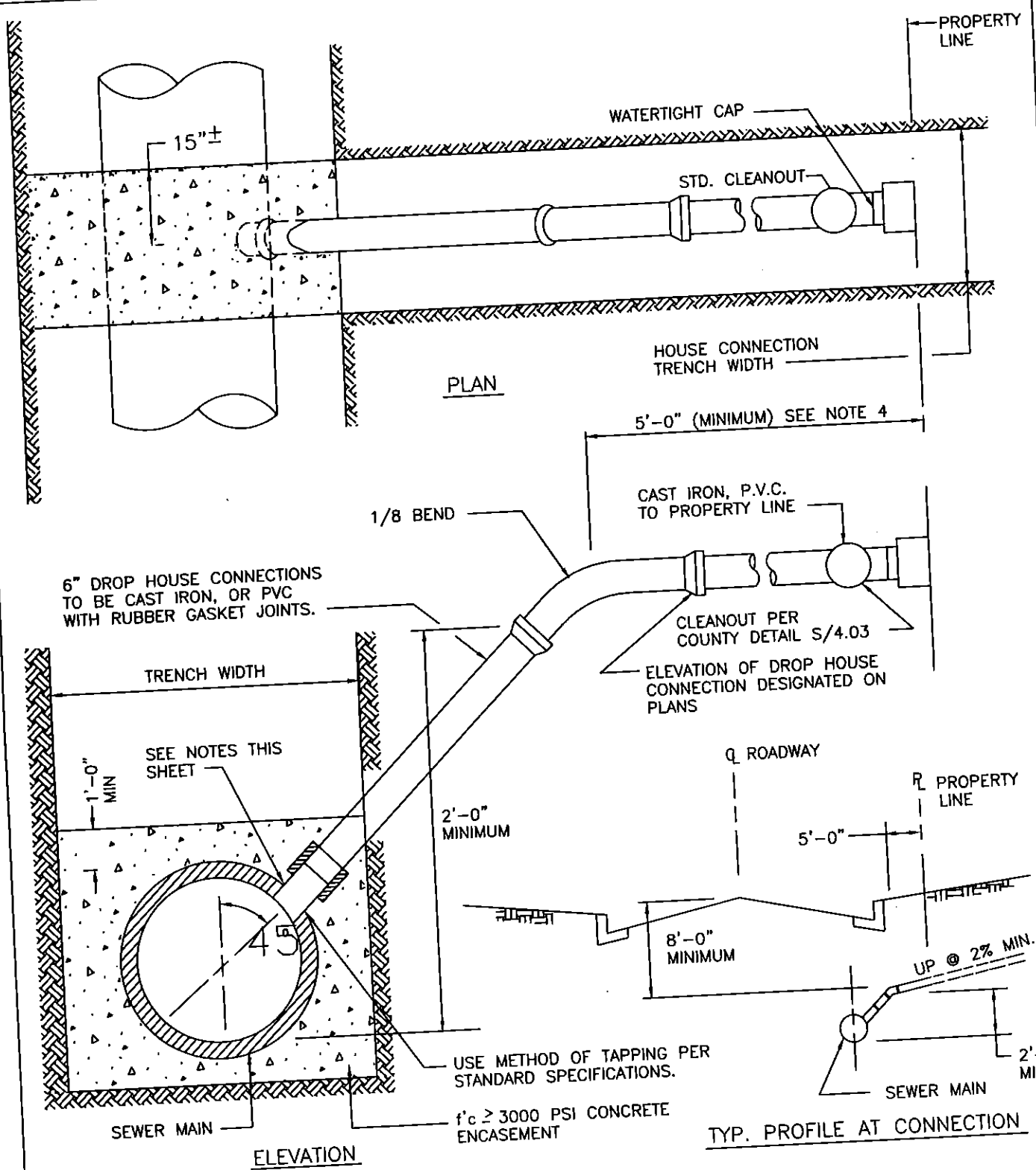
SECTION

TOWN OF INDIAN HEAD	STREAM CROSSING DETAIL	



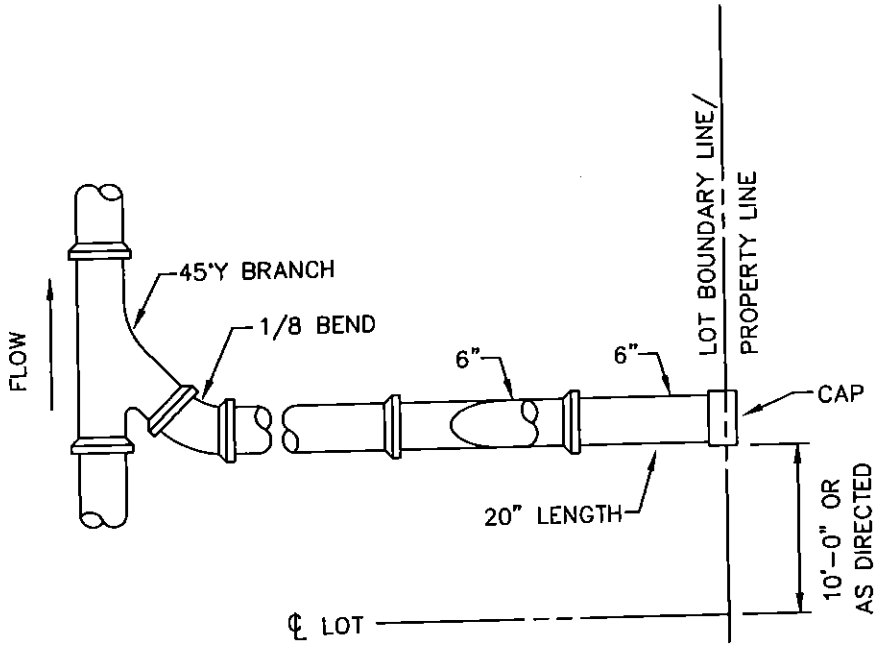
TOWN OF INDIAN HEAD	**WATER CROSSING UTILITY DETAIL (USING DEFLECTING JOINTS)**	

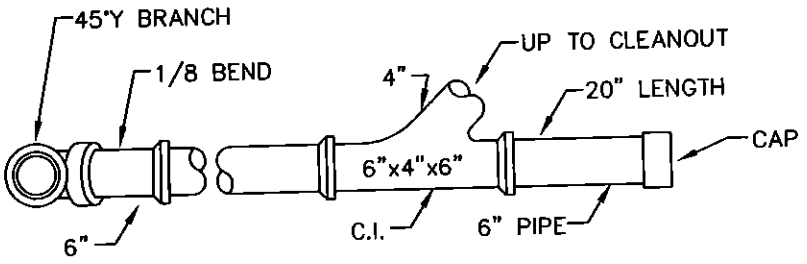
SEWER



NOTES:
1. (A) S.H.C. TO 4" SEWER MAIN USE TEE OR SADDLE.
   (B) S.H.C. TO 6" THRU 12" SEWER MAIN USE SADDLE.
   (C) S.H.C. TO 15" & LARGER SEWER MAIN USE THIMBLE AND EPOXY TO MAIN LINE.
2. S.H.C. TO 4" THRU 15" PVC SEWER MAIN USE SADDLE.
3. S.H.C. TO PROPOSED SEWER MAINS, USE TEES, SEE DETAIL S/4.01
4. S.H.C. AT PROPERTY LINE SHALL TERMINATE WITH MINIMUM PIPE LENGTH OF 5'-0". THIS DETAIL IS NOT APPLICABLE FOR A SHORTER LENGTH THAN 5'-0" AT THE PROPERTY LINE.

TOWN OF INDIAN HEAD	TYPE "A" 6" DROP HOUSE CONNECTION TO SEWER MAIN	





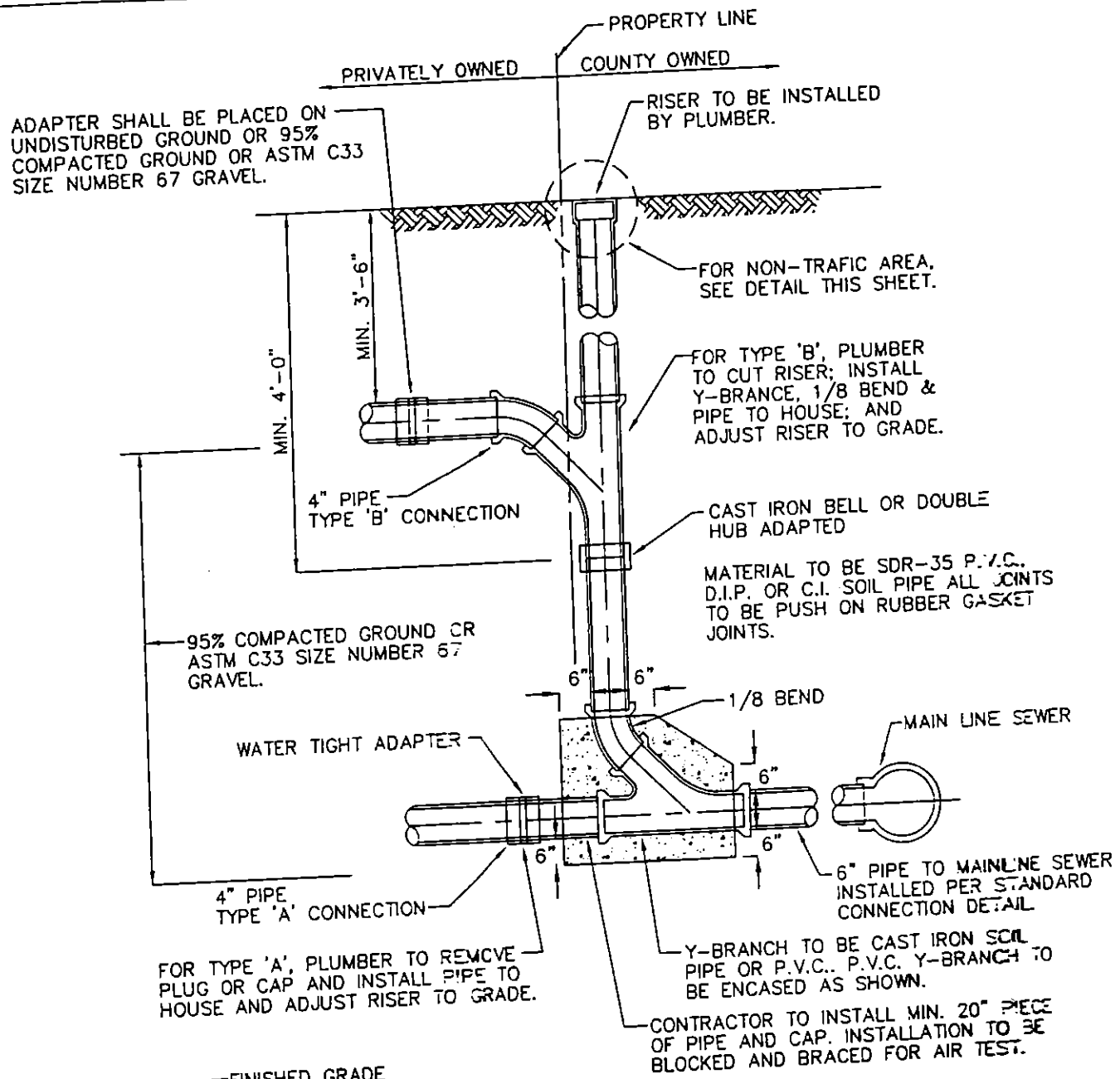
UP AT 2.00% MINIMUM

NOTES:

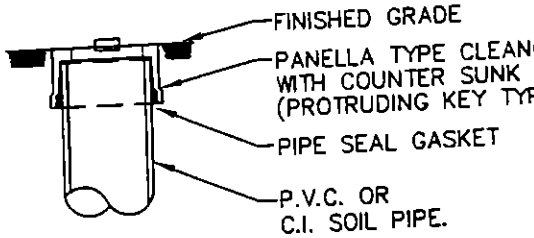
1. Set 2"x6"x8" marker boards at C.O. / Property line. Board should be exposed 4 ft. above grade and painted GREEN.

2. Use proper bedding requirements per county requirements.

TOWN OF INDIAN HEAD	TYPE "B" 6" HOUSE CONNECTION TO SEWER MAIN	



ELEVATION



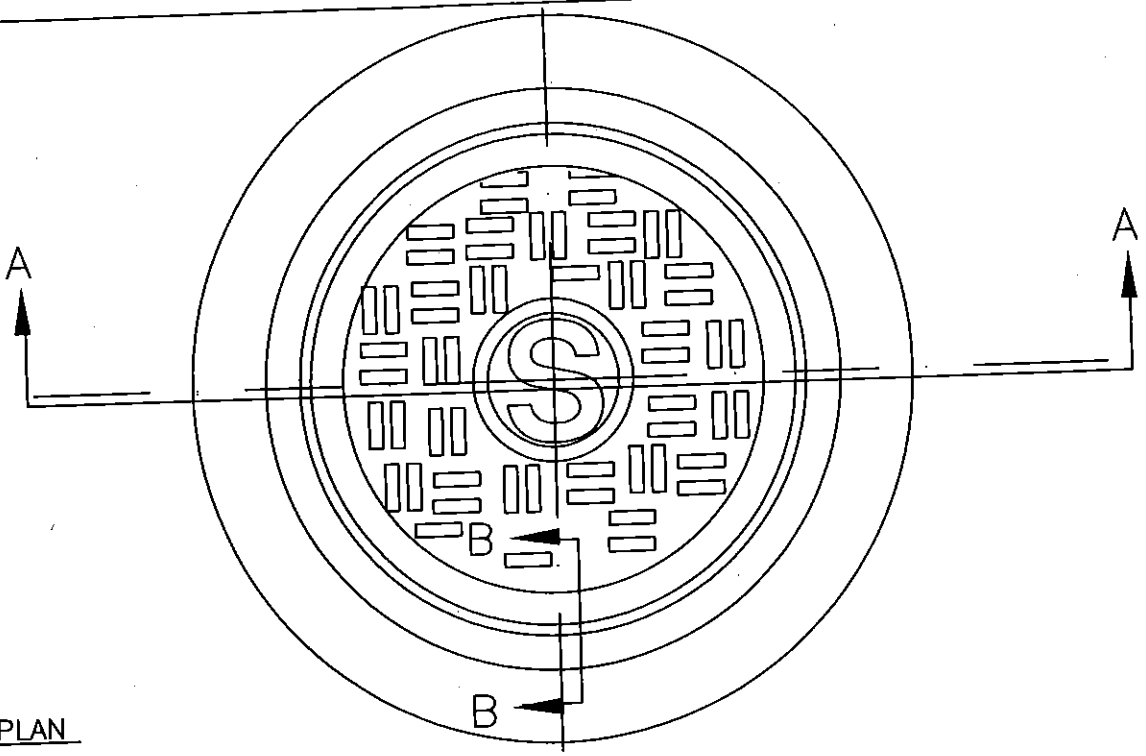
DETAIL

NOTES

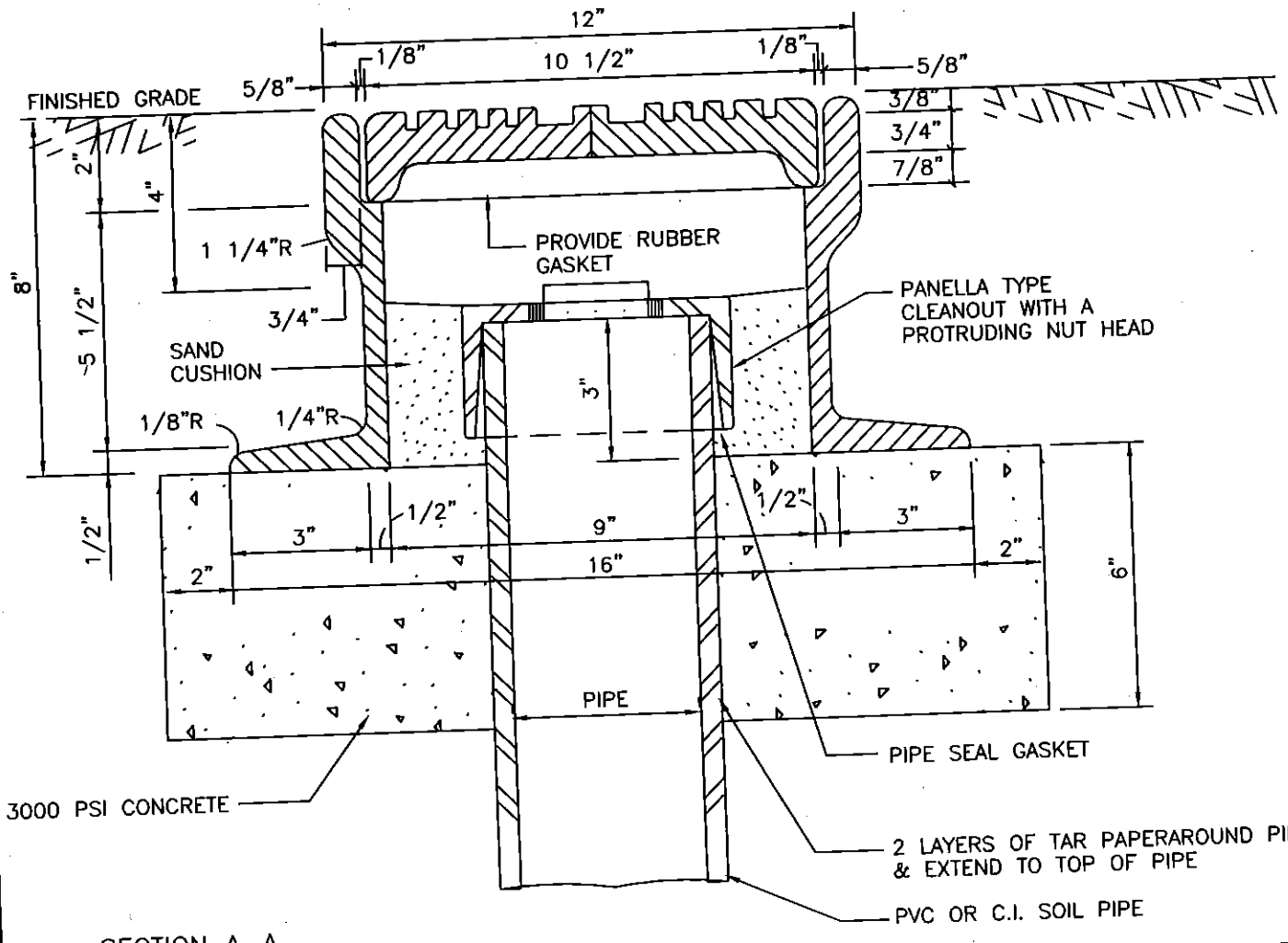
1. FOR PAVED AREAS (INCLUDING SIDEWALKS) SEE CLEANOUT COVER ASSEMBLY DETAIL.
2. VERTICAL CLEANOUT RISER STUB SHALL BE 4 FEET OR LESS BELOW SURFACE FOR UNIMPROVED LOTS AND PROVIDED WITH A WATER TIGHT PLUG. LOCATION IS TO BE MARKED WITH A 2"x6" BOARD EXTENDING ONE FOOT MIN. ABOUVE GRADE.
3. A FLEXIBLE COUPLING WILL BE REQUIRED BETWEEN THE MAIN AND THE CLEANOUT WYE BRANCH IF THE WYE IS A DIFFERENT MATERIAL THAN THE PIPE.
4. IF A PVC WYE IS USED, IT SHALL BE SET ON ITS SIDE WITH TWO 45 DEGREE BENDS WITH A SHORT SPOOL PIECE BETWEEN THE BENDS.

STANDARD SYMBOL — SHC

TOWN OF INDIAN HEAD	STANDARD CLEAN-OUT NON-TRAFFIC AREAS	

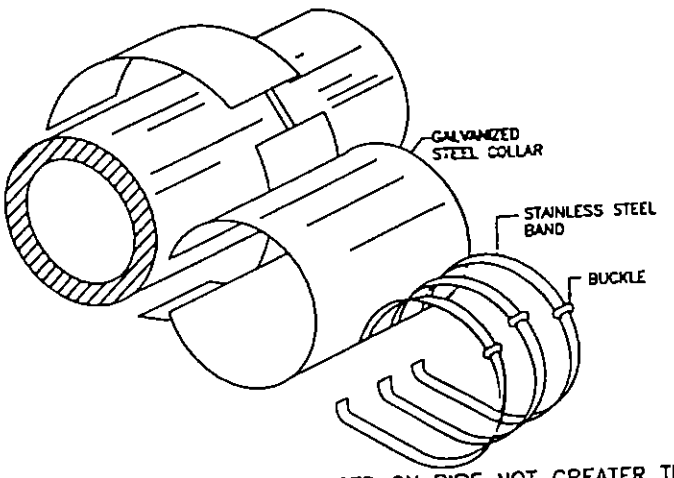


PLAN

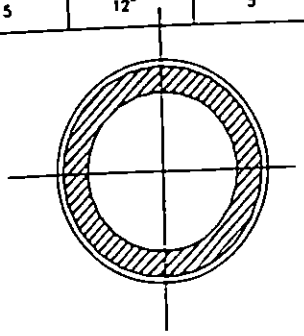


SECTION A–A

TOWN OF INDIAN HEAD	CLEANOUT COVER ASSEMBLY TRAFFIC AREAS	

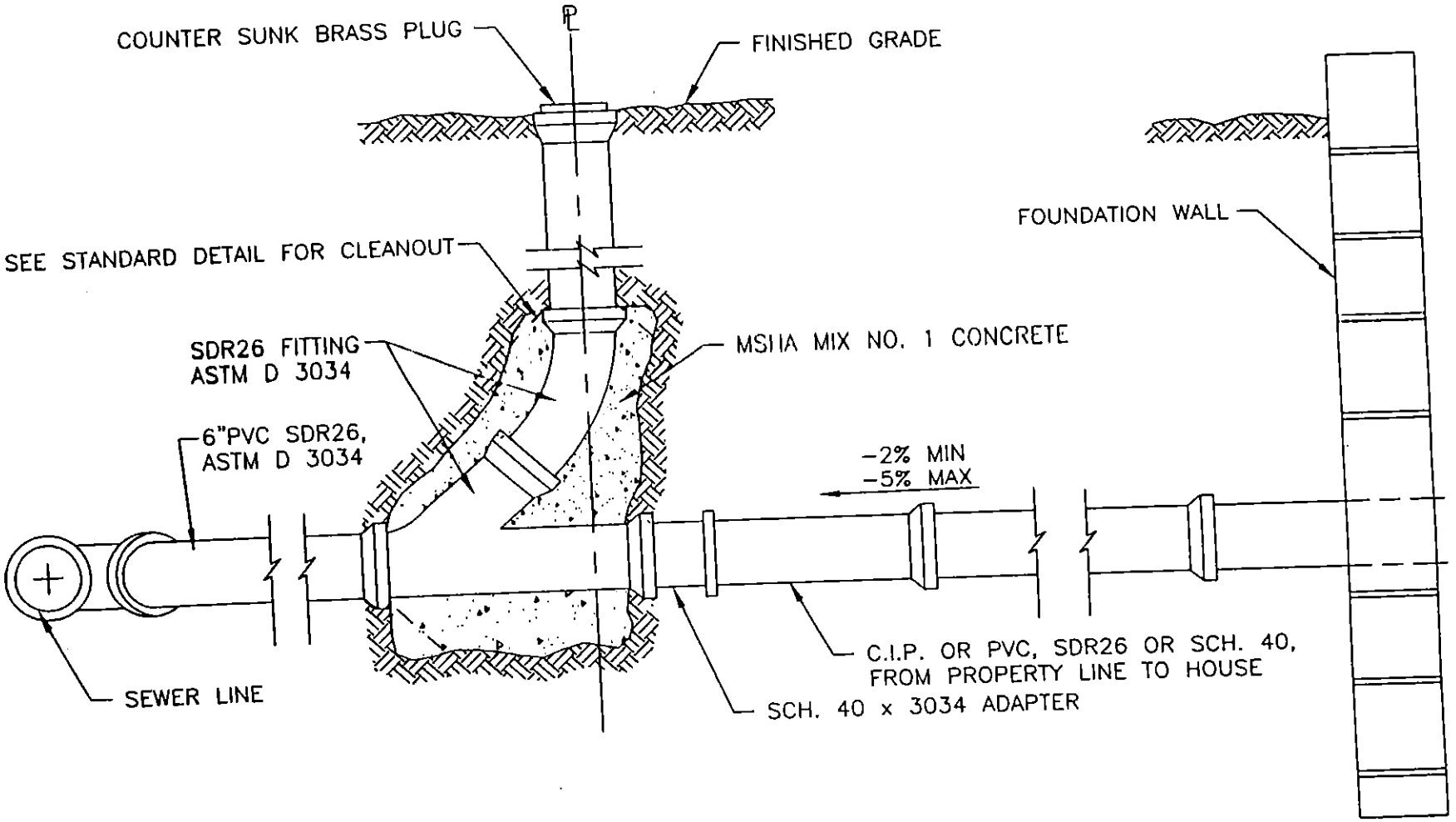


PIPE SIZE	NUMBER OF STRIPS OF RAM-NEK	WIDTH OF GALVANIZED STEEL COLLAR	NUMBER OF STAINLESS STEEL BANDS
6"	3	9"	3
8"	3	9"	3
10"	5	12"	5
12"	5	12"	5

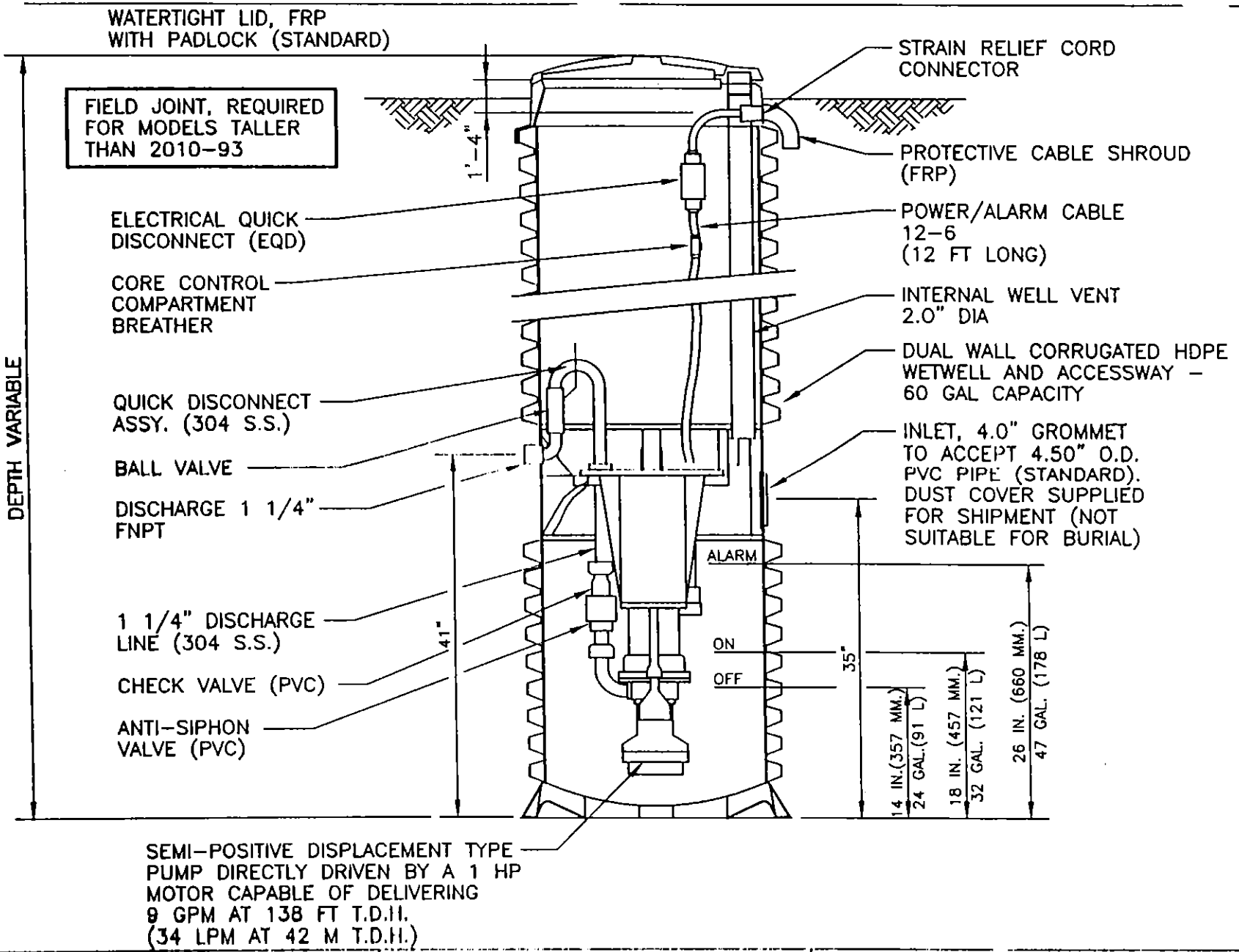


1. SEWER REPAIR CLAMP TO BE USED ON PIPE NOT GREATER THAN 12" IN DIAMETER.
2. SEWER REPAIR CLAMP NOT TO BE USED ON GAPS GREATER THAN 1/2".
3. PIPE SHALL BE CLEANED OF DIRT, GREASE, ETC., WITH SCRUB-BRUSH AND CLEAN WATER AND ALLOWED TO DRY BEFORE APPLYING CLAMP. THE CRACKED PIPE SHALL BE RE-ALIGNED TO THE SLOPE OF ADJACENT PIPE BEFORE INSTALLING THE CLAMP.
4. THE AREA ON THE PIPE WHICH THE CLAMP IS TO BE APPLIED SHALL BE GIVEN A THIN COAT ROOFING CEMENT.
5. STRIPS OF "RAM-NEK" ARE TO BE APPLIED TO THE PIPE SUCH THAT NO STRIP STRETCHES MORE THAN 1". ADJACENT STRIPS OF "RAM-NEK" SHALL ABUT EACH OTHER BUT NOT OVERLAP. THE "RAM-NEK" SHALL COMPLETELY SURROUND THE PIPE WITH ONE TURN OF "RAM-NEK" CENTERED OVER THE CRACK. THE "RAM-NEK" SHALL BE APPLIED TO THE PIPE ONE LAYER THICK.
6. A GALVANIZED STEEL COLLAR SHALL BE WRAPPED TIGHTLY AROUND THE "RAM-NEK" AND THE TWO ENDS OF THE GALVANIZED STEEL COLLAR SHALL OVERLAP NOT MORE THAN 4" NOR LESS THAN 3". THE GALVANIZED STEEL COLLAR SHALL BE CENTERED OVER THE CRACK.
7. THE FIRST STAINLESS STEEL BAND SHALL BE PLACED SUCH THAT IT RESTS ON THE GALVANIZED STEEL COLLAR AND ABOVE THE CRACK. SUBSEQUENT BANDS SHALL BE PLACED ALTERNATELY, ON SIDE OF THE MIDDLE AND THEN ON THE OTHER SIDE. THE BUCKLES FOR THE STAINLESS STEEL BAND SHALL BE PLACED SO THAT THEY REST ON THE AREA OF OVERLAP OF THE TWO ENDS OF THE GALVANIZED STEEL COLLAR. ADJACENT BUCKLES SHALL BE STAGGERED. NO STAINLESS STEEL BANDS SHALL BE PLACED OVER THE GALVANIZED COLLAR WHERE SAID COLLAR EXTENDS PAST THE "RAM-NEK". THE STAINLESS STEEL BANDS SHALL BE TIGHTENED WITH THE APPROPRIATE BANDING TOOL SUCH THAT THE "RAM-NEK" YIELDS SLIGHTLY.
8. IN CASES WHERE THE CRACK IN THE PIPE IS NOT PERPENDICULAR TO THE AXIS OF THE PIPE. THE "RAM-NEK" SHALL EXTEND A DISTANCE OF 3" (6" & 8") OR 5" (10" & 12") PIPE ALONG THE AXIS OF THE PIPE FROM ANY POINT OF THE CRACK. FOR THESE CASES, THE GALVANIZED STEEL COLLAR SHALL EXTEND A DISTANCE OF 2" BEYOND EACH END OF THE "RAM-NEK" ALONG THE PIPE AXIS. THE NUMBER OF STAINLESS STEEL BANDS TO BE USED IN THESE CASES SHALL CONFORM TO THE INCLUDED CHART FOR THE GIVEN PIPE SIZE, OR AS DIRECTED BY THE ENGINEER.
9. A BURLAP DIAPER SHALL BE PUT AROUND THE CLAMP SO THAT IT EXTENDS 2 1/2" PAST EACH END OF GALVANIZED STEEL COLLAR ALONG THE PIPE AXIS. THE DIAPER SHALL THAN BE FILLED WITH A SAND-CEMENT MORTAR IN A RATIO OF 2 TO 1 TO A MINIMUM THICKNESS OF 1 1/2". THE MORTAR SHALL COMPLETELY FILL THE VOID BETWEEN THE PIPE AND THE GALVANIZED STEEL COLLAR WHERE SAID COLLAR EXTENDS PAST THE "RAM-NEK". THE MORTAR SHALL BE OF A POURABLE CONSISTENCY.
10. THE GALVANIZED STEEL COLLAR SHALL BE OF 20 TO 24 GAGE SHEET METAL.
11. THE STAINLESS STEEL BANDS SHALL BE 3/4" CORROSION RESISTANT BAND-IT BAND, OR EQUAL.
12. THE STAINLESS STEEL BUCKLES SHALL BE 3/4" CORROSION RESISTANT BAND-IT BUCKLES, OR EQUAL.
13. THE STAINLESS STEEL BANDS AND BUCKLES SHALL BE APPLIED TO THE CLAMP USING A BAND-IT TOOL BANDING MACHINE, OR EQUAL.
14. IN SIZES GREATER THAN 12", METHOD OF REPAIR MUST BE SUBMITTED FOR REVIEW.

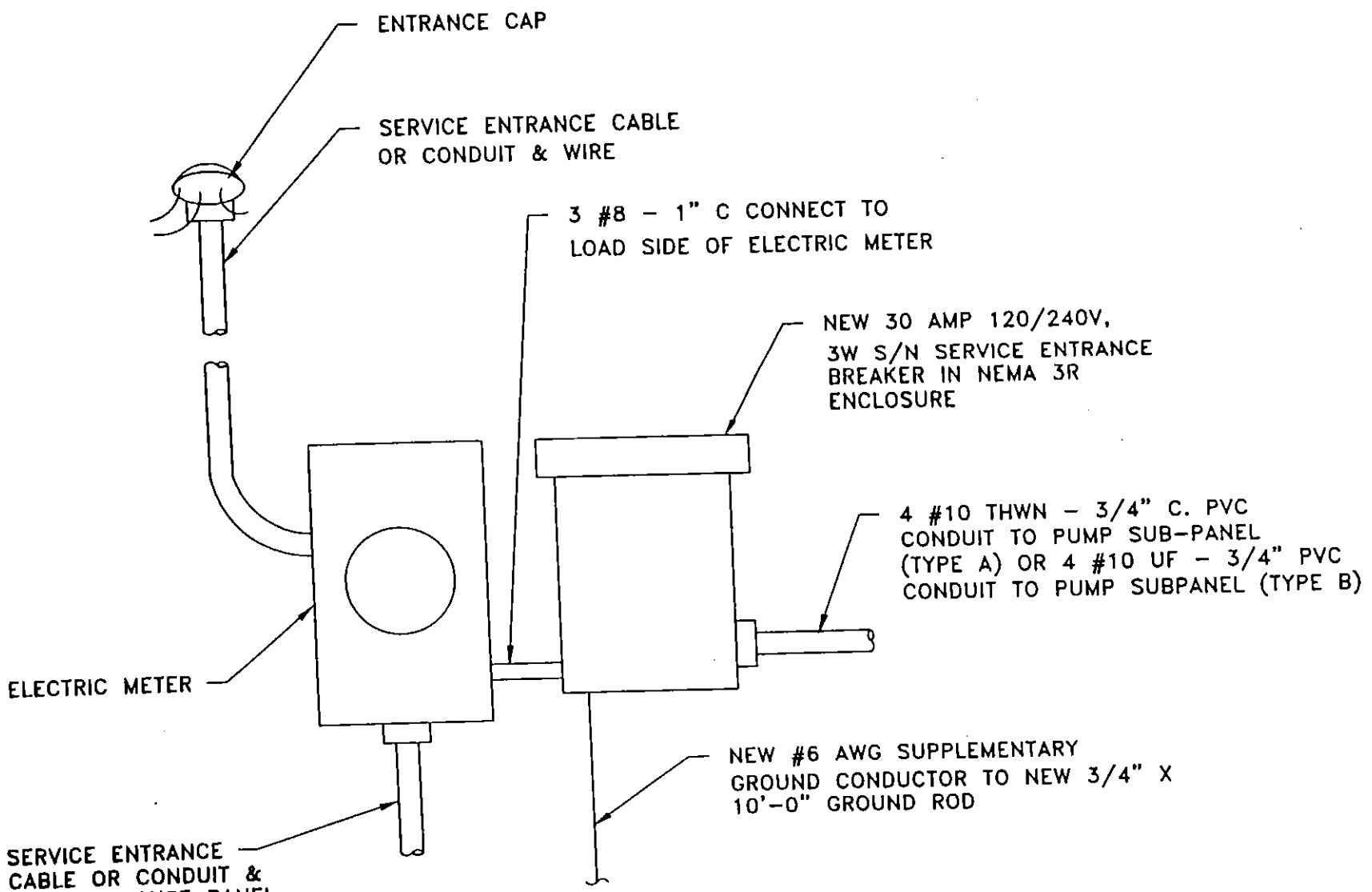
TOWN OF INDIAN HEAD	METHOD OF REPAIRING CRACKED CONCRETE OR VITRIFIED CLAY SEWER PIPE	



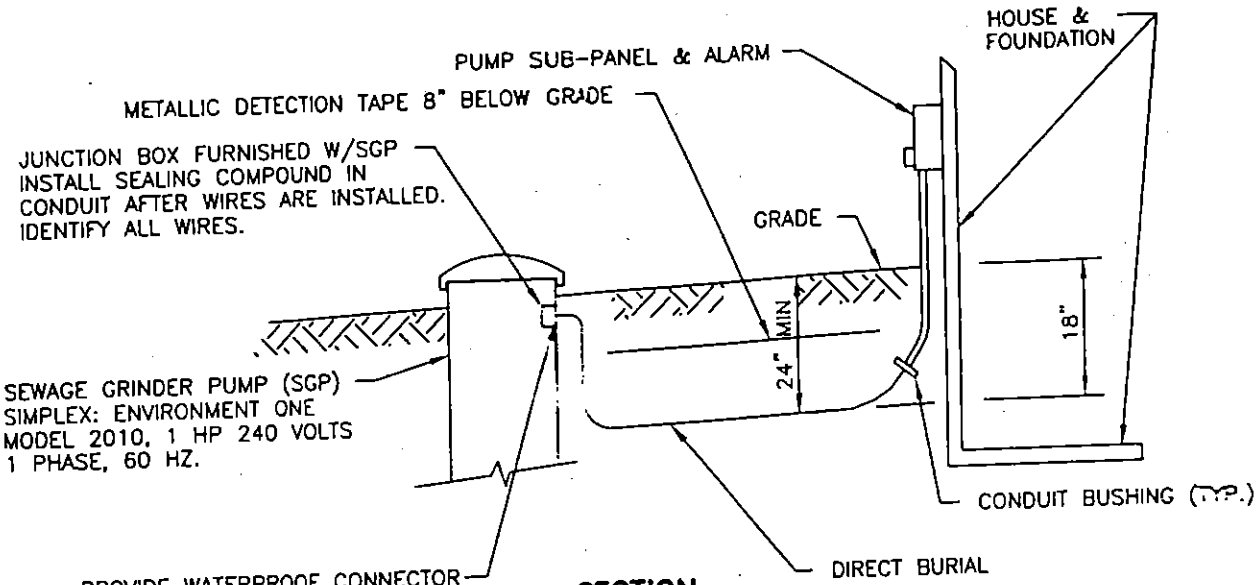
TOWN OF INDIAN HEAD	**SINGLE SEWER HOUSE CONNECTION**	



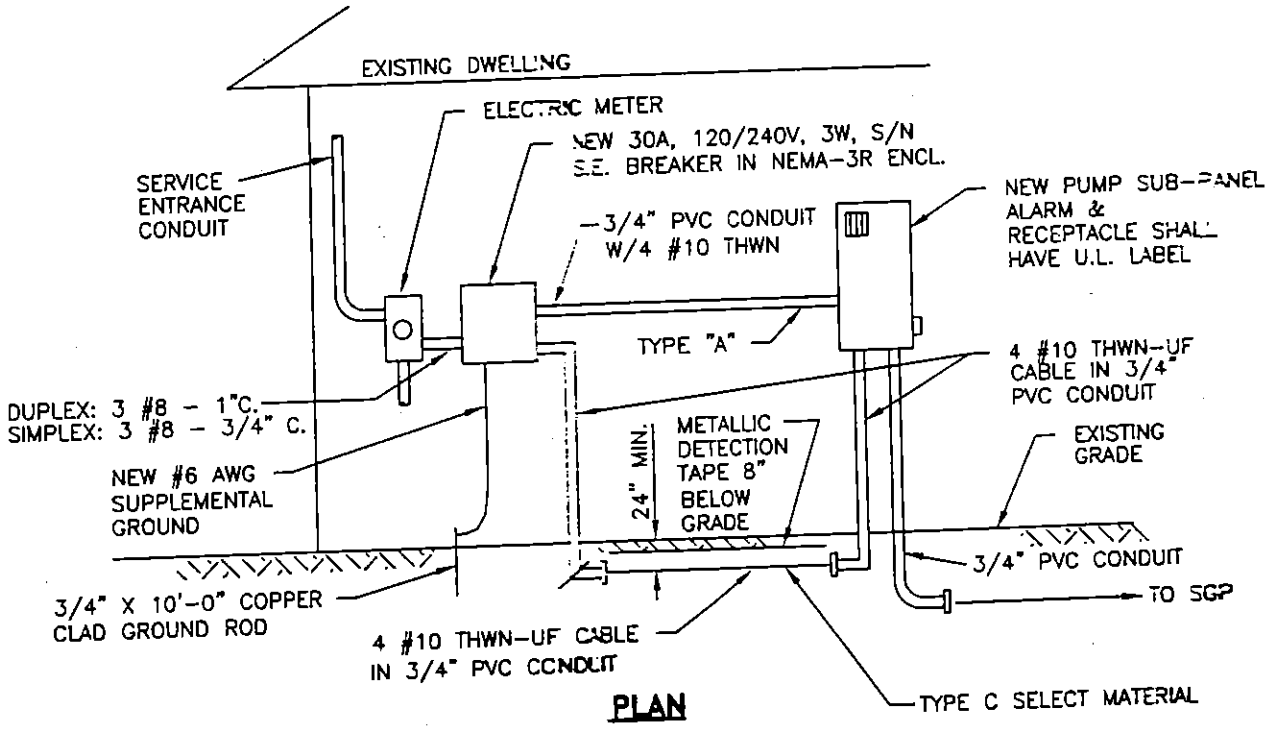
TOWN OF INDIAN HEAD	**TYPICAL SIMPLEX GRINDER PUMP**	



TOWN OF INDIAN HEAD	**SERVICE ENTRANCE ARRANGEMENT**	



SECTION

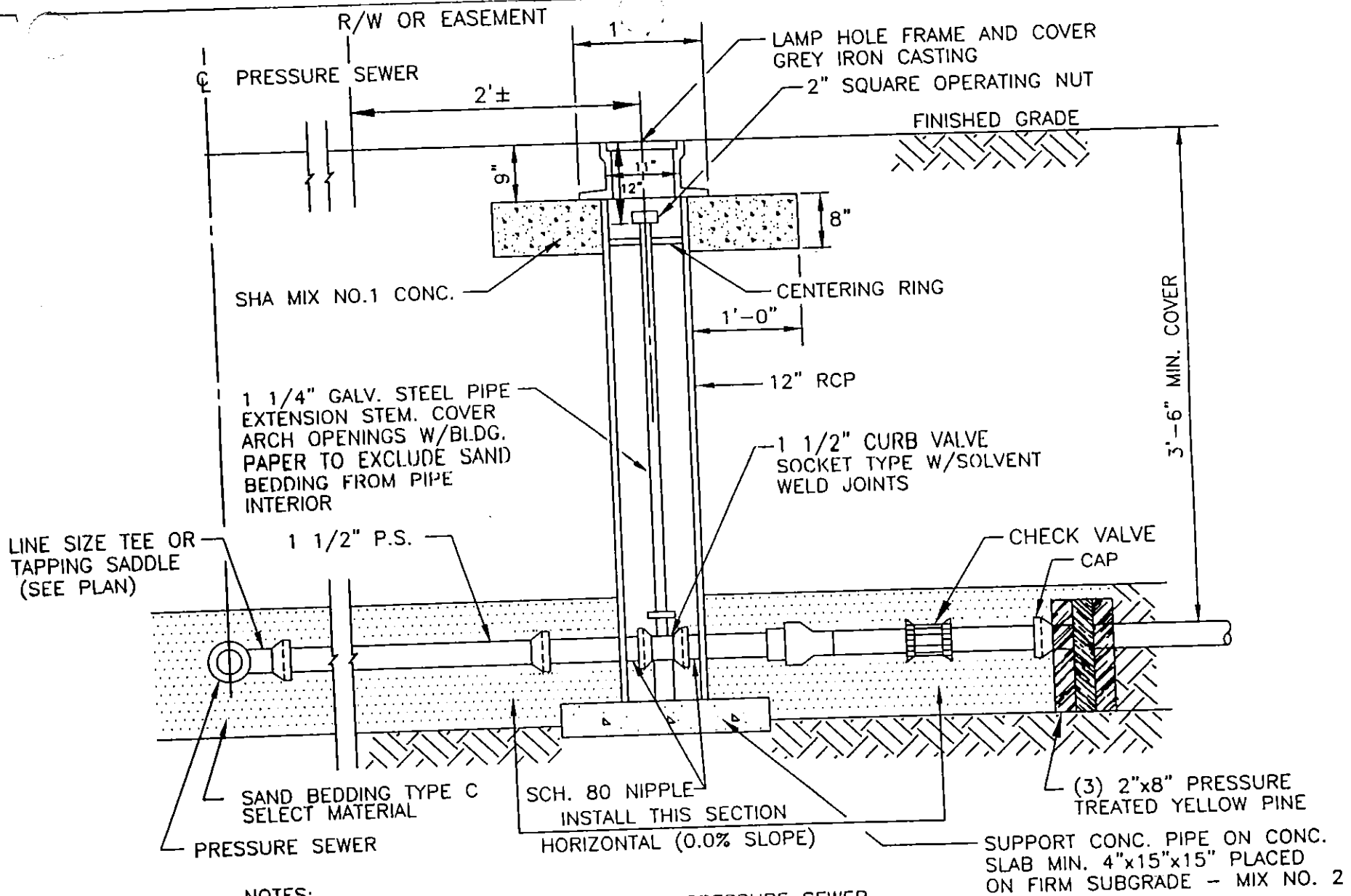


PLAN

NOTES:

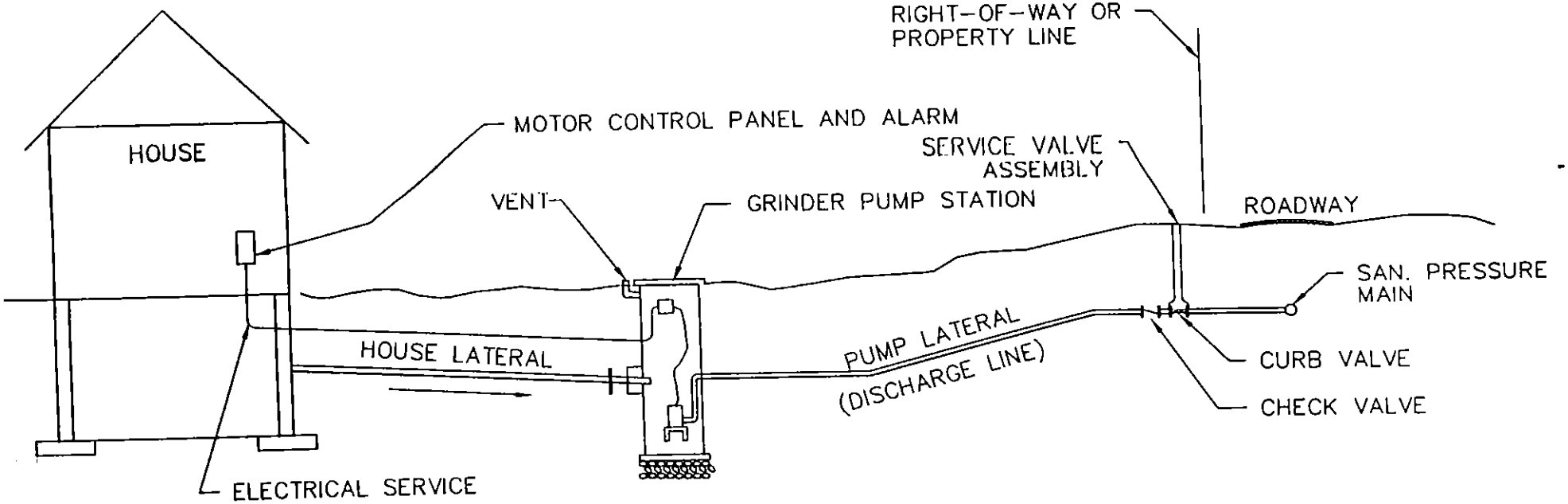
1. USE TYPE "A" CONFIGURATION WHERE PUMP SUB-PANEL IS WITHIN 10 FT. OF SERVICE ENTRANCE.
2. USE TYPE "B" CONFIGURATION WHERE PUMP SUB-PANEL IS MORE THAN 10 FT. AWAY FROM SERVICE ENTRANCE.
3. PUMP SUB-PANEL & ALARM PANEL SHALL BE VISIBLE FROM S.G.P.
4. CONNECTIONS TO ELECTRIC METER SHALL BE COORDINATED WITH SOUTHERN MARYLAND ELECTRIC COOPERATIVE, INC.
5. ALL PVC CONDUIT SHALL TERMINATE 24" BELOW GROUND.
6. EACH GRINDER PUMP SHALL RECIEVE ITS ELECTRICAL SUPPLY FROM THE DWELLING SERVED BY THAT PUMP, AND THE BREAKER AND THE ALARM PANEL SHALL BE ATTACHED TO THE DWELLING SERVED.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ACQUIRING ALL NECESSARY PERMITS FROM ELECTRIC UTILITY.

TOWN OF INDIAN HEAD	TYPICAL ELECTRICAL PANEL ARRANGEMENT	

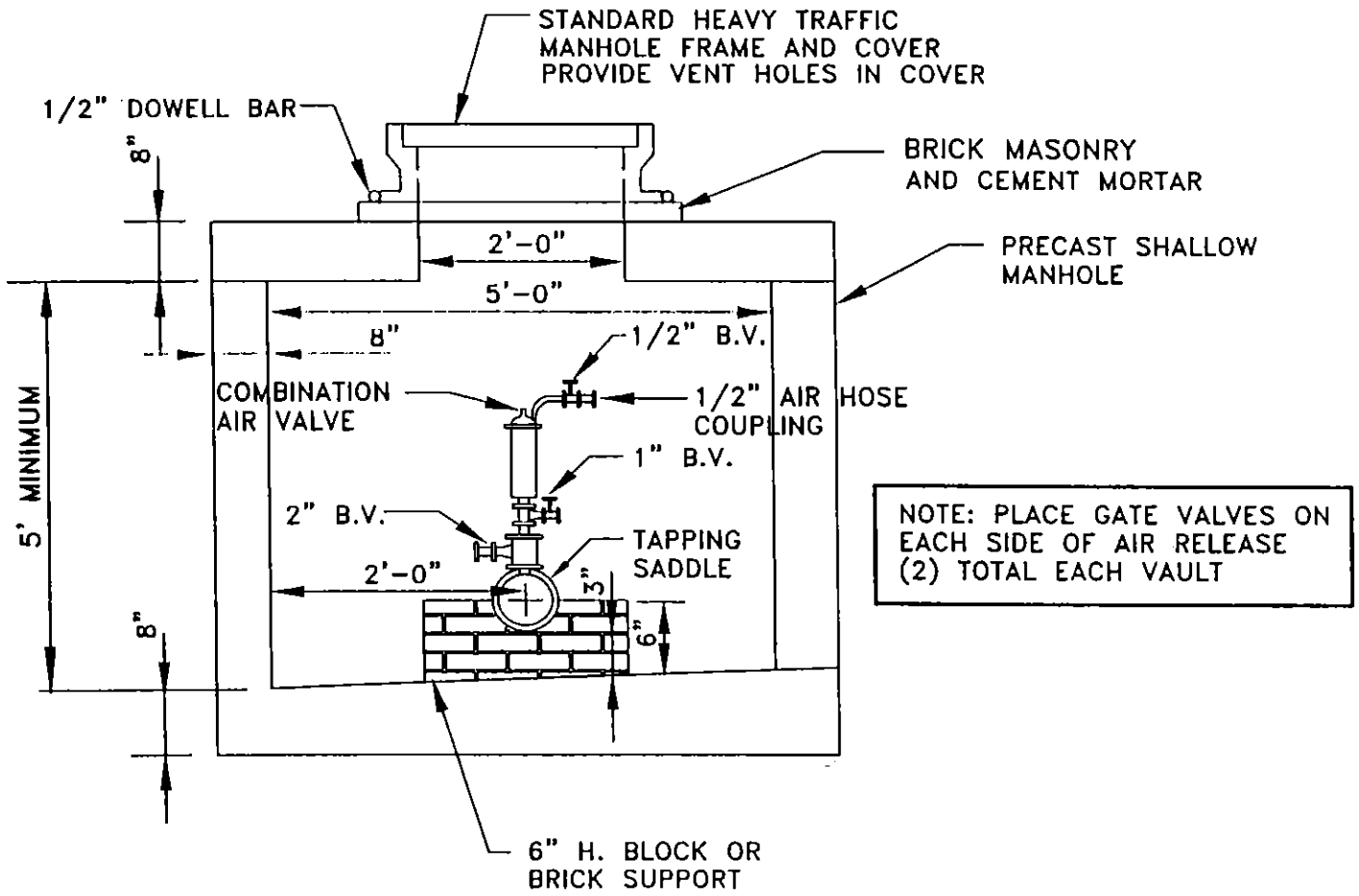


NOTES:
1. MAINTAIN 3'-6" MIN. COVER OVER PRESSURE SEWER.
2. ALL BOARDS TO BE PRESSURE TREATED (CCA) YELLOW PINE AND A NOMINAL THICKNESS OF 2"

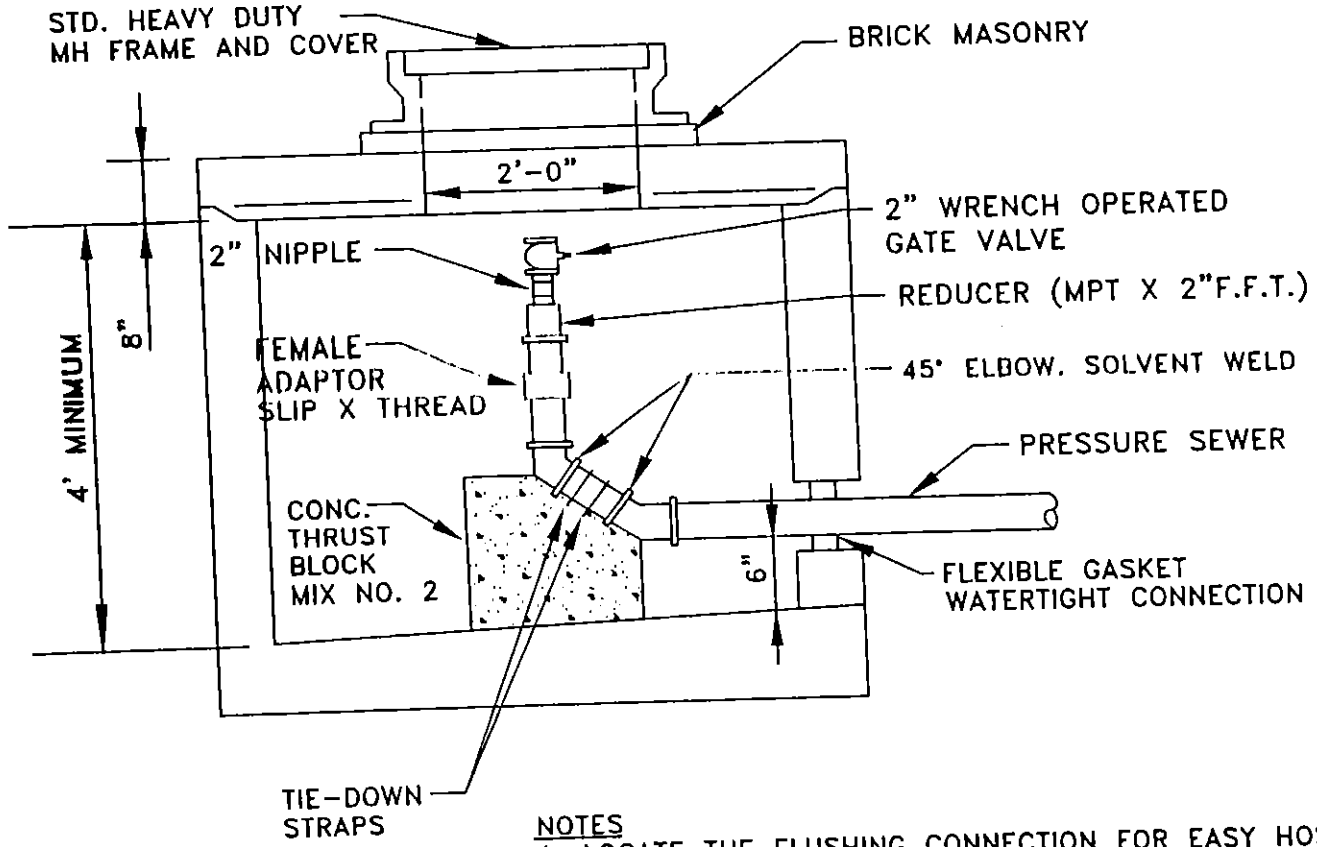
TOWN OF INDIAN HEAD	SEWER SERVICE VALVE ASSEMBLY	



TOWN OF INDIAN HEAD	TYPICAL HOUSE CONNECTION	



TOWN OF INDIAN HEAD	COMBINATION AIR VALVE VAULT	



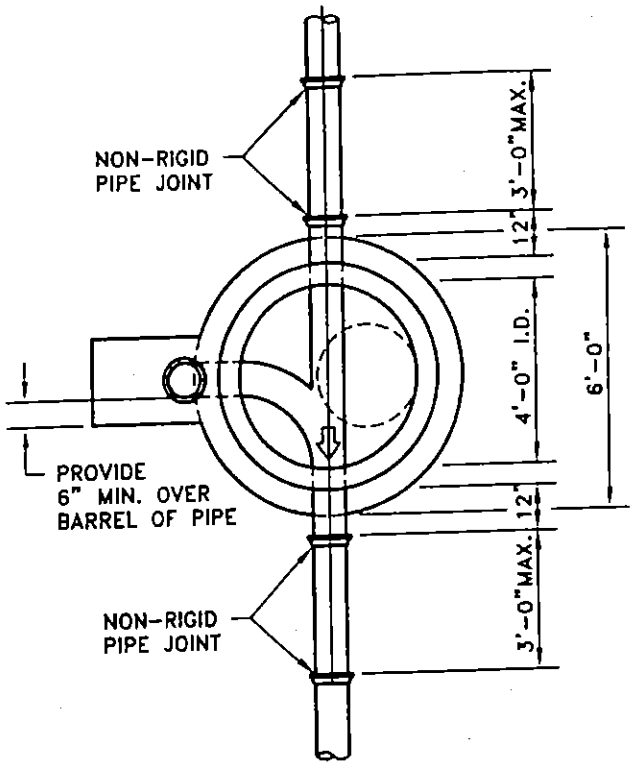
NOTES

1. LOCATE THE FLUSHING CONNECTION FOR EASY HOSE ATTACHMENT BUT NOT BLOCK ACCESS VIA LADDER.
2. APPLY TWO COATS OF A BITUMASTIC COMPOUND OVER PARGING.

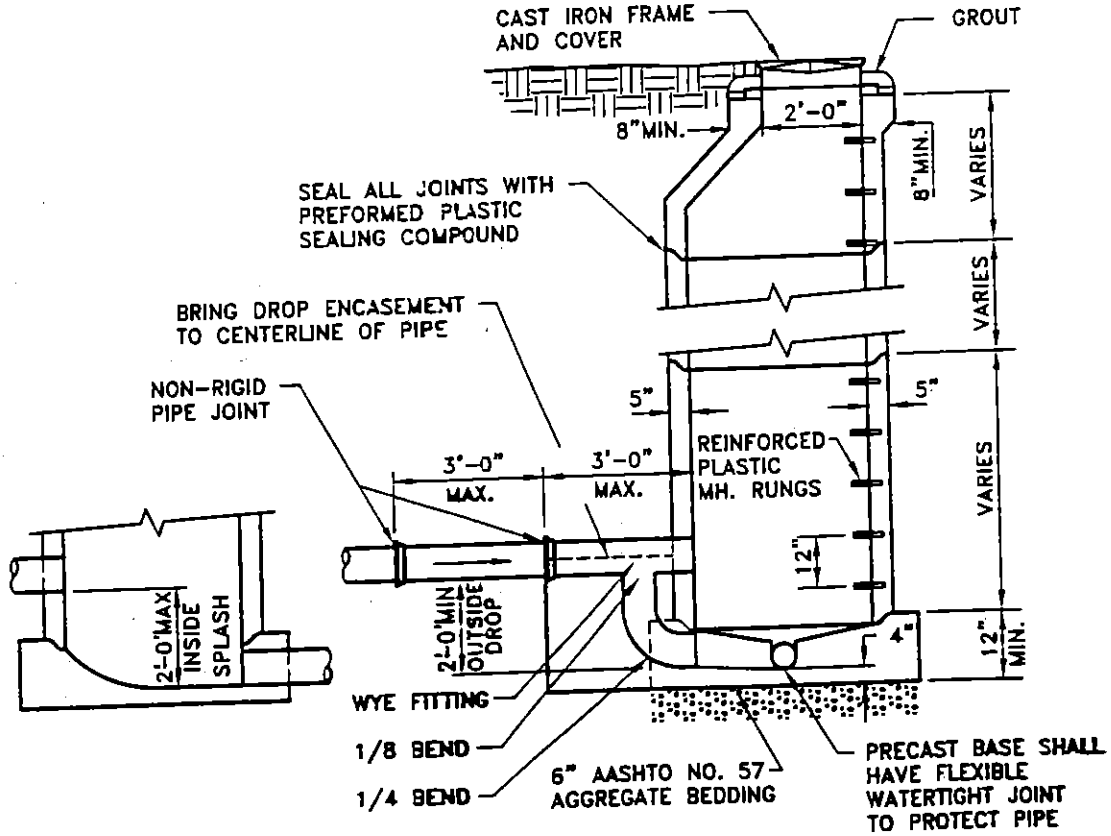
TOWN OF INDIAN HEAD	**TERMINAL FLUSHING CONNECTION**	

NOTES:

1. ADJUST TO GRADE WITH CONCRETE GRADING RINGS
2. MECHANICALLY VIBRATED PRECAST CONCRETE, RISER AND TOP SHALL CONFORM TO A.S.T.M. SPEC. C-478
3. BASE SHALL EXTEND ABOVE PIPE AND BE PROVIDED WITH A KEY TO RECEIVE BOTTOM SECTION OF MANHOLE.
4. IF INSIDE SPLASH EXCEEDS 2'-0" PROVIDE OUTSIDE DROP.
5. FOR MANHOLES WHERE T/RIM TO INVERT IS LESS THAN 5'-0", USE FLAT TOP MANHOLE IN LIEU OF CONE TOP.
6. CONNECTION BETWEEN WALL AND SEWER PIPE TO BE FLEXIBLE GASKET

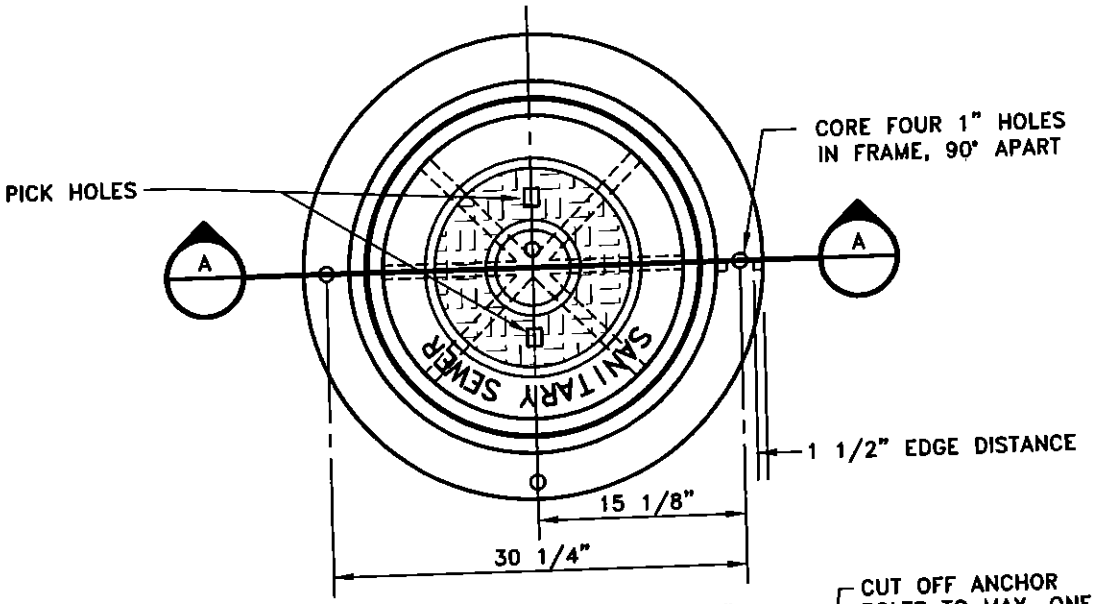


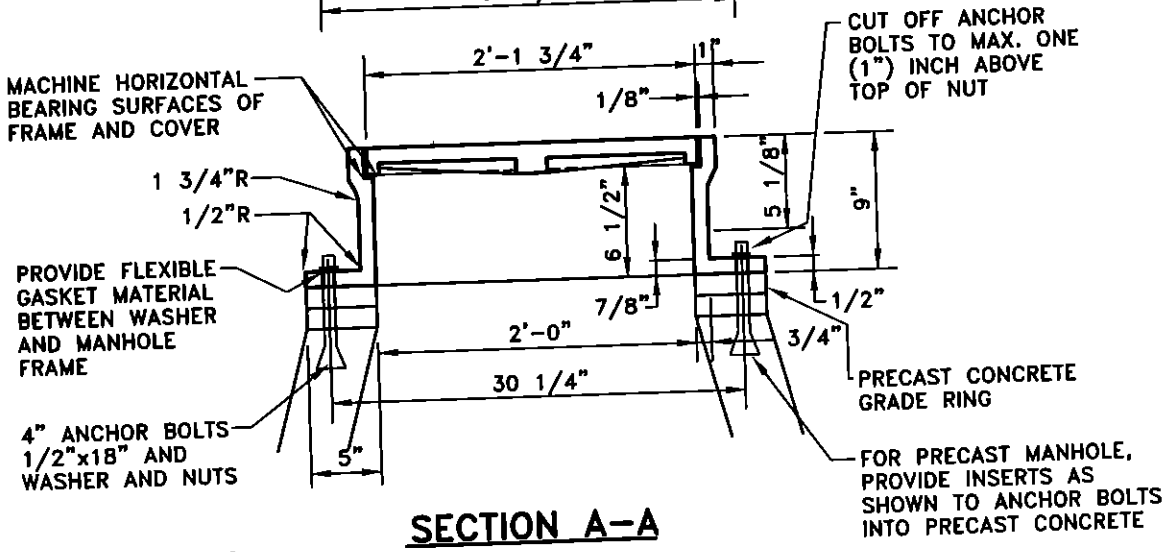
PLAN



SECTION

TOWN OF INDIAN HEAD	PRECAST CONCRETE MANHOLE	



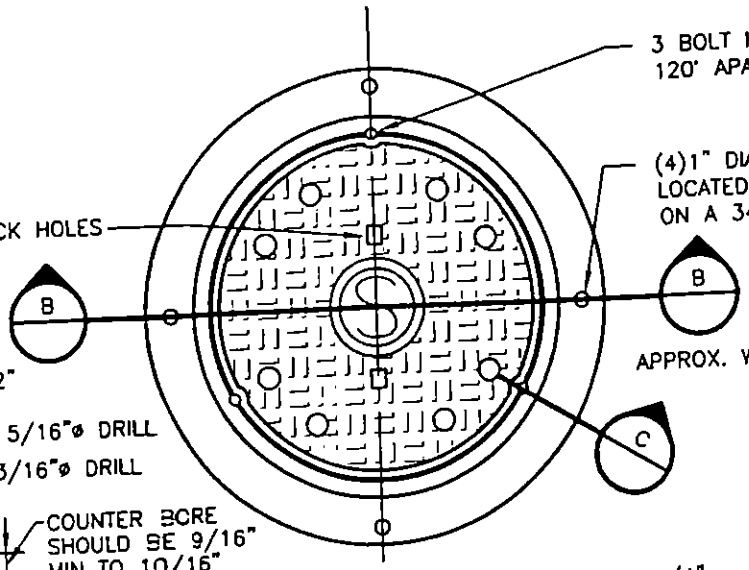


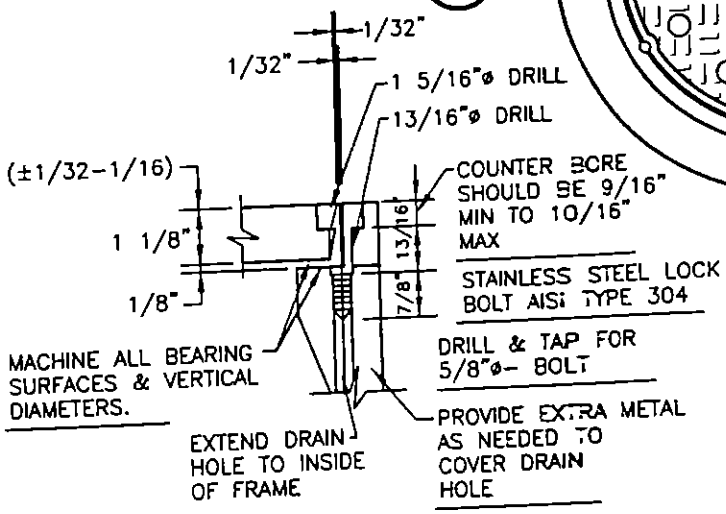
SECTION A–A

NOTE:

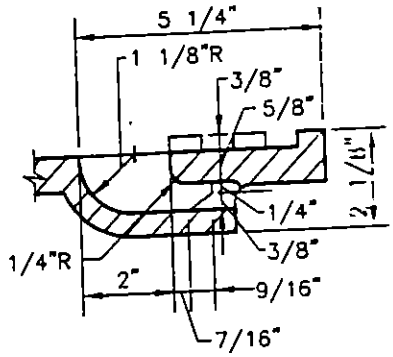
1. ANCHOR BOLTS SHALL ONLY BE USED IN OFF ROAD LOCATIONS. IN ROADWAYS A CONCRETE COLLAR SHALL BE USED.
2. PATTERN TO BE MADE OF CORE TYPE. PROVIDE RAPPING PLATES ON PATTERN.
3. AVERAGE WEIGHT OF FRAME– 280 LBS
   AVERAGE WEIGHT OF COVER– 150 LBS
   AVERAGE TOTAL WEIGHT– 430 LBS
4. MATERIAL– CAST IRON, ASTM A–48, CLASS 35
5. COMPONENT PARTS OF ASSEMBLY SHALL BE INTERCHANGEABLE.

TOWN OF INDIAN HEAD	HEAVY DUTY TRAFFIC MANHOLE FRAME & COVER	



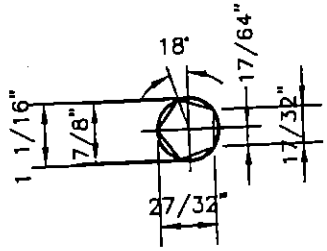


SECTION C–C



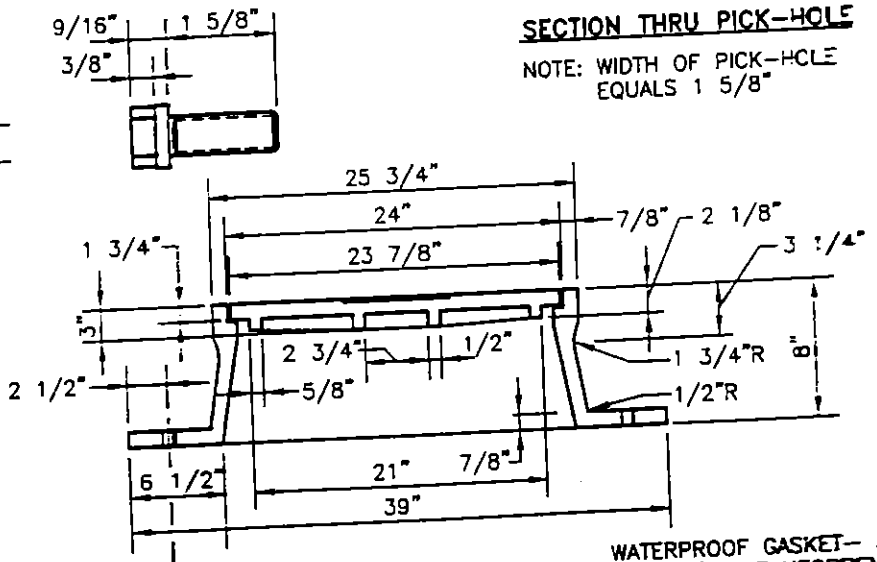
SECTION THRU PICK–HOLE

NOTE: WIDTH OF PICK–HOLE
EQUALS 1 5/8"



LOCK BOLT

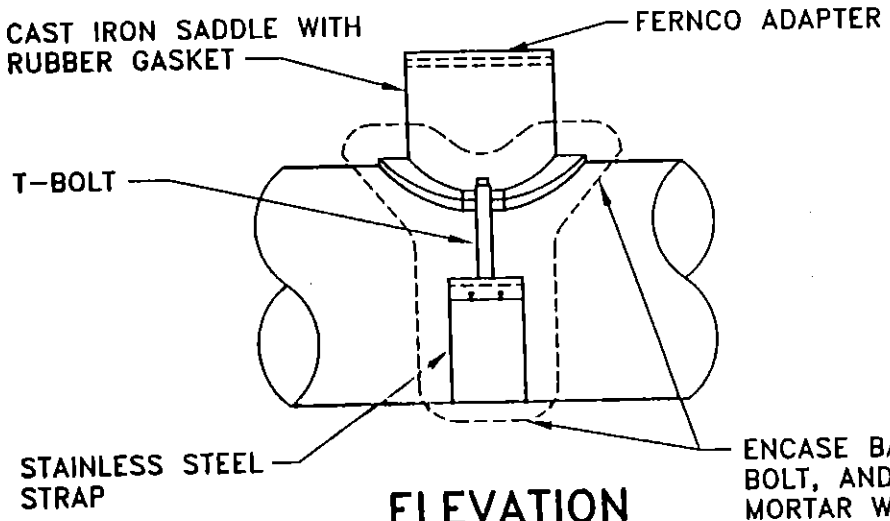
PROVIDE THREE (3)
PENTAGON HEAD,
SHOULDERED STAINLESS
STEEL LOCK BOLT FOR
EACH ASSEMBLY, PER
DETAIL ABOVE.
MATERIAL: AISI TYPE 304 S.S.



SECTION B–B

WATERPROOF GASKET– 3/16" THICK
BY 3/4" WIDE NEOPRENE. CEMENTED
TO BEARING SURFACE OF FRAME WITH
3M SUPER WEATHER STRIP ADHESIVE
PART 8001.

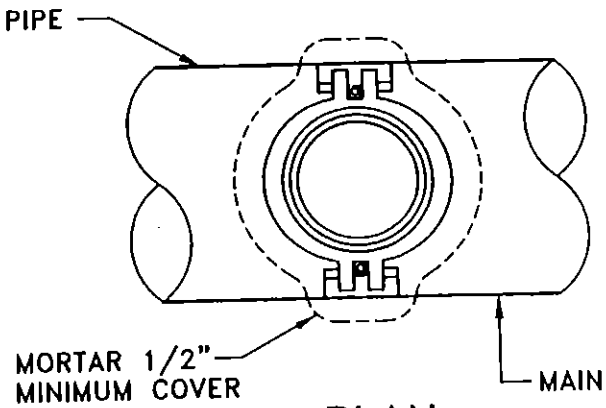
TOWN OF INDIAN HEAD	STANDARD WATERTIGHT MANHOLE FRAME AND COVER	



ELEVATION

WHEN CONNECTING TO CONCRETE SEWERS THE FOLLOWING LISTED SADDLE SIZES SHALL BE USED:

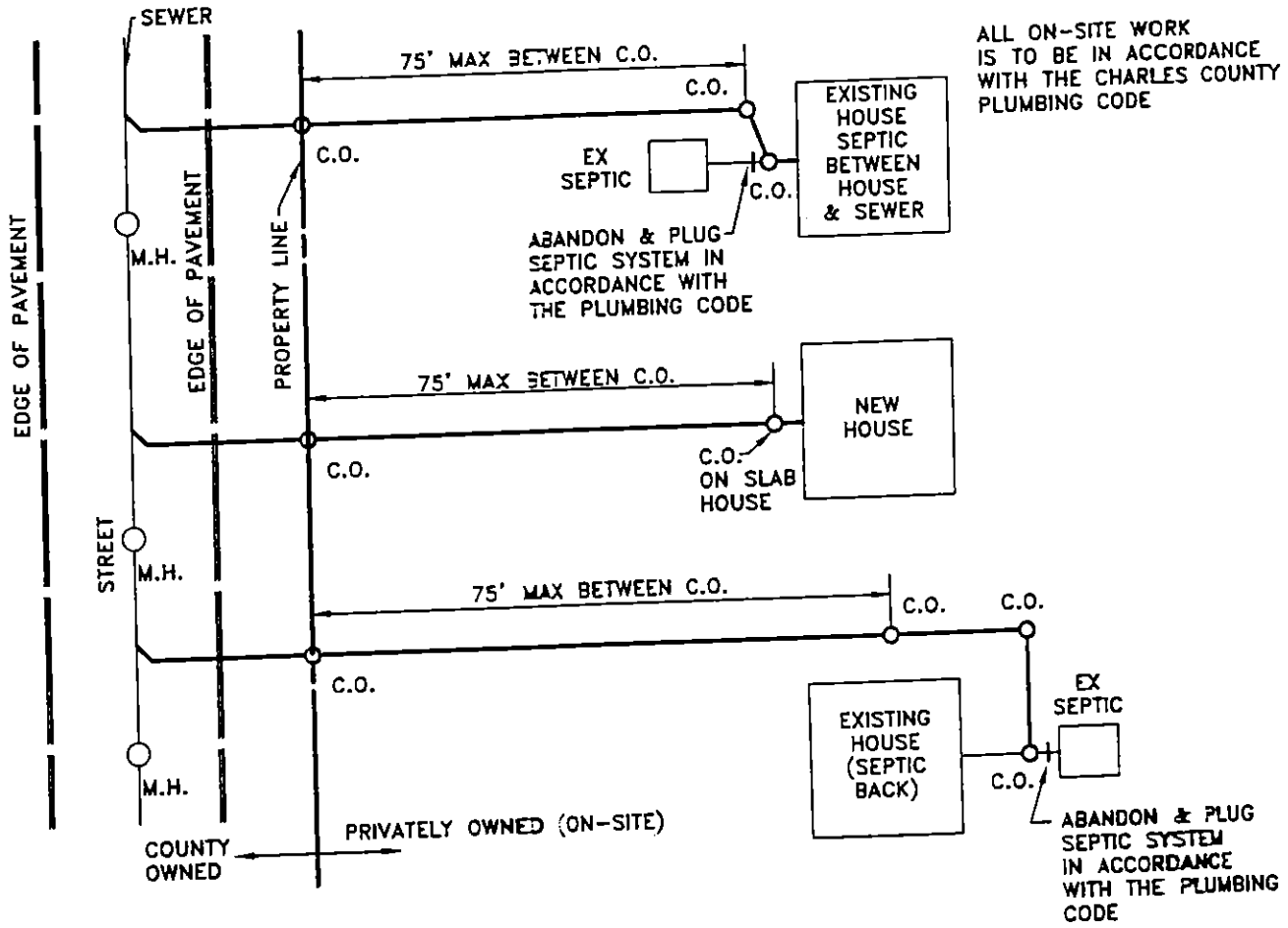
CONCRETE SEWER PIPE	SADDLE SIZE
6"	4"x8"
8"	6" OR 4"x10"
10"	6" OR 4"x12"



PLAN

JOINT BETWEEN SADDLE AND HOUSE CONNECTION PIPE TO BE FERNCO COMPRESSION GASKET. OPENING IN SEWER PIPE WALL TO BE MECHANICALLY CORED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATION.

TOWN OF INDIAN HEAD	SADDLE INSTALLATION – MAINLINE TO HOUSE CONN.	



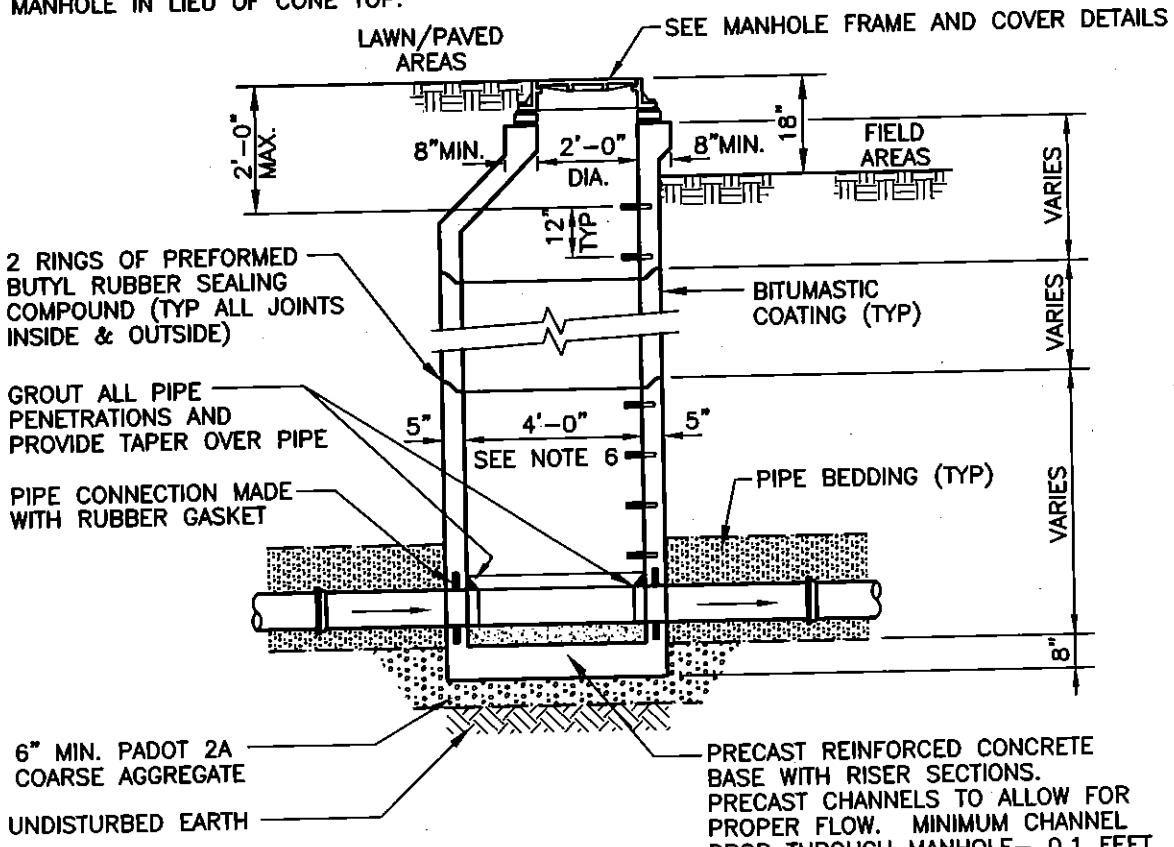
NOTE:

ALL ON-SITE WORK IS TO BE IN ACCORDANCE WITH THE CHARLES COUNTY PLUMBING CODE

TOWN OF INDIAN HEAD	BUILDING SEWER LAYOUT	

NOTES:

1. ADJUST TO GRADE WITH CONC GRADE RINGS (MAX. VERT. ADJUST. 6") SEE FRAME & COVER DETAILS
2. MECHANICALLY VIBRATED PRECAST CONC SHALL CONFORM TO A.S.T.M. SPEC. C-478.
3. IF INCOMING INVERT EXCEEDS OUTGOING INVERT BY GREATER THAN OR EQUAL TO 6", SEE INSIDE SPLASH/ INSIDE DROP MANHOLE DETAILS.
4. FOR MANHOLES WHERE TOP OF RIM TO INVERT DISTANCE IS LESS THAN 5'-0", USE FLAT TOP MANHOLE IN LIEU OF CONE TOP.
5. FILL ALL LIFTING HOLES WITH NON-SHRINK GROUT.
6. LARGER DIA MANHOLE REQUIRED ON INSIDE DROP AND INSIDE SPLASH CONNECTION GREATER THAN 12".

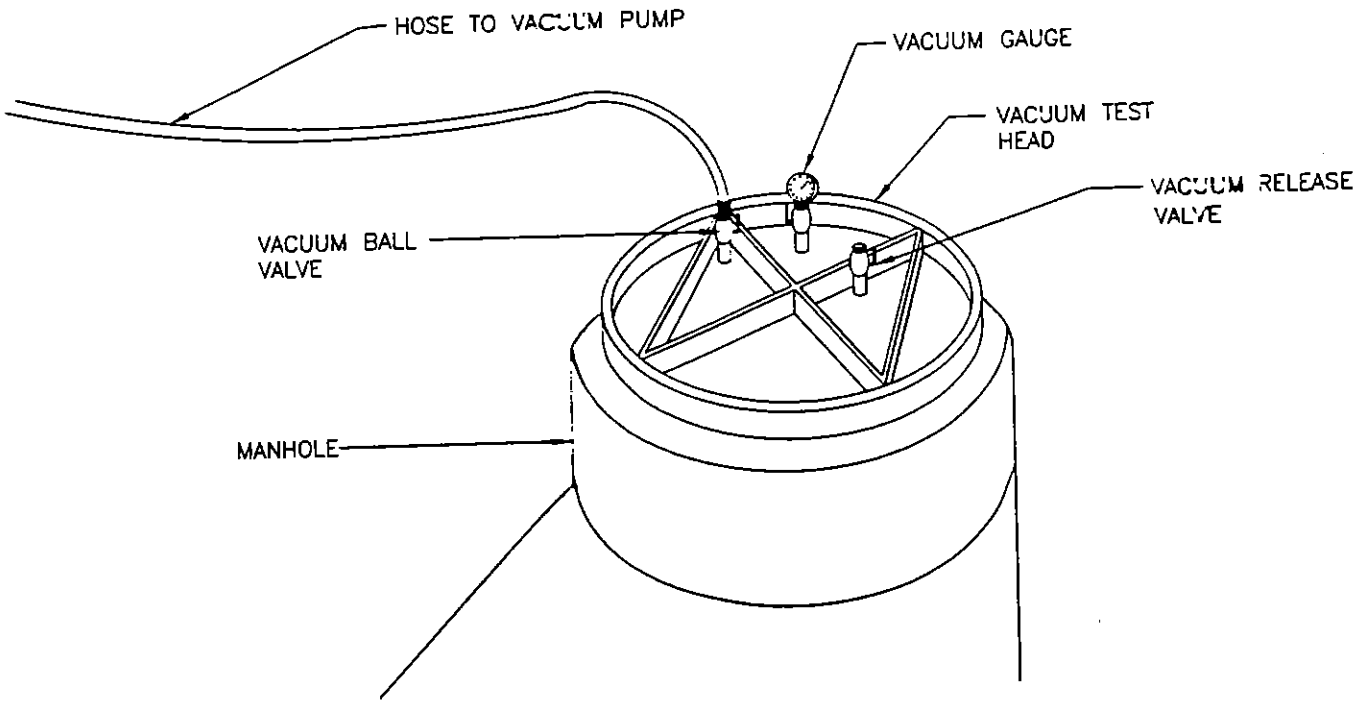


SECTION

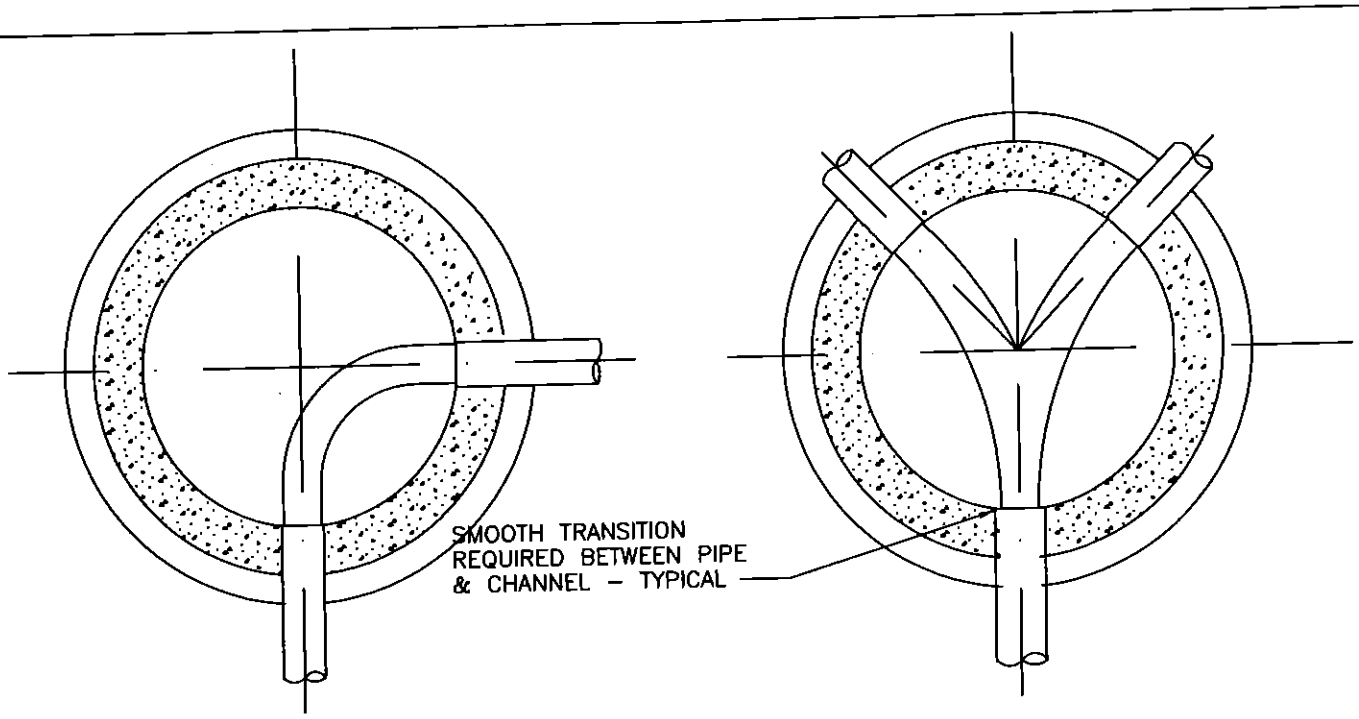
TOWN OF INDIAN HEAD	PRECAST MANHOLE DETAIL 8" THRU 24" SEWERS	

NOTES:

1. PLUG ALL CHANNEL INLETS AND OUTLETS IN THE MANHOLE BASE AND BRACE EACH PLUG.
2. PLACE THE VACUUM TEST HEAD ON THE TOP SURFACE OF THE MANHOLE (CONE OR CAST IRON CASTING–USE APPROPRIATE TEST HEAD FOR APPLICATION). MAKE SURE THE BALL VALVE ON THE TEST HEAD IS CLOSED.
3. START THE VACUUM PUMP.
4. OPEN THE BALL VALVE INITIATING THE VACUUM IN THE MANHOLE. THE HIGH VOLUME VACUUM PUMP WILL SEAL THE TEST HEAD TO THE MANHOLE UNDER TEST.
5. WHEN THE VACUUM REACHES 10" Hg SHUT OFF THE VACUUM BALL VALVE THUS ISOLATING THE VACUUM INSIDE THE MANHOLE. A PRESSURE RELIEF VALVE SHOULD BE PRESENT ON THE EQUIPMENT WHICH WILL ALLOW THE VACUUM PUMP TO IDLE DURING THE TEST WITHOUT CAUSING ANY DAMAGE.
6. MEASURE THE TIME WHICH THE VACUUM IN THE MANHOLE UNDER TEST FALLS TO 9" hG.
7. RECORD THE TIME.
8. RELEASE THE VACUUM IN THE MANHOLE BY OPENING THE VACUUM RELEASE VALVE ON THE TEST HEAD.
9. REFER TO CHARLES COUNTY SEWER SPECIFICATIONS FOR SPECIFIC TESTING CRITERIA.

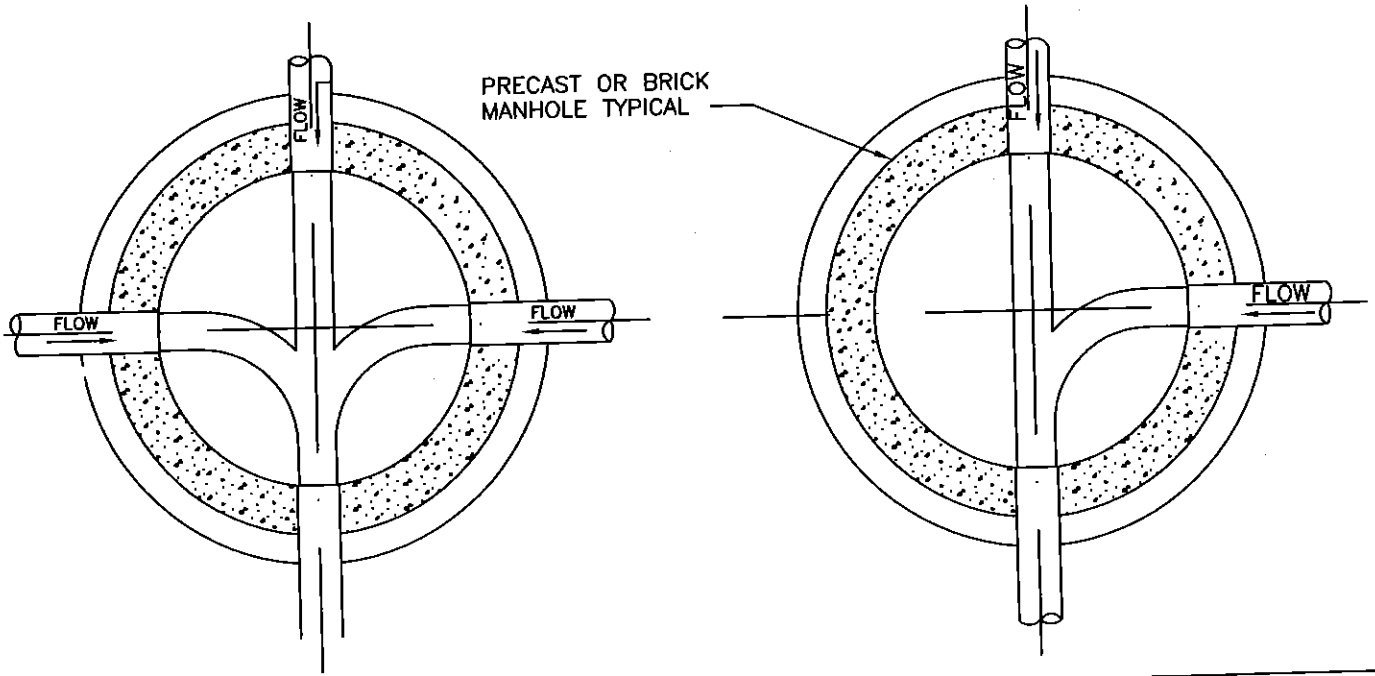


TOWN OF INDIAN HEAD	MANHOLE VACUUM TESTING	



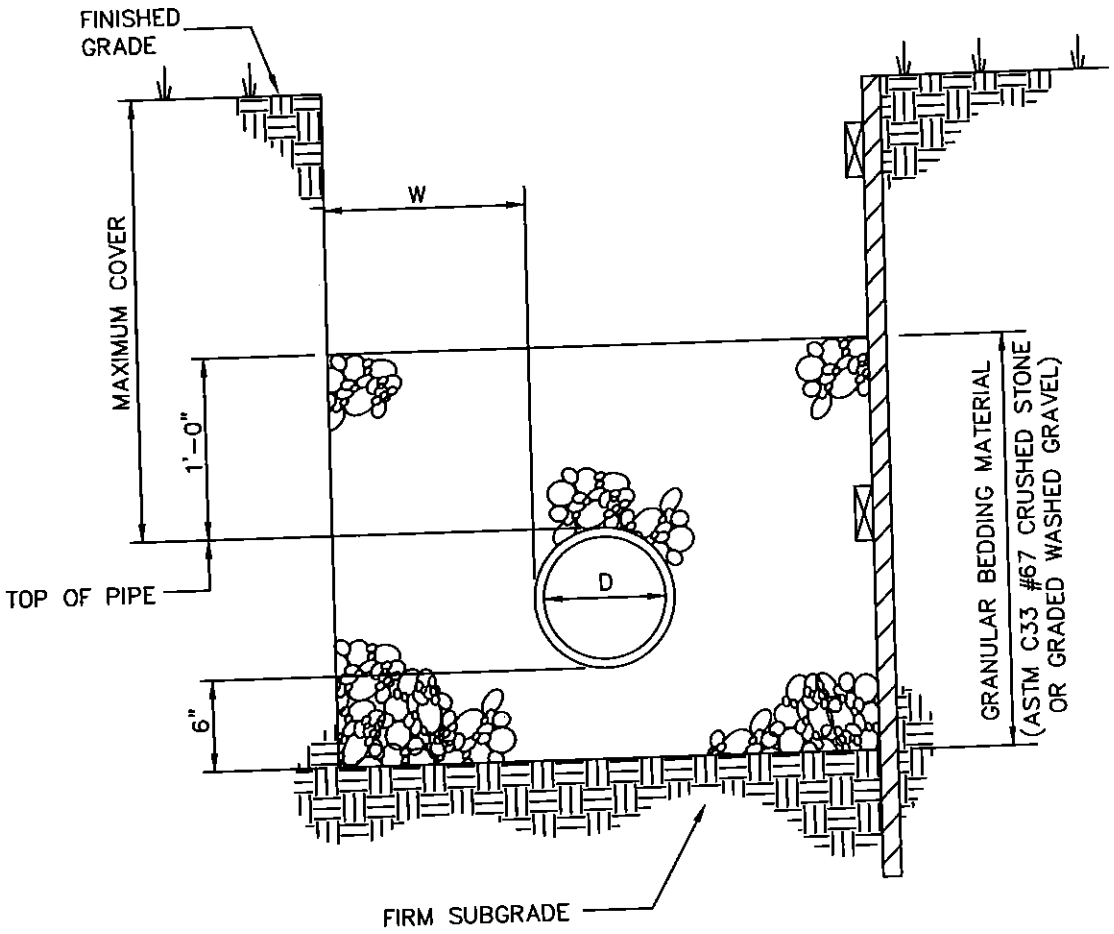
CHANNEL LINING NOTES:

1. CHANNEL LINING SHALL BE EITHER BRICK OR CONCRETE, MINIMUM 4" THICK.
2. WIDTH OF CHANNEL SHALL MATCH INSIDE DIAMETER OF INCOMING AND OUTGOING PIPES. BLEND CHANNEL LINING FOR SMOOTH CONTOUR BETWEEN PIPES.
3. CONCRETE CHANNELS SHALL BE FORMED AS SHOWN. F'c FOR CAST–IN–PLACE CHANNELS AND BENCHES SHALL BE 3000 PSI @ 28 DAYS. FOR PRECAST CHANNELS AND BENCHES, F'c x 4000 PSI MINIMUM.
4. BRICK CHANNELS SHALL BE FORMED AS SHOWN.
5. ALL INVERT ELEVATIONS SHALL BE SHOWN ON THE CONTRACTORS DRAWINGS.
6. EACH CHANNEL SHALL MAINTAIN A SLOPE OF TWO PERCENT THROUGH THE MANHOLE
7. SHC'S SHALL NOT ENTER A MANHOLE AT AN ANGLE LESS THAN 90° TO THE EFFLUENT PIPE.



TOWN OF INDIAN HEAD	PLAN OF TYPICAL CHANNELIZATION OF MAINLINE SEWER MANHOLES	

D	W
8"	10"
10"	9"
12-21"	8"

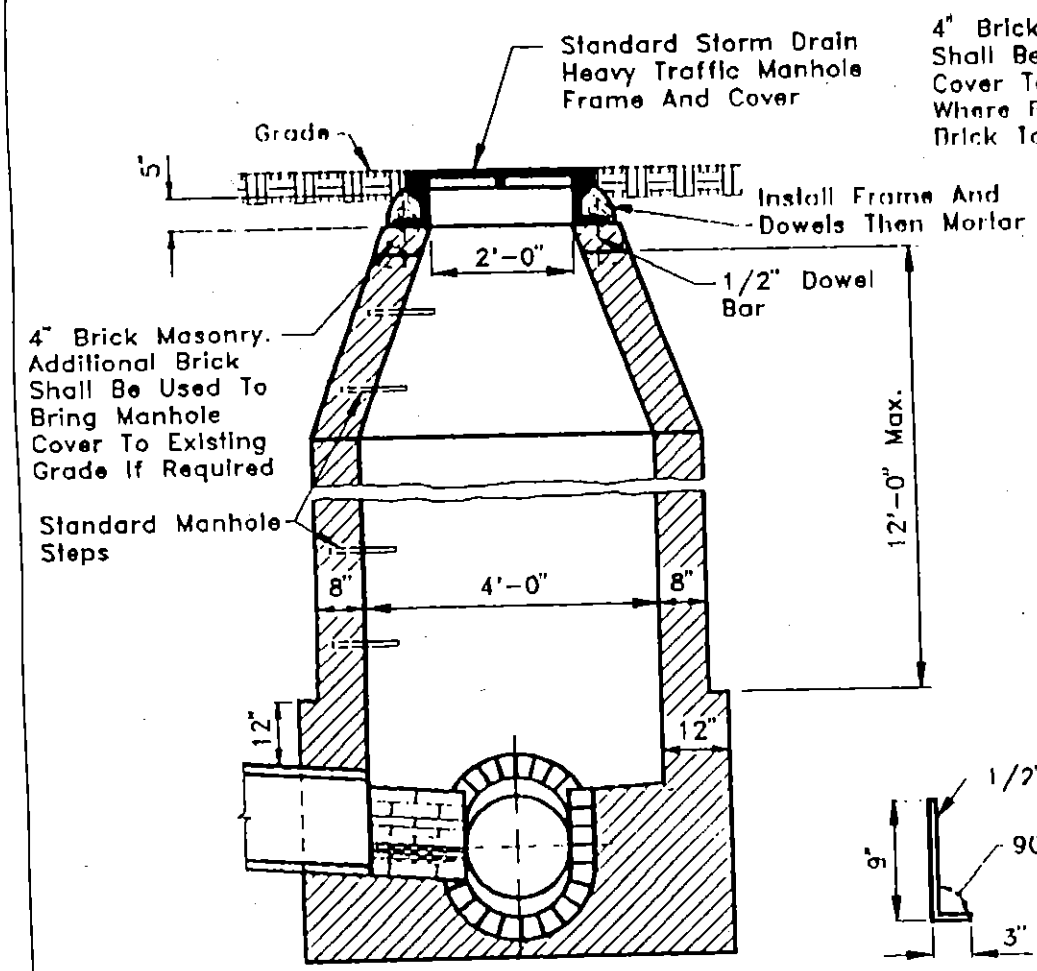


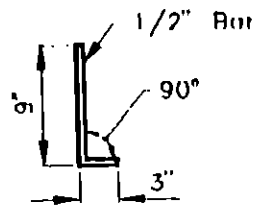
NOTES:

1. WHERE TRENCH WALLS BELOW TOP OF PIPE ARE UNSTABLE AND REQUIRE SUPPORT TO MAINTAIN TRENCH DIMENSION, THE SUPPORT SHALL BE LEFT IN PLACE.
2. MAXIMUM COVER = 15'-0".
3. DETAIL APPLIES TO PVC PIPE.
4. IF SUBGRADE IS NOT STABLE, UTILIZE ASTM C33 #2 OR #3 CRUSHED STONE STABILIZE AND TRANSMIT GROUNDWATER. ORIGINAL BEDDING DETAIL TO BE UTILIZED OVER THE SUBGRADE STONE STABILIZATION.

TOWN OF INDIAN HEAD	BEDDING, EMBEDMENT AND MAXIMUM COVER PVC PIPE	

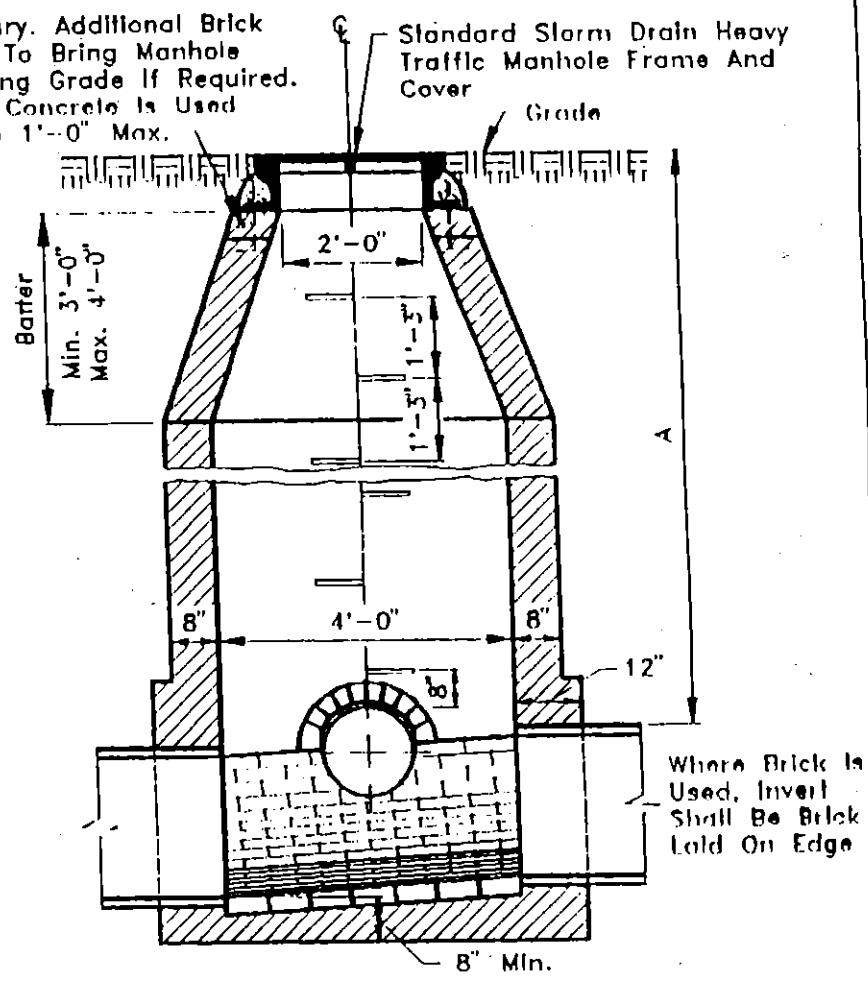
STORM DRAIN





DOWEL

4" Brick Masonry. Additional Brick Shall Be Used To Bring Manhole Cover To Existing Grade If Required. Where Precast Concrete Is Used Brick To Grade 1'-0" Max.

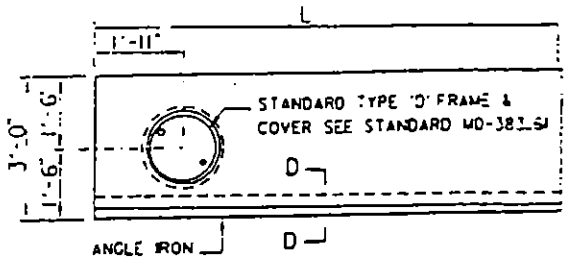


NOTES:

If Precast Concrete Is Used In Lieu Of Brick Any Connections To Storm Drain Manholes With Plastic Pipe Requires A-Lok Gaskets Or Approved Equal.

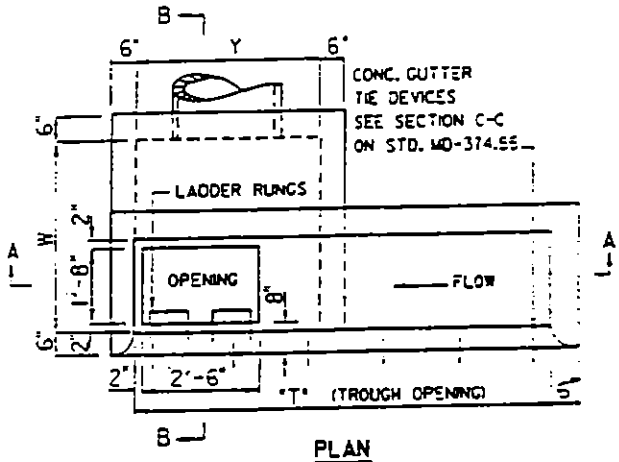
Where "A" (Cover) Is Less Than 4'-0" Use Shallow Manhole (For Pipes 36" And Smaller).

TOWN OF INDIAN HEAD	**TYPE A-1 MANHOLE (FOR NORMAL DEPTHS)**	



PRECAST CONCRETE TROUGH SLAB

(6" THICK)

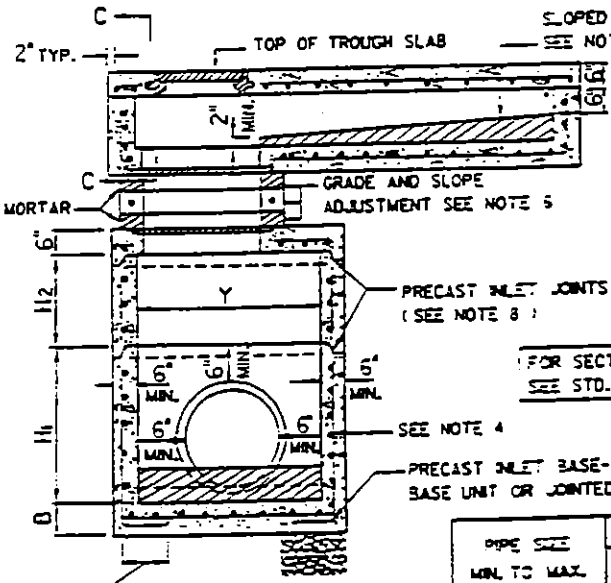


PLAN

(SHOWN WITHOUT TROUGH SLAB)

NOTES:

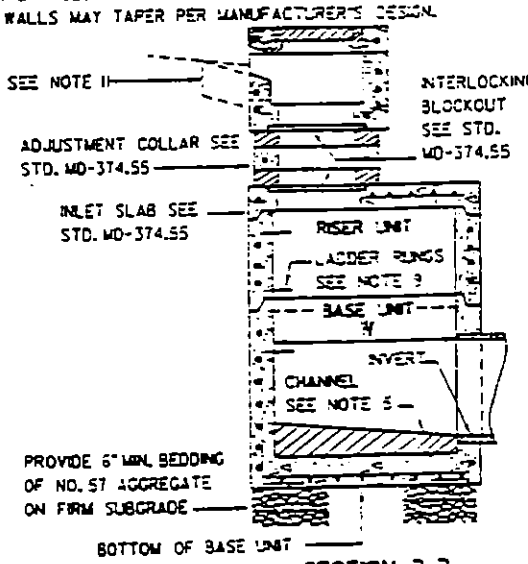
1. THIS STANDARD TO BE USED WITH TYPE A COMBINATION CURB AND GUTTER ONLY.
2. CURB OPENINGS SHALL NOT ENCROACH ON CROSSWALK AREAS.
3. CONCRETE SHALL BE MIX NO. 6 (4500 PSI) FOR PRECAST UNITS AND MIX NO. 3 (3500 PSI) FOR STRUCTURES CAST IN PLACE.
4. INLET MAY BE PRECAST OR CAST IN PLACE. REINFORCEMENT SHALL BE NO. 4 BARS PLACED IN THE CENTER OF INLET WALLS AT 6" O/C 2 WAYS OR 2 LAYERS OF 4x4-W4.0xW4.0 WELDED WIRE FABRIC WITH 1" COVER.
5. A CONCRETE OR BRICK CHANNEL WHICH SLOPES AT LEAST 2 IN. TOWARD THE OUTLET SHALL BE PROVIDED IN THE FIELD.
6. GRADE AND SLOPE ADJUSTMENTS SHALL BE COMPLETED IN THE FIELD USING PRECAST ADJUSTMENT COLLAR AND MORTAR.
7. SLOPED TROUGH FLOOR TO BE CAST IN THE FIELD AND USED ONLY WHEN PIPE GRADE IS 1.5% OR LESS. WHEN SLOPED TROUGH FLOOR IS USED, PROVIDE PRECAST TROUGH FLOOR.
8. PRECAST INLET JOINTS-THE MANUFACTURER SHALL FORM MALE AND FEMALE ENDS OF JOINTS USING THEIR OWN DESIGN. THE JOINTS SHALL BE SEALED BY THE CONTRACTOR AND MADE WATERTIGHT USING THE MANUFACTURER'S APPROVED ASTM OR AASHTO APPROVED SEALENT.
9. LADDER RUNGS SHALL BE PLACED IN VERTICAL ALIGNMENT AT [illegible] TYPE SHALL BE IN ACCORDANCE WITH STANDARDS MD-383.54 OR MD-[illegible] ARE INCIDENTAL TO THE COST OF THE INLET.
10. ANGLE IRON AND SHEAR STUD CONNECTORS SHALL BE GALVANIZED AFTER WELDING IN ACCORDANCE WITH ASTM A 123. SEE STDS. MD-374.55 & MD-374.64.
11. SEE STANDARD MD-374.65 FOR DEPRESSED GUTTER PAN.
12. SEE STD. MD-374.64 FOR ALTERNATE PRECAST COG TROUGHS.
13. PAY MEASUREMENTS FOR CAST IN PLACE UNIT SHALL BE THE SAME AS THE PRECAST UNIT. REFER TO NOTE 14. ALL OTHER DIMENSIONS SHOWN FOR PRECAST SHALL APPLY TO CAST IN PLACE.
14. MINIMUM DEPTH PAYMENT PER EACH SHALL BE 6'-2" MEASURED FROM THE BOTTOM OF THE BASE UNIT TO THE TOP OF THE TROUGH SLAB. VERTICAL DEPTH PAYMENT PER LINEAR FOOT SHALL INCLUDE ALL DEPTHS IN EXCESS OF 6'-2" INCLUDING ALL APPURTENANCES.
15. PRECAST BASE UNIT WALLS MAY TAPER PER MANUFACTURER'S DESIGN.



SECTION A-A

(SHOWN AS PRECAST)

FOR SECTIONS C-C AND D-D SEE STD. MD-374.55



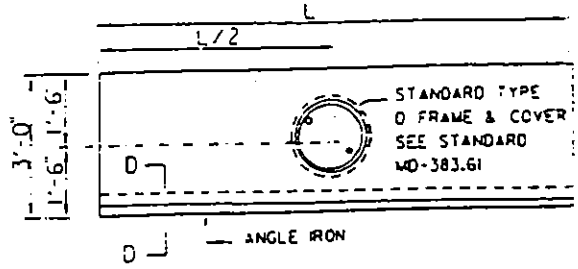
SECTION B-B

(SHOWN AS PRECAST)

pipe size MIN. TO MAX.	PRECAST DIMENSIONS				
	W	Y	H_1 BASE	H_2 RISER	B
12" - 36"	4'-0"	4'-0"	3' to 10'	1' to 5'	6"
42" - 60"	4'-0"	6'-0"	3' to 10'	1' to 5'	6"
42" - 60"	6'-0"	6'-0"	3' to 10'	1' to 5'	6"
72" - 84"	6'-0"	8'-0"	3' to 10'	1' to 5'	8"
90" - 108"	6'-0"	10'-0"	3' to 10'	1' to 5'	8"
90" - 108"	6'-0"	12'-0"	3' to 10'	1' to 5'	8"

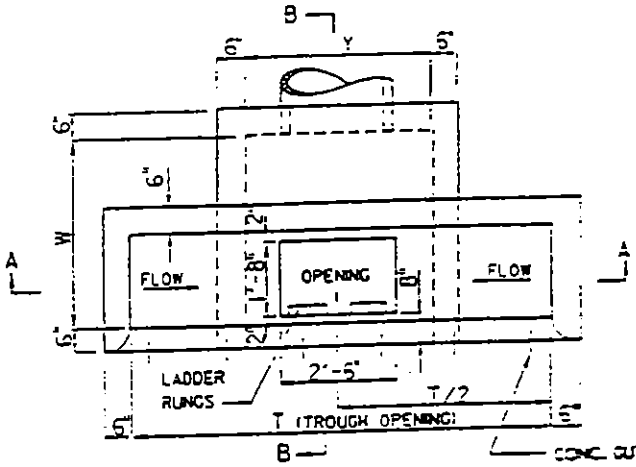
INLET TYPE		L
COG-5	5'-0"	6'-0"
COG-10	10'-0"	11'-0"
COG-15	15'-0"	16'-0"
COG-20	20'-0"	21'-0"

TOWN OF INDIAN HEAD	PRECAST OR CAST-IN-PLACE SQUARE OR RECTANGULAR COG INLETS 5', 10', 15', & 20'	



PRECAST CONCRETE TROUGH SLAB

(6" THICK)

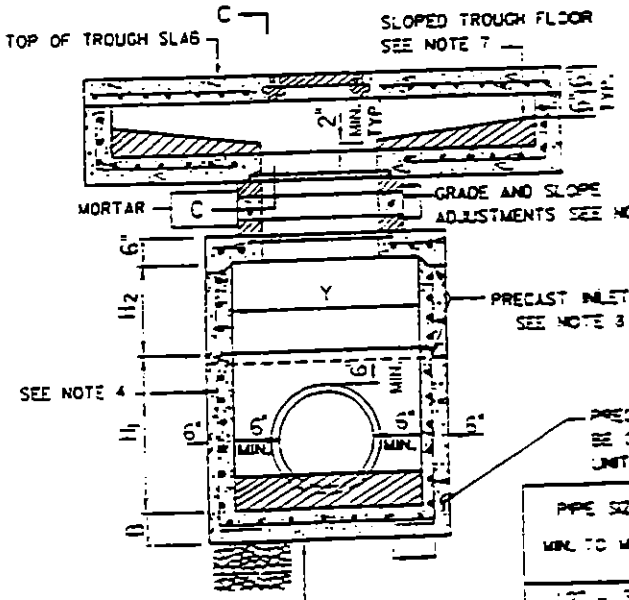


PLAN

(SHOWN WITHOUT TROUGH SLAB)

NOTES:

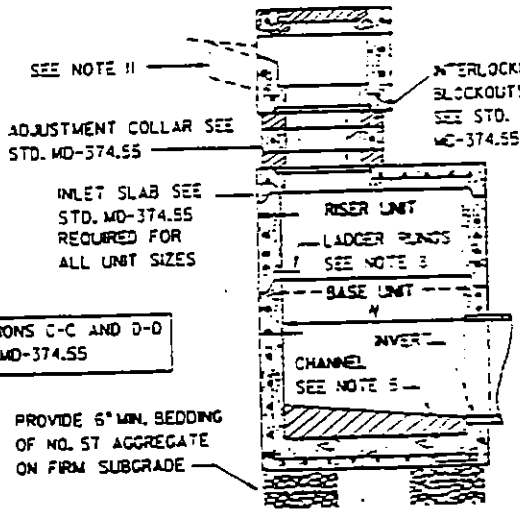
1. THIS STANDARD TO BE USED WITH TYPE A COMBINATION CURB AND GUTTER ONLY.
2. CURB OPENINGS SHALL NOT ENCROACH ON CROSSWALK AREAS.
3. CONCRETE SHALL BE MIX NO. 6 (4500 PSI) FOR PRECAST UNITS AND CONCRETE MIX NO. 3 (3500 PSI) FOR CAST IN PLACE UNITS.
4. INLET MAY BE PRECAST OR CAST IN PLACE. REINFORCEMENT SHALL BE NO. 4 BARS PLACED IN THE CENTER OF INLET WALLS AT 6" C/C 2 WAYS OR 2 LAYERS OF 4x4-W4.0xW4.0 WELDED WIRE FABRIC WITH 1½" COVER.
5. A CONCRETE OR BRICK CHANNEL WHICH SLOPES AT LEAST 2 INCHES TOWARD THE OUTLET SHALL BE PROVIDED IN THE FIELD.
6. GRADE AND SLOPE ADJUSTMENTS SHALL BE COMPLETED IN THE FIELD USING PRECAST ADJUSTMENT COLLAR AND MORTAR.
7. SLOPED TROUGH FLOOR TO BE CAST IN THE FIELD AND USED ONLY WHEN ROAD GRADE IS 1.5% OR LESS. WHEN SLOPED TROUGH FLOOR IS USED, ROUGHEN PRECAST TROUGH FLOOR.
8. PRECAST INLET JOINTS-THE MANUFACTURER SHALL FORM MALE AND FEMALE ENDS OF JOINTS USING THEIR OWN DESIGN. THE JOINTS SHALL BE SEALED BY THE CONTRACTOR AND MADE WATERTIGHT USING THE MANUFACTURER'S RECOMMENDED ASTM OR AASHTO APPROVED SEALENT.
9. LADDER RUNGS SHALL BE PLACED IN VERTICAL ALIGNMENT AT 1'-1" C/C. RUNG TYPE SHALL BE IN ACCORDANCE WITH STANDARDS MD-383.51 OR MD-383.52. RUNGS ARE INCIDENTAL TO THE COST OF THE INLET.
10. ANGLE IRON AND SHEAR STUD CONNECTORS SHALL BE GALVANIZED AFTER WELDING IN ACCORDANCE WITH ASTM A 123. SEE STDS. MD-374.53 & MD-374.64.
11. SEE STANDARD MD-374.65 FOR DEPRESSED GUTTER PAN.
12. SEE STANDARD MD-374.64 FOR ALTERNATE PRECAST COS TROUGHS.
13. PAY MEASUREMENTS FOR CAST IN PLACE UNIT SHALL BE THE SAME AS THE PRECAST UNIT. REFER TO NOTE 14. ALL OTHER DIMENSIONS SHOWN FOR PRECAST UNIT SHALL APPLY TO CAST IN PLACE UNIT.
14. MINIMUM DEPTH PAYMENT PER EACH SHALL BE 6'-2" MEASURED FROM THE BOTTOM OF THE BASE UNIT TO THE TOP OF THE TROUGH SLAB. VERTICAL DEPTH PAYMENT PER LINEAR FOOT SHALL INCLUDE ALL DEPTHS IN EXCESS OF 6'-2" INCLUDING ALL APPURTENANCES.
15. PRECAST BASE UNIT WALLS MAY TAPER PER MANUFACTURER'S DESIGN.



LAP SPLICE REINFORCEMENT 1'-0" (TYP.) AROUND OUTSIDE CORNERS AS SHOWN. (MONOLITHIC BASE ONLY)

SECTION A-A

(SHOWN AS PRECAST)



FOR SECTIONS C-C AND D-D SEE STD. MD-374.55

SECTION B-B

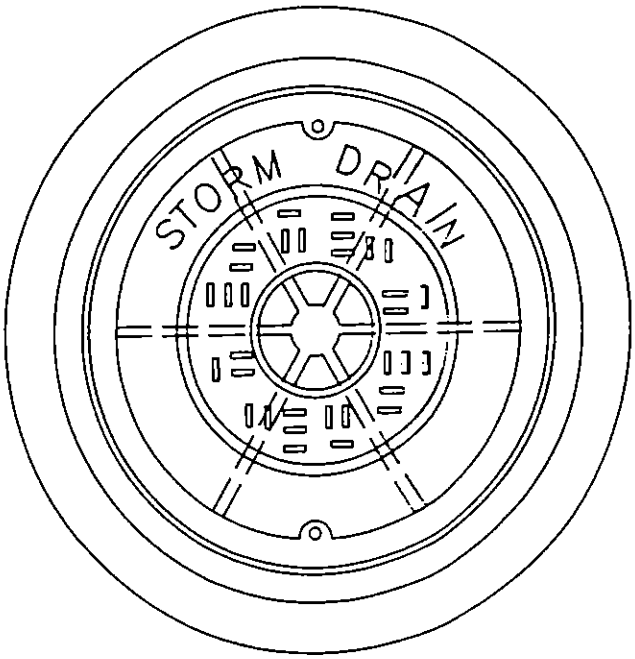
(SHOWN AS PRECAST)

PRECAST INLET BASE-THE BASE MAY BE CAST MONOLITHIC WITH THE BASE UNIT OR JOINTED PER MANUFACTURER'S DESIGN

PIPE SIZE MIN. TO MAX.	PRECAST DIMENSIONS				
	W	Y	H_1 BASE	H_2 RISER	B BASE THICKNESS
12" - 36"	4'-0"	4'-0"	3"to10"	11"to5'-1"	6"
42" - 60"	4'-0"	6'-0"	3"to10"	11"to5'-1"	6"
42" - 60"	6'-0"	6'-0"	3"to10"	11"to5'-1"	6"
72" - 84"	6'-0"	8'-0"	3"to10"	11"to5'-1"	8"
90" - 108"	6'-0"	10'-0"	3"to10"	11"to5'-1"	8"
90" - 108"	6'-0"	12'-0"	3"to10"	11"to5'-1"	8"

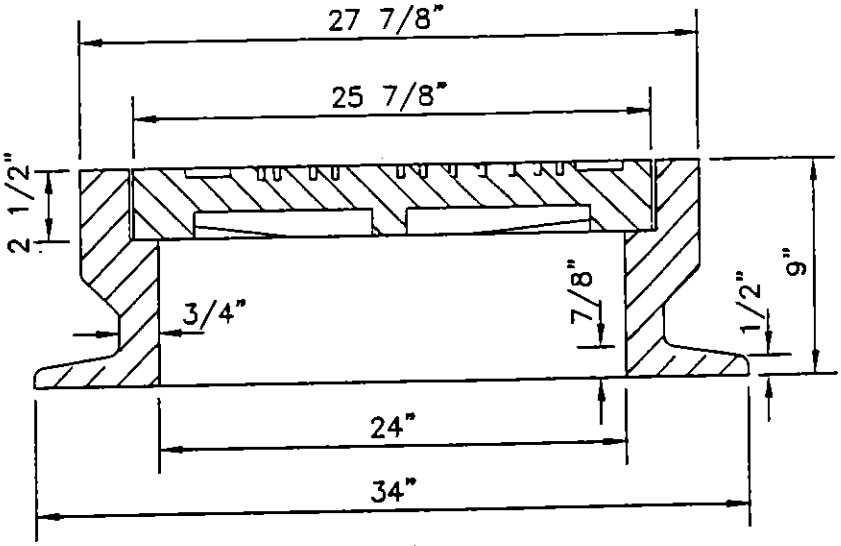
INLET TYPE	-	-
COS-5	5'-0"	6'-0"
COS-10	10'-0"	6'-0"
COS-15	15'-0"	6'-0"
COS-20	20'-0"	6'-0"

TOWN OF INDIAN HEAD	PRECAST OR CAST-IN-PLACE SQUARE OR RECTANGULAR COS INLETS 5', 10', 15', & 20'	

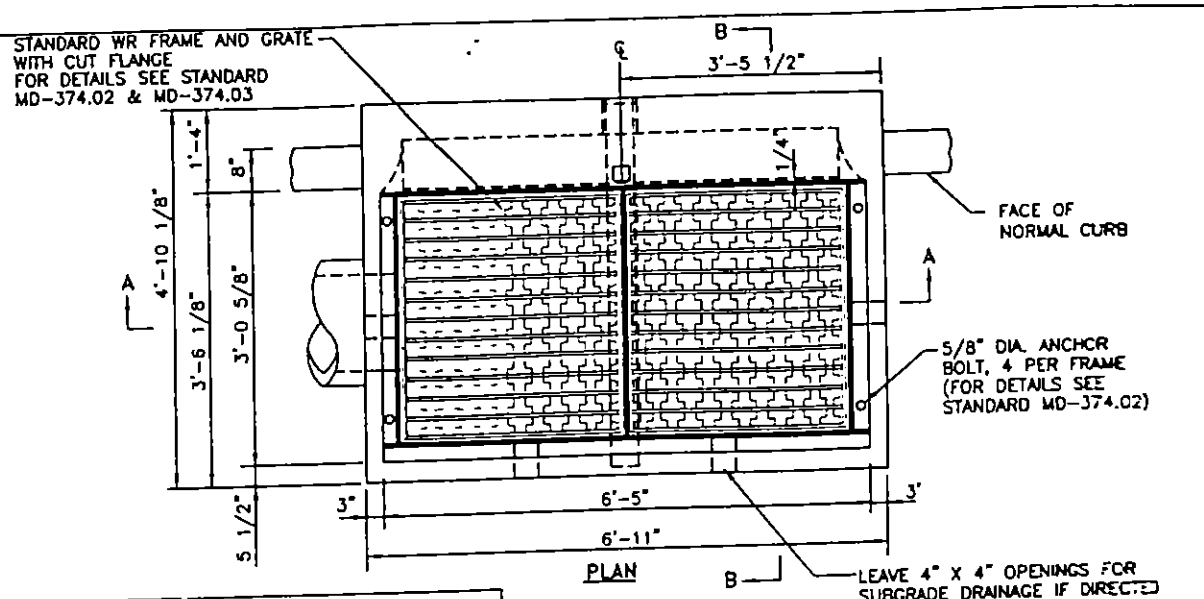


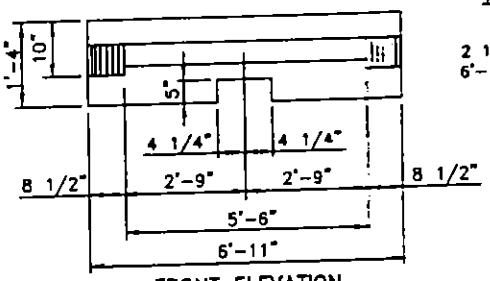
NOTES:

1. MATERIAL TO BE CAST IRON ASTM A-48, CLASS 30.
2. HEAVY DUTY MANHOLE FRAME AND COVER DESIGNED FOR H-20 LOADING: FRAME-(9)" 250 LBS. COVER-170 LBS.
3. FRAME TO BE FURNISHED WITH 4-1" DIA. FLANGE HOLES LOCATED 90° APART ON A 30 1/4" BOLT CIRCLE.
4. MANUFACTURED BY B&C UTILITY SUPPLY, INC., FINKSBURG, MARYLAND OR APPROVED EQUAL.

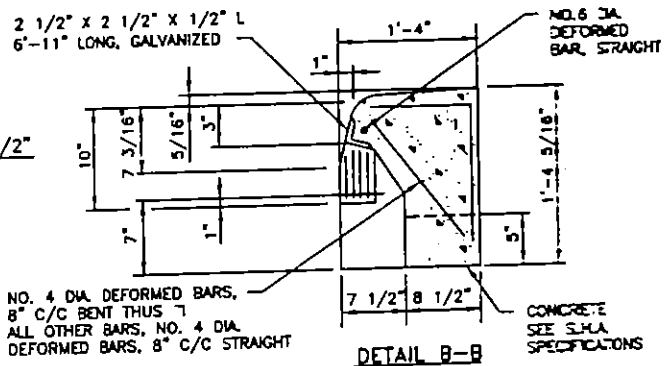


TOWN OF INDIAN HEAD	HEAVY DUTY STORM DRAIN MANHOLE FRAME AND COVER	

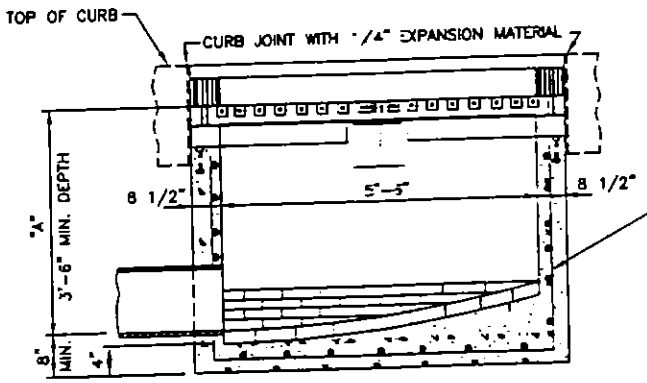




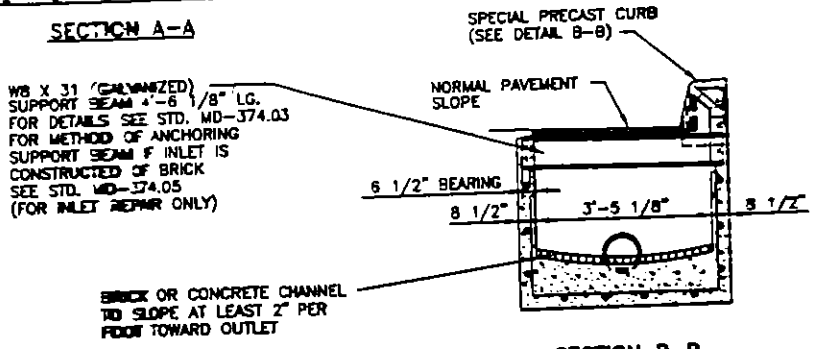
FRONT ELEVATION
PRECAST CURB



DETAIL B-B
PRECAST CURB



SECTION A-A

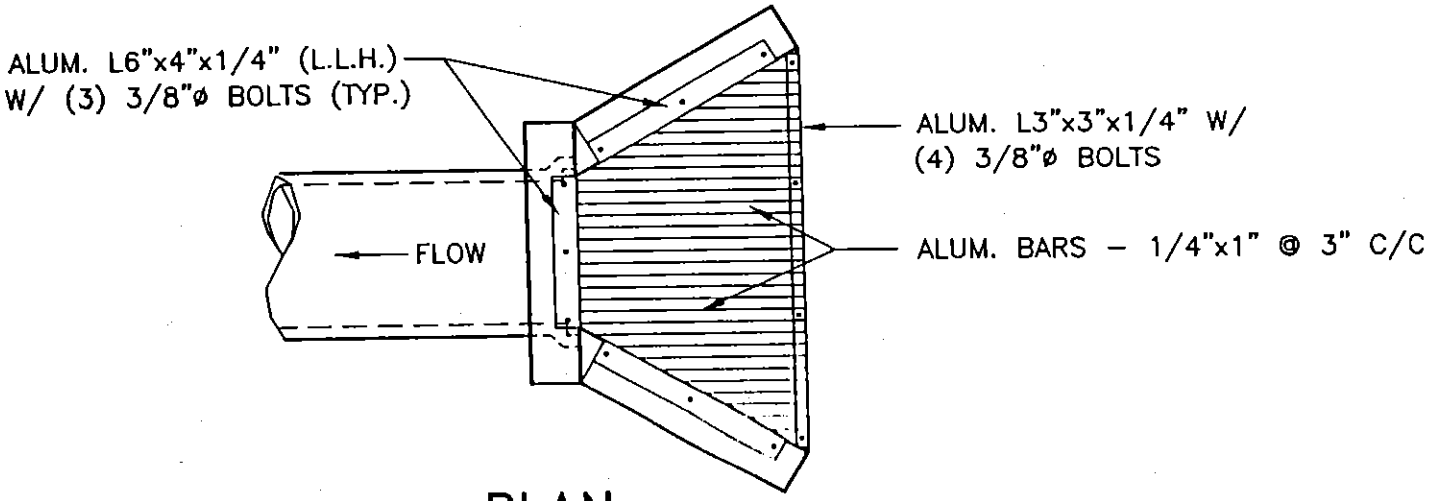


SECTION B-B

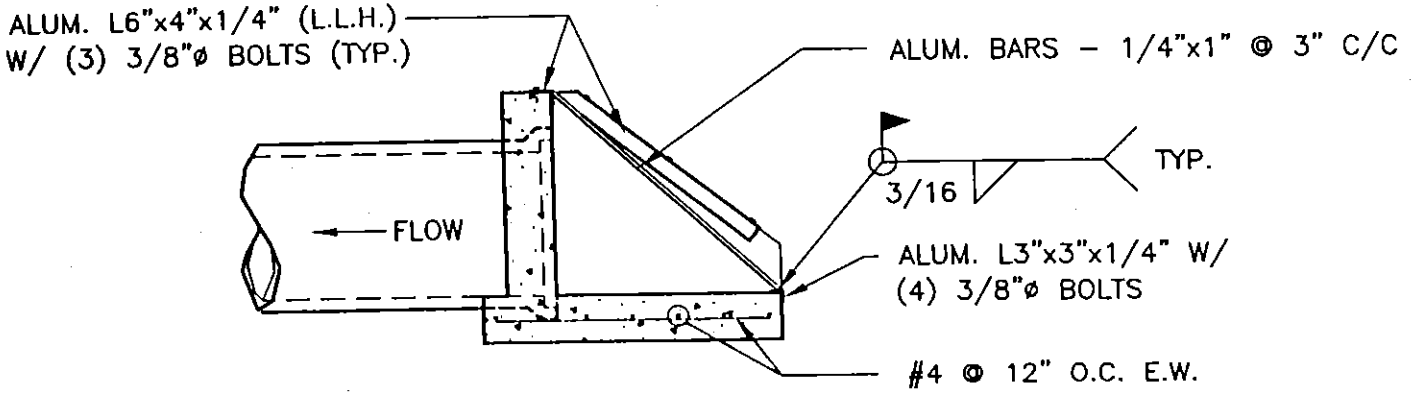
NOTES:

INLET SHALL BE CONSTRUCTED OF REINFORCED CONCRETE MIX NO. 2. SIZE, TYPE & DIRECTION OF INLET CONNECTION WILL VARY TO SUIT CONDITIONS. SEE S.H.A. SPECIFICATION FOR INLETS. REINFORCEMENT REQUIRED ON OUTSIDE, AS WELL AS ON INSIDE, OF WALLS BELOW 7'-0" WHEN "A" IS GREATER THAN 7'-0". SPACING, SAME AS FOR INSIDE OF WALL. PLACE 1/4" EXPANSION MATERIAL OF SAME TYPE APPROVED FOR PAVEMENT BETWEEN THE FRAME & ABUTTING RIGID PAVEMENT & BETWEEN ENDS OF INLET CURB & NORMAL CURB. BRICK FOR MASONRY TO COMPLY WITH THE S.H.A. SPECIFICATIONS. FOR UNDEPRESSED INLETS, USE NORMAL PAVEMENT SLOPE. FOR DEPRESSED INLETS, SEE S.H.A. STD. MD-300.02. IF LADDER RUNGS ARE REQUIRED SEE STANDARD MD-383.91 OR MD-383.92.

TOWN OF INDIAN HEAD	STD. WR INLET	

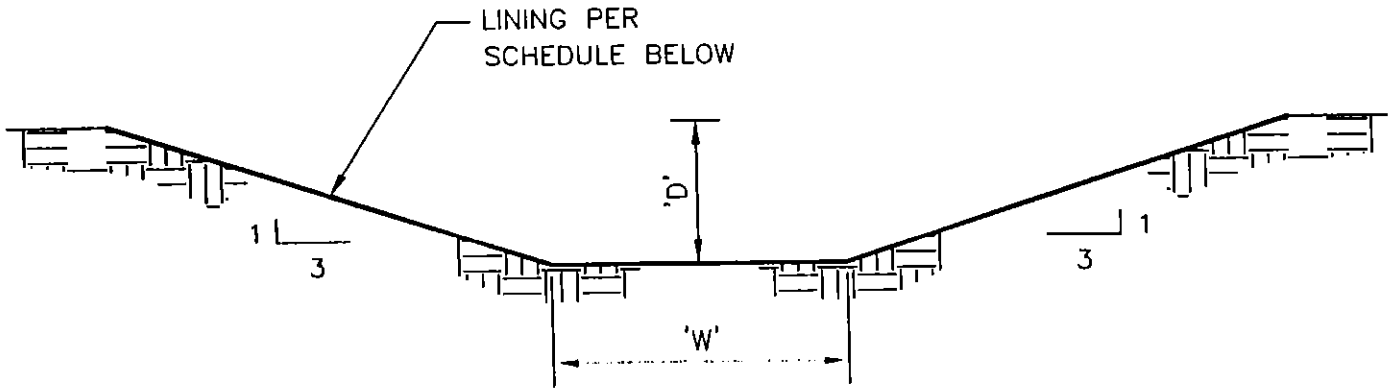


PLAN



SECTION

TOWN OF INDIAN HEAD	**TRASH RACK DETAIL**	



CROSS SECTION

SWALE NO.	WIDTH (W)	DEPTH (D)	SLOPE	LINING

TOWN OF INDIAN HEAD	TYPICAL TRAPEZOIDAL SWALE AND SCHEDULE	

MISCELLANEOUS

AS-BUILT DRAWING

I HEREBY STATE, TO THE BEST OF MY KNOWLEDGE AND PERSONAL BELIEF, THAT THE WORK SHOWN ON THESE PLANS WAS CONSTRUCTED TO THE LINES AND GRADES SHOWN.

ENGINEER DATE P.E. NO.

TOWN OF INDIAN HEAD	AS-BUILT DRAWING STATEMENT	

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT EJCDC 1910-8

This document has important legal consequences: consultation with an attorney is encouraged with respect to its completion or modification.

STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT

Prepared by

Engineers Joint Contract Documents Committee

and

Issued and Published Jointly By

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A practice division of the
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AMERICAN CONSULTING ENGINEERS COUNCIL

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CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General Contractors of America

These General Conditions have been prepared for use with the Owner-Contractor Agreements (No. 1910-A-1 or 1910-8-A-2) (1990 Editions). Their provisions are interrelated and a change in one may necessitate a change in the others. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents (No. 1910-9) (1986 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. 1910-17) (1990 Edition). When bidding is involved, the Standard Form of Instructions to Bidders (No. 1910-12) (1990 Edition) may be used.

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American Society of Civil Engineers
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Construction Specifications Institute
601 Madison St., Alexandria, VA 22314

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GENERAL CONDITIONS

ARTICLE 1—DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents.

1.2. *Agreement*—The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3. *Application for Payment*—The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

1.5. *Bid*—The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6. *Bidding Documents*—The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

1.7. *Bidding Requirements*—The advertisement or invitation to Bid, instructions to bidders, and the Bid form.

1.8. *Bonds*—Performance and Payment bonds and other instruments of security.

1.9. *Change Order*—A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.10. *Contract Documents*—The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1.1 and 4.2.2.2 are not Contract Documents.

1.11. *Contract Price*—The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

1.12. *Contract Times*—The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.13. *CONTRACTOR*—The person, firm or corporation with whom OWNER has entered into the Agreement.

1.14. *defective*—An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

1.15. *Drawings*—The drawings which show the scope, extent and character of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop drawings are not Drawings as so defined.

1.16. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

1.17. *ENGINEER*—The person, firm or corporation named as such in the Agreement.

1.18. *ENGINEER's Consultant*—A person, firm or corporation having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.19. *Field Order*—A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.20. *General Requirements*—Sections of Division 1 of the Specifications.

1.21. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

1.22. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

1.23. *Liens*—Liens, charges, security interests or encumbrances upon real property or personal property.

1.24. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.25. *Notice of Award*—The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.26. *Notice to Proceed*—A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.27. *OWNER*—The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.28. *Partial Utilization*—Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

1.29. *PCBs*—Polychlorinated biphenyls.

1.30. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

1.31. *Project*—The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.32. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

1.33. *Resident Project Representative*— The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

1.35. *Shop Drawings*—All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

1.36. *Specifications*—Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.37. *Subcontractor*—An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.38. *Substantial Completion*—The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.39. *Supplementary Conditions*—The part of the Contract Documents which amends or supplements these General Conditions.

1.40. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.41. *Underground Facilities*—All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

1.42. *Unit Price Work*—Work to be paid for on the basis of unit prices.

1.43. *Work*—The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.44. *Work Change Directive*—A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.

1.45. *Written Amendment*—A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2—PRELIMINARY MATTERS

Delivery of Bonds:

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

2.3. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Work:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or reasonably should have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2.6.2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.7. Before any Work at the site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6 and 5.7.

Preconstruction Conference:

2.8. Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference

attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.6. procedures for handling Shop Drawings and other submittals, processing Applications for Payment and maintaining required records.

Initially Acceptable Schedules:

2.9. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until the schedules are submitted to and acceptable to ENGINEER as provided below. The progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor. CONTRACTOR's schedule of Shop Drawing and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the required submittals. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases which have a well- known technical or construction industry or trade meaning are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. Reference to Standards and Specifications of Technical Societies; Reporting and Resolving Discrepancies:

3.3.1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

3.3.3. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and:

3.3.3.1. the provisions of any such standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

3.3.3.2. the provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

No provision of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or

performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

Amending and Supplementing Contract Documents:

3.5. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1. a formal Written Amendment,

3.5.2. a Change Order (pursuant to paragraph 10.4), or

3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1. a Field Order (pursuant to paragraph 9.5),

3.6.2. ENGINEER's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.7. CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

ARTICLE 4—AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2. *Subsurface and Physical Conditions:*

4.2.1. *Reports and Drawings:* Reference is made to the Supplementary Conditions for identification of:

4.2.1.1. *Subsurface Conditions:* Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents; and

4.2.1.2. *Physical Conditions:* Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by ENGINEER in preparing the Contract Documents.

4.2.2. *Limited Reliance by CONTRACTOR Authorized; Technical Data:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

4.2.2.1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto, or

4.2.2.2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or

4.2.2.3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

4.2.3. *Notice of Differing Subsurface or Physical Conditions:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the site that is uncovered or revealed either:

4.2.3.1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, or

4.2.3.2. is of such a nature as to require a change in the Contract Documents, or

4.2.3.3. differs materially from that shown or indicated in the Contract Documents, or

4.2.3.4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then

CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

4.2.4. *ENGINEER's Review:* ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5. *Possible Contract Documents Change:* If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition that meets one or more of the categories in paragraph 4.2.3., a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6. *Possible Price and Times Adjustments:* An equitable adjustment in the Contract Price or in the Contract Times, or both, will be allowed to the extent that the existence of such uncovered or revealed condition causes an increase or decrease in CONTRACTOR's cost of, or time required for performance of, the Work; subject, however, to the following:

4.2.6.1. such condition must meet any one or more of the categories described in paragraphs 4.2.3.1 through 4.2.3.4, inclusive;

4.2.6.2. a change in the Contract Documents pursuant to paragraph 4.2.5 will not be an automatic authorization of nor a condition precedent to entitlement to any such adjustment;

4.2.6.3. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.10 and 11.9; and

4.2.6.4. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Times if:

4.2.6.4.1. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a bid or becoming bound under a negotiated contract; or

4.2.6.4.2. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test or study of the site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

4.2.6.4.3. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.2.3.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.3. *Physical Conditions—Underground Facilities:*

4.3.1. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on

information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2. The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2. *Not Shown or Indicated:* If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.23), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Price or Contract Times, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages incurred or sustained by CONTRACTOR on or in connection with any other project or anticipated project.

Reference Points:

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

4.5. Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1. OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought to the site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2. CONTRACTOR shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23), and (ii) notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.

4.5.3. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's

Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5. The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

ARTICLE 5—BONDS AND INSURANCE

Performance, Payment and Other Bonds:

5.1. CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

5.3. *Licensed Sureties and Insurers; Certificates of Insurance:*

5.3.1. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

CONTRACTOR's Liability Insurance:

5.4. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1. claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.4.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.4.4. claims for damages insured by customary personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5.4.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

5.4.6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7. with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8. include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

5.4.9. include completed operations insurance;

5.4.10. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.12, 6.16 and 6.31 through 6.33;

5.4.11. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12; and

5.4.13. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

OWNER's Liability Insurance:

5.5. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.4, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance:

5.6. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework and Work in transit and shall insure against at least the following perils fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

5.6.3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.4. cover materials and equipment stored at the site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5.6.5. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

5.8. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.11.

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraphs 5.6 or 5.7, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

5.11. *Waiver of Rights:*

5.11.1. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraphs 5.6 and 5.7 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2. In addition, OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them, for:

5.11.2.1. loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by OWNER; and

5.11.2.2. loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured peril covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.10, after substantial completion pursuant to paragraph 14.8 or after final payment pursuant to paragraph 14.13.

Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in this paragraph 5.11.2 shall contain provisions to the effect that in the event of payment of any such loss, damage or consequential loss the insurers will have no rights of recovery against any of CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them.

Receipt and Application of Insurance Proceeds

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

Acceptance of Bonds and Insurance; Option to Replace:

5.14. If either party (OWNER or CONTRACTOR) has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was

required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

Partial Utilization—Property Insurance:

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6—CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

Progress Schedule:

6.6. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.9 as it may be adjusted from time to time as provided below:

6.6.1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.6.2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of paragraph 12.1. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.7. *Substitutes and "Or-Equal" Items:*

6.7.1. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by ENGINEER under the following circumstances:

6.7.1.1. *"Or-Equal":* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2. *Substitute Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under subparagraph 6.7.1.1, it will be considered a proposed substitute item. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the ENGINEER will include the following as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall first make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

6.7.1.3. *CONTRACTOR's Expense:* All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense.

6.7.2. *Substitute Construction Methods or Procedures:* If a pecific means, method, technique, sequence or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.7.1.2.

6.7.3. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.7.1.2 and 6.7.2. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitutes proposed or submitted by CONTRACTOR pursuant to paragraphs 6.7.1.2 and 6.7.2 and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER accepts a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute item.

Concerning Subcontractors, Suppliers and Others:

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials or equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be adjusted by the difference in the cost occasioned by such

substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9.1. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.9.2. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

Patent Fees and Royalties:

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents.

Permits:

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses and damages caused by, arising out of or resulting therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.3.2.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of

the Project which are applicable during the performance of the Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. CONTRACTOR shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all persons on the Work site or who may be affected by the Work;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

Safety Representative:

6.21. CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and

responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

Hazard Communication Programs:

6.22. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with Laws or Regulations.

Emergencies:

6.23. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.24. *Shop Drawings and Samples:*

6.24.1. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25. *Submittal Procedures:*

6.25.1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

6.25.1.1. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto.

6.25.1.2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

6.25.1.2. all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2. Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contact Documents with respect to CONTRACTOR'S review and approval of that submittal.

6.25.3. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by ENGINEER as required by paragraph 2.9. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contrac

Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.30. *CONTRACTOR's General Warranty and Guarantee:*

6.30.1. CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

6.30.1.1. abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or

6.30.1.2. normal wear and tear under normal usage.

6.30.2. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

6.30.2.1. observations by ENGINEER;

6.30.2.3. recommendation of any progress or final payment by ENGINEER;

6.30.2.3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4. use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5. any acceptance by OWNER or any failure to do so;

6.30.2.6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13;

6.30.2.7. any inspection, test or approval by others; or

6.30.2.8. any correction of *defective* Work by OWNER.

Indemnification:

6.31. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused by, arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage: (i) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.32. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.33. The indemnification obligations of CONTRACTOR under paragraph 6.31 shall not extend to the liability of ENGINEER and ENGINEER's Consultants, officers, directors, employees or agents caused by the professional negligence, errors or omissions of any of them.

Survival of Obligations:

6.34. All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with

the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7—OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, then: (i) written notice thereof will be given to CONTRACTOR prior to starting any such other work, and (ii) CONTRACTOR may make a claim therefor as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

Coordination:

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1. the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2. the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3. the extent of such authority and responsibilities will be provided.

Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8—OWNER'S RESPONSIBILITIES

8.1. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of physical conditions in existing structures at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9. The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10. OWNER'S responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Materials uncovered or revealed at the site is set forth in paragraph 4.5.

8.11. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9—ENGINEER'S STATUS DURING CONSTRUCTION

OWNER's Representative:

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against *defective* Work. ENGINEER's visits and on-site observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.13, and particularly, but without limitation, during or as a result of ENGINEER's on-site visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

Project Representative:

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.13 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretations:

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER or CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree to the amount or extent thereof, if any, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR who shall perform the Work involved promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree as to the amount or extent thereof, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or 12.

Rejecting Defective Work:

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be *defective*, or

that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

9.9. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

Determinations for Unit Prices:

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other and to ENGINEER written notice of intention to appeal from ENGINEER's decision and: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in Exhibit GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to ENGINEER's decision, unless otherwise agreed in writing by OWNER and CONTRACTOR. Such appeal will not be subject to the procedures of paragraph 9.11.

Decisions on Disputes:

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and Claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within thirty days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. ENGINEER's written decision on such claim, dispute or other matter will be final and binding upon OWNER and CONTRACTOR unless: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in EXHIBIT GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within thirty days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty days of the date of such decision, unless otherwise agreed in writing by OWNER and CONTRACTOR.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 or 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16.

9.13. *Limitations on ENGINEER's Authority and Responsibilities:*

9.13.1. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by ENGINEER shall create, impose or give rise to any duty owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them.

9.13.2. ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.13.4. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and Other documentation required to be delivered by paragraph 14.12 will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, the Contract Documents.

9.13.5. The limitations upon authority and responsibility set forth in this paragraph 9.13 shall also apply to ENGINEER's Consultants, Resident Project Representative and assistants.

ARTICLE 10—CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefor as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.5 and 3.6 except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1. changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11—CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after the start of such occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the adjustment claimed covers all known amounts to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will

be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive);

11.3.2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2);

11.3.3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 11.6).

Cost of the Work:

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen and other personnel employed full- time at the site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids, if any, will be accepted. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof—all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4—all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of *defective* Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

11.6. The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or

11.6.2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR's fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR's fee shall be five percent;

11.6.2.3. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of fifteen percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

11.6.2.4. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and

11.6.2.5. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.5, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraphs 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

11.8.1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.9. *Unit Price Work:*

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

11.9.3. OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2. there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12—CHANGE OF CONTRACT TIMES

12.1. The Contract Times (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times (or Milestones) shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefor as provided in paragraph 12.1. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER be liable to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of CONTRACTOR, or (ii)

delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

ARTICLE 13—TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF *DEFECTIVE* WORK

13.1. *Notice of Defects:* Prompt notice of all *defective* Work of which OWNER or ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective* Work may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

Tests and Inspections:

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

13.4.1. for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3. as otherwise specifically provided in the Contract Documents.

13.5. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6. If any Work (or the work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

13.7. Uncovering Work as provided in paragraph 13.6 shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

Uncovering Work:

13.8. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

OWNER May Stop the Work:

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work

shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any surety or other party.

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.12. *Correction Period:*

13.12.1. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

13.12.2. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.12.3. Where *defective* Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph 13.12, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all claims, costs, losses and damages attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors and ENGINEER and ENGINEER's Consultants access to the site to enable OWNER to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by OWNER in exercising such rights and remedies will be charged against CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14—PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and

will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment:

14.2. At least twenty days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

14.5.1. the Work has progressed to the point indicated,

14.5.2. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation), and

14.5.3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER's recommendation of any payment, including final payment, shall not mean that ENGINEER is responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.5. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5. claims have been made against OWNER on account of CONTRACTORs performance or furnishing of the Work,

14.7.6. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens,

14.7.7. there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10. Use by OWNER at OWNER's option of any substantially completed part of the Work which: (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all

particulars in which this inspection reveals that the Work is incomplete or *defective*. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

Final Application for Payment:

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu of such releases or waivers of Liens and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

Final Payment and Acceptance:

14.13. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after the presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Waiver of Claims:

14.15. The making and acceptance of final payment will constitute:

14.15.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from *defective* Work appearing after final inspection pursuant to paragraph 14.11, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

ARTICLE 15—SUSPENSION OF WORK AND TERMINATION

OWNER May Suspend Work:

15.1. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

OWNER May Terminate:

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as adjusted from time to time pursuant to paragraph 6.6);

15.2.2. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.2. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.4. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by OWNER arising out of or resulting from completing the Work such excess will be paid to CONTRACTOR. If such claims, costs, losses and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

15.4.1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

15.4.2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

15.4.3. for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

15.4.4. for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

CONTRACTOR May Stop Work or Terminate:

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven day's written notice to OWNER and ENGINEER stop the Work until payment of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16—DISPUTE RESOLUTION

If and to the extent that OWNER and CONTRACTOR have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution method and procedure, if any, shall be as set forth in Exhibit GC-A, "Dispute Resolution Agreement," to be attached hereto and made a part hereof. If no such agreement on the method and procedure for resolving such disputes has been reached, and subject to the provisions of paragraphs 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise

such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17—MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Times:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

Notice of Claim:

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

Cumulative Remedies:

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.12, 6.16, 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

Professional Fees and Court Costs Included:

17.5. Whenever reference is made to "claims, costs, losses and damages," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

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EXHIBIT GC-A to General Conditions of the Agreement Between OWNER and CONTRACTOR Dated_____ For use with EJCDC No. 1910-8 (1990 ed.)

DISPUTE RESOLUTION AGREEMENT

OWNER and CONTRACTOR hereby agree that Article 16 of the General Conditions to the Agreement between OWNER and CONTRACTOR is amended to include the following agreement of the parties:

16.1. All claims, disputes and other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment as provided by paragraph 14.15) will be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining, subject to the limitations of this Article 16. This agreement so to arbitrate and any other agreement or consent to arbitrate entered into in accordance herewith as provided in this Article 16 will be specifically enforceable under the prevailing law of any court having jurisdiction.

16.2. No demand for arbitration of any claim, dispute or other matter that is required to be referred to ENGINEER initially for decision in accordance with paragraph 9.11 will be made until the earlier of (a) the date on which ENGINEER has rendered a written decision or (b) the thirty-first day after the parties have presented their evidence to ENGINEER if a written decision has not been rendered by ENGINEER before that date. No demand for arbitration of any such claim, dispute or other matter will be made later than thirty days after the date on which ENGINEER has rendered a written decision in respect thereof in accordance with paragraph 9.11; and the failure to demand arbitration within said thirty days' period will result in ENGINEER's decision being final and binding upon OWNER and CONTRACTOR. If ENGINEER renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but will not supersede the arbitration proceedings, except where the decision is acceptable to the parties concerned. No demand for arbitration of any written decision of ENGINEER rendered in accordance with paragraph 9.10 will be made later than ten days after the party making such demand has delivered written notice of intention to appeal as provided in paragraph 9.10.

16.3. Notice of the demand for arbitration will be filed in writing with the other party to the Agreement and with the American Arbitration Association, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the thirty-day or ten- day period specified in paragraph 16.2 as applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

16.4. Except as provided in paragraph 16.5 below, no arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder or in any other manner any other person or entity (including ENGINEER, ENGINEER's Consultant and the officers, directors, agents, employees or consultants of any of them) who is not a party to this contract unless:

16.4.1. the inclusion of such other person or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration, and

16.4.2. such other person or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings, and

16.4.3. the written consent of the other person or entity sought to be included and of OWNER and CONTRACTOR has been obtained for such inclusion, which consent shall make specific reference to this paragraph; but no such consent shall constitute consent to arbitration of any dispute not specifically described in such consent or to arbitration with any party not specifically identified in such consent.

16.5. Notwithstanding paragraph 16.4 if a claim, dispute or other matter in question between OWNER and CONTRACTOR involves the Work of a Subcontractor, either OWNER or CONTRACTOR may join such Subcontractor as a party to the arbitration between OWNER and CONTRACTOR hereunder. CONTRACTOR shall include in all subcontracts required by paragraph 6.11 a specific provision whereby the Subcontractor consents to being joined in an arbitration between OWNER and CONTRACTOR involving the Work of such Subcontractor. Nothing in this paragraph 16.5 nor in the provision of such subcontract consenting to joinder shall create any claim, right or cause of action in favor of Subcontractor and against OWNER, ENGINEER or ENGINEER's Consultants that does not otherwise exist.

16.6. The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal.

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16.7. OWNER and CONTRACTOR agree that they shall first submit any and all unsettled claims, counterclaims, disputes and other matters in question between them arising out of or relating to the Contract Documents or the breach thereof ("disputes"), to mediation by The American Arbitration Association under the Construction Industry Mediation Rules of the American Arbitration Association prior to either of them initiating against the other a demand for arbitration pursuant to paragraphs 16.1 through 16.6, unless delay in initiating arbitration would irrevocably prejudice one of the parties. The respective thirty and ten day time limits within which to file a demand for arbitration as provided in paragraphs 16.2 and 16.3 above shall be suspended with respect to a dispute submitted to mediation within those same applicable time limits and shall remain suspended until ten days after the termination of the mediation. The mediator of any dispute submitted to mediation under this Agreement shall not serve as arbitrator of such dispute unless otherwise agreed.

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SUPPLEMENTARY CONDITIONS

DOCUMENT 00800

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the General Conditions as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

SC-1

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meaning assigned to them in the General Conditions. The following definition(s) are added to the General Conditions.

1.46 Products -- New materials, machinery, components, equipment, fixtures, systems, and any other item which will become or has become a physical portion of the Work. The term "Products" does not include machinery and equipment used for preparation, fabrication, conveying, or erection of the Work. The term "Products" may include materials, equipment, or components removed from existing facilities that may, if specifically permitted by the Contract Documents, be re-used in the Work.

1.47 General Conditions -- Engineers' Joint Contract Documents Committee (EJCDC) Document No. 1910-8 (1990 Edition) "Standard General Conditions of the Construction Contract".

SC-1.6

Delete General Conditions Paragraph 1.6 in its entirety and insert the following in its place:

1.6 Bidding Documents -- The Invitation to Bid, Instructions to Bidders, Bid Form, Bid Bond Form, Experience Questionnaire, List of Proposed Subcontractors, all Addenda, and the proposed Contract Documents.

SC-1.12

Delete General Conditions Paragraph 1.12 in its entirety and insert the following in its place:

1.12 Contract Times -- The numbers of calendar days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with Paragraph 14.13.

SC-1.33

Delete General Conditions Paragraph 1.33 in its entirety and insert the following in its place:

1.33 Resident Project Representative -- A representative of either the Owner or Engineer who may be assigned to the Project site on either a full- or part-time basis. The duties, responsibilities, and

limitations on authority of the Resident Project Representative are specified in SC-17.6.

SC-2.2

Delete General Conditions Paragraph 2.2 in its entirety and insert the following in its place:

2.2 Owner will furnish to the Contractor 3 complete sets of the Contract Documents. Additional copies of the Contract Documents may be obtained from the Owner at the cost specified below.

2.2.1 Additional bound copies of the Project Manual: $70.00 per set.

2.2.2 Additional Drawings: $2.00 per sheet.

SC-2.3

Delete the second and third sentences of General Conditions Paragraph 2.3.

SC-2.7

Delete General Conditions Paragraph 2.7 in its entirety and insert the following in its place:

2.7 Before any Work at the site is started, Contractor shall deliver to Owner, with a copy to Engineer, certificates (and other evidence of insurance requested by Owner) which Contractor is required to purchase and maintain in accordance with General Conditions Paragraph 5.4 and Supplementary Conditions Paragraphs SC-5.6 and SC-5.7.

SC-4.2.1.1

In the preparation of Drawings and Specifications, Engineer has utilized the following report(s) of explorations and tests of subsurface conditions at or contiguous to the site of the Work:

Title _____

_____

Date _____

Prepared by _____

_____

_____

_____

Report listed in SC-4.2.1.1 is not part of the Bidding Documents or Contract Documents and a copy is not included herewith. A copy of the report may be examined at the Office of the Engineer, address given in the Invitation to Bid, during regular business hours. Copies of the report may be purchased at the location specified for a fee equal to the cost of reproduction.

SC-4.2.2

Bidder/Contractor may rely on the general accuracy of the following "technical data" in the reports and drawings listed above in SC-4.2.1.1:

SC-4.2.2.1 Numerical data presented on the boring logs, except for numerical data showing the depth to ground water level. Depth to ground water level may vary significantly and is therefore not considered as "technical data" upon which the Bidder/Contractor may rely.

SC-4.2.2.2 Descriptions or classifications of soil and rock presented on the boring logs.

SC-4.2.2.3 Bidder/Contractor may rely on the general accuracy of the "technical data" specified above only to the extent that such data reflects conditions in the immediate vicinity of the boring or sample.

SC-4.6

Add a new General Conditions paragraph which reads as follows:

4.6 Existing Utilities

4.6.1 Contractor shall comply with Federal, State, and local regulations relating to the requirement to notify utility companies prior to performing work which has the potential to damage the facilities of such utility companies. Where such utility company facilities are located underground, Contractor shall make arrangements for a utility company representative to locate the underground facilities prior to initiating excavation work.

4.6.2 If any utility company facility is damaged during the Work, Contractor shall immediately notify the affected utility company. Contractor shall be fully responsible for repairing or replacing such damaged facilities in accordance with utility company's requirements. If Contractor fails to promptly repair or replace damaged facilities, Owner or utility company may arrange to have the required work performed by others and the cost of such work will be charged to the Contractor by deduction from a progress payment.

SC-5.3.2

Delete General Conditions Paragraph 5.3.2 in its entirety and insert the following in its place:

5.3.2 Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain in accordance with General Conditions Paragraph 5.4 and Supplementary Conditions Paragraphs SC-5.6 and SC-5.7.

SC-5.3.3

Add a new General Conditions paragraph which reads as follows:

5.3.3 Contractor shall submit evidence of required insurance coverage on Accord 25 form "Certificate of Insurance", which shall be modified to state: "All policies of insurance shown on this form will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to Owner and Engineer and to each other additional insured.

SC-5.4.8

The limits of liability for the insurance required by General Conditions Paragraph 5.4 shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

Type of Coverage	Minimum Limits
5.4.8.1 Workmen's Compensation (Including coverage under United States Longshoremen's and Harbor Workers Act, where applicable)	Statutory
5.4.8.2 Employer's Liability	
Each Accident	$100,000
Disease; Each Employee	$100,000
Disease; Aggregate	$500,000

Type of Coverage	Minimum Limits
5.4.8.3 Comprehensive General (Public) Liability, including the following:	
(1) XCU coverage covering explosion, collapse, underground damage or blasting hazards where applicable.	
(2) Products--Completed Operations Coverage until two years after final payment to be provided by endorsement or issuance of separate policy of insurance in name of Owner.	
(3) Contractual Liability insuring the hold harmless and indemnification provisions of the Contract Documents.	
(4) Personal Injury Aggregate	$3,000,000
Bodily Injury and Property Damage	combined single limit
5.4.8.4 Contractor's Protective Liability (If subcontractors are employed)	

Bodily Injury and Property Damage	$3,000,000 combined single limit

5.4.8.5 Motor Vehicle Liability

Bodily Injury and Property Damage	$1,000,000 combined single limit

SC-5.6

Delete General Conditions Paragraph 5.6, including subparagraphs 5.6.1 through 5.6.5, in its entirety and insert the following in its place:

5.6 Contractor shall purchase and maintain property insurance upon the Work at the site in the full amount of the Contract Price (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1 Include the interests of Owner, Contractor, Subcontractors, Engineer, Engineers's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

5.6.2 Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to Work, temporary buildings, falsework and Work in transit and shall insure against at least the following perils: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions.

5.6.3 Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges or engineers and architects).

5.6.4 Cover materials and equipment in transit for incorporation in the Work or stored at the Project site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer.

5.6.5 Be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

SC-5.7

Delete General Conditions Paragraph 5.7 in its entirety and insert the following in its place:

5.7 Contractor shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which shall include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and any other persons or entities identified n the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

SC-5.8

Delete General Conditions Paragraph 5.8 in its entirety and insert the following in its place:

5.8 All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by Contractor in accordance with Paragraphs 5.6 and 5.7 shall contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to Owner and Engineer and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.11.

SC-5.9

Delete General Conditions Paragraph 5.9 in its entirety.

SC-5.10

Delete General Conditions Paragraph 5.10 in its entirety.

SC-5.16

At the end of General Conditions Article 5, add a new paragraph which reads as follows:

5.16 If Contract Price or Contract Time is changed in accordance with General Conditions Article 10, Owner or Engineer may require that Contractor's bonds and insurance policies be modified to reflect such changes. Any resulting changes in Contractor's bond and insurance costs will be paid for in accordance with General Conditions Paragraph 11.4.5.9.

SC-6.3

Add the following subparagraphs under General Conditions Paragraph 6.3:

6.3.1 Regular working hours for the Project are defined as 7:00 a.m. to 5:00 p.m. Monday through Friday.

6.3.2 If Owner consents to Contractor working during non-regular hours or on Saturday, Sunday, or any legal holiday, Contractor shall reimburse Owner for wages, salaries, and expenses paid to Owner's and Engineer's personnel which, in the Owner's judgement, are required to be present at the Project site during the Contractor's Work. Contractor's reimbursement to Owner for these extra personnel costs will be in the form of deduction from a progress payment.

SC-6.7.1

Delete General Conditions Paragraphs 6.7.1.1, 6.7.1.2 and 6.7.1.3 in their entirety and insert the following Paragraphs 6.7.1.1 through 6.7.1.9 in their place:

6.7.1.1 "Or-Equal": If in Engineer's sole discretion a Product proposed by Contractor is functionally the same, is fully equivalent in quality and durability, and is sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed Product may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2 Substitute Items: If in Engineer's sole discretion a Product proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.7.1.1, it will be considered a proposed substitute item. The determination as to whether the Product is an "or-equal" or a proposed substitute item will be made during Engineer's review of the Product Shop Drawing, as defined in Article 1 of the General Conditions. If the Product proposed by the Contractor is not considered an "or-equal" Product, the Shop Drawing will be returned to the Contractor with the notation "Returned for Correction". Contractor will then be

required to proceed as specified in the following Paragraphs 6.7.1.3 through 6.7.1.8.

6.7.1.3 Submit three copies of request for substitution, plus the number required to be returned to the entity making the request, to the Engineer. Each request for substitution shall cover one Product only.

6.7.1.4 Requests for substitutions will be accepted only from a prime Contractor on the Project.

6.7.1.5 Submit, with request for substitution, Shop Drawings, Product data, warranty information, case histories, lists of projects on which the Product has been successfully used, test reports, manufacturer's company profile, name and address of manufacturer's service organization, and other data as required to establish that proposed substitute Product is fully equivalent in quality to the Product of the named manufacturer(s) and meets all Specification requirements.

6.7.1.6 Submit, with request for substitution, the dollar amount which the Owner will receive as a credit toward the Contract Price if the substitution is approved. The Owner and Engineer reserve the right to make an independent investigation of the cost savings, to negotiate with the Contractor to increase the credit, and to reject a proposed substitution if the credit is considered insufficient.

6.7.1.7 Attach letters, provided by other contractors whose work may be affected by the proposed substitution, stating that the substitution will either have no effect on their work or that the substitution will affect their work and that the entity making the request for substitution has agreed to pay any extra costs which may be incurred if the substitution is approved.

6.7.1.8 The entity submitting the request for substitution shall include, on its transmittal letter, the signed statement: "The signer of this letter certifies that all requirements of General Conditions Paragraph 6.7.1.8 have been or will be met". The signer of the transmittal letter, by making this statement, affirms that: the proposed substitute Product has been investigated and has been found to equal or exceed in quality and durability the Product of the named manufacturer(s) and, further, that it meets all Specification requirements; all other prime contractors on the Project have been contacted as to the effect of the proposed substitution on their work and that letters from all other prime contractors are being submitted with the request; the same Product warranty, which would have been provided by the named manufacturer(s), will be provided for the substitute Product; the entity submitting the request for

substitution will coordinate installation of the proposed substitute and make any required changes in the Work at no additional cost to the Owner; the entity submitting the request for substitution will not make claims for additional costs or additional time required to implement the substitution; the entity making the request for substitution will reimburse the Owner for all costs associated with review of the request for substitution, all redesign costs, and all costs required to obtain re-approval from regulatory agencies; all licenses required for use of the proposed substitute Product will be obtained and paid for by the entity submitting the request for substitution and such license(s) will be transferred to the Owner; if required by the Engineer, the entity submitting the request for substitution will provide a special performance warranty or bond (separate from the Contract Performance Bond) as a condition of Engineer's acceptance of the proposed substitute Product (such bond may be in an amount up to 200 percent of the dollar value of the Product as determined by the Engineer).

6.7.1.9 Engineer will notify the entity submitting the request, in writing, of decision to accept or reject proposed substitute Product.

SC-6.7.2

Change the last sentence in General Conditions Paragraph 6.7.2 to read:

The procedures for such proposed substitute means, methods, techniques, sequences, or procedures shall be equivalent to those specified in Paragraphs 6.7.1.3 through 6.7.1.10.

SC-6.7.3

Delete General Conditions Paragraph 6.7.3 in its entirety and insert the following in its place:

6.7.3 Engineer will be allowed a reasonable time within which to evaluate each proposed substitute. Engineer will be the sole judge of acceptability, and no substitute will be ordered, installed, or utilized without Engineer's prior written approval. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitutions, making any required revisions to Contract Documents, and obtaining re-approval from regulatory agencies. Contractor will be charged for the recorded manhours, whether or not substitution is approved, at Engineer's and Engineer's Consultant's current hourly rates. Charges will be subtracted from the Contractor's next progress payment.

SC-6.8.2

Instructions to Bidders and these Supplementary Conditions require that a list of proposed Subcontractors be submitted with the Bid. No

substitutions for Subcontractors shown on the list shall be made by Contractor without prior written approval of Owner or Engineer.

SC-6.14.1

Add the following subparagraph(s) under General Conditions Paragraph 6.14.1:

6.14.1.3 Section 17-303 of the State Finance and Procurement Article of the Annotated Code of Maryland requires use of American steel products on this Project, with exceptions noted in the statute.

6.14.1.4 (1) FEDERAL CONSTRUCTION SAFETY AND HEALTH STANDARDS AND REGULATIONS promulgated by the United States Secretary of Labor and in accordance with Section 107 of the Contract Work Hours and Safety Standard Act (83 Stat. 96) == Title 29, Part 1926 (formerly Part 1518), Code of Federal Regulations, as revised from time to time.

(2) STATE CONSTRUCTION SAFETY AND HEALTH STANDARDS AND REGULATIONS promulgated by the Maryland State Commissioner of Labor and Industry in accordance with the Maryland Occupational Safety and Health Act == Article 89, Sections 28 through 49A inclusive, Annotated Code of Maryland, as may be amended from time to time.

SC-6.15

Delete General Conditions Paragraph 6.15 in its entirety and insert the following in its place:

6.15 The Contractor shall be responsible for the payment of all taxes required by law on all materials, tools, apparatus, equipment, fixtures, services, and incidentals which may be purchased or used for the purpose of performing the Work. Owner may be exempt from sales and use taxes for certain items to be incorporated into the Work. Contractor shall obtain legal advice to determine how and to what extent the Owner's tax exemption may be utilized by the Contractor. Owner will provide, at Contractor's request, required documentation to assist Contractor in obtaining any applicable tax exemptions.

SC-6.18

Add the following to the end of General Conditions Paragraph 6.18:

The Contractor shall determine the legal dimensional and load limits on all roads and bridges over and under which equipment and materials will be moved. In the event that loads or dimensions exceed legal limits, the Contractor shall obtain the necessary permits, pay permit fees, and comply with all regulations for moving such loads.

SC-6.23

Add the following subparagraph under General Conditions Paragraph 6.23:

6.23.1 The Contractor shall provide during non-working hours a maintenance crew to correct conditions which are hazardous to the public or detrimental to proper system operation. If the Contractor fails to correct the problem within a reasonable period of time, the necessary corrections will be performed by others and the full costs of the work charged to the Contractor. Names, addresses, and telephone numbers of the Contractor's emergency repair personnel shall be submitted to the Owner and Engineer at the preconstruction conference.

SC-8.5

Delete General Conditions Paragraph 8.5 in its entirety.

SC-9.3

Delete General Conditions Paragraph 9.3 in its entirety and insert the following in its place:

9.3 Engineer will assign a Resident Project Representative to the Project site. The responsibilities and authority and limitations thereon of the Resident Project Representative will be as provided in Supplementary Conditions Paragraph SC-17.6.

SC-9.10

Delete General Conditions Paragraph 9.10 in its entirety, including the heading "Determinations for Unit Prices:" Delete all other General Conditions references to Paragraph 9.10.

SC-13.4.3

Method of paying for certain tests and inspections is covered in the General Requirements. If General Requirements provisions related to tests and inspections are in conflict with the provisions of General Conditions Paragraph 13.4, the General Requirements provisions shall govern.

SC-14.2.1

Add the following subparagraph under General Conditions Paragraph 14.2:

14.2.1 Conditions relating to payment for Products suitably stored on the Project site, but not yet incorporated in the Work, are given in General Requirements Section 01025.

SC-14.10

Delete General Conditions Paragraph 14.10 and subparagraphs 14.10.1 and 14.10.2, in their entirety. Delete all other General Conditions references to Paragraph 14.10.

Replace General Conditions Paragraph 14.10 with the following Paragraph:

14.10 The Owner reserves the right to, before Substantial Completion, make connections to a portion of the Work or utilize a portion of the Work, providing such connection or utilization does not unreasonably interfere with the Contractor's operations. Such partial utilization of the Work by the Owner prior to Substantial Completion will not be construed as Owner's acceptance of any portion of the Work and will not be considered as a valid basis for changes in the Contract Price or Contract Time.

SC-17.6

At the end of General Conditions Article 17, add a new Paragraph which reads as follows:

Resident Project Representative:

17.6 A Resident Project Representative will be assigned to the Project site. The responsibilities and authority and limitations thereon of the Resident Project Representative will be as follows:

17.6.1 Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, pre-installation conferences and other project-related meetings.

17.6.2 Liaison

17.6.2.1 Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent to assist in understanding the intent of the Contract Documents.

17.6.2.2 Serve as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations.

17.6.2.3 Assist in obtaining from Owner or Engineer additional details or information, when required for proper execution of the Work.

17.6.3 Shop Drawings and Samples

17.6.3.1 Receive samples which are furnished at the site by Contractor, and notify Owner and Engineer of availability of samples for examination.

17.6.3.2 Advise Owner and Engineer and Contractor of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved.

17.6.4 Review of Work, Rejection of Defective Work, Inspections, and Tests

17.6.4.1 Conduct on-site observations of the Work in progress to assist Owner and Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

17.6.4.2 Report to Engineer whenever any work is unsatisfactory, faulty or defective, or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test, or approval required to be made; and advise Engineer of Work that should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection, or approval.

17.6.4.3 Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof; and observe, record, and report to Engineer appropriate details relative to the test procedures and start-ups.

17.6.4.4 Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project; record the results of these inspections and report to Engineer.

17.6.5 Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

17.6.6 Modifications

17.6.6.1 Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report with recommendations to Engineer. Transmit to Contractor decisions as issued by Engineer.

17.6.6.2 Allow minor deviations from Drawings or Specifications when Resident Project Representative is considered to be in the best

position to make such decisions on a timely basis.

17.6.7 Records

17.6.7.1 Maintain orderly files of correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including all Work Change Directives, Addenda, Change Orders, Field Orders, additional Drawings and Specifications issued subsequent to the execution of the Agreement, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project-related documents.

17.6.7.1 Monitor Contractor's work on Record Documents.

17.6.7.2 Keep a diary or log book, recording Contractor hours on the job site, weather conditions, data relative to questions on Work Change Directives, Change Orders or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

17.6.7.3 Record names, addresses, and telephone numbers of all Contractors, Subcontractors, and major suppliers of materials and equipment.

17.6.8 Reports

17.6.8.1 Furnish Owner and Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the progress schedule and schedule of Shop Drawing and sample submittals.

17.6.8.2 Consult with Engineer in advance of scheduled major tests, inspections, or start of important phases of the Work.

17.6.8.3 Report immediately to Owner and Engineer upon the occurrence of any accident.

17.6.9 Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed, and materials and equipment delivered at the site but not incorporated in the Work.

17.6.10 Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that

certificates, Operation and Maintenance manuals, and other data required to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents.

17.6.11 Completion

17.6.11.1 Conduct closeout and final inspections in the company of Engineer, Owner, and Contractor, and assist in preparation of lists of items to be completed or corrected.

17.6.12 The authority of the Resident Project Representative is limited and he is not authorized to:

17.6.12.1 Exceed limitations of authority as set forth in the Agreement or other Contract Documents.

17.6.12.2 Undertake any of the responsibilities of Contractor, subcontractors, or Contractor's superintendent.

17.6.12.3 Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction unless such advice or directions are specifically required by the Contract Documents.

17.6.14.4 Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.

END OF DOCUMENT

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Project Description

B. Project Location.

C. Contractor's Use of Premises.

D. Work Sequence.

E. Special Requirements.

1.02 PROJECT LOCATION

A. Project site(s) is indicated on the "Location Map" on Drawing Sheet No. 1 and "Vicinity Map".

1.03 CONTRACTOR'S USE OF PREMISES

A. Confine construction equipment, the storage of materials and equipment, and operations of workmen to within the permanent and temporary rights-of-way and, in the case of pump station site, to the Owner's property.

B. Pipeline materials may be stored appropriately along the route of the Work provided such stored materials do not unduly restrict public use or infringe on private property.

C. Assume full responsibility for materials stored on site (including materials for which the Owner has made payment).

D. The Contractor shall limit his use of the premises to the Work indicated, so as to allow for Owner occupancy and use by the public.
   1. Keep existing driveways and entrances clear and usable at all times. Do not use these areas for parking or storage of materials.
   2. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas designated by the Owner. If additional storage is necessary obtain and pay for such storage off site.

1.04 WORK SEQUENCE

A. Submit with initial progress schedule required by Section 01300, a detailed step-by-step Work sequence which will achieve compliance with the requirements of this Section 01010. Refer to sequence of construction on Plan Sheet 18 of 19.

B. Sequence construction operations to:
   1. Minimize inconvenience to businesses, public facilities, and residences located adjacent to the Project.

2. Minimize disruption of traffic and maintain continuous traffic flow through the Work area to the maximum extent practicable.
3. Maintain continuous access to the Project site for the Owner and the general public.

1.05 SPECIAL REQUIREMENTS

A. Maintain continuous flow, to the maximum extent practicable, in all existing pipelines affected by construction operations. When necessary to interrupt or bypass flow, provide temporary facilities for bypassing, pumping, or other Engineer-approved methods of diverting flows. When pumping or pumping and hauling is required, provide standby equipment to protect against equipment breakdown. Submit detailed plans for flow diversions, including data on equipment capacities and standby equipment, at least seven days prior to the initiation of each flow diversion. Cost of such temporary flow diversions is considered to be included in the Bid price(s) and no extra compensation will be allowed. Contractor will be held responsible for paying any fines or other costs resulting from wastewater spills.

B. When the nature of construction operations requires that wastewater be removed from the Project site, provide Engineer-approved equipment and dispose of such material at legally acceptable sites. Submit details of hauling equipment and location(s) of disposal sites within 20 days after Commencement of Contract Time as defined in Paragraph 2.3 of the General Conditions. Cost of such hauling and disposal is considered to be included in the Bid price(s) and no extra compensation will be allowed. Contractor will be held responsible for paying any fines or other costs resulting from spillage during the loading and hauling operation and from disposal at unacceptable sites.

C. If the nature of construction work requires temporary disruption, relocation, or modification of utility services to businesses, public facilities, or residences adjacent to the Project, provide temporary services by methods approved by the utility company and the Engineer. Cost of such temporary services is considered to be included in the Bid price(s) and no extra compensation will be allowed. If the Contractor's operations result in extended (in excess of one hour) interruption of services, Owner or Engineer may direct utility company to correct such interruptions and the utility company's costs will be charged to the Contractor.

D. In the event that utility relocations or modifications are required during the Work, make arrangements with the affected utility company to perform such relocations or modifications. Cost of such utility relocations or modifications is considered part of the Bid price(s) and no extra compensation will be allowed.

E. Contractor shall communicate and coordinate work with all property owners on which dwellings are located to determine precise location of proposed and existing water and sewer lines to the property.

F. Contractor is responsible for obtaining and paying all costs to acquire a temporary space for trailers, storage areas and similar operations.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Schedule of Values.

B. Applications for Payment.

C. Payment for Tests and Inspections.

D. Products Stored on Project Site.

E. Payment for Contingency Items.

1.02 SCHEDULE OF VALUES

A. Paragraph 2.6.3 of the General Conditions requires submission of a Schedule of Values for lump sum contracts. Prepare this Schedule as follows:
   1. Use format that can later be used as Application for Payment.
   2. Set up "Mobilization/Demobilization" as a separate line item which shall not exceed five percent of the Contract Price, unless prior approval is received from Engineer.
   3. Set up each of the following as separate line items:
      a. Bonds and insurance.
      b. Attendance at conferences and meetings as required by Section 01200.
      c. Sediment and Erosion Control as required by Section 01560.
      d. Record Document preparation as required by Section 01700.
      e. Operation and Maintenance Manual preparation as required by Section 01700.
      f. Submission of spare parts and extra materials as required by Section 01700.
      g. Providing field services of manufacturers' representatives.
      h. Demonstrations and training of Owner's operating personnel.
   4. When Work has been broken down into several portions, each with an associated lump sum price, use the Work portion description as the primary subdivision for the Schedule of Values.
   5. Use Table of Contents for Divisions 2 through 17 to establish line items for Schedule of Values. Provide values for, at least, every Section in Divisions 2 through 17.
   6. When a Section covers several different but related items, provide a value for each separate item. For example, if a pump section covers several different sizes of the same type pump, provide a value for each size pump.
   7. Include within each line item a directly proportional amount of Contractor's overhead and profit.

1.03 APPLICATIONS FOR PAYMENT

A. Submit four copies of Application for Payment at times specified in Paragraphs 14.2 and 14.12 of the General Conditions.

B. Submit Application for Payment on form which has been used for the Schedule of Values and approved by the Engineer.

C. Include following Contractor's signed certification on Application for Payment:

The undersigned Contractor certifies that (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied to discharge in full all obligations of Contractor incurred in connection with Work covered by prior Applications for Payment numbered 1 through X inclusive; (2) title to all materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all liens, claims, security interests, and encumbrances (except such as covered by Bond acceptable to Owner indemnifying Owner against any such lien, claim, security interest, or encumbrance); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective, as that term is defined in the Contract Documents.

1.04 PAYMENT FOR TESTS AND INSPECTIONS

A. Include the costs of shop tests and shop inspections in the price of the manufactured Products, and no separate or extra payment will be made for such tests and inspections.

B. Contractor shall employ and pay for the services of an independent firm(s) to perform laboratory and field testing and inspections as required in the various Specification Sections. Obtain approval of the proposed testing and inspection firms from Engineer. Costs of such tests and inspections shall be included in the bid prices and no separate or extra payments will be made.

1.05 PRODUCTS STORED ON PROJECT SITE

A. Payment will not be made for Products stored on the Project site but not yet incorporated in the Work.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01040

COORDINATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Coordination.

B. Cutting and patching.

1.02 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Do not unload or store materials or equipment where they will interfere with the progress of the Project.

C. For equipment units, coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

E. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.03 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request, and obtain Engineer's approval of proposed cutting and patching methods, in advance of cutting or altering elements which affects:

1. Structural integrity of element.

2. Integrity of weather-exposed or moisture-resistant elements.

3. Efficiency, maintenance, or safety of element.

4. Visual qualities of sight-exposed elements.

5. Work of Owner or separate Contractor.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:

1. Fit the several parts together, to integrate with other Work.

2. Uncover Work to install or correct ill-timed Work.

3. Remove and replace defective and non-conforming Work.

4. Remove samples of installed Work for testing.

D. Execute Work by methods which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.

E. Restore Work with new Products in accordance with requirements of Contract Documents.

F. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

H. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

I. Identify any hazardous substance or condition exposed during the Work to the Engineer for decision or remedy.

J. Cutting and patching methods for piping.

K. Core-Drilling: Make penetrations as required to accommodate the setting of sleeves and pipes through existing walls by the core-drilling method. Make such core-drilled penetrations true, clean, and free from spilling of existing materials.
   a. Following setting of sleeves and conduits in core-drilled penetrations install seals and sealant.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reference surveys.

B. Construction control surveys.

C. Surveys for measurement and payment.

1.02 REFERENCE SURVEYS

A. Prior to the start of construction, Owner will provide and pay for surveys to establish reference baselines and benchmarks.

B. During progress of the Work, protect and preserve reference points, baselines, and benchmarks. Report to Engineer the loss or destruction of any reference points or permanent benchmarks. Replace any damaged or dislocated reference points or permanent benchmarks at Contractor's expense.

1.03 CONSTRUCTION SURVEYS

A. Provide and pay for surveys to establish locations of the Work.

B. Establish and stake locations for:
1. Tank and Structure locations and foundation elevations.

2. Locations and elevations of manholes.

3. Location and elevations for site improvements including roads, walks, fences, catch basins, culverts, storm drains, embankments, manholes, and utility lines.

4. Location and elevation of service connections.

5. Location and elevation of pipelines and utilities.

C. Prior to the start of construction, prepare and submit a drawing, prepared by a registered Maryland surveyor approved by the Engineer, certifying that the locations and elevations established by field surveys are in conformity with the Contract Documents.

D. If, during the construction surveys, Contractor discovers an apparent problem with the reference surveys, immediately report this situation to the Engineer. Do not proceed with construction until the problem has been resolved and, if required, the reference surveys have been corrected.

1.04 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Perform surveys to determine quantities of unit price work, including control surveys to establish measurement reference lines. Notify Resident Project Representative prior to starting work.

B. Contractor shall sign surveyor's field notes and shall calculate and certify quantities for payment purposes.

C. The cost for performing Contractor stakeout shall not be measured or paid for separate, but all costs are to be included in other pay items as appropriate.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preconstruction conference.

B. Progress meetings.

1.02 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a conference to be held prior to Contractor's commencement of the Work.

B. Attendance
   1. Owner's representatives
   2. Engineer
   3. Contractor (attendance required)
   4. Major Subcontractors
   5. Governmental agency representatives, utility representatives, and other parties who may have control of, or may be affected by, the Work.

C. Agenda Items (as applicable to the Project)
   1. Designation of Contractor's supervisory personnel and phone numbers to be used in event of an emergency during non-working hours.
   2. List of major Subcontractors and suppliers
   3. List of proposed Products
   4. Schedule of Shop Drawing submissions
   5. Construction progress schedule and work sequencing
   6. Utility relocations
   7. Procedures for submittals; Field Orders and Change Orders; and Applications for Payment
   8. Reference points
   9. Record documents
   10. Project coordination
   11. Site security
   12. Temporary utilities
   13. Field offices
   14. Housekeeping
   15. Safety and first-aid procedures
   16. Environmental requirements

D. Engineer will preside at conference and prepare minutes for distribution to participants.

1.03 PROGRESS MEETINGS

A. Engineer will schedule progress meetings throughout the construction period at intervals as required.

B. Attendance
   1. Owner's representative.

2. Contractor's Project Superintendent (attendance required) and other Contractor(s) representatives.
3. Major Subcontractors and suppliers.
4. Engineer.
5. Resident Project Representative.
6. Others as appropriate for agenda topics for each meeting.

C. Agenda
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

D. Engineer will conduct meeting and prepare minutes for distribution to participants.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.

B. Action on submittals.

C. Shop Drawings.

D. Product data.

E. Samples.

F. Manufacturers' instructions.

G. Manufacturers' certificates.

H. Construction progress schedules.

I. Construction photographs.

J. Proposed Products list.

L. Submittals specified in other Documents/Sections.

1.02 SUBMITTAL PROCEDURES

A. Transmit each submittal with Engineer accepted form.

B. Number each submittal. Number shall consist of the following parts, each separated by a dash:
   1. Contract number.
   2. Five-digit Specification Section number.
   3. Two-digit sequence number starting for each Specification Section with 01 and continuing with 02, 03, etc., for subsequent submittals with the same Specification Section number.
   4. Use the fourth part of the number only for resubmittals. For the first resubmittal of a previous submittal, add -R1 to the previous number. For the second resubmittal, change to -R2, and so on.

   As an example of the numbering process for Contract Number 1, the third submittal under Section 03300 would be numbered 1-03300-03 and the second resubmittal of this same submittal would be numbered 1-03300-03-R2.

C. Identify Project, Contractor, Subcontractor, or supplier. Identify pertinent Drawing sheet and detail number(s), and Specification Section number, as appropriate.

D. Apply Contractor's stamp, signed or initialled certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance

with the requirements of the Work and Contract Documents. Stamp shall have the following format:

Approved for Contract Requirements

The Contractor's signature below indicates that this Submittal has been checked with the Drawings, Specifications, and site conditions and found to meet all requirements of same including dimensions, and that the Contractor's guarantee fully applies to the Product(s) covered.

RE: Project _____

Submittal Number _____

Drawing Sheet Number _____ Detail Number _____

Deviations from Contract Documents? No _____ Yes _____ (letter attached)

By _____
Signature (Contractor)

Contractor's Name _____

E. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.

F. Submit letter which specifically identifies deviations from Contract Documents. Identify Product or system limitations which may be detrimental to successful performance of the completed Work.

G. Where deviations from Contract Documents will affect the Work of another Contractor, the Contractor making the submittal shall attach a letter from the other Contractor(s) stating that the deviation will either:

1. Have no effect on the other Contractor's Work; or

2. Have an effect on the other Contractor's Work and that the Contractor making the submittal has agreed to pay all extra costs associated with the deviation.

H. Provide space for Contractor and Engineer review stamps.

I. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 ACTION ON SUBMITTALS

A. Engineer's Action: Where action and return is required or requested, Engineer will review each submittal, mark with the action taken, and

where possible return within two weeks of receipt. Where submittal must be held for coordination, Contractor will be so advised by Engineer.

B. Submittals returned with "APPROVED" action indicate that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Contract Documents. The Contractor remains responsible for work-related errors, deviations, and discrepancies in the submittal, but may proceed with performance of the work covered by the submittal.

C. Submittals returned with "APPROVED AS NOTED" action indicate that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Contract Documents, provided the noted clarifications or corrections are incorporated in the Work and in the Record Documents. The Contractor remains responsible for work-related errors, deviations, and discrepancies in the submittal, but may proceed with performance of the work covered by the submittal. Resubmission of information is not required.

D. Submittals returned with "RETURNED FOR CORRECTION" action indicate that: (1) information submitted is at least partially not in conformance with the design concept, (2) information submitted is at least partially not in compliance with the requirements of the Contract Documents, (3) submittal is incomplete and does not include all items required by the individual Specification Sections, or (4) certifications or computations required by the individual Specification Sections have not been included with the Shop Drawings and Product data. Engineer will note the deficiencies or corrections required, and return the submittal to the Contractor. Performance of the work covered by the submittal shall not proceed until corrected information is submitted and approved.

E. Submittals returned with "NOT AS SPECIFIED" action indicate that the Engineer interprets the information submitted to be not in conformance with the design concept or not in compliance with the Contract Documents. This action may also indicate non-compliance with the Contractor's responsibility to review information and submit notification of deviations and discrepancies for the Engineer's review. Performance of the work shall not proceed until new information is submitted and approved.

F. Review Action does not establish submitted information as a Contract Document, a Change Order, or authorization to deviate from the Contract Documents.

G. For all re-submittals except the first, Engineer and Engineer's consultants will record manhours required for review of the re-submittal. At the discretion of the Engineer, Contractor may be charged for review of such repeat re-submittals at Engineer's (and Engineer's consultant's) current hourly rates. Charges for repeat re-submittals will be subtracted from Contractor's next progress payment.

1.04 SHOP DRAWINGS

A. Submit the number of opaque reproductions which Contractor requires, plus three copies which will be retained by Engineer.

B. After review, distribute in accordance with Article on "Submittal Procedures" above and provide copies for Record Documents described in Section 01700 - Contract Closeout.

1.05 PRODUCT DATA

A. Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Engineer.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

C. After review, distribute in accordance with Article on "Submittal Procedures" above and provide copies for Record Documents described in Section 01700 - Contract Closeout.

1.06 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Engineer's or Owner's selection.

C. Include identification on each sample, with full Project information.

D. Large, bulky samples may be submitted to the Resident Project Representative at the Project site. Whenever a sample is submitted at the Project site, immediately notify the Owner and Engineer of this submittal in writing.

1.07 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product data.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.08 MANUFACTURER'S CERTIFICATES

A. When specified in individual Specification Sections, submit manufacturers' certificate to Engineer for review, in quantities specified for Product data.

B. Indicate Product conforms to or exceeds specified requirements. Submit supporting computations, reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

D. When required by individual Specification Sections, include computations signed and sealed (or stamped) by a registered Professional Engineer.

E. When Supplementary Conditions specify certain regulatory restrictions concerning origin of Products (for example, that any steel used on the Project must be a Product of the United States), submit a certificate from Products manufacturer that Products supplied to the Contractor are in conformity with the regulatory requirements.

1.09 CONSTRUCTION PROGRESS SCHEDULES

A. Submit four copies of progress schedule for Engineer review. Revise and resubmit as required.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version.

C. Indicate submittal dates required for Shop Drawings, Product data, samples, and Product delivery dates, including those furnished by Owner and under Allowances.

D. Do not include extensions to the Contract Time in revised progress schedules until such extensions have been approved by Owner and Engineer in accordance with Article 12 of the General Conditions.

E. Failure to submit an initial or revised progress schedule, acceptable to the Engineer, before or with each Application for Payment will be considered a substantial violation of the Contract Document provisions. In accordance with Paragraph 14.7 of the General Conditions, the Engineer may recommend that the Owner withhold payment of all or part of the amount shown in an Application for Payment until an acceptable progress schedule is submitted.

F. Time unit used on progress schedule: Week.

G. Establish a dollar value for each schedule activity and include on the schedule.

H. Submit a bar chart (Gantt chart) showing, for each activity on each submittal:
   1. Anticipated start date.
   2. Anticipated completion date.
   3. Actual start date.
   4. Actual completion date.
   5. Percentage of activity completed on date of each submittal.

I. Provide with each submittal a narrative report indicating the activities which have the potential for delaying Substantial Completion beyond the Contract Time. Describe corrective actions which will be taken to prevent this delay.

1.10 CONSTRUCTION PHOTOGRAPHS

A. Each month submit photographs to Engineer with Application for Payment.

B. Photographs: Two prints; color, glossy; 8 x 10 inch size; mounted on 8½ x 11 inch soft card stock, with left edge binding margin for three hole punch.

C. Prior to submission of the first construction photographs, submit sample photograph to Resident Project Representative for approval. Approved sample will serve as the standard of quality for all subsequent photographs.

D. Take photographs no earlier than ten days prior to submitting.

E. Take a minimum of four photographs showing work in progress and indicating work accomplished since last photographs were taken.

F. Identify photographs with date, time, orientation, and project identification.

1.11 PROPOSED PRODUCTS LIST

A. Within 20 days after Commencement of Contract Time as defined in Paragraph 2.3 of the General Conditions, submit four copies of complete list of major Products proposed for use.

B. Include name of manufacturer, trade name, model or catalog designation and, where applicable, reference standard.

1.12 SUBMITTALS SPECIFIED IN OTHER DOCUMENTS/SECTIONS

A. Schedule of Shop Drawing Submittals: General Conditions 2.6.2 and 2.9.

B. Requests for Substitutions: General Conditions 6.7.1, 6.7.2, 6.7.3, as amended by the Supplementary Conditions.

C. Claim Documentation: General Conditions 11.2 and 12.1.

D. Documentation Required with Applications for Progress Payments and Final Application for Payment: General Conditions 14.2 and 14.12.

E. Emergency Crew Names, Addresses, and Telephone Numbers: Supplementary Conditions 6.23.1.

F. Work Sequence: Section 01010.

G. Notice to Owner of Required Electrical Outages or Utility Service Interruptions: Section 01010.

H. Plans for Flow Diversions: Section 01010.

I. Plans for Hauling and Disposal of Wastewater or Sludge: Section 01010.

J. Plans for Traffic Control: Section 01570.

K. Applications for Payment: Section 01025.

L. Request for Approval of Field Survey Firm: Section 01050.

M. Construction Survey Drawing and Certification: Section 01050.

N. Supervisory Personnel Names and Phone Numbers: Section 01200.

O. Request for Approval of Independent Testing and Inspection Firm(s): Section 01025.

P. Reports on Tests and Inspections: Section 01400.

Q. Manufacturers' Field Service Reports: Section 01400.

R. Layout of Resident Project Representative's Office: Section 01500.

S. Plans for Supplementary Erosion and Sedimentation Control Facilities: Section 01560.

T. Start-up Plan: Section 01650.

U. Start-up Certification: Section 01650.

V. Request for Closeout Inspection: Section 01700.

W. Record Documents: Section 01700.

X. Operation and Maintenance Manuals: Section 01700.

Y. Warranties: Section 01700.

Z. Spare Parts and Maintenance Materials: Section 01700.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Quality assurance and control of installation.

B. References.

C. Inspection and testing laboratory services.

D. Manufacturers' field services and reports.

E. Leakage testing.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.03 REFERENCES

A. Conform to reference standards cited in Specifications.

B. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

D. Any measurement or payment provisions included in a reference standard are not applicable to this Project.

1.04 INSPECTION AND TESTING LABORATORY SERVICES

A. The Contractor is expected to secure the services of a qualified firm to perform his own compaction testing, concrete tests and other quality control testing to confirm that the Contractor's work is in conformance with the project documents.

B. The owner will secure and pay for services of an independent testing firm to verify on its own that the work is performed in compliance with the requirements of the project specifications.

C. Cooperate with the Owner's independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

1.05 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification Sections, require Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, and testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.

B. Submit report in duplicate within 14 days of observation to Owner and Engineer for review.

1.06 LEAKAGE TESTING

A. Upon completion of all liquid retaining structures, test for leakage as follows:

1. Fill structure to normal liquid level with potable water.
2. Allow water to remain in tank for 48 hours prior to start of test, then add water as required to bring level up to the initial level.
3. Test for leakage for a period of 96 consecutive hours. For open-top structures, Engineer will measure or compute evaporation loss and precipitation gain during the test period.
4. If, during the 96-hour test period, water loss exceeds an average of 0.1 percent (corrected for evaporation loss and precipitation gain) of the initial water volume in each 24-hour period, leakage rate will be considered unacceptable.
5. When leakage rate is found to be unacceptable, empty structure, make corrections, and retest. Submit plan of corrections to Engineer and obtain approval of such plan prior to start of corrective measures.
6. Obtain approval from Resident Project Representative for method of disposing of water used in testing.

B. Leakage tests for piping systems are covered in Division 15. Other leakage testing requirements, relating to a specific system or structure, may be found in the individual Specification Sections, Divisions 2 through 16. Where other leakage testing requirements are found in these Division 2 through 16 Sections, such specific requirements take precedence over those found in this Section 01400.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Regulatory requirements.

B. Temporary electricity.

C. Temporary lighting.

D. Temporary heat.

E. Temporary ventilation.

F. Temporary telephone service to field office(s).

G. Temporary water service.

H. Temporary sanitary facilities.

I. Barriers.

J. Water control.

K. Dust control.

L. Protection of installed work.

M. Security.

N. Access roads.

O. Parking.

P. Progress cleaning.

Q. Project identification.

R. Contractor's field offices and sheds.

S. Safety equipment.

T. Removal of utilities, facilities.

1.02 REGULATORY REQUIREMENTS

A. Comply with applicable laws and regulations of authorities having jurisdiction, including but not limited to building codes, health and safety regulations, utility company regulations, and environmental protection regulations.

B. Provide electrical equipment which is UL listed.

1.03 TEMPORARY ELECTRICITY

A. Provide and pay for temporary electrical service required from utility company.

B. Provide step down transformers if required for temporary power.

C. Provide main service disconnect and overcurrent protection at convenient location.

D. Provide receptacles and branch wiring for construction operations.

E. Provide flexible power cords as required.

F. Provide engine-generator set to supply power where utility company service is not available.

1.04 TEMPORARY LIGHTING

A. Provide and maintain one watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.

B. Maintain lighting and provide routine repairs.

1.05 TEMPORARY HEAT

A. Provide and pay for heat devices and heat as required to maintain specified conditions for construction operations.

B. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

C. Maintain minimum ambient indoor or within-enclosure temperature of 50°F in areas where construction is in progress, unless indicated otherwise in Specifications.

1.06 TEMPORARY VENTILATION

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.07 TELEPHONE SERVICE TO FIELD OFFICE(S)

A. Provide, maintain, and pay for telephone service to field office(s).

1.08 TEMPORARY WATER SERVICE

A. Provide, maintain and pay for suitable quality water service required.

B. Connect to existing water source for construction operations.

1.09 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facilities shall not be used.

B. Provide self-contained single-occupant toilet units of the chemical, aerated-circulation, or combustion type. Units shall be properly vented and fully enclosed with a shell of glass fiber-reinforced polyester or similar non-absorbent material.

1.10 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide protection for plant life designated to remain. Replace damaged plant life.

C. Protect vehicular traffic, stored Products, site and structures from damage.

1.11 WATER CONTROL

A. At all times during the construction of Work on this Project maintain the flow of storm water, naturally occurring water and wastewater in existing facilities and channels affected by the Work.

B. Contractor assumes risk from flood damages to the work in progress or to work completed. Make repairs and replacements to the satisfaction of the Engineer or Resident Project Representative.

C. Contractor assumes responsibility for damages to property caused by flooding due to blocking or restriction of storm water passages, natural waterways, and wastewater facilities.

D. Do not at any time permit wastewater flow from existing sewers to flow into nearby waterways or to flow on surface areas.

E. See other water control requirements under Section 01560 -- "Sediment and Erosion Control".

1.12 DUST CONTROL

A. Maintain all work areas, both on and off the Project site, free from dust.

B. Use sprinkling of water and/or, if approved by the Engineer or Resident Project Representative, chemical or light bituminous treatment to control dust.

C. Where sprinkling is used, repeat at intervals as required to keep all parts of the disturbed area at least damp at all times.

D. Perform dust control whenever a dust nuisance or hazard occurs and whenever directed by the Engineer or Resident Project Representative.

1.13 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

C. Prohibit traffic from landscaped areas.

1.14 SECURITY

A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft.

1.15 ACCESS ROADS

A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to fire hydrants, free of obstructions.

1.16 PARKING

A. Provide temporary crushed stone surface parking areas to accommodate construction personnel.

B. When site space is not adequate, provide additional off-site parking.

1.17 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove waste materials, debris, and rubbish from site daily and dispose off-site.

C. Remove mud and construction debris on a daily basis from paved surfaces used by the Contractor.

1.18 PROJECT IDENTIFICATION

A. Provide Project signs of Exterior grade plywood and wood frame construction, painted, with exhibit lettering by professional sign painter. Format of signs shall be as shown on the attachment at the end of this Section 01500.

B. Erect signs on site at location established by Resident Project Representative.

C. No other signs are allowed without Owner permission except those required by law.

1.19 CONTRACTORS' FIELD OFFICES AND SHEDS (Optional)

A. Office: Weather-tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Locate offices and sheds a minimum distance of 50 feet from existing and new structures.

1.20 SAFETY EQUIPMENT

A. First Aid Supplies: Comply with governing regulations.

B. Fire Extinguishers
   1. Provide wall-mounted fire extinguishers for temporary offices and for work spaces.
   2. Comply with NFPA 10 and 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.21 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, and materials prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01560

SEDIMENT AND EROSION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work required by regulations to prevent soil erosion and control sedimentation during Work on the Project.

1.02 SEDIMENT AND EROSION CONTROL PLAN

A. The requirements of the Sediment and Erosion Control Plan are given in the following Articles of this Section. Construction details for various Sediment and Erosion Control measures are shown on the Drawings.

1.03 REGULATORY REQUIREMENTS

A. The sediment and erosion control measures are subject to inspection by State, county, and local regulatory agencies. The Contractor shall be fully responsible for constructing and maintaining the sediment and erosion control measures to the extent that they are, at all times, acceptable to the regulatory agencies. The Contractor shall be liable for payment of any fines or legal costs that the Owner may incur as a result of the Contractor's failure to properly construct and maintain the sediment and erosion control measures.

B. The objective of the "Sediment and Erosion Control Plan" is the protection of private property. To assist any damaged property owners in redress of grievances, the following stipulations are made:
   1. Any silt, sediment, or mud leaving the construction site will be construed as damage to neighboring property and evidence of negligence on the part of the Contractor.
   2. Any damages claimed by neighboring property owners will be rectified and restitution made by the Contractor.

C. Comply with the *1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control*, published jointly by the Water Resources Administration, Soil Conservation Service and State Soil Conservation Committee.

D. Comply with any local laws, codes, and regulations concerning the construction and maintenance of sediment and erosion control measures.

1.04 CONSTRUCTION SEQUENCE

A. Install all sediment and erosion control measures prior to start of clearing operations.

B. Conduct construction operations in accordance with the sequence shown on Plan sheet 18 of 19.

1.05 GENERAL SEDIMENT AND EROSION CONTROL METHODS/PROCEDURES

A. In all cases, the smallest practical area of land surface shall be disturbed.

B. Stripped topsoil shall be placed up slope from proposed construction areas where possible. Stockpiles shall be stabilized if to remain in place longer than 14 days. Topsoil shall be kept separate from all other materials.

C. Utility excavations shall be open only long enough to properly install and inspect all underground facilities in accordance with applicable Specification Sections.

D. Excavated material shall be placed up slope from the excavation whenever possible. Runoff from spoil piles shall be directed through a sediment filter structure and discharged in a non-erosive manner. Stockpiles of excavated material shall be stabilized if to remain in place longer than 14 days.

E. Dewatering equipment discharge shall be directed onto a stabilized surface so that erosion does not occur. Discharges shall be directed through a sediment filter structure or sedimentation basin and discharged in a non-erosive manner.

F. Backfilled excavations shall be restored to original type of cover and grade in accordance with Specifications. Temporary stabilization is required for any and all erodible/soluble areas and materials to be exposed for a period of time exceeding 20 days.

G. Areas to be seeded or sodded shall be finish graded with six inches of topsoil unless otherwise specified. Positive drainage shall be maintained away from all structures. No isolated low spots shall be created.

H. All sediment shall be prevented from entering any storm drain, ditch, or water course through use of a sediment filter structure.

I. Construction access from unpaved areas to paved areas or streets (public or private) shall be via a stabilized construction entrance. The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto the paved surface. Sediment spilled, dropped, or tracked onto paved surface shall be removed immediately.

1.06 SPECIFIC SEDIMENT AND EROSION CONTROL PROCEDURES

A. Clearing/Grubbing
   1. Upstream diversion facilities shall be constructed and operational prior to removal of vegetation from Project areas. This system shall divert surface runoff away from the construction area.
   2. A temporary diversion and collection system shall be provided at the downstream limits of all areas to be stripped. This facility shall be in place and functional prior to stripping operations. This system shall collect sediment-carrying water from the construction area and convey it to temporary or permanent sediment traps for non-erosive discharge onto stabilized areas.
   3. Temporary and permanent sediment traps and discharge structures shall be located such that all surface water leaving the construction area passes through them.

B. Rough Grading Excavation

1. Upstream diversion facilities shall be re-established and relocated as required to maintain function during excavation operations.

2. Temporary and permanent diversion and collection system shall be modified or installed at the downstream limits of all areas to be excavated. All discharge from such facilities shall be via either temporary or permanent sediment traps and discharge structures.

3. Temporary and permanent sediment traps and discharge structures shall be modified or installed at all points of discharge of sediment-carrying water.

C. Stockpiles: Soil stockpile areas to remain in place for periods of time greater than 20 days shall be stabilized with temporary seeding.

D. Dewatering Operations: Dewatering operations, when required, shall discharge through sediment traps onto non-erodible surfaces. Existing sediment trap structures may be utilized or additional structures may be required.

E. Temporary Sediment Traps for Storm Drain Inlets
1. Traps shall be installed immediately upon completion of any new storm drainage inlet structure. Traps shall also be installed where there is a possibility of runoff from the construction area entering existing storm drain inlets.
2. Sediment traps shall be inspected after each rain and maintained in a functional condition at all times during the construction period.
3. Traps shall be removed when contributing drainage areas are stabilized.

F. Temporary Sediment Traps for Ditches and Swales
1. Traps shall be installed immediately upon completion of the ditch or swale.
2. Sediment traps shall be inspected after each rain and maintained in a functional condition at all times during the construction period.
3. Traps shall be removed when entire ditch has been stabilized by seeding or other methods.

G. Dewatering Basins
1. Construct dewatering basin(s) to intercept any water, including that from dewatering operations, where required to remove sediment by providing detention volume and settling time.
2. Remove sediment from basin whenever approximately one-third of basin volume is filled with sediment.
3. Construct dewatering basins as shown on the Drawings.

H. Silt Fence Sediment Barrier
1. Silt fence sediment barrier shall be used to filter sediment from runoff.
2. Sediment barriers shall be inspected after each rain and repaired as required to maintain proper function.
3. Remove sediment behind barrier whenever sediment deposit reaches depth of approximately six inches.
4. See Drawings for details on construction of silt fence sediment barrier.

I. Straw Bale Sediment Barrier

1. Straw bales shall be used only as short-term control measures.

2. Bales shall be securely staked across areas of concentrated flow.
3. Bales shall be inspected regularly and replaced as necessary.

J. Stabilized Construction Entrance
   1. Install stabilized construction entrance at each point where construction traffic leaves Project site and enters any paved or public roads.
   2. Stabilized construction entrances shall be used to reduce tracking of mud onto paved roads.
   3. Any sediment or mud which flows or is tracked onto any paved or public roads shall be removed daily.
   4. The stabilized construction entrance shall be removed when permanent pavement structure will be constructed.
   5. See Drawings for details on construction of stabilized construction entrance.

K. Temporary Stabilization of Construction Roads (including those which will become permanent roads), Temporary Parking Areas, and Construction Staging Areas
   1. Stabilize all areas which will be used for storage and by construction vehicles to minimize dusting, to prevent accumulation of water, and to prevent erosion.
   2. Where temporary stabilization methods have been used on roads which will become a permanent feature of the finished Project, remove all temporary stabilization materials which have been contaminated with mud or are otherwise unsuitable as permanent surfaces or as base/subbase for bituminous or cement concrete paving materials.

L. Channel Diversions
   1. When required, construct fabric-based channel diversions to route flow around sections of existing channels.
   2. See Drawings for configuration of diversion ditches or dikes.

M. Temporary Cover -- The following methods shall be used to provide temporary ground cover and stabilization of erodible surfaces:
   1. Seeding
      a. The seed shall be 100% (by weight) annual rye, and shall be applied at the rate of 10 pounds per 1,000 square yards.
      b. Temporary seeding on slopes in excess of 5:1 shall be mulched. All temporary seeding between June 1 and September 15 shall be mulched. Temporary seeding shall be watered as required to develop cover.
      c. Mulch shall be straw, shall be clean and free from noxious weeds, and shall be applied at the rate of 100 pounds (2-3 bales) per 1,000 square feet.
   2. Black Polyethylene Sheeting: 3 mil black polyethylene sheeting may be used to stabilize erodible/soluble material stockpiles. Sheets shall be overlapped so as to shed and not contain water. Sheets shall be anchored with tires or approved equal at six feet 0.C. along seams and edges and ten feet 0.C. throughout.
   3. Plywood Sheeting: Plywood sheeting may be used to protect existing vegetation under short duration storage/stockpile areas. Use of this protection method shall be limited to maximum four days. Contractor shall be responsible for restoring or replacing vegetation damaged under sheeting.

1.07 RESTORATION

A. After completion of construction, remove all temporary erosion and sedimentation control devices. Restore areas in which these devices were located to the original condition or to the condition called for by the Contract Documents.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General requirements for control of public traffic through the Work area with the goal of ensuring safe and efficient traffic movement and providing safe working conditions for Contractor's personnel.

1.02 TRAFFIC REGULATION REQUIREMENTS

A. Requirements of Regulatory Agencies:
   1. Traffic regulation on streets other than State Highways shall be performed in accordance with the requirements of local agencies having jurisdiction.

B. Maintenance of Traffic
   1. It shall be the Contractor's responsibility to maintain pedestrian and vehicular traffic safety adequately and continuously on all portions of existing facilities affected by the work. In addition to existing facilities undergoing improvement, this responsibility also extends to crossroads, approaches, crossovers and entrances affected or made necessary by the work.
      a. Flagging motor vehicular traffic
         1) For all construction operations requiring the flagging of motor vehicles, said flagging shall be conducted as specified in the *Manual on Uniform Traffic Control Devices for Streets and Highways*.
      b. Barricades and warning signs
         1) The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices; and the Contractor shall take all necessary precautions for the protection of the Work and the safety of the public.
         2) The Contractor shall erect warning signs, in advance, of any place on the project where operations may interfere with the use of the facility by vehicular traffic and at all other points where the new work crosses or coincides with an existing roadway or traffic lane(s). Such Warning Signs shall be constructed and erected in accordance with the *Manual on Uniform Traffic Control Devices*, or as directed.
         3) The Contractor shall furnish, erect, and maintain Warning and Direction signs in the number required by the Engineer through the limits of the Project. For street and highway-type traffic, the signs shall conform in every respect to the requirements of the *Manual on Uniform Traffic Control Devices for Streets and Highways*. Signs shall be freshly painted before being placed on the Project. No Work may begin or be done unless an adequate number of signs of the proper category are in place.
         4) Where the Contractor's sequence of operations results in grade differentials which would be hazardous to vehicular traffic, the Contractor shall provide suitable guardrail.

c. Detours
   1) Where it has been established that traffic cannot be maintained, the Contractor may request the Engineer to consider a detour route.
   2) Before using an approved detour route, the Contractor shall notify the Owner seven days in advance of road closure.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Transportation and handling.

B. Storage and protection.

1.02 TRANSPORTATION AND HANDLING

A. Transport and handle Products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.

C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.03 STORAGE AND PROTECTION

A. Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive Products in weather-tight, climate controlled enclosures.

B. For exterior storage of fabricated Products, place on sloped supports, above ground.

C. Provide off-site storage and protection when site does not permit on-site storage or protection.

D. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

F. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained under specified conditions.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01650

EQUIPMENT, SYSTEMS, AND FACILITY START-UP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Start-up and testing of equipment and systems.

B. Demonstration and instructions.

1.02 START-UP AND TESTING OF EQUIPMENT AND SYSTEMS

A. General

1. Costs of start-up and testing are considered part of the Contractor's Bid price(s) and no extra compensation will be granted for this phase of Work.

2. Submit a start-up and testing plan to Engineer for approval at least 14 days prior to the initiation of this phase of the work. Include:
   a. Proposed dates and time periods for starting and testing each system or equipment item.
   b. Names of manufacturers' representatives which will be present during this phase of the Work and the time periods during which they will be on the Project site.
   c. Dates and time periods proposed for "Demonstration and Instructions" for each system and equipment item.
   d. Plans for coordinating with other Contract Document requirements, including:
      1) Structure leakage testing.
      2) Pipe system testing.
      3) Disinfection of potable water systems.
      4) Electrical system testing.
3. Notify Engineer at least seven days prior to the start-up of each system and equipment item.
4. Coordinate start-up and testing of various systems and equipment items.
5. Execute equipment and system start-up and testing under supervision of responsible manufacturer's representatives and in accordance with manufacturers' instructions.
6. Where specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and testing.
7. Requirements for electrical system testing are specified in Section 16010.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

C. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that instrumentation, control, alarm, annunciation, and automatic shutdown systems are operating properly.

E. Verify wiring and support components for equipment are complete and secure.

F. Check water containment structures, piping, and equipment for leaks.

G. Verify that equipment items are operating without excess vibration.

H. Verify that all valves will open and close without binding.

I. Simulate power failure to verify that standby systems function properly and that re-activation of utility power source will not result in damage to or malfunction of equipment and control systems.

J. See individual Specification Sections for start-up and testing requirements for specific equipment items.

K. Correct any deficiencies prior to requesting closeout inspection.

L. Submit a written report certifying that all systems and equipment items are functioning correctly and ready for long-term operation.

1.03 DEMONSTRATION AND INSTRUCTIONS

A. During start-up and testing operations, demonstrate operation and maintenance of equipment to Owner's personnel.

B. Where required by individual Specification Sections, require qualified manufacturers' representatives to participate in demonstration and instructions.

C. Utilize Operation and Maintenance manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location.

E. Prepare and insert additional data in Operations and Maintenance manual when need for additional data becomes apparent during instruction.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Project record documents.

D. Adjusting.

E. Operation and maintenance data.

F. Warranties.

G. Spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. General Conditions Article 14 contains detailed requirements for Project closeout. Sequence of closeout procedures is as follows:

1. Contractor submits written request for closeout inspection to Engineer.
2. Owner, Engineer, and Contractor conduct closeout inspection.
3. Engineer prepares "punchlist" of items to be completed and submits to Contractor.
4. Contractor completes items on punchlist and requests re-inspection.
5. Engineer and Contractor conduct re-inspection.
6. If, on the basis of re-inspection, Engineer believes Project to be substantially complete, Engineer prepares a tentative certificate of Substantial Completion and submits to Owner for approval. Tentative certificate fixes the date of Substantial Completion and includes a list of items to be completed and time limit for their completion. List of items to be completed will include deficiencies in cleaning and in submittal of spare parts, extra materials, Operation and Maintenance manuals, inspection certificates from regulatory agencies, Record Documents, warranties, and other items required by the Contract Documents.
7. When Owner accepts the tentative certificate, Engineer issues to the Contractor a Certificate of Substantial Completion as described in the General Conditions.
8. When Contractor completes items on the final punchlist, as issued with the Certificate of Substantial Completion, he requests final inspection.
9. Owner, Engineer, and Contractor conduct final inspection.
10. If Owner and Engineer agree that all items have been completed, Contractor will submit Final Application for Payment.
11. Contractor submits Final Application for Payment, including all documents required by the General Conditions and any other portion of the Contract Documents, to the Engineer. Final Applications for Payment shall identify total adjusted Contract Price, previous payments, and amount remaining due.

12. When Engineer approves Final Application for Payment, he submits to Owner with recommendation for payment.
13. Owner makes final payment to Contractor, deducting the amount of liquidated damages and the amount of any unresolved claims which have been filed against the Owner in connection with the Work.

1.03 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Remove paint spatters from all exposed surfaces.

C. Remove paint from mechanical and electrical equipment name plates.

D. Replace filters of operating equipment.

E. Remove debris from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, and manholes.

F. Wipe surfaces of mechanical and electrical equipment clean; remove excess lubrication.

G. Sweep and remove stains and foreign deposits from paved areas.

H. Rake landscaped areas.

I. Remove waste and surplus materials, rubbish, and construction facilities from the site. Do not burn waste materials, bury debris or excess materials on Owner's property, or discharge volatile or other hazardous materials into drainage systems. Remove waste materials from the Project site and dispose of in a lawful manner.

1.04 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed Shop Drawings, Product data, and samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product Section description of actual Products installed, including the following:
1. Manufacturer's name and Product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured elevations of foundations in relation to plant datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to plant datum and base lines.

3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Drawings.

F. Delete Engineer title block and seal (by crossing out) from Record Drawings.

G. Include the following Contractor's signed statement on each Record Drawing sheet:

These Record Drawings have been prepared by

_____
(Name of Contractor)
and accurately reflect as-built conditions. Responsibility for accuracy of the Record Drawings rests with the Contractor.

H. Submit documents to Engineer with request for closeout inspection. (See Paragraph 1.02A1 of this Section.)

1.05 ADJUSTING

A. Adjust operating Products to ensure smooth and unhindered operation.

1.06 OPERATION AND MAINTENANCE DATA

A. Furnish Operations and Maintenance manuals for each piece of mechanical or electrical equipment supplied under this Contract.

B. Submit three draft copies of each manual to the Engineer for review at least 30 days prior to the 60 percent payment. At draft stage, Shop Drawings may be omitted.

C. Following approval of the draft copies and at least 30 days prior to the 90 percent payment, furnish for the Engineer's review and approval three copies of the proposed final manuals, bound in three-ring binders as described below.

D. The final bound manuals must be approved by the Engineer before the first closeout inspection will be conducted.

E. The required number of copies of all sections of the final approved manuals must be received by the Engineer before starting the "Demonstration and Instructions" as described in Section 01650.

F. Include the following materials in the manuals for each piece of equipment supplied under this Contract:
1. Equipment name, location, and number of units.
2. Manufacturer's name, address, and phone number.
3. Name, address, and phone number of the nearest certified manufacturer's representative.
4. Nameplate data for basic unit as well as components such as motor and drive.
5. Approved Shop Drawings, corrected to as-built conditions.
6. Manufacturer's bulletins, schematics, diagrams, and supplemental material which is necessary to provide a complete functional

description of the subject equipment and component parts including basic configuration and nomenclature; operating principles and characteristics including test data and performance curves where applicable; dimension drawings; and capacity or conditions of service. If the manufacturer's bulletins cover more than one size, model, or configuration, clearly indicate the information covering the specific unit or units supplied under this Contract.

7. Detailed written procedures to be used for all modes of operation including any precautions for personal safety or for prevention of damage to the equipment. This includes initial start-up, normal operation, emergency operation, shutdown, and restarting. Describe required operating checks, calibration, and field performance measurements.
8. Guides to testing and troubleshooting. Include a chart giving symptoms, probable cause, and remedies.
9. Instructions with easily understood schematics or diagrams for disassembling and assembling the equipment for overhaul and repair.
10. A lubricating schedule showing lubrication point, frequency, and recommended lubricant, including one or more major brand alternates. Include lubrication recommendations for periods when equipment is in standby or storage.
11. Recommended preventive maintenance measures and frequency of performance. Describe each recommended maintenance measure in terms of procedure, tools, parts, materials, or test equipment necessary to perform the procedure.
12. Complete parts list with parts assembly drawing (preferably by exploded view), recommended list of spare parts to be kept "in stock", and ordering information.
13. Identification of any special tools required for proper maintenance.
14. Any additional information required to maintain equipment warranty.

G. For equipment that will function as part of a system, assemble data in a manner that describes the operation and maintenance of the entire system. Provide systems information described below, corrected to as-built conditions:
   1. Process and instrumentation drawings.
   2. Ladder diagrams.
   3. Wiring diagrams including one-line diagrams, schematic or elementary diagrams, and terminal board identification diagrams.
   4. Piping and interconnection drawings.

H. Submit final Operation and Maintenance manuals bound in loose-leaf three-ring binders designed for paper sized 8½ by 11 inches and having black vinyl covers. Larger sized sheets may be folded, no more than twice. Use pages which are linen reinforced on binding side. Use National Brand 98-984 binders, or equal.

I. Fold Shop Drawings to approximately 8 by 10 inches with drawing title block exposed. Group Shop Drawings descriptive of a single item of equipment together. Place Shop Drawings in clear plastic, three-hole punched sheet protectors equivalent to Oxford Copy-Safe.

J. Include in binders Shop Drawings previously submitted for review and approval and bearing the Engineer's stamp of approval and comments.

K. Provide each binder with a title page giving the Owner's name, contract name and number, and date of submission. Provide label on binder back,

giving same data as on title page and showing volume identification if more than one volume is required. Provide, following the title page, an index listing the contents of the documents. Arrange contents by Specification Section. Provide each Section with an indexed tab for quick reference.

L. Subsequent to the Engineer's approval and return of the final bound manuals, submit six complete bound sets of manuals for distribution by the Engineer.

M. Certificate of Substantial Completion will positively not be issued until approved Operations and Maintenance Manuals have been submitted. Partial approvals of the final manual will not be made.

1.07 WARRANTIES

A. Provide duplicate notarized copies.

B. Assemble documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.

D. Submit prior to final Application for Payment.

E. Date of warranty shall be no earlier than the date of Substantial Completion.

F. For items of Work delayed beyond date of Substantial Completion, provide updated warranty within ten days after acceptance of such work, listing date of acceptance as start of warranty period.

G. For warranties with coverage period exceeding one year, make provisions for direct assignment of warranty to Owner one year after date of Substantial Completion.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide Products, spare parts, maintenance, and extra materials in quantities specified in individual Specification Sections.

B. Deliver to Project site and place in location as directed; obtain receipt prior to Final Application for Payment.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 02010

MOBILIZATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Mobilization

1.02 DESCRIPTION

A. Mobilization shall include, but not necessarily limited to, the performance of preparatory construction operations, including the movement of personnel and equipment to the project site; application, fee payment and acquisition for all necessary permits (i.e., sediment control plan for staging areas, temporary and permanent building permits, utility connections, etc.); and the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work on a substantial phase of the Contract. The cost of required insurance and bonds shall be included in this item.

1.03 SUBMITTALS

A. Submittals:

The Contractor shall furnish proof of carriage of insurance as specified elsewhere in these specifications.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.01 PERFORMANCE

A. All work performed in providing the facilities and services shall be done in a safe and workmanlike manner.

END OF SECTION

SECTION 02040

MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Maintenance of Traffic

1.02 RELATED SECTIONS

A. Traffic Control Plan for Maintenance of Traffic: Section 02045.

B. Traffic Manager for Maintenance of Traffic: Section 02051.

C. Arrow Board for Maintenance of Traffic: Section 02052.

D. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

E. Temporary Pavement Tape Marking for Maintenance of Traffic: Section 02054.

F. Reflectorization of Channeling Devices: Section 02055.

G. Drums for Maintenance of Traffic: Section 02056.

H. Temporary Precast Concrete Traffic Barriers for Maintenance of Traffic: Section 02057.

I. Barricades for Maintenance of Traffic: Section 02058.

J. Temporary Crash Cushion Sand Filled Plastic Barrels: Section 02059.

1.03 DESCRIPTION

A. This work pertains to the maintenance of traffic, both vehicular and pedestrian, on any facility affected by the work of the Contract.

B. All work shall be in accordance with the latest issue of the Manual on Uniform Traffic Control Devices, the Contract Documents, and as directed by the Engineer. Unless specifically included in the Proposal as a bid item, maintenance of traffic shall include furnishing traffic managers and flaggers; relocating, maintaining, and removing existing traffic signs and other traffic control devices; and implementation of a Traffic Control Plan (TCP).

1.04 QUALITY ASSURANCE

A. Source Quality Control

1. The Engineer will inspect all materials furnished by the Contractor for maintenance of traffic to ensure compliance with the Contract Documents. However, the inspection, or the lack thereof, by the Engineer shall in no way relieve the Contractor of his responsibility to provide for the maintenance of traffic in accordance with the Contract Documents.

1.05 SUBMITTALS

A. The Contractor shall submit a Traffic Control Plan (TCP) for all work within any obstruction of and/or crossing of any public right-of-way or any private drive, access road, parking lot, or sidewalk.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials, whether temporary or permanent, shall meet the requirements of the Manual on Uniform Traffic Control Devices and the Contract Documents.

PART 3 - EXECUTION

3.01 PERFORMANCE

A. The Contractor shall provide for the safe and expeditious movement of all traffic through the project in accordance with the TCP, the Contract Documents, and as directed by the Engineer.

B. Equipment which is in use and requires temporary storage within the limits of the project and materials stored or stockpiled on the project site shall be placed in a location which shall not be hazardous to the traveling public and as approved by the Engineer.

C. All vehicles and all construction equipment entering or leaving the Project site and/or work area must follow the traffic flow pattern as established by the Traffic Control Plan.

D. All construction operations shall be performed in the normal direction of traffic flow unless written permission is obtained from the Engineer prior to the commencement of such work. Work performed and equipment moving against the normal traffic flow pattern is strictly prohibited unless a written exception is granted by the Engineer.

END OF SECTION

SECTION 02045

TRAFFIC CONTROL PLAN FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Traffic Control Plan

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

1.03 DESCRIPTION

A. Each Contract shall contain a Traffic Control Plan (TCP), which will assure the safety of motorists, pedestrians and construction workers for highway construction projects. The TCP will cover such items as signing, pavement markings, methods and devices for delineation and channelization, the placement and design of barriers, barricades and impact attenuators, and other items as required.

B. The Contractor is required to develop and implement the TCP. The Contractor's TCP shall be submitted in writing to the Engineer 20 days prior to starting any work. The Contractor must have written approval from the Engineer of his TCP prior to its implementation.

C. The TCP shall be implemented by the Contractor's traffic manager as specified in Section 02053. The TCP is subject to amendment during the life of the Contract due to changing field conditions. Implementation of either TCP does not relieve the Contractor of any of the provisions set forth in the Special Provisions or of these Specifications.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 02051

TRAFFIC MANAGER FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Traffic Manager

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

1.03 DESCRIPTION

A. The Contractor shall assign to the project an employee to serve in the capacity of traffic manager. The employee shall be thoroughly experienced in all aspects of traffic control.

B. The Contractor shall submit the traffic manager's name, qualifications and copy of certificates, to the Engineer for approval at least 10 working days prior to commencing any work on the project. Any change in the appointment of the individual during the term of the Contract shall require a written submission and approval by the Engineer.

C. The traffic manager shall have the primary responsibility and sufficient authority for the implementation of the approved Traffic Control Plan, the monitoring and maintenance of signs, pavement markings, channelizing devices, arrow boards, detour signals, turnouts, the furnishing of watchpersons, flaggers and other safety aspects of the Contract.

D. The traffic manager shall closely coordinate his operations with the City. The traffic manager shall oversee and supervise all aspects of maintenance of traffic on the project including those involving Subcontractors. He will be required to make on-site inspection of those operations that affect traffic (vehicular and pedestrian) on a regular basis and be available for consultation at all times. The increase, decrease or elimination of the item shall be in accordance with the Specifications.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 02052

ARROW BOARD FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Arrow Board

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

1.03 DESCRIPTION

A. At those locations where a traffic lane is being closed for purposes of construction, an arrow board meeting the specifications noted below shall be used at the direction of the Engineer. The arrow board shall supplement standard signing as required by the Manual on Uniform Traffic Control Devices (MUTCD), State Highway Administation (SHA) Specifications, the Traffic Control Plan (TCP) and/or the Standards.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The arrow board(s) may be self-contained, vehicle mounted or portable and, as a maximum, meet the requirements of the State Highway AdministratIon Specifications, Section 104.07.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Arrow board(s) or maintenance of traffic shall be used when necessary to temporarily occupy any part of the travelled width of roadway which will restrict traffic, either on the project or on any other existing roadway. Arrow boards shall not be placed without the approval of the Engineer. Where the State Highway Administration's TCP indicates that arrow board(s) will be used, any alternate plans to the State Highway Administration's TCP must also include arrow board(s). The Contractor is responsible for maintaining the unit(s) in good operating order.

B. On two-lane, bidirectional highways, arrow board(s) shall be used only in the caution mode unless indicated otherwise by the TCP or the Engineer.

C. The Contractor is responsible for maintenance of the units, including cleaning, so as to provide maximum protection for and visibility to the travelling public.

D. The Contractor shall make a request to the Engineer for such lane usage 24 hours in advance of the time a traffic lane is desired to be made available to him for the prosecution of the work. Prior to opening the closed lane to traffic, the Contractor shall clear the lane of all material, equipment and debris and shall leave it in a condition satisfactory to the Engineer for the resumption of its use by the public.

END OF SECTION

SECTION 02053

TRAFFIC CONTROL SIGNS THROUGH CONSTRUCTION AREAS FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Traffic Control Signs

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

1.03 DESCRIPTION

A. This work shall consist of furnishing and placing of signs for the purpose of controlling traffic, vehicular and pedestrian, through all construction areas on State highways.

B. All traffic control signs used on construction, maintenance and public utility operations under the jurisdiction of the Town of Indian Head shall be in accordance with this section and the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD)and the State Highway Administration (SHA) Specifications.

C. Traffic control signs shall be installed at the beginning of construction operations and shall be properly maintained and/or operated during the time such conditions exist. They shall remain in place only as they are needed and shall be immediately removed thereafter. Where operations are performed in stages, only those devices that apply to the conditions present shall be used. Signs that do not apply to existing conditions shall be removed, covered with opaque material or turned so as not to be readable by oncoming traffic. Sign supports shall be constructed and erected in a workmanlike manner.

D. Signs for the purpose of controlling traffic shall not be obscured by weeds, trees, shrubbery, construction equipment, materials or spoil, personal vehicles, etc.

E. All traffic control signs (rigid or flexible) used at night shall be reflectorized to show the same shape and color as in daylight conditions. The sign background shall be the color/colors as specified (MUTCD).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reflective sheeting shall have either a wood or aluminum backing.

B. The reflective sheeting shall be the encapsulated lens type meeting the latest requirements of Federal Highway's Standard

Specifications for Construction of Roads and Bridges on Federal Highway Projects.

2.02 COLOR REQUIREMENTS

A. The color specified shall be matched visually and be within the color tolerance limits shown on the appropriate Highway Color Tolerance Charts issued by the Federal Highway Administration and utilizing the instructions thereon. Certification as to conformance with this requirement will be accepted by the Engineer.

TABLE 02053-1

MINIMUM REFLECTIVE INTENSITY VALUES FOR ENCAPSULATED LENS SHEETING

Observation Angle (°)	Entrance Angle (°)	Silver-White	Yellow	Red	Orange	Green	Blue
0.2	- 4	250	170	45	100	45	20.0
0.2	+ 30	150	100	25	60	25	11.0
0.5	- 4	95	62	15	30	15	7.5
0.5	+ 30	65	45	10	25	10	5.0

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. All traffic control signs used on construction or maintenance work in both rural and urban areas shall be in accordance with the applicable sections of the MUTCD. Since it is not practical for MUTCD to prescribe detailed standards of application for all the situations that may conceivably arise, the standards presented are for the most common situations. It is emphasized that they are for normal situations and that additional protection must be provided when special complexities and hazards prevail. Less protection may be warranted under special conditions as well. The variety of conditions encountered makes the establishment of inflexible arrangements totally impractical. Nothing in this specification shall be interpreted as precluding the application of engineering judgment. In all questions of interpretations, the judgment of the Engineer will be final.

3.02 GROUND MOUNTED SIGNS

A. The placement of the signs shall be in accordance with the detailed dimensions shown in MUTCD or shown on the approved TCP.

B. Sign posts shall be 4 x 4 in. (100 x 100 mm) lumber. The length shall be sufficient so that the buried portion will adequately and firmly support the sign.

C. All wood sign panel backing shall be of 5/8 in. (16 mm) high density overlay exterior plywood. All aluminum sign panel backing shall have a minimum thickness of 0.100 in. (2.54 mm). The chromatic protective coating for flat sheet blanks shall meet

the requirement of ASTM B 449, Class II, and shall be at least standard aluminum designation 3003 alloy.

D. Blanks shall be free of buckles, warps, dents, burrs, oils and foreign contaminants prior to application of reflective sheeting.

E. The Contractor is responsible for maintaining the signs and the mounting in their proper location. This includes any necessary cleaning so that the signs are legible at all times.

3.03 SIGN REPLACEMENT

A. Signs that become faded or illegible shall be replaced. Signs that are not new will be permitted to be used provided their reflective intensity at a divergence angle of 0.2 degrees and incidence angle of minus 4 degrees meets at least 60 percent of the values of Table 02053-1.

B. Signs damaged by traffic shall be replaced.

C. The acceptability of the signs shall be measured by means of a calibrated, one foot square test standard that meets 60 percent of the reflective requirements at a divergence angle of 0.2 degrees and incidence angle of minus 4 degrees from Table 02053-1.

D. The calibrated sheeting shall be attached by temporary means to the sign in question and viewed at night from the portion of roadway that is being maintained through the construction area. The intent is to view the sign as the motorist sees it. If the sign has less intensity than the standard, it shall be replaced at the Contractor's expense.

END OF SECTION

SECTION 02054

TEMPORARY PAVEMENT TAPE MARKING FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Pavement Markings

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

1.03 DESCRIPTION

A. This work consists of furnishing and installing, complete in place, and removal of temporary reflective marking tape. Such tapes are intended for temporary use on construction projects. Placement shall be as shown on the Traffic Control Pans (TCP) or as directed by the Engineer. The tape shall be removed when it is no longer required for a particular construction phase or equence, or at the completion of the Contract.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The temporary pavement tape marking material shall consist of a eather and traffic resistant reflecting film on a conformable backing.

B. The temporary pavement tape marking material as supplied shall be of good appearance, free from cracks, and edges shall be trimmed traight and unbroken. The material shall be available in rolls, and there shall be no more than three splices per 50 yd (45m) of length. The material shall be packaged in accordance with accepted commercial standards. When the material is stored under normal conditions, it shall be suitable for use for a period of at least one year after purchase.

2.02 COLOR

A. The temporary pavement tape marking material shall be reflective white or yellow color as specified for pavement marking in the current edition of MUTCD.

2.03 REFLECTIVITY

A. The white and yellow film shall have the following initial minimum reflective intensity values measured in accordance with Federal Test Method Standard 370:

	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°

Specific Intensity/Unit Area Candelas/Foot Candle/sq ft	.65	.50	.48	.32
Entrance Angle		-4°		-4°

2.04 ADHESIVE

A. The temporary pavement tape marking material shall be capable of being affixed to bituminous concrete, Portland cement concrete or similar surfaces when applied according to the manufacturer's recommendations at surface temperatures down to 35 F and shall require no protective devices such as traffic cones or barricades after application.

2.05 SKID RESISTANCE

A. The surface of the reflective film shall provide a minimum skid resistance value of 35 BPN when tested according to ASTM E 303.

2.06 DURABILITY AND WEAR RESISTANCE

A. Samples of the material shall be applied to a 4 x 4 in. (100 x 100 mm) metal test panel which is a minimum thickness of 0.040 in. (1.02 mm) and prepared for application according to the recommendations of the manufacturer. The applied sample shall be tested in accordance with Federal Test Method Standard No. 141, Method 6192, using a CS-17 wheel and 1000 g load and shall not wear through to the metallic surface in less than 3000 cycles. Care should be taken to adjust the vacuum suction for the most effective removal of the abradings.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The temporary pavement tape marking material may be installed either by hand application or mechanical applicator in accordance with the manufacturer's recommendations. The temporary pavement marking tape material shall be maintained and/or replaced by the Contractor until final removal is directed by the Engineer.

3.02 SURFACE CONDITION

A. The pavement should be clean and dry with all contaminants such as dirt and loose asphalt particles removed prior to application of temporary pavement marking material. Loose or poorly adhered painted markings must be removed as well and an effort should be made not to apply temporary pavement marking tape over existing painted surfaces.

3.03 TAPE REMOVAL

A. The Contractor must physically demonstrate to the Engineer that there will be no damage to the pavement surface upon removal of the temporary pavement tape marking material. However, the illusion of a line may appear due to adhesive residue remaining after removal of the tape. All tape and all adhesive residue

remaining that is indicated by the Engineer for removal must be completely removed by the Contractor.

END OF SECTION

SECTION 02055

REFLECTORIZATION OF CHANNELIZING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reflectorization of Channelizing Devices

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

C. Drums for Maintenance of Traffic: Section 02056.

D. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

1.03 DESCRIPTION

A. All channelizing devices (cones, tubes, vertical panels and barricades) used to guide traffic through construction and maintenance work zones are to be reflectorized as set forth in the MUTCD.

PART 2 - PRODUCTS

2.01 CONSTRUCTION REQUIREMENTS

A. The reflective sheeting used for reflectorizing channelizing devices shall be the encapsulated lens type meeting the requirements of Subsection 02053.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The reflective sheeting shall be applied to the channelizing devices in strict accordance with the sheeting manufacturer's specifications.

3.02 CHANNELIZING DEVICE REPLACEMENT

A. Channelizing devices that become faded or otherwise difficult to see fully shall be replaced. Channelizing devices that are not new will be permitted to be used provided their reflective intensity meets at least 60 percent of the values of Table 02053-1 over at least 90 percent of the reflectorized surface area.

B. Channelizing devices damaged by traffic shall be replaced by the Contractor at his expense. The acceptability of the

reflectorization of the channelizing devices shall be the same as described for signs in Subsection 02053.

END OF SECTION

SECTION 02056

DRUMS FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Drums for Maintenance of Traffic

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

C. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

D. Reflectorization of Channelizing Devices: Section 02055.

1.03 DESCRIPTION

A. Drums used for warning or channelization shall be 36 in. in height and 18 in. in diameter. The reflectorized stripes shall be horizontal, circumferential, orange and white, 6 in. in width, 2 each of white and orange alternating, with the top stripe being orange in color. All drums shall be new or like new condition.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Drums shall be manufactured of various materials to withstand impact without damage to themselves or to vehicles. Reflective sheeting shall meet the requirements of paragraphs 2 and 3 of Subsection 02053 MATERIALS and TABLE 02053-1.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Drums in use on projects with an advertisement date prior to January 1, 1986 having a flattened or elliptical shape may be permitted for use provided that (a) such drums have a minimum diameter (exclusive of handles and warning light appendages) of 18 in. in the longer dimension; (b) such drums have a diameter of at least 12 in. in the shorter dimension and (c) such drums be oriented to the degree possible with the wider dimension toward the major flow of traffic. Drums not fully meeting the MUTCD requirement of having a minimum 18 in. diameter at all points along the circumference but which otherwise meet the requirements noted herein will be permitted for use through June 30, 1987, subject to any FHWA ruling during the interim.

END OF SECTION

SECTION 02057

TEMPORARY PRECAST CONCRETE TRAFFIC BARRIER (TCB)
FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Precast Concrete Traffic Barriers.

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

C. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

D. Reflectorization of Channelizing Devices: Section 02055.

1.03 DESCRIPTION

A. This work shall consist of furnishing, placing, resetting, painting, and removing TCB's for use at locations specified in the Contract Documents or as directed by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Vertical Panels, Relflective Barrier Markers and Warning Lights as approved by the Engineer.

B. Waterborne Acrylic Paint, Section 912.15 of the State Highway Administration Standard Specifications, October 1993.

C. Precast Concrete Traffic Barrier, Section 950.01 of the State Highway Administration Standard Specifications, October 1993.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The Contractor shall be responsible for maintaining TCB's in alignment and in a like new condition acceptable to the Engineer.

B. Resetting TCB's shall consist of removing and relocating TCB's as directed by the Engineer.

C. Items such as reflective barrier markers, vertical panels (object markers), and warning lights shall be installed on the TCb as specified in the Contract Documents. Both faces and the top of the TCB shall be painted or repainted as directed by the Engineer.

END OF SECTION

SECTION 02058

BARRICADES FOR MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Barricades for Maintenance of Traffic.

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

C. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

D. Reflectorization of Channelizing Devices: Section 02055.

1.03 DESCRIPTION

A. This work shall consist of furnishing and installing Type I, Type II, and Type III barricades for maintenance of traffic. Barricades shall be used as specified in the Contract Documents or as directed by the Engineer.

B. All barricade rails shall conform to the minimum design requirements as specified in Section 6C of the MUTCD, unless otherwise specified in the Contract Documents. The barricade reflective sheeting and its installation will be approved by the Engineer.

C. The barricade frame shall be designed and fabricated in conformance with the State Highway Administration Standard Specifications and the MUTCD.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Barricades as approved by the Engineer.

B. Reflectorization, Section 950.03 of the State Highway Administration Standard Specifications, October 1993.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. All materials, equipment, and labor necessary for the complete installation of the barricades, as specified in the TCP, shall conform to the Contract Documents, MUTCD and the State Highway Administration Standard Specifications, October 1993.

B. Barricades damaged by traffic shall be replaced no later than four hours after the Contractor is notified.

END OF SECTION

SECTION 02059

TEMPORARY CRASH CUSHION SAND FILLED PLASTIC BARRELS (SFPB)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Crash Cushion Sand Filled Plastic Barrels (SFPB) for Maintenance of Traffic.

1.02 RELATED SECTIONS

A. Maintenance of Traffic: Section 02040.

B. Traffic Control Plan for Maintenance of Traffic: Section 02045.

C. Traffic Control Signs Through Construction Areas for Maintenance of Traffic: Section 02053.

D. Reflectorization of Channelizing Devices: Section 02055.

1.03 DESCRIPTION

A. This work shall consist of furnishing and installing SFPB. SFPB shall be arranged as specified in the TCP or as directed by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Plastic Barrels, as approved by the Engineer.

B. Sand, Section 901 - Table 901A of the State Highway Administration Standard Specifications, October 1993.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The ground shall be leveled with material comparable to the existing ground to support the system prior to installing the SFPB.

B. The coponents, assembly, placing configuration, and filling of the individual standard yellow plastic barrels with varying weights of sand shall conform to the manufacturer's recommendations or as specified in the Contract Documents. Each SFPB shall be separated from all other SFPB by a distance of 3 in. (75 mm). The distance between the last row of SFPB and the object being shielded shall be 12 in. (300 mm). SFPB may be permitted to stand on pallets 4 in. (100 mm) or less in height.

C. The first barrel fo the SFPB configuration shall be reflectorized as specified in the State Highway Administration Standard

Specifications. Following an impact, an approved reflectorized drum, conforming to 104.12 of the State Highway Administation Standard Specifications, will suffice temporarily as reflectorization of the SFPB until the damaged SFPB can be replaced.

D. The damaged barrels shall be replaced no later than four hours after the Contractor is notified.

E. All sand to be placed in the barrles shall be dry and loose. Bags of sand are prohibited. The Contractor shall have available sufficient replacement items including sand. The barrels shall be watertight. An antifreeze shall be added to the sand in conformance with the manufacturer's recommendations.

F. Immediately after the SFPB have served their intended purpose, the Contractor shall remove the installation and restore the site as directed by the Engineer.

END OF SECTION

SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Clearing and Grubbing.

1.02 RELATED SECTIONS

A. Soil and Select Materials: Section 02240.

1.03 SITE CONDITIONS

A. Environmental Requirements: Exercise the necessary means and methods to control dust on the site during performance of the work.

B. Burning: Perform on-site and off-site burning only if permitted by governing local laws and regulations.

C. Protection:
1. Preserve all objects, including trees and shrubs designated to remain (if any). The means and methods used for protection are at the Contractor's option.
2. Use required protective measures during the felling of trees and debris removal to provide for the safety of employees and others.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fill Material: Common Earth Backfill as specified in Section 02240.

PART 3 - EXECUTION

3.01 INSPECTION

A. Prior to performance of the actual work, carefully inspect the entire site and locate objects and the plant life designated to be preserved.

The Contract Documents require that any existing trees within five (5) feet of either side of the existing sewer (in areas outside the pavement) must be removed by the Contractor. Prior to the actual removing of trees, however, the Contractor, Engineer, City and Property Owner shall meet in the field to discuss the removal for each tree. A final decision to remove a tree must be provided to the Contractor by the Engineer prior to removing a tree. Similarly, the Engineer will provide direction as to where to install new trees, if required, using the contingent item for new trees in the bid schedule.

3.02 PERFORMANCE

A. Where Excavation work is to be performed, clear and grub the area within 5 feet of each side of the center of pipe to the depths as follows:
   1. Sewer Mains and Services: 12 inches.

B. Stump Removal:
   1. Remove stumps and roots completely in areas of Excavation and Embankment.
   2. In all other areas as specified previously and not included in Excavation and Embankment area, remove stumps and roots, matted roots and similar subsurface debris to the depths as previously specified.
   3. Stumps over 4 inches in diameter left in place in areas other than Excavations and Embankments areas shall be treated with herbicide to prevent regrowth.
   4. Backfill stump holes with fill material as previously specified.

C. Disposal: Burnable debris may be disposed of by controlled, supervised burning; local laws and regulations permitting.
   1. Contractor option to dispose of burnable debris along with non-burnable debris off-site in a lawful manner.
   2. Dispose of debris from clearing and grubbing in a site having current approval for conducting solid waste disposal.
   3. Remove clearing and grubbing debris accumulations daily.
   4. Should the Contractor elect to continue work beyond normal working hours, clearing and grubbing debris shall not be allowed to accumulate for more than 48 hours.

END OF SECTION

SECTION 02101

EROSION AND SEDIMENT CONTROL MEASURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sediment and Erosion Control Measures.

1.02 RELATED SECTIONS

A. Sediment and Erosion Control: Section 01560.

B. Slope and Channel Silt Fence: Section 02110.

C. Riprap Slope and Channel Protection: Section 02295.

1.03 DESCRIPTION

A. This work shall consist of the installation of both structural and vegetative erosion and sediment control practices as indicated on the Plans. The practices shall include, but are not limited to, the use of berms, dikes, swales, silt fences, inlet protection, sediment traps and sediment basins, crushed stone, filters or other approved methods indicated on the Plans.

B. Erosion and sediment control measures shall be implemented any time that land is disturbed by construction activities including clearing, grading, excavating, stripping, filling or related work unless exempt by State law or local ordinance.

C. Application of erosion and sediment control measures shall be coordinated with the construction of permanent sewer facilities to insure effective control of erosion from the construction site.

1.04 REFERENCE DOCUMENTS

A. The Contractor shall obtain and maintain on the site at all times a copy of the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment control, available from the local Soil Conservation District.

B. The specific construction requirements in this document for the practices being employed are to be strictly adhered to throughout construction.

1.05 PERMITS

A. The Contractor shall not utilize any off site areas for obtaining borrow material or for depositing spoil material unless those areas have an approved erosion and sediment control plan and all current permits as may be required by state law or local ordinance.

PART 2 - PRODUCTS

2.01 DETAILED MATERIAL REQUIREMENTS

A. Stone for Stabilized Construction Entrance: Crushed stone shall meet the requirements of AASHTO M43 No. 1 (4" to 3/4"). Crusher run stone (Maryland GA Base or GA S/B) is not acceptable.

B. Riprap: Class I, small riprap 3" to 15" in size (2 pounds to 150 pounds) shall be as specified in Section 02295.

C. Filter Fabric

1. For use in stabilized construction entrances and temporary access water crossings.
   a. Fabric shall consist of long chain polymeric filaments or yarns of polypropylene, polyethylene, polyester, polyamide or polyvinylidene-chloride formed into a stable network.
   b. Fabric shall be inert to chemicals commonly encountered in soil and to hydrocarbons.
   c. Fabric shall be resistant to mildew, rot, insect and rodent attack.
   d. Fabric shall contain ultraviolet ray inhibitors and stabilizers and be suitable at temperatures of 0°F to 120°F.
   e. Fabric shall conform to the following test criteria:

Test and Method	Specification Limits
Grab Tensile Strength, ASTM D1682, lbs min	115
Tensil Elongation, ASTM D 1682, % min	50
Burst Strength, ASTM D 3786, psi min	190
Traperzoidal Tear Strength, ASTM D 117, psi min	45

2. For use in riprap pipe outlets.
   a. Fabric shall be a non-woven fabric consisting of long chain polymeric filaments or yarns of polypropkylene, polyester, polyamide or polyvinylidene-chloride formed into a stabile network.
   b. Fabric shall be inert to chemicals commonly encountered in soil and to hydrocarbons.
   c. Fabric shall be resistant to mildew, rot, insects and rodent attack.
   d. Fabric shall contain ultraviolet ray inhibitors and stabilizers and be suitable at a temperature of 0°F to 120°F.
   e. Fabric shall conform to the following test criteria:

Test and Method	Specification Limits
Grab Tensile Strength, ASTM D1682, lbs min	90
Tensil Elongation, ASTM D 1682, % min	20
Burst Strength, ASTM D 3786, psi min	140
Traperzoidal Tear Strength, ASTM D 117, psi min	45
Equivalent Opening Size, U.S. Standard Sieve Size, CW-02215 Corps of Engineers	40-100 as shown on plans

Flow Rate, AASHTO M 228 Appendix, gpm/sq ft min	40
Coefficient of Permeability, ASSHTO M 228 Appendix, cm/sec min	0.05

3. For use in temporary inlet protection
   a. Fabric may be either woven or non-woven.
      1) Non-woven fabric shall consist of long chain polymeric filaments or yarns of polyester.
      2) Woven fabric shall consist of monon filaments of polyproplylene treated with ultraviolet light stabilizers.
   b. Fabric shall be inert to chemicals commonly encountered in soil and to hydrocarbons.
   c. Fabric shall be resistant to mildew, rot, insects and rodent attack.
   d. Fabric shall contain ultraviolet ray inhibitors and stabilizers and be suitable at a temperature of 0°F to 120°F.
   e. Fabric shall conform to the following test criteria:

Test and Method	Specification Limits
Grab Tensile Strength, ASTM D1682, lbs min	90
Tensile Elongation, ASTM D 1682, % min	50
Tensile Elongation, ASTM D 1682, % max	115
Burst Strength, ASTM D 3786, psi min	190
Puncture Strength, ASTM D 751, lbs min	60
Flow Rate, AASHTO M 228 Appendix, gpm/sq ft min	40
Coefficient of Permeability, ASSHTO M 228 Appendix, cm/sec min	0.1
Equivalent Opening Size, U.S. Standard Sieve Size, CW-02215 Corps of Engineers	40-100 as shown on plans
Ultraviolet Radiation Stability, ASTMG 26, %	90

   f. Prefabricated silt fence units of the trade name Geofab or Envirofence or equal, at the Contractor's option, may be used in lieu of an on-site fabrication inlet barrier.

D. Silt Fence: as specified in Section 02110.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The Contractor shall adhere strictly to the "sequence of construction" as tabulated on the approved Plans. If such a "sequence of construction" is not included on the Plans, the Contractor shall submit his schedules of erosion and sediment control work to the Engineer for approval. No work shall begin until erosion control schedules are approved by the Engineer.

B. Phasing of erosion and sediment control measures with the construction project, unless approved otherwise, shall be as follows:
   1. Clear only those areas as required to construct the erosion and sediment control practices indicated on the Plans as perimeter controls and install the perimeter controls as detailed before continuing construction. Perimeter controls shall include earth berms, embankments, swales, silt fence,

stone outlet structures, pipe outlet structures and sediment basins.

2. Proceed with clearing, stripping, grading and related construction activity to the extent that erosion from exposed surfaces can be managed effectively by the controls in place. The Contractor shall endeavor to minimize the extent of exposed earth by avoiding mass grading as practical and shall follow with stabilization immediately as finished grading is accomplished. No disturbed earth shall be allowed to remain exposed for longer than 30 days without receiving temporary stabilization with seed and mulch or mulch anchored by a mulching tool outside of the growing season.
3. As construction of drainage structures is completed, apply the erosion controls where detailed on the Plans for pipe entrances, inlets, etc. and apply permanent structural practices as may be indicated for grade stabilization, slope protection, open channels and swales.

3.02 STABILIZED CONSTRUCTION ENTRANCES

A. The Contractor shall construct stabilized construction entrances at all construction site vehicular access locations in accordance with the Plans.

B. All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.

C. The entrance shall be maintained by the Contractor in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. Reconstruction will be required when stone becomes contaminated to the degree that the effectiveness of the device is lost.

D. All sediment spilled, dropped, washed, or tracked onto public rights-of-way shall be removed immediately by the Contractor.

3.03 INLET PROTECTION

A. Inlet protection shall be installed by the Contractor where indicated on the Plans and at all existing inlets subject to runoff from areas disturbed by the Contractor, in accordance with the Plans and the 1994 Manual on Sediment and Erosion Control Measures.

B. Filter cloth shall be securely fastened across the top of the inlet box in such a manner that it will intercept all stormwater flows entering the inlet. The cloth shall be kept clean of accumulated debris. Any cloth that becomes torn, clogged, or otherwise damaged shall be replaced.

C. Swale, ditchline, or yard inlet protection shall be constructed as follows:
   1. Excavate completely around inlet to a depth of 18 inches below notch elevation.

2. Drive 2-inch x 4-inch post 1 foot into ground at each corner of the inlet. Place nail strips between posts on ends of inlet. Assemble top portion of 2-inch x 4-inch frame using overlap point. Top of frame (weir) must be 6 inches below edge of earth dike or swale to inlet.
3. Stretch wire mesh tightly around frame and fasten securely without gaps.
4. Stretch filter cloth tightly over wire mesh, with the cloth extending from top of frame to 18 inches below inlet notch elevation. Fasten securely to frame. Ends must meet at post, be overlapped and folded, then fastened down.
5. Backfill around inlet in compacted 6-inch layers until layer of earth is even with notch elevation on ends and top elevation on side.
6. If the inlet is not in a low point, construct a compacted earth dike in the ditchline below it. The top of this dike is to be at least 6 inches higher than the top of frame (weir).

D. Curb Inlet Protection shall be constructed as follows:
1. Attach a continuous piece of wire mesh (30 inches min. width by throat length plus 4 feet) to the 2-inch x 4-inch weir (measuring throat length plus 2 feet).
2. Place a piece of filter cloth of the same dimensions as the wire mesh over the wire mesh and securely attach to the 2-inch x 4-inch weir.
3. Securely nail the 2-inch x 4-inch weir to 9-inch long vertical spacers to be located between the weir and inlet face (max. 6 feet apart).
4. Place the assembly against the inlet throat and nail (minimum 2-foot lengths of 2-inch x 4-inch) to the top of the weir at spacer locations. These 2-inch x 4-inch anchors shall extend across the inlet top and be held in place by sandbags or other approved weights.
5. The assembly shall be placed so that the end spacers area minimum of 1 foot beyond both ends of the throat opening.
6. Form the wire mesh and filter cloth to the concrete gutter and against the face of curb on both sides of the inlet. Place clean AASHTO M43 No. 1 stone over the wire mesh and filter fabric in such a manner as to prevent water from entering the inlet under or around the filter cloth.
7. Assure that storm flow does not bypass inlet by installing temporary earth or asphalt dikes directing flow into inlet.
8. Inlet protection shall be inspected and maintained, if required, by the Contractor after each storm event.
9. Inlet protection shall be removed from the Project Site by the Contractor after the contributing area is stabilized.

E. Ground Stabilization
1. General: Following initial soil disturbance or redisturbance, the Contractor shall complete permanent or temporary soil stabilization with:
   a. Seven (7) calendar days as to the surface of all perimeter controls, dikes, swales, ditches, perimeter slopes, and all slopes greater than 3 horizontal to 1 vertical (3:1) and
   b. Fourteen (14) calendar days as to all other disturbed or graded areas on the Project Site.

These requirements do not apply to those areas which are shown on the Plan and are currently being used for material storage or for those areas where construction activities are currently being performed.

2. Temporary Stabilization

a. The embankments and cuts around sediment traps; earth dikes; all stockpiles of topsoil or earth; and all cleared or graded areas shall be temporarily stabilized by the Contractor with seed and/or mulch.

b. Temporary seeding shall be applied to any disturbed area scheduled to be left or remaining inactive more than 15 days as follows:

1) Loosen top 2 inches of seedbed.
2) Apply lime at the rate of 50 pounds per 1000 square feet and fertilizer at the rate of 15 pounds per 1000 square feet.
3) Moisten seedbed during periods of high temperature and when directed by the Engineer.
4) Apply appropriate seasonal seed mixture uniformly at the rate of 0.92 pounds per 1000 square feet with mechanical power drawn seeders, mechanical cyclone hand seeders, or hydroseeding equipment. (Slurry for hydroseeder may contain seed and fertilizer only.)
5) Disc seed 1 inch into soil in floodplain areas. Rake, roll, or drag seedbed in all other areas.
6) Apply mulch in accordance with Section 02820.03.
7) Anchor mulch in accordance wit Section 02820.03.
8) The Contractor shall maintain seeded areas including watering if soil moisture becomes deficient. Repair as periodic inspection by the Contractor dictates including replacement and/or reseeding.

c. Temporary Mulching Only

1) Apply mulch materials uniformly by hand or mechanically at the following rates:
Straw mulch: 70 to 90 pounds per 1,000 square feet
Mulch matting: full coverage with minimum 6 inch overlap between blankets
Wood chips: 275 pounds per 1,000 square feet
Crush rock, stones or gravel: 900 to 4500 pounds per 1000 square feet with coarsest material applied at highest rate
2) Anchor mulch immediately after placement by one of the following methods:
a) Mulch Anchoring Tool: for use on slopes flatter than 3:1 only. Use mechanical equipment operated on the surface to punch and anchor the mulch into the surface a minimum of 2 inches at each punch location. Anchorage shall be provided at a minimum of 1 location per square feet.
b) Mulch Tracking: Use tracked type construction equipment to cut the mulch into the soil with cleated type tracks to a depth of 1-1/2 inches.

Tracking shall be done uniformly across the entire surface.

c) Mulch Netting: Staple lightweight biodegradable paper, plastic or cotton netting over mulch using manufacturer's recommendation for type and spacing of staples.

d) Liquid Mulch Binders: Apply liquid mulch binders uniformly to entire mulched area with heavier application rate applied along edges and where wind tends to catch the mulch, in valleys and at crests of banks. Caution shall be used to prevent damage to adjacent structures and undisturbed areas. The type of binder and the application rates may be as follows:

(1) Cutback asphalt - Apply RC-70, RC-250, RC-800, MC-250 or MC-800 cutback asphalt at minimum rate of 5 gallons per 1000 square feet on flat areas and slopes less than 8 feet in height. On slopes 8 feet or greater in height apply at minimum rate of 8 gallons per 1000 square feet.

(2) Emulsified asphalt - Apply SS-1, CSS-1, CMS-2, MS-2, RS-1, RS-2, CDRS-2 or CRS-2 emulsified asphalt at minimum rate of 5 gallons per 1000 square feet on flat areas and slopes less than 8 feet in height. On slopes 8 feet or greater in height apply at minimum rate of 8 gallons per 1000 square feet.

(3) Synthetic binders - Apply Acrylic BCR (agri-tac), DCA-70, Petroset or Terra Tac or equal at rates recommended by manufacturer.

e) Wood Cellulose Fiber Binder - Apply fiber binder at a net dry weight of 750 lbs/acres using approved mechanical slurry application equipment. The slurry shall consist of a water and fiber mixture of not more than 50 pounds wood cellulose fiber per 1000 gallons of clean water.

f) Peg and Twine - The peg and twine anchorage system shall consist of 8 to 10 inch long wooden pegs driven either before or after mulch placement to within 2 to 3 inches of the soil surface at a maximum spacing of 4 feet on centers with the mulch secured to the soil surface by stretching twine between and secured to the pegs in a criss-cross within a square pattern.

3) The Contractor shall maintain as required until final grading and permanent surface stabilization is completed. Repair as periodic inspection by the Contractor requires.

3. Permanent Stabilization

a. The Contractor shall apply permanent stabilization measures to the finished grading surface of all areas disturbed by construction as soon as possible subject

to the seasonal limitations for seed and shrubbery planting.

b. All areas disturbed by construction not indicated to be paved or occupied by structures shall be permanently stabilized with vegetative cover in accordance with Section 2820, "Turf Establishment."

F. Class I Small Riprap: The Contractor shall construct Class I small riprap in accordance with Section 02295.

3.04 MAINTENANCE, REMOVAL AND RESTABILIZATION

A. At the end of each working day and after any rainfall event, the Contractor shall inspect all erosion and sediment control structures. Any structures found to need maintenance or repair shall be serviced immediately to insure continuous functioning. Special attention should be given to cleanout of sediment trapping devices such as silt traps and sediment basins so that minimum design storage volumes are never reduced by excess sediment.

B. After contributing areas become stabilized with vegetation and/or hard surfacing, the Contractor may remove the specified erosion and sediment controls protecting those areas after obtaining approval from the Engineer.

C. Re-stabilization of surfaces disturbed by the removal of erosion and sediment controls shall commence immediately following removal. Re-stabilization efforts shall include restoration of surfaces to required grades, topsoiling, seeding, sodding, mulching or other treatment as specified on the Plans.

END OF SECTION

SECTION 02110

SLOPE AND CHANNEL SILT FENCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Slope and Channel Silt Fence for Temporary Erosion and Sediment Control.

1.02 RELATED SECTIONS

A. Sediment and Erosion Control: Section 01560.

B. Erosion and Sediment Control Measures: Section 02101.

1.03 DESCRIPTION

A. This work shall consist of furnishing and installing slope and channel silt fence as indicated on the Plans, as directed by the Engineer and in accordance with these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall meet the following requirements:

1. Geotextile. Geotextile shall meet the requirements of SHA specifications, Section 921.09, Class F.

2. Posts. Slope and Channel Silt fence posts shall be rough or finished wood having nominal dimensions of 2 x 2 in. or 2 1/2 in. diameter; schedule 40 metal pipe; or 1.33 lb/ft minimum standard T or U section steel. The posts for the slope silt fence shall be a minimum length of 42 in. The posts for the channel silt fence shall be a minimum length of 32 in.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Slope and Channel Silt Fence shall be erected as shown on the Plans, and at locations indicated on the Plans or as directed by the Engineer.

B. Posts shall be driven 18 in. minimum depth into the ground. The ends of the geotextile rolls shall be fastened securely to a common post and overlapped a minimum 3 ft. The top edge of the geotextile shall have a 1 in. tuck with rope in the hem. The geotextile shall be fastened securely to the posts by use of wire ties or hog rings, 3 per post.

C. Posts shall be driven 12 in. minimum depth into the ground. The geotextile will not be overlapped. The top edge of the geotextile shall have a 1 in. tuck for reinforcement or other suitable reinforced top end. The geotextile shall be fastened securely to the posts by use of wire ties or hog rings, 2 per post.

D. When slope and channel silt fence is no longer required, as determined by the Engineer, it shall be removed and disposed of by the Contractor.

3.02 QUALITY CONTROL

A. During the life of this contract including periods of non-construction activities the Erosion and Sediment Control Manager and the Engineer shall inspect all slope and channel silt fence immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the Contractor. In addition, the Contractor and Engineer shall make a daily review of the location for slope and channel silt fence in areas where construction activities change the earth contour and drainage runoff to ensure that the slope and channel silt fence is properly located for effectiveness. Where deficiencies exist, additional slope and channel silt fence shall be installed as directed by the Engineer.

Sediment deposits shall be removed when the deposits reach approximately half of the height of the slope or channel silt fence, and disposed of as directed by the Engineer. Any sediment deposits remaining in place after the slope or channel silt fence is no longer required shall be removed and the area dressed to conform with the existing grade, prepared and seeded in accordance with Section 02221.

END OF SECTION

SECTION 02130

ADJUSTING AND REPLACING FENCES, SHRUBS, HEDGES, ETC.

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Adjustment and Replacing Miscellaneous Surface Features.

1.02 RELATED SECTIONS

A. Clearing and Grubbing: Section 02100.

1.03 DESCRIPTION

A. Adjusting and replacing shed, fences, sheds, shrubs, hedges, mailboxes, etc. shall include but not necessarily be limited to the removal and relocation of fences, signs, property markers, mail boxes, and other improvements within the easement or right-of-way area as indicated on the Plans and/or directed by the Engineer and in accordance with the Contract Documents.

B. Shrubs, hedges, plants within the easement or right-of-way area that are to be removed do not have to be adjusted or replaced by the Contractor. Those shrubs, hedges and other plants outside the limits of the easement or right-of-way area, or within construction strips that are damaged by the Contractor, shall be replaced by him at his expense.

1.04 QUALITY ASSURANCE

A. The Engineer will inspect all work to ensure that it is performed in accordance with the Contract Documents.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.01 IMPROVEMENTS OTHER THAN PLANTINGS

A. Existing fences, paper boxes, sheds, signs, property markers, and other similar items that are within the easement or right-of-way area or conflict with the proposed sewer lines shall be carefully removed by the Contractor to the extent required to permit construction operations and as directed by the Engineer. The Contractor shall safely store all items during the time that they are down and, when possible, erect them in the original locations or at locations designated by the Engineer. Materials not

capable of being re-erected through no fault of the Contractor shall be replaced on a Force Account basis for materials only.

B. Mail boxes shall be carefully removed by the Contractor to the extent required to permit construction operations and as directed by the Engineer. It shall be the Contractor's responsibility to temporarily reset mail boxes during construction to maintain service until the boxes are permanently reset in their original locations or at locations designated by the Engineer. The Contractor shall comply with all Postal Service regulations regarding the location and height of all mail boxes disturbed by his activities.

3.02 Plantings

A. Shrubs, hedges, and other plantings that are in conflict with proposed sewer lines shall be transplanted with sufficient earth to insure that no damage to their major root system occurs. After transplanting has been accomplished, it shall be the Contractor's responsibility to water all plants until their growth is established.

END OF SECTION

SECTION 02140

CONSTRUCTION STAKEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction Stakeout

1.02 DESCRIPTION

A. This work shall consist of furnishing, placing, and maintaining construction layout stakes necessary for the proper prosecution of the work in accordance with the Contract Documents.

B. Related Work Included Elsewhere - Not Applicable

1.03 QUALITY ASSURANCE

A. The Engineer may check any control point established by the Contractor. However, the checking or failure to check Contractor-furnished controls by the Engineer shall not relieve the Contractor from his responsibility to construct the facility in accordance with the Contract Documents.

B. The Contractor shall use competent personnel and suitable equipment for all engineering work required to complete the work in accordance with lines, grades, elevations,and dimensions indicated on the plans.

1.04 SUBMITTALS

A. The Contractor shall furnish the Engineer with copies of all cut sheets and other control documents as may be required for control of the work.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.01 ALIGNMENT MARKERS

A. The Contractor shall exercise care in the preservation of stakes, general reference points, and bench marks set by the Engineer and shall reset them at his own expense when any are damaged or destroyed.

3.02 DETAILED STAKE-OUT

A. The Contractor will be required to provide all construction stakeout required for proper installation of the new sewer

line. The proposed sewer main will connect the existing or proposed manhole openings in a straight line both vertically and horizontally and on a line and grade equal to the existing alignment or as shown on the plan.

3.03 ADDITIONAL REQUIREMENTS

A. The Contractor shall be required to furnish to utility companies or agencies working within the limits of the project, promptly upon request, reference to control points and alignment and grade data, so that they may properly locate and coordinate their work and improvements in relation to this project.

B. The Contractor shall be required to define only right-of-way and easement lines of the project for property owners.

END OF SECTION

SECTION 02151

SHORING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Shoring, sheeting and bracing necessary to protect excavations against loss of ground, caving or slipping.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

1.03 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Shoring materials and installation work shall conform to Federal, including but not limited to MOSHA, OSHA regulations, State and local laws, rules, regulations and requirements.
   2. Provide material for sheet piling, sheeting bracing and shoring and drive or set in place in accordance with Federal, State and local laws for excavations and construction and as may be required to protect the workers and the public, or to maintain the trench pay-line widths specified in Section 02221.

1.04 SITE CONDITIONS

A. Responsibility for Condition of Excavation:
   1. The failure or refusal of the Engineer or Resident Project Representative (RPR) to suggest the use of bracing or sheeting, or a better quality, grade, or section, or larger sizes of steel or timber, or to suggest sheeting, bracing, struts, or shoring to be left in place, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavation or of any of his obligations under the Contract, nor impose any liability on the Engineer or the Owner; nor shall any delay, whether caused by any action or want of action on the part of the Contractor, or by any act of the Engineer, Owner, or their agents, or employees, resulting in the keeping of any excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of his obligations under the Contract relating to injury to persons or property, nor entitle him to any claims for extra compensation.

B. The Engineer reserves the right to order sheeting and bracing left in place for the protection of the finished work or adjacent property. Sheeting and bracing which have been ordered left in place by the Engineer must be removed for a distance of three feet below the established or existing grade, whichever is lower. Trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing.

C. Before starting work, check and verify governing dimensions and elevations.

D. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal and discontinuing of services, as affected by this work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide suitable shoring and bracing materials which will support loads imposed.

B. Wood Materials: Use wood sheeting, sheet piling, bracing and shoring which is in good serviceable condition and timbers of sound condition.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Drive or set sheeting, sheet piling, braces or shores in place and arrange such that they may be withdrawn as the excavations are backfilled, without damage to piping and structures, and without damage to or settlement of adjacent structures and pavements.

B. Engineer reserves the right to order sheeting driven to the full depth of the excavation or to such additional depths as may be required for the protection of the work.

C. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

D. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.

E. Do not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to Engineer.

F. Maintain bracing until structural elements are rebraced by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

G. Install internal bracing, if required, to prevent spreading or distortion to braced frames.

H. Remove sheeting, shoring and bracing in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.

I. Repair or replace, as acceptable to Engineer, adjacent work damaged or displaced through installation or removal of shoring and bracing work.

END OF SECTION

SECTION 02210

SITE GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Topsoil removal and stockpiling, overlot grading, removal of obstructions and soil compaction in preparation of final grading.

1.02 RELATED SECTIONS

A. Sediment and Erosion Control: Section 01560.

B. Soil and Select Materials: Section 02240.

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T 99, Moisture-Density Relations of Soils, Using a 5.5-lb. Rammer and a 12-in. Drop.
   2. AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand Cone Method.

B. American Society for Testing and Materials: ASTM D 2167, Density of Soil in Place by the Rubber-Balloon Method.

1.04 SITE CONDITIONS

A. Classification of Excavated Materials: No consideration will be given to the nature of materials encountered in site grading operations. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of materials.

B. Environmental Requirements:
   1. Do not perform grading when soil or weather conditions are unsuitable. Unsuitable conditions include moisture saturated or frozen in place soil and precipitation of any kind present on the soil or occurring during the Work.
   2. Exercise the necessary means and methods to control dust on the site as well as in the off site work areas where excavation and grading are required.
   3. Do not leave the site in a dusting condition following the work of this Section. If necessary, employ a watering schedule to control the dust.
   4. Do not use frozen material in performing the work or place materials on frozen surfaces.
   5. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials on roadways caused by hauling at no expense to the Owner.

6. Plan work so as to provide adequate protection during storms with provisions available at all times for preventing flood damage.

C. Protection: Assume all risks attending the presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work for same, also existing structures and property of whatever nature, in or over excavations or adjacent to such excavations. Complete responsibility for replacement and restitution work of whatever nature to the above, as damaged or destroyed by work of this Contract, rests solely with the Contractor and at no expense to the Owner.

D. Accommodation of Traffic: Do not obstruct streets, roads and highways, unless the Municipality or Governing Agency authorizes in writing the complete closing of the street, road or highway. Employ such measures, at no expense to the Owner, as may be necessary to keep the street, road or highway open and safe for traffic. DO NOT OBSTRUCT FIRE HYDRANTS.

E. Explosives and Blasting: Not permitted in performance of site grading.

F. Borrow Excavation: When the required quantity of earth fill material exceeds the quantity of suitable on site fill material, provide borrow excavation. If borrow excavation is needed, notify the Engineer sufficiently in advance to permit the Engineer to verify such need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to the Engineer's approval whose written consent shall be obtained prior to its use.

G. Excess Materials: No right of property in materials is granted the Contractor of excess on site materials prior to completion of Site Work. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials. Unsuitable material such as sod, stumps and spongy soil as well as excess rock shall become the property of the Contractor and shall be disposed of legally off-site.

H. Dust Control: Exercise the necessary means and methods to control dust on the site during the roadway excavation, backfill and compaction work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: See Section 02240.

PART 3 - EXECUTION

3.01 PREPARATION

A. Salvaged Topsoil: Within the areas indicated for grading, strip turf and topsoil to the depth of suitable topsoil material and stock pile for subsequent topsoiling operations.

B. Stockpiling: Place topsoil storage piles within the limits of the project, on well drained land and at locations not interfering with the Prosecution of Work.

3.02 PERFORMANCE

A. Erosion Control: Implement erosion control measures during performance of work of this Section. Erosion Control as specified in Section 01560.

B. Overlot Grading: Perform rough grading over the site within the areas to be graded as indicated on the Drawings.
   1. Topsoiled areas: Not more than 0.15 ft. above or below indicated grade less specified topsoil depths.
   2. Vehicle Traffic Areas: Not more than 0.10 ft. above or below indicated grade less specified or indicated depths of paving and aggregate base.

C. Removing Obstructions: Where rock is encountered at proposed subgrade elevations, remove such for a depth of six inches below proposed subgrade.

D. Compaction: Compact finished subgrades to the minimum final density percentages specified herein which are based on the maximum dry weight density of subgrade materials at their optimum moisture content.
   1. Overlot Grading: Not less than 90%.
   2. Roadway Subgrade: Not less than 95%.

3.03 FIELD QUALITY CONTROL

A. Surface Tolerance: Check finished subgrade for smoothness and elevation in accordance with the following:
   1. Use an approved ten foot straightedge to check for longitudinal irregularities in the subgrade.

B. Field Moisture-Density Tests: The Contractor will be required to conduct a minimum of two field moisture-density determinations on Site Grading work at locations designated by the Engineer.
   1. The moisture content at which the maximum density of the Backfill is obtained with a given compactive effort, AASHTO T99, shall be considered the optimum moisture content.
   2. Field compaction density may be determined by the Rubber Balloon Method, ASTM D 2167, or other acceptable method, in lieu of the sand-cone method specified above; but only with Engineer's written permission.
   3. Determine compaction density of roadway subgrade in accordance with AASHTO 191.

END OF SECTION

SECTION 02220

STRUCTURAL EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation for structures.

B. Bedding, backfill, and compaction.

1.02 RELATED SECTIONS

A. Sediment and Erosion Control: Section 01560.

B. Site Preparation: Section 02100.

C. Shoring: Section 02151.

D. Trenching, Backfilling and Compacting: Section 02221.

E. Soil and Select Materials: Section 02240.

F. Cast-In-Place Concrete: Section 03300.

1.03 DESCRIPTION

A. Definitions:
   1. Unclassified Excavation: Removal of materials of any kind in the excavation, including rock excavation.
   2. Miscellaneous Unclassified Excavation: Unclassified excavation required by the Engineer and not included in other items for payment.
   3. Subgrade: The areas upon which rest the planned bottoms of footings, foundations or slabs.

1.04 QUALITY ASSURANCE

A. Source Quality Control:
   1. Laboratory Tests: Certain materials stated herein under Products may require advance examination or testing according to methods referenced, or as required by the Engineer.
      a. Testing laboratory shall furnish both Engineer and Contractor two (2) copies of test result reports. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
   2. Aggregate Material Tests:
      a. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such materials.
      b. The Engineer reserves the right to accept aggregate materials based on certification from supplier that the aggregate originates from a source approved by MDT and that the aggregate complies with specified MDT requirements.

1.05 REFERENCES

A. American Society For Testing and Materials:
   1. ASTM D 698, Laboratory Compaction Characteristics of Soil Using Standard Effort.
   2. ASTM D 1556, Density of Soil In Place By the Sand-Cone Method.
   3. ASTM D 2167, Density of Soil In Place By the Rubber-Balloon Method.
   4. ASTM D 2922, Density Of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
   5. ASTM D 3017, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. Testing Agency: As approved by the Engineer with the following required qualifications.
   1. Laboratory and field testing must be performed under the general supervision of a Registered Professional Engineer.
   2. The independent testing agency must have experience in quality control of earthwork structural fills.

1.06 SUBMITTALS

A. Testing Agency Approval: Submit experience qualifications of the proposed independent testing agency for approval.

1.07 SITE CONDITIONS

A. Classification of Excavated Materials: No consideration will be given to the nature of materials encountered in structural excavating operations. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of materials.

B. Environmental Requirements:
   1. Do not perform excavating, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of the Engineer, that work cannot be performed satisfactorily.
   2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
   3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
   4. Accommodation of Drainage: Maintain sewers, drains and ditches free of debris for surface drainage. No damming or ponding of water in gutters or other waterways will be permitted. Do not direct flow of water across or over pavements except through approved pipes or properly constructed troughs. Provide pipes or troughs of such sizes and lengths as may be required. Control grading in the vicinity of excavations so the ground surface is properly pitched to prevent water running into excavated areas.
   5. Pumping: Keep excavations free from water. Build dams and other devices necessary for this purpose, including lowering the water table below excavation bottom by deep wells, well points and pumping. Provide and operate pumps of sufficient capacity for dewatering the excavations. Dispose of water removed from excavations in a manner that will not cause injury to the public health, to public or private property, to the work of other Trades or Contractors, to any portion of the work completed or in progress or produce impediment to the use of highways, roads, lanes and streets by the public. No additional payment will be made for pumping or other difficulties encountered due to water.

6. Control groundwater and surface water during construction in order to maintain soil stability. Maintain the water table elevation sufficiently below the levels of excavations that slopes will remain stable and bottoms of excavations will not become loosened by flow of water. If the foundation material looses its strength due to improper dewatering techniques, overexcavate the material and replace it with Structural Foundation Backfill at the Contractor's expense.

C. Dust Control: To prevent spread of dust during performance of work of this Section, thoroughly moisten excavation areas by sprinkling or other methods as approved by the Engineer.

D. Explosives and Blasting: Not permitted in performance of structural excavation work.

E. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements, remove by the use of mechanical surface impact equipment, or by drilling and hydraulic rock splitting equipment, or by other methods.

F. Responsibility For Condition Of Excavation: The Contractor shall solely be responsible for the condition and results of excavations made by him. Slides and cave-ins shall be removed without extra compensation at whatever time and under whatever circumstances they may occur.

G. Protection:
1. The Contractor shall, at his own expense, sustain in their places, and protect from direct or indirect injury, all pipes, tracks, walls, buildings, and other structures or property in the vicinity of his work, whether above or below ground, or that may appear in the excavation. He shall at all times have a sufficient quantity of timber and plank, chains, ropes, and other material and equipment, on the ground and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened, or weakened.
2. Pipes and underground conduits exposed as a result of the Contractor's operations shall be adequately supported along their entire exposed length by timber or planking, installed in such manner that the anchorage of the supporting members will not be disturbed or weakened during the backfilling operation. Backfill of selected material shall be carefully rammed and tamped under and around the supports and all supports shall be left in place as a guard against breakage of the supported structure due to backfill settlement. No additional payment will be due the Contractor for the material left in place nor for the labor of installing and maintaining supports.
3. The Contractor shall take all risks attending the presence or proximity of pipes, poles, power lines or wires, tracks, walls, buildings, and other structures and property, of every kind and description, in or over his excavation, or in the vicinity of his work, whether above or below the surface of the ground; and he alone shall be responsible for all damages and assume all expense for direct or indirect injury, caused by his work, to any of them,

or to any person or property by reason of them or by reason of injury to them, whether such structures are or are not indicated on the Drawings.

4. Where necessary, in order to keep one side of the street or roadway free from any obstruction or to keep the material piled alongside the excavation from falling on private property outside the rights-of-way, safe and suitable fence shall be placed alongside the excavation.
5. In the event of encountering quicksand, subsurface streams or similar dangerous contingencies, or where passing especially heavy buildings or any structures which by their construction or position might bring a great pressure upon the excavations, the right is reserved by the Engineer to require that such buildings or structures shall be underpinned, or supported and protected, or that special sheeting shall be driven in such a manner and to such depth, as may be approved or that only a shore length of excavation shall be opened at one time; and furthermore, if necessary, that the excavation shall be securely sheeted and braced on all sides; after the manner of a shaft, and that the permanent work shall be constructed in the same way and the shaft backfilled before another opening is made. Any work done as above required shall be at the cost, expense and sole liability of the Contractor.
6. The Engineer reserves the right under such conditions to stop the excavation or any other part of the work, and to require the Contractor to complete the structure and the backfilling up to such a point as the Engineer, without assuming responsibility for safety to persons or property may require before proceeding further with the excavation; and the Contractor shall not thereby become entitled to demand or to receive any allowance or compensation, other than an extension of the contract time for as many days as the Engineer may determine that the work was delayed by such stoppage.

H. Removal of Obstructions:

1. Should the position of any pipe, conduit, pole, or other structures, above or below the ground be such as, in the opinion of the Engineer, to require its removal, realignment, or change due to work to be done under the Contract, the work of removal, realignment, or change will be done as extra work, or will be done by the owner of the obstructions, without cost to the Contractor; but the Contractor shall uncover and sustain the structures, at his own expense, before such removal and before and after such realignment or change as constituting part of the Contract; and the Contractor shall not be entitled to any claim for damage or extra compensation on any account of the presence of said structure, or on account of any delay in the removal or rearrangement of same.
2. The Contractor shall, without extra compensation, break through and reconstruct, if necessary, the invert or arch of any sewer, culvert, or conduit that may be encountered, if the said structure is in such a position, in the judgment of the Engineer, as not to require its removal, realignment, or complete reconstruction.
3. The Contractor shall not interfere with any person, firms or corporations or with the Owner, in protecting, removing, changing, or replacing their pipes, conduits, poles, or other structures; but he shall allow said persons, firms, or corporations, or the Owner, to take all such measures as they may deem necessary or advisable for the purpose aforesaid, and the Contractor shall thereby be in no way relieved of any of his responsibilities under the Contract.

I. Borrow Excavation: Where the required quantity of backfill exceeds the quantity of suitable material excavated within the limits of the project site and rights-of-way, obtain sufficient material to complete the backfill at no additional cost to the Owner. If borrow excavation is needed, notify the Engineer sufficiently in advance of borrow excavation requirements to permit the Engineer to verify the need for such borrow excavation and to view the proposed borrow pit and determine the suitability of the material to be provided. Borrow excavation from outside sources must be suitable in all respects and will be subject to the approval of the Engineer, whose written consent must be obtained before its use will be permitted.

J. Excess Materials: No right of property in materials is granted the Contractor of excavated materials prior to backfilling. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated material.

K. Change of Excavation Location:
   1. Should the Engineer require a change in location of excavation from that indicated on the Drawings due to the presence of an obstruction, or from other cause and such change is made before the excavation is begun, the Contractor shall not be entitled to extra compensation or to a claim for damages.
   2. Should the Engineer require a change in location of any excavation from that indicated on the Drawings due to the presence of an obstruction or from any other cause, and if such changed location increases or decreases the quantity of excavation, then an adjustment will be made in lump sum price bid under which the work was performed.
   3. The adjustment will be made by increasing or decreasing the lump sum price bid in accordance with the actual increase or decrease in excavation quantities by applying the applicable unit price per cubic yard for excavation of earth or rock bid under the Schedule of Unit Prices for Quantity Adjustments.
   4. If, however, such change involves the abandonment of excavations already made, such abandoned excavation (including refill) will also be paid for at the applicable unit price for excavation bid under the Schedule of Unit Prices for Quantity Adjustments.
   5. If a change of excavation location is authorized by the Engineer upon the Contractor's request, the Contractor shall not be entitled to extra compensation, and if such change of excavation location involves the abandonment of excavation already made, the abandoned excavation and refill shall be at the Contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Common Earth Backfill: See Section 02240.

B. Select Aggregate Materials: See Section 02240.

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform sheeting and shoring in accordance with requirements of Section 02151.

B. Perform soil erosion control work in accordance with requirements of Section 01560.

3.02 EXCAVATION

A. General:
   1. Perform excavation using machinery, except that hand excavation may be required where necessary to protect existing structures, buried utilities or private or public properties. No additional compensation will be paid for hand excavation instead of machine excavation as may be necessary from any cause whatever.
   2. Perform excavation of every description and of whatever substances encountered to the lines and grades or depths indicated by the Drawings and as specified herein.
   3. Where work space is limited, remove excavated material from the limited area and replace the material after the structure has been installed. No additional compensation will be made for such removal and replacement.
   4. Extend excavation a sufficient distance from footings, and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

B. Rock Excavation: Remove rock below subgrade that is shattered due to rock removal operations and in the opinion of the Engineer is unfit for foundations. Fill to subgrade with Structural Foundation Backfill those areas where shattered rock has been removed. Perform such backfilling to the satisfaction of the Engineer. No separate or additional payment will be made for such removal and backfill.

C. Excavation Below Subgrade:
   1. Do not excavate below depths indicated on the Drawings or such depths as required by the Engineer.
   2. Excavation below depths indicated on the Drawings or as required by the Engineer, through the fault of the Contractor, shall be restored to the indicated or required depths with Structural Foundation Backfill at the expense of the Contractor. Structural Foundation Backfill material as selected by Engineer.
   3. If the foundation for any structure is required by the Engineer to be carried lower than plan subgrade elevation, the voids caused by this excavation shall be backfilled up to plan subgrade elevation with Type B Select Material as specified in Section 02240.
      a. Payment for this additional work will be made at the applicable unit prices bid under the Schedule of Unit Prices for Additions, Deductions or Deletions in Contract Quantities.

D. Storage of Approved Materials: If approved materials are not used immediately, store or stockpile the various approved materials separately and apart from unapproved materials.
   1. Mixing of various approved materials is not permitted, nor is mixing of approved materials with unapproved materials permitted.
   2. No additional compensation made for storage, stockpiling, or rehandling of materials.

E. Borrow Excavation: Perform excavation of borrow material in a manner satisfactory to the Engineer. Strip borrow pits of brush, trees, roots, grass and other vegetation prior to removal of material for use in backfill. During the excavation operation, grade the borrow area to insure free drainage of water from the area. After completion of the excavation, grade the excavated area, including side slopes, to drain and present a uniformly trim appearance merging into the surrounding terrain. After borrowing operations are completed, regrade area, if necessary, to prevent erosion.

3.03 SUBGRADE AND FOUNDATION BEDDING PREPARATION

A. General: Remove and replace soft, loose, and disturbed materials. Perform compaction as directed by Engineer.
   1. Do not place fill materials of any type on surfaces that are muddy, frozen, or contain frost.
   2. Trim bottoms to indicated lines and grades to leave solid base to receive other work.

B. Placement and Compaction:
   1. Type B Select Material:
      a. Provide at locations where shown on the Drawings and as directed by the Engineer.
      b. Maintain material in a moist condition during hauling, placing and compacting.
      c. Spread material uniformly without segregation of coarse and fine material.
      d. Place material in 8-inch layers and compact to 100 percent of the maximum dry density based on ASTM D 698, Method C, with replacement of oversize material.
      e. One field density determination is required for each layer of material placed.

3.04 BACKFILLING

A. General:
   1. Perform backfilling using machinery, except that hand backfilling may be required where necessary to prevent displacing walls, foundations or buried utilities or damage to such. No additional compensation will be paid where backfilling by hand is required.
   2. After completion of footings and walls and the removal of forms and prior to backfilling, clean excavation free of trash and debris.
   3. Do not place Backfill material prior to seven days after completion of structure walls.
   4. Do not place Backfill material on wet or frozen areas.
   5. Do not operate heavy equipment closer to walls than a distance equal to the height of Backfill material above the top of the structure footing.
   6. Do not place Backfill material against exterior walls until supporting floors or slabs at top of walls are in place.
   7. Perform compaction using power driven tampers or compactors suitable for material being placed.

B. Backfill: Place Backfill in loose, uniform horizontal layers not exceeding six inches in depth.
   1. Use "Common Earth Backfill," Type B Select Material," or "Type C Select Material" as shown on the Drawings. Backfill materials are specified in Section 02240.

2. For "Common Earth Backfill" and "Type B Select Material":
   a. Maintain moisture content of Backfill at compaction within two percent of optimum moisture as determined by ASTM D 698.
   b. Compact Backfill to at least 95 percent of the maximum dry density based on ASTM D 698.
3. For "Type C Select Material," compact using vibratory plate or vibratory roller to the satisfaction of the Resident Project Representative.

C. Cleanup: Excess excavated material that cannot be used at the project site shall be removed and disposed of off the site in a legal manner at no additional expense to the Owner.

3.05 FIELD QUALITY CONTROL

A. Testing: Performed by the independent testing agency as prior approved for laboratory testing.
1. In-place field density tests conducted in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If methods of ASTM D 2922 are used for density testing, the moisture content must be determined as stated in ASTM D 3017.
2. Perform at least one field moisture-density determination (test) for each layer of material placed.
3. Test locations as directed by the Engineer.
4. The Engineer may require additional tests whenever necessary to ensure that the specified density is being obtained.

B. Corrective Measures: Whenever tests indicate that the field moisture or density does not meet specified requirements, take corrective action as approved by the Engineer.
1. Corrective measures may include loosening the soil and wetting or drying it prior to recompaction, additional compaction, or removing and replacing the material.
2. Retest material that did not meet the moisture and density requirements after corrective measures have been performed.

C. Retesting: The Engineer may at any time require retesting of any material, whether in stockpiles or being placed, if it appears that the material differs from that which has previously been approved for use.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trench excavation for underground piping.

B. Trench excavation for electrical work.

C. Bedding and backfilling.

D. Surface restoration.

1.02 RELATED SECTIONS

A. Sediment and Erosion Control: Section 01560.

B. Shoring: Section 02151.

C. Soil and Select Materials: Section 02240.

D. Paving and Surfacing: Section 02500.

E. Water Mains: Section 02950.

F. Gravity Wastewater Sewer: Section 02731.

G. Force Mains: Section 02732.

H. Division 3 - Concrete.

1.03 DESCRIPTION

A. Definitions:
   1. Unclassified Excavation: Removal of materials of any kind in the excavation, including rock excavation.
   2. Miscellaneous Unclassified Excavation: Unclassified excavation required by the Engineer and not included in other items for payment.
   3. Subgrade: Trench bottom prepared as specified to receive pipe bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.

1.04 PROJECT CONDITIONS

A. Classification of Excavated Materials: Under this contract, all excavation shall be unclassified; that is, the removal of all material of any nature, kind, type or origin will be considered the same and shall be included in the unit pricing as indicated in the Proposal.

B. Trench Work for Electrical:
   1. Requirements specified herein for excavating, backfilling and compacting pipe line trench work shall also apply to such work required for electrical conduit and cable installations.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Common Earth Backfill: As specified in Section 02240.

B. Select Material Bedding, Haunching, and Backfill: As specified in Section 02240.

C. Classification of Backfill and Bedding Materials:
   1. Pipe and Conduit Bedding: Type B or C Select Material, as specified in Section 02240 at locations as shown on the Drawings.
   2. Pipe and Conduit Initial Backfill: Type B or C Select Material, as specified in Section 02240 at locations as shown on the Drawings.
   3. Backfill Material To Restoration Depth: Common Earth Backfill as specified in Section 02240.

D. Underground Warning Tape:
   1. Printed polyethylene tape, 3 inches minimum width, color coded, 1 inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
   2. Non-magnetic.
   3. Provide for:
      a. Water line, blue.
      b. Sanitary sewer force main, brown.
      c. Electrical conduit and cable, red.
      d. Sanitary sewer gravity line, green.

PART 3 - EXECUTION

3.01 TRENCH PREPARATION AND EXCAVATION

A. Perform sheeting and shoring in accordance with requirements of Shoring: Section 02151.

B. Perform soil erosion control work in accordance with requirements of Sediment and Erosion Control: Section 01560.

C. General: Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated on the Drawings and specified herein, or as directed by the Engineer.
   1. Excavation shall be made by open cut, unless written permission to tunnel or bore is given by the Engineer or is specifically outlined in the specifications or shown on the Drawings.
   2. Trenches may be excavated and backfilled either by machinery or by hand as the Contractor may elect, provided, however, the Contractor shall use hand excavation where necessary to protect existing structures, utilities, or private or public properties and provided, further, that backfilling shall be done by hand to the extent hereinafter specified.
   3. The Contractor shall have no claim for extra compensation due to the fact that hand excavation, instead of machine excavation, may be made necessary from any cause whatever.

D. Stripping, Storing and Restoring Surface Items: The Contractor shall remove all paving, sub-paving, curbing, gutters, brick, paving block,

granite curbing, flagging or other similar materials, and grub and clear the surface over the area to be excavated. He shall properly store and preserve such materials that may be required for future use in restoring the surface. The Contractor shall be responsible for any loss or damage to said materials because of careless removal or neglectful or wasteful storage, disposal, or use of the materials.

1. All materials which may be removed, including rock, earth and sand taken from the excavation, shall be stored, if practical, in the roadway or such other suitable place and in such manner as the Engineer shall approve.
2. If more materials are removed from any trench than can be backfilled over the completed pipe or stored in the street, leaving space for traffic, the excess materials shall be removed and stored at a suitable site provided by the Contractor.
3. The Contractor shall, at his own expense, bring back as much of the approved materials so removed as may be required to properly refill the trench.
4. When directed by the Engineer, the Contractor shall furnish such other suitable materials as may be necessary to properly refill the trench at no additional cost to the Owner.
5. The Contractor shall restore all shrubbery, 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, without any additional cost to the Owner.
6. The Engineer may mark certain trees, shrubs, or other items that are not to be disturbed or damaged. In the event such items are disturbed or damaged, they shall be replaced or compensated for at the Contractor's expense.

E. Width of Trench: Pipe trenches shall be sufficiently true in alignment to permit the pipe to be laid in the approximate center of the trench. The trench shall be wide enough to provide a free working space on each side of the pipe; however, the trench width at least 12 inches above the top of the outside barrel of the pipe shall not exceed dimensions in the following table:

Nominal Pipe Diameter (Inches)	MAXIMUM TRENCH WIDTHS
3 and smaller	12
*4	14
6	15
*8	16
10	18
	20
	21
	24
	27
	30
	33
	36
	42
	48
	54
	60
	66

Aggregate Backfill and Temporary Pavement (Width Inches)	Final Pavement Restoration and Reseeding (Width Inches)
12	36
24	48
24	48
24+ Pipe O.D.	48
28	52
30	54
32	56
33	57
34	58
36	60
40	64
42	66
48	72
54	78
60	84
63	87
66	90
75	99
84	108
90	114
96	120
106	130

1. At manholes, valve pits, and other structures, the pay-line shall be measured as 1-foot outside the wall for excavation and 18-inches outside the wall for restoration.
2. Where sheeting and shoring are used, the maximum allowable width of trench as shown in the preceding table shall be measured between the closest interior faces of the sheeting or shoring as placed. Whenever, for any reason, the maximum trench width is exceeded below the top of the pipe, the Contractor may be ordered by the Engineer to cradle or encase the pipe in concrete at the Contractor's expense in order to insure the structural integrity of the pipe.
3. If the maximum width of trench specified above cannot be maintained, the Contractor shall install temporary sheeting at his own cost and expense.
4. Where lines are to be constructed on rights-of-way or easements in open areas, the maximum width of trench at the top specified hereinbefore may be exceeded only if the construction is kept entirely within the limits of the right-of-way or easements and can be carried on without damage to adjoining property. The angle of slope shall be the angle at which the trench bank will stand without sliding and in no case shall the angle of slope be steeper than one-half horizontal to one vertical.
5. In locations other than rights-of-way or easements, the Engineer may, as warranted by working conditions, waive the requirements that the maximum width of trench at the top shall not exceed the dimensions specified hereinbefore.
6. If the maximum width requirement at the top is waived by the Engineer, the Contractor will not be entitled to additional compensation beyond the specified trench widths.

7. Where the Engineer specifically requires the contractor in writing to excavate beyond the maximum allowable trench width, the Contractor will be entitled to and will be reimbursed for the quantity of material excavated beyond the specified trench widths in accordance with the applicable unit price bid under the Schedule of Unit Prices for Additions, Deductions, or Deletions in Contract Quantities.

F. Trench Width and Depth for Electrical Work:
   1. Excavate trenches for cable or conduit runs to vertical lines not exceeding maximum trench pay-line widths specified previously for piping, to accommodate the conduit or conduits width.
   2. Excavate trenches to the depth required to provide a minimum of two feet of cover unless indicated otherwise on Drawings.

G. Length of Trench:
   1. No trench shall be opened more than 100 feet in advance of the pipe lines laid.
   2. The Contractor shall limit all trench openings to a distance commensurate with all rules of safety.
   3. If the work is stopped either totally or partially, the Contractor shall refill the trench and temporarily repave over the same at his expense and the trench shall not be opened until he is ready to proceed with the construction of the pipeline.

H. Pumping and Draining: The Contractor shall remove by pumping, draining, or otherwise, any water which may accumulate in the trenches and other excavations and shall build all dams and do all other work necessary to keep the trenches or other excavation as free from water as possible.
   1. Where it is impractical to completely drain the trench, special pipe or jointing materials may be authorized at no additional expense to the Owner.
   2. While the pipelines are being laid, the Contractor shall have sufficient pumping machinery ready for immediate use.
   3. All surface waters shall be prevented from entering the open ditches or excavations by proper grading of the surface in the vicinity of the excavation.

I. Accommodations of Drainage: The Contractor shall keep gutters, sewers, drains and ditches open at all times so that the flow of storm or other waters shall not be obstructed. If the material excavated from the trenches must temporarily extend over gutters or other waterways, it shall be the duty of the Contractor to plank or bridge over the gutters, without extra compensation, so that the flow of water is not impeded.

J. Protection of Utilities, Property and Structures: The existence and location of underground utilities as indicated on the plans is presented merely to serve as a notification that such utilities do exist in the general proximity of the work. Any utilities not shown, or not located as shown, shall not be cause of the Contractor to deny responsibility for their protection and/or repair during construction.
   1. The Contractor shall notify all utility companies in advance of construction to include requesting the utilities to be field located and cooperate with agents of these companies during the progress of the work. Procedures for emergency action and repairs to utilities shall be established with the utility company prior to

commencement of the work. During the course of his work, if the Contractor damages any of the aforementioned utilities, he shall immediately follow the procedure of emergency action and repair as established at his own expense.

2. Whenever the Contractor, during the progress of the excavation, shall uncover service pipes or lines, which because of injury or age are in poor condition, he shall immediately notify the proper authority in order that steps may be taken for replacement or repair. Locations of repairs, and the procedures of repairs that have been made shall be recorded by the Contractor.
3. The Contractor shall, at his own expense, sustain in their places, and protect from direct or indirect injury, all pipes, conduits, tracks, walls, buildings, and other structures or property in the vicinity of his work, whether above or below the ground, or that may appear in the trench. He shall at all times have a sufficient quantity of timber and plank, chains, ropes, etc., on the ground and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened, or weakened, whether such structures are or are not shown on the drawings.
4. Pipes and underground conduits exposed as a result of the Contractor's operations shall be adequately supported along their entire exposed length by timber or planking, installed in such manner that the anchorage of the supporting members will not be disturbed or weakened during the backfilling operation. Backfill of selected material shall be carefully rammed and tamped under and around the supports and all supports shall be left in place as a guard against breakage of the supported structure due to trench settlement. No additional payment will be due the Contractor for material left in place nor for the labor of installing and maintaining supports.

3.02 PIPE BEDDING AND TRENCH BACKFILL

A. Bedding: The trench shall be excavated to a depth of three (3) inches below the outside diameter of the pipe, or deeper if so specified. The resultant subgrade shall be undisturbed, or compacted as approved by the Engineer if disturbed. The bedding shall then be prepared by placing a thoroughly compacted aggregate pipe bedding and initial backfill material, as specified herein, in 3-inch (uncompacted thickness) layers to 12-inches above top of pipe. Bedding shall provide uniform and continuous bearing and support for the pipe.

B. Special Bedding:
   1. Unstable Subgrade: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, which, in the opinion of the Engineer, should be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth recommended by the Engineer.
      a. Before pipe is laid, the subgrade shall be made by backfilling with Type B Select Material, as directed by the Engineer, in 3-inch (uncompacted thickness) layers thoroughly tamped and the bedding prepared as hereinbefore specified.

b. Aggregate backfill when used at the direction of the Engineer to stabilize trench subgrade will be paid for in accordance with the applicable unit price bid under the Schedule of Unit Prices for Quantity Adjustments, exclusive of the pipe bedding.

c. Additional excavation required to remove unstable material will be paid for in accordance with the applicable unit price bid for Miscellaneous Excavation under the Schedule of Unit Prices for Quantity Adjustments.

2. Concrete Cradle and Concrete Encasement: If concrete cradle and/or encasement is indicated on the Drawings or required by the Engineer, the trench shall be excavated to a depth of 6-inches below the outside of the barrel of pipes 24-inches in diameter or less and nine (9) inches below the outside of the barrel of pipes larger than 24-inches in diameter. All of this excavation may be done by machine. Method of placement is specified in Related Sections.

3. Special Foundations: Where the bottom of the trench at the subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timbers or other materials, in accordance with plans prepared by the Engineer. Compensation for such additional work shall be in accordance with the General Conditions of the Contract.

4. Excavation in Fill: When the pipe is laid in fill, the compacted embankment shall be brought to a height of at least 9-inches above the proposed top of the pipe before the trench is excavated.

C. Backfilling Methods:

1. General: Backfilling shall not be done in freezing weather except by permission of the Engineer, and it shall not be done with frozen material. Do not backfill when the material already in the trench is frozen.

a. Where Select Material is not indicated on the Drawings or specified herein, and in the opinion of the Engineer should be used in any part of the work, the Contractor shall furnish and backfill with Select Material as directed.

b. Payment will be made in accordance with the unit price bid under the Schedule of Unit Prices for Quantity Adjustments.

c. No extra compensation will be made for Select Material backfill required for the pipe bedding, or due to excavation made beyond the limits specified, or where used as special bedding at the discretion of the Contractor.

D. Pipe Bedding Beneath and Haunching to Centerline of Pipe: All trenches shall be backfilled by hand, from the bottom of the trench to the centerline of the pipe with Select Material placed in layers of 3 inches (uncompacted thickness) and compacted by tamping. Bedding and haunching material shall be deposited in the trench for its full width on each side of the pipe and fittings simultaneously.

E. Initial Backfill Over Pipe: From the centerline of the pipe and fittings to a depth of one (1) foot above the top of the pipe, the trench shall be backfilled with Select Material by hand or by approved mechanical methods. The Contractor shall use special care in placing this portion of the backfill so as to avoid injuring or moving the

pipe. The backfill shall be placed in 4-inch layers (uncompacted thickness) and compacted by tamping.

F. Backfill Material to Restoration Depth: From one (1) foot above the top of the pipe to restoration depth, the trench shall be backfilled with Common Earth Backfill by hand or by approved mechanical methods. Backfill in this section of the trench shall be consolidated by tamping in eight (8) inch layers or other approved mechanical methods unless otherwise specified. Any consolidation method utilizing water, such as jetting or puddling shall not be permitted. Consolidation shall proceed from the center of the trench to the sides to prevent arching. No extra payment for Common Earth Backfill will be given the Contractor.

G. Underground Warning Tape: For the purposes of early warning and identification of buried pipes during future trenching or other excavation, provide continuous identification tapes in trenches. Install in accordance with printed recommendations of the tape manufacturer, and as modified herein. Bury tape at a depth of 8-12 inches below grade; in pavements measure 12 inches from subgrade of pavement.
   1. Provide in trenches for utilities indicated in Part 2 of this Specification Section.

H. Backfilling Trenches for Electrical Work:
   1. Perform trench backfilling for cable and conduits by methods which will result in thorough compaction of backfill material without displacement of the conduit and minimum settlement of backfilled material. Settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require removing and recompacting settled material at no expense to the Owner.

I. Compacting: During the course of backfilling and compacting work, the Engineer may, at any location or depth of trench, make tests to determine whether the Contractor's compaction operations are sufficient to meet specified requirements. Compact trench backfill as follows:
   1. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 95 percent of maximum density obtained at optimum moisture content as determined by AASHTO T 99. Perform field determinations of density, when requested by the Engineer, in accordance with AASHTO T 191.

3.03 RESTORATION AND CLEAN-UP OF SURFACE

A. Replacement of Structures by Contractor: The Contractor shall restore (unless otherwise stipulated) all sidewalks, curbings, gutters, shrubbery, fences, poles, sod 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.

B. Clean-Up and Maintenance of Surfaces:
   1. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition. Streets shall be swept and flushed after

backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates. Failure of the Contractor to perform this work shall be cause for the Engineer to order the work by others, and backcharge all costs to the Contractor.

a. All surplus materials furnished by the Contractor and temporary structures shall be removed from the site by the Contractor.
b. All dirt, rubbish and excess earth from the excavation shall be disposed of by the Contractor in a manner and place acceptable to all governing agencies.
c. The construction site shall be left clean at the end of each working day to the satisfaction of the Engineer.

2. Repair or Correction of Unsatisfactory Conditions: All unsatisfactory conditions resulting from the work shall be corrected.
   a. Any subnormal or dangerous condition caused by the work, on any surface, shall be repaired or corrected within two hours of observance or notification of its existence. If repairs or corrections are not made within this period, the Owner shall cause to have the work completed with the resulting cost subtracted from the Contractor's next monthly payment request. Any such costs shall be deemed a reduction in the total amount due the Contractor under the contract and no subsequent reimbursement shall be made to the Contractor by the Owner for these costs.

C. Restoration of Lawns, Meadows, and Cultivated Fields:
   1. General: Final restoration of all areas shall be performed in accordance with the specifications for the particular land use as herein defined.
      a. Final restoration shall be performed no later than the start of the next planting season following construction. The planting season shall be as established by the U.S. Agricultural Service for the area of construction.
      b. Topsoil shall be free from subsoil, brush, weeds, or other litter, clay lumps and stones, but may contain decaying vegetable matter as is present in good topsoil.
      c. Precautions shall be exercised as necessary to conform with laws relating to erosion and sediment control.
      d. Seed shall be not more than two (2) years old. Germination tests of seeds shall be made not more than six (6) months prior to seeding. Seed which has become wet, moldy or otherwise damaged shall not be used.
      e. All seed mixtures shall be submitted to the Engineer for approval prior to seeding.
      f. The Contractor shall be responsible to produce a stand of grass in all seeded or sodded areas. Erosion, drought, or any other condition encountered shall not relieve the Contractor of this requirement.
   2. Lawns: All disturbed areas, whether inside or outside the paylines shall receive a minimum of 6-inches of topsoil, and the surface hand raked, stones removed and natural drainage features provided and/or restored prior to the application of seed. The Contractor shall improve all disturbed areas to a condition equal to or better than prior to construction.
      a. The lawn seed mixture shall be equivalent to the following:

Red Fescue	40%
Common Kentucky Bluegrass	50%

Annual Ryegrass	10%

b. The seed shall be sown with approved seeding procedure at the rate of four (4) pounds per 1,000 square feet. An approved starter fertilizer shall be utilized and applied per manufacturer's recommendations. Hydroseed shall be allowed with approved application mixtures.

3. Pasture and Meadow Grass: Prior to construction, the full depth of the existing topsoil, but no less than 12-inches, shall be stripped from all areas anticipated to be disturbed, and shall be stockpiled during construction. Upon completion of the construction, all topsoil removed shall be replaced. As the final class of material is applied, bringing the area to finished grade, the depth of topsoil replaced shall not be less than the depth removed.

a. The seed mixture shall be equivalent to the following:

Timothy	18%
Orchard Grass (Pennlate or Pennmeade)	46%
Redtop	18%
Kentucky Bluegrass	18%

b. The seed shall be sown with approved seeding procedure at the rate of 22 to 25 pounds per acre.

4. Cultivated Fields: Prior to construction, the full depth of the existing topsoil, but no less than 12-inches, shall be stripped from the area of the anticipated trench, and shall be stockpiled during construction.

a. Upon completion of construction, the entire disturbed area shall be cleaned of all rubbish, stones, and other objects over 2-inches in maximum dimension, and all crushed stone related to the construction operations.

b. All disturbed and traveled areas relevant to the work shall be scarified to a depth of 10-inches.

c. All the topsoil removed shall be replaced, and the entire disturbed and traveled areas graded to the original grade. The depth of the topsoil replaced shall not be less than the depth removed.

END OF SECTION

SECTION 02230

ROADWAY EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation backfill and compaction requirements for constructing road subgrade.

1.02 RELATED SECTIONS

A. Paving and Surfacing: Section 02500.

B. Sediment and Erosion Control: Section 01560.

1.03 SYSTEM DESCRIPTION

A. Definitions:
   1. Roadway Subgrade: The prepared earth surfaces on or over which additional roadway materials will be placed or work is to be performed.

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T 99, Moisture-Density Relations of Soils using a 5.5-lb. Rammer and a 12-in. Drop.
   2. AASHTO T 191, Density of Soil In-Place by the Sand Cone Method.

B. American Society for Testing and Materials: ASTM D 2167, Density of Soil in Place by the Rubber-Balloon Method, Test Method for.

1.05 SITE CONDITIONS

A. As specified previously under Section 02210.

PART 2 - PRODUCTS

2.01 MATERIALS

A. As specified previously under Section 02210.

PART 3 - EXECUTION

3.01 PERFORMANCE

A. Roadway Grading: Shape subgrade of roadways, intersections, approaches, entrances and adjoining pedestrian walkways to no more than 0.10 foot above or below the elevations indicated on the Drawings.

B. Roadways Embankments: Construct embankments for roadways as specified in Section 02210 with the exception that materials other than Backfill may be used. Materials such as shale or other rock formations that can be readily incorporated in a 36 inch layer may be used. Construction

requirements for roadway embankment containing rock shall be as follows:

1. Breakup shale and other rock-like materials formed by natural consolidation of mud, clay, silt and fine sand into a maximum size that can be readily placed and compacted in loose eight inch layers.
2. Place rock to form the base of roadway embankments. Place in uniform loose layers not exceeding in depth the approximate average size of the larger rock, but not exceeding 36 inches deep.
3. Do not dump rock in final position. Position rock by blading or dozing in a manner that will minimize voids, pockets and bridging.
4. Smooth and level each layer adding Coarse Aggregate Material in sufficient quantity to supplement the smaller rock pieces in filling the voids and pockets.
5. Form the top 18 inches of roadway embankments with Backfill and construct in the same manner specified for formation of embankments other than those containing rock.
6. Compact embankment material to a minimum final density of not less than 90 percent of the maximum dry weight density at its optimum moisture content.
7. Borrow Excavation materials required for embankment shall meet the requirements of Backfill. During the excavation operation, keep the borrow area graded to insure free water drainage. Following completion of work in the borrow area, grade the area to present a uniformly trim appearance merging into the surrounding terrain and to prevent serious erosion.

3.02 FIELD QUALITY CONTROL

A. Surface Tolerance: Check finished subgrade surface for smoothness and elevation in accordance with the following:
   1. Use an approved template shaped to conform to the design requirement indicated on the Drawings for checking crown and contour of roadways.
   2. Use an approved ten foot straightedge to check for longitudinal irregularities in the subgrade.
   3. Use string lines for controlling the finished elevation of roadway subgrade. Maintain such lines until surface irregularities have been satisfactorily corrected.

B. Corrections: Correct surface irregularities exceeding previously specified limits to the Engineer's satisfaction either by removing or adding material as required, followed by rolling until satisfactorily compacted.

C. Field Moisture-Density Tests: Conduct such tests as specified in Section 02210.

END OF SECTION

SECTION 02240

SOIL AND SELECT MATERIALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for Soil and Select Materials specified in other Specification Sections.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
   2. ASTM D2487 - Classification of Soils for Engineering Purposes.

B. Maryland Department of Transportation, State Highway Administration, "Standard Specifications for Construction and Materials," (MDT Specifications).

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Topsoil From On-Site Excavations
   1. Free of roots, rocks larger than one inch, subsoil, debris, and weeds.
   2. Ash or soil containing ash will not be accepted for use as topsoil.

B. Imported Topsoil - If Topsoil from on-site excavations is not sufficient to cover all areas requiring Topsoil, provide imported material meeting the following requirements:
   1. Friable loam.
   2. Free of subsoil, roots, grass, weeds, stone, and foreign matter.
   3. Acidity range (pH): 5.5 to 7.5.
   4. Organic Matter: Minimum of four percent, maximum of 25 percent.

C. Suitable Subsoil From On-Site Excavations (for use as Common Earth Backfill)
   1. Excavated material which is free of lumps larger than six inches, rocks larger than three inches, debris, and ash.
   2. Classified as CL, ML, SC, SM, SP, SW, GC, GM, GP, or GW in accordance with ASTM D2487.

D. Imported Common Earth Backfill: If Suitable Subsoil from on-site excavations is not sufficient to satisfy the total requirement for Common Earth Backfill on the Project, provide imported Common Earth Backfill material meeting the specifications for Suitable Subsoil in 2.01C above.

E. Unsuitable Soil from On-Site Excavations
   1. Material which does not meet the requirements for Topsoil or Suitable Subsoil as specified in 2.01A and 2.01C above.

2. Ash or any soil containing ash will be classified as Unsuitable Soil.
3. Remove Unsuitable Soil materials from the Project site. Unsuitable Soils shall be removed from the Project site and disposed of at no additional cost to the Owner.

F. Cost of Imported Soil Materials: If imported soils are required, obtain, haul, stockpile, and place such imported materials at no additional cost to the Owner.

2.02 SELECT MATERIALS

A. Coarse Aggregates
1. Type A
a. Rounded natural gravel.
b. Free of shale, clay, friable material, and debris.
c. Graded in accordance with ASTM C136 within the following limits:

Sieve Size	Percent Passing
2½"	100
1"	90 - 100
½"	60 - 70
#10	35 - 90
#40	20 - 55
#200	5 - 25

d. Meet requirements in MDT Specifications Section 901.01 for "Bank Run Gravel - Subbase."

2. Type B
a. Coarse, crushed aggregate with fines.
b. Free of shale, clay, friable material, and debris.
c. Graded in accordance with ASTM C136 within the following limits:

Sieve Size	Percent Passing
2"	100
1½"	90 - 100
3/4"	60 - 85
3/8"	40 - 70
#4	30 - 60
#40	10 - 25
#200	0 - 12

d. Meet requirements in MDT Specifications Section 901.01 for "Graded Aggregate - Subbase Design Range."

B. Fine Aggregates
1. Type C
a. High quality, free draining sand.
b. Graded in accordance with ASTM C136 within the following limits:

Sieve Size	Percent Passing

3/8"	100
#4	95 - 100
#16	45 - 80
#50	10 - 30
#100	2 - 10

c. Meet the requirements of MDT Specifications Section 901.01 for "Fine Aggregate - Portland Cement Concrete and Underdrain."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Place and compact Soil and Select Materials in accordance with the requirements given in "Related Sections" and the Drawings.

END OF SECTION

SECTION 02295

RIPRAP SLOPE AND CHANNEL PROTECTION

PART 1 - GENERAL

A. Description

Riprap slope and channel protection shall include, but not necessarily be limited to, protecting slopes and channels with coverings of stone to the lines and grades shown on the Plans in accordance with the Contract Documents or as directed by the Engineer.

B. Quality Assurance
1. The Engineer will inspect all materials and work to ensure compliance with the Contract Documents.

C. Submittals
1. Shop Drawings
Shop drawings shall be submitted for all filter fabric furnished. The shop drawings shall include general product information and a tabulation of the fabrics physical properties. The Contractor shall also submit his stone source.
2. Certificates of Compliance
Certificates of compliance shall be submitted for the filter fabric stating that the filter fabric meets the materials requirements specified.

PART 2 - MATERIALS

A. Detailed Material Requirements
1. Stone
Stone shall meet the general requirements for stone and the size requirements of Class I Riprap as specified in Section 901.02 of the SHA Specifications. In addition, the stone shall meet the following quality requirements.

Test and Method	Specification Limits
Apparent Specific Gravity, AASHTO T 85, min.	2.50
Absorption, AASHTO T 85, % max.	3.0
Sodium Sulfate Soundness 5 cycles, 2 1/2 to 1 1/2 inch Aggregate, AASHTO T 104, % max. loss	20

3. Filter Blanket
Filter blanket for riprap slope and channel protection shall be graded aggregate AASHTO M 43, No. 57 meeting the gradation

requirements and quality requirements for graded aggregate for base courses.

4. Filter Fabric
   a. Fabric shall be a nonwoven fabric consisting of long chain polymeric filaments or yarns or polypropylene, polyester, polyamide, or polyvinylidene-chloride formed into a stable network.
   b. Fabric shall be inert to chemicals commonly encountered in soil and to hydrocarbons.
   c. Fabric shall be resistant to mildew, rot, and insect and rodent attacks.
   d. Fabric shall contain ultraviolet ray inhibitors and stabilizers and be suitable for use at temperatures of 0°F to 120°F.
   e. Fabric shall conform to the following test criteria:

Test and Method	Specification Limits
Grab Tensile Strength, ASTM D 1682, lbs min.	90
Tensile Elongation, ASTM D 1682, % min.	20
Burst Strength, ASTM D 3786, psi min.	140
Trapezoidal Tear Strength, ASTM D 1117, psi min.	45
Equivalent Opening Size, U.S. Standard Sieve Size, CW-02215 Corps. of Engineers	40-100 As shown on the Plans
Flow Rate, AASHTO M 2281 Appendix, gpm/sq ft min.	40
Coefficient Permeability, AASHTO M 228 Appendix, cm/sec min.	

   f. Fabric securing pins shall be 3/16-inch diameter steel, pointed at one end, and fabricated at the other end with a head to retain a steel washer having an outside diameter of not less than 1 1/2 inches. Pin length shall be at least 18 inches.

PART 3 - EXECUTION

A. Excavation

Excavation for riprap slope and channel protection, including cutoff walls, shall be made in reasonably close conformity with the lines and grades shown on the Plans. The foundation upon which the slope and channel protection is to be placed shall be an even surface that is acceptable to the Engineer.

B. Foundation

1. Filter Fabric
   After the Engineer has approved the excavation, the Contractor shall install the filter fabric over the prepared surface. Securing pins shall be used to anchor the fabric in place. Where fabric overlaps are necessary, the minimum overlap shall be 12 inches.
2. Filter Blanket
   The filter fabric shall be covered with a 6-inch deep filter blanket which shall be consolidated to the satisfaction of the Engineer.

C. Riprap Placement

The placement of the riprap shall begin with the cutoff walls. The larger stones should be placed in the cutoff walls and along the outside edges of the limits of the slope and channel protection. The riprap shall be placed with suitable equipment in such a manner as to produce a reasonably graded mass of stones. Placing the stones by methods that causes extensive segregation or damage to the underlying filter fabric will not be permitted.

D. Backfill

An excavation voids existing along the edges of the completed slope and channel protection shall be backfilled to the satisfaction of the Engineer.

END OF SECTION

SECTION 02444

CHAIN LINK FENCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fence Fabric and Fence Supports.

B. Sliding and Swing Gates.

1.02 RELATED SECTIONS

A. Division 3 - Concrete.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Continuing member of the Chain Link Fence Manufacturer Institute (CLFMI).

B. Erector Qualifications: Provide at least one person in a supervisory capacity who is skilled and experienced in erecting chain link fence and who readily understands the proposed layout and is completely familiar with current erection practices of the CLFMI. Said person shall be present at all times during progress of the fence installation.

C. Product Compatibility: Provide chain link fence components products of one manufacturer.

1.04 REFERENCES

A. American Society For Testing and Materials:
1. ASTM A 123; Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.
2. ASTM A 392; Zinc-Coated Steel Chain-Link Fence Fabric.

1.05 SUBMITTALS

A. Shop Drawings and Product Data: Manufacturer's published details modified to suit design and field conditions. Manufacturer's descriptive literature and specifications covering the products specified. Descriptive literature shall include installation information.

B. Certificates: Include in Submittals certified mill certificates indicating material conformity to yield strengths of these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Galvanizing: Ferrous metal elements of the fence shall receive zinc coating by the hot dip process after fabrication. Metal coated to 1.8 oz. of zinc coating per square foot of surface, in a smooth finish, free from dross, uncoated spots and foreign materials, ASTM A 123.

B. Galvanized Fabric: No. 9 gauge galvanized steel wire having a hot-dipped zinc coating of 1.2 ounce per square foot of wire surface. Fabric interwoven in a 2-inch mesh with top and bottom selvage edges both twisted and barbed. Fabric shall conform to ASTM A 392.
   1. Fabric Height: 6 feet, or to match existing.

C. Galvanized Tension Wire: Six gauge coil spring wire galvanized of same quality and process as specified for Fabric.

D. Frame Work: Roll-formed shapes or tubular members with zinc hot-galvanized coating per ASTM A 123, and comprised of the following components:
   1. Line Posts: Nominal two inch roll formed shapes or tubular members fabricated from 50,000 psi minimum yield strength steel and weighing 2.34 lbs. per ft.
   2. End, Pull and Corner Posts: Nominal three inch roll formed shapes or tubular members fabricated from 42,000 psi minimum yield strength steel and weighing 5.10-lbs. per ft.
   3. Gate Posts: Nominal four inch steel pipe or tubular members fabricated from 30,000 psi minimum yield strength steel and weighing 9.10 lbs. per ft.
   4. Post Braces: Nominal 1-1/4 inch steel pipe weighing 2.27 lbs. per ft. minimum, with 3/8 inch diameter truss rod and adjustable take-up device. Provide two brace assemblies at each corner post and one brace assembly at each end and gate post.
   5. Top Rail: Nominal 1-1/4 inch steel pipe weighing 2.27 lbs. per ft. Minimum.
      (Not required unless shown on Drawings.)
   6. Post Tops: Where barbed wire supporting arms are not required cover post ends with pressed steel or malleable iron, weather tight caps designed to permit passage of top rail, if any.
   7. Stretcher Bars: One piece 3/16 x 3/4 inch bar of length equal to full height of fabric. Provide one bar for each gate and end post and two for each corner and pull post. Provide 1/2 inch wide stretcher bar bands spaced not over 15 inches O.C. to secure stretcher bars to posts.

E. Gate Frame, Swing Type: Nominal two inch tubular horizontal and vertical members and truss members (if required) assembled by welding. Provide the same fabric as fence and install with stretcher bars and bar ties at 15 inches O.C. Provide diagonal cross bracing of 3/8 inch diameter adjustable length truss rods. Attach gate hardware with rivets or by other means which will provide security against removal. Gate hardware as follows:
   1. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, and offset to permit 180 degree swing. Provide one pair (top and bottom) per gate leaf.
   2. Latch: Forked or plunger-bar type to permit operation either side of gate. Provide padlock eye as integral part of latch. Provide

gate stops for pair of gates designed to accept drop rod or plunger bar.

3. Keeper: Provide keeper for each gate leaf which will hold gate leaf in open position until manually released.

F. Framework products of SS40 may be submitted as an alternate to Sch 40. Provide nominal sizes as noted in D. Framework above.

G. Acceptable Manufacturers:
1. Anchor Fence, Inc.
2. CYCLONE Fence.
3. Allied Fence Products.
4. Or Equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Distorted, deformed or damaged fencing resulting from storage will not be permitted for use.

3.02 INSTALLATION

A. Do not begin fence installation prior to completion of all forms of Site Grading.

B. Drill or dig holes for post footings in firm, undisturbed or compacted soil. Holes shall have a diameter equal to three times the diameter of the post. Excavate hole depths approximately three inches deeper than Post bottom, with bottom of posts set not less than 36 inches in concrete base. Space posts a maximum of ten feet on center.

C. Place concrete around posts in a continuous pour. Tamp concrete for consolidation. Check each post for vertical and top alignment. Crown top of post footings to shed water.

D. Set keepers, stops, sleeves and other accessories into concrete as required.

E. Install braces so posts are plumb when diagonal rods are under proper tension.

F. Install tension wires before stretching fabric and tie to each post with ties or clips.

G. Pull fabric taut and tie to posts, rails and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tensions after pulling force is released.

H. Thread stretcher bars through fabric. and secure to posts with metal bands spaced not over 15 inches O.C.

I. Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by the fence manufacturer and as detailed. Adjust hardware for smooth operation and lubricate where necessary.

END OF SECTION

SECTION 02480

LANDSCAPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trees.

B. Seed and Soil Supplement Materials.

C. Mulching.

D. Protective Materials.

E. Performance and Maintenance of Landscape Work.

1.02 RELATED SECTIONS

A. Site Grading: Section 02210.

B. Finish Grading: Section 02260.

1.03 QUALITY ASSURANCE

A. Source Quality Control:
   1. Packaged Products shall indicate the manufacturer's guaranteed analysis on each package and arrive on site as originally packaged and unopened.
   2. For freshly dug plants, use nursery grown stock acclimated to the soil and climatic conditions in the local area of intended planting.
   3. Use plants grown under good nursery practices for a period of two full growing seasons in a State certified nursery.

1.04 REFERENCES

A. American Association of Nurserymen, AAN American Standard for Nursery Stock.

B. American National Standards Institute, ANSI Z60.1 Standard for Nursery Stock.

C. American Society for Testing and Materials, ASTM C 602 Agricultural Liming Materials.

D. Standardized Plant Names, Second Edition, American Joint Committee on Horticultural Nomenclature.

1.06 SUBMITTALS

A. Test Reports: Submit laboratory test reports of the soil analysis and supplement recommendations to the Engineer for approval prior to adding any soil supplements to the topsoil.
   1. Laboratory reports shall recommend both grade and application rates of fertilizer and such other soil supplements as required.

2. Take sufficient quantity of topsoil samples to give a representative analysis of on-site topsoil and topsoil from outside sources, if any.

B. Soil Supplement Product Certification: Submit certificates certifying such products to have a guaranteed analysis in conformity with the Engineer approved laboratory soil supplement recommendations report.

C. Seed Certification: Submit certificates or certifying tags indicating lawn seed mixture, seed purity percentage, seed germination percentage and weed seed content percentage to certify conformity with the Specifications.

D. Plant Certifications: Submit plant material certificates certifying the plants to be typical of the species or variety and in conformity to the current edition of American Standard for Nursery Stock of the AAN.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver packaged products to the site in unopened containers with labels intact and legible.

B. Deliver plant materials to the site in a protected condition to prevent wind damage and drying. Plant material exhibiting a heated or sweated condition due to tight packing or poor ventilation is subject to rejection.

C. Deliver plants with a securely attached waterproof tag legibly indicating the name and size in accordance with the AAN standards of practice. Provide at least one tagged plant in each bundle or lot. In all cases, botanical names shall take precedence over common names.

D. Store packaged products in such a manner to prevent moisture damage and other forms of contamination.

E. Store balled or wrapped and potted plants in accordance with the AAN practices to prevent drying out. Store bare rooted plants by the heeling-in-method immediately after delivery, or permanently plant such bare rooted plant, immediately after delivery.

F. Prepare dug plants for handling and shipment with balled and burlapped (B&B) root systems. Perform B&B work in accordance with AAN Standards and in accordance with ANSI Z60.1 concerning diameter and depths of balls on B&B plants. B&B plants arriving at the site with broken, loose or fractured balls are subject to rejection.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Do not perform Work of this Section when soil or weather conditions are unsuitable. Unsuitable conditions include moisture saturated or frozen in place soil and precipitation of any kind present or occurring during the Work.

B. Seeding Dates: The following dates shall govern except when environmental conditions warrant, the Engineer may extend the seeding dates.
   1. Spring: March 1 to June 1.
   2. Fall: August 1 to October 1.

C. Sodding Dates. The following dates shall govern except when environmental conditions warrant, the Architect may extend the sodding dates.
   1. Do not place sod between dates June 1 and August 15 inclusive nor times when ambient temperature is below 32 degrees F.

D. Plant Setting Dates: The following dates shall govern except when environmental conditions warrant, the Engineer may extend the plant setting dates.
   1. Deciduous Trees (and Shrubs): October 15 to May 15.
   2. Evergreen Trees (and Crownvetch): Spring - March 1 to May 15; Fall - August 1 to September 15
   3. Seedlings and Seedling Transplants: March 1 to May 15.
   4. Crownvetch Seeding: Do not seed between dates September 1 and October 31, inclusive, nor times when ambient temperature is below 32 degrees F.

E. Protection:
   1. Protect seeded areas from washouts by one of the methods specified in this Section. Should washouts and bare spots develop resulting from inadequate protection or otherwise, perform such reseeding as required until a healthy, complete coverage stand of grass is obtained.
   2. Use temporary barricades to protect lawn areas from foot traffic or other uses until a healthy, total coverage stand of grass is obtained. Barricade materials subject to Engineer's approval.
   3. After plant setting work, install stake and guy supports on those plants indicated as being staked to prevent uprooting by wind or otherwise. Do not locate stakes and guy supports where pedestrian safety would be endangered.

1.08 WARRANTY

A. Warranty trees and shrubs, for a period of one year after date of contract completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Contractor's control.

B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period.

PART 2 - PRODUCTS

2.01 SOIL SUPPLEMENT MATERIALS

A. Agricultural Liming Materials: Products containing calcium and magnesium compounds capable of neutralizing soil acidity and containing not less than 80 percent of total carbonates. Use liming material

meeting requirements of ASTM Designation C602 and conforming to applicable state liming material regulations.

B. Fertilizer: Commercial fertilizer of uniform composition. free-flowing and in conformity with applicable state fertilizer laws.
   1. Analysis: As recommended by laboratory soil supplement recommendations report.

C. Bone Meal: Horticultural grade, pulverized bone meal containing minimums of 4 percent nitrogen and 8 percent phosphoric acid.

D. Peat: Commercially available material consisting of shredded sedge peat and reed peat or sphagnum moss peat, or combinations of such, from fresh water sites. Peats in advanced stages of decay (parent material not identifiable) not permitted. Use peat having a minimum organic content of 80 percent organic matter by weight, a pH value of 4.5 to 6.0 and a maximum ash content of 15 percent.

2.02 LAWN AND SEED MATERIALS

A. Grass Seed: New crop seed, furnished in sealed packages with proof of correct mixture evidenced, age of seed indicated and compliance with applicable state regulations evidenced if required. Seeds and mixture as follows:
   1. Mixture:

Species in Mix	Mix Percent by Weight	Min. Percent Purity	Min. Percent Germination	Max. Percent Weed Seed
Kentucky 31, Tall Fescue	31	90	90	0.50
Kentucky Bluegrass	60	85	80	0.40
Perennial Rye Grass	20	90	90	0.50

B. Crownvetch Seed: New crop seed, furnished in sealed packages with proof of correct mixture evidenced, age of seed indicated, and compliance with applicable state regulations evidenced if required. Seeds and mixture as follows:

Species in Mix	Mix Percent by Weight	Min. Percent Purity	Min. Percent Germination	Max. Percent Weed Seed
Crownvetch	45	99	70*	0.10
Ryegrass, Annual	55	95	90	0.15

*Minimum 35 percent normal sprouts and minimum 35 percent hardseed.

C. Crownvetch Seed Inoculation: Use a pure culture of Nitrogen-Fixing Bacteria selected for maximum vitality and ability to transform nitrogen from the air into soluble nitrates, and deposit them in the soil. Perform the inoculation process as recommended by the seed supplier subject to the Engineer's approval. Maintain temperatures of inoculant in strict compliance with manufacturer's requirements.

2.03 PLANT MATERIAL

A. Plant Stock: Provide plants of species and specified below. Provide healthy plants free from insect infestations, typical of the species or variety, and which conform to the current edition of American Standard for Nursery Stock of the AAN for grading requirements; and ANSI Z60.1 for plant quality and minimum root spread.
   1. Pump Station Screening Trees: White Pine; in the range of 6 to 8 feet tall.

B. Minimum Acceptable Plant Sizes: Measure plants before pruning with branches in normal position; plant size shall conform to specifications. Plants larger in size than indicated may be used, but at no change in Contract Price. If larger plants are used, proportionately increase the root ball or spread of roots in accordance with AAN rules.

C. Container Grown Plants: Provisions of ANSI Z60.1 shall also govern container grown plants. Provide container grown plants of at least one year but not more than two years growth in the same container.

2.04 MULCHING MATERIAL

A. Lawn Mulch: Straw Stalks of any threshed grain or tall hay grass stalks free from seed bearing stalks or roots harmful to lawn growth. Mulch material containing noxious weeds, decomposed material or brittle weed material is not acceptable.

B. Plant Mulch: Tanbark, a by-product of the tanning process, or Hardwood and Pine Bark consisting of ground or shredded bark, a fibrous material free from foreign material and substances toxic to plant growth.

C. Mulch Binder: Emulsified asphalt conforming to the requirements of AASHTO M 140, Grade RS-1 and which does not contain solvents or other diluting agents toxic to plant life.

2.05 PROTECTIVE MATERIALS

A. Stakes and Wires: Rough sawn straight-grained hardwood stakes, free of serious defect and of dimensions indicated on the Drawings. Use wires no smaller than No. 14 gauge galvanized steel with fabric reinforced rubber hose not less than 5/8-inch nor more than one inch O.D. of sufficient length to protect trees from damage by wire.

PART 3 - EXECUTION

3.01 PREPARATION

A. Tillage: Perform tillage of finish graded soil over areas indicated for lawn regardless of type of lawn work performed. Use equipment and methods common to such work, and till soil to a two inch depth minimum.

B. Soil Supplement Addition: The soil supplements for lawn areas, as required according to the Engineer approved laboratory test reports, may be incorporated into the soil during tillage operations.
   1. Perform tilling operations in accordance with Section 02260.

C. Plant Pits: Prepare planting beds, plant trenches and plant pits to the depths required below finished grade according to the recommended practices of the AAN. However, the following minimum plant pit dimensions shall take precedence over the AAN if in conflict.
   1. Excavate plant pits with vertical sides and flat bottoms.
   2. Excavate plant pits large enough to allow a minimum of 12 inches beyond the circumference of the root system or ball and six to eight inches beneath the root system or ball.

D. Plant Beds: Prepare plant beds for ground cover by incorporating peat and the required soil supplements into the top 6 inches of existing topsoil. Incorporate peat into the topsoil in quantity equal to three inches of peat spread uniformly over the plant bed.

E. Backfill Mix For Plant Pits: Prepare a mix consisting of one part peat to three parts excavated topsoil by volume and one pound of bone meal added for each cubic yard of excavated topsoil.

3.02 PERFORMANCE

A. Seeding: Sow seed mixtures when air current is low and not more than five days after soil supplements have been applied. Sow seeds in two applications using either mechanical power seeders or mechanical hand seeders. Sow one-half of the seed mixtures in one direction over designated areas and the remainder at right angles to the first sowing. Seeding rates as follows:
   1. Grass Seed Mixture: 5 pounds per 1,000 sq. ft. areas.
   2. Crownvetch Mixture: 4 pounds per 1,000 sq. yds. with the ryegrass at 5 pounds per 1,000 sq. yds.

B. Seed Cover: Imbed seed mixtures into topsoil 1/4-inch using a light drag or rake and moving in directions parallel to the contour lines. Immediately after dragging or raking, compact seeded areas using a cultipacker or similar design lawn roller, weighing 60 to 90 pounds per linear foot of roller, and roll at right angles to existing slopes.

C. Contractor Option: Seeding and soil supplement application may be performed by the hydroseeding method. However, rates of application, methods and equipment shall receive Engineer's prior approval.

D. Lawn Mulching: Evenly apply mulch over seeded areas not more than 48 hours after seeding. Start mulching at windward side of relatively flat areas, or at the upper part of slopes. Spread mulch in a total coverage at a depth not less than 1-1/2 inches nor more than three inches.

E. Mulch Binding: Immediately following mulch spreading, apply mulch binder to anchor mulch to the soil. The number of passes over the mulch as needed to secure it firmly shall not exceed three passes with maximum applied binder not exceeding ten gallons per 1,000 square feet.

F. Contractor Option: Secure mulch by the peg and string method in lieu of mulch binding. Drive stakes into ground on three foot centers or less, and string binder twine between adjacent stakes in straight lines and criss-crossed diagonally over mulch. After twine is attached, drive stakes nearly flush to ground to draw twine down tight onto mulch.

G. Plant Setting Operations: Set plants to insure that after settlement the plant stem projects from the soil as much as before transplanting. Set plants plumb and straight with allowance for settlement and in accordance with following:

1. Ground Cover Plants: Set each plant in a slight depression for catching rainwater and top-off such depressions with two inches of mulch spread uniformly and compacted. Thoroughly water groundcover bed immediately following planting.
2. Balled & Potted Plants: Set each plant in prepared circular pits deep enough to accommodate a bed of topsoil not less than six inches deep under the ball or pot of shrubs and 12 inches under the ball of trees. Remove burlap from the top third of root balls, and completely remove ropes, twine and wires from root balls. Completely remove containers from potted plants, however, the earth shall remain unbroken around roots. Place Backfill Mix in plant pits under and around root balls in six inch layers and tamp to eliminate voids. At the half-way point in backfilling, flood pit with water and continue backfilling after water dissipates. Backfill pits to grade, and build up a ring of soil three inches deep over edge of plant pit to facilitate maintenance watering. Place a two inch layer of plant mulch within the ring prior to watering.
   a. Spacing of pump station screening trees: 3 feet on centers.

3.03 PROTECTION INSTALLATION

A. Staking Trees: Within three days after planting, stake trees as detailed at perimeter line of root ball and to sufficient depth to hold tree rigid. Drive stakes vertically and not twisted or pulled. Place wire ties as indicated with protection (hose) at points of contact with bark. Stake trees as follows:
   1. Stake evergreen plants six feet and taller with two stakes.

3.04 PRUNING

A. Prune new plant material to minimum necessary to remove injured twigs and branches and to compensate for loss of roots during transplanting, but never to exceed more than half of the branch structure. Pruning may be done before delivery of plants, but not before plants have been inspected and approved. Paint cuts over 3/4-inch in diameter with an approved tree-wound paint.

B. Prune existing trees indicated to remain to remove all dead and interfacing branches. Remove lower branches to provide a minimum clearance five feet from finished grade. Paint cuts over 3/4-inch in diameter with an approved tree-wound paint.

C. To repair small decay cavities in existing trees, remove decayed material to a depth which exposes healthy tissue. Shape cavities to provide drainage. Cover exposed cambium layers with clear shellac or tree-wound paint, to prevent drying and leave cavities open.

3.05 MAINTENANCE

A. Maintenance operations shall begin immediately after seeding and planting is performed and shall continue throughout the construction period. In general, maintenance shall include weeding, applying mulch

as needed, controlling insects and diseases and performing other particular operations as follows:

1. Seeded Areas: Keep seed moist continually for proper germination and water thereafter as necessary to prevent drying out or burning. Reseed areas not showing a prompt catch of grass, correct depressions and irregularities and reseed; repeat until a complete coverage is obtained. Cut seeded areas at required intervals to maintain grass at a maximum height of 2-1/3 inches.
2. Plants: Water the plant root systems at regular intervals and keep surrounding soil in condition for promotion of root growth. Maintain and adjust stake wires if necessary. Perform pruning, other than initial pruning, as necessary to remove dead leaders and branches. Replace plants that are dead, unhealthy or in a badly damaged condition with like species plants. Do not make replacements during seasons definitely unfavorable for planting.

B. At conclusion of construction period, the Engineer shall make an inspection of the landscaping work to determine condition of acceptance. Make such additional repairs and replacements as required by the Engineer. Perform such work at no expense to the Owner.

END OF SECTION

SECTION 02500

PAVING AND SURFACING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Bituminous material and requirements.

1.02 RELATED SECTIONS

A. Site Grading: Section 02210.

B. Soil and Select Materials: Section 02240.

1.03 QUALITY ASSURANCE

A. Source Quality Control:
   1. Use materials conforming to requirements of the Maryland Department of Transportation, State Highway Administration Standard Specifications for Construction and Materials.
   2. Use products of a bituminous concrete producer regularly engaged in production of bituminous concrete conforming to the standards referenced herein.
   3. Maintain quality of work by using products of a qualified bituminous concrete producer and qualified plant operating workmen.

1.04 REFERENCES

A. The MDT noted herein refer to sections contained in the Maryland Department of Transportation State Highway Administration Specifications for Construction and Materials. The references pertain only to materials, construction, equipment, methods and labor.

B. Maryland Standard Method of Tests.

C. American Society for Testing and Materials:
   1. ASTM D 1557, Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. (4.5 Kg) Rammer and 18-inch (457 mm) Drop, Test Methods for.
   2. ASTM D 2167, Density of Soil in Place by the Rubber-Balloon Method, Test Method for.

D. American Association of State Highway and Transportation Officials:
   1. AASHTO T180, Moisture-Density Relations of Soils Using a 10 lb. Rammer and an 18-inch Drop.

1.05 SUBMITTALS

A. Certificates: Furnish certification from bituminous and aggregate producer attesting that materials conform to requirements of Maryland Department of Transportation State Highway Administration Specifications.

1.06 PROJECT CONDITIONS

A. Protection:

1. Protect paved surfaces outside of the limits of work. Repair pavement outside limits damaged by constructing operations at no additional expense to the Owner.
2. The Contractor shall be liable for damages to municipal roads caused by his equipment. The repairs may include lane or full roadway width overlays as directed by the Owner. No additional payment will be made for repairs to municipal roads damaged by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coarse Aggregate Base Course:
   1. Type B Select Material as specified in Section 02240.

B. Bituminous Materials and Pavements:
   1. Bituminous Tack Coat: MDT Section 904.04.
   2. Surface Course: Hot mixed, hot laid, Bituminous Surface Courses SC Type A and SF, conforming to MDT Section 904.06.
   3. Base Course: Hot mixed, hot laid, Bituminous Base Course BC conforming to MDT Section 904.06.

PART 3 - EXECUTION

3.01 PREPARATION

A. Subsurface Preparation: Perform site grading, roadway grading and finish rolling just prior to subbase installation as previously specified in Section 02210.

B. At joints between existing pavements and new paving work, the edges of existing pavements shall be cut and neatly trimmed. An application of Class AC-20 petroleum asphalt shall be provided at all locations where new bituminous paving joins existing bituminous paving.

3.02 INSTALLATION (NEW PAVING)

A. Subbase Construction: Install coarse aggregate base course in accordance with MDT. Install base course to after-compaction thickness indicated on Drawings.

B. Bituminous Pavement Construction: Method of preparing mixture, placing mixture, compaction, and protection of in-place bituminous concrete for paving shall comply with MDT Section 504. Minimum thickness of bituminous concrete base and surface courses as indicated on the drawings.
   1. Use Bituminous Tack Coat material to seal joints in wearing courses as specified in MDT Section 504.03.07.
   2. Dust Control: Provide effective dust control by sprinkling water, by the use of calcium chloride or by any other methods approved by the Engineer. Use dust control measures where, when and in a manner required by the Engineer.

3.03 CLEAN-UP AND MAINTENANCE

A. During construction, surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition.
   1. Surfaces shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates.
   2. Failure of the Contractor to perform this work shall be cause for the Engineer to order the work to be done by others, and backcharge all costs to the Contractor.

B. Repair or Correction of Unsatisfactory Conditions: All unsatisfactory conditions resulting from the work shall be corrected.

C. Continuously maintain temporary pavement without additional compensation until it is replaced with permanent pavement.

D. Any subnormal or dangerous condition caused by the work, on any surface, shall be repaired or corrected within two hours of observance or notification of its existence. If repairs or corrections are not made within this period, the Owner shall cause to have the work completed with the resulting cost subtracted from the Contractor's next monthly payment request. Any such costs shall be deemed a reduction in the total amount due the Contractor under the contract and no subsequent reimbursement shall be made to the Contractor by the Owner for these costs.

END OF SECTION

SECTION 02510

MILLING EXISTING HOT MIX ASPHALT PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removing existing Hot Mix Asphalt Paving by means of milling.

1.02 RELATED SECTIONS

A. Pavement: Section 02500.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. This item consists of milling the existing pavement from edge of curb to edge of curb or to road centerline as shown on the Plans to a depth of 2 inches and 25 feet minimum beyond the sewer main terminus at each end of the project. All work shall be in accordance with Section 508 of the State Highway Administration Standard Specifications for Construction and Materials, October 1993, except as modified herein.

B. The Contractor shall furnish all labor, material and equipment to perform the milling of existing bituminous concrete pavement at locations shown in this document or as directed by the Engineer.

C. The equipment for removing the bituminous surface shall be a power operated planing machine or grinder. The equipment shall be capable of accurately establishing profile grade elevation. The equipment shall also have an effective means for preventing any dust resulting from the operation from escaping into the air. The surface texture shall provide a smooth skid resistant finish with a tolerance of one-eighth inch (1/8") using a ten foot (10') straight edge. The equipment must observe the weight limit of the bridges.

D. A street sweeper, vacuum equipped, capable of removing all loose material without causing dust to escape into the air, shall follow immediately behind the milling operation.

E. In addition, all unstable utility patches, curb patches, or other areas created by the milling operation shall be cleaned, prepared, and filled with bituminous concrete. This work shall be completed by the Contractor at the unit price bid for bituminous asphalt.

F. A small portable milling machine is also required for the project. At the discretion of the City, the Contractor shall mill around existing curbing, storm drain inlets, handicapped ramps, entrances, railroad tracks, etc. to achieve smooth transitions from proposed pavement to

existing adjoining surfaces.

G. Total milling depths are variable, but estimated quantities are based on a depth of two inches (2").

H. In order to establish payment, depth of milling will be on a square yard per two inch (2") basis. Where milling is completed at a greater depth, the payment will be adjusted accordingly. For example, a three inch (3") depth will be paid at a rate of one-and-one-half (1-1/2) times the unit price in the proposal. Measurement will be taken by the Resident Project Representative assigned to the project.

I. The Town may wish to retain the "millings" removed during the operation. The Contractor shall load and deliver to sites in the Town of Indian Head as directed by the Inspector, for no additional compensation.

J. The Contractor shall adjust utilities, if necessary, and include all costs in the unit price for milling. Patching requirements for the adjustment of manholes, valves, and other utility frames and covers are as follows:
   1. The area of excavation removed around manholes, valves or other utility frames and covers requiring adjustment shall be filled with SHA Mix No. 3 concrete from the undisturbed material at the bottom
   2. Respective utility Department approved adjusting rings may be used
   3. Where manholes and/or valves are adjusted by the paving contractor to a height exceeding 1-1/2" above the existing street surface, or the location creates a possible hazardous condition, paving contractor will be required to temporarily patch around the manhole and/or valve with bituminous concrete and maintain the locations Appurtenances adjusted by the respective utilities will be temporarily patched by them.
   4. Paving contractor shall remove <u>all</u> temporary patches around raised

END OF SECTION

SECTION 02520

REMOVAL OF EXISTING PAVEMENT, SIDEWALK, PAVED DITCHES, CURB OR COMBINATION CURB AND GUTTER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of existing curb, pavement, sidewalk, paved ditches and concrete or asphalt paved driveways for installation of the new sewer main and laterals.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Paving: Section 02500.

C. Curb, Curb and Gutter and Sidewalk: Section 02525.

1.03 DESCRIPTION

A. This work shall consist of the full depth removal and disposal of existing pavement, sidewalk, paved ditches, curb or combination curb and gutter as specified in the Contract Documents or as directed by the Engineer.

PART 2 - PRODUCTS

NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. The Contractor shall saw cut the existing pavement, sidewalk, paved ditches, curb or combination curb and gutter along the lines specified in the Contract Documents or to the nearest joint. The Contractor shall not damage sections which are not meant to be removed. Damage done by the Contractor to those areas to remain in place shall be repaired or restored at the Contractor's expense.

3.02 BROKEN MATERIAL

A. Broken pavement, sidewalk, paved ditches, curb or combination curb and gutter materials shall be disposed of by the Contractor in an approved manner.

END OF SECTION

SECTION 02525

CURB, CURB AND GUTTER, AND SIDEWALK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Replacement of disturbed curb, curb and gutter, sidewalk or concrete driveways or new installation.

1.02 RELATED SECTIONS

A. Removal of Existing Pavement, Sidewalk, Paved Ditches, Curb or Combination Curb and Gutter: Section 02520.

B. Division 3 - Concrete.

1.03 DESCRIPTION

A. This section includes placing concrete curb, curb and gutter and sidewalks and providing new curb, curb and gutter and sidewalks, within the limits indicated, including preparation of subgrade and providing base courses as required in accordance with the Contract Documents.

1.04 SUBMITTALS

A. Submittals shall be as set forth in the project permits and as required by the governing jurisdiction.

PART 2 - PRODUCTS AND EXECUTION

2.01 MATERIALS AND CONSTRUCTION

A. Jurisdictional Requirements
   1. Materials and construction shall meet the following jurisdictional requirements, unless otherwise indicated:
      a. Town facilities; Town of Indian Head Specifications and
      b. State facilities; Maryland State Highway Administration

B. Preparation
   1. Preparation of subgrade shall meet jurisdictional requirements
   2. Provide base for pavement where required as specified elsewhere in these specifications.
   3. Compaction shall meet requirements specified elsewhere in these specifications.

C. Temporary Facilities: Unless otherwise indicated, provide temporary facilities where so directed by Engineer.

D. Formwork: Forms shall be steel forms with the exception of approved flexible forms for radii formation.

E. Concrete: Concrete to be MSHA Class 2, air entrained. Concrete

F. Replacement: Joint spacing shall match existing contiguous work.

G. Cold Weather Concrete: Requirements for protection of concrete in

H. Slip Form Method for Curb and Gutter to comply with State Highway

END OF SECTION

SECTION 02601

MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete Manholes for:
   1. Gravity Wastewater Sewer.
   2. Gravity Stormwater.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Soil and Select Materials: Section 02240.

C. Gravity Wastewater Sewer: Section 02731.

D. Division 3 - Concrete.

1.03 QUALITY ASSURANCE

A. Shop Inspection:
   1. All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.

B. Field Inspection:
   1. All materials shall be furnished and installed and tested for defects in material and/or workmanship in the manner specified and in the presence of and as approved by the Engineer. Any exposed reinforcement will be cause for rejection.

C. Source Quality Control:
   1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete manholes.
   2. Obtain certificate of construction compliance with ASTM C478 from the precast reinforced concrete manhole manufacturer. Submit same certificate as part of required submittals.
   3. Obtain certificate of material compliance with ASTM A48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings. Submit same certificates as part of required submittals.

1.04 REFERENCES

A. American Society for Testing and Materials.
   1. ASTM A 48, Gray Iron Castings, Spec. for.
   2. ASTM A 276, Stainless and Heat-Resisting Steel Bars and Shapes, Spec. for.
   3. ASTM A 307, Carbon Steel Externally Threaded Standard Fasteners, Spec. for.
   4. ASTM C 32, Sewer and Manhole Brick (Made from Clay or Shale), Spec. for.
   5. ASTM C 139, Concrete Masonry Units for Construction of Catch Basins and Manholes, Spec. for.

6. ASTM C 270, Mortar for Unit Masonry, Spec. for.
7. ASTM C 361, Reinforced Concrete Low-Head Pressure Pipe, Spec. for.
8. ASTM C 443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Spec. for.
9. ASTM C 478, Precast Reinforced Concrete Manhole Sections, Spec. for.
10. ASTM C 923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
11. ASTM D 2240, Rubber Property-Durometer Hardness, Test Method for.

B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.

C. American Water Works Association:
1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe Non-cylinder Type, Not Prestressed.

D. Federal Specifications:
1. Fed. Spec. SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).

1.05 SUBMITTALS

A. Shop Drawings and Product Data:
1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.
2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

B. Certificates:
1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.
3. Manufacturer's sworn certification that manhole frame and cover tensile test bars were poured from the same iron as castings they represent.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast reinforced concrete manhole components and other Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects. Through-wall lifting holes not permitted in manhole component construction.

B. Store precast reinforced concrete manhole components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified Products as recommended by the respective manufacturers.

1.07 SITE CONDITIONS

A. Environmental Requirements:

1. In no instance set or construct manhole bases on subgrade containing frost.

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Cast-In-Place Concrete Products: Formwork, Reinforcement, and Cast-In-Place Concrete conforming to requirements of Division 3 - Concrete.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C270, Type M with waterproofing admixture included.
1. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
2. Grace Construction Materials; Hydratite.
3. Chem-Master Corporation; Hydrolox.
4. Or Equal.

C. Epoxy Bonding Compound: Use product such as A. C. Horn EPOXTITE BINDER; Sika Chemical SIKADUR-HI-MOD or equal.

D. Manhole Brick: Commercially manufactured brick made from clay or shale and burned, meeting requirements of ASTM C32, Grade MS.

E. Manhole Steps: Spacing as indicated on Drawings or Standard Town Details.
1. Aluminum Step: Aluminum Alloy AA Designation 6061-T6. Coat that portion of aluminum step being embedded in concrete with heavy bodied bituminous paint. Steps shall be F-14-2-B from Washington aluminum Company or equal.

F. Manhole Frame and Cover: Gray iron castings conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Frame and cover design and dimensions to match Town of Hagerstown's existing castings used in system.
1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting surfaces shotblast cleaned and coated with asphalt paint, non-tacky drying.
2. Identification: Cast the word "Sanitary Sewer" integrally on cover in 2-inch size raised letters.
3. Frame Hold-down Bolts: ASTM A 307.
4. Anchor Bolts: J or L shape with standard coarse thread ends, ASTM A307.
5. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.

G. Watertight Manhole Frame and Cover: Gray iron castings conforming to previously specified requirements for Manhole Frame and Cover with the addition of cover hold-down bolts.(inner sealing lid, gasket, and locking bar.)
1. Cover Hold-down Bolts: Type 316 stainless steel, ASTM A 276, bolts and washers; or manufacturer's standard bronze bolts and washers.
2. Inner Sealing Lid: Gray iron casting with steel locking bar and bronze locking screw. Provide rubber gasket of commercial grade rubber.

H. Preformed Plastic Sealing Compound: Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.
1. K. T. Snyder Company, Inc.; RUB'R-NEK.
2. Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2.
3. Or Equal.

I. Waterstop: Gasket type waterstop composed of polyisoprene compound, ASTM C 923 with stainless steel take-up clamps.
1. Acceptable Manufacturer:
   a. Press-Seal Gasket Corporation.

J. Exterior Coating: Coat exterior as shown on the Plans.

2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

A. Materials and Construction: Conforming to requirements specified in ASTM C 478 except as follows:
1. Concrete: Composition and compressive strength conforming to ASTM C 478 except use Type II or Type III cement in manhole components and increase compressive strength to 4500 psi (at 28 days) in precast bases.
2. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C 302.
3. Manhole Steps: Factory installed in manhole components, pre-aligned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on Drawings.
4. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.
   a. Rubber Compression Gasket: Composition conforming to ASTM C 361 or ASTM C 443.
   b. Preformed Plastic Sealing Compound: As specified previously.
5. Manhole Component Design: Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C 478, are as indicated on Drawings.

B. Pipe Openings: Custom preformed during manufacturing in each base and riser section requiring such, to accommodate type of pipe and pipe opening seal provided.
1. Pipe Opening Seals: ((To 60" diameter-round pipe)) Resilient gasket type, cast integrally with manhole component conforming to requirements specified in ASTM C 923 and of the following acceptable manufacturers:
   a. Press-Seal Gasket Corporation.
   b. Star Seal or Press Wedge II.

C. Precast Top Sections: Designs as required by Drawings, of materials and construction as specified previously except additional and differing requirements as follows:
1. Hold Down Bolt Inserts: Factory cast in top section no less than two 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of 3-inches depth. Both insert types designed for an ultimate load in tension of

12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.

2. Flat Slab Tops: Thickness versus diameter as indicated on Drawings. Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.
3. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

D. Precast Grade Rings: Leveling and adjusting units of 3-inches or 4-inches thickness of materials and constructions as specified previously. Factory cast grade rings with hold down bolt holes matching location of same in manhole frame. Design must provide for full bearing of manhole frame.

E. Coatings:
1. Prepare surfaces to be coated in accordance with the written instructions of the coating manufacturer, including cleaning, sandblasting or acid etching as necessary.
2. Coat precast components at the factory.
3. Exterior Surface Coating; Use one of the following:
   a. Kop-Coat, Inc., Bitumastic No. 300-M, 20 mil minimum thickness.
   b. Coopers Creek Chemical Corp., Epoxy-Tar Kote #775.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C 478 regarding repairable defects and defects subject to rejection by the Engineer.

B. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed from the site.

3.02 PREPARATION

A. Keep pipe and manhole interiors cleared of debris as construction progresses.

B. Earthwork: Perform earthwork for manhole installation as previously specified in Trenching, Backfilling and Compacting: Section 02221.

3.03 MANHOLE CONSTRUCTION METHODS

A. Cast-In-Place Concrete Manhole Base: Construct in accordance with design and dimensions indicated on Drawings. When necessary to construct wider or deeper manhole bases than indicated or specified, build such bases as required by the Engineer.
1. Form and pour concrete in accordance with requirements of Division 3 - Concrete. Additional requirements as follows:
   a. Vibrate poured concrete using mechanical vibrator of a type and design approved by Engineer. Use vibrators of type capable of

transmitting vibration to concrete in frequencies of not less than five thousand impulses per minute.

b. Form and pour joint monolithically in manhole base top to match joint of adjoining precast riser section. Use template as obtained from precast concrete manhole component manufacturer of manhole components used in the Project.

c. Do not place precast riser sections on cast-in-place bases for a minimum of 48 hours after pour.

2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete.
   a. Apply Epoxy Bonding Compound in accordance with manufacturers instructions to pipe at base connection prior to pouring the concrete.
   b. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.
3. Use 4000 psi concrete as specified in Section 03300, unless indicated otherwise on Drawings.
4. Coat bases in accordance with the requirements for precast manhole components.

B. Precast Concrete Bases: Install bases on a 6-inch deep compacted layer of aggregate meeting requirements of Pipe Bedding as specified previously in Section 02221.
   1. When using prefabricated pipe opening seals for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.
      a. Tightly caulk sealing compound into annular spaces, completely filling the spaces, and render the installation watertight.
      b. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

C. Concrete Channel Fill: Precast Performed channels only for each manhole base.
   1. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
   2. Make changes in size and grade gradually.
   3. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
   4. Make slopes gradual outside the invert channels.
   5. Use 3000 psi concrete as specified in Section 03300, unless indicated otherwise on Drawings.

D. Manhole Wall Erection: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.
   1. If rubber compression gaskets are used between sections, install gaskets and join sections in accordance with written instructions of manhole component manufacturer.
   2. If preformed plastic sealing compound is used between sections, install sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.
      a. Prime joint surfaces if required by preformed sealing compound manufacturer.

b. If sealing compound is installed in advance of section joining leave exposed half of two piece protective wrapper in place until just prior to section joining.
c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
d. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
e. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

E. Lifting Hole Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into holes in such manner to render holes completely water and air tight. Sealing of lifting holes with grout not permitted.

F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using (the following) (materials selected in Contractor's options).
1. Precast Grade Rings:
a. Set precast grade rings in Water-Proof Mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.
b. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding one square inch wide on all sides. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial mortar set.
2. Precast Concrete Leveling Unit: Lay precast concrete leveling units to line and in radial courses with completely filled mortar joints. Flush cut exposed horizontal and vertical joints on manhole interior and exterior. Leave exterior surface ready for parging.
3. Parge the outside of finished concrete leveling units with a minimum of 1/2-inch thick waterproof mortar.
4. Bolt manhole frames in place on manhole top section, or on leveling units if required, after installing 1/2-inch thick preformed plastic sealing compound on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
5. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.
6. Perform manhole frame sealing in accordance with requirements of

G. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.
1. Use masonry units and waterproofed mortar laid up to prevent deterioration.
2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.

H. Drop Manholes: Construct in accordance with Type indicated in details on Drawings. Use same type pipe and fittings in drop connection as used in sewer line from which drop connection is made.

3.04 MODIFYING INVERTS OF EXISTING MANHOLES TO NEW ELEVATIONS

A. When indicated on the Plans that the invert of an existing manhole is to be modified to a new elevation to match new pipe invert elevations, the existing concrete channel bottom shall be removed to 1/2 inch to 1 inch below the new elevation. Prior to work, the manhole pipe upstream shall be plugged and flow bypassed.

B. The surface of the concrete channel shall then be made clean and sound. Remove all grease, curing compounds, oils and the like by mechanical means such as sandblasting or waterblasting. Remove all standing water and contaminants, although a surface saturated dry condition is acceptable. Do not "feather" new concrete repair to existing but rather square off to create a minimum of 1/2" of new concrete at all locations within the channel.

C. The Contractor shall apply Sikatop 122, as manufactured by SIKA Corp., Lyndhurst, New Jersey, in accordance with manufacturer's

instructions to the new line and grade shaping to conform to new desired channel configuration.

3.05 FIELD QUALITY CONTROL

A. General: Test each manhole constructed in the Project by one of the methods specified herein. If the manhole is constructed on an existing sewer where sewage flow must be maintained, the test will be waived.
   1. Conduct tests in presence of and to complete satisfaction of the Engineer.
   2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.
   3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.
      a. Vacuum Testing Equipment:
         1) Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
         2) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
         3) Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.
         4) Provide seal plate with vacuum piping connections for inserting in manhole frame.
   4. Prior to testing manholes, thoroughly clean such and seal openings, both to complete satisfaction of the Engineer. Seal openings using properly sized plugs.
   5. Perform testing with frames installed. The joint between the manhole and the manhole frame shall be included in the test.
   6. The Contractor may elect to make a test prior to backfilling for his own purposes; however, the tests of the manholes for

acceptance, shall be conducted after the backfilling has been completed.

B. Vacuum Test Procedure (Optional, at Engineer's discretion):
   1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
   2. Draw a vacuum of 10 inches of mercury and close the valves.
   3. Consider manhole acceptable when vacuum does not drop below 9 inches of mercury for the following manhole sizes and times:

DEPTH OF MANHOLE (feet)	Time Lapse (seconds)		
	Manhole Diameter (inches)		
	48"	60"	72"
8 or less	14	18	23
10	17	23	28
12	21	28	34
14	25	32	40
16	28	37	45
18	32	41	51
20	35	46	57
22	39	51	62
24	42	55	68
26	46	60	74
28	49	64	80
30	53	69	85

C. Repair and Retest: Determine source(s) of leak(s) in manholes failing acceptable limits.
   1. Repair or replace defective materials and workmanship, and conduct such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.
   2. Materials and methods used to make manhole repairs must meet with Engineer's approval prior to use.
   3. Make repairs, replacements and retests at no additional expense to Owner.

END OF SECTION

SECTION 02721

STORM SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe materials and inlets.

B. Precast End Walls.

C. Ground Stabilizing Blanket.

1.02 RELATED SECTIONS

A. Trenching, Backfilling, and Compacting: Section 02221.

1.03 SUBMITTALS

A. Shop Drawings and Product Data:
1. Submit shop drawings with information necessary for fabrication and installation.
2. Submit manufacturer's descriptive literature covering the piping and those products to be used in its installation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Replacement of Damaged Material: The Contractor shall replace, at his own expense, all material furnished by him and found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for replacement of installed material.

B. Responsibility for Safe Storage: The Contractor shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times. All equipment and materials subject to damage from freezing shall be drained and stored in a manner which will protect them.

C. Hauling: All materials furnished by the Contractor shall be delivered and distributed at the site by the Contractor.
1. Pipe, fittings, items of equipment, and other materials of construction shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped.
2. Materials handled on skidways shall not be skidded or rolled against materials already on the ground.
3. Materials furnished by the Owner shall be picked up by the Contractor at the location designated by the Owner and delivered to and distributed at the site.

D. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench, or as otherwise directed by the Engineer. Under

no circumstances should lawns, grass plots or other private property be used for this purpose without the consent of the property owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforced Concrete Pipe (RCP): Class III, unless indicated otherwise on the Drawings, conforming to requirements of ASTM C76. Pipe manufactured free of honeycomb with hard, dense surface inside and outside to roughness coefficient (Kutters 'n') not exceeding 0.013.
   1. Pipe Joints: Tongue and groove or bell and spigot type.
   2. Joint Gaskets: Compression type conforming to requirements of ASTM C443.
   3. Cement Concrete: ASTM C150.
   4. Aggregate: ASTM C33.
   5. Steel Reinforcement: ASTM A82 Wire and ASTM A185 Wire Fabric.

PART 3 - EXECUTION

3.01 PREPARATION

A. Inspection: Prior to start of storm drainage construction, inspect each section of pipe for defects before actual use. Pipe already laid and later found defective will not be accepted and shall be replaced with new materials and relayed at the Contractor's expense.

B. In no instance lay pipe or set or construct inlets, endwalls or manhole bases in excavations containing water or on subgrade containing frost. In all instances, keep excavations water-free until concrete pours of whatever nature have cured. Keep pipe and manhole interiors cleared of debris as construction progresses.

3.02 CONSTRUCTION

A. Earthwork: Perform earthwork for buried storm sewer piping and associated concrete structures as specified previously in Trenching, Backfilling, and Compacting: Section 02221.

B. Storm Sewer Piping Installation:
   1. Following trench preparation, install pipe bedding, and lay pipe proceeding up-grade true to lines and grades given.
   2. Rest each pipe section on bedding for the full length of its barrel. Make recesses to facilitate joint band installation. Backfill recesses with pipe bedding material immediately following pipe jointing operations.
   3. Connect new pipe to existing pipe with a concrete collar that completely encapsulates the joint a minimum of 6 inches on each side of joint and consists of 6 inches minimum thickness around the circumference of the pipe joints.

END OF SECTION

SECTION 02731

GRAVITY WASTEWATER SEWER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wastewater Sewer Gravity Pipelines

B. Service Connection Piping

C. Pipeline Testing

1.02 RELATED SECTIONS

A. Trenching Backfilling and Compacting: Section 02221.

B. Cast-In-Place Concrete: Section 03300.

C. Grout: Section 03600.

1.03 QUALITY ASSURANCE

A. Source Quality Control:
   1. Shop Tests and Inspection:
      a. All material furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.

B. Disposition of Defective Material: All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed by him from the site at his own expense.

1.04 REFERENCES

A. American Society for Testing and Materials.
   1. ASTM D 2321, Underground Installation of Flexible Thermoplastic Sewer Pipe, Rec. Practice for.
   2. ASTM D 2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
   3. ASTM D 3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, Spec.
   4. ASTM D 3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals, Spec. for.
   5. ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe, Spec. for.
   6. ASTM F 789, Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.

7. ASTM F 794, Std. Spec. for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

1.05 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping and piping specialties.

B. Certificates:
1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

1.07 SITE CONDITIONS

A. Environmental Requirements:
1. Keep trenches dewatered until pipe joints have been made and concrete cradle or encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.
3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 - PRODUCTS

2.01 SEWER PIPE AND FITTINGS

A. For pipe joints, use rubber gaskets suitable for conveying domestic sewage.

B. Polyvinyl Chloride Pipe (PVC):
1. Pipe: Type PSM SDR-35, ASTM D 3034, or Type PS-46, ASTM F 789, or ASTM F 794 ribbed.
2. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
3. Joints: Push-on with elastomeric gasket, ASTM D 3212; and ASTM F 477 for gasket specifications.

2.02 SERVICE CONNECTION PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe (PVC):
1. Pipe: Type PSM SDR-35, ASTM D 3034, or Type PS-46, ASTM F 789.
2. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
3. Joints: Push-on with elastomeric gasket, ASTM D 3212; and ASTM F 477 for gasket specifications.

B. Flexible Pipe Coupling: Clamped design with virgin PVC coupling and two type #305 stainless steel bands, such as manufactured by Fernco Joint Sealer Co. (Flexible Couplings distributed by The General Engineering Company, Frederick, Maryland).

C. Saddles (PVC): Correctly contoured for outside diameter of pipe and incorporating ring gasket bell outlet.
   1. Wye or tee saddle of same material as specified previously for Sewer Pipe.
   2. Solvent Cement: ASTM D 2564.

D. Pipe Plugs: Designed for permanent installation and removable. Obtain Plugs for various types of pipe used from the respective pipe manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Earthwork: Perform earthwork for sewer installation as specified in Trenching, Backfilling, and Compacting: Section 02221.

3.02 PIPE LAYING

A. General: All pipe shall be laid to a uniform line and grade between manholes, socket ends upgrade, with a firm and even bearing along the barrel of the pipe, close joints and smooth invert. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell or socket of the previously laid pipe. The interior of each pipe shall be cleaned of all excess joint and foreign material before the next pipe is laid. The pipe shall be laid in the bedding materials as specified in Section 02221. Pipe-laying shall commence at the lowest point and proceed upgrade. 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.

B. Joints: Make joints in joining of pipe materials specified under PART 2 and not specifically covered for installation under PART 3 of this Specification, in strict accordance with manufacturer's installation instructions.

C. Laying Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321.

D. Construction Control: The Contractor shall provide at least three grade boards in advance of pipe laying at all times at intervals not exceeding fifty feet and stretch a line parallel with the grade line. From this line, the trench and every pipe laid shall be tested as to grade and alignment. Base lines and controlling elevations established for the construction of the work shall be preserved and kept uncovered so that they can be examined at any time.
   1. The use of laser equipment shall be permitted. Grade boards as specified will not be required if a laser is used.
   2. Regardless of control used, the Contractor shall provide alternative verification of grade as work progresses. Pipe not

laid to proper line and grade will be removed and reconstructed at the Contractor's expense.

E. Variations: The Engineer reserves the right to vary the line and/or grade from that shown on the drawings for pipe lines and manholes when such changes may be necessary or advantageous. No claims will be allowed for changes in location or grade except as such changes are made after trenching has been done. Payment for all variances shall be in accordance with the unit pricing as indicated in the Bid and all excavation shall be unclassified.

F. Handling of Sewer Line Materials into Trench: Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, jointing materials, etc. shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to sewer line materials and/or workmen. Under no circumstances shall such materials be dropped or dumped into the trench.

G. Pipe Clearance in Rocks: Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or less, and 9 inches for pipes larger than 24 inches in diameter.
   1. The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of such rock, boulder or stone.

H. Pipes at Manholes or Other Rigid Structures: Pipe directly connected to or supported by rigid structures shall be as indicated on the Drawings.

I. Drop Connections: Make drop connections where indicated on the Drawings, where drop in invert is two feet or more or as required by the Engineer. Use same pipe material used to construct the main from which the drop connection is made. Construct drop connection in accordance with design shown on the Drawings.

J. Concrete Cradle and Encasement:
   1. Preparation: Prior to the formation of cradle or encasement, if any, temporary supports consisting of timber wedges and solid concrete bricks or cap blocks shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at not more than two locations, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket and the other near the spigot end.
   2. Placing: After jointing of the pipe has been completed, concrete shall be uniformly poured beneath and on both sides of the pipe. Placement shall be done by the use of suitable equipment. The concrete shall be wet enough during placement to permit its flow, without excessive prodding, to all required points around the pipe surface. The width of cradle shall be such as to fill completely the trench width. In case of extremely wide trenches, concrete encasement may be confined above the top of the pipe to a narrower

width but in no case shall it be less than the width of trench required for the size of pipe being used. Before depositing concrete, the space within the limits of the pour shall have been cleared of all debris and water. Water shall not be allowed to rise adjacent to, or flow over, concrete deposited for less than 24 hours. Concrete shall be protected from the direct rays of the sun and kept moist, by a method acceptable to the Engineer, for a period of seven days or until backfilling is begun. In no case shall backfilling begin within 24 hours of the time of placing and the Engineer shall have strict control of the rate of backfilling.

3. Concrete: 3000 psi per requirements of Section 03300.

3.03 SERVICE CONNECTIONS

A. Fittings, (Wye branches, risers and bends) and service pipe shall be provided in strict accordance with these specifications and any and all practices and precautions required for the sewer main are equally applicable to the service connections from the sewer to the right-of-way line, or to a location designated by the Engineer. The Contractor shall place a cleanout at the end of each sewer lateral.

B. The Contractor shall submit to the Engineer, on a monthly basis, all as-built information which shall include: manhole run, station, length from centerline of sewer, invert elevation at the termination point of lateral and the address or property owner's name for whom the lateral is provided.

C. Reconnection of Existing Service Connections: Use wye or tee fittings or PVC tee or wye solvent weld saddles for connection to the sewer main. Use pipe if required as specified previously. Make connection to existing piping with flexible pipe couplings.
   1. After coupling is satisfactorily installed, completely concrete encase sewer pipe and coupling to a minimum thickness of 6-inches and extend encasement along the pipe 6-inches minimum on each side of coupling.
   2. Service connection fittings as specified previously. Use commercially manufactured wye or tee fittings and one-eighth bends.
   3. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.
   4. Fittings locations determined by the Engineer with respect to existing service connection location.
   5. Saddles (PVC): Place saddle in position on pipe and mark guide for hole cut-in, using saddle as a template. Remove saddle from pipe and using hole guide mark, cut hole through pipe wall 1/2-inch outside the hole guide mark.
      a. Install saddle in accordance with manufacturer's installation instructions for solvent weld sewer saddle connections.
      b. After saddle is satisfactorily installed, completely concrete encase sewer pipe and saddle to a minimum thickness of 6-inches and extend encasement along the sewer pipe 8-inches minimum on each side of center line of the saddle.

D. House Services: Connect cleanout of property line with existing house service 5 feet outside of house with a cleanout. Place cleanouts at 75 feet intervals and at all changes in vertical and horizontal direction. Use Fernco coupling with stainless steel bands to connect to existing

sewer. Abandon existing septic tanks per County regulations. All work on private property shall be done by a Master Plumber registered in Maryland and Charles County, with all work conforming to the requirements of the plumbing code.

3.04 TESTS

A. Alignment: After the mains have been laid and backfilled, a light will be flashed between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer. Each section (manhole to manhole) of sewer shall show a good light circle throughout its length and any and all defects shall be corrected by the Contractor, to the satisfaction of the Engineer, before the work shall proceed and before acceptance of and/or payment therefore shall be made.

B. Leakage Tests:
   1. Air Testing: The Contractor shall test each section of sewer between manholes and all laterals to the limit of this contract using low pressure air. Testing shall not be performed, until all backfilling has been completed. The Contractor may, at his option, test the section of sewer for his own purposes, prior to completion of backfilling; however, the requirements of this subsection shall not be deemed to be completed until the lines have been tested after the backfilling has been completed and trench settlement has been minimized. The costs of any testing incurred prior to authorization from the Engineer after backfilling has been completed shall be borne by the Contractor.
   2. A minimum of two minutes shall be provided to allow equilibrium of the air temperature with pipe wall before test readings shall commence. The rate of air loss shall be determined by measuring the time interval required for the average internal pressure to decrease by 1.0 psig.
   3. The initial test pressure to be developed in the sewer and laterals shall be determined as follows:
      a. For depths six feet or less, the internal pressure shall not be less than 6.0 psig.
      b. For depths greater than six feet, the internal pressure in psig shall be calculated as the sum of 3.5 plus the maximum height in feet divided by 2.3 between the invert of the sewer and the existing ground surface in the section of sewer to be tested. (For example, if the maximum height is determined to be 9.2 feet, the added pressure would be 4.0 psig. The initial test pressure in the sewer would then be 7.5 psig. The allowable drip would be to 6.5 psig within the time indicated elsewhere in this subsection.)
      c. In no case shall the test pressure in the sewers or laterals be greater than the maximum internal differential joint pressure recommended by the manufacturer of the pipe.
   4. The pipe shall be considered acceptable if the air loss rate does not exceed 0.0030 cubic feet per minute per square foot of internal pipe surface when tested at the initial pressure previously defined in this subsection. The time for the air pressure to decrease 1.0 psig shall not be <u>less</u> than the time indicated in the following table:

Pipe Diameter	Minutes	Seconds
6" & 4"	2	55
8"	3	57

5. If the above rates of leakage are exceeded, the Contractor shall, at his expense, determine source of leakage and make all necessary corrections and retest.
6. The Contractor shall submit to the Engineer for approval the detailed test procedure and list of test equipment he proposes to use prior to testing.

C. Infiltration:
1. After the air testing described in the preceding paragraph has been completed by the Contractor, regardless of any indications of the test results made by the Engineer or the Owner, the Engineer and the Owner reserve the right to perform field investigations, prior to final written acceptance of each sewer run by the Owner and/or during the maintenance period specified elsewhere in these specifications, to establish the leakage of groundwater into the sewer and laterals constructed under this contract. The cost of these investigations shall be borne by the Owner.
2. Should the leakage exceed 100 gallons per day per inch diameter per mile of pipe for any section, the Contractor shall, at the direction of the Engineer or Owner, and at no cost to the Owner, perform any additional testing or corrective work required to reduce the infiltration in each manhole run from those lines installed by the Contractor to less than 100 gallons per day per inch diameter per mile of pipe. This leakage applies to each manhole run separately and should not be construed to mean total leakage in the total system. The scope of this corrective work shall include, but not be limited to, cleaning, televising and testing the sewer and laterals to the limits installed by the Contractor, to include testing and grouting of joints, excavation and replacement of faulty or damaged portions of the work, and all final restoration.

D. Acceptance: Observation of successful testing of manholes, sewers or force mains by the Engineer does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the Engineer may recommend final acceptance to the Owner. Only upon final inspection by the Owner or Engineer, and upon written acceptance for same will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the manholes, sewers or force main will commence.
1. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.

END OF SECTION

SECTION 02732

FORCE MAINS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wastewater Sewer Force Main Piping.

B. Low Pressure Wastewater Sewer Piping.

C. Concrete Vaults and Manholes.

D. Thrust Restraint.

E. Pipeline Testing.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Manholes: Section 02601.

C. Gravity Wastewater Sewer: Section 02731.

E. Division 3 - Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials.
   1. ASTM A 126, Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. ASTM A 536, Ductile Iron Castings.
   3. ASTM D 1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   4. ASTM D 2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR), Spec. for.
   5. ASTM D 3139, Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals, Spec. for.

B. American Water Works Association:
   1. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3-in. thru 48-in. for Water and Other Liquids.
   2. AWWA C153, Ductile-Iron Compact Fittings, 3 In. through 16 In. for Water and Other Liquids.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of piping, piping specialties, restraint systems and valves.

B. Certificates:
   1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.

2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.05 QUALITY ASSURANCE

A. Source Quality Control:
1. Shop Tests and Inspection: All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.

B. Disposition of Defective Material: All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed by him from the site at his own expense.

1.06 DELIVERY, STORAGE AND HANDLING

A. Replacement of Damaged Material: The Contractor shall replace, at his own expense, all material furnished by him and found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for replacement of installed material.

B. Responsibility for Safe Storage: The Contractor shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter, at all times. All equipment and materials subject to damage from freezing shall be drained and stored in a manner which will protect them.

C. Hauling: All materials furnished by the Contractor shall be delivered and distributed at the site by the Contractor.
1. Pipe, fittings, items of equipment, and other materials of construction shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped.
2. Materials handled on skidways shall not be skidded or rolled against materials already on the ground.

D. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench, or as otherwise directed by the Engineer. Under no circumstances should lawns, grass plots or other private property be used for this purpose without the consent of the property owner.

1.07 SITE CONDITIONS

A. Environmental Requirements:
1. Keep trenches dewatered until pipe joints have been made and concrete cradle, thrust blocks and encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.

3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 - PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. Polyvinyl Chloride Pipe (PVC):
   1. PVC pipe conforming to ASTM D2241, Class 12454-A, PVC resin compound conforming to ASTM D1784.
   2. Wall Thickness: SDR 21.

B. Fittings: Gray iron or ductile iron AWWA C 110 or ductile iron compact fittings AWWA C 153. All Fittings shall have a minimum pressure rating of 250 psi and shall have cement lining and joints as required for pipe restraint.
   1. Joints: Push-on type conforming to ASTM D 3139.
      a) Split retainer flanges shall not be used in place of thrust blocks.
      b) Proposed joint restraint system shall be submitted for Engineer's review and approval.

C. Fittings for Small Diameter PVC Pipe: For pipe sizes for which gray or ductile iron fittings are not available, use Schedule 80 PVC solvent weld fittings.

D. Saddle Connection for Air Valves: Correctly contoured for outside diameter of pipe and incorporating a gasket and band assembly.
   1. Saddle Body: Ductile iron, ASTM A 536, fusion coated inside and out with heavy resilient plastic.
   2. Gasket: Buna N.
   3. Band: Double Type 304 stainless steel bands, each assembled with two minimum 3/4-inch Type 304 stainless steel bolts, washers and hex nuts.
   4. Provide coropration stop suitable for connecting the air valve inlet pipe.
   5. Acceptable Manufacturer: JCM Industries, Inc. 406, or equal.

2.02 SEWAGE VALVES

A. Sewage Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with sewage during operation. Valve construction as follows:
   1. Valve Bodie and Cover: Cast iron, ASTM A 126, Class B.
   2. Inlet Size: 2-inches.
   3. Air Release Outlet Size: 1-inch, NPT.
   4. Air and Vacuum Inlet/Outlet Size: 2-inches.
   5. Air Valve Working Pressure Rating: 75 psi.
   6. Air Release Valve Vent Orifice: 1/2-inch.
   7. Air Release Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
   8. Air Release Valve Orifice Button: Stainless Steel and Buna-N.

9. Air Release Valve Mechanism Lever Pins and Float: High strength stainless steel.
10. Air and Vacuum Valve Float Stem and Guide: Stainless Steel.
11. Air and Vacuum Valve Floats: Stainless Steel.
12. Air and Vacuum Valve Orifice Seat: Buna-N.
13. Backflushing and Cleaning Accessories: Factory assembled to the combination valves and consisting of two inlet shut-off valves, two blow-off valves, two clear water inlet valves, section of rubber hose and quick disconnect couplings.
14. Acceptable Manufacturers:
    a. Val-Matic Valve and Manufacturing Corp.; Model No. 49/302 BW.
    b. Or Equal.

2.03 CONCRETE VAULTS AND MANHOLES

A. Concrete Vaults and Manholes for Use on Force Main and Low Pressure Sewer Lines: As specified in Section 02601.

PART 3 - EXECUTION

3.01 PREPARATION

A. Earthwork: Perform earthwork for force mains as specified in Trenching, Backfilling and Compacting: Section 02221.

3.02 PIPE INSTALLATION:

A. General: All pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations; spigots centered in bells; and all valves plumb. The pipe shall be laid in the backfill materials as specified.

B. Construction Control: During the installation of pressure lines, the pipe shall be laid at a constantly increasing grade to each high point, air release manhole, or point of discharge, as indicated on the Drawings. The Contractor shall provide sufficient construction control to assure that there are no sags or loss in grade in the force main which could tend to accumulate air other than at the high points shown on the Drawings. Failure to comply with this requirement shall necessitate the Contractor take remedial steps to correct this situation. All such costs shall be borne by the Contractor.

C. Variations: The Engineer reserves the right to vary the line and/or grade from that shown on the Drawings for the pipe lines and manholes and to vary the location of fittings and valves when such changes may be necessary or advantageous. No claims for extra work will be allowed for changes in location or grade except as such changes are made after trenching has been done.

D. Caution in Excavation: The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.

E. Subsurface Explorations: Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of existing underground structures, the Contractor shall make explorations and excavations for such purposes. If the Contractor is required to perform additional work in making the explorations and excavations, extra compensation will be allowed for such additional work.

F. Depth of Pipe: All pipe shall be laid to the depth indicated on the Contract Drawings or a minimum of 3.5' from grade to the crown of pipe.

G. Handling of Sewer Line Materials Into Trench: Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves, etc., shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to sewer line materials. Under no circumstances shall such materials be dropped or dumped into the trench.

H. Cleaning Pipe and Fittings: All foreign matter shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wiped clean and dry and free from oil and grease before the pipe is laid.

I. Laying Pipe: Every precaution shall be taken to prevent foreign material from entering the pipe while the pipe is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without allowing earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and let there until the connection is to be made into the adjacent pipe. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the joints. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space.
   1. Precautions shall be taken to prevent dirt from entering the joint space.
   2. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

J. Cutting Pipe: The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner, without damage to the pipe, so as to leave a smooth end at right angles to the axis of the pipe.

K. Bell Ends to Face Direction of Laying: Bell and spigot pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.

L. Permissible Deflection of Joints: If deflection is required, make after joint is assembled. The amount of deflection shall not exceed

fifty percent (50%) of the maximum limits as specified by the pipe manufacturer.

M. Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.

3.03 PIPE JOINTING

A. Jointing PVC Pipe: Make joints as recommended by the manufacturer so as to effect the joint seal.

3.04 SETTING AIR VALVES

A. General: Air valves shall be connected to the top of the pipe using a tapping saddle as specified in Paragraph 2.01 D of this Section.

B. Provide a precast concrete manhole for every air valve meeting the requirements for manholes as previously specified. The manholes shall be constructed to permit valve repairs and afford protection to the valve and pipe from impact where they pass through the manhole walls. All valves shall be supported by saddles as indicated on the Drawings. The saddles shall be continuous under all valves and fittings within the valve manholes.

3.05 ANCHORAGE

A. Concrete Thrust Blocks: Provide concrete thrust blocks for all fittings, and at all locations where horizontal and/or vertical deflections are made in the joints of the piping. Thrust blocking and buttresses of design indicated on Drawings.
   1. Reaction Backing: Reaction backing shall be 2500 psi concrete as specified in Section 03300. Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be as indicated on the Drawings or directed by the Engineer. The backing shall, unless otherwise indicated or directed, be so placed that the pipe and fitting joints will be accessible for repair.
   2. Metal Harness: Metal harness of tie rods of adequate strength to prevent movement shall be used. Steel rods or clamps shall be type 304 stainless steel.

B. Anchorage for Bends: All bends deflecting 11.25 degrees or more on mains 6-inches in diameter or greater shall be provided with a thrust restrain system to prevent movement.
   1. Only a thrust block system will be used for PVC pipe.
   2. Suitable metal rods shall be used only as indicated on the Drawings or directed by the Engineer.
   3. Split retainer flanges on PVC pipe shall not be used to obtain a restrained joint.

3.06 MANHOLES AND VAULTS

A. As specified in Section 02601.

3.07 FIELD QUALITY CONTROL

A. Hydrostatic Tests

1. Pressure Test: After the pipe has been laid and backfilled as specified, all newly laid pipe or any valves section thereof, shall be subjected to a hydrostatic pressure of 75 pounds per square inch, or 50% in excess of the normal working pressure, whichever is greater. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
   a. Duration of Test: Two hours.
   b. Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connections, and all necessary apparatus including gauges, shall be furnished by the Contractor. The Contractor will make all taps into the pipe, and furnish all necessary assistance for conducting the tests.
   c. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall make the necessary taps at such points before the test is made. After the test has been completed, the Contractor shall insert plugs at the tapping points.
   d. Examination Under Pressure: Any cracks or defective pipes, fittings, or valves discovered in consequence of this pressure test, shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory to the Engineer.
2. Leakage Test: A leakage test shall be conducted concurrently with the pressure test. The Contractor will furnish laboratory calibrated test gauge and measuring device, and all necessary assistance to conduct the test.
   a. Leakage Definition: Leakage is defined as the quantity of water that must be supplied into the newly laid pipe, or any valve section thereof, to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
   b. Permitted Leakage: No pipe installed will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

in which "L" equals the allowable leakage in gallons per hour; "N" is number of joints in the length of pipeline tested; "D" is the nominal diameter of the pipe, in inches, and "P" is the average test pressure during the leakage test, in pounds per square inch gauge.
      1) The Engineer will record both the makeup water and pressure at one-half hour intervals during the test period.
      2) Should any test of pipe laid disclose leakage greater than that specified above, the Contractor shall, at his own expense, locate, repair, and replace the defective joints,

pipe, or fittings until the leakage is within the specified allowance.

3. Common Requirements:
   a. Engineer Presence: The Engineer shall monitor the pressure and leakage tests. The Contractor shall notify the Engineer of the test day at least 48 hours in advance.
   b. If test fails to meet test requirements, the Contractor shall pay for all additional engineering personnel testing time.
   c. Weather: No testing will be authorized unless air temperature is 35 degrees F. or higher.
   d. Field Joints: All field joints of fittings and valves shall be exposed and examined during pressure and leakage test.
   e. Acceptance: Observation of successful testing of pressure lines by the Engineer does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the Engineer may recommend final acceptance to the Owner. Only upon final inspection by the Owner or Engineer and upon written acceptance for same will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the pressure line will commence. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.

END OF SECTION

SECTION 02910

BORING AND/OR JACKING PIPE ETC.

PART 1 - GENERAL

A. Description

Boring and/or jacking pipe shall include, but not necessarily be limited to, furnishing and installing carrier pipe and a casing pipe, beneath roadways, or other locations indicated on the Plans and in accordance with the Contract Documents.

B. Quality Assurance

1. Materials

a. General

The Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. When specific materials test are required by the referenced standards and specifications, the Engineer will have the option of requiring that any or all of these tests be performed for materials furnished for a specific project.

b. Steel Pipe

Steel pipe shall be free from any visible defects or surface imperfections such as kinks, scars, or bends which may impair the performance or life of the pipe. Defects shall be considered injurious when the depth of the defect is greater than 12.5% of the nominal wall thickness. The pipe shall be substantially round. The outside circumference of the pipe shall not vary more than ±1% from the nominal outside circumference based upon the diameter specified. The pipe shall not deviate by more than 1/8 inch from a 10-foot long straightedge held against the pipe. Defective or damaged coatings may be repaired in accordance with the coating manufacturer's written recommendations.

2. Field Tests

a. General

No testing will be conducted on bored and/or jacked casing pipe, installed in accordance with this Section, however, the work will be visually inspected after installation by the Engineer prior to the installation of the carrier pipe.

b. Bored and/or Jacked Carrier and Casing Pipe

Bored or jacked carrier pipe shall be installed to the line and grade indicated on the Plans to within a tolerance of 2 inches.

c. Carrier Pipe

Carrier pipe will be inspected and/or tested in accordance with the applicable section or sections under which the remainder of the pipeline was installed.

C. Submittals

1. Shop Drawings

a. Shop drawings shall be submitted for the various types of pipe specified. The shop drawings shall include: product

information; material strength, type, or class; and joint details.

b. The Contractors shall also submit detailed drawings including proposed method of boring and advancing casing or proposed method of preparing bored hole for installation of carrier pipe; size, capacity, and arrangement of equipment; method of dewatering; size and location of pit including configuration, backstop, pit base material, and type of cutter head; proposed method of monitoring and controlling line and grade; and proposed method of anchoring the carrier pipe within the casing to prevent flotation. Boring/jacking work shall not proceed until drawings have been reviewed and returned by the Engineer.

2. Certificates of Compliance
Certificates of compliance shall be submitted for pipe and bituminous coatings. The certificate shall state that the item furnished has been manufactured in accordance with, and meets the requirements of the standard referenced.

PART 2 - MATERIALS

A. Detailed Material Requirements

1. Portland Cement Concrete
Portland cement concrete for inverts or cradles shall be Mix No. 2.

2. Mortar for Grout
Mortar and/or sand used for filling voids outside the casing or carrier pipe shall conform to the requirements specified in other sections.

3. Steel Casing Pipe
   a. Steel casing pipe shall be smooth walled and have a minimum yield strength of 36,000 psi. Minimum wall thickness shall be as specified in the Contract Documents.
   b. The pipe shall be fabricated and field connected. Joints shall be fully welded around the circumference of the pipe.
   c. The exterior of the pipe including field connections shall be bituminous coated before installation. Bituminous coating shall meet the requirements of MIL P 23236 P, Class 2.

4. Carrier Pipe
Carrier pipe shall be as specified in the Contract Documents and meet the requirements specified in other appropriate sections.

PART 3 - EXECUTION

A. Preparation

Preliminary work shall consist of excavating and sheeting a suitable shaft on the lower side of the crossing and installation of a backstop and guide timbers. The guide timbers shall be long

enough to hold at least two lengths of pipe and shall be carefully checked for line and grade before any pipe is placed on them. The Contractor may also perform soil borings, at the Contractor's expense to confirm the soils type, presence of rock, and other parameters deemed appropriate by the Contractor.

B. Boring and/or Jacking
   1. When augers or similar devices are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The arrangement shall be removable from within the pipe in the event an obstruction is encountered. The excavation by the cutting head shall not exceed the outside diameter of the pipe by more than 1/2 inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft material.
   2. The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.
   3. If an obstruction is encountered during installation that stops the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations shall cease and the pipe abandoned in place and filled completely with grout.
   4. Bored or jacked installations shall have a bored hole essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (plus coating) by more than approximately 1-inch, grouting or other methods approved by the Engineer shall be employed to fill such voids.
   5. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site. The pumps shall be in constantly attended operation on a 24 hour basis until, in the sole judgement of the Engineer their operation can be safely halted. When dewatering, close observation shall be maintained to detect any settlement or displacement of surface facilities. Should settlement or displacement be detected, the Contractor shall notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent any further damage.
   6. All operations shall be conducted so as not to interfere with, interrupt, or endanger the operation of traffic, or damage, destroy, or endanger the integrity of any surface facilities.
   7. The procedure outlined above will also apply to installations where excavation with mechanical augers are used in smaller steel casings except there is not overcutting or grouting required under normal circumstances.

C. Installation of Carrier Pipe
   1. Carrier pipe shall be installed within the casing pipe as shown in the Contract Documents and as specified elsewhere.
   2. Where shown or specified in the Contract Documents, the annular space between the casing and carrier pipes shall be filled with sand or grout. Materials shall be as specified elsewhere.

END OF SECTION

SECTION 02950

WATER MAINS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Water Main Pipelines.

B. Valves, Valve Boxes and Hydrants.

C. Water Branch and Service Lines.

D. Pipeline Testing.

E. Disinfection.

F. Environmental Requirements

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Soil and Select Materials: Section 02240.

C. Division 3 - Concrete

1.03 REFERENCES

A. American National Standards Institute:
1. ANSI/NSF 60, Drinking Water Treatment Chemicals - Health Effects.
2. ANSI/NSF 61, Drinking Water System Components - Health Effects

B. American Society for Testing and Materials:
1. ASTM A 48, Gray Iron Castings.
2. ASTM A 53, Std. Spec. for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
3. ASTM A 126, Std. Spec. for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
4. ASTM A 240, Std. Spec. for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
5. ASTM B 88, Seamless Copper Water Tube, Spec. for.
6. ASTM C 32, Std. Spec. for Sewer and Manhole Brick (Made from Clay or Shale) (AASHTO No. M91-78).
7. ASTM C 144, Std. Spec. for Aggregate for Masonry Mortar (AASHTO No. M45-70).
8. ASTM C 207, Std. Spec. for Hydrated Lime for Masonry Purposes.
9. ASTM D 1784, Rigidized Poly (Vinyl Chloride (PVC) Compounds and Chlorinated Poly (Vinyl) (PVC) Compounds.
10. ASTM D 2241, Poly (Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
11. ASTM D 3139, Joints for Plastic Pressure-Rated Pipes using Flexible Elastomeric Seals.
12. ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association:
   1. AWWA C 110, Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in. for Water and Other Liquids.
   2. AWWA C 153, Ductile-Iron Compact Fittings, 3-inch through 12-inch (75mm through 300mm) for Water and Other Liquids.
   3. AWWA C 502, Dry-Barrel Fire Hydrants.
   4. AWWA C 509, Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems.
   5. AWWA C 550, Protective Interior Coatings for Valves and Hydrants.
   6. AWWA C 651, Disinfecting Water Mains.
   7. AWWA C 800, Underground Service Line Valves and Fittings.
   8. AWWA C 900, Poly (Vinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water Distribution.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of pipe and piping specialties.

B. Certificates: Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.

1.05 QUALITY ASSURANCE

A. Source Quality Control:
   1. Shop Tests and Inspection: All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.

B. All pipe and appurtenances shall be furnished, installed, and tested for defects in material and/or workmanship in the manner specified and in the presence of and as approved by the Engineer.

C. Disposition of Defective Material: All material found during the progress of the work, either before or after installation, to have cracks, flaws, or other defects will be rejected. All defective materials furnished by the Contractor shall be promptly removed by him from the site at his own expense.

1.06 DELIVERY, STORAGE AND HANDLING

A. Replacement of Damaged Material: The Contractor shall replace, at his own expense, all material furnished by him and found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for replacement of installed material.

B. Responsibility for Safe Storage: The Contractor shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all

times. All equipment and materials subject to damage from freezing shall be drained and stored in a manner which will protect them.

C. Hauling: All materials furnished by the Contractor shall be delivered and distributed at the site by the Contractor.
   1. Pipe, fittings, items of equipment, and other materials of construction shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped.
   2. Materials handled on skidways shall not be skidded or rolled against materials already on the ground.
   3. Materials furnished by the Owner shall be picked up by the Contractor at the location designated by the Owner and delivered to and distributed at the site.

D. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench, or as otherwise directed by the Engineer. Under no circumstances should lawns, grass plots or other private property be used for this purpose without the consent of the property owner.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Chemicals or materials which may come in contact with or affect the quality of water and are used in the construction, treatment processes, containment or conveyance of public water supply systems shall be certified for conformance with ANSI/NSF Standards 60 & 61.

B. Submit certificate of conformance with ANSI/NSF Standard 60 & 61 with product data submittals in accordance with Section 01300.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: All materials shall be new, manufactured within 2 (two) years prior to date of installation.

B. Ductile Iron Pipe: Ductile iron pipe conforming to ANSI/AWWA C151/C150/A 21.50 for wall thickness.
   1. Minimum Thickness: Class 52 except as may be required for flanged pipeor restrained joints, use Class 53.
   2. Cement Mortar Linings: Conforming to ANSI/AWWA C 104/A 21.4, except the thickness of linings should not be less than the following:
      a. 3-inches through 12-inches 1-8 inch
   3. Iron Fittings: Gray iron or ductile iron ANSI/AWWA C110/A 21.10 or ductile iron compact fittings ANSI/AWWA C 153/A 21.53. All fittings shall have a minimum pressure rating of 250 psi and shall have cement lining and joints as required for pipe restraint.
      a. Joints: Push-on type or mechanical joint type in accordance with ANSI/AWWA C 111/A 21.11, for all pipe except at changes in alignment, valves or other conditions requiring pipe restraint or as noted on the Drawings.

C. Polyvinyl Chloride (PVC) Pipe and Fittings - Greater Than 2-inch Diameter:
   1. PVC pipe conforming to AWWA C 900 for following working pressures plus applicable safety factors:
      a. DR 18 - 150 psi.
   2. Wall Thickness (OR): As noted on the Drawings.
   3. Fittings: Gray iron or ductile iron AWWA C 110 or ductile iron compact fittings AWWA C 153. All fittings shall have a minimum pressure rating of 250 psi and shall have cement lining. Joints as required for proper pipe restraint. All flanged fittings drilled and faced for 125 lb. drilling pattern.
      a. Joints: Push-on type or mechanical joint type in accordance with AWWA standards for all straight lengths of pipe. Changes in alignment, valves or other conditions requiring pipe restraint or as noted on the Drawings shall have mechanical type joints.
      b. When joint restraint other than thrust blocks or Megalug retainer glands is proposed, the Contractor shall submit information on the proposed joint restraint system to the Engineer for review and approval.
      c. Megalug retainer glands as specified in this Section.

D. Polyvinyl Chloride (PVC) Pipe and Fittings - 2-inch Diameter or Less:
   1. Material: ASTM D1784, Class 12454-B or 12454-C.
   2. Pipe: ASTM D2241.
   3. Joints: ASTM D3139.
   4. Gaskets: ASTM F4779.
   5. Pressure Rating: 315 psi (SDR 13.5).
   6. Identification: Mark each length of pipe with manufacturer's name, material type, pressure rating, nominal pipe size, and ASTM designation.
   7. Fittings: PVC, 200 psi, gasketed joints, by HARCO.

E. Gate Valves:
   1. Provide valves of non-rising stem type when installed underground.
   2. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
   3. Valves 3-inches through 12-inches in diameter:
      a. Iron body, 250 psi working pressure, bronze mounted with resilient-seated wedge conforming to AWWA C 509.
      b. Resilient seat of Styrene Butadiene SBR or Urethane Rubber bonded to cast iron wedge.
      c. Stem seals of "O"-ring type.
      d. Valves equipped with 2-inch square operating nut and open counter-clockwise (left).
      e. Exterior and interior ferrous metal parts to be epoxy coated, AWWA C 550.
   4. Acceptable Manufacturers:
      a. American Flow Control, AFC 2500
      b. Or Equal.

F. Pressure Reducing Valve
   1. The reducing balve shall function to maintain a uniform valve downstream pressure as pre-adjusted on the control pilot handwheel or adjusting screw. The control pilot shall be capable of field adjustments from near zero PSI to 10% above the factory pre-set pressure. The valve shall be completely pipe ready for installation.

2. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area, and the area on the upper surface of the piston is of a greater area than the underside of the piston.
   The valve piston shall be guided on its outside diameter by long stroke stationary Vee ports which shall be downstream of the seating surface to minimize the consequences of throttling. Throttling shall be done by the valve Vee ports and not the valve seating surfaces. The valve shall be capable of operating in any position and shall incorporate only one flanged cover at the valve top from which all internal parts shall be accessible. There shall be no springs to assist the valve operation.
3. The valve body shall be of cast iron ASTMA-126 with flanges conforming to the latest ANSI Standards. The valve interior trim shall be bronze B-62 as well as the main valve operation.
   The valve seals shall be easily renewable while no diaphragm shall be permitted within the main valve body. All controls and piping shall be of non-corrosive construction.
   A visual valve position indictor shall be provided for observing the valve position at any time.
4. The valve shall be as manufactured by GA Industries of Mars, Pennsylvania and shall be of their Fig. 4500-D (globe). Small 2" Pressure Reducing valve shall be Figure 43-D by Golden-Anderson, or equal.

G. Megalug Mechanical Joint Restraint:
   1. Glands shall be designed to allow flexibility of pipe joints after installation and backfill.
   2. Glands shall be manufactured of ductile iron, conforming to ASTM A536-80.
   3. Restraining devices shall be of ductile iron, heat-treated to a minimum hardness of 370 BHN.
   4. Dimensions of gland shall be such that it can be used with the standardized mechanical joint bell with tee-head bolts conforming to ANSI/AWWA A 21-11 and ANSI/AWWA A 21.53/C 153 latest revision.
   5. The design shall incorporate twist-off nuts to insure proper torque upon installation, leaving hex head nut for disassembly if required.
   6. The mechanical joint restraining device in sizes 3" through 16" shall have a working pressure of 350 psi, with a safety factor of 2 to 1.
   7. In sizes 18" through 48", the working pressure shall be 250 psi with a 2 to 1 safety factor.
   8. Glands shall have UL listing through 24" in size and factory mutual approval through 12".
   9. Restraining glands shall be as manufactured by EBAA Iron Mega Lugs, 1100 Series (for DIP) and SERIES 200 PV for PVC.

H. Plugs and caps shall be of the same material as the pipe on which it is installed.

I. Tie rods, nuts, and washers utilized for anchorage shall be Type 304 stainless steel.

J. Air Release Valves:
   1. The air release valve shall be of the float operated, compound leverage type, stainless steel construction conforming to ASTM A 240 and A 276, and capable of automatically releasing accumulated air from a fluid system while that system is in operation and under pressure. The body and trim shall be cast iron construction conforming to ASTM A 48, Class 35 or ASTM A126 Class B.
   2. To assure drop tight shut off, a viton orifice button having an adjustable feature shall be used to seal the valve discharge orifice. The orifice diameter must be sized for use within a given operating pressure range to ensure maximum discharge capacity.
   3. The float shall be of all stainless steel construction and capable of withstanding a pressure of 1,000 psi, conforming to ASTM A 240.
   4. Acceptable Manufacturers:
      a. APCO.
      b. ValMatic.
      c. GA Industries.
      d. Or Equal.

K. Branch and Service Saddles: Correctly contoured for outside diameter of pipe and incorporating a gasket and band assembly.
   1. Saddle Body: Ductile iron, ASTM A 536, fusion coated inside and out with heavy resilient plastic.
   2. Gasket: Buna-N.
   3. Band: Double Type 304 stainless steel bands, each assembled with two minimum 3/4-inch Type 304 stainless steel bolts, washers and hex nuts.
   4. Provide corporation stop suitable for connecting the air valve inlet pipe.
   5. Acceptable Manufacturer: JCM Industries, Inc.; 406, or equal.

L. Fire Hydrants: Shall be cast iron body, fully bronze mounted, suitable for a working pressure of 150 psi, and shall conform to AWWA Standard C 502, latest revision. Hydrants shall be constructed in a manner permitting withdrawal of internal working parts without disturbing the barrel or casing. Valve, when shut, shall be reasonably tight when upper portion of barrel is broken off. Valve opening shall be at least 5-1/4 inch in diameter, with net area of waterway at smallest, with valves wide open, not less than 120% of valve opening. Each hydrant shall be shop tested to hydrostatic pressure of 300 lbs. per sq. in. with valve in both open and closed positions.
   1. The standpipe shall be connected to the ground line either by a frangible coupling or by flanges with frangible cast iron bolts. The main valve rod at the ground line shall be connected employing a frangible coupling. Hydrants shall be provided with an "0" ring type seal plate. The seal plate shall be fitted with at least two "0" rings. The lower "0" ring shall serve as the pressure seal and the upper "0" ring as a combined dirt and moisture seal.
   2. The main valve shall open left with the direction of opening cast on head of hydrant. Hose nipples shall be bronze or non-corrosive metal, and threads shall be in accordance with specifications of the Local Fire Department. Nipple caps shall be securely chained in the barrel. The hydrant shall be currently dated.
   3. Hydrants shall be painted one coat of red lead paint and two finishing coats of an approved paint of color as directed by the

Engineer, after their installation. Hydrants shall be American Flow Control B-84B. H-205.

M. Valve Boxes: For valves 2-inches and larger, provide Buffalo Style adjustable roadway type constructed of cast iron with a shaft provided with screw type or extension pieces and either round or oval detachable base. Valve boxes shall have a 5 1/4-inch wide shaft. Box shall have a plug lid fitting into a recessed seat. The lid shall have the word "WATER" cast on the top surface. All parts of the box shall be of gray iron, free from cold shuts and blow holes and shall be painted with black bituminous paint or Coal Tar Epoxy. Valve boxes shall be set at the surface of the adjoining ground or roadway and shall be provided for all buried valves. Valve box shall have an adjustable range up to 6-inches above grade.
1. Valve boxes by Tyler Pipe, or equal.

N. Water Service Lines: 3/4-inch diameter copper tubing conforming to ASTM B 88, "Type K," soft temper.
1. Wall Thickness: In accordance with ASTM B 88 Table 4 "Dimensions, Weights, and Tolerances in Diameter and Wall Thickness for Nominal or Standard Copper Water Tube."

O. Corporation stops, curb stops and unions shall be brass, compression-outlet type of the size shown on the Drawings or directed by the Owner and shall be manufactured by Ford Meter Box Co. Inlet threads shall be compatible with tapping saddle threads. Meet the requirements of AWWA C800. Corporation stops shall be FR 800, Ford Meter Box Co.

2.02 STEEL CASING

A. Steel Casing Pipe: ASTM A 53
1. 35,000 psi minimum yield strength.
2. Full circumference welded joints.
3. Asphalt coated.
4. Minimum Wall Thickness: .313 inch.
5. Steel casing pipe diameter as indicated on the Drawings, or if not indicated shall be at least six (6) inches larger than the outside diameter of the pipe bell, or as required by the owner of the right-of-way or entity issuing the permit.

B. Casing Cradles: Contractor shall have option to provide one of the following types:
1. Constructed of wolmanized lumber and stainless steel straps or bituminous coated cables and shall be similar in design to 3-way cradle type as manufactured by T. D. Williamson, Inc., Tulsa, Oklahoma.
2. Constructed of two piece solid shell of Type 304 stainless steel, 14 gauge thickness; lined with ribbed PVC sheet, .090-inch thickness; runners made form ultra high molecular weight (UHMW) polymer and attached to Type 304 stainless steel risers; fasteners shall be Type 304 stainless steel. Provide casing cradles similar or equal to Model SSI as manufactured by Advanced Products and Systems, Inc.

C. Brick: New, whole, common brick, conforming to ASTM C 32.

D. Mortar: One part Portland cement and two parts fine sand. For brickwork, lime may be added to the mortar in an amount not more than 25 percent of the volume of the cement. Sand shall be clean and sharp and conform to ASTM C 144. Hydrated lime shall conform to ASTM C 207. Retempered mortar or mortar which has been mixed for more than 45 minutes shall not be used.

E. Mixing Water: Potable water, clean and free from oil, acid, alkali, or other deleterious substances.

F. Sand Bedding (for Small Diameter Water Service Lines): Type C Select Material as specified in Section 02240.

PART 3 - EXECUTION

3.01 PREPARATION

A. Earthwork: Perform earthwork for water mains as specified in Trenching, Backfilling and Compacting: Section 02221.

3.02 PIPE INSTALLATION

A. General: All pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations, spigots centered in bells, and all valves plumb.
   1. The pipe shall be laid in the bedding materials as specified in Section 02221.
   2. Construction of the pipelines shall begin with connections to existing, active water lines and shall proceed with adjoining main line sections.

B. Construction Control: During the installation of a water main, the pipe shall be laid at a constantly increasing grade to each high point, air release manhole, or point of discharge. The Contractor shall provide sufficient construction control to assure that there are no sags or loss in grade in the force main which could tend to accumulate air. Failure to comply with this requirement shall necessitate the Contractor take remedial steps to correct this situation. All such costs shall be borne by the Contractor.

C. Caution in Excavation: The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground facilities, both known and unknown, may be determined, and he shall be held responsible for the repair of such facilities when broken or otherwise damaged.

D. Subsurface Explorations: Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of existing underground facilities, the Contractor shall make explorations and excavations for such purposes.

E. Depth of Pipe: All pipe shall be laid to a minimum depth of 3.5 feet from grade to the crown of pipe, unless otherwise approved by the Engineer.

F. Separation of Water Mains, Sanitary Sewers and Storm Sewers:

1. Parallel Installation: Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, deviations may be allowed, if approved in writing by the Engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is a least 18 inches above the top of the sewer.
2. Crossings: Whenever water mains must cross building drains, storm drains, or sanitary sewers, the water main shall be laid at such an elevation that the bottom of the water main is 18 inches above the top of the drain or sewer. This vertical separation shall be maintained for the portion of the water main located within 10 feet horizontally of any sewer or drain it crosses. The 10 feet is to be measured as a perpendicular distance from the drain or sewer line to the water line.
    a. Where water mains must cross under a sewer, additional protection shall be provided by:
        1) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line.
        2) Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line,
        3) That the length of the water line be centered at the point of the crossing so that the joints shall be equidistant and as far as possible from the sewer.
    b. If any of the above conditions cannot be met, concrete encasement of the sewer and/or water lines may be utilized and installed. Concrete encasement shall extend ten feet in each direction from the crossing, measured perpendicular to the sewer or storm drain. Requirements for concrete are as specified in Division 3 - Concrete.
    c. The Contractor is responsible for providing all fittings, anchorage, excavation, backfill, as required to cross any and all sanitary sewer lines and appurtenances and storm drain lines within the above requirements.
    d. Where specific crossing methods are shown on the Drawings, the Drawing details take precedence over the specifications.

G. Handling of Pipeline Materials Into Trench: Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves, etc., shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipeline materials, protective coatings and linings. Under no circumstances shall such materials be dropped or dumped into the trench.

H. Cleaning Pipe and Fittings: All lumps, blisters, and excess coal tar coating shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

I. Laying Pipe: Every precaution shall be taken to prevent foreign material from entering the pipe while the pipe is being placed in the

trench. If the pipe-laying crew cannot put the pipe into the trench and in place without allowing earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and let there until the connection is to be made into the adjacent pipe. During laying operations, no debris, tools, clothing, or other material shall be placed in the pipe.

1. After placing a length of pipe in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the joints. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space.
2. Precautions shall be taken to prevent dirt from entering the joint space.
3. At times when pipe-laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

J. Cutting Pipe: The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner, without damage to the pipe, so as to leave a smooth end at right angles to the axis of the pipe.

K. Bell Ends to Face Direction of Laying: Bell and spigot pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.

L. Permissible Deflection of Joints: If deflection is required, make after joint is assembled. The amount of deflection shall not exceed 50 percent of the maximum limits as specified by the pipe manufacturer.

M. Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.

N. The Plans of Cross Connections between new mains and existing shown on plans have been prepared from all available information; however, should the existing mains when exposed vary in size from that shown on the plans, the Contractor shall provide the necessary fitting for the cross connection and install the same at the price bid. By reason of said changes should any surplus remain after the completion of the contract, these fittings will be paid for at cost to the Contractor and become the property of the Owner.

O. Variations: The Engineer reserves the right to vary the line and/or grade from that shown on the drawings for the pipe lines and manholes and to vary the location of fittings, valves and hydrants when such changes may be necessary or advantageous. No claims for extra work will be allowed for changes in location or grade except as such changes are made after trenching has been done.

3.03 PIPE JOINTING

A. Jointing Ductile Iron Pipe:

1. Mechanical Joints: The spigot end of the pipe shall be centrally located in the bell so that the rubber gasket is evenly seated.
   a. All loose rust or foreign matter shall be removed from the inside surfaces of the bell and outside surface of the sipgot prior to assembly. Bolts shall be tightened uniformly with a rachet wrench so as to affect the joint seal. The normal range of bolt torques to be applied are:

Bolt Size-Inches	Torque-Ft. Lbs.
5/8	45-60
3/4	75-90
1	100-120
1 1/4	120-150

B. Jointing PVC Pipe:
   1. Push-On Type Joints: The joint shall be assembled as recommended by the manufacturer so as to effect the joint seal.
   2. Solvent Weld Joints: Use only where fittings are required and only on pipe sizes for which push-on fittings are not available. Make joints as recommended by the pipe manufacturer.

3.04 SETTING FITTINGS AND VALVES

A. General: Valves and fittings shall be set and jointed to pipe in the manner specified for cleaning, laying, and jointing pipe.
   1. The weight of valves and fittings is not to be supported by pipe.

B. Valve Boxes: A cast iron valve box shall be provided for every valve as shown on the plans. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

3.05 SETTING HYDRANTS

A. Location: Hydrants shall be located as shown on the Drawings or as directed by the Engineer.

B. Position: All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Hydrants shall be set to the established grade, with the nozzles at least 12-inches above the ground, and the frangible ring of the hydrant shall be 2-inches above the ground.

C. Hydrant Drainage: Wherever a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing crushed stone as shown on the Drawings, assuring that the hydrant drain hole is clear.

3.06 ANCHORAGE

A. Anchorage for Bends: All tees, plugged crosses, and bends deflecting 11.25 degrees or more on mains 6-inch in diameter or larger shall be provided with thrust blocking or restrained joints to prevent movement. Suitable metal rods shall be used only as shown on the Drawings or directed by the Engineer. All dead-end valves shall be rodded to main line with 3/4-inch threaded tie rods if thrust blocking or a restrained joint is not utilized. Mechanical joint retainer glands or Duck Lugs

shall not be used. All tie rods, nuts and washers utilized for anchorage shall be Type 304 stainless steel.

B. Thrust Blocking: Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be as shown on the Drawings or directed by the Engineer. The blocking shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair.

C. Metal Harness: Metal harness of tie rods of adequate strength to prevent movement shall be used where shown on the Drawings. Steel rods or clamps shall be Type 304 Stainless Steel.

3.07 CONCRETE ENCASEMENT

A. Preparation: Prior to the formation of the cradle or encasement, temporary supports consisting of solid concrete bricks or cap blocks shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at not more than two locations, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket, and the other near the spigot end.

B. Placing: After jointing of the pipe has been completed, concrete shall be uniformly poured beneath and on both sides of the pipe.
1. Placement shall be done by the use of suitable equipment.
2. The concrete shall be wet enough during placement to permit its flow, without excessive prodding, to all required points around the pipe surface.
3. The width of encasement shall be such as to fill completely the trench width. In case of extremely wide trenches, concrete encasement may be confined above the top of the pipe to a narrower width, but in no case shall it be less than the width of trench required for the size of pipe being used.
4. Before depositing concrete, the space within the limits of the pour shall have been cleared of all debris and water.
5. Water shall not be allowed to rise adjacent to, or flow over, concrete deposited for less than 24 hours.
6. Concrete shall be protected from the direct rays of the sun and kept moist by a method acceptable to the Engineer for a period of seven days or until backfilling is begun.
7. In no case shall backfilling begin within 36 hours of the time of placing. The Engineer shall have strict control of the rate of backfilling.

3.08 CASING CRADLE

A. Secure cradle to the carrier pipe such that movement along carrier pipe barrel will not occur when carrier pipe is inserted into casing pipe.

B. Size cradle such that bell of the carrier pipe does not rest on casing and adequate clearance exists at top of cradle for ease of inserting the carrier pipe into the casing.

C. Placement and spacing of cradles shall be in accordance with manufacturers recommendations or as indicated on the Drawings.

D. Encasing Conduit Filling and Closing: After the pipe has been installed in the encasing conduit and has been tested, fill the encasing conduit with 1/4-inch clean stone chips or Type A Select Material as specified in Section 02240.
   1. Close one end of encasing conduit with brick and mortar before filling encasing conduit. Close other end of encasing conduit with brick and mortar after filling encasing conduit or as operation dictates.

3.09 WATER SERVICE LINE INSTALLATION

A. For all water service lines crossing less than half of the paved roadway, excavate trench to the line and grade shown on the Contract Documents and as specified.

B. All services which must cross more than half of the paved roadway shall be bored with an auger or pushed through a drive pipe. (The drive pipe may be removed when the service is installed.) Where rock or other obstructions are encountered, the location of the service line may be moved as much as is necessary with the Engineer's approval; but the service lines must be extended along the roadway so as to place the curb boxes at the proper locations. Should it be impossible to push or drive any service line under the roadway, the Contractor shall make such excavations as necessary with the Engineer's approval.

C. Screw corporation stops directly into the tapping saddle outlet. Locate corporation stops at least 12-inches apart longitudinally and staggered.

D. Use proper seals or other devices to ensure that no leaks are left in the water mains at the points of tapping. Do not backfill and cover the service connection until approved by the Engineer.

E. Use bends to connect the service pipe or tubing to the tapping fitting or corporation stops to provide flexibility to counteract the effects of settlement or expansion/contraction in the line.

F. All water service lines or portions thereof installed by open cut shall be bedded and backfilled with sand as indicated on the Drawings.

G. Lay each section of the service line in a manner to form a tight joint with the adjoining section. Avoid offsets, kinks or awkward bends to ensure a smooth flow line.

H. Unions shall be utilized at water service joints. Joints shall be a minimum of 60-feet between.

I. When the work is not in progress and at the end of each work day, securely plug the ends of pipe and fittings to prevent any dirt or foreign substances from entering the lines.

J. The Contractor shall install all services to the edge of the rights-of-way at the locations as directed by the Engineer. Where service lines exist adjacent to and outside of the right-of-way, Contractor shall connect the new service line to the existing, unless otherwise directed by the Engineer.

K. Services shall be capped at the right-of-way line.

3.10 FIELD QUALITY CONTROL

A. Hydrostatic Tests:

1. Pressure Test: After the pipe has been laid and backfilled as specified, all newly laid pipe, or any valved section thereof, shall be subjected to a hydrostatic pressure of 150 pounds per square inch, or 50% in excess of the normal working pressure, whichever is greater. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
   a. Duration of Test shall be at least two hours.
   b. Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by the Contractor and are subject to approval by the Engineer. The Contractor will make all taps into the pipe, and furnish all necessary assistance for conducting the tests. The Contractor shall supply either a container calibrated in 0.1 gallon increments or a laboratory certified calibrated water meter accurate to 0.1 gallons.
   c. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall make the necessary taps at such points before the test is made. After the test has been completed the Contractor shall remove and plug the taps or leave them in place at the direction of the Engineer.
   d. Examination Under Pressure: Any cracks or defective pipes, fittings, or valves discovered in consequence of this pressure test shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory to the Engineer.
   e. Test Pressure Variations: Test pressures shall not vary by more than +5 psi for the duration of the test.
2. Leakage Test: A leakage test shall be conducted concurrently with the pressure test. The Contractor will furnish laboratory calibrated test gauge and measuring device, and all necessary assistance to conduct the test.
   a. Leakage Definition: Leakage is defined as the quantity of water that must be supplied into the newly laid pipe, or any section thereof, to maintain pressure within 5 psi of leakage test pressure after the pipe has been filled with water and the air expelled.
   b. Permitted Leakage: No pipe installed will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

in which "L" equals the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipeline tested; "D" is the nominal diameter of the pipe, in inches, and "P" is the average test pressure during the leakage test, in pounds per square inch gauge. There shall be no additional leakage allowed for service connections.

1) The Engineer will record both the makeup water and pressure at one-half hour intervals during the test period.
2) Should any test of pipe laid disclose leakage greater than that specified above, the Contractor shall, at his own expense, locate, repair, and replace the defective joints, pipe, or fittings until the leakage is within the specified allowance.

3. Common Requirements:
   a. Engineer Presence: The Engineer shall monitor the pressure and leakage tests. The Contractor shall notify the Engineer of the test day at least 48 hours in advance.
   b. The Engineer shall be present during the operating of valves required to fill mains for pressure and leakage tests.
   c. If test fails to meet test requirements, the Contractor shall pay for all additional engineering personnel testing time.
   d. Where multiple sections are tested the allowable loss shall be limited to the loss for the smallest main line valve section or 1000 feet whichever is less unless otherwise approved by the engineer.
   e. Weather: No testing will be authorized unless air temperature is 35 degrees F. or higher.
   f. Hydrants: When hydrants are in the test section, the test shall be made against the closed hydrant.
   g. Acceptance: Observation of successful testing of water lines by the Engineer does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the Engineer may recommend final acceptance to the Owner. Only upon final inspection by the Owner or Engineer and upon written acceptance for same will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the water line will commence. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.
4. If the test is applied against an existing valve and the Contractor has determined that said valve is leaking, Contractor shall excavate valve at his expense so Owner or his designated representative can sound valve. In addition to the sound test, test section shall be valved off and system pressure applied. Engineer will observe pressure for 24 hours. This section should remain at system pressure if valve is leaking.

3.11 DISINFECTION

A. General: After completion of satisfactory pressure and leakage testing, disinfect the water pipelines in accordance with the recommended practice established in AWWA Standard C 651. Conduct water line disinfection in the following steps:

1. Preliminary flushing
2. Chlorine application
3. Final flushing
4. Bacteriologic tests

B. Preliminary Flushing: Prior to disinfection, except when the tablet method is used, fill the line to eliminate air pockets and flush the line at a rate of flow of 2.5 feet per second to remove particulates. Refer to AWWA C 651 for rate of flow to produce 2.5 fps in pipe of various sizes. The Engineer shall be notified at least 24 hours in advance of any flushing operation. The Engineer shall be present during the operating of valves required to fill mains. Flushing shall be monitored by the Engineer. Dispose of flushing water.

C. Chlorine Form: The chlorine form to be applied to the system shall be either chlorine gas solution, calcium hypochlorite or sodium hypochlorite. The Engineer's written approval of the chlorine form to be used is required.

D. Chlorine Application:
   1. Continuous Feed Method:
      a. Continuous feed method consists of placing calcium hypochlorite granules in the main during construction. Completely fill the main to remove air pockets, flush to remove particulates, and fill the main with potable water chlorinated so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L.
      b. At a point not more than 10 feet downstream from the beginning of the new main, feed water and chlorine to the line at a constant rate such that the water will have not less than 25 mg/L free chlorine. Chlorine application shall not cease until the entire line is filled with heavily chlorinated water.
      c. During chlorine application, take precautionary measures to prevent the concentrated treatment solution from flowing back into the existing distribution system and/or supply source.
   2. Tablet Method:
      a. The tablet method consists of placing calcium hypochlorite granules and tablets in the water main as it is being installed and then filling the main with potable water when installation is completed.
         1) NOTE: Since the preliminary flushing step must be eliminated, this method may be used only when scrupulous cleanliness has been exercised and only with approval of the Engineer. It shall not be used if trench water or foreign material has entered the main, or if the water temperature is below 41°F.
      b. During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft. intervals. Refer to AWWA C 651 for quantity of granule to be used.
         1) WARNING: This procedure must not be used on solvent welded plastic pipe or in screwed joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.
      c. During construction, place sufficient number of 5g calcium hypochlorite tablets in each section of pipe, in hydrants, hydrant branches, and other appurtenances to obtain a minimum of 25 mg/L available chlorine. Attach tablets to the crown of

only to the broad side of the tablet next to the pipe surface. Refer to AWWA C 651 for the proper number of 5g calcium hypochlorite tablets required.

d. When pipeline installation is completed, fill the main with water at a maximum velocity of one foot per second. This water shall remain in the pipe for at least 24-hours. Manipulate valves so that the chlorine solution does not flow back into the line supplying the water.

3. During the 24-hour treatment, operate all valves, curb stops, and hydrants in the section treated.

4. At the completion of the 24-hour treatment, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.

5. Repeat the disinfection process until the minimum available chlorine is present at the end of the treatment sequence. The tablet method cannot be used in these subsequent disinfections. No additional compensation will be provided the Contractor for repeat treatment or testing.

E. Final Flushing: Within 24-hours after chlorination, flush the heavily chlorinated water from the system under treatment until the chlorine concentration in the water leaving the system is no higher than that generally prevailing in the system or is acceptable for domestic use.

F. Disposing of Heavily Chlorinated Water: It shall be the Contractor's sole responsibility to dispose of the chlorinated water in a manner acceptable to the Engineer. If it is determined that the chlorinated discharge will cause damage to the environment or to sanitary treatment facilities then a neutralizing agent using one of the chemicals listed below shall be applied as per Table A to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water.

TABLE A

Pounds of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 gal. of Water

Residual Chlorine Concentration mg/L	Sulfur Dioxide SO_2	Sodium Bisulfite $NaHSO_3$	Sodium Sulfite	Sodium Thiosulfate $Na_2S_2O_3 5H_2O$
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.00

G. Bacteriological Testing:

1. After final flushing is completed and before the water main is placed in service, test the line for bacteriologic quality.

2. Collect a minimum of one sample at the end of each line for each test, and one sample of the incoming water from the existing water system for comparison.

3. Collect samples in sterile bottles treated with sodium thiosulfate.

4. Sampling tap shall consist of corporation stop installed in the main with copper tube gooseneck assembly. No hose or fire hydrant shall be used to collect samples.

5. Provide bacteriological test reports to the Owner and the Engineer. Failure to meet State health standard requirements will be cause for Contractor to rechlorinate and retest the system, at no additional cost to the Owner.
6. No section of water main shall be approved to be put into service until satisfactory bacteriological test reports for that section have been submitted to the Owner.
7. The Owner or the Engineer reserves the right to test the water at any time prior to final acceptance of the work and if found unsafe bacteriologically, to require the Contractor to rechlorinate the system.

3.12 WATER SERVICE

A. Temporary Services: In the event it is necessary to interfere with any services, temporary lines shall be installed by the Contractor. Delays resulting in residences or businesses having to go overnight or for longer periods without utilities due to the neglect of the Contractor, may be remedied by the Owner at the Contractor's expense without written notice.

3.13 PVR VAULT

A. Excavate and backfillin accordance with Section 0222.

B. Set precast pit on finished, compacted subbase so that top is even with finished grade.

C. Install piping and seal pipe openings watertight with caulk or non-shrink grout.

D. Coat exterior portion of pit with 16 mils bitumastic coating, Koppers Super Service Black or equal.

END OF SECTION

SECTION 02953

CONTINGENT TEST PIT AND MISCELLANEOUS EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Test Pit and Miscellaneous Excavation and Backfill.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Soil and Select Materials: Section 02240.

1.03 DESCRIPTION

A. Contingent excavation shall include test pit and miscellaneous excavation as directed by the Engineer. The work shall include: machine and/or hand excavation to locate underground utilities, structures, or other features; and/or changes in the amount of excavation shown on the Plans or standard detail and in accordance with the Contract Documents.

1.04 QUALITY ASSURANCE

A. The Engineer will inspect all excavations to insure compliance with the specifications.

1.05 SUBMITTALS - none.

PART 2 - PRODUCTS

2.01 MATERIALS: Materials for test pit backfill shall be as specified in Sections 02221 and 02240.

PART 3 - EXECUTION

3.01 TEST PITS AND MISCELLANEOUS EXCAVATION

A. Execution shall be as specified in Section 02221.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in-place concrete including form coatings and ties.

1.02 QUALITY ASSURANCE

A. Design Criteria:
   1. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure.
   2. Maintain formwork construction tolerances complying with ACI 347.
   3. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

1.03 REFERENCES

A. American Concrete Institute:
   1. ACI 347; Recommended Practice for Concrete Formwork.

B. American Plywood Association: APA Grade-Trademarks.

C. U.S. Department of Commerce Product Standards:
   1. PS-1 For Construction and Industrial Plywood.

1.04 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including forming accessories, coatings, and others as requested by Engineer.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms:
   1. Forms (Exposed Finish Concrete): Plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
      a. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
   2. Forms (Unexposed Finish Concrete): Plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

B. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

C. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.
   1. Provide units which will leave no metal closer than 1-1/2" to surface.
   2. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.

PART 3 - EXECUTION

3.01 PREPARATION

A. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.02 ERECTION

A. General: Construct forms in accordance with ACI 347.
   1. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
   2. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work.
   3. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
   4. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

B. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

3.03 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel bars, welded wire fabric, and accessories for cast-in-place concrete.

1.02 RELATED SECTIONS

A. Concrete Formwork: Section 03100

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
   1. ACI 318 "Building Code Requirements for Reinforced Concrete".
   2. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Testing Service: Engage a testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

1.04 REFERENCES

A. American Concrete Institute:
   1. ACI 315; Details and Detailing of Concrete Reinforcement.
   2. ACI 318; Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials.
   1. ASTM A 82; Cold-Drawn Steel Wire for Concrete Reinforcement, Spec. for.
   2. ASTM A 185; Welded Steel Wire Fabric for Concrete Reinforcement, Spec. for.
   3. ASTM A 615; Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, including Supplementary Requirement.

C. Concrete Reinforcing Steel Institute: CRSI, Manual of Standard Practice for Reinforcing Concrete Construction.

1.05 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement, accessories, and others as requested by Engineer.

B. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel:
   1. Reinforcing Bars : ASTM A 615, Grade 60, deformed.
   2. Steel Wire: ASTM A 82, plain, cold-drawn, steel.
   3. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
   4. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate the installation of joint materials and vapor retarders with placement of reinforcing steel.

B. Verify that items to be embedded in concrete are secured in place and block-outs in formwork are secured in place as required. Formwork installed as work of Section 03100.

3.02 INSTALLATION

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
   1. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
   2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
   3. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

B. Anchor Bolts Setting: Set at locations indicated on Drawings and secure in place to prevent movement during concrete pours.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED WORK

A. Concrete Formwork: Section 03100.

B. Concrete Reinforcement: Section 03200.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
   1. ACI 301; Specifications for Structural Concrete for Buildings.
   2. ACI 318; Building Code Requirements for Reinforced Concrete.
   3. ACI 350; Concrete Sanitary Engineering Structures.
   4. Concrete Reinforcing Steel Institute (CRSI); Manual of Standard Practice.

B. Materials and Installed Work Testing: The Engineer may require testing and retesting at anytime during progress of work.
   1. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, will be done at Contractor's expense.

1.02 REFERENCES

A. American Concrete Institute:
   1. ACI 301; Specifications for Structural Concrete for Buildings.
   2. ACI 304; Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
   3. ACI 305R; Hot Weather Concreting.
   4. ACI 306R; Cold Weather Concreting.
   5. ACI 309; Standard Practice for Consolidation of Concrete.
   6. ACI 318; Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials.
   1. ASTM C 31; Making and Curing Concrete Test Specimens in the Field, Method of.
   2. ASTM C 33; Concrete Aggregates, Spec. for.
   3. ASTM C 39; Compressive Strength of Cylindrical Concrete Specimens, Test Method for.
   4. ASTM C 42; Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, Method of.
   5. ASTM C 94; Ready-Mixed Concrete, Spec. for.
   6. ASTM C 143; Slump of Portland Cement Concrete, Test Method for.
   7. ASTM C 150; Portland Cement, Spec. for.
   8. ASTM C 171; Sheet Materials for Curing Concrete, Spec. for.
   9. ASTM C 172; Sampling Freshly Mixed Concrete, Method of.
   10. ASTM C 173; Air Content of Freshly Mixed Concrete by the Volumetric Method, Test Method of.
   11. ASTM C 231; Air Content of Freshly Mixed Concrete by the Pressure

Method, Test Method of.
12. ASTM C 260; Air Entraining Admixtures for Concrete, Spec. for.
13. ASTM C 309; Liquid Membrane - Forming Compounds for Curing Concrete, Spec. for.
14. ASTM C 494; Chemical Admixtures for Concrete, Spec. for.
15. ASTM C 881; Epoxy-Resin-Base Bonding Systems for Concrete, Spec. for.
16. ASTM D 1751; Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types), Spec. for.
17. ASTM D 1752; Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, Spec. for.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items named herein, as requested by Engineer.

B. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

C. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150 of the following Type(s):
1. Type II, Moderate Sulfate Resistance.

B. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.

C. Normal Weight Aggregates: Meeting requirements of ASTM C 33, and as specified herein. Provide aggregates from a single source for exposed concrete.
1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
2. Reduced Aggregate: Reduced aggregate concrete shall contain aggregate with particle size not less than 1/8-inch or more than 1/2-inch in any dimension and a maximum of 5 percent of particles passing a No. 18 sieve.

D. Water: Potable quality, clean and free of injurious amounts of oil, acid, alkali, organic matter, suspended matter, and other deleterious substances.

E. Concrete Admixtures:
1. Air-Entraining Admixture: Use a product conforming to ASTM C 260, certified by manufacturer to be compatible with other

required admixtures.
a. Acceptable Manufacturers:
1) Sika Aer; Sika Corp.
2) MB-VR or MB-AE; Master Builders.
3) Darex AEA or Daravair; W. R. Grace.
4) Or Equal.

2. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
a. Acceptable Manufacturers:
1) WRDA Hycol; W. R. Grace.
2) Pozzolith Normal; Master Builders.
3) Plastocrete 160; Sika Chemical Corp.
4) Or Equal.

3. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
a. Acceptable Manufacturers:
1) Accelguard 80; Euclid Chemical Co.
2) Pozzolith High Early; Master Builders.
3) Or Equal.

4. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
a. Acceptable Manufacturers:
1) Pozzolith Retarder; Master Builders.
2) Daratard; W.R. Grace.
3) Plastiment; Sika Chemical Co.
4) Or Equal.

5. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. Waterstops: Provide bentonite/butyl rubber type in coil form.
1. Acceptable Manufacturer:
a. American Colloid Company; Volclay Waterstop-RX.
b. Or Equal.

F. Preformed Expansion Joint Fillers:
1. Nonextruding and Resilient Bituminous Fiber Types (Exterior Use): ASTM D 1751.

G. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.
4. Or Equal.

H. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq ft./gal.
1. Acceptable Manufacturers:
a. L&M Cure; L & M Construction Chemicals.
b. Masterseal; Master Builders.
c. Kure-N-Seal; Sonneborn-Rexnord.
d. Or Equal.

I. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Polyvinyl Acetate (Interior Only):
   a. Euco Weld; Euclid Chemical Co.
   b. Weldcrete; Larsen Products Corp.
   c. Or Equal.
2. Acrylic or Styrene Butadiene:
   a. Everbond; L & M construction Chemicals.
   b. Sonocrete; Sonneborn-Rexnord.
   c. Daraweld C; W. R. Grace.
   d. Or Equal.

2.02 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Design Mixes: Provide normal weight concrete with the following properties, as indicated on drawings and schedules:
   1. 2500 psi 28-day compressive strength. (SHA Mix No. 1)
   2. 3000 psi 28-day compressive strength. (SHA Mix No. 2)
   3. 4000 psi 28-day compressive strength.

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures:
   1. Use water-reducing admixture in concrete as required for placement and workability.
   2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
   3. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated.

E. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions. Admixtures must be included in initial mix design approved by Engineer and cannot be either added or deleted from the mix without prior approval of Engineer.

F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
   1. Subjected to freezing and thawing; W/C 0.50.
   2. Subjected to deicers/watertight; W/C 0.45.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
   1. Ramps, slabs, and sloping surfaces: Not more than 3".
   2. Reinforced foundation systems: Not less than 1" and not more than 3".

3. Other concrete: Not less than 1" nor more than 4".

2.03 CONCRETE MIXES:

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
   1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
   2. When air temperature is between 85`F (30`C) and 90`F (32`C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90`F (32`C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate the installation of joint materials with placement of forms and reinforcing steel.

B. Prepare formwork in advance and remove snow, ice, water and debris from within forms. Formwork as specified in Section 03100.

C. Pre-position reinforcement in advance of concrete pours. Concrete reinforcement as specified in Section 03200.

D. Pre-position joint materials, anchors and embedded items.

3.02 JOINTS AND EMBEDDED ITEMS

A. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.
   1. Expansion joint filler as specified previously under Part 2 - Products.
   2. Joint sealant materials are specified in Section 07900.

B. Embedded Items: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

3.03 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in.
   1. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.
   2. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. General: Comply with ACI 304 "Recommended Practice for Measuring,

Mixing, Transporting, and Placing Concrete", and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness.
2. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

E. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.

F. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305.

3.04 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Smooth Rubbed Finish: Provide smooth rubbed finish to uncoated exposed to view concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.

1. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.

3.05 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes.

B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view.

C. Non-Slip Broom Finish: Apply non-slip broom finish to exterior

concrete platforms, steps and ramps, and elsewhere as indicated.

3.06 MISCELLANEOUS CONCRETE ITEMS

A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard dense finish with corners, intersections and terminations slightly rounded.

3.07 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof.

3.08 QUALITY CONTROL

A. Contractor will employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete will include the following, as directed by Engineer.
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
3. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.
5. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
6. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
   a. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
   b. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.
   c. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for

protecting and curing the in-place concrete.

d. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

C. Test results will be reported in writing to Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 RELATED WORK

A. Individual grouting requirements as specified in various other Sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Grout manufacturer shall furnish the Engineer with current independent laboratory test results indicating the grout as nonshrink from time of placement; indicating no expansion after final set, ASTM C 827; indicating 4,000 psi strength developed with a trowelable mix within 24 hours, ASTM C 109; and indicating placement time based on initial set of not less than 60 minutes, ASTM C 191.
   2. Test results, as supplied by the grout manufacturer, shall indicate that in projects of similar scope and size, the effective bearing area was between 95 and 100 percent.

1.03 REFERENCES

A. American Concrete Institute: ACI 308, Recommended Practice for Curing Concrete.

B. American Society for Testing and Materials:
   1. ASTM C 109; Compressive Strength of Hydraulic Cement Mortars (Using two inch or 50-mm Cube Specimens), Test Method for.
   2. ASTM C 191; Time of Setting of Hydraulic Cement by Vicat Needle, Test Method for.
   3. ASTM C 596; Drying Shrinkage of Mortar Containing Portland Cement, Test Method for.
   4. ASTM C 827; Early Volume Change of Cementitious Mixtures, Test Method for.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Water: Potable quality, free from deleterious amounts of acids, alkalis, and organic substances.

B. Non-Shrink Non-Metallic Grout: Factory premixed material containing no corrosive irons, aluminums, chemicals or gypsums.
   1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent sand cement and water mix as tested per ASTM C 596.
   2. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C 827.
   3. Initial set of grout not less than 60 minutes per ASTM C 191 Test.

4. Use Type I (Normal) cement for grout applications not in contact with water.
5. Use Type II (Sulfate Resistant) cement for grout applications in contact with water.
6. Acceptable Manufacturer: U.S. Grout Corporation; FIVE STAR, or equal.

2.02 GROUT QUALITY

A. Non-Shrink Grout: Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions shall conform to manufacturer's specifications for the desired mix consistency.

PART 3 - EXECUTION

3.01 PREPARATION

A. Forming:
1. Use forming procedures that allow proper and complete placement of grout.
2. Anchor Support elements so no movement is possible.
3. Remove supports only after grout has hardened.

B. Preparation of Surface:
1. General: Clean areas to be grouted free of oil, grease, laitance, dirt and other contaminants. Remove loose material. Remove rust, paint, and oil from metal components in contact with grout.
2. Non-Shrink Grout: Perform additional surface preparation in accordance with manufacturer's instructions.

3.02 MIXING

A. Equipment: Use power operated mechanical mixer.

B. Time:
1. Non-Shrink Grout: In accordance with manufacturer's instructions.

3.03 PLACING

A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place non-shrink non-metallic grout only where indicated on Drawings.

END OF SECTION

SECTION 11304

PACKAGED SEMI-POSITIVE-DISPLACEMENT GRINDER PUMP STATION PACKAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Packaged factory-assembled grinder pump system including:
   1. Semi-positive-displacement type pump.
   2. Motor.
   3. Fiberglass tank and accessway.
   4. Pump removal system.
   5. Piping connections.
   6. Remote alarm and control panel.
   7. Shut-off, check, and anti-siphon valves.

B. Service entrance circuit breaker.

C. Conduit and wire.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA)
   1. NEMA TC 2 - Electrical Plastic Tubing and Conduit.
   2. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.03 RELATED SECTIONS

A. Section 02220 - Structural Excavation, Backfill and Compaction.

B. Section 02221 - Trenching, Backfilling and Compacting.

1.04 PERFORMANCE REQUIREMENTS

A. Continuous performance: 11 gpm at total head (H) of 92 feet.

B. Intermittent performance: The pump shall be capable of operating for minimum of three minutes at total head of 138 feet without damage to pump or motor.

C. Zero head discharge: 15 gpm.

D. Grinder performance: Capable of reducing domestic sewage components, including paper, wood, plastic, and glass to small particles which will freely pass through 1¼-inch discharge piping and connection.

1.05 SUBMITTALS

A. Submit Shop Drawing and Product data under provisions of General Requirements.

B. Submit Shop Drawing showing complete fabrication, assembly, and installation details.

C. Submit Product data describing materials, parts, devices, and accessories. Include:

1. For pump:
    a. Manufacturer
    b. Type and model
    c. Nominal rotative speed
    d. Discharge diameter
    e. Type of bearings and seals
    f. Weight of package
    g. Complete performance curves showing capacity versus head, efficiency, and bhp
    h. Data on shop painting
2. For motor:
    a. Horsepower rating
    b. Type of bearings and lubrication
    c. Temperature rating
    d. Full load rotative speed
    e. Efficiency at full load and rated pump condition
    f. Full load current
    g. Locked rotor current

D. Submit results of factory tests as specified in Part 2.

E. Submit certified copies of factory test reports for pump system at least ten days before shipping pumps to Project site. Include:
    1. Test log.
    2. Description of test set-up.
    3. Test procedure.
    4. Certified performance curve with the following plotted against flow in gpm. Curves shall have a minimum of three points plotted and maximum pressure on curve shall be no less than 60 psi.
        a. Head
        b. bhp
        c. Efficiency

F. Submit 12 copies of Operating and Maintenance manuals.

G. Submit field report from manufacturer's representative.

H. Submit any inspection certificates required by regulatory agencies.

1.06 QUALITY ASSURANCE

A. Provide equipment which is listed by Underwriters Laboratories (UL) for safe operation under the Project conditions.

B. Provide equipment which is certified by the National Sanitation Foundation (NSF).

C. Manufacturer shall have a minimum five years experience in manufacture of the type of pump package specified.

1.07 REGULATORY REQUIREMENTS

A. Perform all electrical and plumbing work in accordance with codes that apply at Project location.

B. Arrange for all plumbing and electrical inspections required by regulatory agencies.

C. Submit inspection certificates to Owner.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Unload and store pumps and accessories in accordance with the manufacturer's instructions.

1.09 PROJECT CONDITIONS

A. Contractor shall confine construction operations directly related to grinder pump installation and to construction of the pressure sewer lateral and the gravity inlet pipe to within the easement limits.

B. Installation of electrical conduit and wiring will be outside the lateral easement. Contractor shall confine work related to installation of conduit and wiring to the absolute minimum space required for proper performance of this work.

C. Service entrance circuit breaker and pump system control panel will be installed on the exterior side wall of private residences, building, and structures. Consult with property owner to determine best location for the electrical equipment.

D. Service entrance circuit breaker will be wired into existing electrical meter. Consult with utility company to determine requirements and standards for this work.

1.10 WARRANTY

A. Submit manufacturer's 24-month materials and workmanship warranty. Warranty shall become effective on date of Substantial Completion.

1.11 SPARE PARTS AND TOOLS

A. Supply 1 spare grinder pump core unit.

B. Supply the following equipment and tools:
   1. Pressure pump.
   2. Vacuum pump.
   3. Seal assembly tool.
   4. Bearing puller, switch end.
   5. Bearing puller, pump end.
   6. Bearing press-on tool, switch end.
   7. Bearing press-on tool, pump end.
   8. Torque screwdriver.
   9. Shim stack/centrifugal switch gage.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Environment/One Corporation Model 2010 (simplex); or equal.

2.02 MANUFACTURED UNITS

A. Pump and Grinder
   1. Progressing cavity, semi-positive-displacement type.
   2. Rotor: Hardened, polished stainless steel.
   3. Stator
      a. Ethylene Propylene synthetic elastomer.

b. Resistant to tear, abrasion, and grease, detergent, and other components of domestic sewage.

4. Grinder
   a. Located directly below pump intake to direct flow upward to pumping components.
   b. Consists of:
      (1) Rotating impeller, connected directly to motor shaft, and fitted with two Series 400 stainless steel cutter bars.
      (2) Stationary hardened and ground chrome steel shredding ring.
      (3) Inlet shroud with minimum diameter of five inches.
   c. Design to:
      (1) Eliminate clogging and jamming under all operating conditions, including starting.
      (2) Create sufficient vortex action to keep tank bottom free of solids accumulation.

B. Motor
1. Capacitor-start, squirrel-cage induction motor.
2. Rotative speed: 1,725 rpm maximum.
3. Horsepower: One maximum.
4. Power supply: 240 volt AC, single phase, 60 Hz.
5. Starting current: 30 amps maximum.
6. Starting torque: 8.4 foot pounds minimum.
7. Equip with thermal overload protector.
8. Equip with buckboost transformer supplied by pump manufacturer to boost existing 208V to 240V, if required.

C. Shaft Seal
1. Mechanical seal between motor and pump.
2. Stationary ceramic seat; carbon rotating surfaces; stainless steel spring.

D. Tank
1. High Density Polyethylene tank with anti-flotation collar.
2. Wall thickness: 3/16-inch minimum.
3. Capacity
   a. Simplex installation: 60 gallons.
4. Equip with PVC bolt-on inlet connection for minimum four-inch diameter PVC DWV inlet pipe.
5. Integral Accessway
   a. Equip tank with integral high density polyethylene accessway; same wall thickness as tank.
   b. Equip accessway with:
      (1) Lockable fiberglass cover.
      (2) Minimum 1¼-inch copper discharge piping with full-ported shut-off valve, anti-siphon valve, check valve, and minimum 1¼-inch male threaded termination.
      (3) Watertight bulkhead fitting for discharge piping.
      (4) Minimum two-inch PVC vent for venting tank.
      (5) Sealed, integral electrical junction box suitable for outdoor use.
      (6) Factory-installed electrical cable, control breather, pressure switches, relays, timers, and heaters as required.

E. Pump Removal System
1. Removable, watertight core unit shall consist of pump, motor, grinder, controls, check valve, anti-siphon valve, and wiring.

2. Core unit shall be factory tested for watertight integrity under minimum pressure of 5 psi.
3. Design system to permit servicing of core unit without entering tank.
4. Equip top housing with two lifting eyes.
5. Provide quick-disconnect electrical connections to provide for complete removal and re-installation of core unit.

F. Remote Alarm and Control Panel
1. Provide, for each pump installation, a simplex control panel for remote installation.
2. Enclosure: NEMA 3R.
3. Equip with:
   a. Lockable, hinged access panel.
   b. Circuits, breakers, duplex GFI-protected receptacle, controls, and alarm provisions as shown on the Drawings.
   c. Equip with three-inch diameter red alarm light and alarm horn, each of which shall be activated upon high liquid level condition in pump tank. Alarm light shall also function as a push-button alarm horn silencer.

G. Enclosed Circuit Breaker
1. Service entrance breaker in weatherproof enclosure.
2. Ampere rating: 100 amps.
3. Trip: 30 amps.
4. Interrupting current: 22,000 amps.
5. Voltage: 120/240 volts AC.
6. Three-wire; two pole with solid neutral.
7. Enclosure; NEMA 3R.
8. Equip with ground bar kit.
9. Furnish and install ground wire and 3/4 inch x 10 foot long copper clad ground rod, as shown on the Drawings, at each service entrance circuit breaker.

H. Conduit and Wire
1. Conduit: NEMA TC 2; Schedule 40 PVC.
2. Fittings and conduit bodies: NEMA TC 3.
3. Wire and cable: As shown on the Drawings.

2.03 SHOP TESTING

A. Test each pump system as follows:
1. Submerge and operate for five minutes. During operation, test all accessory components including the anti-siphon valve, check valve, discharge pipe, level sensors, controls, and alarms.
2. Test for watertightness of core unit at a minimum pressure of 5 psi.

B. Submit the results of above-specified factory tests, plus certified performance curve as specified in Part 1, at least ten days prior to shipping units to Project site.

2.04 FABRICATION

A. Each grinder pump unit shall be completely assembled into a package at the factory.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Perform all handling at the Project site using the lifting eyes installed on the anti-flotation collar.

B. Excavate for pump unit placement in accordance with Section 02220. Excavate to depth required to provide a minimum of 42 inches cover over discharge pipe and to assure that finished grade is a minimum of six inches below top of accessway.

C. Provide a firm, dry, level subgrade for the unit.

D. Place tank foundation material on subgrade as specified in Section 02220.

E. Place anti-flotation concrete around tank as specified.

F. Backfill tank with compacted sand, as specified in Section 02220, up to level of inlet pipe.

G. Install inlet pipe. Inlet pipe shall extend from the house to the pump station tank. Slope inlet pipe at two percent grade downward from house to pump station.

H. Carefully compact sand, as specified in Section 02220, under pipe haunches and over top of inlet pipe to the level of the discharge pipe.

I. Install discharge piping and connect to main.

J. Complete sand backfill, as specified in Section 02220. Carefully compact sand under haunches of discharge pipe and over top of the pipe to a level of six inches above the pipe crown.

K. Complete backfill with Common Earth Backfill, where applicable, and Type B Select Material where applicable.

L. Restore surface as specified in Section 02221.

M. Install service entrance circuit breaker and pump alarm/control panel for each pump unit.

N. Install electrical conduit and cable between pump unit and alarm/control panel as specified in Section 02221 and as shown on the Drawings. Perform all wiring and electrical work required to comply with applicable codes and to provide a complete operational system.

3.02 MANUFACTURER'S FIELD SERVICES

A. Provide the services of a qualified manufacturer's representative to:
   1. Inspect each unit upon completion to determine that it has been properly installed.
   2. Test each unit as follows:
      a. Provide all required testing equipment, including portable generator and ammeter.
      b. Fill the wet well with water to a depth sufficient to verify proper operation of high liquid level alarm.

c. Initiate pump operation to verify that automatic start/stop controls operate properly.
d. Record ammeter readings to verify that units have been wired correctly and that electrical system is operating properly.

3. Instruct Owner's operating personnel in proper operation and maintenance of the system. Minimum instruction period: Four hours.
4. Prepare and submit inspection report to Engineer certifying that all pump units have been properly installed and tested in accordance with Specifications.

END OF SECTION

SECTION 17000

REFLECTORIZED THERMOPLASTIC PAVEMENT MARKING

PART 1 - DESCRIPTION

1.01 SECTION INCLUDES

A. New replacement of Pavement Markings or trenching and paving operations.

1.02 RELATED SECTIONS

A. Paving: Section 02500.

1.03 DESCRIPTION

A. This specification covers the preparation, application and material requirements of reflectorized thermoplastic pavement markings which shall not deform under traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Requirements of the following parameters shall be in accordance with ASSHTO M249;
   1. Specific gravity
   2. Composition, except modification in paragraph 2.3 below
   3. Color-white and yellow when determined in accordance with ASTM E97.
   4. Softening point
   5. Storage life

B. Loss by abrasion shall not exceed 0.5g when tested in accordance with MSMT 614.

C. Glass beads shall conform to AASHTO M247 and shall be moisture resistant. Type II beads shall be premixed at the rate of 25 to 30 percent by weight. Type I beads shall be used for surface dressing and shall be applied at the rate of 4lb./100 ft.

D. SAMPLING: The Contractor shall submit the sources of thermoplastic material and surface dressing glass beads to the City Engineer for approval in accordance with Section 900 of the Maryland State Highway Administration Specifications. The supplier of the materials shall furnish certificates containing the actual test results showing that the materials meet these specifications.
   1. The thermoplastic material shall be shipped to the project in sealed containers filled by the manufacturer. The label on each container shall include the following information:
      a. Manufacturer's Name
      b. Place of Manufacture
      c. Color of Material
      d. Date of Manufacture (Month and Year)
      e. Batch or Lot Number

1) A batch or lot is defined as containing 10,000 lb. or less of material shipped to the project. The Contractor shall provide a certificate for each new batch or lot in accordance with the requirements of this Section.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Application: A primer may be used at the discretion of the Contractor. Pavement markings shall not be applied over longitudinal joints. All markings shall yield a minimum finished solid thickness of 60 mils. Thickness will be measured in the field by placing two shims approximately 70 mils thick next to each edge of the marking. A straight edge bridging these shims will leave a small space between the marking and the straight edge which will be measured with an "Automotive Feeler Gauge". Subtract the space measurement from the known shim thickness and this will be considered the thickness of the marking.

B. EQUIPMENT: Application equipment shall be capable of applying extruded or atomized spray markings to a continuous uniformity and required dimensions. Prior to the start of work, the Contractor shall demonstrate that his paint guns are adjusted to provide the width of line specified in the Proposal. The equipment shall also be capable of applying intermittent line patterns and continuous lines. The equipment shall be equipped with a cutoff device remotely controlled to provide clean, square stripe ends.
   1. The bead dispensing apparatus used for the surface dressing glass beads shall be capable of applying the beads uniformly across the surface of the stripe at a rate of 4lb./100 ft. to a depth equal to at least 60 percent of the bead diameter.
   2. The application equipment shall maintain the manufacturer's recommended temperature range throughout all mixing and conveying parts up to and including the discharge. The material shall have a minimum temperature of 400 degrees F at the point of disposition.
   3. A footage counter shall be included on the application equipment for measuring the actual linear feet of markings placed. The footage counter shall be calibrated and a notarized certification shall be submitted to the Engineer.
   4. The atomized spray application method shall not be used on plant mixed seal (open graded) bituminous concrete pavements. The pavement on which the thermoplastic markings are to be placed shall have a minimum surface temperature of 55 degrees F. The type of line markings will be specified by the Engineer. The width of the line shall be 4 inches unless otherwise specified.

C. CLEANING: Pavement markings shall be applied to the pavement surfaces which shall be dry and free of glaze, oil, dirt, grease or other contaminants. Surfaces not meeting these requirements shall be cleaned by the Contractor to a width equal to 2 inch wider than the stripe to be applied.
   1. When new pavement markings are to be applied directly over existing worn markings, the Contractor shall clean the existing

residual markings to the extent necessary to assure adherence of the new markings.

D. REMOVAL: Existing pavement markings which conflict with new or altered traffic patterns shall be completely removed. The Contractor's methods shall not damage the pavement surface and shall be acceptable to the Engineer.

E. RESPONSIBILITY: The Contractor shall remove and replace at his expense and to the satisfaction of the Engineer, any material which exhibits any of the following deficiencies:
   1. Nonadherence to road surface.
   2. Material improperly set or tracked.
   3. Insufficient film thickness or width of stripe.
   4. Insufficient glass bead coverage or retention.
   5. Materials spilled or improperly placed.
      a. The Contractor shall protect the markings until dry by placing guards or warning devices as necessary and in accordance with the Manual on Uniform Traffic Control Devices. In the event any vehicle should cross the wet marking, such marking shall be reapplied and marks made by the vehicle removed by the Contractor at his expense. For pavements in service, the Contractor will be allowed to close only one lane at a time.
      b. It shall be the responsibility of the Contractor to remove and dispose of all empty material containers and other debris from the project site.

PART 4 - OBSERVATION PERIOD

4.01 GENERAL

A. The Contractor shall be responsible for any defects in materials and workmanship of the thermoplastic markings for a period of 180 days from the date of installation.

B. A minimum of 95 percent of the applied markings shall remain intact during the Observation Period. The Engineer shall be the sole judge of the percent of the marking area intact during this period.

C. The Contractor shall replace, entirely at his expense, to the above percentage level, the amount of markings required to meet the 95 percent requirement. The Engineer will indicate the area and lines to be replaced to meet the subject percentages.

D. Completion and acceptance of the project will be contingent upon successful completion of the Observation Period.

E. The Contractor will be required to contact the City Engineer two (2) days prior to placing any thermoplastic markings to that a test strip may be demonstrated.

END OF SECTION