Wastewater Specifications

January 2026

INTEGRA WATER TECHNICAL SPECIFICATIONS
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ARTICLE 1 - GENERAL PROVISIONS

1.1 SCOPE OF REGULATIONS

These regulations shall apply to any person, developer, firm, business, or entity interested in and desiring to construct additional sewer lines or to extend sewer lines that will connect to the wastewater collections system owned and operated by Integra Water. Integra Water as well as its successors, assigns and subcontractors shall remain free of any liability resulting from failure of any person, developer, firm, business, or entity to comply with the terms outlined herein.

It is the responsibility of any person, developer, firm, business, or entity to obtain the most recent edition of these specifications and be aware of any changes, modifications, additions, or deletions.

1.2 PLAN REVIEW PROCEDURE

Before any connection is made to a sewer line owned and operated by Integra Water, the Developer or other party through his Engineer shall submit and receive approval of his proposed plan. The submittal shall consist of neat, scale drawings and specifications in pdf format. Plans will not be deemed approved until an Integra Water representative's signature is made on the plans. **The approval of Integra Water must be obtained before submittal of the plans and specifications to any regulatory authorities, and both approvals must be obtained before construction is started**. A copy of the approved plans must be present at the project site during construction. **Approval of plans shall be valid for one (1) year from the date of approval and must be submitted to any regulatory authorities within eight (8) months of said approval to remain valid**

Before construction begins, the contractor shall supply Integra Water with one (1) pdf copy of submittals for each major appurtenance to be used in constructing the proposed sewer facility. Product sheets shall be submitted for, but not limited to, all piping, valves, pumps, concrete, fittings, sleeves, etc. The contractor shall indicate by affixing his stamp or signature to each submittal that the products are in accordance with the requirements and specifications set forth in this document. The contractor shall identify any discrepancies or variations in the product submitted and the specifications set forth herein, or product limitations which may be detrimental to successful performance of work. The contractor shall indicate on each submittal where a material or product conforms to or exceeds the specified requirements and shall supply Integra Water with supporting reference data, affidavits and certifications as deemed necessary. Integra Water retains the right to request additional submittals as needed. Installation of any permanent fixture will not be allowed until Integra Water has approved the product sheet submittal.

Plan submittal procedure shall be as follows:

- All plans shall be submitted to Integra Water with a check for the plan review fee in the amount of $1000.00.Submitted plans shall include, besides the sewer main and related appurtenances, plans showing finished grades for the roadways, curbs, gutters, sidewalks and ground, as well as the location, size and invert elevation of other utilities and drainage structures.

- Integra Water will review the plans and specifications and provide comments or approval within two (2) weeks of submittal. Should the proposed plan need corrections it will be returned with comments to the Engineer for applicable changes.

- Once the proposed sewer plan meets Integra Water's current specifications, one (1) signed copy, as to approval, will be returned to the Engineer or Developer for submittal to any regulatory authorities, if necessary. The plans shall also include the latest revision date if applicable. All final construction plans shall be based on field run survey information and shall include the name and stamp of the registered surveyor.

1.3 STANDARDS FOR CONSTRUCTION PLANS

All Construction Plans must have a Title Sheet with certain required signatures, including a Professional Engineer's seal. The signatures for Integra Water personnel indicate the following:

> "Engineer": Indicates review of Construction Plans as above, plus, at Integra Water's discretion, a review of the Construction Plans for acceptable hydraulic and flow-carrying capacity of the proposed sewer facilities. (See "Construction Drawings Review and Approval" for required sequence for affixing signatures).

The Title Sheet must contain a location map at a scale not smaller than 1"=1,000', the name of the project, and the name(s), addresses, and telephone numbers of the Developer(s). The Title Sheet must also contain an index to all sheets, and the following statement in the lower right-hand corner:

> "'Construction Specifications for Sanitary Sewer', latest edition as adopted by Integra Water, is hereby made a part of these Plans."

Sanitary Sewer Construction Plans shall contain the following information:

1. Plan and profile of proposed sewer system, drawn at 1"=50' horizontal and 1"=10' vertical scales, with grades (%) indicated and invert elevations shown at 100-foot stations and at every manhole.

2. Location, size, and material of all existing and proposed sewers, with locations of connections to other sewers and locations of service laterals.

3. Direction of flow in each sewer line.

4. Horizontal location of all manholes and other system features, and deflection angles at manholes.

5. Construction details of typical manholes, connections, service laterals, pipe bedding, trenches, road crossings (including encasement if required), stream or ditch crossings, and slope protection. Standard Details are included by reference.

6. North arrow on each Plan sheet.

7. Professional Engineer's seal on each Plan sheet.

8. Benchmark elevation based on USGS datum.

9. All topographic features, both existing and proposed.

10. All property lines including subdivision block and lot numbers, rights-of-way, and required or utilized easements.

11. Dedicated rights-of-way and easements for sewer lines. Show width and delineate as sewer rights-of-way or easements, noting the recording number and date for each document.

12. Location of all existing or proposed utilities on or adjacent to the project or tract, including size and elevation.

13. If any portion of the land of the proposed subdivision or project is subject to inundation by storm drainage, overflow, or ponding of local storm water, such fact and portion shall be clearly shown and identified.

14. Backfill detail showing crossing of all roadways acceptable to the State and/or United States Department of Transportation specifications.

1.4 DESIGN FEATURES

Sewer system design features shall generally conform to good engineering practice and to the requirements of any and all regulatory authorities including Integra Water's.

Sanitary Sewers

All sanitary sewers shall be designed in accordance with these criteria, Specifications contained in other Sections, and the standards of all Regulatory Authorities.

Sanitary sewers to be dedicated to Integra Water shall be constructed within dedicated rights-of-way or sanitary sewer easements.

Planning Period

To determine the capacity for a sanitary sewer, population and land use projections for the sewer's service area shall be made for a 20-year planning period, and also the saturation condition based on information obtained from the area's authority.

Service Area land Use and Population Projections

The land use and population projections for a sanitary sewer shall be coordinated with Integra Water and with the area planning authority to incorporate the latest revisions in the projections.

Sizing of Pipe

Design calculations for sizing pipe shall be conducted using the following criteria:

- For pipe sizes 8" to 15", design for ½ full depth flow.
- For pipe sizes greater than 15", design for ¾ full depth flow.

The appropriate pipe size and slope to transport the design flow shall be calculated using Manning's Equation as shown below. The minimum pipe size shall be 8 inches.

Sewers shall be designed for a minimum velocity of 2.0 ft./second at design flow, a maximum velocity of 10.0 ft./second and shall accommodate design flow at one-half full for 8" to 15" pipe sizes. Minimum slope for 8- inch diameter sewers shall be 0.44% (0.44 ft./100 ft.). A roughness coefficient of n=0.013 for ductile iron (n=0.011 for PVC) shall be used for sanitary sewers.

Manning's Equation

$$V = \frac{1.486 R^{2/3} S^{1/2}}{n}$$

V = velocity in ft/s
n = roughness coefficient
R = hydraulic radius in ft (area/wetted perimeter)
S = slope in ft/ft

Manning's Equation for Pipes Flowing Full

$$V = \frac{.590 D^{2/3} S^{1/2}}{n}$$

$$Q = \frac{.463D^{8/3}S^{1/2}}{n}$$

V = velocity in ft/s
n = roughness coefficient
D = pipe diameter in ft
S = slope in ft/ft

Wastewater Flow Projections

Wastewater flows shall be estimated from population projections, commercial land usage and an estimated infiltration/inflow (I/I) in the sanitary sewer service area. The sewer shall be designed for an estimated peak hourly flow as described below. Appendix C and G shall be used for estimating wastewater flow projections.

Residential Flow

The residential wastewater flows shall be calculated using an average per capita per day flow of 85 gallons multiplied by a peak factor. However, an additional allowance for inflow and infiltration should be made where conditions are unfavorable, such as areas of known high groundwater, at the discretion of Integra Water.

Commercial Flows

When no specific flow data is available, Appendix C and G shall be used for estimating peak commercial flows. Every effort shall be made to obtain accurate data as the flows vary widely depending upon specific needs of the user.

A list of known users may also be prepared for planning purposes. The commercial users' flow may be estimated using water usage records. Included below are two charts of standard wastewater flow data assumptions for different types of developments. These charts may be used for flow projections, if no other data is available.

Total Peak Flow

Total peak hourly design flow can be calculated by adding the residential and the commercial peak flows.

To determine the anticipated peak flow (APF), terms shall have the meanings assigned to them below:

Required APF

APF shall mean the anticipated peak flow of sewage necessary to accommodate a proposed development at full build-out, measured in gallons per minute. The Required APF of any proposed development shall be included by the Developer with plans submitted to the local governing Board for approval. The municipal Engineer shall review and verify the Required APF for each development prior to approval. In case of any discrepancy between the Required APF submitted by the Developer and the opinion of the Town Engineer as to the Required APF, the opinion of the Town Engineer shall be used for purposes of calculating the Trunk Sewer Capacity Charge.

Required APF = Average Daily Flow x Peak Factor (PF)

For new Residential service units:

$$ADF = \frac{85 \text{ gpcd X No. of persons served}}{1440 \text{ minutes}}$$

$$PF = \frac{18 + P^{1/2}}{4 + P^{1/2}}$$

ADF = average daily flow in gallons
Number of persons served = 3 persons/dwelling unit x number of dwelling units
P = number of persons, in thousands
PF = peak factor

For existing Residential service units:

$$ADF = (\text{average monthly water usage}) \text{ X } 70\% \text{ X } (30.5 \frac{\text{days}}{\text{month}}) \text{ X } (1440 \text{ minutes})$$

PF = 4.50

Wastewater Design Flow Submittals

An Engineering Report on flow calculations must be reviewed with Integra Water before final preliminary design is attempted. This review will offer Integra Water the opportunity to alter specific design criteria if needed. Required items for the Engineering Report on Flow Calculations are as follows:

- Topographic map outlining the drainage area. Service area and acreage for each zoning classification shall be shown.
- General layout of the proposed sanitary sewer line.
- Flow Calculations – present and future users and population for each drainage area. Must include all assumptions with basis for determining numbers. Use the calculation form in Appendix G. Electronic copies of the calculation sheet are available from Integra Water.
- Peaking Factor used for each basin or zoning.
- The minimum design velocity shall be 2.0 fps and the maximum design velocity shall be 10.0 fps. In areas where velocities exceeding 10.0 fps are needed due to the existing site conditions, such as mountainside development, prior approval from Integra Water is required. Appropriate design for safety and durability under the increased stress shall be incorporated into the plans and specifications for these higher velocity sections of pipe.

Slopes

The minimum allowable slopes for each pipe size are displayed in Table 1.1 and the maximum allowable slopes for each pipe size are displayed in Table 1.2. These slopes were calculated using Manning's Equation with a Roughness coefficient of n = 0.011 (PVC) and n = 0.013 (DIP, RCP) as shown. The last 8" run or segment of sewer at the upper end of a collector system shall have a minimum slope of 0.010 foot per foot or greater. This will allow for proper drainage of this dead-end line.

Table 1.1
Minimum Allowable Pipe Slopes

Pipe Dia. (inches)	Slope (ft/ft)	V_{Full} (for n = 0.011) (ft/s)	V_{Full} (for n = 0.013) (ft/s)
8	0.0040	2.6	2.2
10	0.0028	2.5	2.1
12	0.0022		2.1
15	0.0015		2.0
18	0.0012		2.0
21	0.0010		2.1
24	0.0008		2.0
27	0.00067		2.0
30	0.00058		2.0
36	0.00046		2.0
42	0.00037		2.0
48	0.00030		2.0
54	0.00026		2.0

60	0.00026		2.0
66	0.00026		2.3
72	0.00026		2.4
	0.00026		2.6

Table 1.2
Maximum Allowable Slopes

Pipe Dia. (inches)	V_{Full}* (ft/s)	Slope (for n = 0.011) (ft/ft)	Slope (for n = 0.013) (ft/ft)
8	10.0	0.05970	0.08339
10	10.0	0.04433	0.06192
12	10.0		0.04855
15	10.0		0.03605
18	10.0		0.02827
21	10.0		0.02301
24	10.0		0.01926
27	10.0		0.01646
30	10.0		0.01430
36	10.0		0.01121
42	10.0		0.00913
48	10.0		0.00764
54	10.0		0.00653
60	10.0		0.00567
66	10.0		0.00500
72	10.0		0.00445
78	10.0		0.00400

*Steep grades that produce pipe velocities greater than 10.0 fps will require prior approval from Integra Water.

At points of the sewer where a change in pipe classification is shown on the Plans, the Contractor may begin at the next joint of pipe rather than cutting the pipe and constructing a collar except where there is a change in horizontal or verticalalignment.

Separation between sanitary sewers shall be 10 ft. horizontal, and 18 inches vertical clearance between adjacent pipe. In cases where it is not practical to maintain a ten-foot separation, Integra Water may allow deviation on a case-by-case basis. Joints or pipe crossing horizontally shall be equidistant from other lines.

Design Criteria for Manholes

Manholes shall be installed at the upper end of each line, at all changes in grade, size, or alignment, at all sewer intersections and at the appropriate distances. The maximum distance between manholes shall be 400 ft.

Every effort shall be made to avoid drop inlets. However, when required, a drop inlet shall be installed in manholes that have an incoming pipe invert elevation of 2 feet or more above the outgoing pipe invert and as shown in the standard detail for drop inlets. The drop inlet piping that is encased in concrete shall be ductile iron pipe or PVC as shown in the standard detail. Channel inverts inside the manhole shall be built up to prevent splashing as shown in the standard detail for drop inlets.

The top of manholes shall be set one foot above grade in non-traffic areas to aid in locating and maintenance purposes.

Flow Channel
The flow channel shall conform in shape and size to that of the connecting sewers. Minimum drops shall be increased when curved flow channels are required inside manholes.

Bench
When pipe diameters are less than 48 inches, a bench shall be provided on each side of the flow channel. The bench slope shall be 1 inch per foot. No pipe shall discharge onto the bench surface.

Manhole Types:

Shallow Manhole
A shallow manhole is defined as any manhole that is 6 feet or less in depth, as measured from the invert of the manhole base at its center to the finished ground.

Standard Manhole
A standard manhole is defined as any manhole that is greater than 6 feet in depth, as measured from the invert of the manhole base at its center to the finished ground.

Manhole Frames and Covers
Sewers proposed along drains, within potential 100-year flood plains, adjacent to drainage ditches or drainage structures in which there is a potential problem of storm water entering the sanitary sewer shall be designed with the rim elevation above the 100-year flood elevation. The surrounding ground shall be built up around the manhole so that the rim of the manhole is no higher than 4 feet above the ground surface. This will allow easy access to the manhole. In areas where raised manholes are not allowed, such as state road rights-of-way, manholes shall be equipped with standard watertight frame and covers as shown in the standard details. Watertight frames and covers shall be required where the proposed manholes are subject to inundation. All watertight frames and covers shall be bolted to the manhole.

Manholes 6 feet or less shall be constructed with the appropriate cones for shallow manholes. Written approval from Integra Water will be required for the design of manholes of 6 feet or less. Every effort shall be made to avoid using manholes less than 5 feet deep.

Manholes located within traffic areas shall have standard traffic type frame and covers and the depth of a standard manhole. No flat top manholes will be allowed.

All manhole frame and covers shall include butyl sealant (ram neck) under the flange of the manhole frame prior to grouting as shown in the Integra Water standard details. Maximum deflection angle at manholes shall be 90 degrees.

Abandoned Manholes and Sewer Line
All piping connected to abandoned manholes shall be plugged and filled with 24” of grout fill or flowable fill at each end as shown on the standard details. The manhole top shall be removed down to not less than 3 feet below final grade and the remaining portion shall be filled with crushed rock and capped with 12” of concrete or filled with flowable fill as shown on the standard details.

Testing Requirements
Integra Water requires testing of all new sanitary sewer lines and manholes. Minimum testing requirements are included in the Integra Water Construction Specifications. The Contractor must provide a 48-hour notice to Integra Water prior to testing. A representative from Integra Water must be present during final testing procedures. A copy of all tapes and logs on testing results shall be submitted to Integra Water prior to acceptance

Miscellaneous

All sanitary sewer or Force main (FM) facilities which connect to, or will be dedicated to, the Integra Water's existing infrastructure shall be designed in accordance with all criteria established herein. Also, all materials, construction, and testing of such facilities shall be in accordance with all Sections of this manual, regardless of whether such facilities will be dedicated to Integra Water, and therefore, shall be subject to inspection by Integra Water as deemed necessary to ensure the requirements contained herein are met.

If a proposed street, roadway, driveway, bike path, or sidewalk crosses an existing sanitary sewer line, the trench backfill for that pipeline shall comply with the standard details. That is, the trench shall be filled completely with properly compacted select earth material or with crushed stone. Alternatively, the trench may be bridged as shown in the standard details. The method proposed by the Design Engineer or Developer will be reviewed by Integra Water and approved according to Integra Water's best interests.

Sanitary sewer line mains shall be located as follows:

Trunk sewers shall be routed along natural drainage features, where practical, to provide a conduit at elevations low enough to serve the entire drainage basin within which the trunk is located, and to minimize impact on existing or proposed development. Trunk sewers are principal sewers to which collector sewers are tributary. All trunk sewers shall be designed to transport the saturation levels of the cumulative collector sewer drainage areas, except as otherwise required by Integra Water.

- Collector sewers shall be routed along existing or proposed street centerlines. In curved roadways, sewers shall be routed as close to centerline as possible while maintaining a clearance of 5.0 feet, minimum, from faces of curbs, edges of pavement, or other drainage features. Collector Sewers transport wastewater directly from property service connections. Changes in land use can have a significant impact on the quantity of flow to a collector sewer. For this reason, collector systems shall be designed to transport the saturation flows of the service area, except as otherwise required by Integra Water.

Deviations from the above, such as the routing of collector sewers along rear lot lines, shall be presented to Integra Water and considered on a case-by-case basis. Integra Water reserves the right to reject any layout or design of any sanitary sewers within its service areas.

Any facilities not specifically covered herein shall be presented to Integra Water for its approval. It is recommended that Integra Water be contacted prior to detailed design to discuss specific requirements.

Preliminary discussions concerning pump station design are encouraged before preparation of preliminary plans so specific design requirements can be established. It is imperative that the pump station design not only incorporates the specific requirements within a subdivision but also incorporates the overall requirements given the pump station's location within Integra Water's entire wastewater collection system. Sewage pumping stations, if needed, to be coordinated with Integra Water for criteria, design, construction, and cost responsibilities prior to preparation of the preliminary plans and such prior coordination confirmed on the plans. Integra Water does not represent itself as an engineer and does not warrant the design or sufficiency of any pump station designs. The engineering and design of pump stations is solely the responsibility of the designing engineer. Any developer or contractor should look to the designing engineer for any concerns related to the design or engineering associated with the pump station.

Pipe Material shall be as designated on approved construction drawings and shall conform to applicable specifications included in Section 2 of these Standard Specifications. The Engineer shall, therefore, designate pipe materials on all construction drawings.

1.5 PERMITS

Before beginning any construction, the Developer and/or Contractor shall obtain all necessary permits as required by all Regulatory Authorities.

1.6 EASEMENTS

Installation of sanitary sewer facilities to be maintained by Integra Water shall be constructed within dedicated rights-of-way and sanitary sewer easements if available. Permanent easements for sanitary sewers shall be a minimum width of 20 feet and dedicated to Integra Water at no cost. If no existing easements are available for the proposed sewer, easement plats must be surveyed and prepared by a licensed professional land surveyor and submitted to Integra Water. These documents must include a legal description of the easement(s), legal owner's name, and Deed Book and Page. A licensed professional land surveyor must stamp easement plats. All easement plat submittals (hard copies and digital copies) shall meet the requirements of the Land Acquisition Department.

Special easements such as Railroad Crossings, Tennessee Valley Authority (TVA) crossings, and State Highway crossings will require special permitting. The Design Engineer shall be required to submit copies of the plans showing crossings to the appropriate agencies and obtain all necessary permits.

Table 1.3 displays the standard minimum permanent easement requirements for different size sewer pipe. Written approval from Integra Water shall be required for additional permanent easement or for decreasing permanent easement widths. The Contractor is required to conduct work in accordance with all safety requirements set by OSHA and all other regulatory agencies.

Table 1.3
Easement Widths

Pipe Diameters	Minimum Width Permanent Easement*	
2" through 6"	10 ft	
8" through 24"	20 ft	
24" through 54"	30 ft	
60" and larger	50 ft	

*Additional permanent easement may be required on lines with depths greater than 8 feet. Integra Water shall determine this additional easement.

1.7 NOTIFICATION OF CONSTRUCTION

Integra Water should be notified at least 48 hours before construction is to begin for a pre-construction conference.

1.8 INSPECTION

All projects shall be subject to inspection during and upon completion of construction by an authorized representative of Integra Water. Inspection may consist of full-time resident inspection or part- time inspection at the sole discretion of Integra Water. The presence or absence of the inspector during construction does not relieve the Developer and/or Contractor from adherence to approved plans and specifications. The work shall, always, be subject to the inspection of authorized representatives of Integra Water and materials and/or workmanship found not meeting requirements of approved plans and specifications shall be immediately brought into conformity with said plans and specifications. An authorized representative of Integra Water shall make a final inspection of the project after completion to determine the acceptability of the work. Before this final inspection can be made, the Engineer responsible for the project shall notify Integra Water in writing that the work has been completed in accordance with approved plans and specifications.

The intent and desire of Integra Water is that all developments be constructed in such a manner and under such supervision and inspection that Integra Water may be assured that acceptable materials are used, and appropriate construction standards observed.

The following will be conditions of acceptance of the constructed project:

- A mandatory Pre-Construction Conference at an agreed upon time, location, and date will be held with Integra Water's personnel at least 2 days prior to the beginning of construction activities. Integra Water will establish the date, time, and location of the Conference.

  During construction, the Design Engineer will be responsible for communicating with the Integra Water Representative on any anticipated changes to the Plans. Changes must be approved by Integra Water.

- Acceptable testing has been completed.
- Final plat depicts true and accurate information in conformance with the outlined specifications.
- As-builts in .pdf and .dwg format have been provided to Integra Water
- All required fees have been paid to Integra Water
- All agreements between the developer and Integra Water have been executed and recorded with the county.

1.9 FINAL ACCEPTANCE

The "As-Built" drawings shall be completed by the Developer's Engineer and show the final location of sewer lines, lift stations, valves, service lines, and other items appurtenant to the system. "As-Built" drawings shall be sealed by a registered surveyor or the engineer of record. Two (2) sets of "As-Built" drawings , one in .pdf format and one in .dwg format, shall be submitted to Integra Water before final acceptance of the work is made. Integra Water will review the prints and, if acceptable, will sign the final plat for acceptance.

Final acceptance by Integra Water will be made in writing upon satisfactory completion of the project including final inspection, acceptable testing, and acceptance of "As-Built" drawings and payment of all fees due. The Developer shall guarantee the work for a period of one (1) year from the date of 25% of the dwellings in the community being completed and shall immediately correct any deficiencies in the work due to materials and/or workmanship, which occur during the guarantee period.
Integra Water will assume the maintenance and repair of the Development's sewage collection system located in the dedicated sanitary sewer easements or right-of-ways after the conclusion of the developer's one (1) year warranty period.

1.10 DISCHARGE PROHIBITIONS

No user, person, firm, or corporation shall contribute or cause to be contributed, directly or indirectly, any pollutant or wastewater which will interfere with the operation of performances of the Wastewater Treatment Plant (WWTP). These general prohibitions apply to all such users or WWTP whether the user is subject to Nation Categorical Pretreatment Standards or any other National, State, or local Pretreatment Standards or Requirements. A user may not contribute the following substances to any WWTP:

- Any liquids, solids, or gases which by reason of their nature or quantity are, or may be, sufficient either alone or by interaction with other substances to cause fire or explosion or be injurious in any other way to the WWTP or to the operation of the WWTP. At no time shall two successive readings on an explosion hazard meter, at the point of discharge into the system (or at any point in the system), be more than five percent (5%) nor any single reading over ten percent (10%) of the Lower Explosive Limit (LEL) of the meter. Prohibited materials include, but are not limited to: alcohols, aldehydes, benzene, bromates, carbides, chlorates, commercial solvents, ethers, fuel oil, gasoline, or any hydrocarbon derivatives, hydrides, kerosene, ketones, mineral spirits, motor oils, naphtha, perchlorates, peroxides, sulfides, toluene, xylene, and any other substances which Integra Water, the State, or Environmental Protection Agency (EPA) has notified the User is a fire hazard or a hazard to the system.

- Any pollutants which will cause corrosive structural damage to the WWTP (in no case with a pH less than 6.0 or higher than 10.0) or wastewater having any other corrosive property capable of causing damage or hazard to structures, equipment, and/or personnel of the WWTP, unless the WWTP is specifically designed to accommodate such wastewater (see exceptions below).

- Solid or viscous substances in amounts which may cause obstruction to the flow in a sewer or other interference with the operation of the WWTP such as, but not limited to: garbage not properly shredded or garbage with particles greater than on-half inch in any dimension, ashes, cinders, animal entrails, paunch, manure, offal, bones, hair, hides or fleshings, whole blood, beer or distillery slops, feathers, sand, lime residues, stone or marble dust, metal, glass, straw, grass clippings, rags, spent grains, spent hops, waste paper, wood, plastics, fiberglass, paint, or ink residues, gas, tar, asphalt residues, chemical residues, residues from refining or processing of wastes.

- Any water or waste which contains more than 100 parts per million (ppm), (by weight) of animal or mineral fats, oil, grease; or any water of waste which contains a substance that will solidify or become viscous at temperatures between 32º F and 90º F. The installation and operation of any garbage grinders equipped with a motor of three-fourths horsepower or greater shall be subject to the review and approval of the Integra Water Superintendent.

- Any pollutants, including oxygen-demanding pollutants (Biochemical Oxygen Demand, etc.) released at a flow and/or pollutant concentration that will cause interference to Integra Water. In no case shall a discharge have a flow rate or contain concentration or qualities or pollutants that exceed for any time period longer than fifteen minutes, more than five times the average twenty- four-hour concentration, quantities, or flow during normal operation of the discharger's facility.

- Any wastewater having a temperature that will inhibit biological activity in the WWTP resulting in interference, but in no case wastewater with a temperature at the introduction into the WWTP plant which exceeds 40º C (104º F). Unless a higher temperature is allowed in the user's State Indirect Discharge permit, no user shall discharge into any sewer line or appurtenance of the WWTP wastewater system with a temperature exceeding 65.6º C (150º F) (see exceptions below).

- Any wastewater containing toxic pollutants in sufficient quantity, either singly or by interaction with other pollutants, to injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, create a toxic effect in the receiving waters of the WWTP, or to exceed the limitation set forth in a Categorical Pretreatment Standard. A toxic pollutant shall include but not limited to any pollutant identified pursuant to Section 307(a) of the Act. No Total Toxic Organics, Poly Peptides, or Volatile Organic Compounds shall be discharged into the sewer system without written notification to the Superintendent. A complete list of all such compounds and the amounts of each discharged to the WWTP shall be delivered to the Sewer Superintendent once each calendar quarter, four times a year.

- Any noxious or malodorous liquids, gases, or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance, which being conveyed through the sanitary sewer and at the WWTP operating in its normal mode, as defined by State law, or hazard to life or are sufficient to prevent entry into the sewers for their maintenance and repair.

- Any substance which may cause the WWTP's effluent or any other product of the WWTP such as residues, sludges, or scums, unusual concentrations of inert suspended solids, to be unsuitable for reclamation and reuse or to interfere with the process where the WWTP is pursuing a reuse and reclamation program or to cause undue additional labor and materials in connection with its operation. In no case shall a substance discharged to the WWTP cause the WWTP to be in non-compliance with sludge use or disposal criteria, guidelines, or regulations affecting sludge use or disposal developed pursuant to the Solid Waste Disposal Act, the Clean Air Act, the Toxic Substances Control Act, State criteria applicable to the sludge management method being used or any future Federal regulation.

- Any substance that will cause the WWTP to violate its National Pollution Discharge Elimination System (NPDES)and/or State Disposal System Permit or the receiving water quality standards.

- Any wastewater with color sufficient to increase the color in the receiving stream by more than 50 American Dye Manufacturers Institute (ADMI) units at the design flow rate of the WWTP when the receiving stream is at the calculated 7Q10 rate of flow.

- Any liquid or wastewater containing quantities of radioactive waste in excess of presently existing or subsequently accepted limits for drinking water as established by applicable State or Federal regulations.

- No statement contained in this article shall be construed as preventing any special agreement or arrangement between Integra Water and any industrial concern whereby an industrial waste or unusual strength of character may be accepted by Integra Water for treatment, subject to payment therefore, by the industrial concern, as long as the Integra Water operation complies within the NPDES limits authorized by EPA and the State Regulatory Authority.

- BOD and Total Suspended Solids (TSS) influent concentrations limits shall be set at 250 mg/l each at the point of discharge to Integra Water collection system. The concentration of BOD and TSS shall not exceed these limits when averaged over a three-day period to be determined by Integra Water. Sampling to determine an average value shall consist of six samples total taken over a three-day period. Two samples shall be taken during a 24-hour period, with one sample being obtained during the peak flow hour and a second sample taken during the low flow hour. The final value will be calculated as an average of the six sample values obtained in the seventy- two-hour period.

Exceptions to General Discharge Prohibitions

If the waste is to be conducted by an industrial interceptor directly into the WWTP plant that was designed to accept and treat waste of very high pH, then it is the option of Integra Water to consider such installation and service.

If arrangements are made to provide an industrial interceptor directly to the WWTP plant for such wastes above 104 F, Integra Water has the option to consider such application for service and allow the issuance of the proper permit subject to other agency restrictions.

Industrial Waste Pretreatment

All persons desiring to discharge industrial wastewater to the WWTP must first complete an industrial waste questionnaire and submit the questionnaire to the Engineer for review. If, after review by the Engineer and the Regulatory Authority as noted in the agreement, the industry is found to be subject to the Federal or State pretreatment program, then that person must obtain a State Indirect Discharge (SID) Permit.

All persons discharging industrial wastewater directly or indirectly to the WWTP prior to the effective date of the ordinance from which this section is derived and who have obtained prior approval of the industrial wastewater discharge, must complete the industrial waste questionnaire as required under Section II of the agreement. If, after review by the Superintendent and the Regulatory Authority as noted in the agreement, the industry is found to be subject to the federal and state pretreatment program, then that industry must obtain a SID Permit within the required time frame established by EPA and the Regulatory Authority.

These regulations adopt and use as a guide the national pretreatment standard and the Environmental Protection Agency's pretreatment guidelines. Integra Water recognizes that in some cases these pretreatment standards may not be sufficient to protect the operation of its treatment works or make is unable to comply with terms of its NPDES permit. In such cases, the Superintendent reserves the right to impose more stringent pretreatment standards than those specified in the EPA regulations and required by the State Regulatory Authority.

Prohibitions on Storm Drainage and Groundwater

Storm water, groundwater, rainwater, street drainage, roof top drainage, basement drainage, subsurface drainage, yard drainage, uncontaminated cooling water, unpolluted industrial process waters, shall not be discharged through direct or indirect connections to a community sewer unless a storm sewer or other reasonable alternative for removal of such drainage does not exist, and then only when such discharge is permitted by the User's SID Permit and the appropriate fee is paid for the volume thereof.

Sanitary wastewater shall not be discharged into storm sewers.

Storm water and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as storm sewers, or to a natural outlet approved by the Regulatory Authority to a storm sewer, or natural outlet.

National Categorical Pretreatment Standards

Certain industrial users now or hereafter shall become subject to National Categorical Pretreatment Standards promulgated by the EPA specifying quantities or concentrations of pollutants or pollutant properties that may be discharged into the WWTP. All industrial users subject to a National Categorical Pretreatment Standard shall comply with all requirements of such standard and shall also comply with any additional or more stringent limitations contained in this Article.

State Requirements

State requirements and limitations on discharges shall apply in any case where they are more stringent than Federal requirements and limitations or those in these Rules and Regulations.

Excessive Discharge

No user shall ever increase the use of process water or attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in the National Categorical Pretreatment Standards, or in any other pollutant specific limitation developed by Integra Water and the State/Federal Regulatory Authority. Where necessary in the opinion of the State/Federal Regulatory Authority, equalizing may be required to bring constituents or volume to an acceptable level and to hold or equalize flows such that no peak flow conditions may interfere with the WWTP. Said equalization or holding units shall have a capacity suitable to serve its intended purpose, as stated above, and be equipped with acceptable outlet control facilities to provide flexibility in operation and accommodate changing conditions in the waste flow.

All users of the sewer system and WWTP shall limit the peak daily volume of infiltration and inflow to not more than 75 percent of the average daily waste flow.

Accidental Discharges

General

In the case of accidental discharge, it is the responsibility of the user to immediately notify Integra Water of the incident. The notification shall include: (1) location of the discharge, (2) type of waste, (3) concentration and volume, and (4) corrective actions.

Written Notice

Within five (5) calendar days following an accidental discharge, the user shall submit to the Superintendent and the Regulatory Authority a detailed written report describing the cause of the discharge and the measures to be taken by the user to prevent similar future occurrences. Such notification shall not relieve the user of any expense, loss, damage, or other liability which may be incurred because of damage to the WWTP, fish kills, or any other damage to person or property; nor shall such notifications relieve the user of any fines, civil penalties, or other liability which may be imposed by this Article or other applicable law. Violation of this provision shall constitute a misdemeanor, punishable as provided in Section 8.5 of the Code of Integra Water.

Notice to Employees

A notice advising employees to call Integra Water in the event of a discharge of any of the substances enumerated in Article 1.10 shall be permanently posted on the user's bulletin board or other prominent place.

ARTICLE 2 - MATERIALS

2.1 GENERAL

All materials to be incorporated in the project shall be first quality, new and undamaged material conforming to all applicable portions of these Specifications.

The Contractor will furnish all Materials, unless otherwise indicated on the Plans or in the Special Conditions.

All sanitary sewers shall be constructed of the following types of pipe:

- Sanitary sewers 12 inches in diameter and smaller shall be constructed of ductile iron sewer pipe or PVC sewer pipe, except as specified below. In addition, low pressure force main may also be constructed of HDPE SD11. PVC sewer pipe shall be allowed where the pipe slope is less than or equal to 12.00% and the cut is less than or equal to 14 ft. If the slope is greater than 12.00% or the cut is greater than 14 ft., ductile iron sewer pipe shall be used. "Cut" is defined as the vertical distance from the finished ground, or surface, to the invert of the pipe.

- Sanitary sewers from 14 inches to 21 inches in diameter shall be constructed of ductile iron sewer pipe, except as specified below in "h" below.

- Sanitary sewers 24 inches in diameter and larger shall be constructed of ductile iron sewer pipe or reinforced concrete sewer pipe with steel end ring joints.

- Sanitary sewers crossing, creeks or ditches shall be ductile iron pipe or encased by steel casing pipe

- Sanitary sewers with less than 4 ft. of cover shall be ductile iron pipe.

- All sanitary sewers shall have a minimum cover of 3 feet (36"). Special cases will require approval from Integra Water. Trench bedding and backfill requirements shall be per Integra WasteWater Standard Details.

- When shown on the Plans or specified in the Special Conditions, sanitary sewers shall be constructed of the material called for or specified at the locations indicated. Casing pipe shall be installed where specified or shown on the Plans.

- Listed in Table 2.1 are several general ways to determine which pipe material is best suited for a particular project. Reinforced ductile iron pipe, and polyvinyl chloride pipe are the Integra Water accepted sanitary sewer pipe materials. Use of all other pipe materials must have prior written approval from Integra Water. All gravity and force main piping specified below shall be bedded per Integra Water standard details. The same pipe material shall extend from manhole to manhole. No pipe material changes will be allowed between manholes. The minimum design criteria for each pipe material are discussed below.

Table 2.1
Pipe Material Selection

No.	*Laying Condition*	Required Pipe Material to Specify*
1	For grades less than 0.60%	DIP or PVC
2	For grades from 0.60% to 12.00%	DIP or PVC
3	For grades from 12.00% to 20.00%. **	DIP with no anchors.
4	For grades from 20.00% to 34.00%. **	DIP with anchors required each 36 feet center to center.
5	For grades from 35.00% and up to 50.00%. **	DIP with anchors required each 24 feet center to center.
6	For grades greater than 50.00%. **	DIP with anchors required each 16 feet center to center.
7	For areas where proposed pipe is to be within filled areas.	DIP or PVC
8	For areas where proposed sewer is at depths greater than 15 feet.	DIP *Note: Any service risers to DIP from this depth shall also be DIP.*
9	For areas within backyard and side lot utility and drainage easement or other difficult to access areas.	DIP
10	For crossing ditches and/or streams.	DIP (reinforced concrete encasement shall be required if minimum cover is less than 3 feet) see standard drawing
11	For crossing existing pipe and roadways.	DIP or PVC (steel encasement may be required on certain projects.)

*All pipe materials shall meet minimum requirements as specified in these Specifications.

**The surface area is to be stabilized for grades in excess of 12% (sod, etc.). Steep grades that produce pipe velocities greater than 10.0 fps will require prior approval from Integra Water.

Table 2.2
Ductile Iron Pipe (DIP)

Pipe Size	Minimum Pressure Class
Up to and including 12”	350
14” up to and including 24”	250
Greater than 24”	150
Above Ground Pipe – Up to 12” and including	350
Above Ground Pipe – Greater than 12”	250

2.2 DUCTILE IRON PIPE

Ductile iron pipe shall be centrifugally cast and manufactured and tested in accordance with ANSI/ASTM A 746. Pressure class (wall thickness) will be as indicated in Table 2.2. Each pipe shall be hydrostatically tested before shipment to a minimum pressure of 500 pounds per square inch for a minimum duration for not less than 15 seconds.

All ductile iron pipe and fittings shall have a cement-mortar lining of standard thickness conforming to the requirements of ANSI/AWWA C104/A21.4, unless otherwise specified, and a standard bituminous outer coating meeting the requirements of ANSI/AWWA CI5I/A21.51.

Joints for ductile iron pipe shall be push-on type such as Fastite, Tyton, or Super Bell-Tite or approved equal unless mechanical joints are specified. Joints shall be manufactured and tested in accordance with ANSI/AWWA C111/A21.11.

Where mechanical joints are required for ductile iron pipe, they shall conform to ANSI/AWWA C111/A21.11.

Unless otherwise specified, push-on joint fittings shall be used for service tees and shall be manufactured in accordance with ANSI/AWWA C110/A21.10. As an alternate, mechanical joint fittings may be used conforming to the requirements of Section 3.0213.

Cast iron fittings may be used at the option of the Owner if ductile iron fittings are not available. Cast iron fittings will comply with ANSI/AWWA C110/A21.10 or MJ Compact Fittings AMSI/AWWA C153/ A21-53 for 350 psi, with mechanical joints for 150 psi working pressure.

For ball and socket joints, the bell, ball, and retainer shall be ductile iron, Grade 70-50-05, conforming to the requirements of ANSI A21.11.

Joints for flanged pipe shall conform to the requirements of ANSI/AWWA C111/ A21.11.

Adapters from ductile iron pipe to flange joint valves or fittings shall be cast iron ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110/A21.10. Design and manufacture adapters for a pressure rating of 150 psi. Adapter ends connecting to ductile iron pipe shall have a plain ends, push-on joints, mechanical joints, or restrained push-on joints. Mechanical joints and push- on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained joint shall be Lok- Fast, Lok- Tyte or equal. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.

Nuts and bolts for mechanical joints shall be high strength, heat treated, and cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

The Contractor shall provide manufacturers' certifications that all ductile iron pipe and fittings meet provisions of this section and meet requirements of ANSI A21.51 (AWWA C-151). Product certification shall include tensile and Charpy test results which shall be traceable to pipe numbers and testing periods. For pipe sizes 18 inches and greater, hydrostatic test charts including pipe numbers for each test cycle shall be furnished as part of the certification test reports. Chemical analysis shall be furnished for each ladle of iron, which will cover each pipe cast and must correlate with the mechanical test results. For pipe sizes 18 inches and greater, complete traceability is required throughout the certification process and must be clearly legible on each pipe at the point on installation.

The Contractor shall provide certifications that all pipe joints have been tested and meet requirements of ANSI A 21.11 (AWWA C-515).

Each pipe in the size range or 4"-16" shall receive a hydrostatic proof test of 500 psi for a minimum duration of 15 seconds. Each pipe in the size range or 18 inches and greater shall receive a hydrostatic test not less than 85% of the specified minimum yield strength for duration of not less than 15 seconds. Each test cycle shall be recorded on a strip chart. Each test cycle for pipe 18 inches or greater shall be marked by pipe number. Each pipe shall be inspected for leaks. Pipes that contain evidence of hydrostatic leak shall be scrapped. Repair welding of hydro-leaks is not permitted.

Tensile test specimens shall be cut longitudinally from the midsection of the pipe wall. These specimens shall be machined and tested at least every three hours in accordance with ASTME-8 and ASTM A-370 where applicable, using the 2% offset method. Brinell hardness tests shall be performed at the same frequency as the tensile test and shall meet a maximum Brinell hardness of 230. Pipe failing to meet the minimum requirements of these standards will be rejected. Adjacent test samples shall be made available to the Owner's independent laboratory upon Owner's request.

Charpy impact samples shall be taken during each hour of production. Samples shall be selected to properly represent extremes of pipe diameters and wall thickness. Impact tests shall be conducted in accordance with ASTM E-23. Impact strengths on samples shall be 8 ft.-lb minimums for tests conducted at 70º F +/-10. In addition, adjacent specimens shall be taken and made available to the owner's laboratory for independent testing upon Owner's request.

Each end of each pipe (each pipe socket and pipe spigot) shall be measured and shall conform to the standard dimensions of ANSI A-21.51 (AWWA C-151). In addition, each socket and spigot shall be inspected in a well-lighted area for injurious defects, which could affect joint performance. Such defects may be removed by cutting off pipe ends. Pipe with injurious defects in the bell must be scrapped.

2.3 POLYVINYL CHLORIDE (PVC) PIPE

All polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM specification D3034 (SDR 26 for gravity sewers & SDR21 for offsite force mains), Type PSM. Gaskets shall meet the requirements of ASTM F477. Pipe joints shall meet the requirements of ASTM D3212.

The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13364-B, with a minimum tensile modulus of 500,000 psi as defined in ASTM D1784. Fittings shall be made of DIP fittings.

PVC sewer pipe shall be available in standard laying lengths of 13' and 20'.

Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.

PVC pipe shall be made and joined with an integral bell, bell-and-spigot rubber-gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket conforming to ASTM D3212.

Pipe shall be clearly marked as follows at intervals of 5 ft. or less:

- Manufacturer's name or trademark and code
- Nominal pipe size
- PVC cell classification; for example, 12454-B
- The legend "Type PSM SDR-21/26 PVC Sewer Pipe"
- The designation "Specification D3034"
- The date of manufacture

Fittings shall be clearly marked as follows:

- Manufacturer's name or trademark
- Nominal size
- The material designations "PVC", Type PSM
- The designation "Specification D3034"

Pipe shall be stored in such a manner as to be protected from direct sunlight and heat, and shall not be subjected to trench loads when temperature of the piping material is above 80 degrees F.

PVC pipe shall be supplied in maximum lengths of 20' unless otherwise specified and shall be furnished with integral bell and spigot push on joints. Gaskets shall be locked in. Any couplings jointed to the pipe by the solvent weld process must be applied at the factory. The same company must manufacture both the pipe and the coupling.

- Class 200 pipe shall conform to SDR 21.
- Class 250 pipe shall conform to SDR 17.
- Class 315 pipe shall conform to SDR 13.5.

2.4 MISCELLANEOUS PIPE

Pipe for Flow Diversion

Pipe specified in Sections 2.2 and 2.3 are acceptable for use for sewer flow diversion during construction. Additionally, the following specified pipe may be used:

- Plain concrete 24 inches or less in diameter (or equivalent area in arch pipe) will be permitted. Circular pipe shall meet the requirements for Class 2 pipe of AASHTO M-86 or for Class II of AASHTO M 170 without steel reinforcement, provided the same strength requirements for the same size pipe provided in AASHTOM-86 for Class II pipe are met. Arch or HE pipe equivalent to a 24-inch diameter round pipe or less shall meet the requirements for Class A-II of AASHTO M-206 or Class HE II of AASHTO M-207 without steel reinforcement provided the same strength requirements of the equivalent size circular pipe provided in AASHTO M-86 for Class II pipe are met.

- Polyethylene pipe will be allowed for flow diversion. Polyethylene material shall comply with the requirements for Type III polyethylene, C-5 and P-34 as tabulated in ASTM D 1248 and have the Plastic Pipe Institute recommended designation PE3406. The material shall also have an average specific base resin density of between 0.94 g/cc and 0.955 g/cc (ASTM D l505). Pipe made from these resins must have a long-term strength (50 years) rating of l,250 psi or more per hydrostatic design basis categories of ASTM D 2837. The polyethylene resin shall contain antioxidants and be stabilized against ultraviolet degradation to provide protection during processing and subsequent weather exposure. The polyethylene resin shall have an environmental stress crack resistance, condition C as shown in ASTM D l693, to be greater than 500 hours, 20% failures. All pipe shall be made from virgin quality material. No rework compound, except that obtained from the manufacturers own production of the same formulation shall be used. The polyethylene resin shall have an average melt flow index, condition E as shown in ASTM D 1238, not in excess of 0.25 g/l0 min. Pipe shall be homogeneous throughout, and free of visible cracks, holes, foreign material, blisters, or other deleterious faults. Diameters and wall thickness shall be measured in accordance with ASTM D 2122. Pipe joining will be done by thermal butt fusion method in accordance with ASTM D 2657.

Acrylonitrile- Butadiene-Styrene (ABS) pipe will be allowed for flow diversion. ABS pipe shall comply with the requirements of ASTM D 2751.

2.5 CASING PIPE

Casing pipe shall be provided to enclose sewers where shown on the Plans. **All storm drain pipe crossings will have casing pipe**. Gauge shall be as shown on the Plans. The diameter of the casing pipe shall be not less than 4 inches greater than the largest outside diameter of the sewer, bell, or joints. The casing pipe shall be uncoated steel pipe meeting the minimum requirements of ASTM A36, with minimum yield strength of 35,000 psi. Casing pipe shall have a wall thickness of 0.250", minimum for all sizes 20" or smaller, 0.375 for sizes 24" through 36" and shall conform to ALDOT Section 862 for larger diameter.

Where pipe is to be installed under railroad tracks and in some cases where they are to be installed under paved highways, they shall be laid inside a casing pipe of the size specified. As a general rule, the locations and approximate lengths of the encasements are indicated on the Construction Plans, but the precise location, length of the encasement will be specified in the permit issued by the Railroad or Highway Department involved.

The casing pipe shall be new and be provided with continuous welded joints. The casing pipe shall be jacked through a hole of the proper size that has been previously bored for the purpose or be installed by excavating and installing liner plates as the hole is advanced. The continuous boring and jacking method may also install it.

Spacers shall be used on all casing installation. Spacers shall be APS Model SSI, SI or approved equal with fusion bonded epoxy or PVC coating. Spacers shall be located a minimum of every 10' of pipe length and shall be 8" wide for carrier pipe 6" to 14" in diameter and 12" wide for carrier pipe 16" in diameter and larger.

End seals shall be used on all casing installation. End seals shall be 1/8" thick synthetic rubber seamless pull-on end seals with T-304 stainless steel banding with 100% non-magnetic worm gear mechanism. End seals shall permit pipe movement while maintaining a seal.

2.6 CARRIER PIPE

In general carrier pipe for tunnels and bores will be ductile iron pipe in accordance with Section 2.2, unless specified otherwise in the Special Conditions. Carrier pipe will be push-on joint type or mechanical joint type as specified in the Special Conditions, Plans or Proposal Form.

2.7 POLYETHYLENE PIPE

Polyethylene pipe shall be utilized for all low-pressure sewers within subdivisions. Polyethylene pipe shall be DR 11 with a green stripe. The pipe shall be supplied in lengths not less than 40 feet long, of the size and wall thickness as shown on the plans and in the Special Specifications. The pipe shall be handled and installed in strict accordance with the recommendations of the manufacturer.

Polyethylene pipe used for pressure mains shall be PE 3408 high density, high molecular weight pipe, Driscopipe 1000. The pipe shall comply with ASTM D3350 having a cell classification of PE 345434C. Dimensions and workmanship shall comply with ASTM F714. Pipe sections shall be joined into continuous lengths on the job above ground by use of the butt fusion method performed in strict accordance with the manufacturer's recommendations. The butt fusion equipment shall be capable of meeting all conditions recommended by the pipe manufacturer.

2.8 TUNNEL LINER PLATE

Fabrication

Tunnel liner plates shall be the standard plates manufactured by Armco Drainage and Metal Products, Inc., Republic Steel Corporation or approved equal. Unless otherwise specified on the Plans, in the Special Conditions or in the agreement with the railroad company (or other government or utility). "Armco" plates shall be a minimum thickness of 12-gauge material and "Republic Steel" plates shall be a minimum thickness of 10-gauge material. A minimum section modulus of 0.0608 inches cubed per inch of plate width, average, is required.

The pipe shall be circular and shall consist of a series of steel liner plates assembled in circular rings with staggered longitudinal joints. The plates shall be fabricated in such a manner as to provide for the complete erection to be performed from inside the pipe. A sufficient number of plates shall be fabricated with two-inch diameter grouting holes with plugs spaced no more than 72" along the length of the liner plate so that the grouting may be done as the tunnel progresses. The shop fabrication shall include the punching of the plate for bolting on both longitudinal and circumferential joints. No field cutting, punching, drilling or reaming will be allowed. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

Plates shall be galvanized in accordance with ASTM A123 after they have been formed, punched and curved. After being galvanized the plates shall be dipped in a hot asphaltic bath at the factory to completely cover the inside and the outside of the plate.

Bolts 5/8 inch minimum, nuts and washers shall be galvanized in accordance with ASTM A153 and shall be coarse thread and shall conform to ASTM Specifications A307, Grade A, latest version.

Galvanized plates, bolts, nuts and washers shall be handled in such a manner as to prevent bruising, scaling or breaking of the spelter coating. All plates that are damaged during handling or placing or with damaged spelter coating shall be replaced by the Contractor at his expense except that small areas with minor damage or with field welds may be repaired by the following method. The loose and/or cracked coatings are to be completely removed and the damaged areas shall be painted with at least two coats of Zinc Dust-Zinc oxide paint conforming to Federal Specification TT-P-641.

Circumferential joints shall be flanged. Longitudinal joints may be flanged or lapped. The Manufacturer's Specifications concerning bolt sizes and strengths, bolt spacings, minimum number of boltsper joint, etc. shall be strictly adhered to.

The base metal for the tunnel liner plates shall conform to the Manufacturer's Specifications with which his standard plates are produced. The mechanical requirements for Tensile Strength, Yield Strength and Elongation that formed the basis of design for the Manufacturer's standard plates shall be met. Tension test specimens shall be prepared and tested in accordance with ASTM A245 for sheets and ASTM A283 for plates. Mill test reports for each heat and gauge shall be available to the Owner for review upon request.

The Manufacturer shall provide a certificate of compliance stating that the materials furnished comply in all respects to these Specifications. He shall provide written instruction for the assembly of the liner plates. He shall furnish, for the Owner's approval, a drawing showing a typical section of the tunnel, details of the plates, longitudinal and circumferential seam details, sizes, strengths, and lengths of all bolts and the section modulus (inches cubed per inch of width, average) for one ring of plates.

The inside diameter of the completed ring shall be as specified in the Plans and/or Special Conditions. No part of the plate or reinforcing ribs will be allowed to extend inside this net diameter.

Assembly shall be in accordance with the Manufacturer's written instructions.

2.9 CAST-IN-PLACECONCRETE

General

In general Class A concrete shall be formed, reinforced concrete having a 28-day minimum compressive strength of 3000 pounds per square inch. In general Class B concrete shall be non- formed, non- reinforced concrete having a 28-day minimum compressive strength of 3000 pounds per square inch. Other classes, types or design for cast-in-place concrete may be specified in the Plans or Special Conditions or approved by the Owner, as circumstances require.

Concrete Components
Concrete components shall conform to the minimum requirements of this Section.

Aggregates shall be crushed limestone conforming to the requirements of ASTM C33, except as further specified herein. Crushed limestone for coarse aggregate shall be a minimum size of ¾ inch, consist of uncoated particles of sound, durable rock of uniform quality, without an excess of flat, elongated or laminated pieces. No surface, yellow or soft stone, shall be permitted. The specific gravity of the stone shall be not less than 2.56.

Water used in concrete shall be potable water. A maximum of 500mg/l of chloride ion may be present in the water.

Sand used in concrete shall be natural sand consisting of clean, hard, durable, uncoated grains. Sands containing lignite are not acceptable for exposed architectural concrete.

Cement used in concrete shall be "Portland Cement" conforming to the requirements of ASTM C150, ACI301 and ACI 318. Type II cement shall be used unless otherwise specified.

Air-entraining admixtures if specified shall conform to the requirements of ASTM C260.

Water reducing agents and retarding admixtures shall meet the requirements of ASTM Specification C 494, Type A or Type D, except they shall contain no chlorides.

Water stops shall meet the requirements of Corps of Engineers CRD-C572. Water stops shall be seal tight No. 164, as manufactured by W.R. Meadows, Inc., Elgin, Illinois, or equal.

Mix Design
Concrete mix design for particular applications shall be submitted for approval in each case to Integra Water.

Reinforcing Material for Cast-in-Place Concrete
Reinforcing bars shall conform to the requirements of ASTM A615, A616, or A617. Reinforcing bars shall be grade 60 deformed bars, or as specified on the Plans.

Welded wire fabric or cold-drawn wire for concrete reinforcement shall conform to the requirements of ASTM A185 or ASTM A82, respectively.

Grout
Grout shall consist of a mixture of water and cement or water and one-part cement to two parts mortar sand, by volume. The water may be adjusted to produce a mixture suitable for job conditions.

Testing
Testing of cast-in-place concrete shall be in accordance with Section 6.16 Field Testing Concrete.

2.10 PRECAST CONCRETE MANHOLES

Unless specified otherwise in the Plans or Special Conditions all manholes will be precast concrete manholes as specified herein. All standard manholes shall be 4 feet (minimum) with a minimum compressive strength of 4750 psi at 28 days and shall meet the requirements of ASTM C-478. Larger diameter manholes will be allowed for larger pipes or as required to accommodate sharp changes in alignment or multiple pipes. Manhole sizes for pipes larger than 24 inches shall be verified with manhole manufacturer. All pipe-to-manhole connections shall use prefabricated flexible connectors such as Kor-N-Seal or approved equal. New manholes shall have pre-formed holes for pipe installation and existing manholes shall be cored to install pipe and connector. All pipe-to-manhole connections and grade adjustment rings shall be sealed and grouted with non-shrink materials as specified in the Integra Water Specifications. All lift holes except those in cone section shall also be grouted with the

non-shrink grout. Lift holes shall not penetrate the wall of the manhole. Manholes shall include a manhole lift system as specified in Integra Water Specifications. All manholes shall be backfilled and tested according to Integra Water Specifications.

The precast reinforced concrete manholes shall be constructed in accordance with ASTM C478. These manholes shall consist of circular precast concrete riser sections not less than 4'-0" in diameter and 16", minimum, sections. The precast concrete top section shall be eccentric cone shape and shall be suitable for mounting cast iron manhole frames and covers. All bases shall have monolithically-cast bottoms.

Reinforcing steel shall be bars of intermediate grade, open hearth, billet steel, conforming to ASTM A615, or Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A82; or of wire fabric conforming to ASTM A185. The circumferential reinforcement in the riser and conical top sections shall have an area of not less than 0.12 square inches per linear foot.

The interior and exterior surface of the manhole shall have smooth hard finish, and shall be free from cracks, chips and spalls.

Precast manhole riser joints shall be of the "push-on" type and shall be equipped with "O"-Ring rubber gaskets meeting the requirements of ASTM C443. Alternatively, gaskets may be of the prelubricated lip and compression seal type meeting the requirements of ASTM C443 and C361 such as the F-114 joint manufactured by Forsheda Pipe Seal Corporation, or of the butyl sealant type meeting the requirements of ASTM C-990 such as the ConSeal CS-202 joint manufactured by Concrete Sealants, Inc. In addition, all joints shall have either a butyl sealant material in rope form such as Ramnek, or an external joint wrap such as ConWrap CS-212. Inside of manhole at each seem shall be grouted with the non-shrink grout.

All components of a manhole for a particular location shall be clearly marked in order that the manhole may be correctly assembled to suit construction conditions existing at that particular location.

Steps, frames and covers shall conform to the requirements of Section 2.12.

Manholes shall have the following information clearly marked on each manhole section:

- MH and specification designation
- Date of manufacture
- Name of trademark of manufacturer

All manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. Any leakage in the manhole or structure, before, during, or after the test shall be repaired. A representative from Integra Water must be present for testing or the testing is null and void.

All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10 inches of mercury (hg) (5.0 psi) shall be drawn on the manhole, and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than what is shown in the following table.

Table 2.3
Vacuum Test Timetable

Depth-Feet	48 Inches	60 Inches	72 Inches	96 Inches
4	10 sec.	13 sec.	16 sec.	19 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.

+ Each 2’	+5 sec.	+6.5 sec.	+8.0sec.	+9.5sec.

Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.

If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

2.11 STRUCTURAL MATERIALS AND CASTINGS

Structural Steel
Structural steel shall conform to the requirements of ASTM A283, unless otherwise noted on the Plans.

Steel Castings
Steel castings shall conform to the requirements of ASTM A27. The grades to be used will be specified in the project special conditions or on the Plans.

Gray Iron Castings
Gray iron castings shall conform to the requirements of ASTM A48. All castings shall be clean and free of scale, adhesions or inclusions. They shall be completely coated as required. Gray iron castings for manhole or inlet frames and covers or gratings shall be cast from Class 30B cast iron. Bearing surfaces between manhole or inlet frames and covers or gratings shall be such that the cover or grating shall seat in any position onto the frame without rocking. Bearing surfaces for standard manhole frames and covers shall be machined.

Aluminum Castings
Aluminum castings shall conform to the requirements of ASTM B108.

Structural Aluminum
Structural aluminum shall conform to either ASTM B209, B221, B308, B241, or B211, as applicable. Finished bolts and nuts shall be given an anodic coating of at least 0.0002 inch in thickness.

Manhole Steps and Covers
Manhole frames and covers shall be made from American iron and made in the United States of America.

Frames and covers shall be made of cast iron. All castings shall be made accurately to the required dimensions and shall be sound, smooth, clean, and free from blisters and other defects. Defective castings, which have been plugged or otherwise treated, shall be rejected. Manhole frames and covers for sanitary sewers shall conform to the Integra Water standard frame and cover as shown in the Standard Details. Storm sewer inlet and manhole castings shall comply with the standard drawings or as called for in the Plans. The contact surfaces between the cover and its corresponding supporting ring in the frame shall be machined so that the cover will rest on the ring for the full perimeter of the contact surfaces. Castings shall be thoroughly cleaned of foreign matter and rust and shall be painted with a bituminous coating. There shall be no holes or perforations in the manhole cover.

Manhole frames and covers shall conform to ASTM A48, and have asphalt dip coating that shall be smooth, tough, and non-tacky. Frames and covers shall be as manufactured by John Bouchard & Sons Company Model 1150 or Model 1065, or approved equal, as called for on the Plans.

Manhole and inlet steps shall be made of steel reinforced plastic. Plastic manhole steps shall be polypropylene coated steel reinforcing rods in accordance with the Standard Details with rod and pull- out ratings meeting OSHA standards. Steps shall be Model PS-1, as manufactured by M.A. Industries, or approved equal.

Brick
Brick shall comply to the following requirements for which its use is intended. Bricks with holes through them will not be allowed in the work.

Sewer brick shall conform to ASTM C32 for grade SM. Brick used for lining of channels shall conform to ASTM C32 for grade SS. Bricks shall conform to the following dimensions, unless otherwise approved by the Board:

Table 2.4
Sewer Brick Dimensions

Brick Type	Depth (Inches)	Width (Inches)	Length (Inches)
Standard Size	2-1/4	3-3/4	8
Allowable Variation	+1/4	+1/4	+1/2

All brick shall be new and whole, or uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws and shall have a clear ring when struck together. No soft or salmon brick shall be used in any part of the work. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by Integra Water.

Building brick shall conform to the requirements of ASTM C62, Grade MW, with dimensions as required in the project special conditions or on the Plans.

Facing brick shall conform to the requirements of ASTM C216, Grade MW, Type FBS, with dimensions as required in the project special conditions or on the Plans.

Masonry Blocks
Masonry blocks shall conform to the requirements of ASTM C62, Grade N, Type I or II, for hollow load bearing blocks.

Mortar
Mortar shall be prepared only in the quantities needed for immediate use. Mortar which has been mixed for more than 30 minutes or which has set or has been re-tempered shall not be used in the work.

2.12 POLYETHYLENE ENCASEMENT

Polyethylene encasement for ductile iron pipe shall conform to the requirements of ANSI/AWWA C105/A21.5. Installation of the polyethylene encasement shall be by Method A or Method B; Method C installation will not be allowed.

All fittings shall be wrapped in 6 mil polyethylene encasement extending 6" beyond connection in accordance with AWWA C105.

2.13 IMPROVED SURFACE REPLACEMENT

Asphalt Pavement
In replacing pavements and unpaved surfaces, the materials used, and the construction methods employed shall comply with the applicable requirements of the standard specifications of Integra Water, or the appropriate governing authority.

Concrete Pavement
Concrete for pavement shall be Class A.

Curb and Gutter
Concrete for curb, curb and gutter or valley gutter shall be Class A.

Sidewalks
Concrete for sidewalks shall be Class A.

Driveways
Concrete for driveways shall be Class A.

2.14 RESTRAINED JOINTS

Where restrained joint pipe and fittings are required, flexible push on restrained joint ductile iron pipe and fittings shall be used. All restrained joints shall be suitable for a 350 psig working pressure. Ductile iron locking segments, inserted through slots in the bell face, shall provide a positive axial lock between the bell interior and a retainer weldment on the spigot end of the pipe.

Unless otherwise specified, restrained joints shall be US TR-Flex, McWane, Fastite, American Flex Ring, or other approved equal. Restrained joint gaskets may be used with approval of the Engineer. Restrained joint gaskets shall conform to AWWA C111.

2.15 MILL CERTIFICATES

Mill certificates showing the results of hydrostatic pressure tests made on all types of pipe as required by the manufacturer's specifications shall be furnished.

Thrust restraints shall be 2500 psi concrete poured in place against undisturbed soil unless otherwise approved by the engineer. The design engineer shall submit a detail of thrust restraint with the plans and shall note the volume and size of each individual thrust restraint on the plans.

2.16 FITTINGS AND COUPLINGS

Unless otherwise indicated on the Construction Plans or directed by Integra Water, fittings shall be of the same material as the pipeline in which they are to be installed. The fittings for a PVC sewer force main may be cast iron with mechanical joints. Fittings shall be furnished with joints of the same type used throughout the rest of the pipeline unless such joint shall not be available and Integra Water or his authorized representative should approve a substitute type joint. Fittings shall be of the type indicated on the Construction Plan and shall be the manufacturer’s standard conforming to all applicable standard specifications and dimensional tolerances appropriate for the material of construction. Approved type commercial couplings shall be used in making transitions from one type material to another.

To facilitate the cleaning of the line by “pigging”, tees and 90- degree fittings shall not be installed anywhere on pressure mains located outside of the pump station site.

Ductile iron fittings with retainer glands shall be provided. Ductile iron fittings 24" and smaller shall be rated for 350 psi working pressure, and fittings larger than 24" shall be rated for 250 psi working pressure. Fittings shall be manufactured in accordance with AWWA C153 and provided with mechanical joints, unless otherwise indicated. All fittings shall be provided with a thin cement lining in accordance with AWWA C104.

2.17 FLANGES

Flanges shall conform to the dimensions shown in Table 10.14 of AWWA C110 and shall be adequate for a working pressure of 250 pounds. The bolt circle and bolt holes of these flanges shall match those of the Class 125 flanges shown in ANSI B161. Gaskets shall be of 1/8" thick rubber. Machine bolts shall be of high strength steel and shall have hexagon heads and nuts.

2.18 PIPELINE DETECTION TAPE AND TRACER WIRE

All force mains, pumped sewer lines and sanitary sewer service lines from service junction box to low pressure force main shall be marked by laying a warning tape in the ditch above the line. Gravity sewer mains and sanitary sewer service lines shall also be marked by laying a warning tape in the ditch above the line. The tape shall be color-coded and labeled to identify that the line is a sewer line and shall be manufactured by Alarmatape, Allen Systems, or equal. Tape shall be within one foot of finish grade and shall be at least six inches wide.

A detection wire shall be installed with all force mains. Wire shall be installed with the pipe at the trench bottom and stubbed at each service connection, valve and clean-out assembly. The wire shall be 14 gauge insulated copper wire, commonly called “bell wire.” The wire shall be made accessible by extending up into each valve box installed along the main.

Fiberglass markers shall be placed along the centerline of all force main and off site gravity installations. Markers shall be placed at a spacing of no more than 400 feet apart and at each change in direction of the force main or off site gravity line. The concrete markers shall denote: SANITARY SEWER FORCE MAIN, INTEGRA WATER.

Markers are not necessary for gravity sewer installations within a development. The presence of manholes shall be evidence of gravity sewer locations.

2.19 VALVES

All valves shall be furnished with a valve box. Valves covers shall be encased within a 24” x 24” x 6” thick concrete encasement.

Valves for use with ductile iron pipe shall have mechanical joint end connections unless otherwise shown. Valves used with PVC pipe shall be equipped with end connections and transition gaskets especially made for this type of pipe.

Gate valves shall be iron body, brass mounted, epoxy coated interior and exterior, and be of the resilient seat type. Gate valves shall have a non-rising stem, "0 ring" stem seal, a square operating nut (2") and shall open by turning counterclockwise. Gate valves thru 12" diameter shall be manufactured in accordance with AWWA C509. Gate valves 12" and smaller shall be suitable for a working pressure of 200 psig and shall be tested to 400 psig.

Gate valves larger than 12" diameter shall conform to AWWA C500 and C504. Gate valves larger than 12" shall be suitable for a working pressure of 150 psig and shall be tested to 300 psig.

Tapping valves shall be non-rising stem. Working pressure for 2"-12" valves shall be 200 psi with 400 psi test pressure. For valves greater than 12", the working pressure shall be 150 psi with test pressure of 300 psi. Valves and sleeves shall be cast tapping SCV’s and valves shall be air tested for duration of 10 minutes and 90 PSI.

Valves shall be manufactured by American, M & H, Clow, Mueller, or approved equal.

For offsite force mains, combination air release/ air vacuum valves shall be ball type valves to be field located at high points in the sewer main. The valve shall operate through a compound lever system and shall have an orifice with valve sealing faces of an adjustable BUNA-N rubber valve and stainless steel and shall operate at 150 psi . The valve shall be NPT screwed of ANSI Class (125,250) flanged inlet connection and shall be cast iron body, top and inlet flange (where required), stainless steel float and trim. Valves that use a needle valve to seal the orifice will not be acceptable. The valve shall be Bermad Model C50 wastewater with a 2” inlet and outlet.

For low pressure force mains within subdivisions, combination air release/air vacuum valves shall be ball type valves to be field located at high points in the sewer main. Valve shall be composite with stainless

steel components with a 2” inlet and outlet.

The air release valve shall be connected to the top of the force main by means of a tap in the pipe. Service saddles must be used to connect the valve to the sewer main and shall be attached to the main sewer in such a way as to affect a permanent watertight joint. Services saddles shall be epoxy coated with double stainless-steel straps. The service saddle shall be JCM Model 406, or an approved equal.

The manhole in which the valve assembly is located shall be provided with a concrete footing and an earth bottom on which is provided layer of sand about 6" thick. The top of the sand bottom shall be approximately 12" below the bottom of the force main.

The air release valve shall be connected to the force main by a stainless steel tapping saddle with threaded 2" connection. Between the main connection and the air release valve a 2" shut off valve, ¾” threaded nipple and ball valve, and 1" blow off valve shall be furnished and installed.

After all work has been completed the Contractor shall make a careful inspection of all valves, either previously existing or new, which have been opened or closed during the course of the work, to make sure that all valves that should be opened are open and vice versa.

At the same time all valve boxes shall be inspected to make sure that they are still plumb, centered over the operating nut, at the correct elevation and the cover in position.

Resilient seat gate valves shall be iron body, machined surface, modified wedge disc, resilient rubber seat ring type valves with non-rising stems (NRS). Resilient seat gate valves shall have the bronze stem nut cast integrally with the cast iron valve disc. The valve shall have machined seating surface and capable of being installed and operated in either direction. Valves shall be furnished with mechanical joint ends in accordance with USA Standard A 21.11 unless otherwise shown or directed. Valves shall be suitable for installation in approximately vertical position in buried pipelines. Stem seal shall consist of O-ring seals. All valves shall open to the left (counterclockwise) and shall be provided with 2” square operating nut. All underground gate valves, which have nuts deeper than 30” below the valve box top, shall have extended stems with nuts located within one foot of the valve box cap.

Valves shall be for working pressure up to 200 psi and shall be equal to latest specifications of AWWA C-509 in all respects. Valves shall be equal to Mueller A 2370- 20 unless shown otherwise on project drawings. Iron body resilient seat gate valves shall be as manufactured by Mueller, or equal.

2.20 VALVE BOXES

Valve boxes shall be made of cast iron and be of the two-piece adjustable heavy roadway type. They shall have an inside diameter not less than 5 1/4" and be of the screwed type. They shall be provided with a cast iron cover on which the word **"SEWER"** is embossed and shall be suitable for installation on mains laid at the depths specified elsewhere in these specifications.

Valve boxes shall be set vertically over the valve and centered about the operating nut. The cover shall be flush with the street or ground surface unless otherwise directed by the Engineer. Backfill shall be carefully tamped around the box to prevent it from being moved out of position. The bottom-flared edge of the box shall not rest directly on the valves or pipe. A concrete block shall be installed under the box. Where the standard depth valve box is not high enough to make the cover flush with the ground surface the Contractor shall provide and install, valve box riser sections of the required length to achieve this result.

A pre-cast concrete collar shall be installed around the top of the valve box in subdivisions. A -24” square by 6” thick concrete pad on offsite force mains.

2.21 VALVE MARKERS

The location of pipe and valves shall be marked with fiberglass markers. The markers shall be inscribed "SEWER VALVE" or "SEWER LINE CROSSING" as appropriate. Markers shall be Carsonite, H & W Industries, or other approved equal. Markers shall be installed for all type valves including isolation valves, air release valves, electric control valves, etc. Markers shall also be set at all locations where pipeline crosses streets and highways or other utilities.

2.22 SEWER SERVICE CLEAN-OUTS, WYES, BOXES, AND COVERS

Typical sewer service clean-outs (6-inch or 4-inch) shall be included in the construction plan. The clean out shall consist of a clean out wye (no tees) along with a 45° bend. The 6-inch or 4-inch plug or cap shall be contained in a cast iron valve box.

2.23 DESIGN CRITERIA FOR SERVICE LATERALS

Sewers shall be designed to serve every lot or parcel adjacent to the sewer. Service laterals shall not cross property lines between adjacent properties.

Service laterals shall be installed for each lot or property to 1' behind the utility and drainage easement. The service laterals shall be installed 6' from the side lot line. Standard details for service laterals are included in the standard details. Service laterals shall not be installed beneath driveways or transformers. At the time of final inspection, any laterals found beneath driveways or transformers shall be relocated by the developer.

A permanent marker shall be installed on the curb face at a point which intersects with the service lateral. The curb markers shall be of the manufacturer and make pre-approved by Integra Water. Curb markers shall be of the high-impact PVC (laminate) plastic, reflective, U.V. resistant coating and of color coding that conforms to Integra Water Standards.

Gravity Service Laterals

Ductile iron, mechanical joint wyes shall be used at the service lateral connection to the main as indicated in the Standard Details. The connection between the service lateral and sewer main shall be watertight. The service lateral shall not protrude into the sewer main.

Service laterals may tie into manholes upon a case by case basis and with Integra Water approval. The invert of the service lateral shall be placed above the crown of the mainline pipe inside the manhole. All service laterals shall have warning tape installed one foot below ground surface along length of service lateral pipe.

Service laterals shall not be allowed to tie directly into main interceptors.

Residential service laterals shall not be less than 4 inch in diameter.

Ductile iron pipe service laterals shall be minimum Pressure Class 350. Polyvinyl Chloride service laterals shall be minimum schedule 40.

A manhole shall be installed at the edge of easement or property line in lieu of a cleanout on all commercial service lines greater than or equal to 6 inches in diameter.

Low Pressure Service Laterals

Epoxy coated service saddles with double stainless steel straps shall be used at the service lateral connection to the main as indicated in the Standard Details. Electrofusion saddles are an acceptable alternative. The connection between the service lateral and sewer main shall be watertight. The service lateral shall not protrude into the sewer main. Service lateral shall be one solid pipe from the sewer main and not contain any couplings or compression fittings.

All service laterals shall have warning tape installed one foot below ground surface and tracer wire along the length of the service lateral pipe. Service laterals shall be 1-1/4" unless otherwise noted by the pump manufacturer. Service laterals shall be HDPE DR 11 with a green stripe. Long side service laterals

beneath roadways shall be encased from right of way to right of way with a 2” PVC pipe (green or green stripe)

ARTICLE 3 – CONSTRUCTION

3.1 GENERAL

The streets, roads, and easements in which lines shall be placed have been indicated on the plan. Any change from locations approved by Integra Water shall be approved by Integra Water before construction.

Where the excavation exceeds the required depth, the Contractor shall bring the excavation to proper grade through the use of an approved incompressible backfill material (generally crushed stone or fill concrete, depending upon the nature of the facility to be placed thereon). In the event unstable soil conditions are encountered at the bottom of the excavation, the Engineer will direct the Contractor to continue the excavation to firm soil or to provide pilings or other suitable special foundations, with such action subject to approval by Integra Water.

The Contractor shall take such precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities or structures through cave-ins, slides, settlement or other soil disturbance resulting from his operations.

The Contractor shall submit a work schedule within ten calendar days of the pre-construction meeting.

During construction, material sampling and testing shall be required for concrete and backfill.

The inspector shall insure that the Contractor performs required testing of gravity sewer lines and manholes.

Pipe and fittings shall be handled and stored according to manufacturer's recommendations and Integra Water Specifications.

Project closeout requirements will consist of approved testing results and a final construction inspection in which all items that are deemed inadequate must be repaired or replaced prior to signing off of the construction.

Line and grade of gravity sanitary sewers shall be verified by a Licensed Surveyor prior to backfill.

Engineer must submit a final plat as well as as-builts in .pdf and .dwg formats prior to final

construction inspection requests. Final plats are to be stamped by a State licensed engineer.

All fill areas shall be to sub grade elevation prior to pipe installation.

Backfilling shall be carried out as expeditiously as possible but shall not be undertaken until the Engineer has been given the opportunity to inspect the work. The Contractor must carry out all backfilling operations with due regard for: the protection of pipes, structures and appurtenances; the use of prescribed backfill materials; and procedures to obtain the desired degree of compaction.

All shade trees, telephone poles, power poles, etc., along the line of work shall be protected, and sufficient barricades, lanterns, etc., shall be provided for the protection of the public.

3.2 MEASUREMENT ANDPAYMENT

Basis of Payment

Contractor shall be responsible to repair any damage to those items not designated for demolition or removal in a manner satisfactory to Integra Water at no additional cost to Integra Water.

Integra Water reserves the right to make reasonable changes in line locations without extra cost, except as may be determined by extra units of materials and construction actually involved.

At completion of project, deliver record documents and plan view drawing to Integra Water. Drawings must be submitted and approved prior to acceptance of the sewers. APPROVAL FOR FINAL

PAYMENT WILL BE CONTINGENT UPON COMPLIANCE WITH THESE PROVISIONS.

Subsurface Investigation
No separate pay item shall be included for subsurface investigation. Test borings and other exploratory operations conducted by the Contractor will be at no cost to Integra Water.

Excavation
All excavation of materials shall be included in the unit bid price for the sanitary sewer pipe, unless otherwise specified on the Plans or in the bid proposal.

All excavation will be unclassified, and no additional payment will be made regardless of type of material encountered unless provisions were made in bid documents.

Unauthorized excavation, as well as remedial work directed by Integra Water or Integra Water's Representative, shall be at Contractor's expense.

No compensation will be allowed for additional excavation necessary for establishing stable subgrade; it shall be included in the unit bid price.

Excess soil material and waste materials shall be disposed of in a legal manner per Integra Water's direction at no additional cost to Integra Water.

Pavement shall be sawcut without extra compensation to the Contractor.

Sheeting and shoring of trenches shall be provided at the Contractor's expense. In the event Integra Water directs the Contractor to leave shoring materials in place, Integra Water will reimburse the Contractor for the reasonable cost of leaving such materials in place.

Should the lack of a solid vertical excavation face occur due to improper trench excavation, the entire cost of furnishing and installing metal harness anchorages in excess of the Contract value of the contract blocking replaced by such anchorages shall be borne by the Contractor.

Rock Removal
If provisions are made in the bid for rock excavation, rock excavation shall be paid for. Otherwise, all excavation of any nature shall be unclassified and payment for the same shall be included in the unit price of other items of work.

Dewatering
Dewatering of all excavations shall be the responsibility of the Contractor, and no additional compensation shall be allowed. The presence of groundwater and surface water should be accounted for in the base bid price.

Pressure Sewer Main
Measurement shall be on the basis of linear foot along the centerline of the pipe (excluding fittings and valves) with deductions only for structures such as pump stations, meter vaults, and other structures of similar nature.

Payment shall be as specified below:
* inch Type Sanitary Sewer Pipe, Class ** - per Linear Foot.

Accepted Types are as Follows:
- Ductile Iron (DIP)
- Polyvinyl Chloride (PVC)
- HDPE

* Denotes Pipe Size
** Denotes Class of Pipe

Work under these items includes, but is not limited to, trenching, bedding, backfilling, solid rock removal, hauling and disposal of bedding and waste material, unpaved surface restoration, repair or replacement of fences, pressure testing, cleanup, seeding, and any work included in the Contract not covered by other items on the Bid Form.

Payment for fittings is not included in this pay item.

Copper tracer wire or metallic tape is not included in this pay item and will be paid for separately as shown on Drawings.

Gravity Sewer Main

Payment for gravity sewer lines will be made at the contract unit price per linear foot in place, with deductions for manholes, and shall include compensation for furnishing pipe, trenching (including rock excavation), Class I bedding material, laying, jointing, temporary trench shoring, sheeting and bracing, initial backfill of Class I material over top of pipe, and all other appurtenances required but not specifically delineated herein.

The quantity of sewer to be paid for shall be the length of pipe measured along the centerline of the completed pipelines without deducting the length of branches and fittings to the center of the manhole.

Payment for final backfill shall be included in this pay item including Class II material (DGA) and bituminous binder material required in restoration of paved areas. Class II material and bituminous binder shall be included in this pay item and is considered incidental to the installation of the gravity sewer main.

Payment for concrete sidewalk replacement, including compensation for compacting, Class I material, furnishing and installing concrete to a minimum strength and thickness as specified in the entire area of existing concrete sidewalk disturbed during construction is considered incidental to the installation of the gravity sewer main.

Payment for this item shall include the testing of the completed gravity sewer line and any water, gas, or other utility relocation if necessary.

Standard Manholes and Drop Manholes

Payment is for furnishing and installing standard manholes of the types shown at a depth of six (6) feet or less for six (6) feet to 12 feet, and for manholes greater than 12 feet, as shown on the Drawings, to be measured to the invert including the height of the frame and cover. This is to be paid at the contract unit price each, complete in place, which shall include compensation for materials, furnishing, plugging existing lines, hauling, excavation (including rock excavation), bedding, backfilling, cleanup, and all other items necessary for a complete installation on new or existing sewer lines.

PAYMENT WILL BE MADE UNDER:

Sanitary Sewer Manholes * to * Depth – per Each
* Indicate Depths

Two additional pay items are included for the installation of drop connections for any case where the invert elevations of joining sewer lines do not match. Measurement of Drop manholes shall be made according to the diameter of the pipe in the top clean-out pipe to the invert of the lower pipe entry into the manhole. The size and length of Drops at Manholes measured for payment will be the actual size and linear feet of each as defined here, ordered, completed and accepted.

If the manhole fails the test a second time, the Contractor will be responsible for supplying and installing a brand-new manhole at no cost to Integra Water.

Connection of Existing Sewer to Manhole

Payment for the connection of the existing gravity sewer main to the new manhole, as shown on said drawings will be made at the contract unit price, complete in place, which shall include compensation for materials, backfilling, reforming inverts and/or manhole bench, clean-up and all other items necessary for a complete installation.

Backfill and Fill

Pipe bedding and trench stabilization are not considered separate pay items, regardless of amount or material required.

No additional compensation will be allowed for deep trenches, unless otherwise specified in bid documents.

The use of off-site borrow material for use as non-structural fill shall not result in additional compensation for the Contractor.

Earth, Class I, and Class II material used in final backfill is not a separate pay item.

The Contractor shall receive no extra payment for the filling in of settled or washed areas.

Excavated materials from trenches in excess of the quantity required for trench backfill, shall be disposed of by the Contractor at no additional cost to Integra Water.

When not shown as a bid item, controlled low-strength (CLSM) or flowable backfill will not be measured for separate payment but the cost thereof shall be included in the price bid for the appropriate item. Such price shall be full compensation for furnishing and installing flowable backfill and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

Testing

All testing costs shall be included in the Contractor's base bid. There will be no separate bid item for testing manholes and pipes. Cost associated with testing should be included in the cost of the manholes and pipes unless a Testing Allowance is included in the Contractor's base bid.

Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and re-testing as Integra Water may require without additional compensation.

All pipes that do not pass the deflection test shall be replaced so that they do pass the ball, at no cost to Integra Water.

Television Inspection

All inspection costs shall be included in the Contractor's base bid. There will be no separate bid item for television inspection. Cost associated with television inspection should be included in the unit price bid for sanitary sewer pipe.

When required, the Contractor shall implement wastewater flow control methods at no additional cost to Integra Water.

If excavation is required to remove the television unit, the Contractor shall replace or repair any damage to the sewer pipe that occurs as a result at no extra cost to Integra Water.

Maintaining Wastewater Flow
No direct payment shall be made to the Contractor for this item. The Contractor shall include the cost of this work in other bid items, unless specified in the Contract Documents.

All repairs, replacements, and rebuilding caused by wastewater flow control operations shall be paid for by the Contractor.

Tunneling and Boring
If any public or private property is endangered or has been damaged as a direct result of the tunneling or boring and jacking operations, it shall be repaired at the Contractor's expense. All cost and expense to the Contractor for carrying out the above requirements shall be considered to be included in the lump sum bid prices for the completed sewer installation.

Tunnel stabilization shall be performed at no additional cost to Integra Water.

The Contractor shall receive no compensation for any expenses incurred by unsuccessful bores.

Encasement Pipe
Measurement shall be on the basis of lineal foot along the centerline of the casing pipe.

Bore and Jack Installations
This item includes furnishing casing pipe in sizes and material specified, joining casing pipe, excavation and backfill of the bore pit, boring the hole under the embankment, jacking the casing pipe into place, installing the carrier pipe with pipe insulators to prevent movement of the carrier pipe, sealing of the ends with molded casing seals and all other appurtenances not covered by other sections of these Specifications and detailed on the Drawings.

Open Cut Installation
This item includes furnishing casing pipe in sizes and material specified, joining casing pipe, sawing of pavement, excavation and removal of any rock, placement of casing pipe, backfilling with crushed stone, installing the carrier pipe with pipe insulators to prevent movement of the carrier pipe, sealing of the ends with molded casing seals and all other appurtenances not covered by other sections of these Specifications and detailed on the Drawings.

Payment
Payment will be on the basis of unit price Bid per lineal foot. Payment of this item does not include the cost of the carrier pipe or paved surface replacement.

Crushed Stone Surface Replacement
Measurement shall be on the basis of linear foot along the centerline of carrier pipe.

This item includes the crushed stone (DGA and # 2 stone), equipment, and labor necessary to restore the surfaces of gravel roads, driveways, city streets, shoulders, parking areas, or any other areas subject to traffic to their original conditions. Depth of application shall be 12 inches over the entire excavated area and shall include compaction to 95% STANDARD PROCTOR DENSITY. Width of replacement shall be up to 10 feet wide.

Payment will be on the basis of unit price Bid per linear foot.

Line Markers
This item includes the cost of furnishing all labor, materials, and equipment to complete installation of line markers at locations shown on the Drawings or as directed by the Engineer.

Measurement shall be on a per unit basis.

Payment will be on the basis of the unit price Bid for each item.

Execution

The pay items listed herein before refer to the items listed in the Bid Schedule and cover all the pay items under the base bid for the contract.

Any and all other items of work listed in the specifications or shown on the Contract Drawings for the contract shall be considered incidental to and included in those pay items.

Quantities of Estimate

Wherever the estimated quantities of work to be done and materials to be furnished under this contract are shown in any of the documents, including the Bid Proposal, they are given for use in comparing bids and the right is especially reserved except as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desirable by Integra Water to complete the work contemplated by this contract, and such increase or diminution shall not give cause for claims or liability for damages. The Engineer will not be financially responsible for any omissions from the Contract Documents and therefore not included by the Contractor in his proposal.

The mapping utilized for the sewer line plan sheets in the Contract Documents are indicated at an approximate scale and shall not be scaled for quantity take-offs. The pipeline quantities listed in the bid schedule are given for use in comparing bids and may not be the actual quantities to be installed. It is the Contractor's responsibility to field verify the length and quantities of pipeline to be installed prior to the ordering of materials. Payment on unit price contracts are based on actual quantities installed. Integra Water or Engineer will not be financially responsible for any shortage of pipe or overrun of pipe ordered for the pipeline quantities.

The actual quantities of all materials to be used for this project shall be field verified prior to the Contractor ordering the necessary materials. The quantity listed in the bid schedule is given for use in comparing bids and may increase or diminish as may be deemed necessary or as directed by Integra Water. Any such increase or diminution shall not give cause for claims or liability for damages. The Engineer or Owner will not be financially responsible for any charges incurred for restocking of materials ordered.

3.3 CONSTRUCTION REQUIREMENTS

Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

Testing and Inspection Service: Integra Water shall select the services of a qualified geotechnical engineering, inspection, and testing firm for quality control testing during earthwork operations. The Contractor shall coordinate testing and inspection with the testing firm for services directed by Integra Water.

Inspection: Verify that all stockpiled fill to be reused is approved. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen. Verify foundation perimeter drainage installation has been inspected.

Copies of all test reports and field reports shall be made available to Integra Water.

The Contractor shall provide access to site areas, borrow pits and other areas for testing. The Contractor shall also indicate when there is a need for tests to be performed. The Contractor is responsible for preparation for any tests necessary for the conduct of the Work.

3.4 SITE PREPARATION

Prior to starting construction operations, the Contractor shall remove all vegetable growth, debris and other objectionable matter standing or lying on the surface within the limits of the areas to be excavated or filled; and shall demolish and remove there from such buildings and other structures as are

specifically designated on the Plans for removal.

The Contractor is required to identify all lines, levels, contours and datum necessary during construction work.

Prior to commencement of work, the Contractor shall locate existing underground utilities in areas of the work. If utilities are to remain in place, provide adequate means of protection during earthwork operations where required. Upon discovery of unknown utility or concealed conditions, affected work shall be discontinued until Integra Water is notified.

The site shall have all stumps and roots 2 inches and larger removed to a depth of not less than 6 inches below the original ground surface. Areas of structural excavation shall have all visible stumps and roots 2 inches and larger removed.

Topsoil shall be removed, generally 2 to 6 inches, from all areas to be excavated or filled. Topsoil shall be stockpiled for later reuse at a location approved by Integra Water.

All projects shall require subsurface investigations unless otherwise directed by Integra Water. The investigations may include the following types of studies or inspection: rock soundings, various soil tests when deemed necessary, groundwater levels, etc.

A licensed Geotechnical Engineer shall perform all studies and investigations related to the subsurface investigation.

Materials, methods and equipment used during the subsurface investigations shall be standard documented procedures by regulating agencies such as ASTM Standards.

A geotechnical study shall be conducted in project areas suspected of rock bedding. Rock soundings shall be at intervals not to exceed 350 to 500 (should match manhole location intervals) feet along the centerline of the proposed sewer and to at least one foot below the depth of the sewer at the location of the sounding. If rock is encountered, then the soundings shall be conducted at closer intervals determined by the Engineer and Integra Water.

Use of explosives shall not be allowed without prior written approval from Integra Water. Contractor shall refer to any local Authority Ordinances regarding Blasting.

A professional land surveyor licensed in the applicable State shall conduct the survey of the proposed sanitary sewer line. The surveyor shall stake out the proposed sewer line as follow: stake each manhole's proposed centerline location with offset referencing, reference each P.I. in the field, and note all benchmarks in the field and on the Plans. The surveyor shall provide drawings meeting all requirements of Integra Water.

Test holes are to be made when necessary for locating underground obstructions. Where utilities are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started. Every pipe for water, gas, drainage, or other use, and every conduit, foundation, or other underground structure encountered shall be carefully protected from damage or displacement.

The Contractor shall be responsible for the prevention and control of soil erosion and gullying as a result of the construction. He shall prevent excessive erosion within the sanitary sewer right-of-way and property immediately adjacent thereto. Ground where the soil has been exposed shall be revegetated with grass or other herbaceous plants. Slopes in channel changes on all branches and creeks shall be seeded and fertilized above the water line. In no case will the toe of fill slopes be al- lowed to fall within stream or creek channels unless so noted on the Plans or directed by Integra Water. No material shall be deposited within the flood plain of any stream. Fill slopes shall be provided with adequate slope protection as detailed on the Plans or directed by Integra Water. All soil left within the right-of-way shall be leveled off, dressed out and seeded in a manner that will permit the ground surface to return to a

natural state and present a pleasing appearance.

Construction operations shall be planned and conducted in such a manner so as to prevent and otherwise minimize pollution of streams, lakes and reservoirs with sediment or other harmful material used in the construction of the project. All regulations of the Environmental Protection Agency and the State Regulatory Authority shall be adhered to by the Contractor.

Waste, loose soil, or other materials removed from the right-of-way or channel changes shall not be deposited in live streams. Depositing material along stream banks where it would be washed away by high stream flows will not be permitted. Surplus material may be deposited only in disposal areas approved by Integra Water. All disposal areas shall be dressed and treated with erosion control items.

Fuels, oils, bitumen or other greasy or chemical substances originating from construction operations shall not be allowed to enter or be placed where they may enter a live stream.

The discharge ends of all channel changes shall be so laid out and aligned as to provide direct flow into existing streambeds without an abrupt direction change.

The site shall be graded during construction to eliminate unnecessary ponding of water and provide as dry as possible work site.

The finish grading shall be accomplished after placement of 3 inches of topsoil in all disturbed areas. The finished grade shall be within 0.10 feet of the grade shown on the Plans in areas within 10 feet of any structure or paved area. The finished grade within other areas shall be within 0.15 feet of the grade shown on the Plans.

Finish grading may be accomplished by mechanical means. Failure to achieve the grades specified above will result in the Engineer requiring the Contractor to use hand tools and labor.

All items of material and equipment designated on the Plans to be salvaged shall be the property of Integra Water. The Contractor shall carefully remove, clean, inspect, and transport salvaged items to the place designated by Integra Water. Salvaged materials are not to be used in the new work unless called for on the Plans or authorized in writing by Integra Water.

No waste material shall remain on the job site except as authorized in writing by Integra Water.

Site preparation shall be considered as an integral part of the work and no separate measurement or payment therefore shall be allowed.

The contractor shall dispose of construction debris resulting from clearing, grubbing, excavation, dewatering, and pavement replacement removal, in a landfill approved by the Engineer. Materials used for silt barriers shall be removed and disposed of upon acceptance of restoration of grounds. The contractor is reminded to serve written approval from the State or local authority having jurisdiction over the Air Pollution Control. Burning shall be strictly controlled and all fires shall be attended at all times.

3.5 EXCAVATION AND TRENCHING

All work included in this section shall follow the standards of the Federal Occupational Safety and Health Act and the Department of Labor.

Barricade all open excavations and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. Protect trees and other features remaining as a portion of final landscaping. Protect benchmarks, existing

structures, fences, roads, sidewalks, and other features not designated for demolition. Contractor shall be responsible to repair any damage to those items not designated for demolition or removal in a manner satisfactory to Integra Water.

Materials

Subbase Material
Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

Drainage fill
Washed, uniformly graded mixture of crushed stone or crushed gravel conforming to No. 2 of The Department of Transportation Standard Specifications.

Backfill and non-structural fill materials
Satisfactory soil materials free of debris, waste, frozen materials, vegetable, and other deleterious matter.

Topsoil
Excavated material, graded free of roots, rocks larger than one inch, subsoil, debris, and large weeds.

Subsoil
Excavated material, graded free of lumps larger than 12 inches, rocks larger than 12 inches and debris.

Trenches for the mains shall be excavated in the locations indicated on the plans or as directed by the Engineer. All trees, telephone and power line poles along the line of the work must be protected, and at night a sufficient number of barricades and lights to prevent accidents shall be provided. Where mains are laid between the curb and sidewalk or in other places where shrubbery and grass lawns are encountered the Contractor shall carefully remove and replace the shrubbery and cut the grass sod in sections, laying it to the side and replacing it after the compacted trench has been backfilled.

Trench walls shall be in accordance with OSHA Regulations for depth and type of soil. Where unstable soil conditions are encountered at the trench bottom, the Contractor shall remove such additional material as may be directed by the Engineer and replace the excavated material with approved backfill.

Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material and appurtenances. Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than 300 feet of continuous open trench at any time.

The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up, and in event of failure to do so, may be prohibited from opening additional trench until such work is completed. This requirement is particularly applicable to work being done in developed areas.

In general, the excavated material shall be kept clear of the sidewalks except where unusual conditions prevent this being done. Unless otherwise approved by the Engineer, all pipe shall be installed under driveways by boring and jacking, but where the driveway is cut it shall be backfilled as soon as the pipe is laid. No driveway shall remain inaccessible at the end of the day's work and all street crossings shall be backfilled and opened to traffic before work is stopped for the night.

On paved streets, wherever possible, the mains will be located between the curb and the sidewalk, and in all cases the mains will be located so as to keep cutting and replacing pavement to a minimum.

The width of the trenches shall be in accordance with the manufacturer's recommended installation procedures. The depth of the trenches shall be such that all pipe will have a cover of at least 36".

When underground obstructions occur on other than State or County highway rights-of-¬way, the Contractor may be permitted to lay ductile iron pipe over the obstruction at no additional cost if a minimum cover of 24" over the top of the pipe may be obtained after providing a cushion at least 3" thick between the bottom of the pipe and the top of the obstruction. Where this minimum cover cannot be obtained the pipe shall be laid under the obstruction.

The Contractor shall plan his operations so as to cause a minimum of inconvenience to property owners and to traffic. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

- Permit is secured from appropriate State, County or Municipal authorities having jurisdiction.
- Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without first notifying the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupants' convenience, and except in case of an emergency, drives shall not be blocked for a period of more than 8 hours. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety.

Unless approved by the design Engineer, all trenches shall be closed at the end of the workday.

All signs shall be re-erected in a manner satisfactory to the design Engineer at the end of each workday. Signs shall be permanently re-installed back to the original condition at the end of the project.

All travel-ways shall be kept clean of mud, dust, dirt, or other debris. This requires a daily cleaning of travel-ways to the extent that dust is not a nuisance and roadways do not become hazardous. The amount of cleaning required is strictly left to the direction of the Developer.

3.6 EXCAVATION

Excavation includes excavation to subgrade elevations including excavation of earth, rock, bricks, wood, cinders, and other debris. All excavation shall conform to 29CFR, Part 1926, Subpart P.

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Integra Water.

When excavation has reached required subgrade elevations, notify Integra Water who will make an inspection of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavation deeper and replace excavated material as directed in writing by Integra Water.

Slope sides of excavation to comply with OSHA regulations and all other ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restriction or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

The Contractor shall furnish, put in place, and maintain such sheeting, bracing, etc. as may be necessary to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation to less than that necessary for proper construction, or could otherwise injure or delay the work, or endanger adjacent structures.

Where unstable material is encountered or where the depth of excavation in earth exceeds 5 feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing, and shoring, or the sides sloped to the angle of repose. Sloping the sides of the ditch to the angle of repose will not be permitted in streets, roads, narrow rights-of-way or other constricted areas unless otherwise specified. The design and installation of all sheeting, sheet piling, bracing and shoring shall be based on computations of pressure exerted by the materials to be retained under obtaining conditions. Adequate and proper shoring of all excavations shall be the entire responsibility of the Contractor; however, Integra Water may require the submission of shoring plans (accompanied by supporting computations) for approval prior to the Contractor undertaking any portion of the work. The standards of the Federal Occupational Safety and Health Act and the Department of Labor shall be followed.

Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but if voids occur, they shall be filled immediately with sand and compacted.

The Contractor shall leave in place to be embedded in the backfill, or concrete, all sheeting, bracing, etc. which indicated on the Plans to be so left in place. The Contractor also shall leave in place any and all other sheeting, bracing, etc. which Integra Water may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures or property.

Integra Water may direct that sheeting and bracing be cut at any specified elevation.

All sheeting and bracing not to be left in place shall be carefully removed in such manner as not to endanger the construction or other structures. All voids left or caused by the withdrawal of sheeting shall be backfilled immediately using suitable materials and compaction methods.

Excavation of any existing pavement as is necessary for the prosecution of the work. Pavement shall be sawcut. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.

Trench Excavation

All existing facilities shall be protected from danger or damage while pipelines are being constructed and backfilled, and from damage due to settlement of the backfill.

The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work in a paved area.

From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, the Contractor shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.

In the event any existing structure is damaged, repair and restoration shall be made at once and backfill shall not be replaced until this is done. Restoration and repair shall be such that the damaged structure is equal to or better than its original condition and can serve its purpose as completely as before.

Trenches must be dug to lines and grades shown on the Plans. Hand trenching may be required in areas where machine trenching would result in undue damage to existing structures and facilities.

Sheeting and shoring of trenches shall be provided where necessary to protect life, property and the new or existing structures from damage or to maintain maximum permissible trench widths at top of pipe. All necessary materials, including, but not limited to, sheeting, sheet piling, trench jacks, braces, shores and stringers, shall be used to hold trench walls. Sheeting and shoring may be withdrawn as the trenches are being backfilled, after backfill has been tamped over top of the pipe at least 18-inches. If removal before backfill is completed to surface endangers adjacent structures, such as buildings, pipelines, street

paving, and sidewalks, then the sheeting and shoring shall be left in place until such danger has passed, and then pulled if practical. Voids caused by sheeting withdrawal shall be backfilled and tamped. If not withdrawn, sheeting shall be cut off at least 18-inches below final surface grade, so there is no obstruction at the ground level.

Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed and existing pipe to remain is not damaged.

Where pipe is to be laid directly on the trench bottom, the lower part of trenches in earth shall not be excavated to subgrade by machinery. However, just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom. Notching shall be provided under pipe bells.

The location of the pipelines and their appurtenances as shown on the Plans are those intended for the final construction. However, conditions may present themselves before construction on any line is started that would indicate desirable changes in location. Integra Water reserves the right to make reasonable changes in line and structure locations. Integra Water is under no obligation to locate pipelines, so they may be excavated by machine.

The Contractor shall only have sufficient trench open ahead of the pipe laying work as necessary for the prosecution of the work that day. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room. Provide a minimum of 12-inches clearance on both sides of pipe or conduit. In doing this, based on backfill requirements, the Contractor must use 12” of stone on sides of pipe, even for smaller diameter pipes.

Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

Where rock is encountered, carry excavation 12 inches below required elevation and backfill with a 12- inch layer of crushed stone or gravel prior to pipe installation as shown in the Standard Details in Appendix F.

For pipes or conduit 6 inches or larger in nominal size excavate to subbase depth indicated or, if not otherwise indicated, to 6 inches below of work to be supported.

Except as otherwise indicated, excavate for piping so top of piping is no less than 5-feet 0-inches below finish grade.

Encase pipe with concrete (full encasement) where trench excavations pass within 18 inches of columns, wall footings, or slabs, or which pass under wall footings. Place concrete to level of bottom of adjacent footing(s) or slab.

Concrete is specified in the Integra Water Technical Specifications.

For pipe which is not to be pressure-tested, do not backfill trenches until tests and inspections have been made and backfilling authorized by Integra Water. Use care in backfilling to avoid damage or displacement of pipe systems.

Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.

Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation 1-foot above the top of the pipe.

Cold Weather Protection
Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F (1°C).

Depth of Trench
Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, or depths of cover as indicated on the Plans, and at uniform slopes between indicated elevations.

Trench Excavation in Fill
If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least 1 foot above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.

Dewatering
Dewatering of all excavations shall be the responsibility of the Contractor. The presence of groundwater and surface water can be anticipated during construction.

Dewatering equipment shall be of adequate size and quantity to assure maintaining proper conditions for installing pipe, concrete, backfill or other material or structure in the excavation. Dewater shall include proper removal of any and all liquid, regardless of its source, from the excavation and the use of all practical means available to prevent surface runoff from entering any excavation.

Extra pumps shall be maintained on site for use in the event of a breakdown of operating.

To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations. Such excavation shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged.

All water pumped or drained from the work shall be disposed of in a suitable manner without undue interference with other work, damage to pavements, other surfaces or property. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All groundwater/leachate pumped from site shall be drained to nearby sanitary sewer upon approval from Integra Water.

Temporary underdrains used shall be laid in trenches beneath the grade of the structure. Trenches shall be of suitable dimensions to provide room for the chosen size of underdrain and its surrounding gravel.

Underdrain pipe shall be acceptable vitrified-clay or concrete pipe of standard thickness. Sewer pipe of the quality known as “seconds” will be acceptable.

Underdrains, if used, shall be laid at a suitable distance below the bottom of the normal excavation and with open joints wrapped in cheese cloth, and entirely surrounded by graded gravel, or crushed stone to prevent the admission of sand or other soil into the underdrains. The distance between the bottom of the pipe or structure and the top of the bell of the underdrain pipe shall be at least 3 in unless otherwise permitted. The space between the underdrain and the pipe or structure shall be filled with screened gravel or crushed stone which shall be rammed if necessary and left with a surface suitable for laying the pipe or building the structure.

If necessary, the Contractor shall dewater the excavations by means of an efficient drainage wellpoint system which will drain the soil and prevent saturated soil from flowing into the excavation. The wellpoints shall be designed especially for this type of service. The pumping unit shall be designed for use with the wellpoints and shall be capable of maintaining a high vacuum and of handling large volumes of air and water at the same time.

The installation of the wellpoints and pump shall be done under the supervision of a competent representative of the manufacturer. The Contractor shall do all special work such as surrounding the wellpoints with sand or gravel or other work, which is necessary for the wellpoint system to operate for the successful dewatering of the excavations.

Trench excavation or excavation for pipe lines shall consist of the excavation necessary for the construction of sewers and other pipe lines and all appurtenant facilities therefore, including manholes, inlets, outlets, concrete saddles, pipe cushion, and pipe protection as called for on the Plans and in these specifications. It shall include clearing and grubbing where necessary, backfilling and tamping of pipe trenches and around structures, and the disposal of waste materials, all of which shall conform to the applicable provisions set forth in these Specifications. Integra Water has not prepared for or conducted subsurface investigations for the excavation. The Contractor shall have sole responsibility for his own subsurface investigations for the pipe excavation. The Contractor must comply with all federal, state, and local safety rules and regulations including those of OSHA. Integra Water will not inspect for compliance with safety regulations and disclaims any responsibility to ensure the safety of workers.

The Contractor shall maintain benchmarks, monuments, and other reference points- Replace any disturbed or destroyed benchmarks, monuments, or other reference points. Trench excavation shall be made in open cut unless otherwise specified on the Plans. Trench excavation shall be true to the lines and grades shown on the Plans or established by Integra Water. The controlling elevation for measuring depths described in these Specifications shall be the pipe invert (flow line) elevation as shown on the Plans. The banks of trenches shall be cut in vertical, parallel planes equidistant from the pipe center line from a horizontal plane one (1) foot above the top of the pipe to the bottom of the trench, with shoring, sheeting and/or bracing as necessary, to provide safe working conditions for installation of the pipe. The horizontal distance between such planes, or the overall width of trench, shall be as specified on the Plans. From the top of the trench to a horizontal plane one (1) foot above the top of the pipe, the Contractor shall use appropriate excavation methods to ensure safe working conditions within the trench, which may require the use of sheeting, shoring, and/or bracing, and/or laying back the slopes, provided that such excavation does not damage adjacent structures. The width of trench shall be as shown on the Plans. When shoring, sheeting, and/or bracing is used, the distance between vertical planes shall be measured from the inside faces of the sheeting. The bottom of the trench shall be level in cross section and shall be cut to the depth necessary to properly place the bedding and lay the pipe to grade as shown in the Plans and in the Standard Details. Where concrete cradles or pipe foundations are indicated on the Plans or required by the Engineer, in which case the excavation shall extend to the bottom of the cradle or foundation. All overshot rock must be removed and replaced with acceptable material before placing the bedding.

Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bedding material. Bell holes shall be large enough to permit proper installation of joints in the pipe. Bell holes shall not be excavated more than five (5) joints ahead of pipe laying.

Excavation for manholes and other structures shall not be greater in horizontal area than that required to allow two (2) feet in the clear between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevations shown on the Plans. Should the Contractor excavate below the elevations shown or specified, he shall fill the void thus made with pipe cushion, at his own expense. No earth backfilling will be permitted under structures, unless specifically shown on the Plans.

Dewatering and Drainage may be required at excavations.

When muck, quicksand, soft clay, swampy, or other material unsuitable for foundations or subgrade are encountered which extend below the limits of the excavation, such material shall be removed and replaced with Foundation Backfill (crushed limestone or dolomite), thoroughly compacted, or Class B concrete. Foundation Backfill shall be used only at the direction of Integra Water Engineer and only on a case-by-case basis.

All work shall be performed so as to cause the least possible inconvenience to the public. Temporary bridges or crosswalks shall be constructed where required to maintain vehicular or pedestrian traffic. Plans for all such temporary bridges shall be prepared by a registered engineer and submitted to Integra Water for review prior to any construction. Crosswalks and bridges shall have handrails and/or other features necessary for safe use by the public.

In all cases where materials are deposited along open trenches, they shall be placed so that in the event of rain, no damage will result to the work and/or to the adjacent property.

All streets, sidewalks, and crossings are to be kept open and in a safe condition for their intended use unless written approval to close the street is obtained from the authority having jurisdiction. While the work is steadily advancing for each pipe laying crew, one cross street at a time, may be cut across its roadway and foot crossings. Any additional streets, which the Contractor elects to cut, shall be provided with suitable bridges and handrails. Excavated material is to be removed from the street so as to occasion the least practicable inconvenience to public traffic and to neighboring residents. To prevent obstructing traffic, only as much of the materials of construction as are actually needed are to be piled along the line. If at any time public traffic cannot be properly maintained when materials are stored upon the street, as much materials as necessary are to be removed from the street and stockpiled. Suitable stockpiled materials are to be returned to backfilling as necessary and when appropriate. Where work involves existing public rights-of-way, notification shall be given to Integra Water at least one (1) working day in advance of starting such work.

All fire hydrants, water valves, fire alarm boxes and other similar public utilities are to remain accessible for their intended use. The Contractor must notify the Fire Department involved if any hydrant is made temporarily inaccessible.

Surface drainage shall be maintained at all times. Temporary diversion of surface drainage may be permitted if approved by Integra Water.

Pipe installation shall be accomplished by boring or tunneling methods for crossing major streets, highways, railroads, or other facilities, where shown on the Plans. The methods and procedures are subject to approval by, Integra Water, State Highway Department, Regulating Authority, and by the railroad or other authority having jurisdiction.

The sides of all excavation shall be sufficiently sheeted, shored, and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions that would in any way endanger the workmen or hinder or delay the progress of the work. When wood or steel sheet piling, shoring, and bracing is used, it shall be of ample design and type to have sufficient strength and rigidity to withstand the pressures exerted and to maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. Sheet piling, shoring, or bracing should be designed by a registered engineer. The Contractor shall repair, at no cost to Integra Water; all damage resulting from failure to provide adequate support. The Contractor shall be responsible for damage to property and injury to persons caused directly or indirectly by inadequate sheeting or shoring.

Where excavations are made adjacent to existing buildings or other structures or in paved streets or alleys, the Contractor shall take particular care to sheet, shore and brace the sides of the excavation adequately so as to prevent any undermining of or settlement beneath such structures or pavement. Underpinning of adjacent structures shall be done where and as directed by the Engineer.

Sheeting, shoring, or bracing materials shall be removed unless otherwise directed by the Engineer. Such materials shall be removed in a manner that will not endanger or damage the new structure or any existing structures or property, either public or private, in the vicinity, and so as to avoid cave-ins or slides. Trench sheeting and bracing shall not be removed until the trench has been backfilled one (l) foot above the top of the pipe.

Where the excavation area shown on the Plans falls under the water surface or near the banks of a flowing stream or other body of water, the Contractor may adopt and carry out any method he may deem feasible for the performance of the excavation work and for the protection of the work thereafter, provided the method and equipment to be used results in completed work which complies with these Specifications and have received prior approval of Integra Water. In such cases, the excavation area shall be effectively protected from damage during the excavation period and until all contemplated construction work therein has been completed to the satisfaction of Integra Water.

Rock encountered in trench excavation for sewers shall be removed for the overall width of trench and to a depth below the bottom of the barrel of the pipe. The space excavated below the barrel and bell of the pipe shall be backfilled with pipe bedding. All overshot rock must be removed by the Contractor before placing the bedding. If the Contractor excavates below the required trench bottom, the excess space must be filled with acceptable material. All of the applicable provisions of the above Specifications for excavation and sheeting, shoring, and bracing shall apply to rock excavation.

3.7 BACKFILLING ANDCLEANUP

Backfill Materials

The nature of the materials will govern both their acceptability for backfill and the methods best suited for their placement and compaction in the backfill. No stone or rock fragment larger than 12 inches in greatest dimension shall be placed in the backfill nor shall large masses of backfill materials be dropped into the trench in such a manner as to endanger the pipeline. If necessary, a timber grillage shall be used to break the fall of material dropped from a height of more than 5 feet. Pieces of bituminous pavement shall be excluded from the backfill unless their use is expressly permitted, in which case they shall be broken up as directed. Adequate tamping is also required to prevent sags in the laid line.

Crushed Stone

Crushed stone material shall conform with the requirement of the applicable sections of the DOT Standard Specifications and shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetation or objectionable materials. Two classes of crushed stone may be referred to in this Section, as follows:

- Class I - DOT No. 78 Aggregate.
- Class II - Dense Graded Aggregate (DGA).

General

All material to be used as backfill material shall be tested and approved by Integra Water prior to backfilling excavations.

With the exception of the organic and inorganic debris, and topsoil, the on-site soil removed from the excavations could be used as non-structural/non-low permeability fill or vegetative backfill material provided the moisture content of the soil is within acceptable limits and the Geotechnical Engineer approves the material for the intended use. However, offsite borrow material may be required for use as non-structural fill.

Place acceptable backfill material in maximum 6 inch to 8-inch lifts (loose thickness) as specified in the standard details attached in Appendix F to required subgrade elevations, for each area classification listed below.

In excavations, use satisfactory excavated or borrow material.

Under slabs, use drainage fill material for a minimum depth of 6 inches. Below drainage fill use satisfactory excavated or borrowmaterial.

It is recommended, but not required, that inspection and testing of the sewer lines and manholes be conducted prior to backfilling. The documentation may be of benefit at time of the final testing, which is mandatory after all other utilities are installed, roadway sub-grade is laid, and backfill is complete. Final testing requirements are listed in Article 6.

Backfill excavations as promptly as work permits, but not until completion of the following: Acceptance of construction below finish grade.
Recording locations of underground utilities. Removal of concrete formwork.
Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities or leave in place if required.
Removal of trash and debris.

As soon as practicable after the pipes have been laid and the connection joints have acquired a suitable degree of hardness, if applicable, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, the backfilling shall be started and thereafter it shall proceed until its completion.

It is recommended that trenches not be backfilled at pipe joints until after that section of the pipeline has successfully passed the required and specified tests. Should the Contractor wish to minimize the maintenance of lights and barricades and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practical provided the joints have acquired a suitable degree of hardness, if applicable, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe. Any inspection and testing documentation may be of benefit at time of the final testing, which is mandatory after all other utilities are installed, roadway sub-grade is laid, and backfill is complete. Final testing requirements are listed in Article 6. The approval and acceptance of the sewer lines and manholes will be based on the final testing.

Excavated materials from trenches in excess of the quantity required for trench backfill, shall be disposed of by the Contractor. It shall be the responsibility of the Contractor to obtain location or permits for its disposal, unless specific waste areas have been designated on the Plans.

The Contractor shall protect all sewer, gas, electric, telephone, water, and drain pipes or conduits from damage while pipelines are being constructed and backfilled, and from danger due to settlement of trench backfill.

On completion of the Work, all backfill shall be dressed; holes filled; and surplus material hauled away.

After the pipe has been installed and tested, the trench shall be immediately backfilled. However, the Contractor may backfill the trenches prior to testing if he so desires but, in this case, he will comply with the requirements for testing the mains as specified elsewhere. Where pavement or sidewalk has not been cut to lay the pipe the backfill shall be tamped around and over the pipe to a depth of 12 inches over the top of the pipe. The remaining earth may be filled in and neatly mounded over the trench. Where the pavement or sidewalk has been cut to lay the pipe the backfill shall be thoroughly tamped in six-inch layers for the full depth of the trench.

Where excavated trench material is used for backfilling within the pipe zone, such material shall be free of rubbish, frozen material, broken pavement, other debris, rocks greater than that indicated in the sieve analysis for granular material, fine-grained soils as defined by ASTM 2487, or other material considered deleterious.

The remaining portion of the trench from the pipe zone to the existing ground level or road subgrade shall be backfilled with suitable material excavated from the trench. The backfill material shall be free of rubbish, frozen material, broken pavement, other debris, stones greater than six inches in diameter, organic mulch, or other material considered deleterious.

Where the trench is excavated in rock or other hard material which remains in lumps or pieces after being excavated, dry earth shall be provided and tamped around and over the pipe to a height of 12" above the top of the pipe. No large chunks or fragments of rock shall be placed into the backfill of the ditch.

In places where the trench has been excavated along the side of a paved street not provided with curb and gutter or where construction operations or the weather have spread the excavated material over the surfaces of unpaved streets, the Contractor shall employ a heavy duty motor grader to clean out the side ditches, shape the shoulders and restore the smoothness of the street surface to as good a condition as existed before the work was started. In the event that excavations on the shoulders of streets indicate that washouts or collapse of the shoulder are liable to occur, the backfill shall be carefully tamped and any earth washed out prior to the date of final acceptance shall be replaced. The use of mechanical equipment for this work does not remove from the Contractor the obligation to employ hand labor for the final dressing up.

Before final acceptance of the work all surfaces shall be returned to as good condition as before the work started.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, etc., using hand labor where necessary to achieve a satisfactory result, and the whole left in a tidy and acceptable condition.

The Contractor shall at all times keep the backfilled trenches, particularly those across streets and driveways, filled to grade, and shall make a daily inspection to see that those needing additional fill are attended to. The Contractor shall maintain them in a good and safe condition and will be held responsible for any connection up to the date of final acceptance of the work by Integra Water.

Where mains are laid across State or County highways or City streets and the pavement has been cut to make the installation, the Contractor shall backfill the section under the pavement with an acceptable backfill and tamped in 6" layers for the entire depth of the trench to the densities specified above.

The Contractor shall be responsible for any damage done to paved surfaces or lawns, whether at the site of the work or when moving the equipment from one place to another.

Surfaces of all gravel roads where pipelines are laid shall be brought back to their original condition. If necessary, additional base material as specified by any regulatory authorities shall be spread, smoothed and compacted to the satisfaction of the Engineer.

All excavated areas shall be graded and restored to near original contours or to new grading contours as directed on Plans after backfilling and compaction is completed. Top surface or subgrade should be restored to three (3) inches. Top surface of backfilling should be restored to one (1) inch.

3.8 BACKFILL

Backfilling of sanitary sewer pipe shall be accomplished using the specific backfill material specified in the Plans, the Special Conditions, the Standard Details, or as approved by Integra Water. Alternate materials for backfill may be used if approved by Integra Water.

Stone aggregate backfill shall be crushed limestone, dolomite aggregate, or other suitable material; as approved by Integra Water, in the gradation specified in the Plans or by Integra Water.

Crusher run stone backfill shall be crusher run limestone or dolomite unless a substitute material is approved in writing by Integra Water. Crusher run stone is a local term and may be obtained at any of the local quarries. The maximum sizes screening shall be 2.0 inches (95% to 100% passing a 2.0-inch screen).

Earth backfill shall consist of suitable native materials of low organic content. Stumps, roots, topsoil and other highly organic materials are not acceptable for use as backfill. Earth backfill shall not contain any rocks, stones or boulders which might be large enough to damage or endanger the sanitary sewer pipe. The decision regarding the suitability of a particular material for use as earth backfill will be at the sole discretion of Integra Water.
Adequate tamping is also required to prevent sags in the laid line.

3.9 FOUNDATION BACKFILL

Foundation Backfill is a term used to describe a coarse stone aggregate, which may be used at the direction of Integra Water or its agent to stabilize the bottom of the pipe trench prior to placement of pipe bedding material. Foundation Backfill shall be either crushed limestone or crushed dolomite, unless a substitute material is approved in writing by Integra Water. Integra Water shall determine the gradation(s) to be used.

3.10 BACKFILLING TRENCHES

The backfilling of sewer or other pipeline trenches shall be started immediately after the work has been inspected and approved by Integra Water's Engineer. The initial backfill material as specified in Section 3.6 shall be carefully deposited in 6-inch layers (before compaction) on each side of the pipe and then thoroughly and carefully tamped or rammed around the pipe with approved vibratory compactors or other power tools approved by Integra Water's Engineer to a minimum compaction of 95% of Standard Proctor Density (ASTM D698) where applicable, until enough material has been placed and compacted to provide a cover of not less than one (l) foot over the top of the pipe. Care shall be taken to ensure that material under haunches of pipe is consistently placed, leaving no voids.

Place and tamp bedding haunching and backfill in a manner, which will not damage pipe coatings, wrappings, or encasement. If the trench extends along or across existing paved streets, roadways, alleys or sidewalks, the remainder of the trench shall be backfilled with Crushed Stone according to the Standard Details.

If the trench is along or across a proposed street or roadway, the remainder of the trench shall be backfilled with Crushed Stone or select earth material (as specified in Section 3.6), deposited in uniform layers not to exceed 6 inches in compacted thickness, and compacted to a minimum of 95% Standard Proctor Density. Such compaction shall be verified through appropriate testing methods, conducted by a soil testing laboratory approved by the Integra Water Engineer. Frequency of tests will be at the sole discretion of the Integra Water Engineer to ascertain that this requirement is being met, however, testing will be limited to one passing test per layer per 100 linear feet of trench. The number of failing tests shall be unlimited. It may be necessary to employ an independent laboratory to perform field density tests to ensure proper compaction if there is a question by the Integra Water's Engineer of the Compaction methods and results.

For trenches which do not extend along or across paved streets, roadways, alleys or sidewalks, backfill material from a height of one (1) foot above the top of the pipe upward will not require tamping unless otherwise specified. Backfill material not specified to be tamped shall be as herein before specified, except that a broken stone content of not more than fifty (50) percent by volume of stones not exceeding six (6) inches maximum dimension, will be allowed, if thoroughly mixed with the earth.

Where excavation has been within the limits of easements across private property, the top one (1) foot of backfill materials shall consist of fine, loose earth free from large clods, vegetable matter, debris, stones, and/or other objectionable materials.

Where tamping is not required for the full depth, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Any deficiency in the quantity of

materials for backfilling the trenches, or for filling depressions caused by settlement, shall be supplied by the Contractor.

Where pipe trenches are cut across or along improved streets or roadways, the Contractor shall construct a temporary surface over the cut which will not disintegrate under traffic, and which shall be maintained in good condition under traffic until the permanent pavement has been constructed, or for unpaved streets until the work has been accepted by the Integra Water Engineer. The pavement shall be spread and rolled to accurately conform to the grade of the existing street surface. The trench backfill shall be crushed stone if required by Integra Water, Integra Water's Engineer, or shown on the Plans.

Backfilling around structures located in paved streets shall be done in the manner specified above for pipe trenches by tamping for the full depth of cut from the bottom to the finished grade.

All backfilling shall be done in such manner as will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured, damaged, or moved from its proper line or grade during backfilling operations shall be replaced or repaired and then re-backfilled as herein specified, at the expense of the Contractor.

The Contractor shall replace all surface material and shall restore paving, curbing, sidewalks, gutters, and other surfaces disturbed, to a condition equal to that before the work began.

An impervious clay ditch check shall be required on the downstream side of all stream crossings. This ditch check shall be constructed for a length of fifteen (15) feet as measured along the centerline of the pipe and for the full width and depth of the trench excavation.

3.11 BACKFILL BENEATH FOUNDATION ELEMENTS (I.E. BASE SLABS)

All backfill under foundation elements shall consist of granular structural fill as herein defined.

Initial Backfill

This backfill is defined as the material that is placed over the pipe from the spring line to a point 12 inches above the top of the pipe.

Zone around Pipe: The zone around the pipe shall be backfilled with the materials and to the limits indicated on the standard details in Appendix F. Material shall be compacted by tamping to the percentages shown on the standard details in Appendix F. Uneven places in the backfill shall be leveled by hand.

In areas where large quantities of rock are excavated and the available excavated earth in the immediate vicinity is insufficient for placing the required amount of backfill over the top of the pipe as set forth above, the Contractor shall either haul in earth or order Class I material for backfilling over the pipe. Neither the hauling and placement of earth nor the ordering and placement of Class I material to fulfill the backfill requirements set forth herein is considered a separate pay item.

Packing of crushed stone between joints shall be uniform and progress as the pipe laying progresses. This is in order to avoid danger of misalignment from slides, flooding or other causes.

Final Backfill

There are two cases where the method of final backfilling varies. The various cases and their trench situations are as follows:

- Case I - Areas not subject to vehicular traffic.
- Case II - Paved areas including streets, drives and walks where horizontal borings are not specified.

In all cases, walking or working on the completed pipelines, except as may be necessary in backfilling, will

not be permitted until the trench has been backfilled to a point twelve (12) inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:

Case I – Non-Traffic Areas

The trench shall be backfilled from a point as indicated in the standard details in Appendix F to a point 8 inches below the surface of the ground with earth material free from large rock (over one-half cubic foot in volume), acceptable to Integra Water. The backfill material should be placed in 12 in. lifts and compacted to 95% Standard Proctor Test. The remainder of the trench shall be backfilled with earth material reasonably free of any rocks.

Case II – Traffic Areas

Option 1

The trench shall be backfilled from the top of the pipe to the sub-grade of pavement surface with Class I material. The backfill shall be installed as shown in the standard details located in Appendix F.

Option 2

(This option available for trench depths greater than 15 feet only.) The trench shall be backfilled from a point as indicated on the standard details to a point 6" below dense graded base material with earth material free from large rock (over one-half cubic foot in volume), acceptable to Integra Water. The backfill material should be placed in 6 in. lifts and compacted to 95% Standard Proctor Test. The 6" of pavement subgrade as indicated on the standard details shall be compacted to 100% Standard Proctor Test.

Option 3

Controlled Low Strength (CLSM) or Flowable Backfill

Description: This work shall consist of placing of flowable backfill in lieu of compacted soil or aggregate backfill.

Materials: Cement type shall be approved by Integra Water prior to installation.

Fly Ash shall have no specific requirement for fineness, loss of ignition, or reactivity. Water shall conform to the requirements of Integra Water Technical Specifications.
Aggregates shall conform to the requirements of the Integra Water Technical Specification with a combined gradation as determined by the Contractor.

Admixtures shall conform to the requirements of the Integra Water technical specifications.

Granulated Iron Blast Furnace Slag shall conform to the requirements of these Technical Specifications.

Mixture Design: Mixture design for flowable backfill shall be provided by the Contractor. Flowable backfill shall have a design compressive strength of 30 to 200 psi at 28 days when tested in accordance with AASHTO T-23. Mixture design shall result in a fluid product having an 8 inches to 10 inches slump at time of placement. The Contractor shall submit a mixture design for approval supported by laboratory test data verifying compliance with 28- d a y compressive strength requirements. Mix design shall be approved by Integra Water prior to placement.

Procedures: Mixing and transporting shall be in accordance with these Technical Specifications or by other methods approved by Integra Water.

Temperature of backfill shall be at least 50 degrees Fahrenheit at time of placement. Material shall be protected from freezing for 24 hours after placement.

When used as backfill for pipe and floatation or misalignment occurs, correct alignment of the pipe culvert shall be assured by means of straps, soil anchors or other approved means of restraint.

For temporary measures the Class I material may be brought up to the existing pavement surface. A slight mound may be left if, in the opinion of Integra Water, the public would not be inconvenienced. Extreme care shall be exercised to prevent damage to the pipe during the backfilling operation.

Remainder of Trench

The remainder of the trench (above the zone around the pipe) shall be compacted by tamping as shown on the Integra Water Standard Details in Appendix F. If the material is to be compacted by tamping or, under appropriate circumstances, rolling, the material shall be deposited and spread in uniform, parallel layers. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible and it can be done effectively and without damage to the pipe, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor. If necessary, to ensure proper compaction by tamping (or rolling), the material shall first be wet by sprinkling. However, no compaction by tamping (or rolling) shall be done when the material is too wet either from rain or too great an application of water to be compacted properly; at such times, the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain propercompaction.

Miscellaneous Requirements

Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. Only suitable quantities of stone and rock fragments shall be used in the backfill. The Contractor shall, as part of the work done under the items involving earth excavation and rock excavation as appropriate, furnish and place all other necessary backfillmaterial.

All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.

Excavated material, which is acceptable to the Engineer for surfacing or pavement subbase shall be placed at the top of the backfill to such depths as may be specified elsewhere or as directed. The surface shall be brought to required grade and stones raked out and removed.

Class I – Backfill limitations – Crushed stone or DOT# 78 stone shall be limited to the dimensions specified on the standard details in Appendix F for payment purposes.

A sufficient amount of Class II material shall be stockpiled to insure immediate replacement by the Contractor of any settled areas.

Compaction

Control soil compaction during construction providing minimum percentage of density specified for each area classification indicatedbelow.

Granular structural fill under foundation elements, i.e., footings and base slabs for manholes and vaults shall be compacted to 100% Standard Proctor Density, at a moisture content between 2 percent below to 3 percent above the optimum moisturecontent.

Native soils used as fill under foundation elements shall be placed in maximum eight-inch loose lifts and compacted to a minimum dry density of 100% of the Standard Proctor density at a moisture content between 2 percent below to 3 percent above the optimum moisture content.

Moisture Control

Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface or subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing, or pulverizing until moisture content is reduced to the optimum moisture for compaction.

Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift. All backfill and fill materials shall be compacted per Integra Water Standard Details.

Grading

Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

Compaction

After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or standard proctor density for each area classification.

Slope Protection and Erosion Control

Conform to the requirements of the Department of Transportation Standard Specifications. Slope protection and erosion control shall be maintained throughout the entire construction period and until grassed areas are well established.

Field Quality Control

Quality Control Testing During Construction: Allow the Geotechnical Engineer to inspect and report to Integra Water on findings and approve sub-grades and fill layers before further construction work is performed. Perform field density tests in accordance with ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2992 (nuclear density method), as applicable and at a frequency necessary to be reasonably assured that adequate compaction is achieved.

If in the opinion of Integra Water, based on testing service reports and inspection, subgrade or fills, which have been placed are below specified density, the Contractor shall provide additional compaction and testing at no additional expense to Integra Water.

Maintenance

Reconditioning Compacted Areas

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

Settling

Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, or other finish), add backfill material, compact, and replace

surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

Disposal of Excess Non-Organic Soil and Ro

All excess excavated material shall become the property of the Contractor and shall be disposed by him outside the project limits. It is the Contractor's responsibility to locate a suitable legal waste area off-site, obtain necessary permits or use of the waste area and be in compliance with applicable laws and regulations.

3.12 OBSTRUCTIONS

Each building, wall, fence, pole, bridge, railroad, driveway or other property or improvement encountered is to be carefully protected from all injury, and in the event that any of the foregoing are damaged or removed during the progress of the work the same shall be repaired or replaced within a reasonable time, and before final acceptance of the work shall be returned to as good condition as before the work started. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays and the danger of injury resulting there from, and the Contractor must use care in all phases of the construction work, for he will be held liable for damages caused by carelessness.

In excavating, backfilling and laying pipe care must be taken not to remove, disturb or injure any water or gas pipes or other conduits or structures. If necessary, the Contractor, shall sling, shore up and maintain such structures in operation. Before final acceptance of the work, he shall return all such structures to as good condition as before the work started.

When necessary, the Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any pipes, conduits, etc., and shall abide by their regulations governing such work. In the event that any subsurface structure becomes broken or damaged in the prosecution of the work, the Contractor shall immediately notify the proper authorities, and shall be responsible for all damage to persons or property caused by such breaks. Failure of the Contractor to promptly notify the affected authorities shall make him liable for any needless loss or for interference with the normal operation of the utility.

When pipes or conduits are broken during the progress of the work, the Contractor shall repair them at once at his own expense, or if required by the utility involved, shall pay the utility the proper charges for having such repairs made by the utility's own forces. Delays, such as would result in buildings being without service overnight or for a needlessly long period during the day, will not be tolerated, and Integra Water reserves the right to make repairs at the Contractor's expense without prior notice. Should it become necessary to move the position of pipe, conduit or structure it will be done by the Contractor in strict accordance with the instructions given by the Engineer or utility involved.

Integra Water will not be liable for any claim made by the Contractor based on underground obstructions being different to that indicated in these contract documents or plans. Where ordered by the Engineer, the Contractor shall uncover subsurface obstructions in advance of construction so that the method of avoiding them may be determined before pipe laying reaches the obstruction. Furthermore, the Contractor shall notify all utility companies involved of his intention to excavate in the locations specified and request that any underground cables be located in advance of construction work.

The Contractor shall notify all utilities involved of his intention to excavate in the locations specified and request that any underground utilities be located in advance of the construction work. The Contractor shall uncover subsurface obstructions in advance of construction so that the method of avoiding them may be determined before pipe laying reaches the obstruction.

3.13 SHEETING AND SHORING

The Contractor shall provide such bracing, sheeting or shoring as may be necessary for the protection of life and property, or where such protection is specifically required by the Engineer because of potential

danger to life, property or the completed structure. Sheeting will be required where necessary to restrict the trench width to acceptable limits above the top of pipe.

Sheeting and shoring shall be furnished and placed in accordance with the requirements of OSHA, "Safety and Health Regulations for Construction", as published in the Federal Register, latest revision. Trench sheeting, where used, shall remain in place until the pipe has been laid, tested for defects, repaired, and until backfill material and earth have been compacted around the pipe and over the pipe to a level at least one foot above the top of the pipe.

If trench support is used, the Contractor shall follow the recommendations made by the manufacture of the pipe and contained in UNIB-5 "Recommended Practice for the Installation of PVC Sewer Pipe. If movable sheeting is used, the recommendations contained in UNI-B-5 section 5.8.5 shall be followed regardless of the type of pipe.

If trench sloping is substituted for shoring, the slope shall be in accordance with all OSHA requirements. The sloping of the trench wall shall terminate twelve inches above the top of the pipe and, from that point to the trench bottom; the trench wall shall be vertical. Paving width restrictions for pay purpose are shown on the drawings.

Sheeting, shoring or bracing shall conform to applicable safety codes and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above top of pipe. The bracing or sheeting may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least 18 inches below the finished ground level.

Care shall be taken in removing sheeting to avoid weakening the trench, increasing the backfill load, or endangering adjacent property. Voids left by the removal of sheeting shall be filled in and compacted with suitable material using tamps intended for this purpose.

Supporting Systems, such as piling, cribbing, shoring, and bracing, shall be designed by a qualified Contractor’s representative and meet accepted engineering requirements.

Take special precautions in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or a fill, particularly when the separation is less than the depth of the excavation.

The Contractor shall be held responsible for the sufficiency of all sheeting and bracing used, and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining, or removing of the same. This includes damage to trees, sidewalks, and to other property on the project site, as well as private grounds.

Drive sheeting ahead of excavation. Do not remove sheeting until the excavation backfill has reached within 2 feet of the top of the excavation, except the lower course of sheeting may be removed from a double-sheeted excavation. When sheeting is drawn, completely fill all cavities remaining in or adjoining the excavation. When sheeting is left in place, completely fill all cavities behind such sheeting.

If it is necessary to place or operate power shovels, derricks, trucks, materials, or other heavy objects on a level above or near an excavation, sheet pile, shore and brace the sides of the excavation as necessary to resist the extra pressure due to such superimposed loads.

3.14 ROCK REMOVAL

Construction Requirements

References: NFPA 495 - Code for the Manufacture, Transportation, Storage and Use of Explosive Materials.

Quality Assurance
Seismic Survey Firm: Company specializing in seismic surveys with five years documented experience.

Explosives Firm
Company specializing in explosives for disintegration of subsurface rock with five years documented experience.

Regulatory Requirements
Conform to Regulating Authority code for explosive disintegration of rock.
Obtain permits from local authorities having jurisdiction before explosives are brought to site or drilling is started.

Contractor shall conform to all State, Federal, and local laws, ordinances and regulations in regard to transportation, use, and handling of explosives.
Indicate proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock recovery method.

Blasting shall be coordinated through the Fire Department. The Contractor shall adhere to all local ordinances.

Inspection
The Contractor shall verify site conditions and note irregularities affecting work of this Section.

A pre-blast survey must be performed on all structures within a 1500-foot radius of all blast sites, in accordance with the Department of Transportation's standard specifications.

Beginning work of this Section means acceptance of existing condition.

Payment
If set up as a separate pay item, the volume of rock paid for will be that from the bottom of the trench, at the elevations specified, or from the bottom of the rock if it lies above the bottom of the trench, to the top of the rock, the form being a prism with vertical sides, and the maximum width of the prism shall not exceed the external diameter of the pipe plus 18 inches. In no case shall any rock be left nearer than 6 inches from the outside of the pipe.

Mechanical Methods
Cut away rock at excavation bottom to form even surface.

In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

Explosives Methods
If rock is uncovered requiring the explosives method for rock disintegration, notify Integra Water. See Section 3.14 for blasting requirements.

Field Quality Control
Integra Water shall approve of final rock cut.

If rock is excavated beyond the limits of excavation indicated on the Plans, specified or authorized in writing by Integra Water, the excess excavation, whether resulting from over breakage or other causes, shall be backfilled by and at the expense of the Contractor, as specified below in this section.

In pipe trenches, excess excavation below the elevation of the top of the bedding, cradle, or envelope shall be filled with material of the same type, placed and compacted in the same manner as specified for the bedding, cradle, or envelope. Excess excavation above said elevation shall be filled with earth.

Rock soundings shall be at intervals of no greater than 500 feet along the proposed sewer line and to at least one foot below the depth of the sewer at the location of the sounding. The soundings shall be conducting at closer intervals, if rock is encountered, as determined by Integra Water.

Geotechnical Reports shall be included with bid documents when applicable. The Geotechnical Reports shall be intended for informational purposes only. The inclusion of these Reports does not relieve the Contractor of the responsibility to investigate and make determinations as to soil types, stability, groundwater level, bearing pressures, etc. in the work areas.

Shattering Rock

Shattering rock at ends of pipe and elsewhere as indicated on the Plans shall be done by drilling and blasting a single line of holes in the vertical face of the rock at the end of the trench.

Drill holes shall have a minimum depth of 4 feet and maximum spacing of 18 in. on centers. Sufficient explosive shall be used to shatter the rock for future excavation. Shattering shall be completed before any pipe or fitting is placed within 50 feet of rock to be shattered.

If the rock below normal depth is shattered due to drilling or blasting operations of the Contractor, and the Integra Water considers such shattered rock to be unfit for foundations, the shattered rock shall be removed, and the excavation shall be backfilled with gravel. All such removal and backfilling shall be done by and at the expense of the Contractor.

Preparation of Rock Surfaces

Whenever so directed during the progress of the work, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly, using steam to melt snow and ice if necessary. Water in depressions shall then be removed as required so that the whole surface of the designated area can be inspected to determine whether seams or other defects exist.

The surfaces of rock foundations shall be left sufficiently rough to bond well with the masonry and embankments to be built thereon and, if required, shall be cut to rough benches or steps.

Before any masonry or embankment is built on or against the rock, the rock shall be scrupulously freed from all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances.

Picking, barring, wedging, streams of water under sufficient pressure, stiff brushes, hammers, steam jets, and other effective means shall be used to accomplish this cleaning. All free water left on the surface of the rock shall be removed.

Piles of boulders or loose rock encountered within the limits of earth embankments shall be removed to a suitable place of disposal.

Excavated rock may be used in backfilling trenches subject to the following limitations:

- The quantity of rock used as backfill in any location shall not be so great as to result in the formation of voids.
- Rock backfill shall not be placed within 16 in. of the surface of the finish grade.

Surplus excavated rock shall be disposed of as specified for surplus excavated material as specified under Section 3.5.

3.15 BLASTING

All operations involving explosives shall be conducted with all possible care to avoid injury to persons and property. The Contractor shall be fully responsible for the protection of lines and property from any harm or damage as would result from exposure to the construction work. The Contractor shall, in all his acts and work, comply with the safety and health regulations referred to hereinabove and with all local ordinances

and regulations pertaining to the work. The area of the work shall be isolated by warning signs and barricades; guards shall be stationed to prevent entry into the area; and efficient and adequate signal system shall be employed to give warning before blasting; and it shall be the responsibility of the Contract to determine that the area is clear before the signal to fire is given. The handling, storing, loading, and firing of explosives shall be performed only by workmen experienced in blasting work. The Contractor hereby agrees to indemnify and save harmless Integra Water against all claims, damages, and expense arising from or caused by, in any manner whatsoever, the handling, storage, or use of explosives on the work, or by any blasting on the work. Blasting shall be done only with such quantities and strengths of explosives and in such manner as will break the rock approximately to the intended lines and grades and yet will leave the rock not to be excavated in an unshattered condition. Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing structures, and any such damage caused shall be promptly repaired by the Contractor at his expense.

Care shall be taken to avoid excessive cracking of the rock upon or against which any structure will be built and to prevent injury to existing pipes or other structures and property above or below ground.

Rock shall be well covered with logs or mats or both where required.

Sufficient warning shall be given to all persons in the vicinity of the work before a charge is exploded.
All blasting shall be completed within a distance of 50 feet before any portion of a structure is placed or any pipe is laid.

All Blasting will be monitored with a blasting seismograph that meets or exceeds the ISEE Blasting Seismograph Performance Standards, and that has been deployed in the field according to the ISEE Field Practice Guidelines for Blasting Seismographs. Drilling and blasting methods used in rock excavation shall be optional with the Contractor but shall be conducted with due regard to the safety of persons and property in the vicinity of the work and in strict conformity with all laws, ordinances, and regulations governing blasting and the use of explosives. Rock excavation near structures of all types shall be con- ducted with the utmost care, and every precaution shall be taken to prevent damage to adjacent pipes or structures. The Contractor or his insurer shall conduct a preblast survey of all structures to determine the existing or preblasting condition, such survey being a written description with special emphasis on defects and documented with appropriate photographs. This survey is intended to serve as a basis of comparison for any postblast claims that may arise. The Contractor will furnish Integra Water with a complete copy of said survey prior to initiation of any blasting. The Contractor or his insurer shall obtain the services of a competent vibration or seismologist consultant to conduct blast noise, vibration and overpressure surveys at periodic intervals during the progress of the blasting operations. Any damage or injury of whatever nature to persons or property caused directly or indirectly by blasting operations shall be promptly repaired, replaced or compensated for by the Contractor at his own expense and to the satisfaction of the persons injured or Integra Water of the damaged property. It is the intent of this Section to serve as protection to the Contractor to minimize the postblast claims and not to require unwarranted work. The Contractor shall use every precaution available and practical to minimize ground vibration, noise and overpressure. The Contractor and his insurer shall indemnify and save harmless Integra Water and all their representatives from all claims for damages arising out of the use, transportation, or storage of explosives.

The Contractor or his insurer shall perform pre-blast surveys of all structures within 1500 feet of the blasting areas to document and photograph the pre-existing conditions.

The Contractor shall employ the services of a registered professional engineer licensed in the working State with a minimum of five years' experience in pipeline construction to design and approve all blasting procedures used in the removal of rock. All primary and secondary blasting shall be monitored by a registered blasting consultant to conduct daily blast noise, vibration and overpressure surveys during the progress of blasting operations.

The limit for each charge will be set to limit the effects to air concussion or air blast of 0.03 psi maximum (140 dBL), particle velocities shall be a maximum of 1.00 inch/second measured from locations directed by the Engineer.

The Contractor shall keep and submit to Integra Water an accurate record of each blast. The record shall show the general location of the blast, the depth and number of drill holes, the kind and quantity of explosive used, kind and number and interval of delay periods used, and other data required for a complete record

The observation of safety provisions of applicable laws and local building and construction codes shall be the responsibility of the Contractor and the Developer. Persons responsible for blasting shall be present and supervise all blasting design, loading and shot firing at all times.

The Contractor is reminded that he has sole and complete responsibility for the conditions on, in, or near the job site, including safety of all persons and property during the performance of the work.

The required duty of the Integra Water's Engineer to conduct construction review of the Contractor's performance does not, and is not intended to, include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

3.16 PIPELINES UNDER PAVEMENT

Where mains are to be laid under paved streets or parking lots, and the installation of casing pipe or the use of cast iron pipe inserted in a bored hole is not required or specified, the Contractor will be permitted to cut and replace this pavement. In the event that subsurface operations result in injury or damage to the pavement, the necessary repairs shall be made by the Contractor.

Where pipelines are to be laid underneath paved sidewalks, the Contractor will be required to install them by means of a boring machine, auger or other suitable apparatus wherever possible, and where it becomes necessary to cut and replace the sidewalk it shall be replaced as soon as practicable after the trench has been backfilled and tamped. The replaced surface shall be 12 inches wider than the width of the trench, the excess width being equally distributed on both sides.

3.17 SPECIAL STRUCTURES

Junction boxes and special manholes shall be constructed of 3000-pound reinforced concrete or per construction drawings.

Headwalls where required shall be constructed of 3000-pound reinforced concrete.

3.18 PERMITS

It is the responsibility of the Developer and/or the Contractor to have all necessary permit applications from State or County Highway Departments, Municipal Street Departments, Railroads, and Utility Companies. Permit applications shall be prepared by the Developer and/or Contractor even though a contract agreement may exist between the Developer and Integra Water.

The Contractor may be required under the terms of this contract to furnish the performance bond, insurance coverage, and any other security required by the Developer, either directly from him or indirectly from Integra Water.

3.19 SAFETY PRECAUTIONS

The Contractor and he alone shall be liable for any claims or law suits made or filed in connection with damages, injuries, loss of life or other accidents caused by his construction operations or due to his negligence or the negligence of his employees in taking proper and adequate precautions to insure the safety of the general public, his own employees, or any other person, or due to unforeseen accidents incident to the work such as trench cave-ins, ruptured water, power, gas or sewer pipes, conduits or cables. The Contractor shall comply with all applicable OSHA requirements.

Flagmen shall be placed along public streets and highways as work is being installed along them and the necessary warning barricades and blinking lights shall be set out each night to clearly mark the areas under construction.

All ditches shall be shored and braced where necessary and the excavated material shall be kept a safe distance away from the ditch. Safety precautions instituted along State Highway rights-of-way shall always conform to the requirements of the State Highway Department and such additional flagmen or other precautions as may be deemed necessary will also be provided by the Contractor.

The Contractor, and he alone, shall be solely responsible for the adoption of all necessary safety standards and precautions, and for the implementation institution, maintenance, supervision of and payment for all devices and arrangements required to carry out the requirements of such standards. He shall hold and save harmless Integra Water or any employees thereof against all actions or suits filed in connection with any accidents or damage to property caused by inadequate or insufficient safety precautions being placed in effect by him to ensure the complete safety of all construction, inspection or supervisory forces employed around the project, or of the general public.

3.20 PREPARING FOR PIPEINSTALLATION

The Contractor shall use only experienced men in the final assembly of pipe in the trench, and all pipe shall be laid in accordance with these Specifications and the recommended practice of the pipe manufacturer. Trench bottoms shall be carefully prepared, shall be free of water and bedding as specified shall be in place. Care shall be exercised to ensure that pipe of the proper strength or classification meeting the specifications in every respect is provided at the site of pipe laying operations.

Recommended tools, equipment, lubricant and other accessories needed for proper assembly or installation of the pipe shall be provided at the site of the work. Any damaged or defective pipe discovered during the pipe laying operations shall be discarded and removed from the site of the pipe laying operations.

Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the Engineer and Integra Water and must produce the desired results. The top of the bedding material must be brought to the exact grade and must be shaped so as to provide effective support for the bottom quadrant of the pipe except at the bells.

The Contractor shall exercise care in the storage and handling of pipe, both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site of laying operations, and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

Following the laying of the pipe, the pipe shall be centered in the trench, adjusted to line and grade and the initial bedding material shall be carefully placed on both sides of the pipe so as not to disturb the alignment and grade of the pipeline. The bedding material shall be placed under the haunches of the pipe and compacted to fill all voids. Placement shall be performed when the bedding material is no higher than one- fourth of the pipe diameter.

The Contractor shall, at all times during construction, provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work and shall keep said excavation and work dry until the structures to be built therein are completed, or until the Engineers direct the Contractor to discontinue dewatering operations. Wherever judged necessary by the Engineer, the Contractor shall employ well points to insure a dry excavation.

The trench shall be so drained that workmen can work safely and efficiently therein. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property owners. It is essential that the discharge from trench pumps be led to natural drainage channels. No water shall be

drained into work built under construction unless the consent of the Engineer is first obtained.

Angular stone used for foundation and bedding material as specified above shall be No. 67 Coarse Aggregate as defined by the following gradation standards and the latest AHD specifications:

Table 3-1
#67 Stone Aggregate Gradation

Percent Passing	Sieve No.
100	1”
90-100	¾”
20-55	3/8”
0-10	#4
0-5	#8

In places where the trench has been excavated along the side of a paved street not provided with curb and gutter or where construction operations or the weather have spread the excavated material over the surfaces of unpaved streets, the Contractor shall employ a heavy duty motor grader to clean out the side ditches, shape the shoulders and restore the smoothness of the street surface to as good a condition as existed before the work was started. In the event that excavations on the shoulders of streets indicate that washouts or collapse of the shoulder are liable to occur, the backfill shall be carefully tamped and any earth washed out prior to the date of final acceptance shall be replaced. The use of mechanical equipment for this work does not remove from the Contractor the obligation to employ hand labor for final dressing up.

All pipe shall be installed in strict accordance with the latest published recommendations of the manufacturer, with particular regard to the preparation of the trench bottom, making of joints, and backfill material, placement and compaction.

Each section of pipe shall be inspected and cleaned before being placed in position and it shall be arranged so that any permissible defects are at the top. Earth shall be scraped and tamped under the pipe where necessary to bring it to correct line and grade. Pipe shall be laid with the bell up-grade.

The bell of each joint shall be wiped clean before the gasket is inserted in it and the gasket covered with lubricant before the pipe sections are jointed together.

When construction of the sewer has been completed, it shall be to all intents and purposes substantially dry and there shall be no visible infiltration.

It is desired that trench widths from a point 1 foot above the top of the pipe down to the bottom of the trench be held to a minimum consistent with the provisions of necessary space for proper assembly of the pipe. In general, the trench width shall not exceed the nominal pipe diameter plus 16 inches.

3.21 PIPE BEDDING

All pipe shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be Class I and shall be placed to a depth of 6 inches in a stable earth trench and 12 inches in a rock or unstable earth trench. The Contractor will not be permitted to use dense graded aggregate material for pipe bedding.

Pipe bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.

After each pipe has been brought to grade, aligned, and placed in final position, Class I material shall be deposited and densified under the pipe haunches and on each side of the pipe, up to the spring line of the pipe or as indicated on the standard details in Appendix F, to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.

In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.

Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required DOT #78 crushed stone aggregate bedding material can be placed.

No pipe shall be laid on solid or blasted rock.

All sanitary sewer pipe shall be bedded on stone aggregate meeting the requirements of this Section or approved by Integra Water and as specified in Appendix F Standard Details, or as specifically modified in the Plans or the Special Conditions. Aggregates used for pipe bedding shall be either crushed limestone or crushed dolomite. The use of slag will not be allowed. Gradations of aggregates shall be as specified by Integra Water for the specific bedding called for on the Plans or by Integra Water. Where concrete bedding is required on the Plans or by Integra Water, the concrete shall be Class B conforming to the requirements of Section 2.9.

The amount of deleterious substances in coarse aggregates shall not exceed the following limits:

- Soft Particles 5.00%
- Coal and Lignite 0.25%
- Coal Lumps 0.25%
- Material Passing the No. 200 Sieve 1.00%
- Thin or Elongated Pieces (length greater than 5 times avg. thickness) 10.00%
- Other Deleterious Substances (Shale, Mica, highly absorbent particles and Marcasite, etc.) 2.00%
- Total (a) - (f), excluding (e) above 6.00%

Bedding material shall have a minimum thickness beneath the pipe of 4 inches or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe when not specified.

In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation.
Bell holes shall be excavated in advance of pipe laying, so the entire barrel will bear uniformly.

Pipe bedding shall be placed below the barrel of the pipe, across the full width of the trench, to the minimum depth indicated on the Standard Details in Appendix F. Bedding shall be compacted to the exact grade or the full length of the pipe barrel and for the full width of the trench before each pipe is laid backfill material shall be thoroughly compacted by use of pneumatic or mechanical tamping
equipment or by other approved methods. Where appropriate, sling or cable grooves shall be excavated at proper intervals to facilitate installation of pipe.

Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. The Contractor shall not open up at any time more trench than his available pumping facilities are able to dewater. Movement of water that would tend to erode or affect the trench walls or bottom will not be allowed. Ground water will not be allowed to be pumped or discharged into the existing sewer system.

As the work progresses, the interior of all pipe in place shall be thoroughly cleaned. After each line of pipe has been laid, it shall be carefully inspected, and all earth, trash, rags, and other foreign matter removed from the interior.

Backfilling of trenches shall be started immediately after the pipe is in place and the joints completed and, if desired, inspected and accepted by us. Trench backfilling shall be accomplished in accordance with Section 3.8.

3.22 PIPE LAYING

The Contractor is responsible for accurately placing pipe to the exact line and grade called for on the Plans. The control of vertical and horizontal alignments shall be accomplished by the use of a laser beam instrument. When a laser is used, the elevation and alignment of the pipe shall be checked by transit and level rod every 50 feet for smaller pipe and every joint for pipe 48 inches and larger. Other approved methods of controlling vertical and horizontal alignments may be used if specifically authorized by Integra Water. The pipe section may be adjusted by use of "come-along" of approved design and anchorage. The practice of bumping or snatching (with backhoe or crane, etc.) to adjust pipe after placement in the trench, will not be permitted. The Contractor shall furnish all labor and materials necessary for controlling the line and grade. At the end of each working day the Contractor shall plug all ends of lines with a water-tight plug.

Each piece of pipe and special fitting shall be carefully inspected before it is placed. No defective pipe shall be laid in the trench. Before sewer pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared. Pipe laying shall proceed up-grade, starting at the lower end of the grade and with the bells up-grade. Trench bottoms found to be unsuitable for foundations shall be undercut and brought to exact line and grade with foundation material in accordance with Section 3.8.

After the pipe has been cleaned and inspected for defects and lowered into the trench, the mating surfaces of the compression joint shall be wiped clean and coated with lubricant of a type supplied by the pipe manufacturer. The pipe shall then be assembled with due care being taken to ensure that the spigot end of the pipe is shoved home and that the pipe is left in proper grade and alignment.

Whenever pipe laying operations are to be discontinued for a period of time exceeding 2 hours, the end of the pipe shall be carefully secured to avoid displacement or misalignment and a tight-fitting plug or stopper shall be placed in the line. Upon resumption of laying operations, the plug or stopper shall not be removed from the line until any water, mud or other debris has been removed to avoid entry into the completed section of the sewer.

Installation of sewer pipe including force mains shall conform to provisions of these Specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer and lubricants shall be delivered to the job site in properly labeled, unopened containers. The Contractor shall keep accurate records of their location.

Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions, the cutting may be made with either hand or mechanical saws or plastic pipe cutters. The cut shall be square and perpendicular to the pipe axis. The cut end shall be beveled to as closely resemble the factory bevels as possible. Assemble all joints in accordance with recommendations of the manufacturer.

Where ductile iron pipe is shown, specified or directed by the Engineer the pipe shall be of the type and class as indicated. Ductile iron pipe to be installed in trenches shall be laid on crushed stone bedding and shall be backfilled with compacted crushed stone around and above the pipe as specified for other pipe materials. The bedding material shall be shaped to provide continuous support for the ductile iron pipe throughout its length except at bells. Whenever it is necessary to cut a joint in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave a smooth end at right angles to the axis of the bore and the end shall be beveled or finished as required to make the joint without risk of damage to the gasket. In stream crossings, ravines, shallow cuts and other locations where the pipe will not be laid on

bedding placed on original subgrade the pipe shall be supported on concrete piers as detailed in the plans.

Piers shall be of Class A concrete with reinforcing as shown. The tops of piers shall be carefully set at the exact elevation and shall be shaped so as to provide support for the bottom half of the pipe with allowance being made for the outside diameter of the pipe plus the thickness of a layer of tarred felt around the outside of the pipe. After the concrete has obtained satisfactory strength the ductile iron pipe may be installed across the piers using one or more layers of tarred felt between the surface of the concrete and the outside diameter of the pipe. The Contractor may, at his option, install the pipe to exact grade and alignment using temporary supports and then construct the permanent piers for the pipe, provided suitable precautions are taken to avoid any misalignment during the construction of the piers.

Lower no pipes and fittings into the trench until they have been swabbed to remove any mud, debris, etc. that may have accumulated within them. After the pipe has been lowered, remove all unnecessary materials from it. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell and ensure that the pipe is dry andoil-free.

Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside it, then place a heavy, tightly woven canvas bag of suitable size over each end of the pipe and leave it there until it is time to connect that pipe to the one adjacent to it.

Place no debris, tools, clothing, or other materials in the pipe during laying operations. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material aroundit.

Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

Whenever pipe laying is not in progress, close the open ends of pipe in the trench that cannot be completed until a later time with packing in order to make them as watertight as possible. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, this seal shall remain in place until the trench has been pumped completely dry. The cutting of pipe so that fittings or closure pieces can be inserted shall be done in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

Unless otherwise directed by the Engineer, lay pipe with the bell ends facing in the direction of laying. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions of plumb stems or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the Engineer. Lay no pipe in water or when it is the Engineer's opinion that trench conditions are unsuitable. Install thrust blocks wherever the force main changes direction (e.g., at bends), at dead ends, or at any other point where the manufacturer recommends, and/or the Engineer indicates that they are to beused.

Make all joints, whether standard mechanical or push-on joints, in conformance with the recommendations of the joint manufacturer or as approved by the Engineer. The detectable tape and 14-guage insulated copper tracer wire shall be buried in the utility line trench directly above the installation to be identified. The tracer wire shall be placed directly on top of the pressure sewer and the marking tape shall be placed 15-inches from finish grade of the trench. The tape shall be placed in the trench with the printed side up and be essentially parallel to the finished surface. The Contractor will take necessary precautions to ensure that the tape and tracer wire are not pulled, distorted, or otherwise misplaced in completing the trench backfill.

3.23 CONNECTION TO EXISTING SYSTEM

No pipe shall be connected to the existing sewage system until all new upstream construction has been completed, tested, and free of foreign materials and obvious defects have been corrected. In addition, Integra Water must give approval for connection. New lines, then, must remain disconnected from the existing system by actual physical separation, by plugs of a type approved by Integra Water, or by other means approved by Integra Water. A note on the construction plans stating this requirement shall be required for the approval of the plans.

Where "cut in" connection is indicated on the plans or directed by the Engineer, the Contractor shall connect the new mains to, and install valves in, the existing mains. These connections will normally be made in the afternoon, but when required to do so, the Contractor shall be prepared to make them at night. Before any existing mains are cut the Contractor will work out a plan of procedure with Integra's representative.

The Contractor will not be permitted to cut the existing main until he has everything ready to make the connection. The Contractor shall be fully and properly equipped to do the work entirely with his own resources. Failure to have everything in readiness to the satisfaction of Integra Water may result in a postponement of the connection.

Where indicated on the plans, tapping sleeve and valves shall be used to make the connection. Where used, the tapping sleeve and valve shall be subjected to an air pressure test of 90 psi for 10 minutes.

3.24 CLEAN-UP PROCEDURES AND REQUIREMENTS

As soon as the backfilling of any excavation is completed and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the filling unless otherwise provided in the special specifications. He shall also remove all the pipe and other material placed or left on the street by him except material needed for the replacement of paving, and the street shall be opened up and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces, bridges, crossings and all places affected by the work shall be done as promptly as possible.

Before final acceptance of the work all surfaces shall be returned to as good condition as before the work started. All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, etc., using hand labor where necessary to achieve a satisfactory result, and the whole left in a tidy and acceptable condition. All disturbed areas along highway rights-of-way shall be regrassed and dressed up to the requirements and satisfaction of the Highway Department.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable conditions. Contractor will be required to re-grass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral ground by his operations. Rough clean-up shall consist of removal of rocks larger than 1 foot in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same.

Rough clean up shall, in general, be prosecuted no later than 1 day after pipe laying and backfilling or no farther behind pipe laying operations than 1000 feet, whichever time limit is shortest shall govern. Final clean up consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc., of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall, in general, be prosecuted no later than 2 weeks after pipe has been laid and backfilled.

3.25 DISPOSAL OF MATERIALS

All materials removed by excavation which are suitable for the purpose shall be used whenever practicable for backfilling and for such other purposes as may be shown on the Plans or directed by the Integra Water Engineer. All materials not used for such purposes shall be considered as waste materials and disposed of by the Contractor in an approved manner.

Waste materials may be deposited in spoil banks at locations to be obtained by the Contractor and authorized by the Integra Water Engineer. Such materials shall not be left in unsightly piles but shall be spread in uniform layers and neatly leveled and shaped to the satisfaction of the property owner. Spoil banks shall be provided with adequate openings to permit surface drainage of adjacent lands. No waste or surplus materials shall be placed or permitted to be used at points below the flow line of open channels nor within the flood plain.

On completion of any part of the work, proper disposal shall be made of all surplus or unused materials left within the construction limits of such work and the surface of the work left in a neat and workmanlike condition.

All excavated areas, backfills, embankments, trenches, access road grading, and ditches shall be maintained by the Contractor in good condition at all times until final acceptance of the work by Integra Water.

Where materials are to be disposed of on private property, the Contractor shall furnish to Integra Water a copy of a written release signed and approved by the private property owner, allowing the Contractor to dispose of the waste material on that private property, prior to beginning disposal operations.

3.26 CONSTRUCTION SEQUENCE CONSTRAINTS

Sections of sewer under construction upstream of an existing or recently accepted sewer shall be kept isolated, by means of a plug or semi-permanent bulkhead, until the section under construction has been fully tested and accepted by an Integra Water Representative. The plug or bulkhead may be removed only with the permission of an Integra Water Representative.

New sections of sewer shall be constructed, when feasible, from the lower end to the higher end so that testing and acceptance can proceed in a logical sequence and new sections placed into service.

Sanitary sewage may not be discharged into any section of sewer upstream of uncompleted or unaccepted sections, unless special arrangements have been made to divert the flow into the existing Integra Water's system. An Integra Water Representative must approve such special arrangements prior to implementation.

3.27 JOINT CONSTRUCTION

Each joint shall be laid so it will form a close concentric joint with adjoining pipe and so as to avoid sudden offsets or inequalities in the flow line. For bell and spigot pipe the inside of all bells and the outside of all spigots shall be wiped to remove all dirt, water, or other foreign matter so that their surfaces are clean and dry when the pipes are joined.

Any leaks or defects discovered at any time after completion of work shall be repaired immediately. All pipe in place shall be carefully protected from damage until the backfilling operations have been completed. Any pipe which has been disturbed after jointing shall be taken up, the joint cleaned and remade and the pipe re-laid at the Contractor's expense.

Contractor is referred to Article 2 for additional specifications regarding joints for specific types of pipe.

All pipe joints will be made in accordance with the pipe manufacturer's recommendations and appropriate AWWA and ASTM Specifications.

3.28 LEAKAGE AND INFILTRATION

The Contractor will test the sewer as directed by Integra Water's Representative, in accordance with Specifications applying to infiltration and exfiltration. Integra Water reserves the right to participate in all such tests as prescribed herein. Integra Water's Engineer shall be the judge of the final acceptance of the work.

All pipe joints shall be as near watertight as it is practicable to construct them with the material and methods specified herein.

3.29 GRAVITY SERVICE CONNECTIONS

Ductile Iron, mechanical joint wyes shall be installed in sanitary sewer lines at all points shown on the Plans and in accordance with the Standard Details. If such wyes are not to be used immediately, they shall be closed with approved stoppers and shall be physically restrained.

If the work consists of the construction of a sewer that is to replace an existing sewer, all existing service lines shall be connected to the new sewer, and the location of the connection recorded by station for record drawing purposes.

Wyes shall be installed in sanitary sewers so as to properly serve each existing house, active service or inactive, and each vacant lot facing or abutting on the street or alley in which the sewer is being laid and at such other locations as may be designated by Integra Water's Representative. . The exact location of each connection shall be recorded by the Contractor before backfilling and indicated on the As-Constructed Plans.

Wyes for new sewer pipe shall be ductile iron, mechanical joint.

3.30 CONNECTING RISERS

Where shown on the Plans, included in the Special Conditions, or directed by Integra Water's Engineer, and where the depth of cut is over 8 feet or where the grade of a sanitary sewer is lower than necessary to drain abutting property, and at such other locations as may be designated by Integra Water's Engineer, connecting risers shall be installed to serve each existing house and each vacant lot facing or abutting on the street on which the sewer is being laid.

Connecting risers shall be sized in accordance with the plumbing code in effect at the time of construction but shall not be smaller in size than shown on the Plans. Risers shall be installed from a tee connection to the elevation shown on the Plans, or as directed by Integra Water's Engineer. Open ends of connecting risers shall be closed with approved stoppers and be physically restrained. Backfilling shall be carefully done around these risers using materials specified and, compacted to the equivalent density of the surrounding undisturbed material. The Engineer may direct that connecting risers be constructed of ductile iron pipe when, in his opinion, such materials are necessary because of special or unusual conditions. Risers shall not be constructed on an angle exceeding 60 degrees as measured from the horizontal.

3.31 SERVICE LINES

Service lines shall be installed from the sanitary sewer to all adjacent lots and individual properties; additional connections shall be installed when directed by Integra Water's Representative**. Service line cleanouts or low pressure service boxes shall be installed 1' behind the Utility and Drainage easement and 6' from the side lot line.** If service line cleanouts or low pressure services are not installed 1' behind the back of the Utility and Drainage easement, they shall be relocated by the developer at no additional cost to Integra Water. Service laterals shall not be installed beneath driveways or transformers. At the time of final inspection, any laterals found beneath driveways or transformers shall be relocated by the developer at no additional cost to Integra Water.

Service lines shall not be more than seven (7) feet Below the top of curbs or pavement edges. The open end of such stubouts shall be closed with approved stoppers properly restrained.

Backfilling for service lines shall commence immediately upon acceptance by Integra Water's Representative. Backfill materials shall be as specified and shall be compacted to the equivalent density of the surrounding undisturbed material.

Gravity Service Laterals

House service laterals shall consist of four- i n c h (4") diameter sewer pipes, and service lines for multiple dwelling units or non-residential units served by a single line shall consist of six-inch (6") diameter sewer pipes, constructed as specified herein. If the plumbing code in effect at the time of construction specifies larger pipe, then the larger pipe shall be installed.

Low Pressure Service Laterals

House service lines shall consist of 1-1/4" diameter sewer pipes unless otherwise specified by pump manufacturer. Service laterals shall be HDPE DR 11 with a green stripe.

3.32 CONNECTING NEW SEWERS TO EXISTING SEWERS

Connections shall be made to all existing sewer lines in the vicinity of the work, as shown on the Plans or as directed by Integra Water's Engineer, and with the written approval of Integra Water. Connections shall be made by the construction of a manhole or utilization of an existing manhole.

Connections to existing manholes shall be made by boring an opening in the wall of the existing structure, installing a flexible manhole sleeve ("boot") in the opening, inserting a minimum length of eighteen (18) inches of ductile iron sewer pipe into the hole, and sealing around same with non-shrinking grout. Connections of new sewers to existing sewers shall be plugged and shall remain plugged until final acceptance by Integra Water.

3.33 PIPE PROTECTION

Sewer pipe which, when completed, will have less than 18 inches of cover shall be constructed of ductile iron pipe or encased in concrete, as shown on the Plans or as directed by Integra Water's Engineer.

Where foundation conditions are not satisfactory, as determined by Integra Water, sewer pipe shall be either laid on a concrete cradle, on Class A bedding as shown in the Standard Details, or on Foundation Backfill as specified in Article 2 in these Specifications, or shall be constructed of ductile iron pipe, with proper pipe protection as shown on the Plans or as directed by Integra Water's Engineer.

Plain concrete ditch checks may be required by Integra Water's Engineer on steep slopes and other locations to prevent erosion of the backfilled trench.

When formed, reinforced concrete shall be as shown on the Plans for reinforced cradles and reinforced concrete encasement

Integra Water's engineer may require plain concrete encasement or cradles for pipe protection.

3.34 MANHOLES

Foundation Systems-Manhole & Vault

Soil Bearing Foundation Systems: All Structures shall be designed assuming their foundation elements would bear on a minimum of one foot of compacted granular structural fill to native soil.

If rock is encountered while excavating for soil bearing foundation elements, the rock shall be undercut to a minimum of two (2) feet below the bearing elevation. The area shall then be backfilled with compacted soil fill and No. 78 stone as approved by Integra Water.

Soil bearing foundation areas shall be stripped of all vegetation, topsoil, soft soils, organic matter and other deleterious material. The stripped area shall extend two (2) feet outside the foundation limits. Areas receiving fill shall be brought to subgrade elevation with compacted-engineered fill. The last 12" of fill under slabs on grade shall be No. 78 stone. Fill shall be placed and compacted in accordance with these specifications.

The excavation for all slabs on grade shall be undercut a minimum of 12 in. (or as shown on standard details). The area under the slab shall be brought to grade with a 12 in. (or as shown on standard details) layer of No. 78 stone.

Care shall be exercised to ensure that the foundation bearing soils do not experience changes in moisture content.

Foundation excavation, proof rolling, backfilling and compaction work shall be performed under the supervision of a professional geotechnical engineer.

Manholes shall be constructed to the sizes, shapes, and dimensions as detailed in the Standard Details and at the locations shown on the Plans. At all locations the cover (or lid) shall be at the finished grade of the pavement or ground surface, or as otherwise indicated on the Plans. In undeveloped or rural areas, manholes shall be furnished to a height of approximately two (2) feet above ground. The invert shall be placed at the elevation shown on the Plans. Eccentric cone sections will not be allowed; only concentric cones will be used, as detailed in the Standard Details.

The design of manhole base sections shall be approved by Integra Water's Engineer prior to manufacture and shall facilitate a proper lid elevation when the manhole is completely assembled. Bases shall be set on a foundation of No. 78 or 67 compacted stone aggregate, l2 inch minimum thickness, covering the entire bottom of the excavation, as shown in the Standard Details. Aggregate size may be adjusted by Integra Water's Engineer based on field conditions.

Flexible manhole connectors will be used for sealing the space between the manhole wall and the pipe and are required for all incoming and outgoing pipes. The remaining space between the boot and manhole wall shall be filled with non-shrinking grout. Boots shall be secured to pipe by stainless steel clamp and bolt assembly conforming to ASTM Specifications C923 and ASTM A167.

Precast concrete manholes for sewers 48 inches in diameter and larger shall be as specified above, except that they shall be installed on a saddle constructed on the barrel of the sewer. Precast concrete manholes for sewers 30, 36 and 42 inches shall be saddle-types or precast base types as specified in the Plans. General details of the precast manhole bases and the saddles for various pipe sizes are given in the Standard Details. Reinforcing steel in the saddle shall be welded to the reinforcing steel of the pipe. Integra Water's Engineer prior to manufacture shall approve the design of these saddles.

All joints for precast manhole stacks shall be tongue and groove with gaskets meeting the approval of the Integra Water. Where the difference in the invert elevation of 2 or more sewers, l8 inches in diameter or smaller, intersecting in one (l) manhole is 2 feet or more, a Memphis Tee Manhole (drop manhole) shall be constructed in the manner shown in the Standard Details. They shall be similar in construction to the standard manhole, except that a drop connection of a pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class B concrete. The manhole and the drop

connection shall be placed on a l2 inch reinforced concrete base as detailed in the Standard Details. The drop connection piping assembly shall be bolted to the barrel of the manhole riser using four (4) 5/8-inch diameter stainless steel (316) bolts with suitable washers to prevent failure caused by pulling the bolt head through the manhole wall.

Manhole inverts shall be constructed of cement mortar and shall have the same cross-section as the invert of the sewers which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.

All water standing in the excavation shall be removed before the manhole base is placed, and the foundation maintained in a dry condition.

Manholes shall be constructed using precast risers, in 16", minimum, sections.

Shallow manholes shall be constructed to the sizes, shapes and dimensions as detailed in the Standard Details and at the locations shown on the Plans. They shall be constructed of precast concrete sections as shown on the Plans and as directed by Integra Water's Engineer.

Manhole frames and covers shall be of the type shown in the Standard Details and shall be suitable for use under service conditions applicable for locations shown in the plan assembly. Iron castings shall conform to requirements of Section 2. Cast iron spacers will not be accepted as a means of making minor adjustments of the frame and cover to the proper elevation.

Manhole frames shall be set on a cement mortar bed and properly bonded to the manhole cone. Metal plates shall be used to hold the frame to the manhole as shown in the Standard Details.

The top elevation of manhole frames must be adjusted to finished grade in areas such as streets, alleys, and parking lots, or where indicated on Plans. Adjustment of frames will be allowed using brick and mortar or concrete adjusting rings ("donuts"). However, adjustments equal to or greater than 8" must be made by changing precast sections, and all possible combinations of precast riser sections and cones shall be utilized prior to the use of adjusting rings. Brick used in making adjustments will be in accordance with Section 2. The following information shall be clearly marked on each manhole section:

- MH and specification designation
- Date of manufacture
- Name or trademark of the manufacturer

3.35 CONCRETE WORK

Concrete shall be either Class A or Class B. In general, Class A concrete shall be reinforced concrete masonry, cast-in-place in forms for foundations, pipe collars, footings, piers, headwalls, manholes, monolithic sewer and similar structures; Class B concrete shall be plain concrete and shall be used for trench bottom stabilization, pipe protection, anchors, massive sections and similar work.

Materials used in the concrete shall conform to these Specifications.

Concrete ingredients shall be selected, proportioned, and mixed to produce a workable, homogeneous concrete. The slump, at the point of delivery, shall be a minimum of 1.5 inches and a maximum of 4 inches for Classes A and B unless specifically approved by Integra Water's Engineer.

Forms shall be constructed of steel or finished lumber true to line and grade, mortar tight, free from irregularities and holes. They shall be of sufficient strength to avoid displacement and held together with approved form clamps. Forms shall be coated with approved mineral oil before concrete is placed. Forms shall be removed within 24 to 72 hours after placing concrete but shall not be removed until inspected and approved by Integra Water. Contractor will not be allowed to backfill against any structural concrete prior

to testing showing the concrete has achieved 70% of expected design strength.

The concrete shall be placed in such manner as to produce solid concrete free of honeycomb and sand streaks. Concrete shall not be allowed to drop freely a distance greater than 5 feet. Concrete shall be compacted with mechanical vibrating equipment supplemented by hand spading and tamping. It shall be placed in the dry upon clean, damp surfaces, free from water. Concrete which has contained its water content for more than 45 minutes shall not be placed unless a variance is approved by Integra Water's Engineer. Freshly placed concrete shall be protected from wash by rain, flowing water or other injurious conditions, and shall not be allowed to become dry from the time it is placed until the expiration of the 7-day curing period. Concrete shall be placed only when the temperature is at 40 degrees Fahrenheit or above, and rising, unless specifically authorized by the Integra Water Representative.

The Contractor shall be required to have all necessary equipment and supplies on site before starting a pour, including two vibrators, concrete buckets, pumps, cranes and curing compounds as applicable.

All permanently exposed concrete work inside and outside shall be thoroughly rubbed with carborundum stones to remove form marks and other defects and produce a smooth, uniform finish, no sooner than 24 hours, nor later than 72 hours after placement of the concrete. In lieu of rubbing the unfinished concrete, the Contractor may seal the concrete with a sealing compound approved by Integra Water's Engineer.

After concrete has been placed, it shall be protected against the loss of moisture and from damage from other adjacent construction operations. The concrete shall be kept wet until forms have been removed. After forms have been removed, the concrete shall be rubbed as specified, and then wetted and tightly covered with polyethylene film or other approved curing material for a period of twenty-one (21) days in accordance with ASTM C309 for curing concrete. It shall be the responsibility of the Contractor to maintain moisture in the concrete during the specified curing period.

Formed Concrete will be tested.

3.36 PAVEMENT REPLACEMENT

The Contractor shall obtain prior approval by Integra Water for any paving subcontracts.

Where paved streets, sidewalks, driveways, and gutters are removed within the construction limits as specified or beyond the specified construction limits, such pavements removed or damaged by the Contractor shall be replaced in accordance with these Specifications at the Contractor's expense.

Where chert, gravel, slag, or other unpaved street or driveway surfaces are removed or damaged, they shall be replaced with the same type of materials that were removed.

Where shown on Plans, service lines and small diameter pipe (eight (8) inches in diameter or less) located across paved surfaces shall be installed by boring, or other approved methods that will not require cutting or removing the pavement where feasible.

All concrete pavement replaced shall be not less than 4 inches thick or equal to the original if greater than 4 inches.

Pavements replaced shall be the same type of construction as was removed, except that no asphalt surface replaced shall be less than three inches thick consisting of two inches of binder and one inch of seal coat.

Wearing surfaces shall be slag sealed.

3.37 TEMPORARY ROADWAY PAVING REPAIRS

Temporary cold or permanent hot asphalt patching will be required for both transverse and longitudinal roadway cuts upon completing backfilling requirements at the end of each day's work if the road is to be

opened for local traffic while work has stopped, if required by Integra Water's Engineer.

Temporary paving shall be maintained for at least thirty (30) days before installation of the permanent paving.

3.38 CONTROLLED TEMPORARY FLOW DIVERSION OPERATION

During construction, flows in sections of the existing sewer being rehabilitated by removal and replacement shall be accommodated by temporary flow diversion.

The Contractor shall use the provided creek access and construction easement for the flow diversion if not otherwise shown on the Plans. It shall be the Contractor's option to lay diversionary pipe in the creek or in temporary trenches within the construction easement. The Contractor shall use ingenuity and skill to develop a flow diversion program. The program must keep the sewer flowing without discharge or spills into the creek or on the ground. The Contractor will seek and obtain inspection of each section of newly laid sewer before taking the diversion out of service and placing the newly laid section in service. Each section of new sewer shall be tested and accepted, according to the Specifications, before being placed in service.

The material of which the temporary line shall be constructed will be the choice of the Contractor, subject, however, to the approval of Integra Water's Engineer. The material shall be such that no breaks, stream pollution, or other nuisance conditions ensue. The temporary line shall be the responsibility of the Contractor, including but not limited to, its installation and removal, its connection at existing manholes, or excavation and backfilling of trenches for the temporary diversion line.

In sections of the existing trunk sewer being rehabilitated by laying a new line parallel to the existing trunk, the existing trunk shall be used to accommodate the existing flow and no temporary flow diversion will be necessary if the existing trunk is not damaged or its use restricted by the Contractor's operations.

The Contractor shall provide a temporary closure in all cases practical to ensure that in the event of temporary line failure or a high likelihood of such failure (as determined by the Design Engineer), flows may be redirected through the existing permanent line.

The Contractor shall provide an approved system of shut-off gates on the temporary diversion line to ensure that alternative flow routing is possible.

3.39 EXISTING UTILITIES

Gas lines for the transmission or distribution of natural, manufactured, or liquified petroleum gas are dangerous to work around. Accidents can be caused by direct damage to these gas mains or service lines during construction or by settlement in the trenches, or settlement of structures after construction is completed. The Contractor shall take every possible precaution to minimize the hazards of working in proximity to gas lines and shall be solely responsible for any damage to them or for any injury to persons or damage to property arising from or caused by his operations.

No excavation or other work shall be done by the Contractor within a gas pipeline right-of-way or within 10 feet of a gas transmission line until the owner of the gas line has been notified not less than 72 hours in advance of such work and until the gas line has been exposed by the Contractor sufficiently to determine its exact horizontal and vertical location. In addition, the owner of the gas line shall be allowed to keep a qualified representative present while any construction work that could damage such line is being done. Methods of excavation specified by the owner of the utility must be adhered to by the Contractor.

Where work is to be done in areas served by medium and low-pressure gas distribution systems, the owner of such system is to be notified by the Contractor not less than 72 hours before such work is started and such owner given the opportunity to keep a representative present during this construction work or to locate and stake out all gas lines. In such case, the Contractor shall cooperate with the representative of the owner of the gas lines to avoid damage to them.

Should any gas main or service line or other gas facility be damaged during the construction work, the following minimum precautions shall be taken by the Contractor:

- Immediately notify the owner of the gas facility of the nature and location of such damage.
- Stop all construction work that could cause any further damage to the gas facilities or hazards to other persons or property.
- Give adequate warning to any persons who could be injured or owners of any property that could be damaged and take other necessary safety precautions.
- Permanent repairs shall be made by the owners of the gas facility or by the Contractor to their specific satisfaction and approval. Any repairs made by the Contractor shall be in accordance with U. S. A. "Standard Code for Gas Piping" USAS B31.8, latest edition. The Owner's Engineer does not have the responsibility or authority to supervise or inspect repairs to damaged gas facilities.

No structure shall be constructed over or immediately adjacent to a gas pipe line or gas facility, or within the gas line easement. Gas pipe lines shall not pass through manholes or other sewer structures. When sanitary sewer lines cross over gas lines, the minimum cover shall be 10 inches, or as specified by the owner of the gas line (cover is the vertical distance between the outside top and outside bottom of the two pipe lines.) When sanitary sewer lines cross under or below gas lines, the minimum cover shall be 4 inches. In both cases, this cover space shall be carefully backfilled with thoroughly compacted selected soil. Where gas lines cross pipe trenches, the excavated space below such gas lines shall also be carefully backfilled with thoroughly compacted selected soil.

Other utilities such as water lines, steam lines, electrical lines, telephone lines, television cable, and telegraph lines, whether overhead or underground, shall be carefully preserved by the Contractor.

In the event that interference with any existing utilities is imminent, the Contractor shall so notify Integra Water of the utility 72 hours in advance of any construction activities so that service may be relocated or otherwise preserved and protected. The Contractor shall contact Integra Water office in the event conflict with a water line appears imminent.

The Contractor is to cooperate fully with the representative of the utility company to the extent necessary to satisfactorily accomplish the work.

3.40 WORK WITHIN THE RIGHTS-OF-WAY OF HIGHWAYS, RAILWAYS, OR STREETS

In the event the sewer crosses, runs parallel to or alongside of any state highway, county road, city street, or railroad rights-of-way, the Contractor shall obtain a utility permit from the governing body affected.

A Construction License and a Blasting Permit issued by the governing bodies having jurisdiction are required for the installation of a sanitary sewer.

3.41 SPECIAL CONSTRUCTION

Where the work requires special stream or railroad crossings or any other extraordinary conditions, or where alternate types of construction are used that are not covered by these Specifications, the materials and construction methods shall be as shown on the Plans and specified in the Special Conditions.

3.42 RIGHT-OF-WAY CLEANUP AND GRASSING

After the sewer is installed and backfilled and a sufficient amount of time has elapsed for backfill to settle, the disturbed area shall be machined to a smooth surface matching the adjacent or adjoining ground surfaces and the ground profile on the Plans.

The ground preparation before seeding shall consist of cultivation to a loose depth of approximately four (4) inches minimum and the application of lime to the soil at the rate of two (2) tons per acre. The plowing, harrowing, cultivating and all other operations shall be performed with proper equipment and in such a manner as to break up all clods, lumps, or earth balls, and remove all boulders, stumps, large roots, or other particles which would interfere with the work and which will result in a smooth uniform, loose well broken, and fine-grained soil; thus providing a suitable bed for seed grass. The ground shall be plowed to the required depth then cultivated with a rotary tiller and or disc harrow, in both directions if feasible, until ap- proved. In small or inaccessible areas, the use of hand tools will be permitted. The contractor shall add sufficient water to wet the soil in order to prepare the ground to be seeded. Nine hundred twenty (920) pounds of 13,13,13 commercial grade fertilizer per acre of ground shall be spread uniformly into the areas to be planted. The fertilizer shall be well-pulverized and free of lumps when applied. In no case shall full strength fertilizer be permitted in direct contact with the seeds. When fertilizers are applied hydraulically, they must be diluted sufficiently as directed so that no damage is done to either seed or established grasses and legumes.

Work area seeding mixtures shall be as follows:

Table 3-2
Seeding Mixture Rates

Season	Month	Grass Type	Seeding Rate (lbs/acre)
Winter	September - March	Kentucky Blue Grass	6
		Pensacola Bahia	20
		Reseeding White Clover	30
		Kentucky 31 Fescue	20
Spring	April – June	Pensacola Bahia	20
		Kentucky 31 Fescue	20
		Common Lespedeza (TN)	10
		Bermuda Grass (H)	12
Summer	July - August	Bermuda Grass (H)	5
		Pensacola Bahia	20
		Reseeding White Clover	30
		Kentucky 31 Fescue	20

Straw and hay mulch shall be applied with mechanical mulch spreader designed to break up balls or clusters of mulch and apply it evenly over the surface so as to provide adequate shading from sunlight. If an asphalt adhesive is used on the mulch the mulch spreader shall be equipped and so designed to apply effectively the asphalt adhesive to the mulch and form a uniform porous and stable mulch blanket held in place by the adhesive over the designated area.

Hay or straw material which contains an excessive quantity of matured seeds or noxious weeds or a species which would constitute a menace to the planted species and to surrounding farmland, will not be acceptable. Mulch which is too fresh, or excessively brittle, or so decomposed as to retard growth of grass will not be acceptable.

The acceptance of designated seed area will be based on verification of a satisfactory stand of grass in the season for each species required by the mixed designated for use. If a satisfactory stand of grass is not established the area shall be reseeded without additional cost to Integra Water.

The Contractor shall be responsible for securing a satisfactory stand of grass and legumes in accordance with the specification.

The Contractor may, at his option, employ additional measures (other than those specified) to prevent loss of, or damage to the work resulting from the effects of wind and/or water.

The erosion control work shall cover all disturbed areas within the sewer right-of-way and/or easement along which the sewer has been installed. Erosion control work shall not be limited to the easement but shall include all disturbed areas as necessary to complete the grassing of the project.

Solid sod may be used if directed by Integra Water's Engineer or as specified in the proposal. The preparation of the ground will be the same as for seeding. The sod will be placed so as to give a smooth and uniform surface that is being sodded.

Fescue may be substituted for Bahia in work areas adjacent to residential lawns, as directed by Integra Water's Engineer.

The contractor shall remove all stumps, fallen trees, uprooted trees, dead trees and debris from the edge of the R.O.W.

All right-of-way cleanup and grassing on property owned by Integra Water either in fee or easement interest, shall be approved by Integra Water.

3.43 SPECIAL SLOPE PROTECTION

The work covered by this section consists of furnishing all materials, equipment, and labor and performing all necessary operations in connection with the installation of riprap, or other special slope protection, as called for on the Plans, or as directed by the Engineer.

Areas to receive riprap, or special slope protection materials, shall be graded to the lines and slopes shown on the Plans, or as directed by the Engineer. Any loose material shall be compacted by the use of hand or mechanical tampers.

Stone for riprap shall be of the size and weight designated in the Standard Details. In addition, the stones shall be durable and of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free of cracks, seams, and other defects that would tend to unduly increase its deterioration from natural causes. Not more than five percent of the stones shall have shale seams, which would tend to separate when exposed to weathering. The inclusion of objectionable quantities of dirt, sand, clay or rock fines will not be permitted.

Just prior to placing riprap, or other slope protection material, the Contractor shall install a non-woven, plastic filter cloth as described in the Standard Details. The filter cloth shall be approved by Integra Water for installation and shall then be installed in strict accordance with the manufacturer's specifications for installation and use. Only then, and with the approval of Integra Water's Engineer, shall the slope protection material be installed on the filter cloth.

Precast concrete grids "Monoslabs" or approved equals, may be used in lieu of riprap stone for slope protection. The Contractor shall submit in writing to Integra Water, for approval, what materials he is desirous of using for the slope protection material.

3.44 FENCE RESET

Should the construction of the sewer require or result in removal or damage to an existing fence, the Contractor shall replace the fence in kind to the satisfaction of the fence owner.

3.45 TUNNELING, BORING AND JACKING

The Contractor shall submit to Integra Water, details of the procedure proposed for work, along with a description of the equipment available for use.

Steel Tunnel Liner Plates

The base metal for steel plates shall conform to the chemical requirements of ASTM A569, Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality. The flat plate (before cold forming) shall conform to the following minimum mechanical properties:

Tensile Strength	42,000 psi
Yield Strength	28,000 psi
Elongation, 2 inches	30%

Nominal plate dimensions shall provide the sectional properties shown in the current edition of the AASHTO Standard Specifications for Highway Bridges. Thickness tolerances shall conform to Paragraph 14 of AASHTO M167, Standard Specification for Structural Plate for Pipe, Pipe-Arches, and Arches. Steel liner plates shall be of additional thickness or protected by coatings and other means when required in the contract for resistance to abrasion or corrosion.

Bolts and Nuts

Bolts and nuts used with lapped seams shall be no less than 5/8 inch in diameter. The bolts shall conform to ASTM A449, Standard Specification for Quenched and Tempered Steel Bolts and Studs, for plate thicknesses equal to or greater than 0.209 inch and A307, Standard Specification for Carbon Steel Externally Threaded Standard Fasteners, for plate thickness less than 0.209 inch. The nut shall conform to ASTM A307, Grade A.

Bolts and nuts used for 4-flanged plates shall be no less than 1/2 inch in diameter for plate thicknesses to and including 0.179 inch and no less than 5/8 inch in diameter for plates of greater thickness. The bolts and nuts shall be quick acting coarse thread and shall conform to ASTM A307, Grade A.

Steel Casing Pipe (for roadway crossing encasement)
The steel pipe shall be new material, with a minimum yield strength of 35,000 psi in accordance with ASTM A-139, grade B.

Pipe shall have plain ends. Steel shall comply with the appropriate requirements for the size shown in the following table and approved by Integra Water.

Table 3-3
Steel Casing Pipe

Pipe Diameter* (in.)	Minimum Casing Diameter (in.)	Minimum Wall Thickness (in.)
2	6	0.250
4	8	0.250
6	12	0.250
8	16	0.250
12	24	0.250
20	30	0.312
42	54	0.500
48	60	0.625

*Minimum casing diameter shall be obtained by adding 10-inches to carrier pipe diameter and then rounding up to the next available steel pipe diameter. Consult steel casing manufacturer for the minimum wall thickness and obtain approval from Integra Water.

Cement Grout for filling voids outside of tunnel plates or casing pipe
Cement grout for filling voids outside tunnel liner plates and 24 inch and larger casing pipe, unless shown otherwise on the Plans, shall consist of a mixture of water and one part Type 1 Portland Cement to two parts mortar sand by volume. The water shall be adjusted to produce a mixture of consistency suitable for pumping, with a minimum slump of 5 inches and a maximum slump of 9 inches. Provisions shall be made for releasing of air and filling with grout. A pressure of 10 to 15 PSI shall be used.

Casing End Seals
Casing End Seals as manufactured by the CASCADE System or approved equal shall be used to seal off each end of the casing pipe preventing backfill debris and seepage from entering the casing pipe. The seal shall be manufactured of virgin SBR. Stainless Steel bands shall be used to connect the end seal to the casing pipe and carrier pipe. Integra Water shall approve the installation.

Construction Requirements

Pipe Laying
The pipe shall be protected during handling against impact shocks and free fall. Care shall be taken to avoid dragging the spigot ring on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.

After being delivered alongside the trench, the pipe shall be carefully examined for soundness or damage. All pipes shall be new and unused. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned out. Each piece of pipe shall be lowered separately unless special permission is given

otherwise by Integra Water or Owner's Representative. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

The bell and spigot of the joint shall be cleaned of dirt and foreign matter immediately prior to jointing. The contact surfaces shall be coated with a lubricant, primer or adhesive recommended by the pipe manufacturer, and pushed together until the joint snaps distinctly in place. The pushing together of the pipe may be done by hand or by the use of a bar.

All pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. When jointed in the trench the pipe shall form a true and smooth line.

Trenches shall be kept dry during pipe laying. Before pipe laying is started, all water that may have collected in the trench shall be removed.

All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of the flow.

When pipe laying stops for any reason, the exposed end shall be closed with a plywood plug fitted into the bell end, so as to protect it from intrusion of foreign material. The Contractor shall take all precautions to prevent intrusion of any foreign material into the pipe system. Precautions shall also be taken to prevent flotation of pipe caused by flooding of the trench from surface water or ground water.

Site Piping Installation
Excavation and backfilling for pipeline trenches shall be as specified in Section 202 - Excavating, Backfilling and Compacting for Sanitary Sewers, and as shown on the Plans.

Minimum cover for all pipelines shall be 3 ft. - 0 in., unless otherwise shown on the Plans.

Jointing: The types of joints described hereinbefore shall be made in accordance with the manufacturer's recommendations.

Bituminous Pavement Replacement:
Sections of pavement shall be replaced as required to install the pipelines under the work of this Section. Pavement replacement shall be in accordance with the standard details in Appendix F and the Department of Transportation Standard Specifications.

Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to grade. The Contractor shall also remove from roadways, rights-of-way and/or private property all excess earth or other materials resulting from construction in accordance with Section 3.6 and 3.7.

Tunneling, Boring and Jacking Installation General Provisions
Sewer pipe shall be constructed by tunneling or boring and jacking only at those locations and within limits shown on the Plans or as directed by Integra Water. Where pipe is required to be installed under railroads, highways, streets, or other facilities by tunneling or boring and jacking, construction shall be made according to the plans, specifications, and permit requirements in such a manner that will not interfere with the operation of the railroad street, highway, or other facility, and shall not weaken or damage any embankment or structure.

If any utility above or adjacent to the tunnel or bore is endangered or has been damaged because of the tunneling or boring and jacking operations or movements of earth caused by such operations, Integra Water of same shall be notified immediately and shall be given access to the work to carry out all necessary repairs to such utilities.

The Contractor shall be responsible for protection of utilities, sewers, and drains against damage by the work.

Dewatering

Prior to commencing, the Contractor shall furnish and operate all necessary pumping equipment of ample capacity and make all necessary provisions to keep tunnels, shafts and pits free of water during construction and to satisfactorily dispose of such water. During placing of concrete, drainage and pumping shall be so arranged that concrete is placed in the dry and that no water will flow over the concrete until it has hardened.

Line and Grade

Line and grade shall be checked frequently by the Contractor's Professional Land Surveyor and not less than once per day. Results from these checks shall be provided to Integra Water. The Contractor also shall assist Integra Water in checking line and grade as often as Integra Water deems necessary to ensure that proper tolerances in line and grade are being met.

Tunneled or bored and jacked sections of sewers shall be completely installed prior to construction of adjoining sections. If permitted by Integra Water, minor adjustments in the line and/or grade of the adjoining sections shall be allowed to compensate for slight deviations from the Drawing line and grade of the installed tunneled sections.

Tunneling

Tunnel support systems shall be with steel liner plates, ribs and lagging, steel casing pipe or other systems approved by Integra Water. The Contractor shall furnish a detailed Tunneling Plan for review by Integra Water. The plans shall contain a description of the tunneling method and equipment proposed, tunnel support system, shop drawings, details and cross-sections, a schedule of operations, and the proposed work hours. Tunnel construction shall not commence until Integra Water has reviewed the submittal and provided approval of plan. Integra Water approval shall in no way relieve the Contractor of the sole responsibility for the execution of this work or any liability. When tunnel construction occurs under the Department of Transportation or Norfolk-Southern Railway Corporation right of ways or under a stream belonging in the Corps of Engineer's jurisdiction, the tunneling plan shall also be subject to the approval of the governing agency.

All work shall conform to 29 CFR, Part 1926, Subpart S, "Tunneling".

Work hours must be approved by Integra Water as part of the construction schedule submittal. Tunnel construction operations may progress for 24 hours a day, except on Sundays. When work is done at night, the Contractor shall provide adequate safety precautions such as watchmen, barricades, lights, etc., and any mechanical equipment used in the construction operations shall be of a type that produces a minimum amount of noise to avoid creating a nuisance.

Shafts shall be constructed at the locations shown on the Plans. If not shown on the Plans, shafts shall be constructed at locations selected by the Contractor, subject to approval by Integra Water. Temporary construction shafts shall be of adequate size and properly constructed and equipped to meet all requirements of safety to personnel and to the work. All shafts shall be barricaded, lighted, fenced, and properly guarded from the beginning of the excavation until the completion of the construction requiring the shaft. A substantially constructed ladder shall be provided in each shaft and shall be kept in safe, good repair and clean and clear of debris.

Provisions shall be made at each shaft so that plumb lines suspended on the centerline of the sewer at each end of the shaft will hang freely from the surface.

The Contractor shall carry out the work of tunneling and supporting the tunnel face, roof, walls, and floor so that there will be no fall, flow, caving, or heaving of earth or other materials into the

tunnel excavation. If there should be any fall or movement of earth into the tunnel at any time, the Contractor shall proceed with the work with all necessary precautions and in such a manner as will ensure the safety of life and of all sewers, utilities and public and private property above and adjacent to the tunnel.
The Contractor shall furnish, place and maintain all sheeting, bracing or lining required to support the tunnel floor, roof, sides, and face until the pipe and its bedding, jointing, encasement and backfilling have been completed. All liners shall remain in place. Care shall be used in trimming the surfaces of the excavated section and in placing the liners or sheeting and bracing so that the required minimum clearance between the outside of the pipe and the final position of the liners, sheeting and bracing in the tunnel will be attained without any deviation in sewer alignment. Sheeting or lining must be placed and held tightly against the trimmed earth surface of the excavated section so that complete filling of voids may be achieved between the earth and the lining or sheeting placed against it. No part of the lining, bracing, or flanges of steel liner plates shall project closer to the outside top of the pipe than 12 inches, or to the outside bottom of the pipe than 4 inches, unless shown otherwise on the Plans.

Prevention of Loss of Earth Materials
Cavities or spaces between the actual surfaces of excavation and the tunnel liner plates or sheeting, shall be completely filled with cement grout. Grout shall be placed under pressure through grout nipples in the steel liner plates or grout holes in sheeting. The grout holes shall be at minimum 10 feet centers and the grout placed in such sequence as to ensure the complete filling of all cavities and spaces and of carrying loads uniformly from the undisturbed material to the tunnel lining or sheeting. Grouting shall be done at frequent intervals simultaneously with the tunnel construction and immediately whenever a loss of material occurs. In no case should the tunnel be left ungrouted if work is to be stopped or suspended for any extended period of time. Refer to paragraph D.4 of this Section.

At the end of each working day, or whenever a delay in the tunneling is anticipated, the Contractor shall construct a bulkhead to prevent the caving of soil at the working face. The bulkhead shall be required unless Integra Water specifically grants permission to omit the bulkhead.

Wherever unstable conditions are encountered, and the Contractor is unable to proceed without loosening earth or creating voids outside the tunnel lining, the Contractor shall pre-solidify the soil around the area to be excavated by freezing the soil or injecting an approved chemical that will permit the tunnel excavation to proceed without any loss of earth material, or other method approved by Integra Water. Before any stabilization of earth materials is begun, the Contractor shall obtain approvals.

Installation of Carrier Pipe
All pipe used in tunnels shall be of the type shown on the Plans or in the Contract Documents and shall be of the size and strength class required.

After the tunnel section is excavated, lined, and braced, the carrier pipe shall be placed on and supported by steel rails, a concrete pad, or other approved supports. The supporting system shall assure line and grade and shall allow sufficient space below the pipe for placing concrete. Care shall be used to avoid damage to the pipe or to the liner plates. The carrier pipe shall be rigidly braced to prevent its displacement during construction installation.

End seals as specified shall be used to seal off the space between the carrier pipe and sides of the roof of the tunnel.

Temporary shafts shall be completely abandoned. Unless otherwise specified in the Plans or Contract Documents, all sheeting, bracing, and similar items may be removed unless the Contractor requests and receives authorization from Integra Water to leave it in place.

Boring and Jacking

Boring and jacking support systems shall be with steel casing pipe or other systems approved by Integra Water. The Contractor shall furnish a detailed Boring and Jacking Plan for review by Integra Water. The plans shall contain a description of the Boring and Jacking method and equipment proposed, boring and jacking support system, shop drawings, details and cross- sections, a schedule of operations, and the proposed work hours. Boring and Jacking construction shall not commence until Integra Water has reviewed and approved the submittal. Integra Water approval shall in no way relieve the Contractor of the sole responsibility for the execution of this work or any liability. When boring and jacking occurs under the Department of Transportation or Norfolk-Southern Railway Corporation right of ways or under a stream belonging in the Corps of Engineers jurisdiction, the Boring and Jacking Plan shall also be subject to the approval of the governing agency.

Boring and Jacking Equipment and Construction

When required by the Plans, sewers shall be constructed within steel casing pipe that has been jacked or pushed into bored holes. The holes shall be bored from the low or downstream end, unless site conditions dictate otherwise, and Integra Water provides approval.

The access pit shall be of sufficient size to provide ample working space for the boring and jacking equipment, guide rails, reaction blocks, bracing, spoil removal, and sections of pipe as required. Provisions shall be made for the erection of guide rails in the bottom of the pit by providing a crushed stone base where applicable. The Contractor shall be responsible for providing stable foundation and wall supports during boring operations.

The boring and jacking machine to be used shall be in good mechanical condition and capable of advancing the bore hole within the required limits of accuracy. All cutting heads shall be removable without retracting the casing pipe. Backstops and guide rails shall be of sufficient strength and rigidity to support the thrust of the boring and jacking machine without displacement. Guide rails shall be accurately laid to line and grade and maintained in this position until completion of the boring and jacking operation. A smooth casing pipe of sufficient strength and diameter shall be forced into the bored hole to provide a tight fit against the earth sides of the bore hole. The casing pipe shall be of minimum diameters as specified in this section. Joints between sections of the casing pipe shall be welded with a continuous circumferential weld. Following installation, the casing pipe shall be carefully inspected to ensure that the carrier pipe can be properly placed.

During placement of the carrier pipe in the casing, the carrier pipe shall be blocked or otherwise supported to secure the proper flow line elevations throughout its full length. The carrier pipe shall be placed in the casing pipe only by such method that will keep the pipe joints in compression. Any method tending to unjoint the pipe while being placed will not be permitted. End seals shall be used to seal off each end of the casing pipe. Before installing the end seals, the exterior of the casing pipe shall be grouted on 10 feet centers and the carrier pipe shall be carefully inspected for uniformity of grade along its alignment and any required corrections shall be made. Particular attention shall be given to ensuring that the pipe will be solidly supported by grout at its bottom and sides. The method of injection of grout under mechanical pressure shall be approved by Integra Water. Grout shall be placed by filling the exterior of the casing pipe, through 4-inch diameter holes placed on 10 feet centers, beginning at the downstream end and proceeding upstream.

Integra Water shall approve selection of steel casing spacers.

When unforeseen obstructions or conditions require abandonment of a partially completed bore hole, plug end of pipe by filling with grout. Then the Contractor shall backfill the abandoned bore hole and start a new hole.

Waterproofing

After installation of the carrier pipe within the encasement or tunnel pipe, the ends of the casing or tunnel shall be sealed with end seals as specified in this section.

All tunneling shown on the plans shall be by the tunnel method. Open trenches will not be permitted. Tunneling operations and installation of liner plates shall be conducted in accordance with the recommendations of the liner plate manufacturer. Tunneling operations shall begin at the low end of the sewer line and proceed up-grade, care being exercised to install the liner to the proper line and grade as shown on the Plans. Care shall be taken to avoid loss of ground beyond the tunnel lining and to insure bearing against the ground all around the tunnel. Any spaces between the liner plates and the earth or rock surface of the tunnel shall be pressure grouted as the work progresses. Brick bulkheads shall be erected at each end after completion of the tunnel and insertion of the carrier pipe. The carrier pipe shall be bedded and restrained within the tunnel in accordance with the Plans and the Special Conditions.

Only personnel thoroughly experienced in performing jacking and tunneling operations shall be employed for this work. Construction operations must not interfere with highway or railway traffic.

The Contractor shall use tunnel liner plate as specified. The tunnel and carrier pipe shall be installed in accordance with the Plans and Special Conditions.

The Contractor shall make his own investigation as to the actual loads that would result. The Contractor, using his skills and knowledge, shall provide the required support system to support the surrounding materials until tunnel lining is furnished and installed.

At the end of each eight-hour turn, or more often if specified by Integra Water, the void between the liner plates and the tunnel wall shall be force grouted. The grout shall consist of 5 sacks of Portland cement, one cubic yard of sand, 50 pounds of diatomaceous earth and 90 to 100 gallons of water. The sand shall conform to the following grading:

Table 3-4
Sand Gradation

Sieve Size	Percent Passing
No. 4	100
No. 8	90-100
No. 16	90-100
No. 50	20-30
No. 200	0-3

The grouting equipment shall be able to maintain enough pressure to completely fill the void.

Tunnels under railroads may involve special insurance requirements by the railroad company. The Contractor's attention is directed to any agreements between Integra Water and the railroad company which may be included in the Special Conditions or Proposal Form.

The Contractor shall notify the railroad company, highway department, or other utility affected prior to beginning any work so that said utility may have a representative present if desired.

The excavation or pit at each end of the tunnel or bore shall be stabilized by the Contractor using sheeting, shoring, bracing or other means to prevent slides, settlement, movement or erosion of the embankment being tunneled or bored.

3.46 CROSSING EXISTING SEWER LINE

If a proposed street, roadway, driveway, bike path, or sidewalk crosses an existing sanitary sewer line, the trench backfill for that pipeline shall meet the requirements of Section 2. That is, the trench shall be filled completely with properly compacted select earth material or with crushed stone. Alternatively, the trench may be bridged as shown on the Standard Detail. The method proposed by the Design Engineer or Developer will be reviewed by Integra Water, and approved according to Integra Water's best interests.

3.47 ABANDONED LINES

All sanitary sewer lines to be abandoned shall be as noted on the plans. All piping connected to abandoned manholes shall be plugged and filled with 24" of grout fill or flowable fill at each end as shown on the standard details. The manhole top shall be removed down to not less than 3 feet below final grade and the remaining portion shall be filled with crushed rock and capped with 12" of concrete or filled with flowable fill as shown on the standard details in Appendix F. All lines shall be abandoned per Integra Water Technical Specifications.

3.48 STREAM CROSSINGS

Ductile Iron Pipe shall be required at all creek and stream crossings. Ductile Iron Pipe shall extend from manhole to manhole. No pipe material changes will be allowed between manholes. Sewer lines shall cross the streams or creeks as near perpendicular to stream flow as possible. Contractor shall be responsible for acquiring all necessary permitting for working in or near a stream. All design specifications shall be responsible for using Best Management Practices for erosion and sediment control as specified in these specifications and on the Drawings.

3.49 CLEAN UP

Upon completion of the installation of the piping and appurtenances, the Contractor shall remove all debris and surplus construction materials resulting from the work. The Contractor shall grade the ground along each side of pipe trenches in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line or to the grade shown on the Plans.

3.50 RECORD DRAWINGS

The Contractor shall obtain from Integra Water one (1) set of prints of the Contract Drawings. These prints shall be kept and maintained in good condition at the project site All field surveying shall be completed and stamped by a licensed surveyor or engineer. Do not permanently conceal any work until required information has been recorded.
Contract Drawings should include horizontal and vertical location of underground utilities and appurtenances reference to permanent surface improvements, location of internal utilities and appurtenances concealed in construction reference to visible and accessible features of structure, field changes of dimension and detail, changes made by Change Order or Field Order, and Details not on original Contract Drawings.

Specifications should be legibly marked to record manufacturer, trade name, catalog number and supplier of each product and item of equipment installed, changes made by change order or field order, and other matter not originally specified.

Maintain a record of documents; legibly annotate Shop Drawings to record changes made after review.

Record drawings shall include: Horizontal Location of Manholes – Northing and Easting coordinates and Vertical Location of Manholes – Lid elevation and Invert elevation.

ARTICLE 4 - SERVICE CONNECTIONS

4.1 GENERAL

"As-Built" drawings submitted to Integra Water shall indicate the service line locations in such a manner that they can be accurately located in the field using information shown on the drawings and metal detection equipment.

A 3/8" to ½" steel rod shall be driven at the end of each service line stubout. The rod shall be 24" long and be covered/backfilled 4" to 6".

At locations where curb and gutter, valley gutter, etc. are installed, appropriate permanent markings shall be placed in the concrete to indicate the service connection location.

4.2 GRAVITY SERVICE LATERALS

For Gravity Sewer Collection Systems, service connections are to be maintained solely by the property owner. The cleanout shall be installed within 1' of the back of the Utility and Drainage Easement and 6' from the side lot line. Service laterals shall not be installed beneath driveways or transformers. At the time of final inspection, any laterals found beneath driveways or transformers shall be relocated by the builder or developer. The cleanout shall be installed in an access box labeled "Sewer" as shown in the Standard Details.

4.3 LOW PRESSURE SERVICE LATERALS

Low pressure sewer service lines shall be provided as shown on the plans or as directed Integra Water. Service connections shall consist of piping as required to complete the sewer service connection. Service pipe from each grinder pump installation to the force main shall be the responsibility of the customer and consistent with the requirements of the grinder pump manufacturer.

Pressure service lines from the main to the service box shall be a minimum of 1 ¼ inch, HDPE DR 11 with a green stripe, unless otherwise specified in the plans and shall be laid to follow the ground profile with a minimum cover of 18 inches. All long side service laterals beneath roads shall be cased from right of way to right of way with a 2" PVC pipe (green or green stripe). Service connection saddles, corporation stops, check valve, and curb stop shall be a minimum of 1-1/4". Service boxes shall be installed within 1' of the back of the Utility and Drainage easement and 6' from the side lot line. Service laterals shall not be installed beneath driveways or transformers. At the time of final inspection, any laterals found beneath driveways or transformers shall be relocated by the developer or builder.

4.4 GRINDER PUMP STATION

The standard simplex grinder pump station shall consist of a single grinder style submersible pump housed in a fiberglass or HDPE wetwell having a watertight cover and complete with all the appurtenances required for a fully operable pumping system. Pump level controls, starter, alarm, piping, fittings, valves, and all accessories shall be furnished as a part of the factory fabricated package so that burying the wetwell, the field connection of the gravity inlet line, discharge line and electrical service line to the control box will complete the installation of the grinder station.

Each grinder pump station shall be manufactured and assembled by a single manufacturer and shall be shipped ready complete and ready for installation. The pump shall have an integrally built grinder unit and submersible type pump. The pump shall be installed on a lift-out rail system in such a way that solids are fed in an upflow direction to the grinder impeller with no feet, rails or other obstruction below the grinder inlet. Manufacturer shall be Environment-One.

All grinder pumps shall be capable of operating at any point on the hydraulic performance curve without

overloading the motor or sustaining damage from hydraulic cavitation. All pumps shall be capable of pumping sewage at the design rate and total dynamic head requirements as stipulated by the Engineer. The Engineer will determine the head requirements of each grinder pump taking into account the flow rates, head conditions, friction loss, and any other consideration necessary to ensure the pump installed will operate properly.

The wetwell shall consist of a heavy fiberglass or HDPE basin adequately reinforced for buried service and have a minimum storage capacity of 150 gallons. A vertical heavy rib or bottom flange shall be provided for anchoring the basin to prevent floatation. The basin shall have a minimum wall thickness of ¼ inch. A removable cover shall be provided to allow easy access to pump, piping and level controls. Cover shall be sealed with caulking compound to prevent leakage of gas and infiltration of water.

A lift-out rail system shall be provided for easy removal and installation of the grinder pump without requiring personnel to enter the basin. The lift-out rail assembly shall include a combined check valve and seal assembly that mounts vertically into a stationary discharge casing.
Electrical and level controls shall be provided by the pump manufacturer. All controls shall be mounted so that they can be cleaned or replaced without disturbing pump or piping.

The control panels and all associated components on each standard simplex grinder pump station shall be U.L. Approved and shall bear the U.L. Approved label. All equipment associated with each grinder pump station shall meet all applicable Federal, State and local electrical codes.

All electrical elements shall be furnished pre-wired and housed in a control box. The control box shall be constructed of gray thermoplastic/fiberglass material and shall be approximately 12 inches by 14 inches in length and width. The power supply to the control box shall be 230-volt, single phase. Control circuit shall be 115 volt. A 30 Amp, 250 Volt NEMA 3R fusible heavy duty disconnect switch, fused with FNR-R type Busman fuses, sized per manufacturing instructions, at a location not more than ten (10) feet from the simplex grinder pump station.

All piping, fittings, valves, connections, and associated appurtenances shall be provided as required for a complete pumping unit. In addition to the combined check valve and seal fitting, a 1 ¼ inch (minimum) all bronze gate or ball valve shall be installed outside of the wet well, within 3 feet, in the discharge line for closing when pump assembly is removed. The gate valve shall be housed in an appropriate valve box allowing access at all times. The inlet flanges shall be suitable for field mounting on the grinder pump wet well. All hardware, gaskets, and accessories required to affect a watertight seal between the hub and wet well and the gravity inlet sewer and hub shall be supplied.

Installation of the pump station and related appurtenances shall be done in accordance with written instructions provided by the manufacturer. The manufacturer shall provide complete and detailed installation, operating, and maintenance manuals.

4.5 APPURTENANCES

Service saddles must be used to connect the service line to the sewer main and shall be attached to the main sewer in such a way as to affect a permanent water tight joint. Services saddles shall be epoxy coated with double stainless-steel straps. The service saddle shall be JCM Model 406, or an approved equal.

When connecting a discharge pipe to a pressure sewer, each grinder pump station service lateral shall be installed with a brass corporation stop at the service connection to the main. The corporation stop shall be M&H, Mueller, American, Ford, or an approved equal. Corporation stops shall conform to AWWA C515 and C509 and shall be suitable for 200 psig working pressure.

The service 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 finish pavement and centered over the valve and cleanout or approximately 1/2-inch above the ground surface or such other level as may be directed.

Each service pressure line and/or connection assembly shall include a redundant check valve for installation in the service box between the grinder pump and the sewer force main to ensure maximum protection against backflow in the event of sewer service line break. Redundant check valve and curb stop shall be brass. A brass tee with a brass valve (lever handle) shall be placed between the curb stop and check valve.

The redundant check valve and curb stop valve shall be placed inside a (green) plastic box labeled sewer and placed within 1' of the back of the Utility and Drainage easement.

Where ductile iron fittings are not available due to size, stainless steel or brass tees shall be used at the lateral connection to the main. Tees shall be restrained with a concrete thrust block to minimize movement at the connection.

4.6 GREASE TRAPS

Grease traps are small flotation chambers where grease floats to the water surface and is retained while the clear water underneath is discharged. There are no moving mechanical parts, and the design is similar to that of a septic tank.

The grease traps discussed here are the large, outdoor-type units, and should not be confused with the small grease traps found on some kitchen drains.

Grease traps are not used for individual homes. All kitchen wastewaters from motels, cafeterias, restaurants, hospitals, schools and other institutions shall be provided with a grease trap sized, constructed and maintained as described herein.

Influents to grease traps usually contain high organic loads including greases, oils, fats, and dissolved food particles, as well as detergents and suspended solids. Sanitary wastewaters are not treated by grease traps. Wastewaters from garbage grinders shall not be discharged to grease traps, as the high solids loadings can upset grease traps performance and greatly increase both solids accumulations and the need for frequent pump out.

All grease traps shall comply with all current requirements of EPA and the State Regulatory Authority, with regard to both design and operations and maintenance.

Sizing of grease traps shall be based on wastewater flow and calculated from the number and kind of sinks and fixtures discharging to the trap. In addition, a grease traps should be rated on its grease retention capacity, which is the amount of grease (in pounds) that the traps can hold before its average efficiency drops below 90%. Current practice is that grease-retention capacity in pounds should equal at least twice the flow capacity in gallons per minutes. In other words, a trap rated 20 gpm should retain at least 90% of the grease discharged to it until it holds at least 40 lbs of grease.

Another design method has been developed through the years of field experience. The following two equations are used for restaurants and other types of commercial kitchens:

- Restaurants:

$$\text{Volume} = \text{SC X D X GL X } \frac{\text{HR}}{2} \text{ X LF}$$

V = Size of grease interceptor in gallons
SC = Storage capacity factor (Minimum = 1.7, Onsite disposal = 2.5)
D = Number of seats in dining area
GL = Gallons of wastewater per meal (Typically 5 gallons)
HR = Number of hours open

LF = Loading Factor
1.25 Interstate Freeways
1.0 other freeways
1.0 recreational areas
0.8 main highways
0.5 other highways

- Hospitals:

  $$\text{Volume} = \text{M X GL X ST X SCX LF}$$

  V = Size of grease interceptor in gallons
  M = Meals per day
  GL = Gallons of wastewater per meal (Typically 4.5 gallons)
  SC = Storage capacity factor (Minimum = 1.7, Onsite disposal = 2.5)
  LF = Loading Factor
  1.25 garbage disposal and dishwashing
  1.0 without garbage disposal
  0.75 without dishwashing
  0.5 without dishwashing and garbage disposal

The minimum size grease interceptor shall be 750 gal.

Thus, for a restaurant with a 75-seat dining area, an 8 hour per day operation, typical discharge of 5 gal per meal, a storage capacity factor of 1.7 and a loading factor of 0.8, the size of the grease interceptor is calculated as follows:

$$\text{Volume} = 1.7 \text{ X } 75 \text{ X } 5 \text{ X } \frac{8}{2} \text{X } 0.8 = 2{,}040 \text{ gallons}$$

Other design considerations include: facilities for insuring that both the inlet and outlet area properly baffled; easy manhole access for cleaning; and inaccessibility of the trap to insects and vermin.

Grease traps are generally made of pre-cast concrete and are purchased completely assembled. However, very large units may be field constructed. Grease traps come in single-and double- compartment versions. The standard details show a typical precast double compartment trap.

Grease traps are usually buried so as to intercept the building sewer. They must be level, located where they are easily accessible for cleaning, and close to the wastewater source. A two-chamber trap shall be used which has a primary (or grease-separating) chamber and a secondary (or grease-storage) chamber. By placing the trap as close as possible to the source of wastewaters, where the wastewaters are still hot, the separating grease at the surface of the first chamber can be removed by means of an adjustable weir and conveyed to the separate secondary chamber, where it accumulates, cools and solidifies. This decreases the requirement for cleaning and allows better grease separation in the first chamber.

The frequency of cleaning at any given installation can best be determined by experience-based observation. For the first year of operation, the grease traps shall be pumped completely dry to remove all grease, liquid and bottom sediments at least once a month, or when 75% of the grease retention capacity has been reached.

The Superintendent may modify the cleaning schedule by written notification at any time.

ARTICLE 5 - SEWAGE PUMP STATIONS

5.1 SCOPE

The pump station shall include: a concrete wet well with aluminum access hatch and frame, vent, pump hoist socket, base discharge elbows, ductile iron discharge piping and fittings installed in the wet well; two (2) submersible non-clog/vortex sewage pumps with stainless steel lifting cables; concrete valve vault with aluminum access hatch and frame, swing check valves, plug style isolation valves, ductile iron discharge piping and fittings; wet well liquid level controls; a duplex pump power and control panel; four (4) stainless steel control float switches: a stainless steel control float switch support bracket; a natural gas fueled engine driven generator; and other items necessary to provide a complete, operational pump station. Pumps, pump control panels, liquid level controls, valves and generators shall be supplied by the pump supplier to provide single source support and responsibility.

PLEASE NOTE THAT THE REQUIREMENTS HEREIN STATED MAY BE MODIFIED AT THE DIRECTION OF INTEGRA WATER.

ALL SEWAGE PUMP STATIONS SHALL, AT MINIMUM, MEET ALL APPLICABLE REGULATIONS AND SECIFICATIONS SET FORTH BY THE GOVERNING COUNTY OR MUNICIPALITY TO WHICH THE PUMP STATION IS SUBJECT TO. CONTRACTOR SHALL DEFER TO THE HIGHEST QUALITY SPECIFICATION SHOULD ANY CONTRADICTORY LANGUAGE EXIST BETWEEN THE MUNICIPAL AND/OR COUNTY SPECIFICATION AND THE SPECIFICATIONS CONTAINED HEREIN.

5.2 BASIC PUMP STATION DESIGN

Basic pump station design consists of several key elements, some of which are listed below:

- Location: Selecting the optimum location for the pump station will allow effective sanitary sewer service to the largest service area for the longest service life.

- Restrictions: Design of the pump station and its forcemain will require consideration of existing sewer elevations, sewer depth required to service users, environmentally sensitive areas, wetlands, archaeological and cultural resources, creek crossings, underground utilities or facilities, railroads, highways, property values and easements, floodplains, potential development, high usage or aesthetics, minimum cover, minimum slopes, and rock, sinkholes, or other topographic features.

- Design Flows and Pumping Rates: Local Planning projections for the design service area need to be considered to design acceptable pipe sizes to transport the existing and future design flows.

- Construction Materials and Methods: Pump station superstructure, wetwell, piping and valve vaults, and forcemain construction materials and methods must meet Integra Water requirements.

- Contract Documents: Specifications and drawings must be prepared according to the requirements of Integra Water. If the project is funded through a State Revolving Fund loan, the design and documents must also meet the requirements of the Regulatory Authority.

All wastewater handling facilities shall be designed in accordance with the rules, regulations, and standards of all appropriate agencies. Pump stations shall be prepared in accordance with these design standards and all construction documents shall be stamped by a professional engineer registered in the appropriate state. Integra Water must approve the plans prior to bidding and construction.

Where equipment manufacturers are listed in this manual, the intent is for Integra Water to receive equipment compatible with Integra Water standards and existing equipment. Designers writing specifications and/or contractors building Integra Water pump stations must receive approval of equipment

manufacturers and models from Integra Water prior to finalizing design or construction, including instances in which the manufacturer listed in this manual is specified or proposed by a contractor for installation.

5.3 PUMP STATION CAPACITY DETERMINATION

In order to determine pump station capacity, population and land use projections for the station's service area shall be made for a 20-year planning period, based on information obtained from the Local Planning Division. The station will typically be designed for staged construction of multiple pumps to defray part of the capital costs for the planning period.

Approval of pump station designs for projects with less than a 20-year planning period will be handled on a case-by-case basis.

The land use and population projections for a wastewater pump station service area shall be coordinated with Integra Water's latest wastewater system improvements master plan and with the local Planning Division to incorporate the latest revisions in the projections.

Wastewater flows shall be estimated from population projections, commercial/ industrial land usage and an estimated infiltration/inflow (I/I) in the pump station service area, all for a 20-year planning period. The methods of flow projection described in Integra Water's Technical Specifications shall be used. The pump station shall be designed for an estimated peak hourly flow as described below.

The residential wastewater flows shall be calculated using an average per capita per day flow of 100-125 gallons with 3 people per home. However, an additional allowance should be made where conditions are unfavorable, such as areas of known high groundwater.

When historical wastewater flow records are not available, the ratio of peak hourly flow to estimated average daily domestic wastewater flow can be obtained from the curve in Figure G-3.

Commercial Flows
When no specific flow data is available, contact Integra Water to estimate the peak commercial flows.

Total Peak Flow
Total peak hourly design flow can be calculated by adding the residential and the commercial peak flows.

An engineering report describing the pump station capacity determination shall be submitted to Integra Water for review and approval prior to final design. The report shall contain the following items:

- Topographic map outlining the drainage area to be served by the pump station. Pump stations shall be located at the lowest suitable point of the service area for gravity flow of wastewater into the wetwell with the objective of minimizing the wetwell depth. Service area and acreage shall be shown.

- Flow Calculations - present and future users and population for each drainage area. Must include all assumptions with basis for determining numbers.

- Peaking Factors used.

5.4 ACCEPTABLE MANUFACTURERS

Submersible pump suppliers acceptable to Integra Water include Sulzer, Flygt,

Goulds, and Hydromatic.

5.5 SUBMITTALS

Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Pumps

- Name of manufacturer. Type and model.
- Rotative speed.
- Size of suction elbow inlet. Size of discharge elbow outlet.
- Net weight of pump and motor only.
- Complete performance curves showing capacity versus head, bhp, NPSH required, and efficiency. Data on shop painting.
- Dimensioned pump outline drawing.
- Dimensioned drawing of the pump installed on the guide rail system. Installation, Operation and Maintenance manuals. *
- Parts lists. *

*Shall be provided after shipment of pumps

Motors

- Name of manufacturer. Type and model.
- Type of bearings and method of lubrication. Rated size of motor, hp.
- Temperature rating. Full load rotative speed. Net weight.
- Efficiency at full load and rated pump condition. Full load current.
- Locked rotor current.

Control Panel and Components

- Name of manufacturer.
- Type and model.
- Dimensions and net weight of complete panel. Overcurrent characteristics and details of motor control.
- Liquid level sensors with mounting details and cable lengths, and pump controls.

Force Main

- System head curve with roughness factor (C) of both 120 and 150 Plan and profile survey of the line connecting the station to the main.

5.6 SUBSTITUTIONS

After the execution of the contract, should the contractor desire to substitute equipment other than that specified in the contract, such substitution will be considered for one reason only: the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a similar installation. In the event the Contractor obtains Integra Water's approval of equipment other than that for which the station was originally laid out, the Contractor shall, at his own expense, make any changes in the structures, buildings, or piping necessary to accommodate the equipment, and shall furnish as-built drawings to Integra Water.

5.7 EXPERIENCE CLAUSE

The pump manufacturer shall have a minimum of 100 units of similar type pumps installed in the United States.

5.8 PUMP WARRANTY

The non-clog/vortex pump manufacturer shall warrant the pumps being supplied against defects in materials and workmanship for a period a five (5) year or 10,000 hours in permanently installed municipal wastewater pump station service. The warranty shall be NON-PRORATED throughout the five (5) year or 10,000 hours period. The warranty shall cover parts and labor. Pumps having warranty policies wherein the coverage decreases or is pro-rated during the warranty period or wherein parts only are covered shall not be acceptable.

5.9 PUMP REQUIREMENTS

Pump selection shall be based on the number of pumps to be operated, total dynamic head of the pumping system, and capacity requirements at the required design conditions. The minimum velocity requirements of 3.5 to 5.5 fps in the forcemain must be met during pump operation.

Wastewater pump stations with a capacity more than 250,000 gpd shall be designed to accommodate three pumps: two to operate in parallel and one as a standby pump. In smaller capacity pump stations, two pumps, one operating and one standby, are adequate.

Pumps for Integra Water pump stations shall be submersible, non-clog, centrifugal-type, capable of handling raw, unscreened wastewater with 3-inch or larger solids (spheres).

The submersible pumps shall have a simple lower-into-place disconnect/reconnect feature using guide rails and shall not require entry into the wetwell for removal or installation.

Pumps shall be designed to handle peak flow with a single pump. Motors shall be non-overloading over the entire pumping range. Pumping shall be designed to be 45 percent efficient at a minimum.

Levels and alarms shall be as follows:

- All pumps OFF.
- Lead pump ON.
- High-water level alarm (detected by both the ultrasonic level transmitter and the float).
- Lag pump ON

Pump No. 1 Overload
Pump No. 2 Overload
Pump No. 1 Moisture Detected
Pump No. 2 Moisture Detected
Pump No. 1 Over Temperature
Pump No. 2 Over Temperature
Pump No. 1 Phase Protection Trip
Pump No. 2 Phase Protection Trip

To extend pump service life, the pump assigned to the “lead” position should be alternated among the pumps following each pump cycle.

Minimum water level in the wet well shall be above the minimum pump suction submergence required by the pump manufacturer.

A minimum distance of 6 inches shall be provided between the invert of the lowest inlet sewer pipe to the chamber and the top water level of the pump chamber.

Aluminum access covers are to be provided on all chambers and these shall be hinged, and spring assisted with Auto lock in open position. Minimum allowable size of personnel access covers is 30”x30” square. All covers must be lockable. Note covers shall be suitable for vehicular and/or pedestrian load as required.

There shall be a plate near to the top of the pump chamber indicating pump No.1 and pump No.2. Each pump shall be installed with stainless steel (316 grade) guide rail and lifting chains.
The chamber floor is to be benched to a minimum of 15º towards the pumps to reduce the buildup of solids in the chamber.

The pump chamber shall be fitted with a vent stack capped with an anti-bird cowl.

Three phase installations shall have single phasing protection fitted to the motor starter to prevent motor burnout due to loss of phase.

Pumps shall be sized for a peak hourly flow (PHF) using the peaking factor discussed in Article 1. One removable pump hoist shall be supplied for use at the duplex pump station.

For pumps which weigh more than 500 lbs. each, an electric hoist shall be provided. The hoist shall include an electric trolley and a cable reel. The designer shall ensure that the hoist is capable of lifting each pump clear of the wet well and carrying it to a point suitable for loading onto a vehicle.

Strain relief should be provided on pump cables (Kellems – Stainless Steel Corporation).

Sewer influent into the wet well shall be baffled by an aluminum or stainless-steel baffle mounted to the inside wall. The baffle shall extend a minimum of 2 inches beyond the influent pipe wall on all sides so as to cover the entire pipe.

The wet well design should conform to the recommended practices of the Hydraulic Institute. Free-fall of influent onto the wetwell should be eliminated. If that is not possible, the influent pipe outlet should be placed some distance from the pump suction to minimize turbulence and potential pump cavitation.

Structures and access entrances should not be located within the right-of-way of streets and other public travel areas.

Alarms or signals should not be obstructed from view by topographic or landscape features.

All wetwells must bedesigned to withstand flotation.

All entrances, motors, electrical equipment, and unsealable openings in the station shall be at elevations above the maximum expected flood level.

The macerator inlet must be hydraulically submerged, as recommended by its manufacturer, for efficient operation of the unit. Operational levels in the wetwell must be coordinated accordingly; some submergence of the influent line will be required during normal operation. The head loss through the macerator must be incorporated into the pump station hydraulics.

A bypass channel or overflow pipe must be provided where a macerator exists. The bypass shall carry flow around the macerator and into the wet well in the event of a mechanical failure, clogging, or when the macerator is removed for maintenance. The bypass shall be designed to activate automatically upon back- up of the influent flow and shall prevent the influent sewer from surcharging to the point of runout onto the ground.

5.10 PUMP TEST

The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

- Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
- A motor and cable insulation test for moisture content or insulation defects shall be made.
- Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity. The pump shall be run for 30 minutes submerged a minimum of six (6) feet under water.
- After the 30-minute operational test, the insulation test for moisture content or insulation defects is to be performed again.

A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment upon request.

5.11 SITE TEST

The pump shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory certified service personnel shall perform start-up service. Proof of certification shall be required prior to equipment approval. Integra Water staff shall be notified and present at site test or site test is null and void.

5.12 SERVICE

The pump supplier shall employ factory trained service personnel. These persons shall be authorized by the manufacturer to perform all maintenance and repair work on the above pumps. Factory certification of service personnel shall be provided to the Engineer prior to approval of pumps. Only factory certified personnel shall perform start up on the specified material. The supplier shall also maintain a factory trained service person within 150 miles of the jobsite. Suppliers which cannot perform factory warranty work in their own service facility shall not be considered. Proof of such facilities shall be furnished to the Engineer.

5.13 MOTOR

The motor shall be protected from moisture intrusion from the pump's hydraulic end. Motors shall be a squirrel-cage induction motor, continuous duty NEMA Design B, at 40 degrees C ambient, and designed for at least six starts per hour. Motors shall have moisture resistant Class "F" (155 degrees C) insulation. Motors shall have at minimum 1.25 service factor, shall be oil-filled, and shall be designed for continuous operation half-submerged for at least 24 hours under pump cut-off conditions, without exceeding the temperature rise limits for the motor insulation system. High efficiency motors should be used in all cases. Air-filled motors will also be an allowable alternative to oil-filled motors.

The motor and pump shall have a shaft of at a minimum 400 Series stainless steel that is completely isolated from the pump media by a mechanical seal. No other materials shall be acceptable for this application. Mechanical seals of tungsten carbide shall be provided when highly abrasive conditions are anticipated as determined by Integra Water. Impellers shall be nonclogging in design and be secured from rotation on the shaft through the use of a shaft key or locking collet. Pump impellers shall be ASTM A48

Class 30B cast iron except in designated locations as determined by Integra Water where pump impellers shall be ductile iron or Type 416 stainless steel as required for the specific application. Pump volutes shall be of, at a minimum, ASTM A48 Class 30B cast iron having a minimum Brinell hardness rating of 180. The volute shall be further protected from wear through the use of a replaceable wear ring. Lesser grades of cast iron or materials having a Brinell hardness rating less than 180 shall not be acceptable as compatible with the normal grit contaminate of the service. Lower seals shall be carbon to ceramic. Pumps shall be equipped with a plug on the outside of the oil chamber, in order to inspect lower seal condition. Bearing shall be lubricated per manufacturer's specifications and have a B-10 bearing life of at minimum 50,000 hours. B-10 bearing lives of less value shall not be accepted as compatible with the normal overall station life expectancies.

Moisture detection and telemetry shall be required on all pumps. Moisture detection shall be connected to a detection indicator alarm light on the control panel. Moisture detection shall cause motor shutdown.

Overheat detection and telemetry shall be required on all motors. Overheat detection shall be connected to a separate detection indicator alarm light on the control panel. Detection shall cause shutdown.

High-water detection and telemetry shall be required on all pump stations. High-water detection shall be connected to a separate detection indicator alarm light on the control panel.

Monitoring units shall be provided with necessary auxiliary relays and terminals for wiring of sensor leads and external alarm/control functions. Operating voltage power supply requirements required to interrogate the moisture sensing device within each motor shall be provided as necessary within the control panel enclosure.

5.14 VALVES AND VALVING PIT

Each pump discharge line shall have a plug or gate valve with handwheel for isolation, and a cushioned swing check valve with counterweights and an external lever.

If the system operational pressure is expected to exceed 75 psi, a surge relief valve shall be provided. Each pump discharge line shall have a pressure gauge with a 4-20 mA output for the SCADA system.

When space has been created for future installation of additional pumps, only the wall pipe of the future discharge line, with both ends blind flanged, shall be installed.

Flexible couplings (flanged coupling adapters, sleeved couplings, etc.) shall be used in pump station piping to facilitate installation and removal of valves and equipment.

All non-buried valves shall be adequately supported.

Pipe wall penetrations shall be made at right angles; skewed or diagonal wall penetrations shall not be allowed.

Valve chamber(s) shall be located outside of and separate from the pump station building. Valve chambers shall be covered.

Buried piping within the pump station site shall have mechanically restrained joints for protection against potential axial thrust pull-out.

The valve vault shall have perimeter drainage system where required.

Should equipment removal considerations require such, the inclusion of a loading dock, roll-up door, lifting eyes and/or overhead beam and hoist shall be required so as to facilitate maintenance and repair of pumping equipment.

All plug valves and check valves shall be installed in a concrete valving pit with a Integra Water-approved cover OUTSIDE of the wetwell and inside the pump station lot. Plug valves shall be operated by a handwheel having an "open-left" stem operation. Check valves shall be of the lever weight reset type. All valves shall be manufacturer's recommended type unless otherwise detailed and approved by Integra Water. There shall be an eccentric plug valve, with pipe nipple, flange, and pressure gauge installed on the force main side of the check and plug valves of the size and pressure required for the force main as an auxiliary pump feed in the event the existing pump station motors are inoperable. The quick-connect adapter provided for connection to an auxiliary pumping system shall be sized based on the peak design flow capacity of the pump station. The piping and valving arrangement shall be arranged in a horizontal alignment.

All valve pit boxes shall be sized to provide 12-inch minimum overall clearance (top, bottom, sides) between the walls of the box and internal components. Tideflex or flap valve shall be installed where drainpipe enters wet well. The floor of the box shall be shaped/sloped to drain. All piping through the walls of the pit shall be of ferrous material. All valve pit boxes shall be set on a minimum of 18 inches of stone. Over-excavation areas below 18 inches shall be filled with concrete.

5.15 WETWELL/ STORAGE BASINS

The pump station design shall include a wetwell, an above-ground structure (superstructure), an inlet channel (including macerator or comminutor where required), discharge piping including valves and flow meter, pumps and controls. The design will also incorporate standard features for architectural, structural, electrical and heating/ventilation requirements.

The wetwell must provide enough storage volume to prevent frequent pump starts. Adequate storage for the lead pump can be calculated using the following equation from Wastewater Engineering: Collection and Pumping of Wastewater. Metcalf & Eddy, Inc. 1981.

$$V = \frac{\Sigma Q}{4}$$

V = wetwell storage volume required between pump control level in gallons
θ = minimum allowable time of one pump cycle – time between successive pump starts or change in speed of a variable speed pump in minutes
Q = capacity of one pump/lead pump or incremental capacity added by lag pump starting or an increase in pump speed (gpm)

This is the design volume for the wetwell between the levels for "lead pump on" and "all pumps off", and between "lead pump on" and "lag pump on".

Suggested minimum values for θ are as follows:

Table 5-1
Minimum Pump Cycle Time

Motor HP	Minimum Cycle Time (min.)	Maximum Starts per Hour
0.5-15	10	6
20-50	15	4
60-200	30	2
250-600	60	1

Wetwell/storage basins shall be designed and sized to accommodate wastewater flows expected to become tributary to the pump station for the entire project/development at build out. For regional pump stations, the

design shall take into consideration the tributary area, potential growth in the area, and expected service life of the pump station. Wetwell/storage basins shall be designed with an emergency storage capacity of 2- hours of peak flow in the event of pump failure. Approval of staged capacities based on phased development may be allowed, but provisions, requirements, facilities, and costs shall be delineated and accounted for in the initial design. If staged capacity is under consideration, the design engineer shall furnish a development construction schedule that explains the construction sequence for time when additional capacity is added. Staged capacity projects shall not adversely affect Integra Water's ability to operate the pump station.

On pump stations over 250,000 gpd, the wetwell shall be divided into two distinct cells to that one cell can be taken out of service (for cleaning) while at least one-half of the pumping capacity of the station remains on-line.

The pumping station should preferably be of circular pre-cast concrete sections surrounded with a minimum thickness of 8-inch 3000 psi. concrete. The use of GRP/FRP pump stations is also acceptable and will be subject to a 30-year design life. The manufacturer’s data sheet and installation instructions shall be submitted.

Precast concrete shall be manufactured by any process that will produce a dense, homogeneous concrete ring of first quality and shall meet or exceed necessary compression strength. The manhole rings and roof slab have a minimum wall and slab thickness of 8 inches.

The minimum size allowed for any wetwell shall be 6 feet in diameter.

In cases where a storage basin(s) is needed in addition to the wetwell, the storage basin diameter and depth shall be designed to match the wetwell, However, a larger storage basin may be required if greater storage is needed. Also, the storage basin shall be designed with a uniform cross section from top to bottom.

Wetwell designs shall eliminate areas which may cause dead zones or accumulation of debris.

The bottom slab of the wetwell shall be set on a minimum of 12 inches of stone. All over-excavated areas over 18 inches below the wetwell bottom shall be filled with concrete.

The pump station wetwell and superstructure shall be completely separated to avoid the requirement of explosion-proof equipment. No form of entry from the superstructure directly into the wetwell will be permitted. Cable, duct, or pipe penetrations through the walls or floor must be completely, permanently sealed so as not to allow the potential for the transfer of gases.

Concrete surfaces inside the wetwell shall be protected from sewer gas attack by a coating especially formulated to resist such attack. Said coating shall be installed having a smooth surface. Any coatings shall be cleaned from any area not supposed to have such coating. All joints in wetwell shall be grouted before any coating is applied. Wetwells shall be vented to the atmosphere and shall be screened to prevent vermin access. Vents shall be located as far as possible from maintenance work stations. Wetwells using an 8-foot diameter or larger manhole shall utilize a 6-inch minimum diameter vent. The top slab of the wetwell shall be core-drilled and fitted with a 6-inch or 8-inch (as specified by Integra Water) HDPE suction pipe that extends from the bottom of the wet well to 2 feet above the top slab. The bottom of the suction pipe shall be connected to a 90-degree fitting which shall be anchored to the floor of the wet well. The top of the suction pipe shall be connected to a 90-elbow with a quick-connect adapter. A blind cap shall be provided to prevent vermin access through the suction pipe.

XYPEX ADMIX C-500R (available from SteelCon Coating Systems at 205-951-2086) shall be added to the concrete during batching operation to provide chemical resistance and water proofing. The XYPEX ADMIX C-1000R shall be added at 3.5%, including dye, of the weight of Portland Cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added at the XYPEX Manufacturing Plant. Batching, mixing, and application shall be as per manufacturer’s directions.

When needed and approved, steps shall be protected from corrosion by use of non-corrosive material or approved protective non-corrosive coating. All exposed metal items, such as nuts, bolts, cables, supports, rails, etc., shall be made of stainless steel (Type 316). Also, all such metal items shall be configured, covered, protected, or made so as to present non-sparking surfaces. The Supplier shall review this protection with Integra Water for approval before installation. Exceptions to this are manufacturer "package systems" that are approved for use by Integra Water.

5.16 ACCESS DOORS AND HATCHES

All pump, wet well, and valve vault access hatches shall be aluminum.

Access doors/hatches to below ground pump station components shall be sized and located so as to provide easy and direct access for maintenance crews and equipment. Placement shall also factor non-interference with other station components and safety concerns as relating to working in close proximity when in the open position. As far as possible, all hatches and doors shall be located to avoid traffic loading.

Access doors and all appurtenances to the valve pit shall be of a heavy-duty aluminum or stainless- steel type that is weatherproof and rated for either a 300 PSF live loadings or wheel loads from maintenance vehicles in potential traffic applications. Access frames and covers shall be provided with a continuous concrete anchor, as part of the one-piece extrusion.

All access doors shall be mounted in such a way that concrete (or other material used for the basin) completely supports the bottom face of the frame, and the basin material shall be designed to support the hatch support loading. The frame shall be a self-draining channel with a 1-1/2- inch draining coupling located in the channel frame. The doors shall be provided with tamperproof fasteners. The doors shall open to 90 degrees and lock automatically in that position with a positive locking arm and a release handle. Doors shall close flush with the top of the frame, resting on a 1/2-inch minimum wide lip around the entire inside of the frame.

All accessory components of access hatches (hinges, handles, locking arms, etc.) shall be of manufacturer's recommendations and specifications to meet the required loadings and serviceability. All nuts, bolts, washers, and miscellaneous hardware shall be stainless steel Type 316. In no case shall carbon steel components be allowed that will present a rusting or sparking condition.

Any aluminum embedded in concrete shall be coated with bitumastic where directed by Integra Water during station construction.

The minimum dimension of any access door or hatch shall be 30"x30".

All access doors at the pump station facility shall be made as to be lockable. Elevation of the top of all accesses shall be at least 6 inches above final grade and installed level. Finished grade shall be such as to leave no voids under the top slab and shall be stable as to erosion potential.

5.17 CONTROLS

For wetwell level control/pump operation, provide an ultrasonic level sensor (HydroRanger as manufactured by Milltronics, MPE LM-AB, or Integra approved equal).

Wetwell control levels shall have a minimum difference of 6 inches.

Pump controls shall provide for alternation of the pumps following each pump-on cycle. All pump station equipment shall have elapsed run time hour meters.

Controls for operation of the duplex pumping system shall be furnished by the Supplier of the pump station in accordance with the following requirements. All controls and accessories shall be of the pump manufacturer's model and type specified and approved by Integra Water. Controls shall be intrinsically

safe.

5.18 PUMP CONTROL PANEL

Each submersible pump system shall be furnished with pump control panel, control devices, and level.

The control panel shall be designed to operate from a 120/240-, 120/208-, or 277/480-volt, 60-Hz, single- or three-phase external source. Terminals shall be provided for terminating up to #3/0 AWG size cable per phase. Panel shall be intrinsically safe.

5.19 WIRING

All electrical work in the wetwell shall conform to NEC Hazardous Classification Class 1 Division 1 Group D.

No junction boxes will be allowed between the pump and the MCC.

All internal device wiring shall be as normally furnished by the manufacturer. All interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C. All wiring shall be in accordance with the National Electrical Code.

Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Indicating light circuits shall be minimum 16 AWG. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on the system Supplier's panel wiring diagrams.

Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided.

The panel fabricator shall provide such additional circuits as required for proper operation.

5.20 NAME PLATES

Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends consistent with the control descriptions included in the following paragraphs for each device and shall be made of laminated phenolic material having engraved letters. Nameplates shall be secured firmly to the panel.

5.21 CABINET

Cabinet shall be a custom-engineered enclosure, suitable for mounting as indicated on the Drawings, which contain the system components indicated on the Drawings and specified herein as well as being intrinsically safe. In all applications, unless specifically approved by Integra Water, all controls, meters, and devices associated with the pump control system, shall be placed within the interior of this control panel enclosure. All circuits which are routed between backplate-mounted components within the enclosure shall be physically protected in flexible non-metallic conduit. The enclosure shall be 54" x 69" on 12" legs, NEMA rating shall be NEMA 4X, or as specified by Integra Water. Condensation protection space heaters with thermostat control shall be provided for enclosure internal temperature control as recommended by the manufacturer. The enclosure shall be fabricated from 12-gauge steel and shall be equipped with full-size

gasketed doors with a three-point latch and stainless-steel hinges. The doors shall be capable of being locked in an open position. The control panel enclosure shall include a noncorrosive aluminum backplate. Each panel shall be equipped with all air conditioning system to maintain the 4X rating of the panel. HVAT dissipation of all equipment shall be accounted for in sizing the unit. Enclosure shall be mounted on a 6" thick concrete pad. The Control panel may be installed on unitrusts in lieu of a standing cabinet.

5.22 MOTOR STARTERS

The pump Supplier shall match the sizes of control power transformers, overload devices, heaters, and starters to the equipment furnished, as they may differ from the values indicated on the Drawings. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.

Each starter shall have a solid- s t a t e overload relay (Class 20) with 2NO/2NC auxiliary contacts. Each starter shall be provided with an external, manually reset push button for resetting the thermal overload relays. The external reset push buttons shall be accessible by opening the outer door of the control panel enclosure and mounted on hinged interior panel front within the enclosure.

Each starter shall include auxiliary RUNNING status contacts wired to terminals for external connection by others for remote indication.

Each starter shall be provided with interlocking mechanism which, when the disconnect handle is moved to the "OFF" position, disconnects all external sources of power from the terminal blocks within the starter, such as external power across motor auxiliary status contacts.

5.23 THREE-PHASE STARTERS

Three-phase starters shall be circuit breaker combination type consisting of three-phase, 60 Hz contactors with electronic adjustable overloads, a 120-volt ac coil, a dry type control power transformer where required, and a circuit breaker disconnect. Overload relay shall be provided with one normally open dry contact. The contact shall close on motor overload and open when manually reset. Control power transformers shall be sized to handle all simultaneous loads. Starters shall be at least NEMA Size 1.

Circuit breakers shall be 600-volt magnetic motor circuit protectors. If an inverse time thermal magnetic circuit breaker is used, the thermal characteristic shall be externally adjustable from the face of the breaker. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism.

The complete three-phase starter shall have an interrupting rating of at least 14,000 amperes at 208 volts, and 25,000 amperes at 480 volts.

Three Phase motors 5HP and greater shall be provided with a reduced voltage electric soft start in lieu of a full voltage starter.

5.24 CONVENIENCE RECEPTACLE

A single 120-volt, 20-ampere, ground fault interrupting convenience receptacle shall be provided with the control panel enclosure. A step-down transformer to provide 120- volt power to the receptacle shall be provided as necessary. If the receptacle cannot be located within the control panel enclosure, then it shall be located on one exterior side of the control panel enclosure, within its own lockable access receptacle box, which shall be waterproof, dustproof, and weatherproof. Placement shall be in accordance with Integra Water.

5.25 AREA LIGHT CONTROL

A snap action switch shall be furnished and installed on the interior panel within the control panel enclosure. The switch shall be connected to a branch power circuit of minimum 15 amperes at either of 120- or 240-

volt single phase, supplied from the control power transformer within the control panel enclosure.

5.26 CONTROL OPERATION

Wetwell control levels shall have a minimum difference of 6 inches. Level control shall use a Hydroranger ultrasonic level finder as manufactured by Milltronics or MPE LM-AB. All specified or proposed level control equipment must be approved by Integra Water prior to construction or installation.

Within the pump station superstructure, clear-space shall be provided around all equipment and controls for operations. The space provided shall meet all applicable code requirements.

Pump failure relay must combine loss of phase/temp/leak/overload/fail-to-run into one output (MOSCAD system).

Control operation shall correspond to the Drawings and as specified herein. The pumps shall be controlled in a typical duplex lead-lag manner. This includes automatic alternation on successive starts to include the standby pump, automatic failover in the event of a pump failure to start the standby pump, and override to start two pumps if level continues to increase.

HAND-OFF-AUTO pump mode selector switches shall be connected to allow manual start or stop of each pump and to select automatic operation of each pump under control of the level control system. Pump alternator shall be capable of being manually selected to alternate between pumps or individually select a pump to perform pumping duty in response to the level switch contacts of the level control system. In AUTO, pump controls shall also allow for an external RUN command, via telemetry system, to initiate pump operation.

Each pump unit shall be provided with a seal leakage and high temperature detection and alarm systems in the control cabinet for protection of each individual pump motor. A moisture-sensing device shall be provided in the stator housing for seal-leakage protection and, if necessary, a monitoring module shall also be provided within the control panel for alarm transmittal and motor shutdown. This monitoring unit shall be provided with necessary auxiliary relays and terminals for wiring of sensor leads and external alarm/control functions. Operating voltage power supply requirements required to interrogate the moisture sensing device within each motor shall be provided as necessary within the control panel enclosure.

Each three-phase motor shall be protected by a microprocessor-based motor protection relay. The relay shall protect against phase loss, phase reversal, voltage unbalance, and low voltage on any one or more phases, causing a shutdown of the pump if any such abnormality is detected. The relay shall re-activate after power line conditions return to an acceptable level. Trip and reset delays shall prevent nuisance tripping due to rapidly fluctuating power line conditions. The relay shall be RMF Series by Square D, or equal. Motor protection relay shutdown alarm shall be connected to a separate detection indicator light on the control panel. A dry, resistive contact shall also be provided and wired by others for remote notification.

The level control system shall consist of an ultrasonic level transmitter and one level sensing “float” with cable and cable supports provided. The cable and float brackets are to be stainless steel with stainless steel bolts. The pump controller shall be a MPE SC2000-24. The controller shall be housed in the pump station control panel. This device will control the pump off, lead on, lag on and interface with RTU via 4-20MA inputs to monitor wet well levels. The float shall be a weighted pear-shaped enclosure, hermetically sealed, housing a double-pole mercury switch. The switch shall be cushioned, mounted approximately at 65 degrees inclination from the enclosure main axis and connected to a special three- conductor cable. The cable shall be insulated and heavily sheathed with PVC for resistance to immersion, corrosion, and abrasion. The cable length shall be sufficient to extend into the handhole or junction box outside the pumping station and to allow the float to be set within 2 feet of the bottom of the pumping station.

Switches shall be the direct-acting type, designed and constructed for extremely long life in severe applications. Each switch shall contain a single pole mercury switch in the normally open position which

shall close when the switch body is tilted. Switches shall be epoxy encapsulated. The switch housing shall be 316 stainless steel and shall be provided with a Teflon coating to reduce the buildup of grease and other material. #413 AWG Hypalon jacketed type 50 cable shall be provided with each switch.

Levels and alarms shall be as follows:

- Low-water level alarm
- All pumps OFF
- Lead pump ON
- Lag pump ON.
- High-water level alarm (detected by both the ultrasonic level transmitter and the float).

Level switch elevations shall be as indicated on the Drawings.

Contact interrogation voltage across the level sensing switches within the wetwell shall be 24 volts maximum to ensure compliance with intrinsically safe, explosion-proof requirements and shall be a Diversified Electronics ISR Module Part # ISO-120-ACE, 120-volt supply or equivalent. The control power transformer with 24-volt secondary voltage shall be furnished and installed within the control cabinet as necessary to interface with the level sensing switches.

Each control panel shall be equipped with heavy-duty, oil-tight pilot lights, reset buttons, common alarm acknowledges push button and selector switches as required, and mounted on an interior hinged panel door within the control panel enclosure. All operating controls and instruments shall be securely mounted in a logical manner and arrangement and such that any standard options offered by submersible pump manufacturer may be added in the field. All controls, pilot lights, selector switches shall be clearly labeled to indicate function. All push buttons and pilot devices shall be 30mm.

Six-digit elapsed time meters (non-reset type) shall be provided to indicate running time of each pump in "hours" and "tenths of hours". Green "Pump Running" indicator lights and elapsed time meters for each pump shall be mounted on the face of the interior hinged panel door. Individual alarm lights mounted on the hinged interior dead front panel within the control panel shall be provided for the following alarms:

Table 5.2
Control Panel Alarm Lights

ALARM	COLOR
Pump No. 1 Overload	Red
Pump No. 2 Overload	Red
Pump No. 1 Moisture Detected	Amber
Pump No. 2 Moisture Detected	Amber
Pump No. 1 Over Temperature	Red
Pump No. 2 Over Temperature	Red
Pump No. 1 Phase Protection Trip	Red
Pump No. 2 Phase Protection Trip	Red
Wetwell High-Water Level	Blue

Any of the above alarms shall close a single-pole, double-throw relay with a dry, 120-volt ac rated resistive contact, wired to terminals for connection by others, for remote indication. In addition, any alarm will illuminate a flashing red vapor-tight alarm beacon and alarm horn. The alarm beacon shall be furnished with a minimum 60-watt lamp, located on the top of the control panel so as to be readily visible from the main road/street. The alarm horn shall be side mounted to the control panel enclosure and shall have minimum 103 dB at 10 feet distance from the panel. A Liebert UPStation GXT 2U, Model GXT2- 700RT120, 700 VA, 490 watts capacity, 120VAC or equal uninterruptible power supply system shall be provided to operate the alarm beacon and alarm horn.

5.27 ELECTRICAL

Motor rated voltage shall be as follows unless indicated otherwise:

- All three-phase pumps 5 to 10 horsepower shall be rated for 208/120 volts electric power, unless otherwise specified. The motors shall be designed in such a way as to be able to operate with voltage levels 10 percent above or 10 percent below the nameplate rating indicated above.

- All three-phase pumps greater than 10 horsepower shall be rated 277/480 volts from a three- phase external electric power supply. The motors shall be designed to be operational over a power supply voltage range of plus or minus 10 percent of the nominal voltage.

- Pumps requiring horsepower and voltage levels other than those specified above shall, on a case by case basis, be approved by Integra Water.

The Contractor shall coordinate with the serving utility to provide power to the facility. The Contractor or Developer will bear the burden of the cost for establishing single phase and/or three-phase power to the pump station site.

At both single- and three-phase service poles, a lightning arrestor by Delta and a TVSS by Surge Suppression, Inc. shall be furnished and installed within the service disconnect enclosure and connected to the incoming service conductors for surge protection (180 KA per phase).

Duct seal or other approved conduit seals will need to be used as to not allow sewer gases to travel through conduit.

Lightning protection shall be provided and coordinated with Integra Water during design.

A minimum of two 220-volt interior wall receptacles and four 110-volt interior wall receptacles (one on each wall) shall be provided with ground fault protection and waterproof covers.

5.28 AUXILLARY POWER

All pump stations shall be equipped with a quick connect for an emergency generator if a permanent generator is not to be installed. For pump stations equipped with a quick connect, a manual transfer switch must be installed.

Provide an additional 20-amp standby receptacle.

A complete stand-by generator system with automatic transfer switch shall be furnished and installed. The unit shall provide output to drive the load of the pump station with 20% maximum voltage dip and be 80% loaded. The unit shall be driven by a matched natural gas (propane when natural gas is unavailable at the site) engine. The unit shall have a permanent magnet exciter, and electronic engine governor to provide 0.5% frequency regulation and no load to full lead and 0.25% regulation steady state. This unit shall be manufactured by Generac or equal by Caterpillar, ONAN or Kohler.

The automatic transfer switch shall be the same capacity as the service entrance and be rated for continuous operation. The transfer switch with instrumentation shall be contained in NEMA 3R enclosure with thermostatically controlled strip heaters. The automatic transfer switch shall be equipped with an instrumentation/control package to include: utility voltage sensing for drop out and pick up and utility interrupt delay, 5-30 second adjustable timer for loss of utility to generator crank, warm up, in-phase monitor, time delay, neutral return to utility (1-30 minute adjustable timer), engine cool down and transfer on exercise, a return to normal bypass, a preferred source switch, remote auto control. The transfer switch shall have 2 sets of auxiliary controls. The transfer switch shall be open transition type operation. The automatic transfer switch shall be manufactured by Generac or equal by Caterpillar, ONAN or Kohler.

The standby generator unit shall be installed on a concrete pad and connected to the incoming power to the pump station and to the RTU control transmitter. All wiring shall be in accordance with all local and NEC requirements.

The generator unit and automatic transfer switch shall have a 5-year warranty. The Contractor shall warrant the installation for 1 year from the date of acceptance. As part of the scope of work, provide for factory-trained personnel for system start-up, training on operation and maintenance for the Owner's Superintendent, three sets of Owner's Manuals. At the completion of the process, the Generator shall have a full fuel tank of #2 "LP" for 36 hours of runtime @ 80% load.

All required onsite generators shall become the property of Integra Water upon final acceptance of the pump station facility by Integra Water.

5.29 MONITORING EQUIPMENT, SENSING AND ALARMS

As directed by Integra Water, the monitoring and accessory equipment described below and the RTU described later shall be furnished within the control panel enclosure. ALL ALARMS SHALL BE COMPLETE AND TESTED AT STARTUP.

After loss of power, pumps shall automatically restart after power is restored. Automatic restart alarms and signals shall be coordinated with Integra Water.

Alarms shall be transmitted to Integra Water. All alarms are to be piped in and wired by an Electrical Contractor as required by Integra Water.

Audible alarms should be provided with reset.

5.30 PUMP STATION CONTROLLER

Each pump station controller shall be a MPE SC-000-24 equipped with a Db6 transducer and cable. The controller shall be housed in the pump station control panel.

Temperature rating (-20ºC to + 60ºC) -4ºF to 140ºF. Accuracy shall be .25 percent of the measured range or 6mm (whichever is greater) with resolution of 0.1 percent of the measured range or 2mm (whichever is greater).

5.31 SCADA/RADIO COMMUNICATION

Please see separate SCADA specifications. All SCADA must be ordered through Matthews Integration.

5.32 BATTERIES

The battery system shall use Concorde – Sun-Xtender VRCA-AGM Absorbed Glass Mat (AGM) sealed, maintenance free, valve regulated, lead-calcium alloy designed for deep-cycle PV applications.

The temperature operating range shall be -40ºF to 160ºF (-40ºC to +72ºC) as well as low self-discharge of 1 percent per month at 77ºF (25ºC).

The terminals shall be M8 copper alloy with silicon bronze bolted connections.

"Non-spillable batteries" for transport shall comply with DOT-HMR49 non-hazardous materials. UL recognized system component.

Full charge termination voltage (@25ºC) – 14.4 VDC, Floatchange @ 5.4 VDC with temperature compensation plus or minus 3.75 MV Percell/C degrees @ 25ºC, from (0ºC to 40ºC).

A limited two-year warranty shall be provided with life expected cycles versus depth of discharge (DOD) @ 1- hour rate/25ºC (77ºF) as follows: 5200 @ 10 percent DOD, 1850 @ 30 percent DOD, 1050 @ 50 percent DOD.

Multiple batteries shall be series connected to provide the necessary ampere/hour capacity required to operate the entire system at each remote location for (7) seven- d a y autonomy 24- v o l t solar system. Minimum A/H capacity of 100 A/H shall be required using two model PVX890T Concorde batteries.

5.33 REMOTE TERMINAL UNIT (RTU) SPECIFICATION FOR PUMP STATION

Each Pump Station RTU will contain the following equipment:

- MPE SC2000-24 pump controller with ultrasonic level transducer.
- Omnex DME-900 Radio Modem
- Altronics AL624-12C linear power supply/charger system that is battery backed up for continuous radio transmissions for 24 hours.
- Nema 4X 20x16x6 Stainless Steel Enclosure
- Phoenix PT 2-PE surge protection
- Citel P8AX coax surge protection
- Intruder alarm switch
- 35/5 penta pole
- Astron 918-10 Yagi antenna
- Lmr-400 coax

The Pump Station RTU's operations and control shall be as follows:

<u>Operation</u>

- Turn two pumps on/off/alternate
- Measure flow, rate and totalize
- Measure wet well level and alarm overflow
- Sequence pump stations and operations
- Computer override local control
- Low wet well level cut-off

<u>Monitor</u>

- Power – on/fail
- Pumps (2) – on/off/fail
- Wet well level – height in feet/overflow & differential alarm

- Flow rate – GPM/totalize
- Stand-by Generator – off/off/fail
- Security – on/off/alarm
- Discharge pressure – level/alarm

5.34 FLOW METER

A Krohne sanitary sewer magnetic flow meter or approved equal including controls and transmitter as specified by manufacturer. Flow meter size to be determined by size of force main, needs to be NEMA 4x, also needs to be flanged for easy installation or removal, flange class to be 150. Installation of all utilities at the site, including power and telephone service, shall be coordinated with the Owner.

Electromagnetic flowmeters shall operate on electromagnetic induction principle and give an output signal directly proportional to the liquid rate of flow.

Each meter shall have a stainless-steel metering tube and a nonconductive liner. End connections shall be steel flanged ANSI Class 150#. The housing shall be epoxy-coated steel, welded at all joints. Bolted coil-enclosures shall not be acceptable.

The flow meter sensor(s) shall be located in a vault outside of and separate from the pump station building. The flow meter recorder shall be located inside the pump station control panel.

The flow meter shall be installed at a point at least three (3) pipe diameters in distance downstream from any valve or pipe fitting, including bends. The flow meter shall be installed in a p-trap configuration with 2-90° fittings on both sides to ensure full flow through the meter at all times.

The flow meter shall be installed in a doghouse manhole; a perimeter drain shall be provided where required. The vault shall have an aluminum access hatch.

The flow meter vault shall be located within the pump station site fenced-in area.

The flow meter shall be equipped with a rate-of-flow indicator, flow totalization, and a compatible circular-chart recorder.

The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.
There shall be no electronic components on the primary flowhead. Coil drive power shall be supplied by a remote converter. Output signal from the primary shall be fed through “DS” (double shielded) proprietary cable, 25 feet in length, to be supplied with the meter to the signal converter.

The Primary Flowhead shall have a housing rated for complete submergence NEMA 6P. Electrode material shall be corrosion resistant Hastelloy C4.

The flowmeter shall be a magnetic inductive type, model Aquaflux 410 as manufactured by Krohne or approved equal.

The magnetic flowmeter converter shall be remote mounted and provide precisely controlled and regulated, bipolar DC primary field excitation pulses at a keyed frequency of ½, 1/6, 1/18, or 1/36 of line frequency digitally selectable. It shall convert the primary flowmeter signal into a mA DC and pulse output directly proportional to the flow rate.

The full-scale measuring range shall be a direct digital input in gpm and fully adjustable over a range from 1.0 to 40 ft/sec.

Each converter shall contain self-diagnostics, automatic data integrity checking and be completely interchangeable with other converters of the same type without need for recalibration. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of flow

meter/converter.

Each converter shall contain the following features as standard equipment:

- Simultaneous analog output (500-ohm Load) and a scaled pulse output.
- Analog and pulse outputs configurable for passive or active operation.
- Digital "Status" output/input configurable for one of the following functions:
- Input – output hold, output zero, totalizer reset, error reset.
- Output – error indication, flow direction, output overrange, trip point, range change.
- Adjustable damping of analog signal from 0.2 to 99.9 seconds.
- Low flow cutoff.
- Forward/reverse flow measurement capabilities.
- Integral rate of flow indicator and 7-digit LDC totalizer with back lit display.
- Reprogramming of all data and functions, resetting of counters, etc., using magnetic pins from outside without opening the housing.
- The converter shall have HART smart protocol. It shall use the HART protocol via FSK along the analog signal wire to remotely configure, read flowrate, total and diagnose problems without affecting the measurement signal. The intelligence must reside within the converter.
- Capability of testing analog and frequency outputs.
- Ten-year data retention without the need for auxiliary power.
- For ease of wiring, power and output wiring terminals shall be a plug-in type, removable from the instrument without disconnecting wiring.
- The converter shall be capable of interfacing with an IBM compatible PC utilizing the PC Config software via a RS 232/FSK converter.
- For ease of repair/replacement all converter configuration data shall be stored on a removable EPROM. When removed and placed into a replacement/spare converter, no additional programming shall be required.
- Engineering units for display and programming; flow and total shall be user programmable in any engineering unit of measure.

All adjustments and changes of the above features shall be by direct digital input. Repeatability shall be .10% of rate.

Accuracy of the system (Primary Flow Head and Converter) for sizes 3/8"-40" shall be: +/- .30% of actual flowrate (for velocities of 1.3 – 40 ft/sec) (+/- .50% of actual flowrate for sizes 1/10" – 3/8").

The enclosures shall be rated NEMA 4X (IP-65). The instrument shall be manufactured in an ISO 9001 approved facility.

The converter shall incorporate EMI/RFI protection/suppression as well as overload protection for output circuits and meet the requirements of the EU-EMC Directives and bear the CE Approval symbol. The signal converter shall be Krohne model IFC090 or approved equal.

The electronic pressure transducer shall provide a 4-20ma output signal for a pressure range of 0- 100 psig, and be suitable for underground mounting, and connected to the pump controller.

5.35 STATION LOT AND ACCESS REQUIREMENTS

Pump Station shall be located on a dedicated easement, right-of-way or deeded lot having a usable area of not less than 2,000 square feet and shall be located along a public road. All pump stations for Integra Water may be subject to a Location, Character and Extent review.

Pump station sites shall be designed to eliminate mowing or landscape maintenance. Areas within the site fence-line shall be paved or filled with gravel or crushed stone, layed over visqueen or another geotextile fabric. A landscaped buffer zone around the station should be provided for screening,

particularly in residential areas.

The pump station shall be designed to remain fully operational and accessible during a one hundred (100) year flood event.

All developments must include emergency storage basins in case of main breaks downstream. These storage basins shall be sized to handle at least 20 gallons per residential equivalent of emergency flow with a minimum of 4500 gallons. Developments that exceed 250 residential equivalents may require multiple storage basins. These basins will be located within the deeded 2,000 square foot lot and with the capacity for future upgrade as the developments lift station is upgraded. Design consideration as to the location of these basins with respect to future lift station requirements should be given. Location and layout of this facility is subject to approval by Integra Water.

As directed by Integra Water, the chain link fencing and gates described below shall be provided at the pump station lot. All pumping station lots shall be deeded to Integra Water or its successors, assigns, or designees.

Erosion control measures shall be installed and maintained at the site during construction. At the completion of construction and at such time that Integra Water determines that adequate permanent erosion control measures have been established, the Contractor shall remove the temporary erosion control measures and dispose them offsite.

Adequate compaction of backfill around wetwell/storage manholes and valve vaults shall be achieved to prevent erosion around these structures after the pumping station facility is in service. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness and shall be compacted to at least 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

Compaction of structure backfill by rolling will be permitted, provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

5.36 CHAIN LINK FENCING

Lots shall be enclosed by an 8-foot high chain-link security fence, ,2inch diamond mesh interwoven wire, (all materials shall be Class I galvanized coated, 9- gauge mesh), top selvage twisted, and barbed bottom selvage knuckle end closed. Fencing shall be topped with three rows of outward facing barbed wire. Extension arms to be cast steel galvanized, single arm, vertical, sloped to 45 degrees. Wire shall be 12-1/2-gauge galvanized line wire with four-point, 14-gauge barbs spaced 5 inches on centers. Bottom tension wire shall be 7-gauge spring coil wire with galvanized coating. End, corner, and pull posts shall be 3-inch O.D. galvanized coated. Line posts shall be 2 3/8-inch galvanized coated. Top and brace rail to be 1.66-inch plain end, sleeve coupled. Corner, gate and terminal post footing depth to be 4 feet below finished grade. All post footings shall be sloped to drain.

The access gates shall be a pair of 8-foot long, 8-foot high sections constructed of 2-inch O.D. pipe. Gates shall be equipped with a latch and hasp assembly and center post. Gate posts shall be 3-inch O.D. galvanized coated. A ground anchor cast in concrete shall be provided. All gates shall be factory fabricated and equipped with gate hold-backs. A three (3) foot wide manway should also be provided. Panel shall have a horizontal brace center of fabric height. The location shall be coordinated and approved by Integra Water.

5.37 VEGETATION CONTROL

The entire site inside the fence shall be covered with an “anti-weed” fabric that prohibits the growth of vegetation yet allows rainwater to pass through. Covering shall be with 2 inches of crushed stone (ASTM C33, Gradation 67). This covering shall extend to 1 foot outside the fenced area.

5.38 YARD HYDRANT AND WASHDOWN PAD

A convenience yard hydrant (lockable) supplying potable water for a wash-down capability shall be supplied by the Contractor inside the security fencing adjacent to the wash-down pad. The water service line shall be a 3/4-inch or 1-inch line. The service line shall have a double check valve assembly backflow preventer per Integra Water specifications. The dimensions of the wash-down pad shall be as indicated on the drawings but in no case shall be less than 3 feet square. Yard hydrant assembly will consist of a vacuum breaker, head for attaching a hose, riser pipe, and shut off valve below the frost level. The assembly will be surrounded by a minimum of 18" stone to allow draining of the riser.

5.39 SITE ACCESS ROAD REQUIREMENTS

All portions of the lot surface and access road to the facility shall be at least one (1) foot above the 100-year flood (FEMA and local) elevation. Provisions shall be made to protect side slopes from flood erosion and wave action as necessary. Pump stations shall have adequate site and sub-grade drainage.

Access service road shall be paved asphalt or concrete with a minimum width of 12 feet from the road to the fence gate. An access security gate and/or all-weather travel surface may be stipulated by Integra Water on an individual site basis.

The grade of the site access road shall be no more than 8 percent. A vehicle turnaround area shall be provided at the termination of the site access road. At the option of Integra Water, the vehicle turnaround area may be omitted if the site access road length is less than 100 feet. If a vehicle turnaround area is provided, the turning radii used in layout of the area shall be sufficient to accommodate the largest vehicle expected to access the facility. All stations shall be accessible by either the electric utility's bucket truck or line truck.

5.40 FORCE MAINS AND AIR RELEASE VALVES

Forcemain material of construction shall be ductile iron unless otherwise approved by Integra Water. All pipe material, trenching, and bedding shall conform to the requirements set forth in Article 3 of Integra Water's Technical Specifications.

Depth of cover shall be a minimum 4 feet, or as required by the agencies governing right-of-ways for which permits must be obtained. At ditches, swales, or other areas where cover is less than the minimum required, reinforced concrete encasement shall be required.

Forcemain line velocities shall be designed for a minimum velocity of 2.5 fps.

Minimum force main diameter shall be 4 inches without solids removal/handling facilities, such as mechanical bar screens, comminutor, or grinder-type pumps. Minimum force main diameter with solids handling/removal facilities shall be 2 inches.

Sewer force mains not located along public road right of way shall be located inside of a minimum 10-foot wide easement. The easement shall be in the name of Integra Water, LLC and shall include all necessary rights of access for maintenance of the facility.

For offsite forcemains, Air release/anti-vacuum valves shall be installed at high points along the forcemain to prevent air entrapment. Air relief (release, dual function, universal, air and vacuum, etc.) valves shall be vented into a 4-foot manhole cone section with riser ring and rim. An air release valve shall be installed within the valve vault at each pump station site. The floor of the assembly shall be covered with a minimum of 4 inches of washed stone. The air jet shall be directed down onto a splash pad. Gate valve attachments shall be rotated to provide easy operation. The force main valves shall have stainless internals and trim. The assembly shall be secured by anchorage to the manhole wall to prevent flexing and vibration under surge.

Air relief valves shall have a 2" inlet and 2" outlet. In no case shall require air capacity through the valve to relieve vacuum be less than 5 psi. Valves shall be positioned at all high points and at spacings approximately 2,000 feet apart on long ascending or descending runs. All valves shall be capable of venting air or breaking vacuum.

Isolation valves shall be installed on the forcemain at appropriate intermediate locations to be approved by Integra Water.

Backflushing attachments are required on systems that are projected to remain in use more than 3 years if so, designated by Integra Water.

All non-gravity site piping shall have mechanical restrained joints. All buried valves shall have extension stems which allow for operation using a "T" handle. The stems shall terminate below ground so as to require a "T" handle no longer than 4 feet in length.

The forcemain shall be tested in accordance with Article 6 of Integra Water's Technical Specifications.

All forcemains are subject to the requirements of Integra Water's Technical Specifications for easements and utility and stream crossings.

5.41 PUMP STATION BUILDING – ARCHITECTURAL CONSIDERATIONS

Masonry materials shall conform to published standards and references of ASTM, latest revision. Specified masonry materials shall conform to manufacturer's standard sizes. Special shape design on building elevations, for location of solids, split faced, ribbed, scored and common units should be provided. The plan view should show vertical reinforcing locations. Mortar, mortar joint treatment and grout materials by type and ASTM requirements should be specified. Masonry accessories and their location should be shown on contract documents. Schedule and location of all loose steel lintels and formed-in- place masonry lintels should bespecified.

The designer shall show a roof framing plan/layout. The plan shall show types of pre-fabricated wood trusses; member size and spacing; detail types of anchors, connectors and bearing planes, and slope locations. The designer shall show sheathing, sheet spacing, type, thickness, quantity, and grade of ceiling plywood. Wood roof rake construction, fasciae, plates, louvers, and siding should be shown. The designer shall size ceiling materials used; locate access door and indicate size of opening. Types of aluminum soffits, ceilings, fasciae cover, color and gauge shall be specified.

Structural steel, including grades, types, member sizes, and/or weld types shall be located and specified on the Contract Documents. When required, show monorail location and cantilever extension. Specify materials, sizing, supports and details. All miscellaneous lintels shall be located. Specify identification and dedication plaque and show its location on building, including elevations. All access hatches and grating shall be aluminum.

Specify types of waterproofing for both above and below grades uses. Specify and locate all insulation types to be used in walls, ceilings or at perimeter of building walls. Specify, locate and size on contract documents gutters, downspouts, strips, anchors and splashblocks. Pump stations shall have asphalt, minimum thirty (30) year shingles. Specify the weight, color, lap and tab types.

Locate all personnel doors and frames in plan view on Contract Drawings. Specify FRP doors and color. Specify aluminum door frames. Detail wall and frame profile and anchoring. Schedule on drawings and

specify all architectural builder's hardware, finish type, function and mounting locations. Stainless steel screws and hardware shall be specifically required. Schedule quantity for hinges, locksets, closure, door stops and threshold. Call out types of weather stripping. Each hardware item shall be specified by manufacturer's number and series.

The designer shall specify all painting systems required for surface normally painted, including exposed structural steel, wood surfaces and interior C.M.U. Show all surfaces to be painted and scheduled on drawing. Manufacturer's data such as types of paint, recommended usage, percentage of solids by volume shall be specified.

The designer shall specify and show on the Contract Drawings all caulking, sealants, etc., required to provide weather-tight construction. Joint widths and back-rod locations shall be shown. Single-source responsibility shall be specified.

5.42 STRUCTURAL CONSIDERATIONS

The pump station and wet well must be designed to withstand the hydrostatic groundwater pressure and be able to withstand buoyancy with a minimum factor-of-safety against floatation of 1.5. The bottom slab(s) shall be designed for uplift pressures. The weight of the top slab or equipment shall not be included in the dead load resisting buoyancy unless dewatering provisions are made during construction.

Walls shall be designed for lateral pressure from saturated soils using pressures obtained from the Geotechnical Report. The "at-rest" Rankine coefficient should be used in calculating lateral pressures.

The foundation for the station shall bear upon consistent material. For example, the foundation shall not bear partially on rock and partially on soil.

Pipe wall penetrations shall be made at right angles; skewed or diagonal wall penetrations shall not be allowed.

All structures shall have exterior waterproofing.

Pump station concrete shall be designed per the provisions of ACI 318 and ACI 350. Wall reinforcing steel

Waterstops shall be used at all construction joints. Verify the length of the waterstop will work with the placement of the reinforcing steel. The splicing requirements of waterstops should be specified.

All walls, mats, and slabs with a thickness of 12 inches or more shall have a mat of steel in each face of the element.

The openings in the top slab over the wetwell shall be designed to accommodate pump removal. The slab shall be designed to transfer loads to areas adjacent to the opening. The slab shall be designed to support the weight of equipment and/ or pumps that may be permanently or temporarily placed upon the slab during removal or installation. The design live load for the top slab shall be evaluated for the actual load anticipated, but in no case shall be less than 100 PSF.

The top slab shall have top reinforcement and be hooked into the sidewalls at bearing walls.

5.43 HEATING, VENTELATION AND PLUMBING CONSIDERATIONS

A typical HVAC and plumbing layout drawing for a wastewater pump station is included in the standard details in Appendix F and shall be used as a basis for design.

The pump station wetwell and superstructure shall be completely separated to avoid the requirement of explosion-proof equipment. No form of entry from the superstructure directly into the wetwell will be permitted. Cable, duct, or pipe penetrations through the walls or floor must be completely, permanently sealed so as not to allow the potential for the transfer of gasses.

The wetwell shall be ventilated at a minimum of 12 air changes per hour using an exhaust fan. Exhaust air shall be extracted both within one foot of the top of the well and within one foot of the maximum liquid level in the well. The exhaust and induced outside air system shall operate continuously and be designed to maintain a minimum of -0.1 in. water column with respect to outside ambient. All duct, supports, and equipment associated with the ventilation system shall be of a corrosion resistant material or shall be coated to provide a corrosion resistant finish. The exhaust fan shall be of AMCA Type A or B spark-resistant construction meeting the provisions of Article 500 of NFPA 70 Hazardous Classification Class 1 Division 2 Group D. Provisions for proof of operation of the exhaust fan shall be provided with an audible and visual failure indication within the superstructure.

Within the pump station superstructure, clear-space shall be provided around all equipment and controls for operations. The space provided shall meet all applicable code requirements.

Enclosed spaces shall be ventilated using an exhaust fan. The fan shall be mounted on the wall near the roof or on the roof with the intake louver mounted one foot above finished floor. The ventilation system shall provide a minimum of six air changes per hour. Both the heating and ventilating system shall be thermostatically controlled. The fan thermostat shall have provisions for manual switching to continuous operation. Fans shall be provided with backdraft dampers.

On larger pump stations, the ventilation design will not need to incorporate the space above the ceiling in the ventilation capacity calculation (volume to obtain required air changes per hour).

Ventilation fans shall be located for ease in maintenance. The area within three feet of the wetwell intake and exhaust points are classified under Group 1 Division 2 Group D as noted above.

Louvers shall be extruded aluminum and shall have drainable blades and shall be provided with motorized, low leakage dampers interlocked with the associated fan.

Pump stations shall be supplied with water connections for maintenance cleaning. Water service shall be provided by one (1) ¾ in. hose bib and one (1) reduced pressure backflow preventer shall be located inside the building. The backflow preventer shall be as follows.

- ANSI/ASSE 1013, bronze body with bronze and plastic internal parts and stainless-steel springs.
- Two (2) independently operating, spring loaded check valves.
- Diaphragm-type differential pressure relief valve located between the check valves.
- Third check valve which opens under back pressure in case of diaphragm failure.
- Non-threaded vent outlet.
- Two (2) gate valves.
- Strainer.
- Four test cocks.
- Provided with manufacturer's test kit.
- Backflow preventer shall be Model 909 as manufactured by Watts Regulator Company; Mueller, Lawler/ITT; or approved equal.

5.44 SPARE PARTS

The following shall be supplied on or before final inspection:

- Two seal assemblies: top and bottom at impeller and at winding of motor;
- Bearings: one complete set of bearings for each pump;
- Three complete sets of: record drawings, O&M Manuals, copies of certified tests, inspection data, and termination schedule;
- Level switches, one additional float (normally open type) with 30-ft of cable; and
- O-ring and gasket kit for pump motor and impeller housing.

5.45 STARTUP OPERATIONS

Upon construction installation of Integra Water-maintained sewer pump stations, startup operations and testing shall be conducted prior to final acceptance and release of sewer flows under the supervision of Integra Water. At a minimum, a representative of the pump Supplier, a representative of the Contractor and a representative of Integra Water will be present for startup testing.

ARTICLE 6 - INSPECTION & TESTING

Testing shall be accomplished through the combination of visual inspection and hydrostatic pressure testing. The Contractor shall provide all labor, material, and equipment necessary for conducting tests. All testing shall be performed in the presence of an Integra Water representative. Tests performed in the absence of an Integra Water representative shall be considered invalid and be repeated at the Contractor's expense.

6.1 GRAVITY SEWER TESTING

The Contractor will be required to test lines while construction is in progress and before the pipe laying is completed, to ascertain compliance with Section 6.2. Any visible or audible leaks in the sewer that can be located shall be repaired or corrected as directed by an Integra Water Representative, regardless of infiltration test results.

The Contractor shall provide all necessary water, equipment, and instrumentation for flushing and testing. Source and quality of water, test procedures, and disposal of water shall all be approved by Integra Water. If test water is required from Integra Water's potable water system, the developer/contractor will make arrangements for test water. The method(s) of testing shall be as specified herein.

All tests shall be conducted in the presence of an Integra Water Representative, and preliminary tests not observed by an Integra Water Representative will not be accepted. Integra Water Representative shall be notified at least 48 hours before any work is to be inspected or tested. Integra Water Representative is available to witness tests from 9:00 a.m. to 3:00 p.m., Monday through Friday.

All defective sewer lines shall be repaired, or replaced, and retested until acceptable by Integra Water. Repairs shall be made to the standard of quality specified for the entire system.

Sections of the system may be tested separately. However, any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested until acceptable by Integra Water.

All piping systems shall be tested in accordance with these test methods. Any tests required by local plumbing codes or building authorities shall also be conducted at the developer/contractor's expense.

Testing of sewer lines shall include internal television inspection as called for in Section 6.8.

6.2 GRAVITY SEWER TESTING PROCEDURES MINIMUM TESTING REQUIREMENTS

After the sewer mains have been brought to completion, and prior to final inspection, the Contractor shall rod out the entire system by pushing through each individual in the system, from manhole to manhole, appropriate tools for the removal of any and all dirt, debris, and trash. If necessary, during the process of rodding the system water shall be turned into the system in such quantities to carry off the old dirt, debris, and trash. The dirt, debris, trash, and water shall be collected and properly disposed of by the Contractor.

Deflection Test (Mandrel Test)

Integra Water or Integra Water's Representative may require a deflection test to be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.

No pipe shall exceed a deflection of 5 percent. If deflection exceeds 5 percent, replacement or correction shall be accomplished at the Contractor's expense.

The rigid ball or mandrell used for the deflection test shall be a diameter not less than 95 percent of the average inside diameter of the pipe. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices. The Contractor shall thoroughly clean the line prior to the deflection test.

The Contractor shall pass through the system, under its own momentum, a rigid ball or mandrell as specified above. All pipes that do not pass the ball shall be replaced so that they do pass the ball.

All lines or sections of line that are found to be laid improperly with respect to line or grade, found to contain broken or leaking sections of pipe, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the Contractor's expense.

Infiltration and exfiltration of groundwater or other leakage into and out of the sewer (including manholes) shall not exceed 100 gallons per mile of sewer per inch of outside diameter of the sewer per 24 hours in any section of the completed work, and in no case shall it exceed 2500 gallons per mile per 24 hours. Infiltration flow shall be measured in wet weather by a "V-notch" weir with free discharge or other means acceptable to Integra Water. Weirs shall be furnished, installed, and removed by the Contractor.

The Contractor shall provide continuous sanitary sewer service. The Contractor shall be responsible for providing temporary wastewater collection and disposal until a satisfactory leakage test is obtained.

All apparatus and equipment required for testing shall be furnished by the Contractor at no additional cost to Integra Water.

Low Pressure Air Testing
All sewer lines shall be air tested in accordance with ASTM C828 as follows:

General
The Contractor shall conduct Low Pressure Air Tests of all pipes before putting the new sewers into service. Tests shall be made from manhole to manhole at an average pressure of 3.0 psi greater than the average back pressure of any ground water present and shall be conducted in accordance with the test procedure outlined below. These tables are prepared by and may be obtained from the Uni-Bell Plastic Pipe Associated, and at least two copies shall be furnished to Integra Water of Integra Water's Representative by the Contractor. A representative from Integra Water must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these specifications.

Test Equipment
The Contractor shall be responsible for acquiring an approved independent testing firm with all necessary equipment and personnel required to conduct the tests or providing all necessary equipment and personnel required to conduct the test themselves. The equipment used shall be identical or equal to the Air-Loc system as manufactured by Cherne Industrial, Inc., Hopkins, Minnesota.
Equipment used shall meet the following minimum requirements:

Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. The air supply line will contain an on/off valve and a pressure gauge with a range from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of +/- 0.04 psi.

Pneumatic plugs shall resist internal test pressures without requiring bracing or blocking.

All air used shall pass through a single control panel.

Three individual hoses shall be used for the following connections

From control panel to pneumatic plugs for inflation.

From control panel to sealed line for introducing the low-pressure air.

From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

Test Procedure

The sewer line to be tested shall be flushed and cleaned prior to the test (a wetted pipe surface will produce more consistent results).

All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressured to 5.0 psig. The plugs shall hold against this pressure without movement of the plugs out of the pipe.

Plug all pipe outlets with suitable test plugs. It is advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps and tie-rods, or wire harnesses over the pipe bells.

If the sewer line to be tested is submerged in ground water, insert a pipe probe (by boring or jetting) into the backfill material adjacent to the center of the pipe, determine the pressure in the probe when air passes slowly through it. This is the back pressure due to ground water submergence over the end of the probe. All gauge pressures in the test shall be increased by this amount.

Add air slowly to the portion of the sewer line installation under test until the internal pressure is raised to 4.0 psig.

After an internal pressure of 4.0 psig is obtained, allow at least two (2) minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

When the pressure decreases to 3.5 psig, start timing with a stopwatch. Determine the time, in seconds, that is required for the internal air pressure to reach 2.5 psig (a drop of 1.0 psig). Minimum permissible pressure holding times for 100 ft runs of single pipe diameter and for systems of 4-inch laterals in combination with trunk lines are indicated in the following table.

Table 6-1
Air Leakage Minimum Permissible Holding Times

Size of Pipe (inches)	Minutes: Seconds per 100 ft.
4	1:00
6	1:00
8	1:30
10	2:00
12	2:30
18	3:00
21	3:30
24	4:00
27	4:30
30	5:00
36	6:00

When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section and shall be the time shown in the table reduced by 0.5 minutes.

If the pressure drops 1.0 psig before the appropriate time shown on the table has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

It is recommended that inspection and testing of the sewer lines and manholes be conducted prior to backfilling. All documentation should be retained and presented to Integra Water and Integra Water's Representative at time of the final testing which is required after all other utilities are installed, roadway sub-grade is laid, and backfill is complete.

Safety Precautions

The air test may be dangerous if because of ignorance or carelessness a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Since an internal pressure of 5 psi exerts a force of 250 pounds on an 8- inch plug, it should be realized that the sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be very dangerous.

No one shall be allowed in the manholes of the section being tested at the time of the test or until after the lines have been depressurized.

Pressurizing equipment shall include a regulator set at 10 psi to avoid over pressurizing and damaging an otherwise acceptable line.

Smoke Testing

Smoke testing may be required to locate leaks if the low air pressure testing fails. To test for leaks, Integra Water or Integra Water's Representative may also require that all completed sewers be tested by the so- called smoke method in which smoke is blown into closed-off sections of the sewers under pressure and observation made of any smoke appearing on top of the ground indicating the presence of such leaks. All such leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the Contractor at his own expense. Equipment and supplies required for smoke tests shall be furnished by the Contractor.

The Contractor will be required to smoke test the first section (manhole to manhole) of each size of pipe and type of joint on each construction contract prior to backfilling to establish and check laying and jointing procedures. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by Integra Water or Integra Water's Representative.

Exfiltration Test

In order to test for infiltration sources, Integra Water or Integra Water's Representative may also require exfiltration tests on each section of pipe between manholes after it has been laid but prior to backfilling of joints. Exfiltration testing may also be used if the low air pressure testing fails. Exfiltration tests shall be conducted by plugging the lower end of the section of sewer to be tested and filling the sewer with water to a point approximately five feet above the invert at the lower end and at least one foot above the pipe at the upper end, observing for leakage at all joints and measuring the amount of leakage for a given interval of time. Exfiltration shall not exceed 110 percent times the infiltration limits set out in Section 6.2 Minimum Testing Requirements. ALL OBSERVED LEAKS SHALL BE CORRECTED EVEN THOUGH EXFILTRATION IS WITHIN THE ALLOWABLE LIMITS. Exfiltration tests will normally be required for flat sections of sewer that are expected to be below the wet-season ground water table.

The Contractor shall plug the open ends of all lines at the manhole so that measurements may be made at each section of sewer line. This exfiltration test will not be made until the sewer line is completed, and the Contractor will be required to correct all conditions that are conducive to excessive infiltration and may be required to relay such sections of the line that may not be corrected otherwise. ALL OBSERVED LEAKS SHALL BE CORRECTED EVEN THOUGH INFILTRATION IS WITHIN ALLOWABLE LIMITS.

Television Inspection

After completion of laying and backfilling of new pipe, after all other utilities have been installed and after roadway sub-grade has been laid, the sewer installation shall be television inspected in accordance with Section 6.8. All service entrances shall be accounted for. No infiltration should be apparent. If the pipe is not acceptable to Integra Water or Integra Water's Representative, remedies shall be accomplished at the Contractor's expense and to Integra Water's satisfaction.

6.3 VISUAL INSPECTION OF MATERIAL

Integra Water's representative shall visually inspect selected pipe and appurtenances at the point of delivery for damage and other defects. Integra Water's inspection of random materials delivered to the site in no way relieves the Contractor of his responsibility to make certain that all materials comply with Integra Water's requirements. Damaged materials or materials not meeting Integra Water's requirements shall be removed from the site and replaced.

6.4 HYDROSTATIC PRESSURE TESTING OF FORCEMAINS

Minimum Testing Regulation

The purpose of a pressure test is to locate defects in the materials or workmanship, thereby permitting proper repair. All pressure testing of lines shall be done hydrostatically. Do not use air-pressure to test sewer force mains. NOTE: THE USE OF AIR TO PRESSURE TEST A LINE, OR THE FAILURE TO REMOVE ALL AIR FROM A LINE PRIOR TO TESTING, CAN CAUSE EXPLOSIVE PRESSURES TO BUILD UP IN THE LINE CAUSING SERIOUS PERSONAL INJURY.

Construction of all service lines and any other connections involving restrained joints and/or thrust blocking shall have been completed and inspected prior to scheduling of hydrostatic test. Hydrostatic pressure test shall be scheduled with Integra Water a minimum of two (2) working days in advance. The representative must be on site while flushing and testing is being performed.

6.5 PROCEDURES FOR HYDROSTATIC PRESSURE TESTING OF FORCEMAINS

Pressure Test Restrictions

The following restrictions shall be adhered to:

- Test pressure shall not be less than 150 psi at the lowest point along the test section, unless approved by Integra Water.
- Test pressures shall not exceed pipe or thrust-restraint design pressures.
- Hydrostatic tests shall be of at least 3-hour duration unless otherwise requested up to 8-hours.
- The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves. Note: Gate valves approved by Integra Water typically have a working pressure of 200 psig while resilient wedge gate valves incorporated with large backflow devices have a working pressure limit of 175 psig.
- Final testing for piping to be installed beneath paving shall not be performed until all paving on site has been completed.

The following items must be considered prior to testing:

- The pipe to be tested must be sufficiently backfilled (partial backfill) to prevent movements while under pressure.

- Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure. Cure time of seven (7) days is recommended when Type I Portland cement is used; three (3) days is recommended when Type III Portland cement is used.

- Test ends should be restrained to withstand the applicable thrusts that are developed under the test pressure.

Flushing

Foreign material left in the pipeline during installation often results in valve or hydrant seat leakage during pressure testing. Every effort should be made to keep lines clean during installation. Partially opening and closing valves several times under expected line pressure with adequate flow velocities to flush foreign materials out of the valve shall accomplish flushing. Mains shall be flushed to achieve a velocity of not less than two (2) feet per second.

Filling the Line

The main should be filled slowly from an approved source of potable water. The water may be introduced from lines in service through connections with valves, or by temporary connections to hydrants, or by taps at the connection cap. All such connections, however, should be made at the lowest point in the line whenever possible.

Expelling Air from the Line

Compressed entrapped air can greatly amplify any surges as well as pumping pressures. Furthermore, entrapped air can cause erroneous pressure test results. All air should be expelled from the pipeline during filling and again before making either pressure or leakage tests.

Automatic air release valves located at high point are recommended for extended sections. If permanent air vents are not present at the high points, the Contractor may use corporation cocks at these points to expel the air as the line is filled with water. After the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed, and the pipe plugged. It will be left to Integra Water's representative to determine if flushing alone (without the use of air vents or corporation cocks) is sufficient to expel the entrapped air from the main.

Hydrostatic Pressure Testing Procedure

All valves not required to be closed for the isolation of the new main being tested shall be open during testing. The line shall be pumped up to no less than 150 psig and not more than 200 psig. Once the pressure equalizes, the line shall hold said pressure for a minimum of three (3) hours. If the line is not holding specified pressure at the time of arrival of Integra Water's representative, the test will be cancelled and rescheduled at the convenience of Integra Water. This shall be repeated until the test requirements are satisfactory.

The allowable leakage for sewer mains shall be measured in gallons per hour per one thousand feet of pipe. Allowable leakage shall not exceed the following formula:

$$L = \frac{SPD}{133{,}200}$$

L = allowable leakage in GPH
S = length of pipeline section in feet
D = diameter of pipe (nominal) in inches
P = average test pressure, psig

If loss exceeds L, the Contractor shall locate and repair, to Integra Water or Integra Water's Representative's satisfaction, all leaks until the pipe section will pass another leakage test.

Examination

The Contractor shall examine all exposed pipe, fittings, valves, thrust blocks, restraints, and joints during the course of the hydrostatic testing. Any damaged or defective work or material shall be repaired or replaced, and the test shall be repeated until satisfactory results are obtained.

Test Failure
Should a line fail to pass any of the acceptance tests as outlined, the Contractor shall, at his expense, determine the source of failure, make any necessary repairs, and re-test the segment of piping in question.

Pressure Test Equipment
Equipment systems used to perform water pressure test shall be specifically designed for this purpose. The continuous monitoring pressure gauge shall be liquid filled (glycerin) having a pressure range from 0 psig to at least 300 psig with minimum divisions of 5 psig. The gauge face shall be a minimum of 2 inches in diameter and have an accuracy of +/- .04 psig. The gauge shall meet or exceed Grade B ANSI-ASME B40.1.

Air-Testing of Tapping Sleeve
Each tapping sleeve installed to ninety (90) psig shall be air-tested for a period of ten (10) minutes. No pressure drop will be allowed. Successful testing of sleeve shall not relieve the Contractor of any leaks that may occur during the warranty period. At the Contractor's expense, Integra Water will fix all leaks during the warranty period.

6.6 MANHOLE TESTING

Integra Water requires testing of all new manholes. Manhole testing shall be scheduled with the Integra Water's representative a minimum of two (2) working days in advance. All manholes shall be tested by one (1) of the following methods:

Manhole Exfiltration Test
All manholes constructed shall be watertight and show no visible sign of infiltration and shall be tested in accordance with this Specification. The test shall be conducted by the Contractor in coordination with and at the direction of an Integra Water Representative. All incoming and outgoing sewer lines shall be plugged, and the manhole filled with water to a level above the highest section joint. If the water level drop exceeds 1/8" per vertical foot of manhole depth in 5 minutes, the manhole shall have failed the test.

Manhole Vacuum Test
The test shall be conducted by the Contractor in coordination with and at the direction of an Integra Water Representative. The manhole shall be tested, after assembly, as follows: All pipe opening shall be sealed by installing suitable plugs that completely isolate the manhole structure; any other openings, such as lifting holes, shall be permanently sealed. A suitable vacuum pump shall be connected to the manhole, and a vacuum of 10" of Hg drawn. The pump shall then be isolated from the manhole by valving, and the test period begun. The test shall be successful if the vacuum remains at 9" of Hg or greater according to the following table:

Table 6-2
Manhole Vacuum Test Minimum Time

Manhole Diameter	Time, minimum (sec)
48"	60
60"	75
72"	90

All manholes which fail the test or that have visible leaks, even if they pass the test, shall be repaired or replaced at the expense of the Contractor until the manholes pass the test, to the complete satisfaction of Integra Water. Manholes which have any visible leaks will not be accepted. If the manhole fails the test a second time, the Contractor will be responsible for supplying and installing a brand-new manhole. In addition, the Contractor will retest the new manhole as well as all pipe segments connected to the new manhole.

6.7 FIELD TESTING CONCRETE

Strength Tests During the Work: The Contractor will make three concrete test cylinders for each 50 cubic yards poured or for each days pour; whichever amount of concrete is smaller. Cylinders will be made and testing in accordance with ASTM C31, ASTM C172 and ASTM C39. The standard age of the test shall be 28 days. The first cylinder will be broken at 7 days. If the 7-day break exceeds the specified strength, then no further tests will be made until the 28th day. If the 7-day break does not meet the specified strength, then the second cylinder will be tested at the 14 day. In either event, the remaining cylinder(s) will be tested at the 28th day. When the test cylinders fail to conform to the compressive strength requirements, Integra Water shall have the right to order a change in the concrete mix for the remaining portions of the work at n o additional cost to Integra Water. The Contractor may wish to make additional cylinders at his own expense as verification.

Test of Hardened Concrete In or Removed from the Structure: When the results of the strength tests of the control specimens indicate the concrete as placed does not meet specification requirements or where there is other evidence that the quality of the concrete is below specification requirements, core-boring tests shall be made in conformance with ASTM C42. Core specimens will be tested by a certified testing laboratory approved by Integra Water. All deficiencies shall be corrected; or, if the Contractor elects, he may submit a proposal, for approval, that load tests be made. If the proposal is approved, the load test shall be made by the Contractor and the test results evaluated by Integra Water. If any concrete shows evidence of failure during the load test, or fails the core test as evaluated, the deficiency shall be corrected. Any deficiency shall be corrected in a manner approved by Integra Water and at no additional cost to Integra Water.

6.8 TELEVISION INSPECTION OF NEW SEWERS

General

Television inspection is to be completed by the Developer/Contractor or a third-party. In this case, the television inspection shall be witnessed by Integra Water Representative.All photographs and video recordings made in performance of said television inspection shall become the property of Integra Water and shall be delivered to Integra Water immediately upon completion of said inspections. Integra Water must be notified at least 48 hours prior to any testing or inspecting.

The Contractor shall furnish the mobile television inspection studio, all television equipment and other necessary types of equipment, and all materials, electricity, labor, technicians, as may be needed to perform the closed-circuit television inspection of the sewers for final inspection. The television inspection shall be conducted in such a manner that the television control technician or the Engineer can determine that the sewer line is clean, so that all leaking joints, pipe breaks, line sags or dips, service connections, can be accurately seen and located within and along the sewer line.

The Contractor shall take necessary precautions to ensure safety during inspection setup, operation, and breakdown. Requirements of OSHA with respect to confined space entry shall be met by the Contractor

at all times. If a television inspection unit becomes lodged in the sewer line, if possible, remove the unit from the line at the nearest manhole. If excavation is required to remove the television unit, the Contractor shall replace or repair any damage to the sewer pipe that occurs as a result.

Equipment

Television Camera

The television camera used for the sewer line inspection shall be one specifically designed and constructed for such inspection work. Lighting for the camera shall be adequate and suitable, and adjustable to allow a clean picture of the entire periphery of the pipe. The camera shall be water proof and shall be operative in 100 percent humidity conditions. The camera, or cameras, shall be small enough to pass through and clearly televise the interior of a six (6) inch diameter sewer and all larger sewer sizes up to and including a thirty-six (36) inch diameter sewer. The camera focal length or distance shall be adjustable through a range of six (6) inches to infinity. The television camera shall be capable of transmitting a picture having not less than 600 lines of resolution.

Television Monitor

The view seen by the television camera shall be transmitted to a monitor of not less than eleven (11) inches in size. The television monitor shall be capable of receiving and displaying a picture having not less than 600 lines resolution. The television monitor shall be located inside the mobile television studio. The picture shall be free at all times of electrical interference and shall provide a clear stable image having the number of lines of resolution specified.

Television Studio

The Mobile Television Studio shall be large enough to accommodate up to six people for the purpose of viewing the monitor while the inspection is in progress. Integra Water Representative shall have access to view the television screen at all times. The central control panel, television camera control, shall all be located in the mobile television studio. The television studio shall be mounted on a mobile device (truck or trailer) which will allow safe and orderly movement of the inspection equipment throughout the job site.

Still Photographs

The Contractor shall furnish all equipment required for taking instant photographs of the view which appears on the monitor. A camera having the proper lenses and mountings as required to properly frame the monitor shall be available for making these photographs. Pictures which include less than the total screen area, or which extend appreciably beyond the total screen in width or height will not beacceptable.

Procedures and Methods

Operation of Television Equipment

The operation of the television equipment shall be controlled by a skilled technician or supervisor who shall be located at the control panel in the mobile television inspection studio. The control of the television equipment may be accomplished by means of remote-control winches or by telephone or the suitable means of communication between the television control technician in the mobile television studio and the technicians operating the winches at either end of the manhole section being inspected. The control technician in the mobile television studio shall, at all times, be able to move the television camera through the sewers in either direction without loss of quality in the video presentation of the television monitor. The television image on the monitor shall, at all times, be free of electrical interference and shall provide a clear, stable image and picture. When directed to do so by an Integra Water Representative, the television camera shall be stopped and/or backed- up as required so an Integra Water Representative or television control technician can view and analyze and photograph, when so directed, any features or conditions that appear unusual or uncommon to a good sound sewer.

The travel speed of the television camera (through the sewer) shall be uniform and shall not exceed

that maximum speed directed by Integra Water Representative (30 feet per minute under normal conditions). Any means of propelling the camera through the sewer which produces non- uniform rates of speed or which results in a speed faster than that specified by an Integra Water Representative will not be acceptable. The television control technician shall be able to adjust the brilliance of the lighting system (built into the television camera) and be able to change the focus of the television camera by remote control. Measurement of the exact location of any sewer line defects. (i.e., breaks, sags, leaks, obstructions, etc.) shall be at the ground level by means of a metering device. Markings on a cable, or the like, which would require interpolation for the depth of manhole, will not be allowed. Measurement meters shall be accurate to two-tenths (0.2) of a foot. A measuring target shall be used as an exact measurement reference point, and the meter reading shall show the exact location of this measurement reference point.

Obstructions

Where obstructions within the sewer line prevent the passage of equipment (i.e., television camera and other equipment), the Contractor shall reset his equipment to pass through the section from the other end and thereby complete the inspection of that section when possible. When section having obstructions that prevent completion of the television inspection are encountered, the crew shall abandon this section and go on the next section. After the obstruction has been removed, the television inspection crew shall return and complete the inspection.

Photographs

During the course of the inspection Integra Water Representative shall select the specific views which are to be photographed. These photos shall be a quality and definition comparable to the monitor display. The photographic record shall include the photograph number, the location of the photograph in the identified manhole section (to the nearest foot), date of photograph, and the corresponding TV inspection report number. This same information shall be recorded on the back of each photograph in indelible ink.

Video

Continuous video recordings of the inspection view as it appears on the television monitor shall be taken and provided on a thumbdrive to an Integra Water representative. It is intended that a video recording will be made of the complete television inspection of all the sewer lines constructed as a part of this project. Where the television inspection shows that the sewer line has occasional bad features or items, it is identified that said occasional bad features be photographed and that these photographs shall be used as the permanent record of said bad features. The video recording shall be used as the permanent record of said bad features. videoThe video recorder shall be one on which both sound and video information can be reproduced with a video image equal to or better than the quality of the original picture on the television monitor. The composite video and the audiotape recording of the sewer line inspection shall conform to EIAJ, Type I, standards. The replay of the recorded video information, when reviewed on a monitor-receiver, shall be free of electrical interference and shall produce a clear, stable image with a horizontal resolution equal to that of the television monitor in the television inspection studio. The audio portion of the composite signal shall be sufficiently free of electrical interference and background noise to provide an oral report that is clear and completely and easily discernible. The operation technician on the audio-video tapes shall record the audio portion of the tape report as they are being produced and shall include the location or identification of the section, the manhole-to-manhole direction of travel, the distance traveled on the specific run, encountered. Dubbing the audio information onto the video tract after the internal television inspection is completed will not be permitted. The video equipment shall be continuously connected to the television inspection or monitoring equipment. The video and monitoring equipment shall have the built-in capability to allow Integra Water Representative and technician to instantly review both the audio and video quality of the video productions at all times during the television survey. Playback speed shall be continuously adjustable from one-third normal speed for slow-motion viewing to normal playback speed. Video recordings shall be enclosed in an envelope which shall clearly indicate the date the video was taken, the designated section(s) of sewer lines contained on the video, and the referenced sewer inspection report covering the sections of the sewer lines so included.

Depth of Flow

If the depth of flow in the existing sewer segment at a point upstream of the work is above the maximum allowable depth for television inspection, flow shall be reduced to an acceptable level for television inspection by operation of pump station, plugging or blocking of the sewer, or by pumping and bypassing of flow.

In performing TVI, the Contractor shall control the depth of flow in the sewer within the following guidelines:

Table 6-3
Maximum Pipe Flow Depth for Television Inspection

Pipe Diameter	Flow Depth, (% of Diameter)
8 – 10 inch	20%
12 – 24 inch	25%
27 inch or larger	30%

When sewer line flows, as measured in the first manhole upstream of the sewer segment being televised, exceeds the maximum depths listed above or inspection of the complete pipe periphery is necessary for effective inspection, the Contractor shall implement wastewater flow control methods.

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