

WPC 06-0127

**WASTEWATER COLLECTION - CONSTRUCTION SPECIFICATIONS**

**January 2006 Edition**

**THE CITY OF ALCOA, TENNESSEE  
PUBLIC WORKS & ENGINEERING DEPARTMENT  
WATER AND SEWER SERVICES**



**CITY OF ALCOA**

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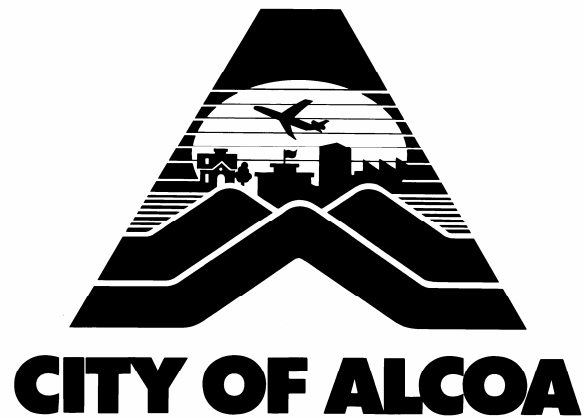
**T. Simon deVente, P.E.  
Assistant Director/Chief Engineer**



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## FOREWORD

These specifications have been compiled to assist in the orderly design and construction of Alcoa's wastewater collection system. Combined with the construction specifications for the water and street & drainage systems, documented procedures have been established that will benefit City of Alcoa staff, City Commission, Regional Planning Commission, and other City committees in the construction, operation, and maintenance of the City's infrastructure system. Just as important, these specifications provide a framework for developers, engineers, and others that are involved with the construction of street, drainage, water and sanitary sewer system improvements in private developments.

The development of these specifications was a combined effort. The basis for the wastewater collection system construction standards are the Tennessee Department of Environment and Conservation Regulations and Guidelines. City of Alcoa staff reviewed and modified the requirements to closely fit the practices desired for the City of Alcoa service area. Key staff members involved in that work were:

- Simon deVente, P.E., Assistant Director/Chief Engineer
- Laurence Harper, Public Works Inspector I
- Kent Harveston, Utility Lead Worker
- Kenneth Hendrix, Public Works Inspector II
- Paul Monroe, Utility Lead Worker
- Danny Ogle, Utility Lead Worker
- Mark Ross, Construction Services Supervisor
- Randy Slagle, Utility Lead Worker
- Kenneth D. Wiggins, P.E., Engineering & Public Works Director

The assembly of comments and suggestions from each of these individuals resulted in these Wastewater Collection – Construction Specifications for the City of Alcoa Public Works & Engineering Department.

## REFERENCE INDEX

The purpose of this Reference Index is to catalog by name and address those agencies, associations and others who are referred to in these Standards by initials.

<b>AASHTO</b>	American Assn. of State Highway and Transportation Officials 444 N. Capitol St., NW	Washington, DC 20001
<b>ANSI</b>	American National Standards Institute 1819 L Street, NW, Suite 600	Washington, DC 20036
<b>ASTM</b>	American Society for Testing and Materials 1916 Race Street	Philadelphia, PA 19103
<b>AWWA</b>	American Water Works Assn. 6666 W. Quincy Ave.,	Denver, CO 80235
<b>DIPRA</b>	Ductile Iron Pipe Research Association 245 Riverchase Parkway, E., Suite 0	Birmingham, AL 35244-1856
<b>HI</b>	Hydraulic Institute 30200 Detroit Road	Cleveland, OH 44145
<b>NFPA</b>	National Fire Protection Association 1 Batterymarch Park	Quincy, MA 02169-7471
<b>NSF</b>	National Sanitation Foundation Testing Laboratory, Inc. P.O Box 1468	University of Michigan Ann Arbor, MI 48106
<b>TDEC – DWS</b>	Tennessee Department of Environment and Conservation Division of Water Supply 6th Floor L&C Tower	401 Church Street Nashville, TN 37243-1534
<b>TDEC – WPC</b>	Tennessee Department of Environment and Conservation Division of Water Pollution Control 6th Floor L&C Tower	401 Church Street Nashville, TN 37243-1534
<b>UL</b>	Underwriters Laboratories, Inc. 333 Pfingsten Road	Northbrook, IL 60062-2096

**SECTION 2**  
**WASTEWATER COLLECTION SYSTEM**  
**TABLE OF CONTENTS**

Forward.....	2
Reference Index.....	3
Table of Contents.....	4
<b>2.0    <u>SYSTEM DESIGN</u></b>	
2.0.1 - Pre-Design Conference .....	6
2.0.2 - Design Basis.....	6
2.0.3 - Design Factors.....	6
2.0.4 - Plans and Specification Approvals .....	7
<b>2.1    <u>DETAILS OF DESIGN OF WASTEWATER COLLECTION LINES</u></b>	
2.1.1 - Minimum Size .....	8
2.1.2 – Depth .....	9
2.1.3 – Slope.....	9
2.1.4 – Alignment.....	9
2.1.5 - Increasing Size .....	9
2.1.6 - High Velocity Protection.....	9
2.1.7 - Pipe Bedding .....	10
2.1.8 - Joints and Infiltration.....	10
2.1.9 – Manholes .....	10
2.1.10 - Protection of Water Supplies .....	10
2.1.11 - Force Mains .....	11
2.1.12 - Wastewater Lift Stations .....	11
<b>2.2    <u>PRODUCTS</u></b>	
2.2.1 - Pipe – Gravity .....	12
2.2.2 - Pipe – Pressurized Main (Force Main) .....	13
2.2.3 - Concrete Materials.....	14
2.2.4 – Manholes .....	14
2.2.5 - Air Release Valves .....	18
<b>2.3    <u>CONSTRUCTION OF WASTEWATER COLLECTION LINES</u></b>	
2.3.1 -Pre-Construction Activities.....	18
2.3.2 - Soil Erosion Control.....	19
2.3.3 - Preparation .....	21
2.3.4 - Installing Gravity Sanitary Sewers .....	21
2.3.5 - Installing / Repairing Sanitary Sewer Lines in Street, Highway, and Railroad Rights-of-Way.....	23
2.3.6 - Initial Proof Testing of Sanitary Sewers.....	23
2.3.7 - Final Testing .....	23
2.3.8 - Installing Manholes.....	24
2.3.9 - Vacuum Testing.....	26
2.3.10 - Sewer Service Assemblies .....	26
2.3.11 - Warranty Inspection.....	27

2.4 STANDARDS FLEXIBILITY  
2.4.1 - Interpretations of these Standards and Design Criteria..... 28  
2.4.2 - Right of Appeal ..... 28

Appendix 1 - Table for Design Basis for New Sanitary Sewers ..... 29  
Appendix 2 - TDEC Hydraulic Design Criteria Table ..... 30

Standard Drawings

## SECTION 2

### WASTEWATER COLLECTION SYSTEM

#### 2.0 **SYSTEM DESIGN**

##### 2.0.1 **Pre-Design Conference**

Prior to the design of a wastewater collection system extension, the design engineer should first confer with the City of Alcoa Planner in regard to growth potential and density that may be expected in the general area of the extension being planned. A conference with the Alcoa Public Works & Engineering Department staff should follow to discuss customer needs, system requirements and standards & specifications as well as any coordination or other issues related to the mains being extended. **In residential, commercial, and industrial developments, fittings and piping for sanitary sewer service connections shall be furnished and installed by the developer.** The design engineer must be licensed to practice in the State of Tennessee by the Tennessee Department of Commerce and Insurance, Board of Architectural and Engineering Examiners.

##### 2.0.2 **Design Basis**

- (a) Generally the sewers should be designed to carry, when running full, not less than the following daily per capita contributions of wastewater, exclusive of wastewater from industrial plants:
  - 1. Laterals and sub-main sewers: 400% of average design flow.
  - 2. Main, trunk & outfall sewers: 250% of average design flow.
- (b) In general, wastewater collection extensions shall be designed for the estimated ultimate tributary population.

##### 2.0.3 **Design Factors**

- (a) In determining the required capacities of sanitary sewers, the following factors must be considered:
  - 1. Maximum hourly quantity of wastewater
  - 2. Additional maximum wastewater from industrial plants
  - 3. Ground water infiltration.
- (b) Typical design flows for various facilities are tabulated in Appendix 1. The flows shown are assumed to include nominal infiltration, but an additional allowance should be made where conditions are unfavorable. However, actual flows shall be used when available.

## 2.0.4 Plans and Specifications Approval

- (a) Submittal of construction plans, hydraulic calculations and construction specifications for a proposed extension must be submitted accordingly:
1. Hydraulic calculations must be submitted for all receiving lines as provided in Chapter 2 of the TDEC Division of Water Pollution Control Design Criteria, see Appendix 2;
  2. Initially to the Alcoa Public Works & Engineering Department for approval;
  3. Then to the Tennessee Department of Environment and Conservation, Division of Water Pollution Control, for approval;
  4. Plans must be submitted to TDEC within 30 days of City of Alcoa approval;  
and
  5. Approval shall expire twelve (12) months from the date of the TDEC approval date.

Upon completion of the project, the design engineer shall prepare detailed plans to reflect As-Built information. As-Built plans shall be submitted to the City:

1. On reproducible mylar sheets,
2. In digital format compatible with the City's mapping system,
3. Four (4) copies of applicable Operations & Maintenance manuals must be delivered prior to or with the as-builts, and
4. All applicable easement drawings and documents.

Hand revised or cloud revision construction sheets will not be accepted as As-Builts.

- (b) Each plan sheet shall bear an appropriate title block showing the name of the project, location, owner, engineer, date, scale in feet, true north where applicable, sheet number and revision data.

Each sheet shall contain a blank area at least 4-inches by 6-inches near the title block for imprinting the official "Approved for Construction" stamps of the Tennessee Department of Environment and Conservation and the Public Works Department of the City of Alcoa. Plans shall be clear and legible and shall conform to the requirements of the Alcoa Public Works & Engineering Department's Standards. Plans shall be on sheets 24-inches by 36-inches.

- (c) Plans of Sewers: A plot plan of the existing and proposed sewers shall be submitted for projects involving substantial additions to the existing sewer system. The plan shall show the location, size and direction of flow of all existing and proposed sewers. Hydraulic calculations are required for all lines in the project.

All lines receiving discharge from the project shall be shown to be adequate. A vicinity map must accompany all sewer line extensions. For projects involving multiple sewer lines, include a project map showing the overall layout of the entire project.

(d) Plan Details: Detail plans shall be submitted. Plans and profiles are required for all wastewater lines. Profiles should have a horizontal scale of not more than 50 feet to the inch. The vertical scale of profiles shall not be more than 10 feet to the inch. The plan view should be drawn to a corresponding horizontal scale. Plans and profiles should be drawn on the same sheet and will show:

1. Location of streets and sewers; line of ground surface; size, material and type of pipe for the main and service lines; length between manholes; invert and surface elevation at each manhole; location and size of service lines and taps; and grade of sewer between each two adjacent manholes. All manholes shall be numbered on the plans and correspondingly numbered on the profiles. Stationing of the sewer line at 100-foot intervals and locations of all appurtenances by stationing shall be shown on the plan and profile. Where there is any question of the sewer being sufficiently deep to serve any residence or other source, the elevation and location of the basement floor or other low point source shall be plotted on the profile of the sewer which is to serve the house or source in question. The engineer shall state that all sewers are sufficiently deep to serve adjacent basements or sources except where otherwise noted on the plans. Whenever possible, sewer service lines shall discharge into a manhole.
2. Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, etc.
3. All known existing structures both above and below ground which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, etc.
4. Show easement, lot and right-of-way lines and corners. Provide lot numbers, street names and proposed edge-of-pavement. Do not include pre-existing lot lines, only those for the proposed or part of build out.
5. No other utilities shall be drawn on the sheet except for clarification or reference and shall be a reduced line weight or grey scale color from the design utility.
6. Plans shall include a permanent Bench Mark based on USGS Datum referenced to Tennessee NAD 83 Coordinate System. Additional Bench Marks will be required when the project area exceeds 2000 feet in length.

## **2.1 DETAILS OF DESIGN OF WASTEWATER COLLECTION LINES**

### **2.1.1 Minimum Size**

No sewer main shall be less than 8 inches in diameter. No service line shall be less than 6 inches in diameter.

### 2.1.2 Depth

In general, sewers should be deep enough to drain basements and to prevent freezing. where practical, a minimum depth of 5 feet should be maintained.

### 2.1.3 Slope

All sewers shall be so designed and constructed to give mean velocities, when flowing half full, of not less than 2.0 feet per second. The minimum recommended slopes for 8-inch through 12-inch sewer mains are shown below. However, these slopes should be used only when required. All sewers shall be laid with uniform slope between manholes.

SEWER SIZE	RECOMMENDED MIN. SLOPES
8-inch	0.522 ft. / 100 ft.
10-inch	0.387 ft. / 100 ft.
12-inch	0.304 ft. / 100 ft.

Sewers larger than 12-inch diameter shall be designed in compliance with the latest TDEC-WPC standards.

### 2.1.4 Alignment

Sewers shall be designed with straight alignment between manholes.

### 2.1.5 Increasing Size

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An acceptable approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

### 2.1.6 High Velocity Protection

Ductile iron pipe shall be used when slopes are greater than:

SEWER SIZE	MAX. SLOPE
8-inch	18%
10-inch	13%
12-inch	9%

Sewers larger than 12-inch diameter shall be designed in compliance with the latest TDEC-WPC standards.

### **2.1.7 Pipe Bedding**

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made because of the width and depth of trench. As a general rule, ductile iron pipe or concrete encasement shall be used in roadways where cover is less than 4 feet, or in open areas where cover is less than 2-1/2 feet. Ductile iron pipe shall be required when sewer installation occurs in areas of non-virgin soil (i.e. areas of "fill"). Piers shall be provided when necessary for support. For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer is less than 18 inches below the bottom of the culvert or other conduit.

### **2.1.8 Joints and Infiltration**

Sewer joints should be designed to minimize infiltration and to prevent the entrance of roots. Standard laying lengths for PVC pipe shall not exceed 13.5 feet.

### **2.1.9 Manholes**

- (a) Location: Manholes shall be installed at the upper end of each collection sewer line, at all changes in grade, at points of changes in size, at all pipe intersections, and at distances not greater than 1,000 feet.
- (b) Drop Manholes: A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be U-shaped to prevent deposition of solids.
- (c) Diameter: The minimum inside diameter of manholes shall be 48 inches. The entrance tube shall be at least 24 inches in diameter (inside).
- (d) Invert Flow Angle: The minimum angle of a pipe invert with flow coming into the manhole shall be 90 degrees from the outlet pipe invert. When it is impossible to obtain this angle the inlet pipe must be a drop, splash or constructed invert above the flow channel installed in a manner that does not inhibit normal flow through the manhole.

### **2.1.10 Protection of Water Supplies**

- (a) Water Supply Interconnections: There shall be no physical connection between a potable water supply line and a sewer or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply.
- (b) Horizontal Separation: Sewers should be installed at least 10 feet from any existing or proposed water pipe. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer to the water main if 1) it is installed in a separate trench and 2) the elevation of the top of the sewer pipe is at

- least 18 inches below the bottom of the water pipe.
- (c) Vertical Separation: Whenever a sewer must cross under a water main, the sewer shall be installed at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot meet the above requirement, the water main shall be relocated to provide the separation or reconstructed with ductile iron pipe for a minimum distance of 10 feet on each side of the sewer. At least one full length of water main should be centered over the sewer so that both joints shall be as far from the sewer as possible.
  - (d) When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water and sewer mains shall be constructed to water line standards and shall be pressure-tested to assure watertightness.

#### **2.1.11 Force Mains**

- (a) Velocity: At design flow, velocity in excess of two feet per second shall be maintained.
- (b) Air Release Valve: An automatic air release valve shall be placed at high points in the force main to prevent air-locking.
- (c) Termination: Force mains shall terminate in the invert of a manhole.
- (d) Pipe diameter: Force mains are to be a minimum of 4 inches in diameter.
- (e) A maximum Hazen and Williams "C" factor of 130 shall be used regardless of the pipe material.

#### **2.1.12 Wastewater Lift Stations**

In general lift stations should be of the wet well/dry sump configuration. Other designs may be considered for installation. Designs must conform to the requirements of ANSI/HI 1.1 through 9.8.

Acceptable submersible designs must be of a non-clog design and be able to pass a 3 inch solid. Grinder type pumps are only allowed for individual users connecting to a low pressure sewer system.

Unless specifically exempted, the design and construction of all lift stations shall include a paved (asphalt or concrete) driveway, minimum 8-foot high 9 gauge chain-link fence enclosing the site, minimum 12-foot wide gate for access, and a permanent potable water supply. Ultrasonic and bubbler type level sensors are acceptable. Piping shall include bypass piping with header piping outside the pump station wall terminating with male OPW type quick connect fittings. An exhaust blower for ventilation must be provided to the pump house, turning on at 70°F and off at 55°F. The exhaust blower shall also be automatically activated when the entry hatch is opened and may be manually operated. Each pump shall have an approved bourdon-type pressure gauge to monitor discharge pressure. All valves must be non-rising stem gate valves. Portable heater and dehumidifier must be supplied with each station.

All electrical equipment must conform to the latest AIEE and NEMA standards and must have UL approval. The control unit must be SCADA (Supervisory Control and Data Acquisition) ready and have – at a minimum – outputs for wet well level, loss of power, operating status, discharge pressure and alarms.

Plans and specifications must be submitted to the Alcoa Public Works & Engineering Department for approval. Prior to final acceptance of the construction station, four (4) sets of installation and operating manuals and two sets of as-built drawings (one reproducible hardcopy and one electronic) shall be submitted. Two sets of installation and operating manuals on CD (compact disk) MS Word or PDF format may be substituted for the 4 hardcopy sets.

## **2.2 PRODUCTS**

### **2.2.1 Pipe – Gravity Flow**

**(a)** All materials used in the construction must be new materials manufactured no earlier than one year prior to the current year. When project material is stored long term prior to use, it must be done to manufacturer's requirements, in a way to prevent contamination and is subject to rejection due to mishandling and improper storage.

#### **(b) PVC Pipe:**

1. Shall be manufactured from virgin, NSF approved resin conforming to the requirements of ASTM Standard D1784.
2. All PVC pipe shall conform to the requirements of either: 1) ASTM Standard 3034 and have a Standard Dimension Ratio (SDR) of 35 or, 2) AWWA Standard C900.
3. Gaskets used for joining PVC pipe shall conform to ASTM Standard F477.
4. All PVC pipe shall be clearly marked with the manufacturer's name, nominal diameter; SDR, ASTM 3034; or AWWA C900 and NSF approved seal.
5. Use of ASTM 3034/SDR35 PVC pipe shall be limited to depths less than twelve (12) feet. Where depths to the sewer invert are twelve (12) feet or more, AWWA C900 PVC pipe or ductile iron pipe shall be used.

#### **(c) Ductile Iron Pipe:**

1. As a minimum, ductile iron pipe shall meet the latest requirements of AWWA Standard C151, min. Class 50 thickness, cement-mortar lined, meeting the latest requirements of AWWA Standard C110, with either mechanical joints or slip-on joints with rubber gaskets.

2. Pipe sections shall be clearly marked with the manufacturer's name, D.I. or Ductile, weight, class or nominal thickness.
3. Ductile iron pipe shall be American, U.S. Pipe, Griffin or McWane pipe, or approval equal.
4. Ductile iron pipe or AWWA C900 PVC pipe shall be required where depths are twelve (12) feet or more to the sewer invert.

**(d) Pipe Fittings:**

1. PVC pipe fittings shall be manufactured from virgin, NSF approved resin conforming to the requirements of ASTM Standard D-1784. Fittings should be supplied from the same manufacturer as the PVC pipe.
2. Ductile Iron and Cast Iron Fittings:
  - i. Ductile iron fittings for use in sewer lines shall be 350 psi pressure rating, cement-mortar lined, mechanical joints, meeting the latest requirements of AWWA Standard C153.
  - ii. Cast iron fittings for use in sewer lines shall be 250 psi pressure rating, cement-mortar lined, mechanical joints, meeting the latest requirements of AWWA Standard C110.
  - iii. Rubber gasket joints shall meet the latest requirements of AWWA Standard C111.
  - iv. Ductile iron or cast iron fittings or other fittings approved by the Engineer shall be used in conjunction with ductile iron and AWWA C900 PVC pipe.

**2.2.2 Pipe – Pressurized Main (Force Main)**

- (a) PVC pipe four (4) inches in diameter and less, Class 200 pressure rated may be used where the working pressure does not exceed 135 psi. The pipe must meet the requirements set forth in ASTM Standard D-2241 for 2-inch through 8-inch pipe designated SDR-21. If working pressure exceeds 135 psi for any portion of the main, DIP meeting the requirements of paragraph (b) of this section shall be used.
- (b) Pipe having a diameter greater than four (4) inches shall be of ductile iron meeting the latest requirements of AWWA Std. C-151, min. Class 50 thickness, cement-mortar lined meeting the latest requirements of AWWA Standard C-110 with either mechanical joints or slip-on joints with rubber gaskets. Ductile iron pipe shall be either American Cast Iron, U. S. Pipe, Griffin, McWane Pipe, or City of Alcoa approved equal.
- (c) All force main pipe, whether PVC or ductile iron, must be installed with 12-gauge wire to allow post construction tracing / locating.
- (d) Fittings for force mains shall comply with the specifications of the City of Alcoa Public Works & Engineering Department for Water Distribution.

### **2.2.3 Concrete Materials**

Concrete used in conjunction with the installation or repair of sewer lines and appurtenances shall be as follows:

1. Minimum compressive strength: 28 days, 4,000 psi average any 3 cylinders.
2. Coarse aggregates: Size No. 57 crushed limestone.
3. Fine aggregates: Natural sand or manufactured limestone sand proportioned by dry weight of fine to total aggregates between 30-45 percent.
4. Slump: 2-4 inches.
5. Mixing water: Maximum 6.0 gallons per sack. Deduct the moisture content of the aggregate from the amount of mixing water required.
6. Cement: Use Portland cement meeting the requirements of ASTM Standard C150. Use minimum 6.6 sacks of cement per cubic yard of concrete.
7. Dry aggregate per cement sack: Coarse aggregate-280, fine aggregate using mfg. limestone sand-194, fine aggregate using natural sand -187.

### **2.2.4 Manholes**

#### **(a) General Requirements**

Manholes shall be precast reinforced concrete meeting the requirements of ASTM Standard C478 except as may be provided otherwise in the following. Where flows may exist at less than 2 fps or where sanitary force mains enter a gravity manhole the interior of the manhole must be coated with an approved corrosion resistant coating.

1. Manhole inside diameter shall be 48 inches for 18-inch and lesser diameter pipe and 60 inches for 21-inch to 30-inch diameter pipe.
2. Wall thickness shall be a minimum of 5 inches.
3. The minimum compressive strength of precast manhole risers, bases, cone or top sections, and grade rings shall be 4,000 psi.
4. The access opening in top sections shall be a minimum diameter of 24 inches.

5. Joints: The reinforced concrete manhole base and riser sections, except grade rings, shall be formed with male and female ends, so that when the manhole base, riser, and top are assembled they will make a continuous and uniform manhole.
6. Lift eyes or holes may be provided in each section for the purpose of handling but must not protrude through the concrete walls.
7. Poured-in-place reinforced concrete manholes, polyethylene manholes, or fiberglass manholes may be used with prior permission of the City.

**(b) Precast reinforced concrete manhole bases:**

1. The base riser sections shall be precast with integral floors.
2. Bases for pipe 10 inches diameter or less shall have a minimum outside height of 24 inches.
3. Bases for 12-inch through 18-inch diameter pipe shall have a minimum outside height of 36 inches.
4. Heights of bases for pipes greater than 18 inches in diameter shall be according to the manufacturer's specifications, subject to prior approval of the City.

**(c) Precast Reinforced Concrete Tops:**

Precast tops may be one of the following three types:

1. Concentric cone
2. Eccentric cone
3. Flat slab top

Lift holes should be installed on the sides on the cone tops.

**(d) Precast Reinforced Concrete Grade Rings:**

1. Grade ring wall thickness shall be a minimum of 5 inches.
2. Grade rings shall be either 2 inches, 4 inches or 6 inches in height.
3. The combined height of grade rings shall be a maximum of 12 inches.

**(e) Manhole Steps:**

1. Manhole steps shall be fabricated from aluminum alloy 6061, T6.
2. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections which may be a safety hazard and shall be of sufficient strength to have a live load of 300 pounds imposed at any point.

3. The minimum width of cleat shall be 10 inches.
4. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4 inches from the wall when the step is securely imbedded in the manhole wall.
5. The top surface of the cleats shall be designed to prevent foot slippage.
6. Steps should be positioned vertically over a pipe inlet or outlet and at a maximum spacing of 16 inches.
7. Steps shall be the same size, projection, spacing, and alignment in each manhole.

**(f) Section Joints:**

Section joints: Base risers, section risers, and tops shall be designed for confined O-ring gasket joints meeting the latest requirements of ASTM Standard C-443 or flexible butyl resin sealant meeting the latest requirements of AASHTO Standard M198-B.

**(g) Openings:**

Openings in the base section wall shall be cored for the required number and size of pipes and shall be manufactured as to allow up to 20 degrees axial deflection.

**(h) Pipe Entrance Couplings:**

1. A watertight pipe to manhole gasket system using a flexible molded neoprene compound boot meeting the latest requirements of ASTM Standard C443 or rubber meeting the latest requirements of ASTM Standard C923 shall be installed for each core opening furnished in base riser sections.
  - i. Gaskets shall be designed to allow up to 20 degrees axial deflection.
  - ii. Internal expanding bands or power sleeves shall be of a type 304 stainless steel meeting the latest requirements of ASTM Standard C923 and shall be designed to allow contraction around the boot to clamp and seal the boot to the pipe.
2. Pipe openings made in the field in existing manhole walls for PVC pipe installation shall be machine cored. Each core shall have installed a flexible molded neoprene boot meeting requirements of Section 2.2.4 (h) 1. of these Standards.
3. Other specially designed flexible products may be approved by the Alcoa

Public Works & Engineering Department.

**(i) Manhole Covers:**

1. Manhole cover frames and lids shall be of gray cast iron meeting the latest requirements of ASTM Standard A48, Class 30, (30,000 psi); painting of the frame and lid is not required.
2. Manhole frames and covers shall be round, with the cover/frame interface machine ground horizontally, and should weigh not less than 375 pounds.
3. Manhole frames shall have clear openings of 24 inches, heights of approximately 7-1/2 inches, and overall base diameters of approximately 35 inches. The base shall have four uniformly spaced holes for attachment to the manhole using 5/8-inch diameter bolts or threaded rods.
4. Lids shall have a thickness of 1-1/2 inches, a diameter of 26 inches, shall be solid and shall have either one or two concealed pick holes for lifting purposes.
5. Top surfaces of lids shall have embossed treads for non-slipage purposes and embossed words "SANITARY SEWER" with letters approximately two (2") inches in size.
6. Manhole covers shall be Neenah R-1642; Vulcan Foundry, Inc., No. V-1380; or approved equal.

**(j) Watertight Manhole Covers:**

1. Watertight manhole frames and covers shall be utilized when the manhole is located in flood prone areas or where storm water drains over a manhole. Where drainage is temporary and shall be removed during restoration and final grading, a manhole cover insert may be used.
2. Watertight manhole frames and covers shall be of the outer lid/inner watertight cover configuration; the frame and outer lid shall meet the same material and dimensional requirements of non-watertight covers.
3. The steel locking bar for the inner watertight cover shall be equipped with a minimum 3/4-inch diameter stainless steel or brass bolt for securing the cover. The bolt shall be equipped with a minimum 1/2-inch diameter, 4-inch long "tee" handle for installation and removal.
4. The inner watertight cover shall be equipped with two (2) cast iron, stainless steel or brass eye-hooks for ease of removal and installation of the cover and a neoprene gasket for a watertight seal between the inner cover and frame.
5. Watertight manhole frames and covers shall be Neenah Foundry Company

No. R-1755-F1, John Bouchard & Sons No. 1123, or approved equal.

### **2.2.5 Air Release Valves**

Air release valves for use on pressure sewage mains shall be of the combination air release/vacuum breaker design. Internal valve components shall be constructed of stainless steel, brass, and/or bronze to minimize corrosion. Each valve shall be designed/sized for its particular application. Valves shall be manufactured by Crispin, Golden-Anderson or approved equal.

## **2.3 CONSTRUCTION OF WASTEWATER COLLECTION LINES**

All construction on the City of Alcoa's wastewater collection system that is not performed by the Public Works Department shall be executed by a person, firm, or corporation licensed to engage in contracting as set forth in the Tennessee Contractors Licensing Act of 1976 (TCA 62-601). This requirement shall apply to all construction regardless of the amount of work involved. These requirements apply also to pipeline subcontractors who may be engaged to conduct any part or all of the line installation work.

### **2.3.1 Pre-Construction Activities**

Prior to commencement of work:

1. The contractor or developer may be required to provide a cash deposit, bond, certified check, or other acceptable form of security for the amount of the work to be completed or a portion thereof pursuant to the approved construction plans. The amount of this security shall be determined by and at the discretion of the Director of Public Works. Should the work not be performed in accordance with these Specifications and/or other applicable requirements, the City may execute the security for the purpose of remediation of any deficiencies and/or for the completion of the project. Within sixty (60) days of the completion and acceptance of all provisions of the approved plans, cash deposits or other legal arrangements, or unexpended or unobligated funds thereof, shall be refunded or terminated.
2. Supply two (2) complete sets of construction drawings, copies of all applicable permits (excluding City of Alcoa) and licenses.
3. Attend a mandatory Pre-Construction meeting with the City of Alcoa Public Works & Engineering staff. Responsible representatives for the contractor, subcontractor(s) & owner/developer must attend. Attendance of the engineer is optional unless required by the utility.
4. Supply material submittal sheets on all materials to be installed. Submittal sheets must contain manufacturer, required standards to be met, and marks or highlights to indicate model, size, type and material of material proposed for the project. All submittals must be approved prior to start of construction. All materials shall be manufactured or assembled in the U.S.A. or under U.S. standards as provided by but not limited to the agencies listed in the reference index of these specifications.

Suppliers/manufacturers must show or disclose adherence to the same on their material submittal sheets.

5. Supply copy of Construction Start Notification submitted to the Division of Water Pollution Control, Tennessee Department of Environment & Conservation to the Public Works & Engineering Department.
6. Request a dig/locate request from the Tennessee One Call system 72 hours prior to commencement of excavation activities.

### **2.3.2 Soil Erosion Control**

Unless otherwise specified, the Contractor shall be responsible for erosion control and slope stabilization relative to the construction of sanitary sewerage improvements. The contractor shall be responsible for installation and maintenance of all necessary temporary and permanent control measures. As a minimum, the Contractor shall construct and maintain all components shown in the Plans or directed by the Engineer during the life of the Contract to control erosion and pollution. Such measures may include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.

#### **(a) Materials**

The more likely erosion control measures to be required during the construction of sanitary sewerage improvements are described below.

##### **1. Sediment Structures**

Sediment basins, ponds and traps, are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the constructed areas from excessive siltation.

##### **2. Check Dams**

Check dams are barriers composed of logs and poles, large stones or other materials placed across a natural or constructed drainway. Stone check dams should not be utilized where the drainage area exceeds fifty (50) acres; log and pole structures should not be used where the drainage area exceeds five (5) acres.

##### **3. Temporary Seeding & Mulching**

Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing and matting utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion.

##### **4. Brush Barriers**

Brush barriers are constructed of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operations. Brush barriers are constructed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located, to restrain sedimentation particles.

#### **5. Baled Hay or Straw Checks**

Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing five (5) cubic feet or more of material. Baled hay or straw checks should be used where the existing ground slopes toward or away from the embankment along the toe of the slopes, in ditches or other areas where siltation erosion or water run-off is a problem.

#### **6. Temporary Silt Fences**

Silt fences are temporary measures utilizing woven wire or other approved material attached to post with filter cloth composed of burlap, plastic filter fabric, etc., attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

#### **(b) Construction Requirements**

1. Unless otherwise specified, the Contractor shall be responsible for acquisition of all Federal, State, and local erosion control, water pollution, and other such permits applicable to construction of the sanitary sewerage improvements.
2. The Engineer may limit the area of erodible soil exposed by clearing and grubbing operations, excavation, and other operations and may direct the Contractor to provide immediate permanent or temporary pollution control measures. The Contractor shall be cognizant of and strive to protect from pollution adjacent watercourses (streams, creeks, etc.), and impoundments (e.g., lakes, ponds). Cut and fill slopes and other excavated areas shall be seeded and mulched as work progresses.
3. The Contractor shall incorporate all erosion control features into the project at the earliest practicable time.
4. The area of erodible soil exposed at one time should not exceed 750,000 square feet without approval of the Engineer. The area of excavation operations in progress shall be limited to the Contractor's ability to finish grade, mulch, seed, and/or construct other such permanent pollution control measures. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be constructed.
5. In the event of conflict between these requirements and pollution control laws, rules or regulations, or other Federal, State or Local agencies, the

more restrictive laws, rules or regulations shall apply.

### **2.3.3 Preparation**

- (a) Precautions and Permit to Excavate:
  - 1. Abide by each utility company's requirements when repairing, replacing or disturbing existing facilities.
  - 2. Prior to trench excavation being performed within any public right-of-way, including public alleys, a permit shall be obtained from the governing authority to perform such excavation. As a minimum, the trench backfill and street repair shall be made in accordance with the City of Alcoa Public Works & Engineering Department's Street &.Drainage – Construction Specifications.
- (b) Prior to laying pipe, prepare suitable bedding in accordance with 2.1.7 of these Standards.
- (c) Before placing pipe in trench, field inspect for cracks or other defects; remove defective pipe from construction site.
- (d) Swab the interior of the pipe to remove all undesirable material.
- (e) Prepare the bell end and remove undesirable material from the gasket and gasket recess.

### **2.3.4 Installing Gravity Sanitary Sewers**

Maintaining accurate field notes of the installation of the waterline and all appurtenances is required of the contractor to insure accurate As-builts are produced for final acceptance of the work.

- (a) Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
  - 1. When laser equipment is used, provide two (2) offset hubs and one (1) grade hub at each manhole set at minimum of fifteen (15) feet from the manhole centerline. Guard stakes should be provided with each.
  - 2. Where batter boards are used, provide offset hubs at intervals of 50 feet along the route and at every manhole location. Set hubs at such distance from the centerline of excavations as is suitable for excavating method and machinery to be used. Provide and use accurately batter boards at a minimum of each 50-foot interval of pipe laid.
- (b) Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.

- (c) Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject any defective pipe or fitting from the job site.
- (d) Lay pipe progressively upgrade, with bell upstream in such a manner as to form close, concentric joints with smooth bottomed inverts. Joining of all pipes shall be in accordance with manufacturer's specifications.
- (e) Bed each pipe section in accordance with the following requirements and those specified in Section 2.1.7 of these standards.
  - 1. Backfill material from a foot above the pipe should not exceed 6 inches in diameter at its greatest dimension. Special care shall be used in placing bedding in the haunching region.
  - 2. Ductile Iron Pipe and AWWA C900 PVC Pipe: Each sewer pipe section shall be laid on a 6-inch bed of Size No. 7 or Size No. 67 crushed stone and shall be backfilled to the springline of the pipe using Size No. 7 or Size No. 67 compacted crushed stone.
  - 3. SDR 35/ASTM 3034 PVC Pipe: Each sewer pipe section shall be completely encapsulated with 6 inches of bedding material on the top, both sides, and the bottom of the pipe. Bedding materials shall be Size No. 7 or Size No. 67 crushed stone.
  - 4. Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject to the french drain effect of gravel bedding. Major rehabilitation projects should also include check dams in the design. Dams shall consist of compacted clay bedding and backfill at least three (3) feet thick to the top of the trench and cut into the walls of the trench two (2) feet. Alternatively, concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart. The preferred location is upstream of each manhole. All stream crossings will include check dams on both sides of the crossing
- (f) Unless otherwise specified, provide all gravity sewer lines with a minimum of 4 feet of cover in roadways and 2-1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.
- (g) Ductile iron pipe shall be required when sewer installation occurs in areas of non-virgin soil (i.e. areas of "fill"). Piers shall be provided for when necessary for support. An impermeable barrier of compacted clay or concrete encasement shall be used at the transition from fill to virgin soil to prevent piping of water through the crushed stone bedding.
- (h) For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer

is less than 18 inches below the bottom of the culvert or conduit.

- (i) Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.
- (j) Keep the pipe free of all unneeded material; upon completion of a section between any two manholes, it shall be possible to view a complete circle of light when looking through the pipe.
- (k) When laying pipe ceases, close the open ends of the pipe with a suitable plug for preventing the entrance of foreign materials.
- (l) Couplings and adapters used for joining dissimilar gravity pipe materials or for repairing and rejoining sections of gravity sewer shall be of neoprene construction with stainless steel clamps.
- (m) All connections, tapping and other modifications to the existing Public Sanitary Sewer System shall be conducted by the City of Alcoa or when approved in the presence of authorized City of Alcoa personnel.

### **2.3.5 Installing / Repairing Sanitary Sewer Lines in Street, Highway, and Railroad Rights-of-Way**

- (a) Permits as may be required for crossing streets, highways, and railroads and performing other work within their rights-of-way shall be obtained from the appropriate authorities.
- (b) As a minimum, boring and jacking methods shall be in accordance with the current Public Works & Engineering Department Standards.

### **2.3.6 Initial Proof Testing of Sanitary Sewers**

It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance. Initial proof testing will be required when the total footage of a contracted project is greater than 4000 LF and when 50% of the project footage has been installed or in the event the run between manholes is greater than 12 ft in depth. Acceptance does not initiate a reduction in retainage for that section of completed work.

### **2.3.7 Final Testing**

- (a) Before the sewer line is accepted and before any houses are connected, a final testing procedure is to be followed. Testing must be coordinated with and conducted in the presence of authorized City of Alcoa personnel.
- (b) Perform a visual inspection. A TV-inspection of the line may be required. All visible leaks shall be repaired.
- (c) If there is evidence of infiltration, make measurement with suitable pipe weirs or

other instrumentation.

1. If the flow through the lowermost manhole of a continuous section of sewer pipe does not exceed 50 gallons per day per inch of pipe diameter per mile of pipeline and the groundwater level is representative of the highest annual level, the entire continuous section shall be approved for leakage.
  2. The leakage test will be conducted with all lines connected, including service lines.
  3. If the apparent infiltration rate exceeds 50 gallons per day per inch of pipe diameter per mile, then take additional weir measurements to isolate those sections leaking.
  4. Any single reach of pipeline which exhibits an apparent infiltration rate in excess of 50 gallons per day per inch of pipe diameter per mile will not be accepted and all leaks will be located and corrected.
- (d) A low-pressure air test shall be made. Low-pressure air testing of all pipes shall be as specified in ASTM C828-80. The pressure drop shall be calculated as the number of seconds for the air pressure to drop from a stabilized pressure of 3 1/2 psig to 2 1/2 psig.

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES  
(Based upon ASTM C828-80)

NOMINAL PIPE DIA. (inches)	TIME (Min. / 100 ft.)
6	0.7
8	1.2
10	1.5
12	1.8

Sewers larger than 12-inch diameter shall be tested in accordance with the latest TDEC-WPC standards.

Identify and repair / replace any section of line that fails the low-pressure air test.

- (e) When PVC pipe is used, pulling an approved "go/no-go" deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer may be required. No sections will be accepted that exhibit a deflection of more than five (5%) percent.

### 2.3.8 Installing Manholes

- (a) Manholes shall be furnished as provided under Section 2.2.4 of these Standards.
- (b) Depth of manholes shall be the vertical distance from the lowest invert in the

manhole to the top of the manhole cover frame.

- (c) Backfill manholes with the same material used for pipelines.
- (d) Prepare manhole subgrade on undisturbed earth. Remove all loose earth prior to placing crushed stone base or concrete slab. Fill all disturbed areas below subgrade level with compacted bedding stone.
- (e) Manholes having a depth of less than 12 feet shall be set on a compacted Size No. 7 or 67 crushed limestone base of minimum 6 inches thickness. Manholes having a depth of 12 feet or more shall be set on a 6-inch thick reinforced concrete slab having a minimum diameter 1 foot greater than the outside diameter of the manhole base section. The concrete slab shall be poured on a minimum 3-inch thick compacted crushed stone bedding. Concrete shall meet the conditions of Section 2.2.3 of these Standards.
- (f) The crushed limestone base shall be placed on dry consolidated and, when possible, undisturbed soil. If earth beneath the manhole has been disturbed, it shall be compacted using an approved mechanical compaction device or under cut to suitable material and back filled with clean stone as provided in Section 2.3.8 (e).
- (g) Manholes shall be set plumb.
- (h) Manhole inverts shall be accurately shaped, using concrete, to a smooth surface texture. Invert flow channels shall be shaped having the same radii as those of the pipes for which the channels are being provided. The depth of the channels shall be a minimum of 1/2 the diameter of the pipes being accommodated. From the edge of the shaped flow channels to the manhole walls, inverts shall be sloped upward at a minimum of 1 to 6.
- (i) Inlets and outlets of each manhole shall be finished smooth and flush with the sides of the manhole wall so as not to obstruct the flow of wastewater through the manhole.
- (j) When completed, the manhole shall be free from channel obstruction and leakage.
- (k) Seal joints between manhole sections with rubber O-ring gaskets or flexible butyl resin sealant. Manufacturer's recommendations for placing gaskets or sealant shall be followed.
- (l) All fully penetrated lift eyes or holes provided in precast manhole sections shall be filled with concrete or cement mortar.
- (m) Precast concrete grade rings shall be set using Portland cement mortar. Care should be exercised so as not to allow too much water in the cement mortar mix which may cause shrinkage. Manhole cover frames shall be attached to the manhole barrel or grade rings by means of 4, 5/8-inch anchor bolts or threaded rods and shall be set in a bed of mastic. Joints of precast concrete grade rings and manhole frames shall be made so as to prevent leakage.

(n) Drop Manholes:

1. External Drop Assemblies – The drop pipe construction shall be of ductile iron pipe and either ductile iron or cast iron mechanical joint fittings. The inlet piping of an outside drop shall be bedded in 6 inches of concrete. The remainder of the outside drop shall be backfilled with compacted Size No. 7 or 67 crushed stone. Ductile iron pipe and fittings shall meet the requirements of Section 2.2.1 of these Standards.
2. Internal Drop Assemblies – Shop drawing for pre-manufactured internal drop assemblies shall be submitted for review and approval by the Alcoa Public Works & Engineering Department.
3. Concrete used in constructing drop pipe assemblies shall meet the conditions under Section 2.2.3 of these Standards.

### 2.3.9 Vacuum Testing

Vacuum testing shall be conducted on each manhole. The test shall be performed such that the integrity of each component (i.e. pipe connections, seal(s) between manhole sections, seal between manhole and cover frame) is verified.

Prior to testing, all pipe inlets and outlets shall be plugged and braced. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With no additional vacuum added by the pump, the manhole assembly will be accepted if the time measured for the vacuum to drop to nine (9) inches does not exceed the given value from the table below. If the given time is exceeded, repairs shall be made or manhole parts replaced until the test time is met.

#### MINIMUM TIMES FOR MANHOLE VACUUM TEST (Sec.) \*

##### DEPTHS (ft.)

MH DIA	≤6	8	10	12	14	16	18	20	22	24	26	28	30
48"	10	14	17	21	25	28	32	35	39	42	46	49	53
60"	14	18	23	28	32	37	41	46	51	55	60	64	69
72"	23	28	34	40	45	51	57	62	68	74	80	85	

\* Used by permission - P. A. Glazier, Inc., P. O. Box 1002  
Worcester, MA 01613

### 2.3.10 Sewer Service Assemblies

- (a) The standard collector tap shall consist of a tee connected with a full length section 6-inch diameter branch. The tap will consist of fittings made of the same material as that of the line (i.e. cast iron or ductile iron fittings on a ductile iron or AWWA C900 PVC line) except that PVC fittings may be used on vitrified clay lines. Ductile

iron pipe and either ductile iron fittings or cast iron fittings or concrete encasement shall be used in roadways where cover is less than 4 feet, or in open areas where cover is less than 2-1/2 feet. Also, ductile iron pipe shall be used where velocities greater than 15 feet per second are attained.

- (b) Risers having 45 degree angles or less measured from the horizontal may be used when the depth of the sewer collector is greater than 8 feet or when their use will facilitate connection of individual services. All risers having angles of 30 degrees or greater measured from the horizontal shall be placed in a bedding of compacted Size No. 7 or 67 crushed stone having a minimum width of 3 times the pipe diameter, a minimum thickness under the pipe equal to the pipe diameter, and an overall thickness of twice the pipe diameter. A minimum of 6 inches of bedding stone shall be placed above the top of all PVC risers in accordance with the provisions of Section 2.1.7 of these standards.
- (c) Tee branches not to be used immediately shall be plugged with stoppers of the same material and joints used on the collector lines.
- (d) Installation of Service Pipe and Fittings in Developments
  1. Service pipe and fittings shall be supplied by the developer and installed from the collector lines to the street right-of-way lines or edges of easements provided. Service pipe and fittings shall meet the conditions under Section 2.2 of these Standards.
  2. Ends of service pipe shall be plugged and covered the same as collectors.
  3. The minimum grade on service pipes shall be one percent or 1/8 inch per foot.
  4. Ends of service pipes shall be field located:
    - (i) For as-built drawings, a) record the distances measured along the collector lines from the nearest downstream manhole to points at right angles to such service pipe ends, b) record the perpendicular distances measured between the collector lines and the service pipe ends, and c) record depth of service pipe end from the ground surface; and
    - (ii) Install a length of minimum 1/2-inch diameter iron bar at the service pipe ends, having a 1-foot hook at the base, placed within 1.5 feet of the end of the assembly and buried no more than 6 inches from finished grade.

### **2.3.11 Warranty Inspection**

Twelve (12) months following acceptance of the sewer line, a follow-up inspection will be made to determine if any failures/deficiencies have occurred as a direct result of the contractor's work and/or materials. Present at this inspection will be a representative(s) of

the Alcoa Public Works & Engineering Department and of the developer and/or contractor. The developer and/or contractor will be responsible for correction of all failures/deficiencies that have occurred during the first year of operation.

## **2.4 STANDARDS FLEXIBILITY**

### **2.4.1 Interpretations of these Standards and Design Criteria**

Interpretations of these Standards and Design Criteria or the determination of any other Public Works & Engineering Department standards and design criteria not covered under these Standards shall be at the discretion of the City of Alcoa Engineering & Public Works Director. The decision of the Director shall be based on past practices, traditional policies, widely accepted professional principles and practices of the industry.

### **2.4.2 Right of Appeal**

Any disagreement with the interpretations or determinations made by the Engineering & Public Works Director with respect to these Standards or any other standards not covered herein may be appealed to the Alcoa City Manager.

Appendix 1

Table for  
DESIGN BASIS FOR NEW SANITARY SEWERS

<u>Discharge Facility</u>	<u>Design Units</u>	<u>Flow</u> (gpd)	<u>Flow Duration</u> (hr)
Dwellings	per person	100	24
School w/ showers and cafeteria	per person	16	8
School w/o showers and w/o cafeteria	per person	12	8
Boarding School	per person	75	16
Motels at 65 gal/person (rooms only)	per person	130	16
Trailer courts at 3 persons/trailer	per trailer	225	24
Restaurants	per seat	40	16
Interstate or through highway restaurants	per seat	180	16
Interstate rest areas	per person	5	24
Service stations	per vehicle serviced	10	16
Factories (per 8 hour shift)	per person	25	Shift
Shopping center (no food)	per 1,000 s.f.	150	12
Hospitals	per bed	300	24
Nursing home (add 75 gals for laundry)	per bed	120	24
Homes for the Aged	per bed	60	24
Child Care Center	per child and adult	10	Shift
Laundromats, 9 to 12 machines	per machine	250	16
Swimming pools	per swimmer	10	12
Theaters, auditorium type	per seat	5	12
Picnic areas	per person	5	12
Resort camps, day & night w/ limited plumbing	per campsite	50	24
Luxury camps with flush toilets	per campsite	100	24
Churches (no kitchen)	per seat	3	Shift

Notes:

- 1) Figures include normal infiltration .
- 2) In all cases use actual data from similar facilities when possible. Note variations due to factors such as age, water conservation, etc. Submit all design data used.

