STANDARD SEWER SPECIFICATIONS
FOR THE
CITY OF ROCK HILL

June 2018

City of Rock Hill
Water/Sewer Utilities
P.O. Box 11706
Rock Hill, SC 29731-1706
803-329-5500
June 14, 2018

ROCK HILL CITY OF
PO BOX 11706
ROCK HILL SC  29731-1706

RE:  Standard Specifications for Wastewater System
  ROCK HILL CITY OF
  Approval Number SS-002146

This office has reviewed the wastewater system specifications submitted to this office on 03/08/2018, revised on 6/14/2018 for consideration of becoming Standard Specifications. Based on our review this letter may serve as your approval of these Standard Specifications. The specifications have been approved for the following:

1. Gravity Sewers (PVC, DIP)
2. Force Mains (PVC, DIP)
3. Details (Standard Manhole, Drop Manhole, FM Tie-In)

Please be advised that these Standard Specifications are only approved for those items specifically listed above. Separate “Pump Station Specifications” must be submitted with each wastewater project that includes a pump station design.

For further submittals of projects, please indicate on the application for permit to construct that your specifications have been approved as Standard Specifications and that no additional copies will be necessary.

If you have any questions, please call me at 803-898-1941.

Sincerely,

Maia P Milenkova
Construction Permitting Section
Bureau of Water
# Standard Specifications for Sanitary Sewer Facilities Construction

## Table of Contents

I. Purpose and General Information ......................................................................................................................... 1
   A. Purpose & Application ...................................................................................................................................... 1
   B. Scope of Work .................................................................................................................................................. 1
   C. Order of Work .................................................................................................................................................. 1
   D. Material Inspection .......................................................................................................................................... 1
   E. Organization of Work and Notifications ........................................................................................................... 1
   F. Lead-Free Requirements .................................................................................................................................. 2
   G. Specifications .................................................................................................................................................... 2
   H. Abbreviations ................................................................................................................................................... 2

II. Material Specifications .......................................................................................................................................... 4
   A. General ............................................................................................................................................................. 4
      1. Quality and Inspection ................................................................................................................................. 4
   A. Ductile Iron Pipe and Fittings ........................................................................................................................... 4
      1. Pipe .............................................................................................................................................................. 4
      2. Quality Assurance ........................................................................................................................................ 4
      3. Fittings .......................................................................................................................................................... 4
      4. Joints ............................................................................................................................................................ 4
      5. Markings and Weights ................................................................................................................................. 5
      6. Linings and Coatings ..................................................................................................................................... 5
      7. Certification .................................................................................................................................................. 5
      8. Quality and Inspection ................................................................................................................................. 5
   B. PVC Pipe for Gravity Sewer Applications .......................................................................................................... 5
      1. Pipe .............................................................................................................................................................. 5
      2. Fittings .......................................................................................................................................................... 6
      3. Joints ............................................................................................................................................................ 6
      4. Markings ........................................................................................................................................................ 6
   C. Plastic Pipe for (Pressure) Force Main Applications ............................................................................................ 6
      1. Pipe .............................................................................................................................................................. 6
      2. Fittings .......................................................................................................................................................... 6
      3. Joints ............................................................................................................................................................ 6
1. General ......................................................................................................................................................... 9
2. Manhole Sizes ............................................................................................................................................. 9
3. Base Section ............................................................................................................................................. 9
4. Riser Sections .......................................................................................................................................... 10
5. Cone Section ........................................................................................................................................... 10
6. Slabs ......................................................................................................................................................... 10
7. Doghouse Manhole ............................................................................................................................... 10
8. Joints ....................................................................................................................................................... 10
9. Drop Connections ................................................................................................................................. 10
10. Inverts .................................................................................................................................................. 10
11. Steps .................................................................................................................................................... 11
12. Frames and Covers ............................................................................................................................... 11
13. Brick .................................................................................................................................................. 11
14. Alteration to Manholes ......................................................................................................................... 11
15. Field Adjustments ............................................................................................................................... 11
16. Repaired and Patched Sections ........................................................................................................... 11
17. Testing ................................................................................................................................................. 11
18. Markings ............................................................................................................................................. 11
19. Linings ............................................................................................................................................... 12
G. Appurtenances ....................................................................................................................................... 12
1. Air Release and Air Vacuum Relief Valves .......................................................................................... 12
H. Concrete Work ...................................................................................................................................... 12
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General</td>
<td>13</td>
</tr>
<tr>
<td>2. Cement</td>
<td>13</td>
</tr>
<tr>
<td>3. Aggregate</td>
<td>13</td>
</tr>
<tr>
<td>4. Water</td>
<td>13</td>
</tr>
<tr>
<td>5. Mixing</td>
<td>13</td>
</tr>
<tr>
<td>6. Central Mix Plant</td>
<td>13</td>
</tr>
<tr>
<td>7. Job Site Mix</td>
<td>13</td>
</tr>
<tr>
<td>8. Grouts</td>
<td>13</td>
</tr>
<tr>
<td>9. Mortar</td>
<td>14</td>
</tr>
<tr>
<td>10. Flowable Fill</td>
<td>14</td>
</tr>
<tr>
<td>11. Concrete Cylinders</td>
<td>14</td>
</tr>
<tr>
<td>I. Miscellaneous Steel</td>
<td>14</td>
</tr>
<tr>
<td>1. Steel Pier Material</td>
<td>14</td>
</tr>
<tr>
<td>2. Steel Encasement Pipe</td>
<td>15</td>
</tr>
<tr>
<td>3. Structural Steel Tunnel Liner Plates</td>
<td>15</td>
</tr>
<tr>
<td>4. Steel</td>
<td>15</td>
</tr>
<tr>
<td>5. Steel Vent Pipe</td>
<td>16</td>
</tr>
<tr>
<td>6. Steel Straps and Anchors</td>
<td>16</td>
</tr>
<tr>
<td>J. Stone and Brick</td>
<td>16</td>
</tr>
<tr>
<td>1. Brick</td>
<td>16</td>
</tr>
<tr>
<td>2. Granular Bedding Material</td>
<td>16</td>
</tr>
<tr>
<td>3. Rip Rap</td>
<td>16</td>
</tr>
<tr>
<td>4. Silt Check Dam Material</td>
<td>17</td>
</tr>
<tr>
<td>5. Stone Stabilization Material</td>
<td>17</td>
</tr>
<tr>
<td>K. Ferrous Castings</td>
<td>17</td>
</tr>
<tr>
<td>1. Special Castings</td>
<td>17</td>
</tr>
<tr>
<td>2. Frames, Covers and Grates</td>
<td>17</td>
</tr>
<tr>
<td>L. Defective Materials and Workmanship</td>
<td>17</td>
</tr>
<tr>
<td>III. Construction Specifications</td>
<td>18</td>
</tr>
<tr>
<td>A. Abandonment</td>
<td>18</td>
</tr>
<tr>
<td>1. General</td>
<td>18</td>
</tr>
<tr>
<td>2. Pipe</td>
<td>18</td>
</tr>
<tr>
<td>3. Appurtenances</td>
<td>18</td>
</tr>
<tr>
<td>4. Manholes</td>
<td>18</td>
</tr>
<tr>
<td>5. Mains at Manhole which Remain in Service</td>
<td>18</td>
</tr>
<tr>
<td>6. Exposed Pipe</td>
<td>18</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1. General</td>
<td>27</td>
</tr>
<tr>
<td>2. Testing and Cleaning</td>
<td>27</td>
</tr>
<tr>
<td>3. Temporary Bulkheads</td>
<td>27</td>
</tr>
<tr>
<td>4. Infiltration Test</td>
<td>27</td>
</tr>
<tr>
<td>5. Low-Pressure Air Test</td>
<td>28</td>
</tr>
<tr>
<td>6. Manhole Leakage Tests</td>
<td>28</td>
</tr>
<tr>
<td>7. Force Main Sewer Pipe Leakage Test</td>
<td>28</td>
</tr>
<tr>
<td>8. Deflection Tests and Inspections</td>
<td>29</td>
</tr>
<tr>
<td>L. General Construction</td>
<td>30</td>
</tr>
<tr>
<td>1. Clearing &amp; Grubbing</td>
<td>30</td>
</tr>
<tr>
<td>2. Disposal</td>
<td>30</td>
</tr>
<tr>
<td>3. Removal of Private or Public Facilities</td>
<td>30</td>
</tr>
<tr>
<td>M. Construction Along Highways, Streets, and Roadways</td>
<td>30</td>
</tr>
<tr>
<td>1. General</td>
<td>30</td>
</tr>
<tr>
<td>2. Protection of Traffic</td>
<td>30</td>
</tr>
<tr>
<td>3. Closures</td>
<td>30</td>
</tr>
<tr>
<td>4. Maintaining Highways, Streets, Roadways, and Driveways</td>
<td>30</td>
</tr>
<tr>
<td>5. Construction Operations</td>
<td>31</td>
</tr>
<tr>
<td>6. Removing Pavement</td>
<td>31</td>
</tr>
<tr>
<td>7. Marking and Cutting</td>
<td>31</td>
</tr>
<tr>
<td>8. Stripping</td>
<td>31</td>
</tr>
<tr>
<td>9. Excavated Material</td>
<td>31</td>
</tr>
<tr>
<td>10. Pavers or Curb</td>
<td>31</td>
</tr>
<tr>
<td>11. Machine Pulling</td>
<td>31</td>
</tr>
<tr>
<td>12. Drainage Structures</td>
<td>31</td>
</tr>
<tr>
<td>N. Earthwork</td>
<td>32</td>
</tr>
<tr>
<td>1. General</td>
<td>32</td>
</tr>
<tr>
<td>2. Trench Excavation</td>
<td>32</td>
</tr>
<tr>
<td>3. General Excavation</td>
<td>32</td>
</tr>
<tr>
<td>4. Materials</td>
<td>33</td>
</tr>
<tr>
<td>5. Shoring and Bracing</td>
<td>33</td>
</tr>
<tr>
<td>6. Dewatering</td>
<td>33</td>
</tr>
<tr>
<td>7. Backfill</td>
<td>34</td>
</tr>
<tr>
<td>8. Compaction Consolidation Requirements</td>
<td>34</td>
</tr>
<tr>
<td>9. Crushed Stone Stabilization and Bedding</td>
<td>34</td>
</tr>
<tr>
<td>10. Shaping</td>
<td>34</td>
</tr>
<tr>
<td>Chapter</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>O. Manhole Construction</td>
<td>35</td>
</tr>
<tr>
<td>1. General</td>
<td>35</td>
</tr>
<tr>
<td>2. Outside Drops</td>
<td>35</td>
</tr>
<tr>
<td>3. Inside Drops</td>
<td>35</td>
</tr>
<tr>
<td>4. Frames and Covers</td>
<td>35</td>
</tr>
<tr>
<td>5. Steel Vent Pipes</td>
<td>36</td>
</tr>
<tr>
<td>P. Concrete Construction</td>
<td>36</td>
</tr>
<tr>
<td>1. Placing of Concrete</td>
<td>36</td>
</tr>
<tr>
<td>2. Formwork</td>
<td>36</td>
</tr>
<tr>
<td>3. Setting Forms</td>
<td>36</td>
</tr>
<tr>
<td>4. Curing</td>
<td>37</td>
</tr>
<tr>
<td>5. Removing Forms</td>
<td>37</td>
</tr>
<tr>
<td>6. Finishing</td>
<td>37</td>
</tr>
<tr>
<td>7. Testing</td>
<td>37</td>
</tr>
<tr>
<td>8. Acceptance</td>
<td>37</td>
</tr>
<tr>
<td>9. Blocking Installation</td>
<td>38</td>
</tr>
<tr>
<td>Q. Bores, Tunnels, and Casings</td>
<td>38</td>
</tr>
<tr>
<td>1. Bore Pits (or Tunnel Pits)</td>
<td>38</td>
</tr>
<tr>
<td>2. Sizing</td>
<td>38</td>
</tr>
<tr>
<td>3. Installation</td>
<td>38</td>
</tr>
<tr>
<td>4. Guaranteed Casing Installation</td>
<td>39</td>
</tr>
<tr>
<td>5. Tunnels Using Steel Liner Plates</td>
<td>39</td>
</tr>
<tr>
<td>6. Finish Work</td>
<td>41</td>
</tr>
<tr>
<td>R. Blasting</td>
<td>41</td>
</tr>
<tr>
<td>S. Erosion and Sediment Control</td>
<td>42</td>
</tr>
<tr>
<td>1. General</td>
<td>42</td>
</tr>
<tr>
<td>2. Temporary Erosion Control</td>
<td>42</td>
</tr>
<tr>
<td>3. Construction in Streams and Impoundments</td>
<td>42</td>
</tr>
<tr>
<td>4. Construction in Easements</td>
<td>43</td>
</tr>
<tr>
<td>5. Limit of Progress</td>
<td>43</td>
</tr>
<tr>
<td>6. Surface Stabilization – Permanent Ground Cover</td>
<td>43</td>
</tr>
<tr>
<td>7. Right to Correct</td>
<td>43</td>
</tr>
<tr>
<td>T. Restoration of Disturbed Areas</td>
<td>43</td>
</tr>
<tr>
<td>1. General</td>
<td>43</td>
</tr>
<tr>
<td>2. Stabilization</td>
<td>43</td>
</tr>
<tr>
<td>3. Appurtenances</td>
<td>43</td>
</tr>
</tbody>
</table>
IV. Sanitary Sewer Pump Stations ........................................................................................................................ 47

A. Purpose............................................................................................................................................................... 47
   1. General............................................................................................................................................................ 47
   2. Objectives...................................................................................................................................................... 47
   3. Requirements............................................................................................................................................... 47

B. Design Requirements ....................................................................................................................................... 47
   1. Applicable Regulations and Standards ......................................................................................................... 47
   2. Design Engineer........................................................................................................................................ 48
   3. General....................................................................................................................................................... 48
   4. Public Water ............................................................................................................................................ 48

C. Pre-Approval of Pump Station .......................................................................................................................... 48

D. Pump Station Site ........................................................................................................................................... 48

E. Wet Well Capacity ........................................................................................................................................... 49
   1. General....................................................................................................................................................... 49
   2. Working Volume ....................................................................................................................................... 49
   3. Storage Volume ........................................................................................................................................ 50
   4. Top Slab..................................................................................................................................................... 50

F. Pump Station Control and Monitoring .......................................................................................................... 50

G. Hydrogen Sulfide and Odor Control .............................................................................................................. 50

H. Material Specifications ................................................................................................................................. 52
   1. Description............................................................................................................................................... 52
   2. System Description ................................................................................................................................. 52
   3. Performance Criteria .............................................................................................................................. 52
   4. Submittals ................................................................................................................................................. 52
   5. Quality Assurance ................................................................................................................................. 54
   6. Manufacturer’s Warranty .................................................................................................................... 54

U. Restoration of Existing Paved Surfaces ........................................................................................................... 44
   1. General....................................................................................................................................................... 44
   2. Replacement ............................................................................................................................................ 44
   3. Restoration ............................................................................................................................................. 45
   4. Damage to Adjacent Pavement .................................................................................................................. 45

V. Record/As-Built Drawings ............................................................................................................................... 45

W. Warranty .......................................................................................................................................................... 46
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Unitary Responsibility</td>
<td>55</td>
</tr>
<tr>
<td>8. Pump Design</td>
<td>55</td>
</tr>
<tr>
<td>9. Pump Construction</td>
<td>55</td>
</tr>
<tr>
<td>10. Motor</td>
<td>56</td>
</tr>
<tr>
<td>11. Impeller</td>
<td>56</td>
</tr>
<tr>
<td>12. Electrical Control Components</td>
<td>56</td>
</tr>
<tr>
<td>13. Auxiliary Power Transformer Controls and Accessories</td>
<td>58</td>
</tr>
<tr>
<td>I. Low Pressure Sewer Systems (LPSS)</td>
<td>68</td>
</tr>
<tr>
<td>1. Location/Approval</td>
<td>68</td>
</tr>
<tr>
<td>2. Design</td>
<td>68</td>
</tr>
<tr>
<td>3. Materials and Installation for LPSS</td>
<td>69</td>
</tr>
<tr>
<td>J. Installation and Approval Requirements</td>
<td>72</td>
</tr>
<tr>
<td>1. Handling and Installation</td>
<td>72</td>
</tr>
<tr>
<td>2. Testing</td>
<td>72</td>
</tr>
<tr>
<td>3. Start-up</td>
<td>73</td>
</tr>
</tbody>
</table>
I. PURPOSE AND GENERAL INFORMATION

A. PURPOSE & APPLICATION: This document was created and assembled for use in planning, designing, and constructing sanitary sewer facilities which will be owned and operated by the City of Rock Hill. In addition to the information contained herein, rules and regulations set forth by the South Carolina Department of Health and Environmental Control (SCDHEC) and the US Environmental Protection Agency (EPA) apply to the permitting and construction of these facilities. This information applies to both existing and new facilities construction.

B. SCOPE OF WORK: All materials, labor, and equipment necessary for sewer construction and placing in operation sanitary sewer infrastructure and appurtenances within the City of Rock Hill sewer service territory or to be served by the City of Rock Hill shall be provided in accordance with the following specifications and City of Rock Hill Standard Details.

1. The work shall include all clearing, grubbing, trenching, shoring [in accordance with Occupational Safety & Health Administration (OSHA) regulations], dewatering, installing sanitary sewerage (i.e., foundations, manholes, piping and other appurtenances) shown and specified, backfilling and consolidating the backfill material, as well as other work as may be necessary to complete the work.

2. Construction Drawings shall be prepared under the direction of a Professional Engineer licensed to practice in the state of South Carolina.

3. The Contractor shall furnish all materials, equipment and labor required to construct the project as outlined in these specifications and Construction Drawings.

C. ORDER OF WORK: The Order of Work shall be determined by the Contractor, subject to approval by the City Engineer.

D. MATERIAL INSPECTION: All materials and workmanship shall be subject to inspection by the City Engineer or his or her designee and representatives of SCDHEC or SCDOT or any other entity having permitting authority over the project. Work and/or materials not conforming to these specifications or any applicable permit shall be corrected immediately. The Engineer shall have the right to label materials not meeting the specifications and/or the Contractor shall segregate said materials to distinguish them as such.

E. ORGANIZATION OF WORK AND NOTIFICATIONS

1. The Contractor shall so organize his work that backfilling of open trenches and or excavations and associated cleanup of the construction site shall closely follow pipe laying operations and manhole construction. The City Engineer or his designee shall have the authority to determine if the contractor is negligent in complying with this provision. The City shall have the authority to stop work if needed to bring the site into a respectable level of maintenance.

2. All planned road closures shall be reported to the following entities a minimum of 72 hours prior to closing any street.

   a) The City of Rock Hill’s Homeland Security Director’s office at 803-326-3810; and
b) The York County Public Safety Communications office at 803-329-1110.

3. The Public Safety Communications office will notify the appropriate emergency services responders (i.e., EMS, Fire Department, etc.) of the planned road closure(s). Lane closures, where a minimum of one lane is left open to traffic, do not require notification to either office – City of Rock Hill’s Homeland Security Director’s office or York County’s Public Safety Communications office.

4. Traffic control, signage and barricades for road and lane closures and work inside the road rights-of-way shall be in accordance with applicable encroachment permits and the Federal Highway Administration’s (FHWA), Manual on Uniform Traffic Control Devices.

5. Failure on the part of the Contractor to comply with the above provisions in a reasonable manner, in the opinion of the Engineer, shall be sufficient cause for the Engineer to order a temporary shut-down of trenching and pipe laying operations until the provisions have been met.

6. Contractor shall notify each property owner affected by a planned interruption of existing services at least 72 hours prior to the loss of service. For emergency interruption of services, the Contractor shall notify the property owner as soon as practical.

F. **LEAD-FREE REQUIREMENTS:** Lead-free pipes, plumbing fittings/fixtures, and solder/flux shall contain less than 0.25 percent lead in accordance with the Reduction of Lead in Drinking Water Act (P.L. 111-380).

G. **SPECIFICATIONS:** Unless superseded or modified herein or in the Standard Details, all materials apparatus, supplies, methods of manufacture, or construction shall conform to the specifications contained herein and AWWA specifications. All materials/products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61. National standards (ASTM, ANSI, AWWA, etc.) referenced herein shall be considered to be the latest revisions only.

H. **ABBREVIATIONS**

1. A list for reference purposes is as follows:

   - **AASHTO** American Association of State Highway and Transportation Officials
   - **AC** Asbestos cement
   - **ACI** American Concrete Institute
   - **ASTM** American Society for Testing and Materials
   - **ANSI** American National Standards Institute
   - **ARV** Air release valve
   - **AWS** American Welding Society
   - **AWWA** American Water Works Association
   - **BPD** Backflow Prevention Device
   - °C Degrees Celsius
   - **CIP** Cast iron pipe
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP</td>
<td>Ductile iron pipe</td>
</tr>
<tr>
<td>EPA</td>
<td>US Environmental Protection Agency</td>
</tr>
<tr>
<td>°F</td>
<td>Degrees Fahrenheit</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>FSE</td>
<td>Food Service Establishments</td>
</tr>
<tr>
<td>fps</td>
<td>Feet per second</td>
</tr>
<tr>
<td>gph</td>
<td>Gallons per hour</td>
</tr>
<tr>
<td>gpm</td>
<td>Gallons per minute</td>
</tr>
<tr>
<td>g/m²</td>
<td>grams per square meter</td>
</tr>
<tr>
<td>GMP</td>
<td>Grease Management Program</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>LF</td>
<td>Linear feet</td>
</tr>
<tr>
<td>MJ</td>
<td>Mechanical joint</td>
</tr>
<tr>
<td>MSS</td>
<td>Manufacturers Standardization Society of the Valve and Fittings Industry</td>
</tr>
<tr>
<td>MUTCD</td>
<td>Manual on Uniform Traffic Control Devices</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>NSF</td>
<td>National Sanitation Foundation</td>
</tr>
<tr>
<td>NST</td>
<td>National Standard Thread</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>ppm</td>
<td>Parts per million</td>
</tr>
<tr>
<td>psi</td>
<td>Pounds per square inch</td>
</tr>
<tr>
<td>psig</td>
<td>Pounds per square inch – gauge</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>SC 811</td>
<td>South Carolina 811</td>
</tr>
<tr>
<td>SCDHEC</td>
<td>South Carolina Department of Health and Environmental Control</td>
</tr>
<tr>
<td>SCDOT</td>
<td>South Carolina Department of Transportation</td>
</tr>
<tr>
<td>SDR</td>
<td>Standard Dimension Ratio</td>
</tr>
<tr>
<td>SDWA</td>
<td>Safe Drinking Water Act</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratory</td>
</tr>
<tr>
<td>USDOT</td>
<td>United States Department of Transportation</td>
</tr>
</tbody>
</table>
II. MATERIAL SPECIFICATIONS

A. GENERAL

1. QUALITY AND INSPECTION: Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality, be free from cracks, blisters and other imperfections, and be true to theoretical shapes and forms throughout each length. Pipe that does not conform will be so marked by the Engineer, and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted.

A. DUCTILE IRON PIPE AND FITTINGS

1. PIPE: Ductile-iron pipe (mechanical properties) shall be centrifugally cast and shall be domestically manufactured in the United States. Push-on, and restrained joint pipe shall have a minimum rated working pressure of 150 psi in accordance to bury per AWWA. Pipe 16 inches in diameter or smaller shall be a minimum Pressure Class 350; pipe greater than 16 inches in diameter shall be as approved by the City Engineer. Pipe shall have mechanical or push-on joints as outlined in ANSI A21.11 with laying lengths of at least 18 feet.

   a) Ductile iron pipe for gravity sewers shall meet the requirements of AWWA C150/ANSI A21.50 and AWWA C151/ANSI A21.51.

   b) Ductile iron pipe for force mains shall meet ASTM A-377.

2. QUALITY ASSURANCE: Require submitted evidence that the ductile iron pipe and fitting manufacturer has a minimum of ten-years’ experience in material production of diameters noted on the Construction Drawings and specifications. All ductile iron pipe shall be manufactured in the United States. All pipe material suppliers shall be ISO registered or provide the services of an independent inspection agency. Prior to the start of manufacturing, any manufacturer not meeting the ISO registration requirements shall submit to the owner and owner’s engineer the names of an independent inspection agency for approval. The independent inspection agency shall be responsible for sample monitoring of chemical and mechanical test, sample visual inspection of quality assurance tests performed on in-process pipe and fittings, and a sample visual and dimensional inspection or finished product for this project. A certified inspection report from the independent inspection agency of all witnessed tests shall be supplied to the owner or owner’s engineers within ten (10) days of completion of pipe manufacturing. Chemical samples shall be taken from each ladle of iron and the manufacturers’ chemical control limits shall be maintained for at least the following elements: carbon, sulfur, phosphorus, silicon, magnesium, chromium, manganese, tin, aluminum, cerium, copper, and lead. When chemical values fall outside the manufacturer’s control limits, additional mechanical property tests shall be performed to assure minimum mechanical properties are met.

3. FITTINGS: Fittings shall be cast from ductile iron and shall conform to AWWA C110 (ANSI A21.10) and/or AWWA C153. All fittings shall have standard mechanical joints or as shown. Mechanical joint fittings shall meet AWWA C111 (ANSI A21.11). Bolts and nuts for mechanical joint fittings shall be uncoated, high strength, low alloy steel meeting ASTM A242.

4. JOINTS: Flanges for pipe, fittings, and valves shall be furnished in accordance with AWWA C115 (ANSI 21.15) and shall be faced and drilled identical to Class 125 B16.1 flanges with full-face
rubber gaskets 1/8” thickness. Bolts and nuts for flanges shall be in accordance with ANSI/AWWA Standards for uncoated, high strength, low alloy steel meeting ASTM A242.

5. **MARKINGS AND WEIGHTS:** Markings and weights of pipe and fittings shall conform to the requirements of AWWA Specifications. -

6. **LININGS AND COATINGS:** Force main lining applications shall be at high points in the force main where air is expected to accumulate, at discharge points, and as indicated by the Engineer. Ductile iron pipe for use in wastewater applications (both gravity and pressure) shall contain one of the following linings in accordance with the manufacturer’s recommended guidelines unless otherwise approved by the City Engineer.

   a) **Protecto 401 Ceramic Epoxy lining by Induron Coatings, Inc. of Birmingham, AL, or approved equal.** Thickness:

      (1) 40 mils (0.04-inches) nominal dry film thickness for interior of pipe and fittings

      (2) 6 mils (0.006-inches) nominal, 10 mils (0.01-inches) maximum using Protecto 401 Joint Compound for the gasket area and spigot end up to 6 inches back from the end of the spigot end on the outside of the pipe.

   b) **Coal tar epoxy lined for gravity applications per AWWA C210.**

   c) **Series 431 Perma-Shield PL, by Tnemic Company Inc., or approved equal, at a minimum dry-film thickness of 40 mils.**

   d) **ZINC COATING:** Zinc-coated ductile iron pipe conforming to ISO 8179 standards may be installed as an alternative in corrosive soils and other special conditions as approved by the City Engineer. The exterior zinc coating shall be factory-installed using a thermal arc spray process. The zinc layer shall have a mass of 200 grams per square meter (g/m²) of pipe surface area. A finish layer of bituminous coating shall be placed over the zinc in accordance with AWWA C104, and the pipe shall be marked with the word “zinc”.

7. **CERTIFICATION:** The manufacturer of iron pipe and fittings shall be prepared to furnish both the City and the Contractor with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI Specifications.

8. **QUALITY AND INSPECTION:** Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality, be free from cracks, blisters, and other imperfections, and be true to theoretical shapes and forms throughout each length. Pipe that does not conform will be so marked by the Engineer, and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted

**B. PVC PIPE FOR GRAVITY SEWER APPLICATIONS**

1. **PIPE:** Polyvinyl Chloride (PVC) sewer pipe shall be bell and spigot pipe, shall be in lengths not exceeding 20 feet laying lengths, and shall have minimum wall thickness conforming to ASTM D3034 under the classification for SDR26 pipe.
Section II – Material Specifications

City of Rock Hill Wastewater Specifications

2. FITTINGS: PVC sewer pipe fittings for gravity systems shall be bell and spigot or bell and plain end and shall conform to the same cell classification requirements as defined above. Fittings shall be in accordance with ASTM F794, D3212, and/or D3034, as applicable with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

3. JOINTS: Joining shall be by rubber gaskets that conform in all respects to the physical requirements specified by ASTM F477 for low head applications. The lubricant used for assembly shall be as recommended by the manufacturer and shall have no detrimental effect on either the pipe of the rubber gasket.

4. MARKINGS: The pipe shall contain markings required by ASTM F794.

C. PLASTIC PIPE FOR (PRESSURE) FORCE MAIN APPLICATIONS

1. PIPE: All plastic pressure pipes (sizes 4” through 12”) shall meet all requirements of AWWA Standard C900 and be made from green-pigmented virgin materials. Polyvinyl Chloride (PVC) sewer pipe shall be bell and spigot pipe, shall be in lengths not exceeding 20 feet laying lengths, and shall have minimum wall thickness conforming to SDR18 Class 150 dimensions. Pipe shall be NSF approved. Alternative plastic pipe (sizes 4”-12”), other than C900, shall meet all requirements of ASTM D1785 (Sch. 40) or ASTM D2241 (SDR26 Class 160 and SDR21 Class 200), but its use shall be subject to the approval of the City Engineer. All plastic pipes (sizes 16”-48”) shall also meet all requirements of AWWA Standard C905, but its use shall be subject to the approval of the City Engineer. No new main shall be smaller than 4” diameter, unless designed for a low-pressure sewer system. Thermoplastic pipe shall not be used above grade.

2. FITTINGS: Fittings shall be in accordance with ASTM F794, D3212, and/or D3034, as applicable with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

3. JOINTS: Joints for PVC pipe shall be elastomeric-gasket type with a pressure rating not less than the pipe pressure rating meeting performance requirements of ASTM D3139. All PVC pipes shall have elastomeric joints with an integral belled, bell and spigot rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F477. Joints shall meet the requirements specified in ASTM D3212.

4. MARKINGS: The pipe shall contain markings required by ASTM D3034. All markings shall remain legible during normal handling, storage and installation, and will be applied in a manner that will not reduce the strength of or otherwise damage the pipe or coupling.

B. STEEL PIPE FOR AERIAL CROSSINGS

1. PIPE: High Strength steel pipe shall be welded or seamless, manufactured in accordance
with ASTM A53 for Welded Steel and Seamless Steel Pipe (1/8-inch to 26-inch inclusive) and/or ASTM A139 for Welded Straight-Seam Steel Pipe (4-inch to 92 inch inclusive).

a) All steel shall be Grade “B” only, with minimum yield strength of 35,000 psi. Thickness shall be 0.250-inch unless otherwise specified or shown on the Construction Drawings.

b) The pipe shall be produced in a single continuous length. Welding of two or more individual pieces together end to end shall not be permitted. Spiral-seam pipe shall not be permitted.

c) Pipe ends shall have tolerances within the limits required for approved couplings. Pipe shall also be furnished with plain right-angle ends with all burrs removed from the ends. Steel mechanical transition couplings shall be as follows:

(1) Steel Pipe to Steel Pipe:

(a) 30-inch and smaller pipe sizes shall have a center ring length of seven (7) inches.

(b) 36-inch and larger pipe sizes shall have a center ring length of ten (10) inches.

(c) Couplings shall be manufactured by Dresser Industries Style 38 Straight Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

(2) Steel Pipe to Ductile Iron Pipe:

(a) 8-inch and smaller pipe sizes shall have a center ring length of five (5) inches.

(b) 10-inch through 20-inch pipe sizes shall have a center ring length of seven (7) inches.

(c) 24-inch and larger pipe sizes shall have a center ring length of ten (10) inches.

(d) Couplings shall be as manufactured by Dresser Industries Style 62 Transition Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

(e) Couplings shall receive field applied protective coatings as specified for steel pipe.

2. LININGS: All steel pipe shall receive one (1) of the following shop applied linings on the inside of the pipe barrel:

a) Coal tar lining 3/32-inch minimum dry film thickness in accordance with AWWA 203.
b) Coal tar epoxy lining 24 mils minimum dry film thickness and shall be Carboline Koppers No. 300M, Amercoat No. 78, Carboline Carbomastic No. 14, or approved equal.

3. **COATINGS:** The outside of steel pipe and complete couplings shall receive one coat of Carboline Koppers 300M coal tar epoxy, 16 mils minimum dry film thickness or approved equal. The coal tar epoxy coat shall be shop applied to the pipe, and field applied to the couplings. Damage to exterior shop applied coatings shall be repaired with the same coating used by the manufacturer and applied as recommended by the manufacturer.

C. **VITRIFIED CLAY PIPE (VCP):** Vitrified clay pipe shall not be used in new wastewater system applications.

   1. **EXISTING VCP:** If construction activities are conducted over top an existing VCP, then at a minimum that portion of existing VCP shall be replaced with ductile iron pipe. Replacement length shall be between the two closest adjacent manholes upstream and downstream of the impacted sewer, unless otherwise approve by the City Engineer.

D. **SEWER LATERAL**

   1. **PIPE:** Sewer service piping shall be constructed of Schedule 40 PVC pipe in accordance with ASTM D2665 and ASTM D1785. Service piping shall be sized to accept flows from the structure being served, but in no case shall the size of the service be less than the following:

   a) Residential service piping: Minimum 4-inch diameter piping

   b) Commercial Service piping: Minimum 6-inch diameter piping

   2. **FITTINGS:** Service branch connection for PVC pipe shall consist of a molded wye branch fitting with gasketed connections and shall be in accordance with ASTM D2466. Joining shall be through solvent cement in accordance with ASTM D2564. Sewer service lateral piping shall be installed perpendicular to the mainline when possible.

E. **COUPLINGS AND SADDLES**

   1. **COUPLINGS:** Couplings used to join various types of 12-inch and smaller pipe shall be elastomeric PVC sleeve couplings with stainless steel compression bands and stainless steel shear rings as manufactured by Mission Clay Products, Fernco, Logan Clay Products or approved equal.

   a) Couplings for 12-inch and smaller pipe may also be elastomeric PVC with internally molded rigid fiberglass insert and stainless steel bands as manufactured by DFW Plastics, or approved equal. The coupling shall provide a water and/or gas tight connection.

   b) Couplings for 15-inch and larger pipe shall be submitted to the Engineer for approval.

   c) Fernco couplings shall only be used on clay pipe or orangeburg pipe and when attaching to a different type material.
2. **SADDLES**: Saddles for lateral connections shall be ABS Plastic, PVC, elastomeric PVC, or approved equivalent. Saddles shall be connected to VCP using epoxy sealant. Saddles shall be Style “CB” Sewer Saddles by Romac Industries, or approved equal. The lateral shall be connected to the saddle with a compression gasket, solvent weld adapter, and/or stainless steel band, as applicable.

F. **PRECAST CONCRETE MANHOLES**

1. **GENERAL**: Manholes shall consist of precast reinforced concrete riser sections, top section and a base section manufactured in accordance with ASTM C478 and these specifications. Manholes are to be designed and constructed to withstand HS-20 vehicle live load ratings. Concrete shall have a minimum compressive strength of 4,000 psi when tested in accordance with ASTM C39. Steel reinforcement shall be as specified in ASTM C478, as amended to date. The wall thickness shall be designed for the approved depth of installation, but in no case shall the wall of all sections be less than five (5) inches.

2. **MANHOLE SIZES**: Manholes will be furnished with the following clear inside diameters according to the sewer main diameter, unless amended by the depth of invert, Construction Drawings or other project documents.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Manhole Diameter (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” to 18” pipe</td>
<td>4’</td>
</tr>
<tr>
<td>21” to 24” pipe</td>
<td>5’</td>
</tr>
<tr>
<td>30” to 36” pipe</td>
<td>6’</td>
</tr>
<tr>
<td>48” to 54” pipe</td>
<td>7’</td>
</tr>
<tr>
<td>Larger than 54”</td>
<td>8’ or as necessary to accommodate pipe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manhole Diameter</th>
<th>Invert Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>4’ manhole minimum</td>
<td>Less than or equal to 20’</td>
</tr>
<tr>
<td>5’ manhole minimum</td>
<td>Greater than 20’</td>
</tr>
</tbody>
</table>

3. **BASE SECTION**: Base sections for precast concrete manholes shall have a bottom poured monolithically with the walls. Base sections shall be furnished with inside diameters as required to accommodate the connecting piping. Base sections shall be furnished with a minimum height of 24 inches for pipes having a diameter of 12 inches or less, and a minimum height of 36 inches for pipes having a diameter greater than 12 inches. Minimum height for 5- or 6-foot diameter base sections shall be 48 inches regardless of pipe size. Base sections with 5- or 6-foot inside diameters shall be reduced to 4-foot inside diameter by means of an adapter ring or transition top. Base sections are to be design to resist buoyant forces to prevent the manhole from floating.

   a) The openings in the base section for the accommodation of the pipe shall be cast into the base section and the pipe connection shall be facilitated by the use of a flexible watertight connector, conforming to ASTM C923 such as the Cast-A-Seal products manufactured by the Press-Seal Gasket Corporation and installed in accordance with the manufacturer’s recommended installation guidelines.
b) Manholes shall be furnished with flexible water-tight boots for 15-inch and smaller pipe. The boots shall be cast as integral parts of the basin or installed in cored openings with stainless steel compression bands, and shall conform to ASTM C923. Manholes for 18-inch and larger pipe may be furnished with flexible boots, flexible seals, or concrete collars. The flexible seals shall be A-Lok or Contour Seal. Flexible connectors shall conform to ASTM C923. The concrete collars shall be constructed according to the applicable Standard Detail.

4. **RISER SECTIONS**: The riser sections shall be furnished in a minimum of six-inch (6") increments and shall match the base diameter. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved Epoxy to give a smooth surface free of any honeycomb.

5. **CONE SECTION**: The cone section for manholes shall be eccentric type with the vertical face installed over the manhole's effluent pipe. Cone sections can be eliminated and replaced with a flat top slab meeting SCDOT traffic ratings where elevations preclude the laying height of the cone section. Eccentric cones with bolt-down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones without bolt-down frame and cover to be installed flush to finished grade may have a minimum vertical height of 24-inches. Transition cone sections may be provided for eccentric transition from a 60-inch riser to a 48-inch cone section to be placed directly beneath the 48-inch cone. The minimum access diameter of a manhole shall be 22-inches.

6. **SLABS**: Transition slabs may be placed a minimum of five (5) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried. Flat top slabs may be used in six (6) feet and larger diameter manholes, unless the manhole is located within pavement or maintained lawn.

7. **DOGHOUSE MANHOLE**: Manholes to be placed over existing pipes shall be furnished with “doghouse” openings cast into the bottom section, allowing it to be set over the existing pipe. A concrete base and invert shall be poured around the bottom section, and the pipe according to the applicable Standard Detail.

8. **JOINTS**: Joints between manhole sections shall be manufactured in accordance with ASTM C443. Joints may be sealed with rubber gaskets in accordance with ASTM C443 or with butyl rubber sealants conforming to Federal specification SS-S-210A and AASHTO M198, Type B. An external mastic seal wrap shall be installed per the Standard Details and manufacturer’s instructions.

9. **DROP CONNECTIONS**: Drop manholes are required where the invert differential is twenty-four inches (24") or more. Where drop connections are required, drop pipe shall not be smaller than 8-inches. Generally, drop pipe shall be one size smaller than the sewer that they serve. Openings in walls of precast concrete manholes for drop connections shall not be made at joints. Drop connection fittings and riser pipe shall be located on the outside of the manhole and encased in brick and mortar or formed Class "C" concrete. Drop connections for precast concrete manholes shall conform to the City’s Standard Details. Slide inverts shall be installed on drop connections with drops less than two (2) feet. Drop connections shall be carefully backfilled to prevent dangerous side pressures. Interior drops shall only be installed where approved by the City Engineer.

10. **INVERTS**: Manhole inverts shall be carefully constructed with cement grout, Class "B" concrete, or cement mortar brickwork. Special care shall be taken to form the channel connecting the influent pipe invert(s) to the effluent pipe invert. Cement mortar shall be made of one (1) part cement
and two (2) parts clean sharp sand. Channels shall be properly formed, rounded, and troweled smooth to prevent turbulent flow through the manhole. Manhole inverts shall match the size of the associated influent and effluent pipes and have a smooth transformation between the two pipes on existing and proposed manholes.

11. **STEPS:** Manhole steps are to be copolymer polypropylene plastic covered 1/2 or 5/8 inch grade 60 reinforcing steel measuring a minimum of 11-3/8 inches in overall width and 9-1/16 inches overall depth and as manufactured by M.A. Industries, Inc. or equal. Steps are to resist a pullout force of over 1,500 pounds, and impact of up to 300 foot-pounds. Steps for precast concrete manholes shall be installed along a vertical centerline (centered over the effluent pipe), on approximately 14” to 16” centers.

12. **FRAMES AND COVERS:** Manhole frames and covers shall be secured to the manhole cone section and grouted in place to provide a waterproof seal. Frame and covers shall be as indicated in the Standard Details. Bolt-down watertight lids are to be used where it is anticipated that storm water runoff depth will exceed the rim elevation or on outfall lines located outside the road right-of-way. Manhole rim elevations shall be installed at an elevation two (2) foot above the anticipated 100-year flood water surface elevation, unless watertight covers are provided with approval of the City Engineer.

13. **BRICK:** Brick for manhole invert construction or grade adjustment shall be solid concrete brick. Brick for height adjustment shall not exceed 18 inches in height. Where manholes are installed in a street or other travel ways (i.e., driveways, parking lots, etc.), there shall be a minimum of two courses of brick used for adjusting the manhole rim elevation.

14. **ALTERATION TO MANHOLES:** In the event that a manhole has to be altered after delivery to job site, the Contractor may, with permission of the City Engineer, connect the pipe to the manhole with a Kor-n-seal slotted band style connector manufactured by Trelleborg Pipe Seals Milford, Inc., Kwik Seal Manhole Connector manufactured by the Press-Seal Gasket Corporation, or equal. Any remaining gaps between the pipe and manhole shall be filled with a non-shrink grout installed from the inside of the manhole.

15. **FIELD ADJUSTMENTS:** All final grade adjustment of manhole covers and frame assemblies shall be completed utilizing brick or concrete adjustment rings. The maximum height for field adjustment is 18”-24”.

16. **REPAIRED AND PATCHED SECTIONS:** Repaired and patched sections will not be acceptable unless each individual section to be repaired or patched shall have first been inspected and approved by the Engineer. Repairs to and patching of "O"-ring grooves and shoulders will not be permitted.

17. **TESTING:** Absorption shall not exceed 9 percent when determined in accordance with ASTM C497, as required by the City Engineer.

18. **MARKINGS:** An inspection, by an independent testing laboratory approved by the Engineer, of the manufacturer’s plant and product will be required to assure conformity of the precast manholes to these Specifications, and the minimum requirements of ASTM C478, as amended to date. Each section of precast concrete manhole shall clearly indicate the laboratory's configuration that it was accepted in accordance with applicable ASTM Specifications. Job site inspection shall be visual for shape, uniformity, and density.
Section II – Material Specifications

City of Rock Hill Wastewater Specifications

19. LININGS: Manholes shall be lined in accordance with the following.

   a) Conditions: Manholes meeting any of the following conditions, unless otherwise approved by the City Engineer, shall be lined:

      (1) Manholes receiving discharge from force main piping and adjacent manholes as directed by the City Engineer

      (2) Manholes located within FEMA 100-year flood plain

      (3) Manholes located within flood-prone areas as determined by the Rock Hill Stormwater Master Plan

      (4) Areas indicated by the design engineer

   b) Installation: Installation of the linings shall be one of the following applications on clean surfaces in accordance to the manufacturer’s instructions. For new manholes, lining shall be applied after all repairs have been made and manhole has been successfully vacuum tested. Additional surface preparation, cleaning or other work may be required as directed by the Engineer.

      (1) Manholes shall be lined with Spraywall urethane liner by Sprayroq Inc. or approved equal at a minimum dry-film thickness of 125 mils for the first 9 vertical feet of manhole depth and at 250 mils for manhole depths greater than 9 vertical feet.

      (2) Manholes shall be lined with Ultra-High Build Epoxy Coating System Raven 405 by Raven Lining Systems, or approved equal, at a minimum dry-film thickness of 125 mils.

G. APPURTEANCES

1. AIR RELEASE AND AIR VACUUM RELIEF VALVES – Combination air relief valves (ARV) shall be provided in accordance with sound engineering practice at high points in force mains. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. ARVs shall be furnished and installed as shown on approved Construction Drawings and as specified herein. The combination ARV shall have a cast iron body, and internal parts shall be stainless steel. The combination ARV shall be in accordance with the Standard Details.

   a) ARV PIPING - The open end of an air relief pipe from an automatic valve or from a manually operated valve shall be extended to the top of the pit and provided with a screened downward facing elbow.

   b) FORCE MAIN ALIGNMENT - The route of the force main shall be such that the number of air release and air vacuum valves is minimized.

H. CONCRETE WORK
1. **GENERAL:** Concrete of the respective classes for manhole bottoms, bedding, blocking, headwalls, piers and other miscellaneous structures shall be as called for in the work to which they pertain.

2. **CEMENT:** Cement shall satisfy the requirements of ASTM C150, Type I or Type II.

3. **AGGREGATE:** Aggregate shall satisfy the requirements of ASTM C33.
   
   a) **Course Aggregate:** Course aggregate shall be uniformly and evenly graded for each application in accordance with ACI Standard 318. Unless otherwise approved, aggregates shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.
   
   c) **Fine Aggregate:** Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof and shall be graded to meet the requirements of SCDOT size number FA-10 and 67, as appropriate.

4. **WATER:** Water shall be fresh, clean and free from injurious amounts of oil, acid, alkali, and organic materials.

5. **MIXING:** Mixing shall be accomplished at a central mix plant unless prior approval is given by the Engineer for mixing on the job site.

6. **CENTRAL MIX PLANT:** Concrete supplied from a central mix plant shall have 28-day compressive strengths not less than those listed below.
   
   a) Class "A" 3,000 psi
   
   b) Class "B" 2,200 psi
   
   c) Class "C" 1,500 psi

7. **JOB SITE MIX:** Concrete mixed on the job site shall have 28-day compressive strengths as above and shall contain not less than the following quantities of cement per cubic yard.
   
   a) Class "A" 564 lbs. (6 bags)
   
   b) Class "B" 470 lbs. (5 bags)
   
   c) Class "C" 376 lbs. (4 bags)

8. **GROUTS:** All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application, range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement.
   
   a) Expansion grouts shall be either Gilco premixed or Supreme non-metallic grout as manufactured by Gifford-Hill and Company, Inc., Embeco 636 grout as manufactured by Master Builders, or approved equal.
b) Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer’s recommendations, for each specific application.

9. **MORTAR**: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C398.

10. **FLOWABLE FILL**: Flowable fill shall be controlled, self-leveling, non-shrink, low-strength material consisting of a fluid mixture of cement, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in pipelines or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. Long-term hardened strength shall be between 75 psi and 150 psi at 56 days as determined based on an average of three tests for the same placement.

   a) Fly ash shall not be used in flowable fill adjacent to ductile iron pipe and fittings. Protect pipe and fittings by covering with polyethylene.

11. **CONCRETE CYLINDERS**: Concrete cylinders for testing purposes shall be made in accordance with the procedure described in ASTM C31. Compression tests shall be made at the age of 7 days and 28 days by the testing laboratory as per ASTM C39. Testing shall be done by a laboratory approved by the Engineer. Each test shall consist of at least four (4) specimens; two (2) for field control and two (2) for laboratory control. One (1) initial test will be required and then one (1) test for each one hundred (100) yards thereafter.

I. **MISCELLANEOUS STEEL**

1. **STEEL PIER MATERIAL**: Steel piles, cross braces, cradles, etc., shall consist of structural steel shapes of the section required in the Construction Drawings. The steel shall conform to specifications for ASTM A36 – Carbon Structural Steel.

   a) All bolts and nuts shall conform to ASTM A325 for 7/8-inch and ASTM A490 for 1-inch and larger.

   b) The Contractor shall handle and store steel members above ground on platforms, skids or other supports. Members shall be free of dirt, grease, and other foreign material and protected against corrosion.

   c) Coal tar epoxy coating Carboline Koppers No. 300M, Amercoat No. 78, Carboline Carbomastic No. 14, or approved equal shall be applied to all specified surfaces of the steel pier.

   d) Welding Electrodes shall conform to the following:

      (1) Shielded Metal-arc: AWS A5.1 or AWS 5.5, E70XX

      (2) Submerged-arc: AWS A5.17, F70X-EXXX

      (3) Gas Metal-arc: AWS A5.18, E70S-X or E70U-1
2. **STEEL ENCASEMENT PIPE**: Steel pipe shall be welded or seamless, smooth wall or spiral weld, consisting of Grade “B” steel as specified in ASTM A139. Encasement pipe must be approved by the appropriate controlling agency (i.e. SCDOT, railway corporation, etc.) and the City Engineer prior to ordering.

   a) Minimum yield strength shall be 35,000 psi; and pipe thickness shall be as specified for each individual job.

   b) All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.

3. **STRUCTURAL STEEL TUNNEL LINER PLATES**: The tunnel liner plates shall be either the four (4) flanged type (as approved for use within SCDOT rights-of-way) or the lap seam type (as approved for use within railroad rights-of-way) fabricated to permit assembly of a continuous steel support system as the tunnel is excavated. Tunnel liner plates shall be fabricated from hot rolled, carbon steel sheets or plates conforming to the specifications of ASTM A569 and must be approved by the appropriate controlling agency (i.e. SCDOT, railway corporation, etc.) and the City Engineer prior to ordering.

   a) The tunnel liner shall be designed in accordance with the requirements of Division I, Section 15 and constructed to conform to Division II, Section 25 of the AASHTO Standard Specifications for Highways and Bridges.

   b) Liner plates shall be galvanized in accordance with AASHTO M167 and fully bituminously coated in accordance with AASHTO M190. All hardware necessary to the tunneling operation shall be hot-dip galvanized in accordance with ASTM A153 prior to the bituminous coating application. Hardware shall conform to ASTM A307, Grade A.

   c) The mechanical properties of the flat steel plate before cold forming used for the design of the tunnel liner shall be:

      1. Minimum tensile strength: 42,000 psi
      2. Minimum yield strength: 28,000 psi
      3. Elongation, 2-inches: 30 percent

   d) The moment of inertia shall be 0.042 inches to the 4th power per inch of width for four flange 12 gauge liner plate.

4. **STEEL FOR REINFORCING FOR CONCRETE**

   d) **BARS**: All reinforcement bars shall conform to ASTM A615. All bars shall be deformed and of structural grade 60. All splices shall be lapped 24 diameters unless otherwise noted.

   e) **WIRE**: All reinforcement wire fabric shall conform to ASTM A185.
5. **STEEL VENT PIPE**: Unless otherwise specified, steel vent pipes shall be Schedule 40 five (5) inch diameter steel pipe, consisting of Grade “B” steel as specified in ASTM A139, with a minimum yield strength of 35,000 psi.
   
a) The steel pipe shall have an inside coal tar lining 3/32 inch minimum thickness in accordance with AWWA C203 or a coal tar epoxy lining conforming to that required for steel (aerial creek crossing) pipe.
   
b) Outside surface of pipe shall be sand or grit blasted to commercial standard and have one (1) coat of zinc chromate primer applied in accordance with Federal Specification TT-86A.
   
c) Pipe shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint, either Koppers Glamortex No. 501 Enamel (olive Green), Southern Coatings and Chemical Company Rustaloy No. 0537 Enamel (Garden Green), or approved equal.

6. **STEEL STRAPS AND ANCHORS**: Where stainless steel is identified in the Standard Details, pipes, bolts/anchors and/or straps shall conform to the requirements of ASTM A276. All other steel pipe and/or pier straps shall conform to the requirements of ASTM A36, with minimum yield strength of 36,000 psi.
   
a) Finished straps and anchors of carbon steel shall be galvanized in accordance with ASTM A153. The entire strap and all exposed surfaces of anchors and/or bolts (and nuts) shall be fully bituminously coated in accordance with AASHTO M190. Anchor bolts (non-head) shall conform to ASTM A36 with tension test to be made (as required on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM A307 for carbon steel externally and internally threaded standard fasteners Grade A or B.

J. **STONE AND BRICK**

1. **BRICK**: All brick used to construct manhole inverts or adjust frames shall be made from concrete, shall be solid only and shall be of standard building size. All brick shall meet or exceed the compressive strength and water absorption properties as specified in ASTM C139. All manholes placed within the limits of roadway pavement and sidewalk shall use the minimum course of adjusting brick as indicated in the Standard Details.

2. **GRANULAR BEDDING MATERIAL**: All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #67 in ASTM D448 for “Standard Sizes of Course Aggregate”, or SCDOT Standard Size #67. Bedding material will be used only as instructed in the specifications and/or as specifically directed by the Engineer and be spaded around the pipe on both sides.

3. **RIP RAP**: All rip rap shall consist of clean, field stone or rough unhewn quarry stone, resistant to the action of air and water, varying in weight from 25 to 250 pounds with 60% weighing a minimum of 100 pounds each and no more than 5% weighing less than 50 pounds each (SCDOT Class 2 Rip Rap). Rip rap will be placed from a minimum of 4.0 feet below the toe of the bank to top of the bank in areas determined by field conditions. Rip rap thickness shall be 1-1/2 times the diameter of the largest stones used, or as directed by the Construction Drawings.
4. **SILT CHECK DAM MATERIAL:** Material shall be course angular, clean washed, crushed stone, gravel or rock, well-graded, and ranging in size from 2-inches to 6-inches, or SCDOT stone for erosion control, Class A.

5. **STONE STABILIZATION MATERIAL:** All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #67 in ASTM D448 or SCDOT Standard Size #67. Stabilization material will be used only as instructed in the specifications and/or as specifically directed by the Engineer.

**K. FERROUS CASTINGS**

1. **SPECIAL CASTINGS:** All cast iron pipe fittings and special castings shall be furnished in weight, classes, and/or special thickness as specified elsewhere. The castings shall conform to ASTM A126 and shall be manufactured in domestic foundries. Coatings and linings, if applicable, shall be the same as specified for Ductile Iron Pipe.

2. **FRAMES, COVERS AND GRATES:** All manhole frames and covers shall conform to ASTM A48, Class 30 and shall conform to the Standard Details. Manufactured by domestic foundries preferred, but not required.
   
   a) Manhole frames and covers shall be furnished with the common contract surfaces between frame and cover machines.
   
   b) Where watertight frames and covers are specified, the water tight seal between frame and cover shall be accomplished by means of rubber gasket.

**L. DEFECTIVE MATERIALS AND WORKMANSHIP:** Any cracked or broken material, such as pipe, fittings, valves or hydrants, shall be removed and replaced with sound pieces, at the expense of the Contractor. Joints that leak shall be carefully remade. Remade joints and replaced material shall be retested under the same conditions of operation. If joints or materials are then found to be defective, they shall be remade and replaced until the line passes the required test.
III. CONSTRUCTION SPECIFICATIONS

A. ABANDONMENT

1. GENERAL: The following requirements shall apply for proposed abandonment of existing facilities, unless otherwise shown on the Construction Drawings or approved by the Engineer. All areas disturbed by abandonment shall be restored by the Contractor.

2. PIPE: Piping to be abandoned-in-place shall be cut and plugged on the ends and completely filled with flowable fill as indicated on the Construction Drawings. If existing pipe to be abandoned is less than 8 inches in diameter and has less than 5-feet of cover, then the pipe shall be removed and the trench backfilled with suitable material, unless otherwise approved by the City Engineer.

3. APPURTENANCES: Valves, meters, services, and other sewer main appurtenances to be abandoned shall be removed and the excavations backfilled with suitable material.

4. MANHOLES: Existing manholes which are to be abandoned will first have both influent and effluent lines plugged inside the manhole with watertight masonry. Weeps holes will be drilled into the base of the manhole, and the manhole will then be filled with non-compressible material (#67 stone or as approved) to a point three feet below the finished grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finished grade with suitable soil compacted in place.

5. MAINS AT MANHOLE WHICH REMAIN IN SERVICE: Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform to the Standard Details.

6. EXPOSED PIPE: Exposed sections of abandoned mains shall be removed to a point not less than 5-feet into the adjacent banks. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point 3-feet below the finished grade. Steel piers shall be cut off 3-feet below finished grade.

7. BACKGROUTING: Backgrouting is a secondary stage pressure grouting to ensure that voids have been filled within abandoned pipes. Backgrouting will only be required at critical locations indicated on the Construction Drawings or if there is evidence of incomplete flowable fill placements.

8. PUMP STATIONS: For abandonment of existing pump stations, pumps, motors, controls, etc., shall be salvaged and transported by the Contractor to an area designated by the City Engineer or representative, unless otherwise directed. All influent and effluent pipes shall be plugged with watertight masonry. The pipe chamber and wetwell (if abandoned) will have holes drilled in the bottom, be filled with non-compressible material (#67 stone or as approved) to a point 3-feet below the finished grade. The remainder of the structure shall be broken down and removed. Then the excavation shall be filled to the finished grade with suitable soil compacted in place. All aboveground structures associated with the pump station, including fencing and the access road shall be removed and the area restored.
B. **Handling and Storage of Materials**

1. **GENERAL:** The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him, and intended for the Work, until they have been incorporated into the completed project. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

2. **Transportation of Materials and Equipment:** All materials furnished by the Contractor shall be delivered and distributed at the site by the Contractor or his material supplier. The Contractor and his Supplier are directed to contact the SCDOT to verify axle load limits on State-maintained roads (and bridges) which would be used for hauling of equipment and materials for the Project. The Contractor and his Suppliers shall do all that is necessary to satisfy the SCDOT requirements and will be responsible for any damage to said roads which may be attributed to this project.

3. **Handling:** Proper and suitable tools and equipment shall be used for the safe and convenient handling and laying of pipe. Pipe, fittings and other materials shall be carefully handled so as to prevent breakage and as to prevent damage to the interior lining and coatings on the pipe and fittings. Pipe shall not be unloaded by rolling or dropping off of trucks or cars, but shall be handled by carefully lifting and lowering into position, using approved slings or clamps which shall be provided by the Contractor or material manufacturer for the purpose. Pipes and fittings shall be carefully examined for cracks, broken lining and other defects. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be cracked, broken or defective after being laid, it shall be removed and replaced with sound material at the expense of the Contractor. If any part of the coating or lining is damaged; the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted as completed work.

4. **Loading and Unloading:** Personnel and equipment for unloading, transporting, distributing and storing materials shall be furnished by the Contractor. The Contractor is responsible for the coordination of material deliveries and for providing appropriate staging and or lay-down areas. Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Concrete pipe, and precast manholes shall be loaded and unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

5. **Distributing:** Materials shall be distributed and placed so as to least interfere with traffic and not impair sight distances. The Contractor shall furnish and maintain proper warning signs and lights for the protection of traffic along highways, streets and roadways upon which material is distributed. No distributed materials shall be placed in drainage ditches.

   a) In distributing the material at the site of the Work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

   b) Contractor will string in advance no more than the amount of pipe and material that can be installed within four (4) weeks or less, as approved by the Engineer. All materials shall be placed in such a manner as not to hinder access, endanger or impede traffic or intersection sight distances, or create a public nuisance. Materials strung through residential areas (or
any area with maintained lawns) shall be placed in such a manner as not to restrict normal maintenance of established lawns, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

6. **STORAGE:** All pipe, fittings and other materials that cannot be distributed along the route of the work shall be stored for subsequent use when needed. The Contractor shall make his own arrangements for the use of storage areas. Unless prior written consent from the owner of the proposed storage area is received by the City Engineer, the Contractor will be required to store all equipment and materials within the limits of the right-of-way, permanent easement, and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road rights-of-way if approved by the controlling agency. PVC pipe shall not be exposed to direct sunlight for inordinate periods of time.

C. **SEWER SYSTEM INSTALLATION:** The Contractor shall assemble, joint and lay all ductile iron and plastic pipe and fittings in accordance with the following:

1. **GENERAL:** Installation of all sewer lines and appurtenances shall be conducted in accordance with the requirements of AWWA Section C and/or manufacturer’s recommended installation procedures.

   a) **PIPE** shall be laid in a workmanlike manner, true to line and grade, with bell ends facing up-grade in the direction of laying with a uniform slope between manholes. There shall be no joints in the piping located closer than 10 feet from the exterior wall of the manhole structure. All sewer lines shall be installed in a manner that they intersect at manholes with angles of 90-degrees or greater (measured in plan view) between the in-coming pipe and the discharge pipe. Any sanitary sewer with less than 4 feet of cover to finished grade shall be ductile iron with a minimum cover of three feet. Additionally, any sewer laid with 10 feet to 18 feet of cover shall be ductile iron. No sewer line shall be installed with more than 18 feet of cover. All pipe laid outside the road right-of-way shall be ductile iron. Pipe laid within the roadway may be PVC.

   b) **TRANSITIONS** between DI Pipe and PVC Pipe are allowed in some cases. However, no DI-PVC transitions shall be made within 10-feet of a manhole. DI-PVC transitions must be approved by City Engineer.

   c) **SANITARY SEWER GRADES** shall not exceed 8% and waste velocities in the pipe shall not be designed to exceed 10 feet per second without written approval by the City Engineer. Standard 4-foot diameter manholes with a typical slide invert may be used for differences in grade of 2 feet and less. For elevation differences greater than 2 feet, an outside piping drop must be utilized. Inside piping drops shall only be allowed for tying into existing manholes, and they shall be approved by the City Engineer.

   d) **OVERNIGHT COVER:** During construction all manhole openings shall be covered at the end of each day. For sidewalks, use wing-nut type plugs to secure openings. Trenches shall be covered or backfilled at the end of each working day.

   e) **CONTAMINATED AREAS:** All sewer piping shall be located outside contaminated areas. Re-route line if possible. If the piping must run through a contaminated site, the
piping material must protect the system from being contaminated (e.g. Ductile Iron Pipe with chemical resistant gaskets).

f) **EASEMENTS/RIGHTS-OF-WAY:** Pipe shall be installed in dedicated easements or public rights-of-way. The minimum easement width for sewer main shall be 30 feet; however, this may be increased to accommodate large-diameter pipe or burial greater than standard depth. See City Standard Details for additional information.

g) **UTILITY CROSSINGS:** All crossings with other utilities shall be made with ductile iron pipe.

2. **LOCATION AND GRADE:** The horizontal alignment and grade of the sewer piping and the location of manholes and other structures and or appurtenances shall be determined by the Engineer. The location shall be in agreement with approved Construction Drawings. The grade line shown and specified relates to the invert of the pipe to be installed. Any substantial deviation shall be subject to approval by the City Engineer.

a) Alignment/lines, levels and grades shall be determined by the Engineer/Surveyor, but the Contractor shall be responsible for accurately transferring such alignment/lines and grades to the work. This work by the Contractor shall be subject to frequent checks by the Engineer and City personnel.

b) Each section of sewer pipe shall be laid to the appropriate line and grade, as designed and approved beginning at the downstream end and working in the upstream direction with the bell end laid upgrade. Non-conformance with this provision must be approved by the City Engineer.

c) Any sanitary sewer with less than 4’ of cover to finished grade shall be constructed of ductile iron pipe, but shall have a minimum cover of three feet (3’). Additionally, any sewer laid with at least 12 feet of cover shall be ductile iron. No sewer piping shall be installed with less than 3 feet or more than 18 feet of cover unless approved by the City Engineer.

d) When the sewer line is constructed in the road right-of-way, it shall be in conformance with the City of Rock Hill Utility Location Plan and applicable encroachment permits. All pipe laid outside the road right-of-way shall be ductile iron. In some cases depending on soil types and the presence of other utilities with cathodic protection, 16 mil polyethylene pipe wrap, or PVC pipe may be required for use. Sewer lines crossing or within 10 feet of utilities with cathodic protection shall be designed to protect the sewer line and shall be approved by the City Engineer.

3. **PLACEMENT:** All pipe, fittings, valves, manholes, and appurtenances shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage to protective coatings and linings. Under no circumstance shall materials be dropped or dumped into the trench.

a) **DUCTILE IRON PIPE:** Ductile iron piping shall be installed in accordance with ANSI/AWWA C600 – Installation of Ductile Iron Water Mains and their Appurtenances.

b) **PVC GRAVITY PIPE:** PVC gravity sewer shall be installed in accordance with ASTM

c) PVC FORCE MAIN (PRESSURE) INSTALLATION: PVC force mains shall be installed in accordance with ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

d) FORCE MAIN INSTALLATION: Design and construction of force mains shall be such that they satisfy a leakage test in accordance with specifications herein. Thrust blocking or mechanical restraints shall be provided at all changes in alignment greater than or equal to 11 ¼ - degrees. Automatic air relief valves shall be placed at high points in the force main sewer to prevent air locking. Blocking and/or restraints must be placed as shown on the Construction Drawings and/or as directed by the Engineer. Blocking shall consist of ready mix concrete having a compressive strength of not less than 3,000 psi.

4. DETECTION OF MAINS: All force mains shall be detectable within three (3) feet with electronic locating equipment. Non-metallic pipe shall be installed with solid, UL-approved 14-gage (min) copper tracer wire running along the centerline of the pipe or other means of detection. Warning tape shall be placed 1-foot over top of force main piping.

5. CUTTING PIPE: Whenever pipe or special castings are required to be cut, the cutting shall be done by skilled workmen, using an abrasive wheel cutter. Pipe that is cut in the field must be ground and beveled prior to assembly.

a) DUCTILE IRON: Use of oxyacetylene torch will not be permitted. The plain end shall be beveled, any sharp edges that might damage the gasket shall be removed by means of a file or power grinder.

b) PVC PIPE: The plain end shall be beveled, any sharp edges that might damage the gasket shall be removed by means of a file or power grinder.

5. CREEK CROSSINGS: Creek crossings and other applications may require a specialized section of pipe (e.g., long-span steel pipe with specialized joint restraint). Each such crossing shall be addressed on a case-by-case basis and approved by the City Engineer

a) ABOVE GRADE CROSSINGS: For pipe crossing above creeks, streams and other bodies of water, pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

b) BELOW GRADE CROSSINGS: For pipe crossing under creeks, streams and other bodies of water, a minimum of two (2) feet of cover shall be provided over the pipe unless approved by City Engineer. If cover is less than two (2) feet, then carrier pipe shall be placed inside steel casing pipe. When crossing water courses that are greater than fifteen feet (15’) in width, the pipe and material shall be designed appropriately, manholes shall be located on both sides of crossing to isolate for testing and repair that are easily accessible and not subject to flooding, and ductile iron pipe with mechanical joints shall be used for any lines being installed in rock.

c) WATER STOP: Install water stop per the Standard Details at the downstream
edge of wetland areas, creek crossings, and other bodies of water crossed by a sanitary sewer.

D. **SEWER SERVICE INSTALLATION**

1. **GENERAL:** All laterals except those serving lots adjacent to in-line manholes or upstream from dead-end manholes in cul-de-sacs shall be connected to the sewer main. Service line piping shall be laid with a minimum slope of 1/8-inch per foot for 6-inch diameter service piping and ¼-inch per foot for 4-inch diameter service piping. No service connections shall be located in the sewer piping closer than 10 feet from the exterior wall of the manhole structure (Refer to paragraph C.1.a. Sewer service piping shall extend to and be stubbed out at the applicable right-of-way, easement, or property line (or as otherwise directed or approved by the City Engineer) using a wye fitted with a plug and cleanout. An “S” shall be cut in the curb at the location where the lateral crosses under the curb.

2. **SERVICE LATERAL ELEVATION CHANGES:** In locations where the sanitary sewer main is at such a depth that a service lateral riser pipe is required to place the service piping at an appropriate elevation, service line piping shall be installed by benching the service line trench floor and installing riser in a vertical position against undisturbed earth. A cleanout shall be installed at all vertical riser locations, and bends shall be used to connect the riser to the house service lines.

E. **CONNECTIONS**

1. **CONNECTIONS TO SERVICES**
   a) **SERVICE LATERALS:** The wye fitting connecting the service piping to the main shall be rotated so that the service line branch inclines upward at approximately 45 degrees above a horizontal line normal to main line piping. Service lines shall be laid on a straight line and grade from the service wye fitting to the applicable right-of-way, easement or property line (or as otherwise approved by the City Engineer). The service line piping must be located at a depth to receive wastewater from the lowest floor of the structure to be serviced, but in no event shall the service line piping invert be less than three and one-half feet (3-1/2 feet) below grade at the applicable right-of-way, easement or property line. All service piping is to be equipped with cleanouts.

   b) **CONNECTIONS TO EXISTING MANHOLES:** At locations where new sewer piping is to be connected to existing manholes, the Contractor may temporarily block and/or divert wastewater flows to facilitate construction operations. The connection work shall consist of making the opening in the manhole wall, inserting the new pipe to the elevation shown, filling the space in the wall around the pipe with non-shrink grout, and constructing and remodeling manhole inverts. High-early strength cement shall be used for mortar in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer. Any connection made to an existing sewer system shall be plugged until the City Engineer has authorized removal of plug so as to prevent inflow problems.

2. **CONNECTIONS TO EXISTING SEWERS:** At locations where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer and install a supporting timber beam with suitable straps around the pipe so as to bridge the excavation for the new manhole. The manhole shall then be constructed complete with invert and frame and cover. Under special conditions the Contractor may temporarily block and/or divert sewage
flows to facilitate construction operations. Actual physical connection of the sewers will be made at a later date, as directed.

a) If bypass pumping is required, an identical standby pump shall be onsite in the event of failure of the primary pump. If at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. Quiet pumps (below 70 dBA at 30 feet) shall be used between the hours of 8 pm and 6 am. The Contractor shall be responsible for any fines levied as a result of failure of bypass pumping system. The Contractor will be required to verify his method of handling sewer flows during construction by pumping at peak flows for 1 hour as approved by the Engineer. Bypass system shall be supervised 24 hours a day, 7 days a week or a float and monitor system installed for the duration of the bypass pumping event.

b) All services 6-inches and greater for hotels and restaurants shall tie directly to a manhole.

F. CLEANOUTS

1. GENERAL: Cleanout piping shall be constructed of Schedule 40 PVC pipe and be equipped with a threaded cap to facilitate access.

a) SPACING AND LOCATION: All sanitary sewer services are to have a cleanout installed at the applicable right-of-way, easement or property, or as otherwise approved by the City Engineer. Cleanouts along the service line piping shall be spaced in accordance with Section 708 of the current edition of the International Plumbing Code, but in no case more than 100 feet apart for the portion of the service piping to be maintained by the City.

b) CONSTRUCTION: A cleanout stack constructed of minimum 4-inch diameter piping shall be extended vertically from the wye and terminate with a threaded plug a minimum of 18” above finished lot grade for undeveloped properties and flush or slightly above the ground for developed properties. The cleanout is to be installed to facilitate cleaning in the direction of flow of the pipe (i.e., toward the direction of the main line piping).

2. STOPPERS, CAPS AND PLUGS: All service connections shall be closed or terminated with factory manufactured pipe stopper, cap or plug secured in such a manner as to not leak under a maximum hydrostatic head of ten feet (10’) or five (5) psi air pressure. Pipe stoppers, if used, shall be able to be removed without special tools, excessive force or breakage of the pipe bell.

G. CLEANING: The Contractor shall thoroughly clean all lines prior to placing the piping into operation, without discharging into the existing system.

1. All dirt and foreign material is to be cleaned from each joint of pipe or fitting before being lowered into the trench.

2. Temporary watertight plugs may be installed at any manhole that is incomplete, at the open end of the pipeline prior to leaving the job site daily, and elsewhere as dictated by good engineering and construction practices to prevent infiltration or the introduction of any foreign material into either
the existing or proposed sewer systems.

3. The Contractor will be responsible for the complete removal of all watertight plugs in the necessary sequence to allow testing and subsequent activation, all under the direction of the Engineer.

H. PROXIMITY TO WATER INFRASTRUCTURE

1. GENERAL: All installation practices shall be in accordance with Section R61-58.4D of the State Primary Drinking Water Regulations when installing sanitary sewer piping in the vicinity of a well, potable water main or other public water supply infrastructure.

2. PARALLEL INSTALLATION: Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sewer (gravity or force main). The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, any deviation shall be authorized by SCDHEC on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer. If these condition are not able to be met or an alternative design is not feasible, the sewer pipe shall be replaced and the water line laid such that the distances between joints of water and sewer pipe is maximized and the sewer pipe shall be replaced with ductile iron.

   a) There shall be no physical connection(s) between a public or private potable water supply system and a sanitary sewer collection system.

   b) Sanitary sewer service lateral piping shall be installed no closer than 10 feet as measured horizontally from water service piping.

3. CROSSINGS: Water mains crossing sewers shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.

4. SPECIAL CONDITIONS: When it is impossible to obtain the distances specified in R.61-58.4(D)(12)(a) and (b) SCDHEC may allow an alternative design. Any alternative design shall:

   a) Maximize the distances between the water main and sewer line and the joints of each;

   b) Use materials which meet the requirements R.61-58.4(D)(1) for the sewer line; and,
c) Allow enough distance to make repairs to one of the lines without damaging the other.

5. FORCE MAINS: There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen (18) inch vertical separation at crossing as required in R.61-58.4(D).

6. SEWER MANHOLES: No water pipe shall pass through or come in contact with any part of a sewer manhole.

I. PROTECTION OF OTHER UTILITIES AND STRUCTURES: Before beginning any excavation for installing sanitary sewer infrastructure, the contractor shall locate or cause to have located any water, sewer, gas or other utilities as necessary to avoid conflicts. The Contractor shall excavate and expose existing underground utilities in advance of trenching operations to determine the precise location of the utilities or other underground obstructions shown on the Construction Drawings. Such location and excavation shall be at least 500 feet ahead of the construction, unless otherwise noted. Conflicts with existing utilities shall be reported to the Engineer and conflicting utility’s owner for resolution. Changes to the alignment and or grade of the sanitary sewer piping shall be submitted to the City Engineer for review and approval.

1. All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. To aid in the location of existing utilities, Contractor shall contact the South Carolina 811 (SC 811) by telephone or posting a utility location request on the PUPS website. The following information is provided by the SC 811.

   a) “South Carolina State Law requires the excavator, when planning any activity that results in the movement or removal of earth, rock or other materials in or on the ground, to contact South Carolina 811 and any non-member company with adequate information regarding the excavation.

   b) At least 3 full working day notice at 11:59 pm (not including the day of the call) prior to digging, call SC 811 by dialing 811 or (888) 721-7877. A SC811 representative will record the location of the digging site and notify member companies of your intent to dig. Each member company will then send either one of their employees or a contract locator to your dig site to mark the location of their underground facility lines.

   c) Once the lines have been marked, you may begin carefully to dig, keeping in mind the 2 feet allowance on either side of the markings. [(a) if the diameter of the facility is known, the distance of one-half of the known diameter plus twenty-four inches on either side of the designated center line; (b) if the diameter of the facility is not marked, twenty-four inches on either side of the outside-edge of the mark indicating a facility; or (c) for subaqueous facilities, a clearance of fifteen feet on either side of the indicated facility]. Not all utilities are members with SC 811. If a utility is not named, please contact them directly.

   d) Remember: call 811, wait the required time, respect the marks and dig with care!”

2. Prior to final acceptance by the City of the sewer utility being constructed, the developer/owner shall be responsible for the integrity of the utility and for locating the utility until final acceptance by the City. Final acceptance shall include written documentation, permits to operate, copies of record drawings, and other requirements so listed by the City.
3. **Crossings:**
   
a) Whenever a sewer main crosses under other utility lines (gas, telephone conduit, storm drain, etc.), there shall be 2-feet clearance between the top of the sewer and the bottom of the affected utility. Stone bedding shall be used from 6-inches below the sewer to 12-inches above the sewer from one foot outside the utility trench. If this clearance is not possible, the sewer line shall be ductile iron pipe 1-foot outside the utility trench, with a minimum length of 10 feet.

b) Whenever a sewer main crosses over other utility lines (gas, telephone conduit, storm drain, etc.), there shall be one foot clearance from the top of the utility to the bottom of the sewer for PVC sewer lines. If this clearance is not possible, the sewer line shall be ductile iron pipe from 1-foot outside the utility trench, with a minimum length of 10 feet.

4. The Contractor shall be solely responsible for the repair and payment of penalties for any damage made to existing utilities as a result of the work.

J. **PRE-TREATMENT DEVICES:** Pre-treatment devices, such as grease traps/grease interceptors may be required as determined by the Building Code and/or Pre-treatment Coordinator (See Standard Details). Such devices shall meet the current Building Code as adopted by the City of Rock Hill, be sized accordingly, and must have the written approval of the Building Official and the Pre-treatment Coordinator. Grease traps/interceptors are required at establishments such as food service establishments (FSE) and convenience stores involved in food preparation activities. Grease traps/grease interceptors are not serviced or maintained by the City of Rock Hill. Questions regarding the use of grease traps/interceptors should be directed to the City’s Grease Management Program (GMP) official.

K. **SYSTEM TESTING**

1. **GENERAL:** All required testing of pipelines and valves shall be done under the direct supervision of the City Inspector and must be conducted in accordance with AWWA C600 and C605. Field testing shall not negate the requirements for material certifications as contained in these specifications unless otherwise directed by the Engineer. All testing and cleaning shall be completed prior to connection to any existing line. Contractor shall be responsible for providing all equipment, personnel, and ventilation necessary to comply with OSHA confined space regulations.

2. **TESTING AND CLEANING:** Before acceptance of any sewer or systems of sewers, lines shall be cleaned and tested in accordance with these Specifications. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection. Pipelines shall be straight and show a uniform grade between manholes. The Contractor shall be required to correct any variations that may be disclosed during the inspection.

3. **TEMPORARY BULKHEADS:** The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material. City Inspector shall be present during installation of bulkheads and during the removal of the bulkheads.

4. **INFILTRATION TEST:** Infiltration test is required when groundwater is above the top of pipe.
The infiltration shall not exceed 100 gallons per day per inch diameter per mile as measured for a reach of pipe the same diameter, up to one mile long. However, when excessive infiltration can be isolated to a particular section (manhole to manhole), the limit will be applied to that section. There shall be no visible points of infiltration. Any section (manhole to manhole) must be isolated and tested separately if so directed by the Engineer. Procedure for testing shall follow the procedure below.

a) Step 1: Plug upper section of line.

b) Step 2: Install suitable measuring device at lower end.

c) Step 3: Measure the amount of water flowing through the outlet over a specified period of time.

5. **LOW-PRESSURE AIR TEST:** All gravity sewer piping shall be air tested in accordance with applicable portions of ASTM C828, ASTM C924 and ASTM F1417 or it shall be hydrostatic tested in accordance with ASTM E1003. Test pressure will be measured by gauges furnished and installed by the Contractor aboveground at the manhole opposite the air supply. Contractor shall furnish all other test equipment required. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option sewers may be tested in lengths between manholes or in shorter sections using Air-Lock balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After the test pressure is achieved and stabilized (approximately 2 to 5 minutes), the pressure may be reduced to 3.5 psi before starting the tests. If a 1.0-psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs and retest the line. Minimum test time for various pipe sizes shall be in accordance with ASTM C828.

a) **EQUIPMENT:** Required test equipment includes Air-Lock bails, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of ± 2%.

b) **TEST RECORDS:** The Contractor shall keep records of all tests made. Copy of such records will be given to the City Engineer. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs are properly secured and that care is exercised in their removal. Every precaution shall be taken to avoid the possibility of over pressurizing the sewer line.

c) **REPAIRS:** All visible leaks shall be repaired regardless of whether air test is within allowable limits. No sewer will be accepted until leakage tests demonstrate compliance.

6. **MANHOLE LEAKAGE TESTS:** Manholes shall be tested by plugging the inlet and outlet pipes with airtight plugs and completing a vacuum air test. Manhole vacuum air testing shall be performed in accordance with ASTM C1244. The Engineer will select 25% of the manholes on the project to be tested. Manholes that fail the test shall be repaired as specified and retested until they pass. Manholes that show leaks and are repaired prior to testing shall be tested as specified.

7. **FORCE MAIN SEWER PIPE LEAKAGE TEST:** Pressure and leakage test must be conducted
in accordance with AWWA C600 for ductile iron material and AWWA C605 for PVC material. On completion of the line or sections of the lines, connection and appurtenances, the line shall be filled and hydrostatically tested. All leaks and any defective material shall be repaired or replaced to the satisfaction of the Engineer and the test repeated until the requirements of this specification are met. Any special equipment, pumps, etc., required to make the test shall be furnished and operated by the Contractor. The Contractor shall use great care to remove all air from each section under test. If openings are not available for the purpose of expelling air, the Contractor shall provide air release of sufficient size (as determined by the Engineer) in accordance with the Standard Details, at his expense.

a) The maximum length of pipe tested in one test shall be 5,000 feet, or as close to 5,000 feet as possible depending on valve spacing.

b) Test pressure shall be 1.5 times the maximum working pressure in the system (i.e. 120 psig) and 120 psig minimum as measured at the lowest point of elevation of the section of line being tested. Testing time shall be a minimum of two (2) hours. Leakage shall not exceed the allowable leakage shown in AWWA C600 and C605 or calculated by the formula:

For Ductile Iron Pipe:

\[ G = \frac{(S \times D \times (P^{1.5})}{148,000} \]

Where:
- \( L \) = allowable leakage, in gallons per hour
- \( S \) = length of pipe tested, in feet
- \( D \) = nominal diameter of pipe, in inches
- \( P \) = average test pressure (psig) = 150 psig

For PVC Pipe:

\[ L = \frac{(N \times D \times (P^{1/2})}{7,400} \]

Where:
- \( L \) = allowable leakage, in gallons per hour
- \( N \) = # of joints of pipeline being tested
- \( D \) = nominal diameter of pipe, in inches
- \( P \) = average test pressure (psig) = 150 psig

Note: Add 0.0043 gph for each ¾-inch service and 0.0057 gph for each 1-inch service.

All visible leaks shall be repaired regardless of the amount of leakage, and test will be repeated until it passes.

8. **Deflection Tests and Inspections:** After backfilling trenches, all sewer pipes may be flashed and visually inspected for pipe alignment. Pipelines shall be straight and show uniform grade between manholes. Each run of pipe must present a full circle when viewed from one of the connected manholes. Any run of pipe that does not present a full circle indicates a deficiency in the alignment or failure of the pipe, and it shall be the responsibility of the contractor to correct the installation prior to placing the pipe in operation.

a) The Contractor must perform a Mandrel test on PVC main sewer line piping (excludes laterals) to test deflection a minimum of 30 days after the installation of the line has been completed. The initial diametric deflection shall not exceed five percent (5%) of the
base inside diameter as defined in ASTM D3034. Deflection test will be performed after the
trench is no longer subject to construction traffic loading. The mandrel shall be provided by
the Contractor and pulled through each section of pipe from manhole to manhole. The
mandrel must slide freely through with only a nominal hand force applied. Any pipe that
refuses the mandrel shall be removed and replaced. Such section shall be retested for
defection and infiltration after completion of backfill.

L. GENERAL CONSTRUCTION

1. CLEARING & GRUBBING: The Contractor shall perform all clearing necessary for
installation of the complete work. Clearing shall consist of removing all trees, stumps, roots, brush
and debris in the way of the work. Temporary Construction easements shall be selectively cleared
with specimen trees left standing.

2. DISPOSAL: All excess and waste material shall be legally disposed in a satisfactory
manner. Burning shall be in accordance with City Fire Department regulations and SCDHEC
Regulations. When burning is allowed, the Contractor shall obtain a Burning Permit from the
office of the City Fire Chief prior to any burning operations.

3. REMOVAL OF PRIVATE OR PUBLIC FACILITIES: Any private or public facilities, including
fences, mailboxes, etc., removed for construction purposes shall be promptly replaced of the same
material in the same or better condition than prior to construction. Trees or shrubbery along
highways, roadways and streets shall not be disturbed unless absolutely necessary. Tree removal
is subject to the approval of the City Engineer. Planting such trees or shrubs that are to be removed
and replaced may be heeled in and replanted. Heeling and replanting shall be done under the
direction of an experienced nurseryman and City Forester.

M. CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

1. GENERAL: The Contractor shall install pipelines and appurtenances along publicly owned
and maintained highways, streets and roadways in accordance with all applicable encroachment
permits and City and SCDOT regulations, with reference to construction operations and requirements,
safety, traffic control, road maintenance, and repair.

2. PROTECTION OF TRAFFIC: The Contractor shall provide suitable signs, barricades and lights
for protection of traffic, in locations where traffic may be endangered by construction operations. All
highway signs removed by reason of construction shall be replaced as soon as the conditions that
necessitated such removal have been cleared. No highways, streets or roadways shall be closed
without first obtaining permission from the proper authorities. Before any roadway is blocked, the
Contractor shall notify the City Engineer’s office.

3. CLOSURES: In general, not more than one block of a street or roadway shall be closed for
construction at any one time. Before proceeding with trenching operations in a succeeding block, the
preceding section shall be backfilled, cleaned completely and the street opened to traffic. All planned
road closures shall be reported in accordance with these specifications prior to closing any street, or
for unplanned roadway closings, as soon as possible after the roadway has been closed.

4. MAINTAINING HIGHWAYS, STREETS, ROADWAYS, AND DRIVEWAYS: The Contractor
shall furnish adequate personnel and proper construction equipment, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work. For temporary drive closures, the contractor is to coordinate the closure(s) with applicable property owner(s). The Contractor shall immediately repair all driveways that are cut or damaged and shall maintain them in a suitable condition for use until completion and final acceptance of the work.

5. CONSTRUCTION OPERATIONS: The Contractor shall construct all work along roadways using the sequence of construction operations, as to least interfere with traffic.

6. REMOVING PAVEMENT: The Contractor shall remove pavement as necessary for installing the new piping and appurtenances and for making connections to existing pipelines. Care shall be taken by the contractor to avoid damage to pavement adjoining pavement removal areas. If damaged, the Contractor shall remove the damaged pavement and shall replace it with new pavement at his own expense.

   a) There may be instances where the City requests additional pavement removal and repair based on the condition of the road. In these areas, the City will contract with and negotiate the price with the Contractor for the damaged pavement removal and associated repair work to be completed. Should a portion of this work be completed by City forces, the contractor shall work with the City in coordinating the work as the applicable Encroachment Permit allows.

7. MARKING AND CUTTING: Before removing any pavement, the pavement shall be marked for cuts neatly paralleling pipelines and existing street lines taking into consideration existing pavement conditions. Pavement shall be saw-cut prior to removal to form a clean transition edge. Asphalt pavement shall be broken along the marked cuts by use of a jackhammer or other suitable tool. Concrete pavement and asphalt pavement on concrete base shall be scored to a depth of approximately 2” below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring by use of a jackhammer or other suitable tool.

8. STRIPPING: Where the pipeline is laid along road shoulders, all sod, topsoil and other materials suitable for shoulder restoration shall be stripped and stockpiled for replacement.

9. EXCAVATED MATERIAL: Excavated material shall not be placed along highways, streets and roadways in such a manner as to obstruct traffic. No scattered excavated material shall be allowed to remain on the pavement. All such material shall be kept swept away.

10. PAVERS OR CURB: The Contractor shall remove and replace or tunnel or bore under any paver areas or concrete/stone curb encountered along the project route. In any case, protection of the pavers’ and curb and gutter’s supporting foundation is the responsibility of the Contractor.

11. MACHINE PULLING: No pavement shall be machine pulled until completely broken and separated along the marked cuts.

12. DRAINAGE STRUCTURES: All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.
N. EARTHWORK

1. **GENERAL**: The Contractor shall excavate, install piping and backfill and consolidate the trench backfill as quickly as possible to maintain safety within the construction site. Trenches shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations, and trenches shall be progressively backfilled and consolidated, and excess material removed immediately behind laying operations. Backfill material and material consolidation shall meet SCDOT specifications, but in no case shall the consolidation be less than 95% maximum dry density for each layer of soil material-in-place as determined by ASTM D698 (Standard Proctor) test procedures. The Contractor shall so organize his work that backfilling and cleanup shall closely follow pipe laying operations and manhole construction.

   a) Excavations within street rights-of-way shall be backfilled when left unattended for more than 1 hour, unless otherwise approve by the controlling agency.

   b) Excavations within sewer rights-of-way/easements shall be backfilled, fenced, or otherwise protected when left unattended for more than 1 hour.

   c) Final grades of sewer rights-of-way/easements shall be smooth and at such grade that they can be navigated by vehicles and maintenance equipment. Horizontal and vertical grades of rights-of-way/easements shall be gentle and not exceed roadway standards.

2. **TRENCH EXCAVATION**: Trench excavation shall include the removal of material necessary for the installation of the piping infrastructure and associated fittings and structures. Excavated materials that are not suitable for backfill material shall be removed from and legally disposed offsite.

   a) **DEPTH OF TRENCHES**: The minimum cover over the top of the pipe shall be 3 feet, unless otherwise directed by the City Engineer and/or shown on approved Construction Drawings. Where obstructions are encountered, minimum depth may be changed to avoid interference. Where necessary to increase the depth of cover to avoid interference with underground utilities, obstructions and utilities services, the Contractor shall furnish all construction equipment and shall perform all labor required for additional trench depth.

   b) **LENGTH OF OPEN TRENCH**: A maximum trench of +100 LF shall be open in advance of the pipe laying than is necessary to expedite the work, unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

   c) **WIDTH OF TRENCHES**: Trenches shall be excavated sufficiently wider than the infrastructure to be installed to allow for personnel and the preparation of the infrastructure foundation, installation of infrastructure and associated bedding, and to properly consolidate the backfill material including the pipe support bedding located under the pipe’s haunches. In any case, the width of the trench is not to be narrower than 24 inches plus the outside diameter of the pipe.

3. **GENERAL EXCAVATION**
Section III – Construction Specifications

City of Rock Hill Wastewater Specifications

a) **BELL HOLES:** The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular (as applicable) support for its full length. If stone bedding of sufficient depth is not provided, the Contractor shall over-excavate the locations where the pipe bells rest so the entire length of the pipe will be uniformly supported.

b) **EARTH EXCAVATION:** Earth excavation shall include all excavation of whatever substance encountered, except rock excavation, as further provided in these specifications. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer, and the excavation shall be made to the lines, grades and elevations shown on the Construction Drawings. In locations where pipe is to be bedded in earth excavated trenches and no stone is used for bedding the pipe, the bottoms of such trenches shall be fine graded to allow for a firm and uniform bearing for the bottom of the pipe. Where any part of the trench has been excavated below the engineered grade for the pipe, the part excavated below such grade shall be backfilled with sand and compacted at the Contractor’s expense.

c) **BORE PITS:** Bore pit excavations shall be controlled by the limits of the existing rights-of-way and shall not exceed these without prior written approval of the property owner. The excavation shall be made to the proper elevation, line and grade as required to install the casing pipe as shown on the Construction Drawings. The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore.

d) **ROCK EXCAVATION IN TRENCHES AND PITS** includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42 inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rates as not less than 90 HP flywheel power and 30,000 lb drawbar pull. Rock excavation shall comprise solid rock in the original bed, or in well-defined ledges, the removal of which in the opinion of the City Engineer requires drilling, blasting, or the use of jackhammers or bull-points, and shall also include boulders or detached pieces of rock 8 cubic feet or more in content. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavations. Rock removal shall extend to be a minimum of 6 inches vertically and 12 inches horizontally from the piping to be installed.

4. **MATERIALS:**
   a) Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, GC, SC, CL, ML and SP.
   
   b) Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups MH, CH, OL, OH, and PT.

5. **SHORING AND BRACING:** All shoring and bracing shall conform to all OSHA regulations. The specific type of shoring and bracing used shall be determined by the Contractor as to prevent caving of trench banks and to provide safe excavation.

6. **DEWATERING:** The Contractor shall at all times provide and maintain ample means and
equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the work, and keep all excavation dry until such time as pipe laying and grading is completed and structures to be build therein are completed.

a) No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the Work shall be disposed in such a manner as to prevent siltation and erosion to adjacent property or other construction.

7. BACKFILL: All backfill shall be of non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than ¾ cubic foot, or other objectionable material. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. Material deemed by Engineer to be unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin and replaced with satisfactory soil materials as approved by the Engineer or directed by the permitting agency.

a) Continuous and uniform bedding shall be provided in the trench for all buried pipe. Backfill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe. Stones, other than crushed bedding, shall not come in contact with the pipes and shall not be within 6-inches of the pipe.

8. COMPACTION CONSOLIDATION REQUIREMENTS: Compaction of the trench backfill is to conform to the more stringent requirements of the permit issuing authority and requirements herein. Contractor shall be responsible for testing the material for adequate compaction. Compaction shall be in accordance with the Standard Detail as determined by ASTM D698 (Standard Proctor) test procedures.

9. CRUSHED STONE STABILIZATION AND BEDDING: Crushed stone bedding material shall conform to ASTM C33, as amended to date, graduation #67 (ASTM #67), varying in sizes 1/4” through 3/4”. Stabilization and bedding material shall be placed in the trench and thoroughly compacted to grade by tamping. Compacted bedding material shall be carried up the sides of the pipe to the heights shown on the Construction Drawings.

a) Wherever the sub grade is by nature too soft or mucky, in the opinion of the City Engineer, for the proper installation of the pipe, the Contractor may be ordered to undercut the trench and backfill with crushed stone or gravel.

b) Crushed stone bedding material shall conform ASTM C33, graduation #67 (ASTM #67), varying in sizes ¼” through ¾”. Bedding material shall be placed in the trench and thoroughly compacted by tamping to the grade required for the particular location. Compacted bedding material shall be carried up the sides of the pipe to the heights necessary for the various classes of bedding.

10. SHAPING: Once backfilling operations are complete, the Contractor shall immediately reshape the roadway shoulder area including any damaged cut and fill slopes and ditches, and he shall replace topsoil, sod and any other materials removed from shoulders. When installing pipelines and appurtenances, the Contractor will be required to provide sufficient personnel and equipment so as to simultaneously carry out all of the above operations in an appropriate timeframe.
O. MANHOLE CONSTRUCTION

1. GENERAL: For sewer manholes being installed in developed areas, the sewer manhole ring and covers (castings) are to be installed at an elevation at or slightly above the surrounding finished grade. Manholes within street rights-of-way or landscaped areas of a development shall have finished rim elevations flush with the pavement or adjacent finished grade. Frame and covers of manholes within streets shall be located outside the wheel travel paths. All manholes outside street rights-of-way in landscaped areas of a development shall be constructed to a height of 2 feet above the finished grade, unless otherwise indicated on the Construction Drawings. In undeveloped areas and cross-country sewer installations, the manhole ring and covers (castings) shall be installed at an elevation a minimum of 3 feet and a maximum of 4 feet above finished grade. In flood plain areas manhole rims shall be 1-foot above the 100-year flood elevation or vented.

   a) The Contractor will do that which is necessary to stabilize the soil intended to support the structure. A stable condition shall only be judged only by the Engineer or his authorized representative. Under no circumstances will a precast base section be placed on unstable soil. Any cost incurred by the Contractor in stabilizing the area to support a manhole shall be considered incidental to the manhole construction.

   b) Joining of precast sections will be done in accordance with the manufacturer’s recommendation, with special attention called to the amount of force needed.

   c) All backfill around structures shall be thoroughly tamped in layers a specified for placing backfill.

2. OUTSIDE DROPS: When design considerations dictate a large elevation change across a manhole, an outside drop shall be constructed in accordance with the Standard Details. Depending on the particular fittings used, elevation differences greater than 24 inches are required to accommodate an outside drop. Where there is not sufficient elevation difference to permit construction of an outside drop, the grade of the influent pipe shall be lowered such that the vertical separation of the influent and effluent pipe is 0.2 feet, as measured at the center to the manhole when the grades of both pipes are projected to that point. Outside drops shall not enter the cone section of precast manholes. The influent pipe of an outside drop manhole must be ductile iron pipe, a minimum of 18-feet long.

3. INSIDE DROPS: When connecting a proposed sewer main to an existing manhole at an elevation significantly higher than the existing invert elevation, and where safety consideration or working space limitations preclude building an outside drop, the connection may be made with an inside drop constructed in conformance with the Standard Details. Inside drops will be used only with the approval of the City Engineer and where shown on the Construction Drawings or specifically approved by the Engineer. They may not be used in lieu of outside drops shown on the Construction Drawings. Inside drops shall not enter the manhole in the cone section. Inside drops are not allowed on four-foot diameter manholes.

4. FRAMES AND COVERS: The frame shall be installed on the manhole with anchor bolts on all manholes that are not flush with the ground. The Contractor shall seal the frame to the manhole by installing a length of butyl rubber joint sealant to form a gasket between the frame and the manhole. The butyl rubber joint sealant shall have a one-inch cross-section, shall make two full circles when placed on the cone section, and shall be compressed by the frame with the anchor bolts. Butyl
rubber joint sealant shall be “Rubber Seal as manufactured by Ru Van, Inc. or approved equal. Cement mortar grouting of the frame shall be required. Brick may not be used to adjust rim elevations of above-grade manholes.

a) Manholes that are installed flush with pavement or grade shall have frames attached to the manhole with a bed of cement mortar grout. Standard-size brick shall be used to adjust the finished rim elevation of such manholes.

b) When the manhole rim elevations are greater than the finished grade and in flood plain or flood prone areas, bolt-down type, waterproof manhole covers shall be used.

5. **STEEL VENT PIPES:** Steel vent pipes shall be installed at appropriate locations to facilitate drawing and venting of the piping system, but should be located away from planned vertical (building) construction. Steel vent pipe shall be installed in accordance with the Standard Details. Shop drawings of strap on vents, mounting straps, and other anchor bolts will be subject to approval of the Engineer. Material shall be a specified in the Materials Specification section.

**P. CONCRETE CONSTRUCTION**

1. **PLACING OF CONCRETE:** Placing of concrete shall be in daylight hours. Concrete mixed at a central plant shall be transported to the job site as per ASTM C94 and placed within 90 minutes of the dispatch time. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to re-handling or flowing. Free fall shall not exceed 3-feet. Concrete when placed shall be compacted with mechanical, internal-vibrating equipment and/or with hand spading with a slicing rod. Temperature shall be above 35 degrees Fahrenheit and rising by 10:00 AM for the placement of concrete. Depositing shall cease when the descending air temperature in the shade falls below 40 degrees Fahrenheit. If the temperature drops below 35 degrees after concrete is placed the Contractor shall enclose, heat and protect the concrete or Contractor shall replace the concrete at his own expense. Earth fill shall not be placed on concrete until concrete has been allowed to set for 24 hours. Exposed concrete shall have ¾” chamfered corners.

2. **FORMWORK:** Formwork, where required, shall be built to conform to the shape, lines and dimensions of the concrete work as shown. Forms may be made of wood, plywood, metal or any other material approved by the Engineer. Forms shall be mortar tight, of materials strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Construction Drawings. The design of the forms shall take into account the effect of the vibration of the concrete as it is placed and also the rate of speed at which the forms will be filled.

a) Mechanical vibrators of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense, and impervious artificial stone of uniform texture.

3. **SETTING FORMS:** Forms shall be set to line and grade, and shall be braced, tied, and secured in a manner which will withstand placing of the concrete, and which will maintain shape and position'. Forms shall be tight, and be substantially assembled to prevent bulging and the leaking of concrete. Joints shall be arranged vertically or horizontally. Temporary openings shall be arranged, where required, at the bottoms of wall forms and elsewhere, to facilitate cleaning and inspecting. Lumber
used once in forms shall have nails removed and surfaces in contact with concrete work thoroughly cleaned before reuse. Wall sleeves, inserts, and openings required in concrete work shall be properly set in formwork. Chamfer strips shall be placed in forms for all exterior corners.

4. **CURING:** All concrete will be cured after placement according to the following procedures.
   a) Forms will normally be left in place for the entire curing period. Exposed surfaces not covered by forms will be kept moist continuously for the entire seven day period or will be cured through use of an approved curing compound which will be applied after all surface water has disappeared.
   b) All form marks exposed to view shall be rubbed off with a stone.

5. **REMOVING FORMS:** Under normal conditions, the time elapsing before the forms may be stripped shall not be less than the following:
   a) Slabs 14 days
   b) Piers 7 days
   c) Walls 2 days

6. **FINISHING:** All exposed concrete work shall be kept wetted with water, and shall be rubbed with a carborundum stone of medium fineness, or other equally as good abrasive, to bring the surface to a smooth texture and to remove all form and other marks. The paste formed by the rubbing may be rubbed down by floating with a canvas, carpet-faced, or cork float, or may be rubbed down with dry burlap.

7. **TESTING:** The following test may be performed by the City to ensure the concrete quality.
   a) Compressive Strength – Compressive strength testing shall be conducted in accordance with ASTM C31 and ASTM C39. Test cylinders which are formed in the field will be left in the field until compression testing is completed.
   b) Slump – Slump testing shall be in accordance with ASTM C143.
   c) Air Content Test – The test for air content in the mixture will be in accordance with either ASTM C173 or ASTM C231.

8. **ACCEPTANCE:** Concrete shall be accepted on the basis of its meeting the requirements listed under the Material Specifications and Detail specification Section of this contract. The Inspector will accept no ready mix concrete without the plant dispatch ticket.
   a) The Engineer shall require any test as he deems necessary to insure that the concrete meets specifications. The Engineer may require the test to be performed by an independent testing laboratory at the Contractor’s expense.
   b) Segregated concrete and/or concrete containing foreign material will not be accepted.
9. **BLOCKING INSTALLATION**: Concrete blocking shall be formed and poured at the backs of fittings, including elbows, tees, and other fittings to the dimensions shown on approved detailed Construction Drawings. Unless otherwise noted, concrete shall be 3,000 psi with a four-inch (4") slump. Blocking shall be poured against undisturbed earth. If existing soil conditions will not support concrete blocking, it is the Engineer’s responsibility to recommend proper restraining devices in order to prevent movement of the pipe. Concrete of the respective classes for thrust blocking, bedding, blocking, headwalls, piers and other miscellaneous structures shall be as called for in the work to which they pertain.

Q. **BORES, TUNNELS, AND CASINGS**

1. **BORE PITS (OR TUNNEL PITS)**: Bore or tunnel pits shall be safed-up, shore, well-marked, lighted, and not left unattended except as approved by the controlling agency. Requirements of stabilization and dewatering of bore pits shall be as herein before specified. The angle of repose method (sloping pit walls) for creating a safe working area shall not be used.

2. **SIZING**: Carrier pipe shall be DIP. Casing is to extend beyond the edge of pavement or control structure at least as far out as it is deep and a clearance of 25 feet beyond the casing shall be granted for future removal of the carrier pipe. Spiders shall be used on all gravity sewer lines installed within steel casing when the clearance between the bell of the carrier pipe and the top of the steel casing exceeds the allowable deflection of the carrier pipe. The minimum size and thickness standards for casing pipe and tunnels for various sewer line sizes and types are as follows:

<table>
<thead>
<tr>
<th>Carrier Pipe (inch diameter)</th>
<th>Casing Pipe (inches)</th>
<th>Thickness (inches)</th>
<th>Recommended * Tunnel (inches min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8” DIP</td>
<td>18”</td>
<td>0.250”</td>
<td>48”</td>
</tr>
<tr>
<td>10” DIP</td>
<td>20”</td>
<td>0.250”</td>
<td>48”</td>
</tr>
<tr>
<td>12” DIP</td>
<td>24”</td>
<td>0.250”</td>
<td>48”</td>
</tr>
<tr>
<td>16” DIP</td>
<td>30”</td>
<td>0.312”</td>
<td>48”</td>
</tr>
<tr>
<td>18” DIP</td>
<td>30”</td>
<td>0.312”</td>
<td>48”</td>
</tr>
<tr>
<td>24” DIP</td>
<td>36”</td>
<td>0.375”</td>
<td>48”</td>
</tr>
<tr>
<td>30” DIP</td>
<td>48”</td>
<td>0.500”</td>
<td>60”</td>
</tr>
</tbody>
</table>

- Gauge to be determined by controlling agency and/or by depth of installation

3. **INSTALLATION**: Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as soil is mucked by the auger back through the pipe. As dry boring operation progresses, each new section of encasement pipe shall be butt welded to the section previously jacked into place. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement, as well as the tracks (rails) upon which the boring rig travels.

   a) Installation shall be such to prevent the formation of a waterway under the road or rail bed. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with 1:3 Portland cement grout at sufficient pressure to prevent settlement in the roadway/railway.

   b) Boring operations shall be continuous to their completion, and unnecessary or
prolonged stoppages shall not be allowed.

c) In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland cement grout at sufficient pressure to fill all voids before reapplying to the controlling agency for permission to open cut, bore at an alternative location, or install a tunnel.

d) Installation shall be to the limits specified by the controlling agency and/or as delineated in their encroachment permit issued. The controlling agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the controlling agencies reserve the right to sample, test, and approve all materials and methods used.

e) The Contractor shall notify the controlling agency through the Engineer and an acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within the roadway or railway rights-of-way. If required, 24-hour notice will be given prior to completion.

4. GUARANTEED CASING INSTALLATION: The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the excavated hole shall be no larger than necessary to keep the casing moving freely and lubricant may be used to reduce the jacking forces. Casing sections shall be joined by butt weld.

a) After casing is jacked in place, 20-inch grout holes shall be used to pump a 1:3 Portland cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out the adjacent grout hole. Grout holes shall be a maximum of 10 feet apart at the top of the casing.

5. TUNNELS USING STEEL LINER PLATES: All structural steel liner plates for tunnels shall be formed to provide circumferential-flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both the longitudinal and circumferential seams or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer’s standard spacing and shall be multiples of the plate length so that plates having the same curvature shall be interchangeable to permit staggering of the longitudinal seam. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer’s standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer’s standard, but not less than that required to meet the longitudinal seam strength requirements of the design specifications. All liner plates for the full length of a specified tunnel shall be either the flange or the lapped seam type. The two types shall not be mixed in the same tunnel.

a) Liner plates shall be assembled in accordance with the manufacturer’s instructions. Galvanized and coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during the handling or placing shall be replaced, except that small areas with minor damage may be repaired to the satisfaction of the Engineer or his representative.

b) Galvanized surfaces shall be repaired by thoroughly wire brushing the damaged
areas and removed all loose, cracked coating, after which the cleaned areas shall be painted with two (2) coats of zinc rich paint as approved and an acceptable bituminous coating restored.

c) When tunneling has proceeded in a distance sufficient for placing one section of the tunnel liner, that section of liner will be placed before excavating further. Excavation shall be controlled so that the space outside the liner plate shall be held to a minimum. All voids between the liner plate and tunnel wall shall be filled with 1:3 Portland cement grout, containing no more water than necessary, placed under sufficient pressure to fill all voids. Grout shall be placed through the grout holes provided in the top of the tunnel liner plates. Grout holes 2” in diameter shall be provided at no more that 4.5-foot center or every third ring of plates to permit grouting as the erection of the tunnel liner progresses. At no time will the grouting operations be further than 10 feet from the front end or head of the tunnel construction.

d) At the end of each day’s operations, the voids outside installed liner plates shall be grouted whether 10-feet or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plates so as to plug the next holed, the plug shall be opened by punching through the grout so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

e) The tunnel shall be constructed to the limits, grade and alignment shown on the Construction Drawings. Excavation, without the use of jetting, shall be done in such a manner as to protect public and/or private property from damage. Prior to beginning any construction, the Contractor shall submit pit shoring and tunnel liner details for approval and no tunneling may begin prior to approval of these details by the appropriate controlling agency. After approval of tunnel liner and pit shoring details, a five (5) day notice to the Controlling Agency, through the Engineer shall be provided as previously specified.

f) No blasting will be done without prior written approval of the controlling agency and then only in strict accordance with all Federal, State, and Local laws, ordinances, rules or regulations governing the storage and use of explosives. Where blasting is required, only small controlled charges or 40% dynamite or plastic explosives shall be used. The depths of the holes for these charges shall not exceed the depth necessary to clear an area sufficient to place one section of tunnel liner.

g) The charges for the initial series of blasts should be placed in the triangle method. The second series should be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off following a short interval or using the time-lag method.

h) Where rock is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used before beginning any blasting beneath the railway or shoulders or pavement of the highway as applicable. If rock is encountered after tunneling progresses beneath the pavement or railway, charges will initially be set at very low levels and increased in small increments until the proper amount of charged is determined. In no case will an overshoot be permitted. If a boulder is encountered and removed by blasting or by other methods, a bulkhead will be formed immediately after removal of the boulder and the area filled with
grout before proceeding with the tunneling operations.

i) If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway or railway fill, all operations shall be stopped and the controlling agency notified immediately. If the vertical split is not determined to be out too great a magnitude or too close to the rails/pavement, the split shall be filled with grout at a pressure specified by the controlling agency, allowed to set and tunneling operations may be continued.

j) If it is determined that the vertical split is too great of a magnitude or too close to the pavement or railway, the Controlling Agency shall determine the method to be used to correct the split. If settlement of the roadway or railway occurs, the Controlling Agency will advise the Owner and his Contractor of the proper steps to be taken to correct the settlement. If deemed necessary by the Controlling Agency, adequate warning devices (signs, flasher, etc.) accompanied by responsible flagmen shall be placed at a distance allowing any and all traffic time to stop safely before reaching the questionable area. At the option of the Controlling Agency, it may provide the necessary flagmen, warning devices, etc., at the Contractor’s expense. Traffic shall be allowed over the questionable area, only as directed by the Controlling Agency.

k) The completed liner shall consist of a series of structural steel liner plates assembled with staggered longitudinal joints. Liner plates shall have been fabricated to fit the cross-section of the tunnel. All plates shall be connected by bolts on both longitudinal and circumferential seams or joints.

l) After tunneling operations have been completed, the Contractor will install the carrier pipe in a manner approved by the Engineer. Concrete fill (1:3 Portland Cement grout) will then be placed after completing installation of the sewer pipe within the tunnel liner as directed by the Engineer and end enclosure walls installed as shown on the Construction Drawings or Standard Details. Ends of the tunnel liner will be sealed with an 8-inch masonry wall on the lower end and a 12-inch masonry wall on the higher end. Weep holes will be provided on the downstream end for drainage.

6. **FINISH WORK:** Once the Contractor has installed the carrier pipe, complete and in-place, the Contractor shall then remove the vertical shoring for pits (if ground conditions allow), surplus spoils, and material from the site. The site shall then be returned to its original condition, seeded, mulched, or restored as specified and left in a neat and satisfactory condition. Shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with these Specifications or the requirements of the Controlling Agency.

R. **BLASTING:** The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (SCDOT, railroad, gas, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

1. Prior to commencing any blasting operations, the Contractor shall notify either the City Fire Department – Fire Prevention Section or the County Fire Administrator as applicable, and obtain blasting permits as required. The Contractor must furnish Certification of Insurance specifically covering any and all obligations assumed pursuant to the use of explosives. All blasting supplies shall be stored in a place and manner approved by the City, State Fire Marshal and other entities having jurisdiction over blasting operations. All blasting supplies shall be stored in a place and manner
approved by the City. In no case shall blasting caps or other igniters or exploders be kept in the vicinity of dynamite or where other explosives are stored.

2. Blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the Work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, sober, and experience personnel whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 – Blaster Qualifications.

3. All rock, dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor’s blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using. Charges shall be sized such that no damage to houses, structures, roadways, etc., outside the limits of excavation will occur. Where there is a possibility of such damage, the charge will initially be set at a very low level and increased in small increments until the proper charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property. No blasting will be permitted adjacent to existing buildings and structures. Rock at those locations shall be removed with jackhammers and bull-points. A seismic survey and/or pre-blast surveymay be required.

S. EROSION AND SEDIMENT CONTROL:

1. GENERAL: Erosion and sediment control shall be conducted in accordance with the applicable Erosion and Sediment Control and or NPDES permit. It is the Contractor’s responsibility for controlling soil erosion and sediment runoff. The Contractor is to utilize mulches, mattings and or other fabrics, silt fences and other filters, grasses, slope drains, and other erosion control devices as necessary to control erosion and sediment runoff. Erosion control may include temporary work that must be removed upon achieving construction site surface stabilization.

2. TEMPORARY EROSION CONTROL: Temporary erosion control shall consist of planting temporary grass of a quick growing species such as millet, rye grass, or cereal grasses suitable to the area or other approved temporary means. When used, seed, fertilizer, mulch and periodic watering shall be applied in adequate quantities to assure a full, healthy ground cover over the entire disturbed area of construction operations. All materials shall be of first class quality and subject to approval by the governing erosion control authority. All disturbed areas along the pipeline, with exception to a construction access or haul road, shall be grassed as soon as possible after backfilling operations have been completed.

3. CONSTRUCTION IN STREAMS AND IMPOUNDMENTS: Unless otherwise approved by the City Engineer, construction operations in streams and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. As soon as conditions permit, streams and impoundments shall be promptly cleared of all falsework, piling which are to be removed, debris and other obstructions placed therein or caused by the construction operations. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved by the City Engineer, mechanized equipment shall not be operated in live streams except as may be required to construct channel
changes and temporary or permanent structures, and to remove temporary structures.

4. **CONSTRUCTION IN EASEMENTS:** Erosion control measures shall be constructed such that they do not discharge onto water or sewer easements, but to the opposite sides of such easements to prevent future erosion of the easement.

5. **LIMIT OF PROGRESS:** The Engineer will limit the area of excavation commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such pollution control measures current in accordance with an accepted schedule. Should seasonal limitations make such coordination unrealistic, special erosion control measures shall be taken immediately to the extent feasible and justified.

6. **SURFACE STABILIZATION – PERMANENT GROUND COVER:** Upon construction completion and upon achieving construction site surface stabilization, the Contractor is to establish a permanent ground cover over any remaining denuded areas, and the Contractor shall remove all temporary erosion and sediment control measures upon achieving a permanent ground cover or satisfactory surface stabilization.

7. **RIGHT TO CORRECT:** In the case of failure on the part of the Contractor to adequately control erosion, pollution, and/or Siltation, the City reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Such incurred direct costs will be charged to the Contractor.

**T. RESTORATION OF DISTURBED AREAS**

1. **GENERAL:** All surfaces (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction, or as specified by the Engineer. All surplus materials shall be disposed in a manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean-up. No machinery or equipment shall be left or stored on the job site after the project is complete.

2. **STABILIZATION:** Unless otherwise specified, complete restoration is to include fertilizing, seeding, and mulching any and all areas disturbed during the construction within 30 working days following the initial ground disturbing activity.

3. **APPURTENANCES:** Manholes, valve boxes, drain pipes, and other structures encountered shall be reset or re-laid to match or clear surface grade and/or sewer pipe grade as applicable.

4. **REFUSE BURIAL:** Timber, rock and other refuse may not be buried within the permanent sewer rights-of-way with the exception of rock smaller than ¾ cubic foot.

5. **RIP-RAP:** The Contractor shall place stone rip-rap as specified in those areas subject to severe water action, where directed by the Engineer. Placement of rip-rap as shown on the Construction Drawings shall be considered as a guide only, with final determination made at the time of construction by the Engineer.

   a) Stone rip-rap will be placed as indicated on the Standard Details immediately
following pipe installation and will be installed no steeper than a 2:1 slope, except when specifically approved by the engineer. Grading will be required as necessary to insure continuous even flow.

b) In locations where a creek bank is eroded near the sewer line, the Contractor will be required to place compacted fill material along the creek bank in order to maintain 3-feet of cover over the sewer line in all directions. This is to be done before the rip-rap is placed.

c) The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the sewer line.

6. **JUTE NETTING/EROSION BLANKET:** The Contractor shall install jute netting or erosion control blank in areas subject to high runoff velocities, areas subject to concentrated runoff, and on steep slopes as shown on the Construction Drawings or directed by the Engineer.

U. **RESTORATION OF EXISTING PAVED SURFACES:**

1. **GENERAL:** All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the City of Rock Hill Public Works Department or the South Carolina Department of Transportation, whichever applies.

   a) All restored bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable, unless approved by the Engineer. When pavement repairs do not meet the above criteria or are not permitted in a workmanship manner as determined by the Engineer, the City of Rock Hill Public Works or SCDOT, whichever applies, will remove and re-perform the restoration as specified at the Contractor’s expense.

   b) When cuts are to be made in street rights-of-way under maintenance by the City of Rock Hill Public Works Department, the Contractor shall contact the Public Works Director or his designated representative before each separate pavement cut is made and secure a permit.

2. **REPLACEMENT:** All areas of existing pavement shall be neatly removed with straight edges. The Contractor shall remove and replace pavement, which in the opinion of the Engineer has been cracked or displaced by the operations of the Contractor. Edges shall be sealed upon completion of the repair.

   a) In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1 to 1 ½ inches of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.

   b) Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor shall contact the Public Works Director and/or SCDOT’s District Engineer for determination of the limits of concrete replacement and location of joints. Work procedures shall be such to prevent damage to surrounding pavement.
c) Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of the pavement left between the edge of the ditch and the existing edge of pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12-inches beyond the top of trench.

3. RESTORATION: Restoration of the paved surface shall be in accordance with the following specifications:

a) CONCRETE PAVEMENT: The concrete used to restore pavement shall have a minimum 28-day compressive strength of 3000 psi. The concrete shall conform to the shape, grad, and finish of the existing pavement and will be 1-inch deeper than the original pavement, including base, but in no instance less than 6 inches.

b) ASPHALT PAVEMENT: All material above the sub-base level shall be hot-mix bituminous concrete conforming to the SCDOT Standard Specifications for Roads and Structures for both mix design and placement. The asphalt pavement as placed shall be 1-inch deeper than the original pavement, including base, but in no instance less than 6 inches within City-maintained roadways or eight inches in state-maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall not be hot-mix bituminous concrete binder, Type H. The last 2 inches in either instance shall be bituminous plant mix (Type C – surface course) suitable to the appropriate controlling agency. Type C asphalt pavement surfacing will be placed with paving machines and/or rollers of a size and type currently approved by the SCDDOT for use on resurfacing contracts.

   (1) If bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness or to a level 2-inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

   (2) Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or faces of concrete gutters.

   (3) Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each workday. Following completion of pipeline construction along a continuous section of pavement, 1 to 2 inches shall be replaced weekly or within five days. During inclement weather, the Engineer may permit the use of temporary asphalt (cold Mix) to seal the trench until permanent asphalt can be placed.

   (4) All pavement markings are to be restored.

4. DAMAGE TO ADJACENT PAVEMENT: The pavement adjacent to pipeline trenches must not be disturbed or damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove the damaged pavement and shall replace with new pavement at his own expense.

V. RECORD/AS-BUILT DRAWINGS: The Contractor is to keep a set of approved Construction Drawings on site to make notes to facilitate the preparation as-built/record drawing information for the sewer
infrastructure being installed. Notes taken during construction shall include but is not limited to field changes to the horizontal alignment or grades of the infrastructure being installed, sanitary sewer service locations (station along sewer main), description, size and location (station and elevation(s)) of all underground utility crossings encountered during the construction work, location of bedrock encountered and removed, and other pertinent information.

1. The Contractor shall supply a copy of the field noted drawings to the engineer, along with surveyed as-built/record drawings (signed and sealed by a South Carolina Licensed Surveyor). Surveyed as-built/record drawings shall include the location and elevations of all manholes (rim and invert elevations), locations of service lateral cleanouts (station and offset) and calculated pipe grades. Stations of all service lateral wyes and/or connections and station and elevation of all utilities encountered during the sewer installation shall be incorporated in the drawings. Engineer shall provide to City a hard set (bond and Mylar) of as-built drawings and digital set (in .pdf and .dwg formats) prior to receiving final approval of the project.

2. The Contractor is to provide video imagery from closed-circuit television (CCTV) inspection of the newly installed sanitary sewer infrastructure. The video is to be provided to the Engineer of Record for the project, who is to review it for abnormal or defective structures, infiltration, joint offsets, unacceptable slope conditions, and any other instances of unsatisfactory construction. Engineer of Record is to prepare a sealed letter report to the City stating that there are no abnormalities, deficiencies, or unsatisfactory conditions found in the new infrastructure.

3. The Builder shall field verify the sewer service locations relative to the finished floor elevations of the building prior to installing the service.

4. Prior to receiving a Certificate of Occupancy on a building, residence, structure, or portion thereof that contains a connection to the City’s sewer system, the Plumber shall provide to the City Utilities Department video imagery of the newly installed sanitary sewer service infrastructure to the sewer main.

5. As-built/record documentation is required for pump stations and low pressure sewer system. Please see those sections for additional requirements.

W. **WARRANTY:** The Work shall be free of defects in material and workmanship for a two-year period from the date of acceptance, which is defined as either the date of signature by the City Engineer on the Final Plat or as referenced in correspondence by the City Engineering Division. If neither date can be identified, the date shall be the issuance date for the SCDHEC Permit to Operate.
IV. **SANITARY SEWER PUMP STATIONS**

A. **PURPOSE:**

1. **GENERAL:** These standards address the City’s minimum requirements for operation and control of connecting pump stations and include guidelines for sizing new wet wells to accommodate the service conditions. Standards for hydrogen sulfide control for connecting pump stations are also included herein.

2. **OBJECTIVES:** The objectives of these supplemental standards are as follows:
   
a) Control connecting pump station operations to prevent simultaneous operation with the pump station upstream of the connection point.

b) Minimize number of connecting pumping stations

c) Minimize hydrogen sulfide formation in the City’s collection system.

d) It is the City’s intent to minimize the number of new sewage pump stations connecting to the City’s wastewater system. Since it is required to coordinate pump station operations to mitigate the sewer system capacity deficit, the addition of numerous small pump station connections will complicate the City’s proposed plan.

3. **REQUIREMENTS:** All materials, equipment, and labor for submersible pump station construction shall be furnished in accordance with these specifications and in accordance with the Construction Drawings prepared by a registered Professional Engineer licensed to practice in the state of South Carolina.

B. **DESIGN REQUIREMENTS:**

1. **APPLICABLE REGULATIONS AND STANDARDS:** The design and construction of sewage pump stations shall comply with all applicable City of Rock Hill and SCDHEC standards contained in Regulation 61-67.300. Related buildings and structures shall comply with the Building Officials Conference of America (BOCA) and permitting requirements of the City Planning and Development department. Other standards governing facilities, materials, and construction shall include, but not limited to the following:
   
a) American Society for Testing and Materials (ASTM)
b) American National Standards Institute (ANSI)
c) America Water Works Association (AWWA)
d) Factory Mutual (FM)
e) Hydraulic Institute Standards (HIS)
f) Institute of Electrical and Electronic Engineers (IEEE)
g) Joint Industrial Council (JIC)
h) National Electric Code (NEC)
i) National Electric Manufacturers Association (NEMA)
j) National Fire Protection Association (NFPA)
k) National Institute for Occupational Safety and Health (NIOSH)
l) National Machine and Tool Builders Association (NMTBA)
m) Occupational Safety and Health Administration (OSHA)
n) Ten States Standards
o) Underwriters' Laboratory (UL)

2. **DESIGN ENGINEER:** It is the responsibility of the design engineer to determine the applicability of the design standards and to integrate all applicable criteria and guidelines for sewage pump stations to be connected into the City sewer system.

3. **GENERAL:** Pumping systems shall be designed to serve the upstream basin service area and to achieve a minimum cleansing velocity of 2.5 fps and a maximum design velocity of 6 fps. Wetwells and force mains shall be constructed to serve the entire basin. Pumps may be sized for the development being served, with future developments being required to include the necessary upgrades for additional flows. Arc-flash study to be completed and appropriate labels placed on panels. Contractor to furnish permanent signage for confined space.

4. **PUBLIC WATER:** City water shall be installed at all pump stations. At a minimum, access to City water shall be through an on-site yard hydrant.

C. **PRE-APPROVAL OF PUMP STATION:**

1. To minimize the number of pump stations connecting to the City's collection system, the design engineer shall prepare an evaluation of wastewater collection options for existing and future developments in the vicinity of the proposed development. The evaluation shall consider:

   a) Adjacent drainage areas that can potentially be served by a new sewage pump station, including estimated flow projections and future pump station upgrades.

   b) Connection to an existing pump station, including additional force main length and necessary improvements to the pump station to accept additional flow.

2. Three (3) originals of the evaluation shall be submitted to the City Engineer for review at the preliminary design phase for the project and is required for pre-approval of new sewage pump stations.

3. Design flow for determining pumping station capacity shall be based on peak hourly flow in accordance with the SCDHEC regulations. Information for existing pump stations and possible future developments can be obtained from the City.

4. Additional design will be required to address provisions for emergency pumping for wet wells that are greater than 20 feet in depth. These additional provisions and any associated protocol shall be approved by the City Engineer prior to approval of the pump station use.

D. **PUMP STATION SITE:**

1. Site shall be designed such that pad and fenced area can accommodate a boom truck to remove the pumps from the wet well.
2. A minimum 60-foot by 60-foot fenced area with a 12-foot entrance gate shall be provided.

3. Access drive shall be paved.

4. An area around the fence shall be provided to meet screening requirements if adjacent to a residential development.

E. Wet Well Capacity:

1. **General:** The pumping station wet well shall be sized to accommodate the influent sewer and pump suction piping or pump submergence as recommended by the HIS. Since pumping shall be restricted when the upstream pump station pumps are running, additional storage capacity shall be provided to contain wastewater generated during the required pump-off time. Guidelines for determining the required working and storage volumes are given below.

2. **Working Volume:**
   
   a) Required Working volume and preferred distances between sewer and control elevations shall be determined as follows:

   (1) Working Volume (in gallons) = TQ/4; the volume between the elevations of the lead pump on and lead pump off.

   (2) With T = Minimum time between motor starts or 7 minutes, whichever is greater; For pumps greater than 30 horsepower, minimum cycle shall be 12 minutes.

   (3) Q = Ultimate design discharge rate of one pump (lead pump) in operation, gallons per minute (gpm)

   b) Working volume shall allow no more than 3 or 4 pump cycles considering the minimum cycle time recommended by the pump manufacturer.

   c) Filling rate shall not exceed 30 minutes at the design average flow rate, unless the facility is designed for storage as described in the following section.

   d) Minimum inside width or diameter shall be 8 feet. Considerations shall include retention time and pipe/pump configuration and equipment access.

   e) Minimum elevation difference between influent sewer and high water alarm shall be 18 inches.

   f) Minimum elevation difference between control elevations shall be 6 inches.

   g) Minimum elevation difference between Lead Pump On and bottom of wet well shall be as required for submergence of pumps or pump station.

   (1) As a guideline for determining pump suction pipe submergence, provide 1-foot of submergence for each foot per second (fps) of velocity at the suction pipe.
inlet. Maximum intake velocity shall not exceed 6 fps.

3. **STORAGE VOLUME:**

   a) Storage volume shall be provided in the wet well for containment of wastewater generated during controlled pump-off periods or for emergency storage. Storage volumes shall be determined as described below.

   b) Controlled Pump-Off Storage

      (1) For pumping stations connecting to the City’s collection system, sufficient storage volume shall be provided in the wet well between the pump-on and high water levels for containment of wastewater generated when the pump station upstream of the pump station’s force main connection is operating (controlled pump-off storage). The volume shall be computed from the maximum pump-on time for the upstream pump station and the peak design flow to the pump station.

      (2) Cycle times for the City’s pump stations are extremely variable. However, it can be assumed that pump station pump-on time will generally be approximately 3 minutes to an estimated maximum of 10 minutes (subject to verification by the City). Therefore, storage shall be provided for 10 minutes (subject to verification by the City) of generated wastewater at the design peak flow rate. If emergency storage is provided, as described below, the emergency storage volume can be considered to meet the controlled pump-off storage requirement.

   c) Emergency Storage

      (1) In accordance with SCDHEC regulations, auxiliary power using either two separate power substation connections or an on-site standby generator shall be provided for sewage pump stations. For emergency storage, additional volume shall be computed for the projected flow from the community during the longest reported power outage in the last five (5) years, excluding power outage from a catastrophic storm. As a minimum, the City requires storage for a two-hour period.

4. **TOP SLAB:** The top slab elevation shall be at least 2-feet above the 100-year water surface elevation.

F. **PUMP STATION CONTROL AND MONITORING:**

1. All new pump stations in the City’s sewer collection system shall install computerized supervisory control and data acquisition (SCADA) system equivalent and compatible to the system the City is using at the time of construction.

G. **HYDROGEN SULFIDE AND ODOR CONTROL:**

1. Control Measures shall be provided at pump stations to minimize the release of odorous gases and the effects of hydrogen sulfide (H₂S) on downstream infrastructure. Such measures are required for the following conditions:
a) Condition 1 - For wet wells with a filling rate in excess of 20 minutes at average flow, including initial flows, it shall be assumed that there is potential for septicity and resulting odors.

b) Condition 2 - For force mains with greater than two-hour detention time, it shall be assumed that H₂S will be produced at a level greater than 5 parts per million (ppm).

c) Condition 3 - For pump stations receiving flow from intermediate pump stations or grinder pump systems, it shall be assumed that sufficient H₂S will be present in the incoming wastewater to cause corrosion and odors at the pump station.

2. It is the responsibility of the design professional to determine the conditions at the proposed pump station. Analyses shall be prepared and submitted for the City's review with the preliminary design submittal, and shall consider conditions ranging from initial operation to build-out.

3. The following control measures shall be provided at pump stations meeting the above conditions.

a) Condition 1

(1) Provide either continuous or intermittent mechanical ventilation of wet well. Air shall be forced into the wet well with a fan. Provide a timer for normal operation. Provide a limit switch to energize the fan whenever the entrance hatch is opened.

(2) The fan shall be sized to provide a minimum of 30 complete air changes per hour with continuous operation for worker safety. Timer operation of the fan shall allow a minimum of 2 complete air changes per hour.

(3) The fan shall be direct drive. If the fan is installed outdoors, the fan assembly and housing shall be of corrosion resistant and weather-proof construction.

(4) Exhaust from the wet well shall be passed through a biofilter before released to the atmosphere. The biofilter shall be composed of suitable organic media with embedded air distribution system and sized in accordance with the Standard Detail.

b) Condition 2

(1) Provide chemical dosing system. Equipment shall include chemical metering units, storage facilities, and related piping and controls to feed chemical solution into pump station wet well. Chemicals for H₂S control shall be approved by City Engineer.

(2) Dosing Rates shall be as specified by the manufacturer

c) Condition 3

(1) Provide mechanical ventilation and exhaust air treatment as described for
Condition 1 and chemical dosing as described for Condition 2.

4. Wet well structures shall be lined with Ultra-High Build Epoxy Coating System Raven 405 by Raven Lining Systems, or approved equal, at a minimum dry-film thickness of 125 mils, installed per the manufacturer’s instructions.

H. MATERIAL SPECIFICATIONS:

1. DESCRIPTION: All materials, equipment, and labor for submersible pump station construction shall be furnished in accordance with these specifications and in accordance with the Construction Drawings prepared by a Registered Professional Engineer licensed to practice in the state of South Carolina.

2. SYSTEM DESCRIPTION:
   a) Contractor shall furnish and install one electric submersible non-clog wastewater pump station. The station shall be complete with all equipment and appurtenances specified herein and approved by the City. See Standard Detail for typical layout.
   b) Principle items of equipment shall include two electric submersible pumps (minimum) to be supplied with motor, close-coupled volute, ductile iron discharge elbow, guide bar brackets, power cable and accessories necessary for wet pit installation, on-site generator, monitoring and control equipment, and all other appurtenances as show on the Standard Details. All hardware, including anchors, bolts, etc., shall be 316 stainless steel.
   c) All items associated with the pumps and tier installation and operation shall be provided by the pump manufacturer, unless specified elsewhere. Other items, such as the on-site generator, valves and piping, etc., may be supplied by others.

3. PERFORMANCE CRITERIA:
   a) Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Each pump shall be selected to perform under operating conditions base on, but not limited to the following:
      (1) Capacity (gpm)
      (2) Total Dynamic Head (ft)
      (3) Total Discharge Head (ft)
   b) Site power furnished to pump station shall be three phase, 60 hertz, 460 volts, four wire maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Control voltage shall not exceed 132 volts.

4. SUBMITTALS:
   a) Product Data
Section IV – Sanitary Sewer Pump Stations

City of Rock Hill Wastewater Specifications

Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the manufacturer's data for review and approval. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: catalog cut sheets reflecting characteristics for major items of equipment (including control panels), materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (gpm), head (ft), net positive suction head required (NPSHr), and hydraulic brake power (HBP). Electrical components used in the motor branch and liquid level control shall be fully described.

Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the on-site generator manufacturer's data for review and approval.

Prior to fabrication, the project's contractor or developer's representative, shall submit 3 copies of the SCADA system manufacturer's data for review and approval. The submittal data shall include, but not be limited to, the RTU Communication's Study.

b) Operation Maintenance Manuals

Installation shall be in accordance with written instructions provided by the pump station equipment manufacturer(s). Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied. A minimum of three (3) printed copies and one (1) digital version of the manual shall be provided to the City.

Documentation shall be specific to the pump station and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or include in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum.

(a) Functional description of each major component, complete with operating instructions.

(b) Instructions for operating pumps and pump controls in all modes of operation.

(c) Calibration and adjustment of equipment for initial start-up, replacement of level control components or as required for routine maintenance.

(d) Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
(e) Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

(f) Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

(3) Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

5. **Quality Assurance:**

   a) Upon request from the engineer, the pump station equipment manufacturer(s) shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

   b) The pumps shall be heavy-duty, electric submersible centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater. The pumps shall be capable of pumping a 3.0" spherical solid.

   c) The pumps provided shall be capable of operating in an ambient liquid temperature of 104 degrees F as specified by NEMA and FM.

   d) The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor is not acceptable.

   e) The pump, mechanical seals and motor units provided under this specification shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty.

   f) The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment.

6. **Manufacturer's Warranty:**
a) The pump station equipment manufacturer(s) shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below:

(1) All equipment, apparatus, and parts furnished shall be warranted for one year, excepting only those items normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumps and all its supplied components.

(2) The pump shaft seal shall be warranted for a minimum of four years from the date of shipment. Should the seal fail within the first year, the manufacturer shall furnish a new seal, without charge to the owner, F.O.B. factory. The warranty replacement cost for seals after the first year will be pro-rated as follows:

<table>
<thead>
<tr>
<th>Failure Within</th>
<th>Percent New Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 years</td>
<td>75%</td>
</tr>
<tr>
<td>3 years</td>
<td>50%</td>
</tr>
<tr>
<td>4 years</td>
<td>25%</td>
</tr>
</tbody>
</table>

(3) Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to owner.

b) The warranty provided by the developer to the City shall become effective upon the issuance of a Permit to Operate by SCDHEC.

7. UNITARY RESPONSIBILITY - In order to unify responsibility for proper operation of the pump station, it is the intent of these specifications that all system components associated with the pumps (pumps, motors, installation hardware and controls, etc.) be furnished by a single manufacturer (unitary source) approved by the City. The system must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer’s representative or distributor be accepted.

8. PUMP DESIGN:

a) The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There should be no need for personnel to enter the wet well.

b) Sealing of the pumping unit to the discharge connection shall be accomplished by a machine metal-to-metal watertight connection.

9. PUMP CONSTRUCTION:

a) Major pump components shall be of gray cast iron, ASTM A48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities.

b) All exposed nuts or bolts shall be ANSI type 304 stainless steel construction. All
metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

c) Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of specific torque limit.

d) The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

10. MOTOR:

a) The pump motor shall be induction type with a squirrel-cage rotor, shell-type design, housed in an air filled, watertight chamber, NEMA B type.

b) The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155 degrees C (311 degrees F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing.

c) The motor shall be designed for continuous duty handling pumped media of 40 degrees C (104 degrees F) and capable of up to 15 evenly spaced starts per hour.

d) The motor and pump shall be designed and assembled by the same manufacturer.

e) The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

11. IMPELLER:

a) The impeller shall be of gray cast iron, Class 35B, dynamically balanced, double-shrouded non-clogging design having a long through-let without acute turns.

b) The impeller shall be capable of handling 3" spherical solids, fibrous materials, heavy sludge and other matter found in wastewater.

c) All impellers shall be coated with acrylic dispersion zinc phosphate primer.

12. ELECTRICAL CONTROL COMPONENTS:

a) Electrical control equipment shall be mounted within a NEMA 1 steel, dead-front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs. All control devices and instruments shall be mounted using threaded fastener, and shall be clearly labeled to indicate function.
b) Pump Station controls shall conform to third party safety certification. The enclosure and all components mounted on the subpanel or control cover shall conform to UL descriptions and procedures.

c) Motor branch components to be of highest industrial quality, secured to the subplate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any component.

d) A properly sized heavy-duty circuit breaker, with RMS interrupting rating of 14,000 amperes at 460 volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in the "OFF" position.

e) An open-frame, across-the-line, MENA-rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils to be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability. Overload relays to be block-type with melting alloy spindles, having visual trip indication with trip free operation. Pressing the overload-reset lever shall not actuate the control contact until after the overload spindle has reset. Resetting the overload reset lever will cause a snap-action control and not convertible to automatic reset. Trip settings shall be governed by the heater element only, and not by adjustable settings. Heater elements must provide NEMA Class 20 trip times, selected in accordance with actual motor nameplate data. An overload-reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

f) The control panel shall be equipped with a secondary lightning arrester to minimize damage to the pump motors and control from transient voltage surges. The arrester shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrester shall have a current rating of 60,000 amps, a Joule rating of 1500.

g) The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

h) Control Circuits

(1) A normal-duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

(2) Pump mode selector switches shall permit manual start or stop of each pump set individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except
the motor overload relays. Selector switches to be heavy-duty, oil-tight design with contacts rated NEMA A300 minimum.

(3) Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amps minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alteration of pumps, to select pump set number to be "lead" for each pumping cycle, or to select pump set number two to be "lead" pump for each pumping cycle.

(4) Six-digit elapsed time meter (non-reset type) shall be provided for each pump set to indicate total running time of each pump set in "hours" and "tenths of hours." A pilot light shall be wired in parallel to indicate that the motor is energized and should be running.

(5) A high pump temperature protection circuit shall override the level control and shutdown the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to a high pump temperature shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the pump shutdown circuit to interrupt power to the motor. A visible indicator located on the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remained locked-out until the pump has cooled and circuit has been manually reset. Automatic reset of the circuit is not acceptable.

(6) A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 amp thermal-magnetic circuit breaker.

13. **Auxiliary Power Transformer Controls and Accessories:**

   a) The pump station shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single-phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door, and a pad-lockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.

   b) All wiring, workmanship and schematic wiring diagrams shall comply with applicable standards and specifications of the NEC. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

   |   | Line and Load Circuits, AC or DC power | Black |
   |   | AC Control Circuit Less than Line Voltage | Red |
   |   | DC Control Circuit | Blue |
   |   | Interlock Control Circuit from external source | Yellow |
   |   | Equipment Grounding Conductor | Green |
   |   | Current Carrying Ground | White |
   |   | How With Circuit Breaker Open | Orange |
c) Control circuit wiring inside the panel, with exception of internal wiring of individual component, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum. Motor branch and other power conductors shall not be loaded above 60 degrees C temperature rating, on circuits of 100 amps or less, nor above 75 degrees C on circuits over 100 amps. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon-insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel.

d) All wiring outside the panel shall be routed through conduit. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinge side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices. Factory installed conduit shall conform to following requirements:

1. All conduit and fittings to be US listed.
2. Liquid-tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
3. Conduit to be supported in accordance with articles 346, 347, and 350 of the NEC.
4. Conduit shall be sized according to the NEC.

e) Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the ground-mounting surface before making final connections. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the NEC.

f) Permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:

1. Equipment serial number
2. Supply voltage, phase and frequency
3. Current rating of the minimum main conductor
4. Electrical wiring diagram number
5. Motor horsepower and full load current
6. Motor overload heater element
7. Motor circuit breaker trip current rating
(8) Name and location of equipment manufacturer

g) Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

h) Liquid Level Monitoring Control

(1) The level monitoring and control system shall start and stop the pump motors in response to changes in wet wall level, as set forth herein.

(2) The level monitoring and control system shall be capable of operating as a conductivity probe-type system for liquid level control and with a float-ball system for high and low level alarms, as manufactured by ITT Flygt, DEVAR Inc., or manufacturer approved equal by the City.

(3) The level control system shall utilize the alternator relay to select first one pump set, then the second pump set, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.

(4) The level control system shall be provided with pump start and stop delays to prevent simultaneous motor starts and to reduce the potential of hydraulic surges during motor shutdown.

(5) The level control system shall utilize the conductivity probe-type system which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, conductivity probe-type system shall start the motor for one pump set when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the conductivity probe-type system shall stop these pumps. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the conductivity probe-type system shall start the second pump set with the liquid reaches the "lag pump start level" so that all pumps are operating. These levels shall be adjustable as described below.

(6) The conductivity probe-type system shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Components shall be solid state, and shall be integrated with other components to perform as described below.

(7) The conductivity probe-type system shall be capable of operating on a supply voltage of 108 volts to 132 volts AC, 60 Hz, in an ambient temperature range of -10 degrees C (14 degrees F) through +55 degrees C (131 degrees F). Control range shall be 0 to +0.1 feet of water with an overall repeat accuracy of +0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.

(8) The conductivity probe-type system shall consist of the following integral components, display, and output relays:
(a) The conductivity probe-type system shall incorporate a digital back-lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet-well, and the preset start and stop level for both lead and lag pumps. The display shall include 20 0.19-inch high alphanumeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full-scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

(b) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable and accessible to the operator without opening the cover panel. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, or artificial level simulation.

(c) An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are underway. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil-tight design with contacts rated NEMA A300 minimum.

(d) Station manufacturer will supply on 1515-volt AC alarm light fixture with vapor-tight red glove, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

(e) Station manufacturer will supply on 115-volt AC Weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

(9) The level control system shall be provided with two (2) submersible switches to serve as high-level and low-level alarms. When tripped, the high-level float will initiate local and SCADA alarms and attempt to start both the lead and standby pumps. When tripped, the low-level float will initiate local and SCADA alarms and attempt to de-energize all pumps.

(a) Switches shall have the ability to be wired as either NO or NC and provided with 100 feet of cable, unless otherwise specified by the design engineer.

(b) Switches shall be Flygt type ENM-10 582 8836, or approved equal.

(c) Provide 4-float, T-type bracket with cord snubbers to mount to wall or wet well and hand switches. Bracket shall be constructed of 304 stainless steel and include 316 stainless steel mounting hardware.
i) Telemetry - Each pump station shall be supplied with a SCADA RTU. The work to be accomplished under this specification shall consist of furnishing the equipment necessary for modifying the existing automatic control and monitoring system. The equipment shall be designed, fabricated, programmed, tested, started-up, and warranted by a single supplier.

j) On-site Generator System

(1) General

(a) All pump stations shall have an automatic standby power generation system conforming to these specifications.

(b) The system shall consist of a diesel-fueled standby generator in a weather proof enclosure complete with all equipment and accessories required to automatically supply power to the pump station during a utility power failure. The engine generator set shall start the two wastewater pumps in sequence and will run both simultaneously under full load. Simultaneous starting is not required.

(c) 

(2) Engine

(a) Engine block material: cast iron

(b) Cylinder head material: cast iron

(c) Crankshaft material: Hardened steel

(d) Pistons: Aluminum alloy

(e) Valve seats: Replaceable

(f) Maximum rate RPM: 1800

(3) Engine Governor

(a) Type: Mechanical

(b) No-load to full load frequency regulation: 5.0%

(c) Steady state regulation: ±0.33%

(d) Over-speed shutdown: Automatic solid state

(4) Engine Lubrication System

(a) Oil pump: Gear type

(b) Oil filter: Full-flow cartridge
(c) Low-oil pressure shutdown: Automatic

(5) Engine Cooling System

(a) Type of system: Pressurized, closed recovery
(b) High temperature shutdown: Automatic
(c) Low coolant level shutdown: Automatic
(d) Fan: Pusher type with guard
(e) Engine block heater: 1000 watts (min), 120 VAC, thermostatically controlled
(f) Coolant: Water/ethylene glycol (-34 degree protection)

(6) Engine Fuel System

(a) Fuel: #2 Diesel
(b) Fuel filter: 5 micron
(c) Injection type: Direct
(d) Fuel pump: Mechanical, engine driven
(e) Fuel tank: Integral, UL listed, double-walled, steel fuel storage
(f) Fuel tank capacity: 24 hours (min.) @ rated load
(g) Fuel tank accessories: Fuel level indicator; low-fuel indicator switch (on at 20% capacity); Screened vent for double wall cavity; and Drain port

(7) Engine Exhaust System

(a) Silencer: Critical
(b) Mounting: External with weather cap
(c) Connection: Flexible stainless steel pipe

(8) Engine Combustion Air Intake

(a) Air cleaner: Replaceable dry cartridge

(9) Engine Electrical

(a) Starter motor: 12 or 24 volt
(b) Battery charge alternator: 30 amp (min)

(c) Crank limiter: Solid state

(d) Battery: 2-12 volt (series or parallel, as appropriate)

(e) Battery mounting: Rack inside enclosure

(f) Polarity: Negative ground

(g) Standby charger: 10 amp, automatic float

(10) Generator

(a) General Specifications

(i) Generator type: 4 pole, revolving field
(ii) Output: 12 lead, re-connectable
(iii) Stator: "Skewed" design
(iv) Housing: Drip-proof design, self-ventilated
(v) Rotor insulation: Class F
(vi) Stator insulation: Class F
(vii) Bearings: Sealed, pre-lubed
(viii) Engine coupling: Direct, flexible disc
(ix) Protection: Output circuit breaker (manual reset)

(b) Generator Excitation:

(i) Exciter type: Brushless
(ii) Protection: Manual circuit breaker

(c) Generator Regulation

(i) Type: Solid state
(ii) Regulation: ±2% steady state
(iii) Voltage adjustment: 5% manual rheostat

(d) Generator Set Controls on Control Panel

(i) Engine Gauges: Oil pressure; Coolant temperature; and Battery charging ammeter
(ii) Annunciator: Low oil-pressure shutdown; high temperature/low coolant level shutdown; Overcrank shutdown; Overspeed shutdown; and Low fuel
(iii) Engine hour meter: 99,999.0 hour
(iv) Remote engine hour meter located at transfer switch: 99,999.0 hour
(v) Engine control switch: Off/Manual/Automatic

(e) Generator Controls and Indicators
(i) Gauges: AC frequency; Output voltage; and Output current
(ii) Gauge Selector switch: 3 position with "OFF"
(iii) Manual voltage adjustment: Rheostat, 5% adjustment range

(f) Alarm Output Contacts

(i) Generator Fail
(ii) Generator Operating
(iii) Low Fuel
(iv) Alarm output contacts are to be wired to the local monitoring

(g) Generator Set Enclosure Mounting

(i) Access panels: Lockable (keyed alike), hinged and removable
(ii) Hardware: Stainless steel
(iii) Finish: Baked enamel over zinc-coated steel
(iv) Mounting: Welded steel base with vibration insulators
(v) Mounting location: Top of fuel tank

(11) Automatic Transfer Switch

(a) The automatic transfer switch to be supplies as part of the standby power system shall meet all applicable requirements set forth by the NEC and OSHA. The transfer switch shall also conform to the requirements specified below:

(b) Enclosure Mounting type: Surface

(c) Enclosure type: NEMA 3R, lockable

(d) Electrical Ratings

(i) Operating voltage: Compatible with station voltage
(ii) Operating current: No less than main disconnect
(iii) Withstand and closing rating: 10,000 amps, RMS, Symm. (min)

(e) Transfer Switch

(i) Operating mechanism: Single solenoid
(ii) Holding mechanism: Mechanical
(iii) Interlock: Mechanical and electric
(iv) Contact material: Silver alloy
(v) Neutral delay: 0.1-10 seconds

(f) Timer Setting Ranges
(i) Utility dropout: 70-95%
(ii) Utility pick-up: 70-95%
(iii) Utility interrupt delay: 0.1-10 seconds
(iv) Engine minimum run: 5-30 minutes
(v) Engine warm-up: 5-180 seconds
(vi) Return to utility delay: 1-30 minutes
(vii) Engine cool-down: 1-30 minutes
(viii) Standby voltage: 70-90%
(ix) Standby frequency: 80-90%
(x) Exerciser: Once per week

(g) Operation Selectors:

(i) Exercise: With/Without load
(ii) Engine warm-up bypass: On/Off
(iii) Neutral delay: On/Off
(iv) Mode Selector: Manual test/Standby/Off

(12) Standby Power System Capacity - The standby power system shall be capable of providing continuous standby power for the wastewater pump station. The generator set shall be capable of starting the two pump motor leads sequentially with the full miscellaneous load applied, with no more than 30% dip. The minimum acceptable generator set rating shall be 25 KW for any station. The Contractor shall coordinate the starting requirements of the exact pumps being furnished on the project with the generator set supplier to insure that the generator set has adequate motor starting capability.

(13) Installation - The generator set shall be mounted and anchored to a reinforced concrete pad, located to provide adequate access for fueling and services. The exact dimension of the pad, conduit entries and anchor bolts shall be based on the manufacturer's shop drawings. The pad shall have outer dimensions 1-foot greater than the footprint of the base tank, to provide 6 inches of exposure on all sides. The minimum thickness of the pad shall be 12 inches, with a single mat of #6 rebar, 12-inches OCEW and located in the lower third of the concrete thickness. The weight of the mounting pad shall be equal to or greater than the weight of the generator set. All exposed edges shall be chamfered or rounded with an edging tool.

(14) Tests - The Contractor shall provide start-up and testing services utilizing personnel specifically authorized to perform such services by the standby power system manufacturer. The start-up services shall be scheduled with the City with no less than 3-days' notice. The start-up and testing service shall include a complete inspection of the installation, initial break-in of the engine, testing the system performance, and servicing the engine. The following tests shall be performed in the presence of the City or its representative:

(a) Generator output voltage unloaded and loaded, each phase, based on 2-hour load bank test.

(b) Voltage dip as loads are applied
(c) Complete operating sequence (simulated utility power failure and restoration)

(d) Pressure test engine cooling system for leaks

(e) Test battery charging systems

(f) Test operation of all safety systems

(g) Upon completion of break-in and testing, the engine shall be serviced as follows:

(i) Change engine oil and filter
(ii) Verify anti-freeze protection (-34 degrees F)
(iii) Refill fuel tank (tank shall be left full)
(iv) Check belt tension
(v) Check battery connections and state of charge

(h) During this start-up period, City maintenance personnel shall be fully instructed in the proper maintenance of the standby power system.

(15) Manufacturer

(a) The generator set, controls, and transfer switch shall be furnished by a single supplier. The generator set and accessory equipment shall be supplied by Caterpillar/Olympian, Onan/Cummings, Kohler, or approved equal.

(b) The supplier shall be the authorized dealer of the engine-generator set manufacturer, and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. Parts and service shall be available 24-hours per day, 7 days per week, from a location within a 100-mile radius of the location of the installed generator set.

(16) Shop Drawings - Prior to purchase of standby power generation equipment, the Contractor shall submit not less than four sets of data to the City for approval, including equipment data, accessories, sizing calculations, etc. as may be appropriate to determine compliance with these specifications.

(17) Operating Instructions - Six (6) complete copies of operating instructions and parts list shall be provided prior to acceptance of the unit. Parts list shall include schedule of type and quantity of parts recommended for stock.

(18) Spare Parts to be furnished

(a) Engine fan & accessory drive belts: 1 set

(b) Oil, fuel and air filters: 2 sets
(c) Spare indicator lamps and fuses: 2 sets

(d) Spare parts shall be boxed and labeled with the pumps station identification

(19) Warranty - The complete standby power generating system shall be warranted for one year after the acceptance of the sewer pump station by the City. The warranty shall cover all defects in equipment, parts, assembly and installation. The warranty shall be issued in writing by the supplier and delivered to the City.

I. **LOW PRESSURE SEWER SYSTEMS (LPSS):**

1. **LOCATION/APPROVAL:**

   a) Low pressure sewer systems (LPSS) are permitted in the Rock Hill service territory when approved by the Director of Water and Sewer Utilities in areas adjacent to Lake Wylie/Catawba River or in areas where gravity service would involve numerous small lift stations.

2. **DESIGN:**

   a) Developer shall have LPSS designed by a professional engineer licensed in the state of South Carolina.

   b) In addition to Construction Drawings and specifications, the developer shall include a design memorandum detailing the design procedures used for the LPSS. The design memorandum shall include the following:

      (1) Hydraulic calculations demonstrating that the total dynamic head (TDH) does not exceed 100 feet at any existing or potential grinder pump location.

      (2) Profiles of all low pressure sewer lines demonstrating that the system will be under positive pressure at all times. Specifically, the discharge elevation shall be above all intervening high points.

      (3) Calculations indicating determination of pressure main sizing. Initial pipe line sizing shall be based on providing a minimum of 3.0 fps velocity at a discharge calculated according to the following equation:

      \[
      Q \text{ (in gpm)} = 15 + 0.5D
      \]

      Where D = the number of dwelling units upstream of the reach under investigation.

      (4) Calculation of final pipe size may be adjusted based on evidence from hydraulic calculations, provided that such calculations indicate that a minimum of 2.0 fps can be achieved in all lines with no more than 5% (or a minimum of 2 pumps operating simultaneously through the line under determination).

      (5) Determination of Hazen-Williams coefficient. A Hazen-Williams coefficient, C, of 140 to 150 may be used, provided that if C=150, the nominal pipe
size only may be used, and an allowance for minor losses associated with fittings should be included in the hydraulic calculations.

(6) Calculation of Impeller Diameters for each pump. The impeller diameter of individual pumps in a system with varying pump elevations shall be sized such that full size impellers are used at pumps at the lowest elevations, and reduced size impellers are used at higher pumps, such that the TDH of any one pump is within 20% of all other pumps.

(7) Calculations of the maximum flow discharged from the LPSS with all pumps operating. This condition will be experienced upon restoration of power following a system-wide power outage. If the maximum flow calculated, included in other pressure sewers, exceeds the rated maximum pumping capacity of any downstream pump stations, the discharge shall be into a gravity sewer of sufficient diameter and length to provide 150 gallons of storage capacity per grinder pump within the gravity pipeline.

(8) Private LPSS shall connect to the City’s sanitary sewer system at a stub from the property line side of the dual ball valve/check valve assembly according to the service connection Standard Details.

3. MATERIALS AND INSTALLATION FOR LPSS:

a) Unless superseded or modified by Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specifications for same contained in the City’s Standard Specifications.

b) Pipes: Force main piping for LPSS shall be 6” diameter and smaller.

c) Valves – All valves on LPSS shall be plug or ball valves as specified below. Valve operation shall be open left.

(1) Plug Valves – All valves on low pressure sewer mains shall be eccentric plug valves as follows.

(a) Plug valves shall be non-lubricated, with a plug facing of a material specifically recommended by the valve manufacturer for the indicated service and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valve seats shall be nickel. Valves shall be designed with adjustable seals which are replaceable without removing the bonnet. The bearing and seal area shall be protected with grit seals. Area of port opening for all valves shall be no less than 81% of full pipe area.

(b) Valves that are 12” and smaller shall be rated at 175 psi. Valves that are 15 inches or larger shall be rated at 150 psi. Bi-directional shut-off is required.

(c) Plug valves shall be as manufactured by Dezurik Corporation, Milliken Valve Co., Keystone Valve, Pratt, or approved equal.
(i) Buried valves 4-inches and larger and other valves specifically indicated shall have mechanical joint ends conforming to ANSI A21.11.

(ii) Buried valves 3-inches and smaller shall have schedule 80 threaded ends and shall be connected to the pressure main by schedule 80 PVC threaded by socket adapters.

(d) Buried plug valves shall have 2-inch operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirement and recommendations of the manufacturer.

(e) Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendation of the manufacturer.

(f) Buried plug valves shall be provided with adjustable valve boxes. Valve boxes shall be cast iron conforming to ASTM A48, Class 30. Valve box castings shall be fully bituminous seal coated. Valve box shall be a Tyler 462A or approved equal.

(2) Thermoplastic ball valves – Thermoplastic ball valves shall be used at each service connection and shall be made of PVS Thermoplastic. The valves shall be furnished with Teflon seats and true union threaded ends. Thermoplastic ball valves shall be manufactured by Hayward, Incorporated or approved equal.

(3) Thermoplastic ball check valves – Thermoplastic ball check valves shall be used at each service connection and shall be made of PVC Thermoplastic. The valves shall be furnished with elastomeric seats and true union threaded ends. Thermoplastic ball check valves shall be as manufactured by Hayward, Incorporated or approved equal.

d) Service Boxes and Lids: All service connections and clean-outs shall be placed in an appropriately sized box in accordance with the Standard Details, and shall be as manufactured by Brooks Products Company (36 Series) or approved equal.

(1) Concrete boxes shall be made of concrete mix, 1-2-1 (one part cement, two parts granite screenings, and one part 3/8” granite stone). The meter boxes shall be concrete machine-made and tamped with pneumatic tamps to ensure the proper density. All concrete items shall be steam-cured 24 hours and yard-cured for two weeks.

(2) All service connection boxes shall be made of green plastic with the physical dimensions shown on the Standard Details, and constructed of standard thermoplastic materials using the structural foam approach, and shall be manufactured by Brooks Products Company (Series 1730). The plastic composition shall be uniform and substantially resistant to moderate acid attack, ultraviolet ray action, and weathering as may be encountered in outdoor application and semi-
buried service.

(3) Plastic lids shall be furnished with “snap lock” tabs, interchangeable with existing City of Rock Hill meter boxes, and imprinted with the words “Pressure Sewer” on the lid.

e) Installation of PVC low pressure pipe: PVC low pressure sewer main shall be installed substantially in accordance with ASTM D2321. The following exceptions shall be taken to the Standard:

(1) Installing Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Construction Drawings and/or as directed by the Engineer.

(a) Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement, the top section shall be anchored by and 18”x18”x6” concrete pad or an approved pre-cast pad, set flush with the existing terrain. The top section will be grouted into the precast concrete pad. The location of the valve will be identified by the letters “PSV” imprinted onto the curb adjacent to the pressure sewer valve.

(2) Alignment and Grade: Unless specifically approved by the Director of Water and Sewer Utilities, the curb must be in place and backfilled, and the area between curb and street right-of-way line graded smooth and to finished grade before the low pressure sewer mains are installed. The pressure sewer mains shall be installed on the opposite side of the road from the water main as shown in the Standard Details. The LPSS shall be laid and maintained at the required lines and grades with fittings and valves at the required locations, spigots centered in bells, and all valve stems plumb. After curb and gutter has been installed the location and depth of the pressure sewer main and valves, etc., will be checked for conformance to these Standard Specifications. Any deficiencies will be corrected to the satisfaction of the City prior to testing and activation of the mains.

(3) Depth of Pipe Installation. Unless otherwise indicated on the Construction Drawings or required by existing utility location, all pipes shall be installed at the depths indicated on the Standard Details. The Contractor is instructed to check Construction Drawings and blow-up views for additional requirements. The Contractor may be required to vary the depth of the pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified whether or not the existing pipelines, conduits, cables, mains, etc., are shown on the Construction Drawings. PVC pressure sewer shall be installed with 12-inch clearance above other utilities or 18 inches below other utilities.

f) Testing: The water for testing purposes can be taken from the nearest available water main under the supervision of the City’s inspector and leakage will be measured by the City with a meter furnished by the City. If service connection or other openings are not available for the purposes of expelling air, the Contractor shall provide air release of sufficient
size (as determined by the Engineer) in accordance with the Standard Details. The test pressure will be 100 psi at the low point of the section under test.

(1) Allowable leakage will be determined by Table 6 in AWWA C600 or the formula \( L = 0.000083 \times S \), where \( S \) is the length of pipe under test and \( D \) is the pipe diameter. Add 0.0050 gal/hr for each 1-1/2 inch lateral.

(2) During the last stages of the test and without any reduction in pressure progressing from the end opposite the test pump, each mainline valve will be closed and pressure released to determine if the valve is holding pressure (minimum 10 minutes per valve closing).

g) 1.5-inch Service Connections: On 3-inch mains and smaller, the 1.5-inch laterals shall be connected to the street main with schedule 80 PVC solvent weld wyes. On 4-inch mains and larger, the 1.5-inch laterals shall be connected to the street main with a mechanical joint tee plugged and tapped for a threaded by solvent-weld schedule 80 PVC Adapter. The 1.5-inch service lateral shall be connected to the property line where a service connection meter box shall be installed. The service connection shall contain the following fittings in accordance with the Standard Details, 45-degree solvent weld elbow, solvent-weld nipple, solvent-weld by threaded adapter, two (2) true union threaded ball valves, threaded adapter, threaded 1.5”x1.5”x1.5” tee, threaded adapter, threaded nipple, true union ball check valve, threaded x solvent-weld nipple, 1.5”x1.25” solvent-weld reducing bushing. The top of the 1.5” tee shall have threaded 1.5”x0.75” reducing bushing and a brass 0.75 hose bib.

J. INSTALLATION AND APPROVAL REQUIREMENTS:

1. HANDLING AND INSTALLATION:

a) Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage.

b) Station manufacturer shall provide written instruction for proper handling.

b) Immediately after off-lading, Contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in a written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts list with shipping documentation. Notify the manufacturer’s representative of any unacceptable conditions noted with shipper.

d) Install, level, align and lubricate pump station as indicated on the Construction Drawings. Installation must be in accordance with written instructions supplied by manufacturer at time of delivery.

e) Suction pipe connections shall be vacuum tight. Fasteners as all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

2. TESTING:
a) Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

b) Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

c) After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

d) Leak testing shall be conducted on all force main piping as described in these specifications for pipe installation. The water for testing purposes can be taken from the nearest available water main under the supervision of the City Inspector and leakage shall be measured by the City with a meter furnished by the City. If service connection or other openings are not available for expelling air, the Contractor shall provide air release of sufficient size (as determined by the Engineer) in accordance with the Standard Details. The pressure test shall be the greater of (1) 100 psi at the low point of the section under test, or (2) 1.5 time the working pressure at the low point of the section under test.

(1) Allowable leakage will be determined by Table 6 in AWWA C600 or the formula \( L = 0.000083S \), where \( S \) is the length of pipe under test and \( D \) is the pipe diameter. Add 0.0050 gph for each 1-1/2 inch lateral.

(2) During the last stages of the test and without any reduction in pressure progressing from the end opposite the test pump, each mainline valve will be closed and pressure released to determine if the valve is holding pressure (minimum 10 minutes per valve closing).

e) Prior to acceptance by City, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition and conforms to the specified operating characteristics.

f) After construction debris and foreign material has been removed from the wet well, Contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction, and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

3. **START-UP:**

a) Coordinate station start-up with manufacturer’s technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions and instruct operating personnel in proper operation and maintenance.
b) Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

c) The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

d) Prior to pumps station operation, contractor to provide weather durable sign with a 24-hour emergency phone number to be located on the structure of the pumping station. See standard detail.

e) A start-up report must be supplied to the City by the manufacturer’s technical representative of the pump station start-up conditions.

f) Operation and maintenance manuals must be supplied to City by the Contractor.