ADDENDUM NO. 4

TO: PLANS AND SPECIFICATIONS FOR

Water & Wastewater Systems Upgrade
Poplar Bluff, MO
Project No. H1610-01

BID DATE IS UNCHANGED FROM ADDENDUM #3: 1:30 P.M. (CST), Thursday, December 19, 2019

Bidders are hereby informed that the construction plans and/or specifications are modified as follows:

1. SPECIFICATIONS (For convenience, changes are in red text in the attached specifications):

   a. SECTION 000100 – TABLE OF CONTENTS:
      Replace this section in its entirety and use the attached revised Section 000100 – Table of Contents.

   b. SECTION 000115 LIST OF DRAWINGS:
      Replace this section in its entirety and use the attached revised Section – 000115 List of Drawings; to add a 16th drawing…Sheet C-112 Construction Details (Sheet 14 of 16).

   c. SECTION 004322 – UNIT PRICES FORM:
      Replace this section in its entirety and use the attached revised Section 004322 – Unit Prices Form; to change Unit Prices #4 and #6 to line the lagoon with a Geoliner Membrane (instead of Bentonite). Bidders are reminded that the Unit Prices Form must be completed and submitted with their bid.

   d. SECTION 007300 - SUPPLEMENTARY CONDITIONS:
      Replace this section in its entirety and use the attached revised Section 007300 – Supplementary Conditions; to add contact info for Tony Hughes, Maintenance Supervisor II of the WESYC site.

   e. SECTION 012200 – UNIT PRICES:
      Replace this section in its entirety and use the attached revised Section 012200 - Unit Prices; to change Unit Prices #4 and #6 to line the lagoon with a Geoliner Membrane (instead of Bentonite), and add Unit Price 20 - Rock removal.

      1) Clarification Note: The Sludge Management Plan shall be the responsibility of the Contractor, and the Contractor shall be responsible to provide the Owner with the DNR approved sludge management and disposal plan. Included in Appendix 4 of this addendum are the results of the (3) lagoons’ sludge testing completed as a result of questions during the Pre-Bid Meeting held on 10/30/2019.

      2) Clarification Note: If applicable and approved by DNR within the Sludge Management Plan, the sludge can be placed within the construction site or mixed within the proposed earthwork being completed to form the new Lagoon Cell #1.

      3) Clarification Note: The rip-rap within new Lagoon Cell #1 has been eliminated due to the utilization of the new Section 313526.16 - Geoliner Membrane, and this reduction should be reflected in the bid price for Unit Price #7. The remaining rip-rap areas should still be included within this bid item; and the Rip-Rap thickness is located on Sheet C-106, note #2.

      4) Clarification Note: All Unit Price 8 Force Main piping will need to be restrained. Gravity lines not required, per the specifications.

      5) Clarification Note: During the 10/30/19 Prebid, the Owner requested that no barb-wire fencing be installed around the Sprinkler and Stands; as a result Unit Price 13 in Sections 004322 and 012200 has also been changed to indicate no barb-wire fencing is required around the Sprinkler and Stands. In addition, the detail for barbed-wire fence installation has been modified on Sheet C-111. Furthermore, barbed-wire fence shall be installed along the top of the berm in lieu-of chain-link fence.

      6) Clarification Note: The Owner requested that a Unit Price line item be added to address the issue of rock removal within the project. Unit Price 20 – Rock Removal has been added to Sections 004322 and 012200.
f. SECTION 013300 – SUBMITTALS:
Replace this section in its entirety and use the attached revised Section 013300 – Submittals; to add Section 313526.16 Geoliner Membrane submittal requirements to paragraph 2.1 “Required Submittals”.

g. SECTION 013513.22 – SITE SECURITY AND HEALTH REQUIREMENTS (DYS):
Replace this section in its entirety and use the attached revised Section 001300 – Submittals; to revise paragraph 1.2. Submittals and add paragraph 3.3 Criminal Background and Wants & Warrants Check.

h. SECTION 260000 – ELECTRICAL MATERIALS AND METHODS:
Replace this section in its entirety and use the attached revised Section 260000 – Electrical Materials and Methods; to revised paragraph 1.5.A requirement for a new 100 Amp, 277/480 V, 3-phase, 4-wire electrical service (instead of a 60 Amp) for the pump station; and add clarifying Warranty paragraph 3.10.A “The Project 1 Yr Warranty period applies to Section 260000 - Electrical Materials and Methods.”

i. SECTION 260200 – CONTROL PANEL:
Replace this section in its entirety and use the attached revised Section 260200 – Control Panel; to add clarifying Warranty paragraph 3.3.A “The Project 1 Yr Warranty period applies to Section 260200 – Control Panel.”

j. SECTION 312000 – EXCAVATING & BACKFILLING TRENCHES:
Replace this section in its entirety and use the attached revised Section 312000 – Excavating & Backfilling Trenches; to clarify paragraph 3.20.B to read “Where settling occurs before Project 1 Yr Warranty period elapses…”.

k. SECTION 312500 – PERMANENT EROSION CONTROL & LANDSCAPING:
Replace this section in its entirety and use the attached revised Section 312500 – Permanent Erosion Control & Landscaping; to clarify paragraph 3.5.A to read “At end of Project 1 Yr Warranty period, a healthy, uniform, close stand of grass shall have been established…”.

l. SECTION 313526.16 – GEOLINER MEMBRANE:
Add new Section 313526.16 - Geoliner Membrane specification in its entirety; to revised drawings and specification to require installation of a lagoon Geoliner Membrane (instead of Bentonite Seal).

1) Clarification Note: The added specification Section 313526.16 - Geoliner Membrane shall be utilized in place of the Bentonite Seal, as described in Section 333400 - Lagoon Earthwork and Structures. In addition, Plan Sheets C-104, 105, 106, 110, 111 and newly added C-112 have been updated to indicate deletion of the bentonite seal and installation of the Geoliner Membrane per Section 313526.16 - Geoliner Membrane, and as described in Section 333400 - Lagoon Earthwork and Structures.

2) Clarification Note: Please note that paragraph 1.8 Warranty requires the Contractor to furnish both 5 yr geoliner membrane material + 1 yr installation warranties.

m. SECTION 323100 – CHAIN LINK FENCING & GATES:
Replace this section in its entirety and use the attached revised Section 323100 - Chain Link Fencing & Gates; to add clarifying Warranty paragraph 3.6.C “The Project 1 Yr Warranty period applies to Section 323100 - Chain Link Fencing & Gates.”

n. SECTION 331100 – WATER SUPPLY WELLS:
Replace this section in its entirety and use the attached revised Section 331100 - Water Supply Wells; to add clarifying Warranty paragraph 3.17.A “The Project 1 Yr Warranty period shall apply to Section 331100 - Water Supply Wells.”

o. SECTION 331400 – WATER DISTRIBUTION PIPING:
Replace this section in its entirety and use the attached revised Section 331400 - Water Distribution Piping; to add clarifying Warranty paragraph 3.19.A “The Project 1 Yr Warranty period shall apply to Section 331400 - Water Distribution Piping.”

p. SECTION 333000 – SANITARY SEWERAGE:
Replace this section in its entirety and use the attached revised Section 333000 – Sanitary Sewerage; to add clarifying Warranty paragraph 3.14.A “The Project 1 Yr Warranty period shall apply to Section 333000 - Sanitary Sewerage.”
q. SECTION 333200 – SANITARY SEWER PUMPING STATIONS:
Replace this section in its entirety and use the attached revised Section 333200 - Sanitary Sewer Pumping Stations; to add clarifying Warranty paragraph 3.14.A “The Project 1 Yr Warranty period shall apply to Section 333000 - Sanitary Sewerage.”

r. SECTION 333400 – LAGOON EARTHWORK AND STRUCTURES:
Replace this section in its entirety and use the attached revised Section 333400 – Lagoon Earthwork and Structures; to revise requirement to install lagoon Geoliner Membrane (instead of Bentonite Seal), along with testing and submittal requirements. Also, added clarifying Warranty paragraph 2.10.A “The Project 1 Year Warranty period shall apply to Lagoon Earthwork & Structures.”

s. APPENDIX NO. 4 – SLUDGE SAMPLE RESULTS FOR WESYC’s THREE (3) WASTEWATER TREATMENT LAGOONS:
Add new Appendix No. 4 - Sludge Sampling Results for WESYC’s Three (3) Wastewater Treatment Lagoons in its entirety; to provide supplemental sludge sample results for each of the (3) lagoons.

2. PLANS (Only Sheets with changes noted below are included, otherwise use original bid Plans):

a. Plan Sheet G-001 Cover Sheet:
Replace the plan sheet in its entirety and use the attached revised Plan Sheet G-100; to add Sheet C-112 listing to the table of (16) drawings.

b. Plan Sheet C-102 Water System Construction Details:
Replace the plan sheet in its entirety and use the attached revised Plan Sheet C-102; the scale was shown incorrectly in the upper-left-corner “Proposed Plan View” and has been revised.

c. Plan Sheet C-110 Sanitary Sewer System Details:
Replace the plan sheet in its entirety and use the attached revised Plan Sheet C-110; to correct called-out diameters of the wet wells from 60” to 84” in diameter; and valve vaults’ inside diameter is to be 72”.

d. Plan Sheet C-111 Construction Details:
Replace the plan sheet in its entirety and use the attached revised Plan Sheet C-111; to eliminate installation of called-out fencing around each sprinkler and stand. In addition, Sections 004322 – Unit Prices Form and Section 012200 - Unit Prices have both been changed to delete this fencing.

e. Plan Sheets C-104, 105, 106, 110, 111, and newly added C-112:
All (6) of these plan sheets have been updated to remove the bentonite seal and install the Geoliner Membrane. In addition, Addendum #4 added Section 313526.16 - Geoliner Membrane shall be utilized in place of the Bentonite Seal, as described in Section 333400 -Lagoon Earthwork and Structures.

1) Clarification Note: Surveying/staking is the responsibility of the Contractor.

3. GENERAL NOTES:

a. CLARIFICATIONS REGARDING SLUDGE DISPOSAL:
I. Plan sheet C-103 Note #7 says “Contractor…shall obtain all necessary permitting from the MO Dept of Natural Resources.” To address Contractor questions about how to bid/comply with this requirement; the project engineer provides the following clarification: Typically, if the Contractor is unable to prepare the sludge management plan themselves (which requires DNR approval), or land apply the sludge themselves, they should hire a specialty subcontractor to preform those services. It is up to the Contractor to select subcontractors, but the alphabetic list of plan holders/Contractors (not an endorsement) below should have experience with preparing the sludge management plan and obtaining necessary permit/approvals through DNR:

1) CA Walker Construction, Dexter, MO (Charles Walker, Ph# 573-624-0261)
2) Kajacs Contractors Inc, Poplar Bluff, MO (Rodger Williams, Ph# 573-785-1745)
3) Robertson B&G Inc, Poplar Bluff, MO (David Grubbs, Ph# 573-686-2464)
4) Robertson Contractors Inc, Poplar Bluff, MO (Ty Milner, Ph# 573-785-0880)
b. CLARIFICATION REGARDING ACCESS DOORS TO PUMP and VALVE VAULTS:
   I. Plan sheet C-110’s upper-right corner plan-view detail shows Pump and Valve Vaults to be constructed. To address Contractor questions about size/specification for hinged access doors to be bid; the project engineer provides the following clarification: General reference dimensions were provided for the access doors depicted by dashed-line in the C-110 plan-view; and Section 333200 provides the specifications for access doors/hatches. Access door size(s) to be used is dependent upon the size of the pump/equipment selected by the Contractor. Submittals from the successful Contractor will be required for approval, and failure to submit acceptable required documentation may result in rejection.

c. CLARIFICATION REGARDING FENCING AROUND SPRINKLERS and STANDS:
   I. Plan sheet C-111 called for the installation of fencing around each sprinkler and stand; and has been changed to call for NO fencing.

d. CLARIFICATIONS REGARDING TREE REMOVAL:
   I. Bidders are advised to apply any dollar value they may realize from the removal/sale of any trees or lumber from the project’s 16.8 acre site clearing work, as savings toward their bid.
   II. Burn permits must be obtained by the Contractor prior to burning on-site; Contractor is responsible for observing Red Flag Warnings issued for the area by the National Weather Service, and Contractor is responsible for both supervising fires and any resultant damage.
   III. Any stumps that remain after burning may be buried on-site away from berm, sprinkler or force main construction.

e. CLARIFICATION REGARDING POWER POLE INSTALLATION ON SHEET E-102:
   I. Bidders are advised that the power pole installation shown on Sheet E-102 will be the responsibility of the local utility. The Owner is working with Ozark Border Electric to provide a utility easement and expedite the installation.

4. ATTACHMENTS:

   a. REVISED SECTION 000100 – TABLE OF CONTENTS.
   b. REVISED SECTION 000115 – LIST OF DRAWINGS.
   c. REVISED SECTION 004322 – UNIT PRICES FORM.
   d. REVISED SECTION 007300 - SUPPLEMENTARY CONDITIONS.
   e. REVISED SECTION 012200 – UNIT PRICES.
   f. REVISED SECTION 013300 – SUBMITTALS.
   g. REVISED SECTION 013513.22 – SITE SECURITY AND HEALTH REQUIREMENTS (DYS).
   h. REVISED SECTION 260000 – ELECTRICAL MATERIALS AND METHODS.
   i. REVISED SECTION 260200 – CONTROL PANEL.
   j. REVISED SECTION 312000 – EXCAVATING & BACKFILLING TRENCHES.
   k. REVISED SECTION 312500 – PERMANENT EROSION CONTROL & LANDSCAPING.
   l. ADDED NEW SECTION 313526.16 – GEOLINER MEMBRANE.
   m. REVISED SECTION 323100 – CHAIN LINK FENCING & GATES.
   n. REVISED SECTION 331100 – WATER SUPPLY WELLS.
   o. REVISED SECTION 331400 – WATER DISTRIBUTION PIPING.
   p. REVISED SECTION 333000 – SANITARY SEWERAGE.
   q. REVISED SECTION 333200 – SANITARY SEWER PUMPING STATIONS.
   r. REVISED SECTION 333400 – LAGOON EARTHWORK AND STRUCTURES.
   s. ADDED NEW APPENDIX NO. 4 – SLUDGE SAMPLE RESULTS FOR WESYC’s THREE (3) WASTEWATER TREATMENT LAGOONS.
   t. REVISED PLAN SHEETS G-100, C-102, C-104, C-105, C-106, C-110, C-111; and the new Plan Sheet C-112.

End of Addendum No. 4
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>NUMBER OF PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 00 – PROCUREMENT AND CONTRACTING INFORMATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>000000</td>
<td>INTRODUCTORY INFORMATION</td>
<td></td>
</tr>
<tr>
<td>000101</td>
<td>Project Manual Cover</td>
<td>1</td>
</tr>
<tr>
<td>000107</td>
<td>Professional Seals and Certifications</td>
<td>1</td>
</tr>
<tr>
<td>000110</td>
<td>Table of Contents</td>
<td>2</td>
</tr>
<tr>
<td>000115</td>
<td>List of Drawings</td>
<td>1</td>
</tr>
<tr>
<td>001116</td>
<td>INVITATION FOR BID (IFB)</td>
<td>2</td>
</tr>
<tr>
<td>002113</td>
<td>INSTRUCTIONS TO BIDDERS</td>
<td>7</td>
</tr>
<tr>
<td>002213</td>
<td>Supplementary Instructions to Bidders – MBE/WBE/SDVE Instructions</td>
<td>4</td>
</tr>
<tr>
<td>003144</td>
<td>MBE/WBE/SDVE Directory</td>
<td>1</td>
</tr>
<tr>
<td>004000</td>
<td>PROCUREMENT FORMS &amp; SUPPLEMENTS</td>
<td></td>
</tr>
<tr>
<td>004113</td>
<td>Bid Form</td>
<td>*</td>
</tr>
<tr>
<td>004322</td>
<td>Unit Prices Form</td>
<td>6</td>
</tr>
<tr>
<td>004337</td>
<td>MBE/WBE/SDVE Compliance Evaluation Form</td>
<td>*</td>
</tr>
<tr>
<td>004338</td>
<td>MBE/WBE/SDVE Eligibility Determination for Joint Ventures Form</td>
<td>*</td>
</tr>
<tr>
<td>004339</td>
<td>MBE/WBE/SDVE Good Faith Effort (GFE) Determination Form &amp; Instructions</td>
<td>*</td>
</tr>
<tr>
<td>004340</td>
<td>SDVE Business Form</td>
<td>*</td>
</tr>
<tr>
<td>004541</td>
<td>Affidavit of Work Authorization</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>* These documents may be found on MissouriBUYS at https:\missouribuys.mo.gov/</td>
<td></td>
</tr>
<tr>
<td>005000</td>
<td>CONTRACTING FORMS AND SUPPLEMENTS</td>
<td></td>
</tr>
<tr>
<td>005213</td>
<td>Construction Contract</td>
<td>3</td>
</tr>
<tr>
<td>005414</td>
<td>Affidavit for Affirmative Action</td>
<td>1</td>
</tr>
<tr>
<td>006113</td>
<td>Performance and Payment Bond</td>
<td>2</td>
</tr>
<tr>
<td>006325</td>
<td>Product Substitution Request</td>
<td>2</td>
</tr>
<tr>
<td>006519.16</td>
<td>Final Receipt of Payment and Release Form</td>
<td>1</td>
</tr>
<tr>
<td>006519.18</td>
<td>MBE/WBE/SDVE Progress Report</td>
<td>1</td>
</tr>
<tr>
<td>006519.21</td>
<td>Affidavit of Compliance with Prevailing Wage Law</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>** To view these forms, see <a href="http://oa.mo.gov/facilities/vendor-links/contractor-forms">http://oa.mo.gov/facilities/vendor-links/contractor-forms</a></td>
<td></td>
</tr>
<tr>
<td>007000</td>
<td>CONDITIONS OF THE CONTRACT</td>
<td></td>
</tr>
<tr>
<td>007213</td>
<td>General Conditions</td>
<td>20</td>
</tr>
<tr>
<td>007300</td>
<td>Supplementary Conditions</td>
<td>2</td>
</tr>
<tr>
<td>007346</td>
<td>Wage Rate – Butler County</td>
<td>4</td>
</tr>
<tr>
<td>DIVISION 01 – GENERAL REQUIREMENTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>011000</td>
<td>Summary of Work</td>
<td>2</td>
</tr>
<tr>
<td>012100</td>
<td>Allowances</td>
<td>2</td>
</tr>
<tr>
<td>012200</td>
<td>Unit Prices</td>
<td>6</td>
</tr>
<tr>
<td>012600</td>
<td>Contract Modification Procedures</td>
<td>2</td>
</tr>
<tr>
<td>013100</td>
<td>Coordination</td>
<td>4</td>
</tr>
<tr>
<td>013200</td>
<td>Schedules</td>
<td>4</td>
</tr>
<tr>
<td>013300</td>
<td>Submittals</td>
<td>6</td>
</tr>
<tr>
<td>013513.22</td>
<td>Site Security and Health Requirements (DYS)</td>
<td>3</td>
</tr>
<tr>
<td>015000</td>
<td>Construction Facilities and Temporary Controls</td>
<td>8</td>
</tr>
<tr>
<td>015723</td>
<td>Temporary Storm Water Pollution Prevention / Erosion Control</td>
<td>9</td>
</tr>
<tr>
<td>017400</td>
<td>Cleaning</td>
<td>3</td>
</tr>
<tr>
<td>DIVISION 03 – CONCRETE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>033000</td>
<td>Cast-In-Place Concrete</td>
<td>10</td>
</tr>
<tr>
<td>DIVISION 26 – ELECTRICAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>260000</td>
<td>Electrical Materials and Methods</td>
<td>10</td>
</tr>
<tr>
<td>260020</td>
<td>Control Panel</td>
<td>4</td>
</tr>
</tbody>
</table>
**DIVISION 31 – EARTHWORK**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>310000</td>
<td>Earthwork</td>
<td>9</td>
</tr>
<tr>
<td>311000</td>
<td>Site Clearing</td>
<td>3</td>
</tr>
<tr>
<td>312000</td>
<td>Excavating and Backfilling Trenches</td>
<td>12</td>
</tr>
<tr>
<td>312500</td>
<td>Permanent Erosion Control and Landscaping</td>
<td>5</td>
</tr>
<tr>
<td>313526.16</td>
<td>Geoliner Membrane</td>
<td>12</td>
</tr>
</tbody>
</table>

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>323100</td>
<td>Chain-Link Fencing and Gates</td>
<td>7</td>
</tr>
</tbody>
</table>

**DIVISION 33 – UTILITIES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>331100</td>
<td>Water Supply Wells</td>
<td>6</td>
</tr>
<tr>
<td>331400</td>
<td>Water Distribution Piping</td>
<td>15</td>
</tr>
<tr>
<td>333000</td>
<td>Sanitary Sewage</td>
<td>11</td>
</tr>
<tr>
<td>333200</td>
<td>Sanitary Sewer Pumping Stations</td>
<td>12</td>
</tr>
<tr>
<td>333400</td>
<td>Lagoon Earthwork and Structures</td>
<td>5</td>
</tr>
</tbody>
</table>

**APPENDICES**

- **APPENDIX 1:** MODNR Land Disturbance Operating Permit NO. MO-R100038  
  (Refer to Spec Section 015723 for SWPPP submittal & BMP requirements)  
  - 26

- **APPENDIX 2:** MODNR Construction Permit #CP0002007  
  - 8

- **APPENDIX 3:** Google Directional Maps  
  (W. E. Sears Youth Center (WESYC) is 6 mi N on Hwy 67 of the Poplar Bluff Hwy 60 / Hwy 67 intersection. From Sears Ln / Hwy 67 crossing, go W on Sears Lane (“blue-line” Appendix 3 map), park in Admin Bldg parking lot (“red-dot” on map), come into Admin Bldg visitor’s entrance.)  
  - 2

- **APPENDIX 4:** Sludge Sample Results for WESYC’s Three (3) Wastewater Treatment Lagoons  
  - 2
SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

A. The following list of drawings is a part of the Bid Documents:

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SHEET #</th>
<th>DATE</th>
<th>CAD #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cover Sheet</td>
<td>Sheet G-001</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>2. Legend/Notes</td>
<td>Sheet G-002</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>3. Water System Existing Conditions</td>
<td>Sheet C-101</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>4. Water System Details</td>
<td>Sheet C-102</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>5. Sanitary Sewer Existing Conditions</td>
<td>Sheet C-103</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>6. Sanitary Sewer Proposed Site Plan</td>
<td>Sheet C-104</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>7. Sanitary Sewer Hydraulic Profile</td>
<td>Sheet C-105</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>8. Sanitary Sewer Lagoon #1 Layout</td>
<td>Sheet C-106</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>9. Ground Application Plan &amp; Profile</td>
<td>Sheet C-107</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>10. Ground Application Plan &amp; Profile</td>
<td>Sheet C-108</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>11. Ground Application Plan &amp; Profile</td>
<td>Sheet C-109</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>12. Sanitary Sewer System Details</td>
<td>Sheet C-110</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>13. Construction Details</td>
<td>Sheet C-111</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>14. Construction Details</td>
<td>Sheet C-112</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>15. Water System Electrical Details</td>
<td>Sheet E-101</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
<tr>
<td>16. Sewer System Electrical Details</td>
<td>Sheet E-102</td>
<td>06/21/19</td>
<td>P160201</td>
</tr>
</tbody>
</table>

END OF SECTION 000115
ADDENDUM #4

SECTION 004322 - UNIT PRICES FORM                  PROJECT NUMBER Y1610-01

1.0 Description

A. For changing specified quantities of work from those indicated by the contract drawings and specifications, upon written instructions of Owner, the following unit prices shall prevail. The unit prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover the finished work of the several kinds of work called for. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that shown on the drawings and called for in the specifications or included in the Base Bid. In the event of more or less units than so indicated or included during construction the total contract price shall be decreased as appropriate or increased by contract change in accordance with General Conditions Article 4.1.

2.0 PRICES:

A. Unit Price 1 – Mobilization/Demobilization

1. Description: All labor, equipment and materials necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site and any other items necessary to provide a complete and functional project

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum is to be included in the Base Bid.

   $__________________________ Per Lump Sum of Mobilization/Demobilization.

B. Unit Price 2 – Clearing & Grubbing

1. Description: Clearing & Grubbing according to Division 31 Section 31 10 00 “Site Clearing”

2. Unit of Measurement: Acre (AC).

3. Quantity in Base Bid: Sixteen and Eight-Tenths (16.8) acres are to be included in the Base Bid.

   $__________________________ Per Acre of Clearing & Grubbing.

C. Unit Price 3 – Sludge Removal and Disposal

1. Description: all labor, equipment and materials necessary to remove and dispose of sludge from lagoon cells and any other items necessary to provide a complete and functional project according to the plans and Missouri Department of Natural Resources Regulations

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum to be included in the Base Bid.

   $__________________________ Per Lump Sum of Sludge Removal and Disposal.
ADDENDUM #4

D. Unit Price 4 – Lagoon Modifications

1. Description: all labor, equipment and materials necessary for reshaping and compaction of the lagoon cells and aggregate road. This item also consists of digging required for Geoliner Membrane installation, finish grading as required for placement of Geoliner Membrane, effluent pipe installation, and any other items necessary to provide a complete and functional project according to the plans and Section 333400 "Lagoon Earthwork and Structures”, Section 312000 “Excavating and Backfilling Trenches”, and Section 313536.16 “Geoliner Membrane”.

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum to be included in the Base Bid.

$ _______________________ Per Lump Sum of Lagoon Modifications.

E. Unit Price 5 – Pump Station Improvements:

1. Description: all labor and materials needed to construct the main pump station as shown on the drawings including but not limited to bypass and temporary pumping, constructing the new wetwell, installing new pump bases, pumps, wetwell piping, guide rails, installing new valve vault, valves, and appurtenances, installation of control panel, installing new control panel, wiring, and conduit, float switches, other electrical appurtenances, new pressure gauge, air release valve, factory assistance and startup, testing, daily cleanup, and any and all other items needed to provide a complete and functional pump station as shown on the drawings and described in Division 33 Section 333200 “Sanitary Sewer Pumping Station.”

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum to be included in the Base Bid.

$ _______________________ Per Lump Sum of Pump Station Improvements.

F. Unit Price 6 – Geoliner Membrane:

1. Description: All labor, equipment and materials associated with the installation of a Geoliner Membrane as outlined in Division 31 Section 313526.16 “Geoliner Membrane”.

2. Unit of Measurement: Square Feet (SF).

3. Quantity in Base Bid: Fifty-Seven Thousand Seven-Hundred Seventy (57,770) Square Feet to be included in the Base Bid.

$ _______________________ Per Square Feet of Geoliner Membrane.
G. Unit Price 7 – Rip-Rap Lined Areas:
   1. Description: All labor, equipment and materials associated with the installation of a Rip-Rap as outlined in Division 33 Section 333400 “Lagoon Earthwork and Structures”.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum to be included in the Base Bid.

   $_________________________ Per Lump Sum of Rip-Rap Lined Areas.

H. Unit Price 8 – 6” Force Main:
   1. Description: All labor, equipment and materials necessary for the installation of 6” Force Main piping, including attaching to existing valve box, attachment to Influent Structure, new air release valve, new gate valves and any other items necessary to provide a complete and functional project according to the plans and Division 31 Section 312000 “Excavating and Backfilling Trenches” and Division 33 Section 333000 “Sanitary Sewerage.”
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Seventy-Six (4,076) linear feet of 6” Force Main are included in the Base Bid.

   $_________________________ Per Linear Feet (LF) of 6” Force Main.

I. Unit Price 9 – Modification of Existing Manhole:
   1. Description: All labor, equipment and materials necessary for the installation of a concrete influent transfer structure, including; piping, concrete splash pads, and grating over the end of the pipes and any other items necessary to provide the transfer of waste from gravity system to new cell no. 1 in order to provide a complete and functional project according to the plans and Division 31 Section 312000 “Excavating and Backfilling Trenches,” Division 33 Section 333400 “Lagoon Earthwork and Structures,” Section 333000 “Sanitary Sewerage,” Division 3 Section 033000 "Cast-in-Place Concrete”.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) lump sum of Modification of Existing Manhole is included in the Base Bid.

   $_________________________ Per Lump Sum (LS) of Modification of Existing Manhole.
J. Unit Price 10 – Emergency Overflow Structure:

1. Description: All labor, equipment and materials necessary for the construction of the Emergency Overflow Structure and any other items necessary to provide a complete and functional project according to the plans and specifications; Section 310000 “Earthwork”; 033000 “Cast-in-Place Concrete”.

2. Unit of Measurement: Lump Sum (LS)

3. Quantity in Base Bid: One (1) Lump Sum is included in the Base Bid.

   $ _____________________ Per Lump Sum (LS) of Emergency Overflow Structure.

K. Unit Price 11 – Temporary Treatment:

1. Description: All labor, equipment and materials necessary for the temporary treatment of sewage during construction. This item should include any required pumping and temporary bypass piping and any other items necessary to provide a complete and functional project according to the plans and Missouri Department of Natural Resources Regulations. The contractor shall submit temporary treatment plan to Engineer prior to construction.

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum is included in the Base Bid.

   $ _____________________ Per Lump Sum of Temporary Treatment.

L. Unit Price 12 – Electrical Work:

1. Description: All labor, equipment, framing for equipment mounting and materials necessary for completing the site electrical work, including; wiring, conduit, electrical service, power panels, disconnect switches, main control panel, control wiring, power, receptacles, switches, conduit and any other items necessary to provide a complete and functional project according to the plans and Division 26 Section 260000 “Electrical Materials and Methods”

2. Unit of Measurement: Lump Sum (LS).

3. Quantity in Base Bid: One (1) Lump Sum is included in the Base Bid.

   $ _____________________ Per Lump Sum of Electrical Work.
M. Unit Price 13 – Sprinklers and Stand:
   1. Description: All material, including the sprinklers, concrete stand, all necessary fittings, labor, and any other items necessary to provide a complete and functional project as outlined on the plans and specifications and in Division 33 Section 333000 “Sanitary Sewerage”.
   2. Unit of Measurement: Each (EA).
   3. Quantity in Base Bid: Twenty-five (25) each are included in the Base Bid.

   $ _________________________  Per Each of Sprinklers and Stand installed.

N. Unit Price 14 – Force Main Drainage Structure:
   1. Description: All material, including all necessary fittings, perforated pipe, geotextile fabric, rock filter bed, labor, and any other items necessary to provide a complete and functional project as outlined on the plans and specifications in Division 33 Section 333000 “Sanitary Sewerage”.
   2. Unit of Measurement: Each (EA).
   3. Quantity in Base Bid: Eight (8) each are included in the Base Bid.

   $ _________________________  Per Each of Force Main Drainage Structure installed.

O. Unit Price 15 – Berm Construction:
   1. Description: all labor, equipment and materials necessary for the construction of the earthen berm around the boundary of the application area and any other items necessary to provide a complete and functional project according to the plans and specifications and in Division 31 Section 310000 “Earthwork”.
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Sixty-Four (4,064) linear feet are included in the Base Bid.

   $ _________________________  Per Linear Feet (LF) of Berm Construction installed.

P. Unit Price 16 – Seeding & Mulching
   4. Description: Clearing & Grubbing according to Division 31 Section 312500 "Permanent Erosion Control and Landscaping"
   5. Unit of Measurement: Acre (AC).
   6. Quantity in Base Bid: Sixteen and Eight-Tenths (16.8) acres are to be included in the Base Bid.

   $ _________________________  Per Acre of Seeding & Mulching.
Q. Unit Price 17 – Fencing:
   1. Description: all labor, equipment and materials necessary for placing fencing, gates and any other items necessary to provide a complete and functional project according to the plans and Section 323100 “Fencing and Gates”. Removal and relocation of existing fences during construction shall be incidental to the project.
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Seventy-Four (4,074) linear feet are included in the Base Bid.

   $__________________________ Per Linear Feet (LF) of Fencing installed.

R. Unit Price 18 – Well No. 3 Drawdown Gauge:
   1. Description: All labor, equipment and materials necessary for the installation of a drawdown gauge in the existing well no. 3 and any other items necessary to provide a complete and functional project.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) lump sum is included in the Base Bid.

   $__________________________ Per Lump Sum of Well No. 3 Drawdown Gauge installed.

S. Unit Price 19 – Retrofitting Well No. 1
   1. Description: All labor, equipment and materials necessary to complete the capping of existing Well No. 2 piping and the retrofitting of piping, valves, and any other appurtenances required to construct the necessary components as shown on the plans to allow the smooth transition from operating well to ground monitoring and any other items necessary for the retrofitting of Well No. 1 to provide a complete and functional project as shown on the plans, specifications and Missouri Department of Natural Resources Regulations.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum is included in Base bid.

   $__________________________ Per Lump Sum of Retrofitting Well No. 1 installed.

T. Unit Price 20 – Rock Removal
   1. Description: All labor, equipment and materials necessary for the removal of rock within the confines of the project scope of work and any other items necessary to provide a complete and functional project.
   2. Unit of Measurement: Cubic Yard (CY).
   3. Quantity in Base Bid: Ten (10) Cubic Yard of Rock Removal is to be included in Base bid.

   $__________________________ Per Cubic Yard of Rock Removal.

END OF SECTION 004322
SECTION 007300 – SUPPLEMENTARY CONDITIONS

1.0 GENERAL

A. These Supplementary General Conditions clarify, add, delete, or otherwise modify standard terms and conditions of DIVISION 0, BIDDING AND CONTRACTING REQUIREMENTS.

2.0 CONTACTS

A. Designer: Dominic Thompson, P.E.
Smith & Company Engineers
901 Vine St; PO Box 72
Poplar Bluff, MO 63902
Telephone: (573) 785-9621
Fax: (573) 785-2651
E-Mail: DomT@shsmithco.com

B. Project Manager: Ron Littich
Office of Administration - Division of Facilities Management, Design and Construction (FMDC)
301 West High Street
Harry S. Truman Building, Room 730
Jefferson City, MO 65101
Telephone: (573) 751-8296
Fax: (573) 751-7277
E-Mail: Ronald.Littich@oa.mo.gov

C. Construction Administrator: Tim Deal
Office of Administration - Division of Facilities Management, Design and Construction (FMDC)
(Same address as for Project Manager above)
Telephone: (573) 751-7095
Cell Phone: (573) 645-2457
Fax: (573) 751-7277
E-Mail: Timothy.Deal2@oa.mo.gov

C. Contract Specialist: Kelley Copeland
Office of Administration - Division of Facilities Management, Design and Construction (FMDC)
(Same address as for Project Manager above)
Telephone: (573) 522-2283
Fax: (573) 751-7277
E-Mail: Kelley.Copeland@oa.mo.gov

D. Site Facilities/Maintenance Supervisor: Tony Hughes
W. E. Sears Youth Center
9400 Sears Lane
Poplar Bluff, MO 63901
Telephone: (573) 840-9280
E-Mail: Tony.Hughes@oa.mo.gov

3.0 NOTICE: ALL BID MATERIALS ARE DUE AT THE TIME OF BID SUBMITTAL. THERE IS NO SECOND SUBMITTAL FOR THIS PROJECT

4.0 FUNNISHING CONSTRUCTION DOCUMENTS:

A. The Owner will furnish the Contractor with approximately (5) complete sets of drawings and specifications at no charge.
B. The Owner will furnish the Contractor with approximately (5) sets of explanatory or change drawings at no charge.

C. The Contractor may make copies of the documents as needed, at no additional cost to the Owner.

5.0 ILLEGAL IMMIGRATION AND IMMIGRATION RESPONSIBILITY ACT:
The Contractor understands and agrees that by signing a contract for this project, they certify the following:

A. The Contractor shall only utilize personnel authorized to work in the United States in accordance with applicable federal and state laws. This includes but is not limited to the Illegal Immigration Reform and Immigration Responsibility Act (IIRIRA) and INA Section 274A.

B. If the contractor is found in violation of the requirement or the applicable laws of the state, federal or local laws and regulations, and if the State of Missouri has reasonable cause to believe that the Contractor has knowingly employed individuals who are not eligible to work in the United States, the State shall have the right to cancel the contract immediately without penalty and recourse and suspend or debar the contractor from doing business with the state.

C. The contractor agrees to fully cooperate with any audit or investigation from federal, state or local law enforcement agencies.

6.0 SAFETY REQUIREMENTS:
Contractor and subcontractors at any tier shall comply with RsMO 292.675 and Article 1.3 E, of Section 007213, General Conditions.

7.0 INSURANCE REQUIREMENTS:

A. The successful Contractor shall procure and maintain for the duration of the contract issued policy or policies of insurance for protection of the Contractor, the Owner; and their respective officers, officials, agents, consultants, employees, and property owner(s) as listed in Part 9.0 of this section.

B. SECTION 007213-GENERAL CONDITIONS, ARTICLE 1.11-INDEMNIFICATION, Paragraph A shall be changed as follows: Contractor agrees to indemnify and save harmless Owner and Designer, their agents, servants, employees, and property owners, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants, or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants, employees or property owners, in defense of any claim, action or suit.

8.0 WARRANTY

A. SECTION 007213 GENERAL CONDITIONS, ARTICLE 3.4, A2- GUARANTY AND WARRANTIES. The one-year warranty APPLIES to this project.

9.0 PROPERTY OWNER ADDITIONAL INSURED

A. From SECTION 007213-GENERAL CONDITIONS, Article 6.2, the property owner shall also be named as additionally insured. They are:

1. Division of Youth Services - W. E. Sears Youth Center
   9400 Sears Ln
   Poplar Bluff, MO  63901
   Phone: (573) 840-9280

END OF SECTION 007300
SECTION 012200 – UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

B. Quantities of Units to be included in the Base Bid are indicated in Section 004322 – Unit Prices.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Unit Prices.

B. Related Sections include the following:
   1. Division 1 Section "Allowances" for procedures for using Unit Prices to adjust quantity allowances.
   2. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes.

1.3 DEFINITIONS

A. Unit Price is an amount proposed by bidders, stated on the Bid Form Attachment 004322 a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit Prices include all necessary material plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of Unit Prices. Methods of measurement and payment for Unit Prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of Work in-place that involves use of established Unit Prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of Unit Prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each Unit Price.
PART 2 - EXECUTION

2.1 LIST OF UNIT PRICES

A. Unit Price 1 – Mobilization/Demobilization
   1. Description: All labor, equipment and materials necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site and any other items necessary to provide a complete and functional project.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Mobilization/Demobilization is to be included in the Base Bid.

B. Unit Price 2 – Clearing & Grubbing
   1. Description: Clearing & Grubbing according to Division 31 Section 311000 "Site Clearing”
   2. Unit of Measurement: Acre (AC).
   3. Quantity in Base Bid: Sixteen and Eight-Tenths (16.8) acres of Clearing and Grubbing to be included in the Base Bid.

C. Unit Price 3 – Sludge Removal and Disposal
   1. Description: all labor, equipment and materials necessary to remove and dispose of sludge from lagoon cells and any other items necessary to provide a complete and functional project according to the plans and Missouri Department of Natural Resources Regulations.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Sludge Removal and Disposal to be included in the Base Bid.

D. Unit Price 4 – Lagoon Modifications
   1. Description: all labor, equipment and materials necessary for reshaping and compaction of the lagoon cells and aggregate road. This item also consists of digging required for Geoliner Membrane, finish grading as required for placement of Geoliner Membrane, effluent pipe installation, and any other items necessary to provide a complete and functional project according to the plans and Section 333400 "Lagoon Earthwork and Structures”, Section 312000 “Excavating and Backfilling Trenches”, and Section 313536.16 “Geoliner Membrane”.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Lagoon Modifications to be included in the Base Bid.
E. Unit Price 5 – Pump Station Improvements:
   1. Description: all labor and materials needed to construct the main pump station as shown on the drawings including but not limited to bypass and temporary pumping, constructing the new wetwell, installing new pump bases, pumps, wetwell piping, guide rails, installing new valve vault, valves, and appurtenances, installation of new control panel, wiring, and conduit, float switches, other electrical appurtenances, new pressure gauge, air release valve, factory assistance and startup, testing, daily cleanup, and any and all other items needed to provide a complete and functional pump station as shown on the drawings and described in Division 33 Section 333200 “Sanitary Sewer Pumping Station.”
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Pump Station Improvements to be included in the Base Bid.

F. Unit Price 6 – Geoliner Membrane:
   1. Description: All labor, equipment and materials associated with the installation of a Geoliner Membrane as outlined in Division 31 Section 313526.16 “Geoliner Membrane”.
   2. Unit of Measurement: Square Feet (SF).
   3. Quantity in Base Bid: Fifty-Seven Thousand Seven-Hundred Seventy (57,770) Square Feet of Geoliner Membrane to be included in the Base Bid.

G. Unit Price 7 – Rip-Rap Lined Areas:
   1. Description: All labor, equipment and materials associated with the installation of a Rip-Rap as outlined in Division 33 Section 333400 “Lagoon Earthwork and Structures”.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Rip-Rap Lined Areas to be included in the Base Bid.

H. Unit Price 8 – 6” Force Main:
   1. Description: All labor, equipment and materials necessary for the installation of 6” Force Main piping, including attaching to existing valve box, attachment to Influent Structure, new air release valve, new gate valves and any other items necessary to provide a complete and functional project according to the plans and Division 31 Section 312000 “Excavating and Backfilling Trenches” and Division 33 Section 333000 “Sanitary Sewerage.”
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Seventy-Six (4,076) linear feet of 6” Force Main to be included in the Base Bid.
I. Unit Price 9 – Modification of Existing Manhole:
   1. Description: All labor, equipment and materials necessary for the installation of a concrete influent transfer structure, including; piping, concrete splash pads, and grating over the end of the pipes and any other items necessary to provide the transfer of waste from gravity system to new cell no. 1 in order to provide a complete and functional project according to the plans and Division 31 Section 312000 “Excavating and Backfilling Trenches,” Division 33 Section 333400 “Lagoon Earthwork and Structures,” Section 333000 “Sanitary Sewerage,” 033000 "Cast-in-Place Concrete”.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) lump sum of Modification of Existing Manhole to be included in the Base Bid.

J. Unit Price 10 – Emergency Overflow Structure:
   1. Description: All labor, equipment and materials necessary for the construction of the Emergency Overflow Structure and any other items necessary to provide a complete and functional project according to the plans and specifications; “ Section 310000 “Earthwork”; 033000 "Cast-in-Place Concrete”.
   2. Unit of Measurement: Lump Sum (LS)
   3. Quantity in Base Bid: One (1) Lump Sum of Emergency Overflow Structure is to be included in the Base Bid.

K. Unit Price 11 – Temporary Treatment:
   1. Description: All labor, equipment and materials necessary for the temporary treatment of sewage during construction. This item should include any required pumping and temporary bypass piping and any other items necessary to provide a complete and functional project according to the plans and Missouri Department of Natural Resources Regulations. The contractor shall submit temporary treatment plan to Engineer prior to construction.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Temporary Treatment is to be included in the Base Bid.

L. Unit Price 12 – Electrical Work:
   1. Description: All labor, equipment, framing for equipment mounting and materials necessary for completing the site electrical work, including; wiring, conduit, electrical service, power panels, disconnect switches, main control panel, control wiring, power, receptacles, switches, conduit and any other items necessary to provide a complete and functional project according to the plans and Division 26 Section 260000 “Electrical Materials and Methods”
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Electrical Work is to be included in the Base Bid.
M. Unit Price 13 – Sprinklers and Stand:
   1. Description: All material, including the sprinklers, concrete stand, all necessary fittings, labor,
      and any other items necessary to provide a complete and functional project as outlined on the
      plans and specifications and in Division 33 Section 333000 “Sanitary Sewerage”.
   2. Unit of Measurement: Each (EA).
   3. Quantity in Base Bid: Twenty-five (25) each Sprinkler and Stands are to be included in the
      Base Bid.

N. Unit Price 14 – Force Main Drainage Structure:
   1. Description: All material, including all necessary fittings, perforated pipe, geotextile fabric,
      rock filter bed, labor, and any other items necessary to provide a complete and functional pro-
      ject as outlined on the plans and specifications in Division 33 Section 333000 “Sanitary Sewer-
      age”.
   2. Unit of Measurement: Each (EA).
   3. Quantity in Base Bid: Eight (8) each Force Main Drainage Structures are to be included in the
      Base Bid.

O. Unit Price 15 – Berm Construction:
   1. Description: all labor, equipment and materials necessary for the construction of the earthen
      berm around the boundary of the application area and any other items necessary to provide a
      complete and functional project according to the plans and specifications and in Division 31
      Section 310000 “Earthwork”.
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Sixty-Four (4,064) linear feet of Berm Construction In-
      stalled are to be included in the Base Bid.

P. Unit Price 16 – Seeding & Mulching
   1. Description: Clearing & Grubbing according to Division 31 Section 312500 "Permanent Eros-
      sion Control and Landscaping"
   2. Unit of Measurement: Acre (AC).
   3. Quantity in Base Bid: Sixteen and Eight-Tenths (16.8) acres of Seeding and Mulching are to
      be included in the Base Bid.

Q. Unit Price 17 – Fencing:
   1. Description: all labor, equipment and materials necessary for placing fencing, gates and any
      other items necessary to provide a complete and functional project according to the plans and
      Section 323100 “Fencing and Gates”. Removal and relocation of existing fences during con-
      struction shall be incidental to the project.
   2. Unit of Measurement: Linear Feet (LF).
   3. Quantity in Base Bid: Four Thousand Seventy-Four (4,074) linear feet of Fencing Installed are
      included in the Base Bid.
R. Unit Price 18 – Well No. 3 Drawdown Gauge:
   1. Description: All labor, equipment and materials necessary for the installation of a drawdown gauge in the existing well no. 3 and any other items necessary to provide a complete and functional project.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) lump sum of Well No. 3 Drawdown Gauge Installed is to be included in the Base Bid.

S. Unit Price 19 – Retrofitting Well No. 1
   1. Description: All labor, equipment and materials necessary to complete the capping of existing Well No. 2 piping and the retrofitting of piping, valves, and any other appurtenances required to construct the necessary components as shown on the plans to allow the smooth transition from operating well to ground monitoring and any other items necessary for the retrofitting of Well No. 1 to provide a complete and functional project as shown on the plans, specifications and Missouri Department of Natural Resources Regulations.
   2. Unit of Measurement: Lump Sum (LS).
   3. Quantity in Base Bid: One (1) Lump Sum of Retrofitting Well No. 1 is to be included in Base bid.

T. Unit Price 20 – Rock Removal
   1. Description: All labor, equipment and materials necessary for the removal of rock within the confines of the project scope of work and any other items necessary to provide a complete and functional project.
   2. Unit of Measurement: Cubic Yard (CY).
   3. Quantity in Base Bid: Ten (10) Cubic Yard of Rock Removal is to be included in Base bid.

END OF SECTION 012200
SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:
   1. Shop Drawings
   2. Product Data
   3. Samples
   4. Quality Assurance Submittals
   5. Construction Photographs
   6. Operating and Maintenance Manuals
   7. Warranties

B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
   1. Construction Progress Schedule including Schedule of Values
   2. Performance and Payment Bonds
   3. Insurance Certificates
   4. Applications for Payment
   5. Certified Payroll Reports
   6. Partial and Final Receipt of Payment and Release Forms
   7. Affidavit – Compliance with Prevailing Wage Law
   8. Record Drawings
   9. Notifications, Permits, etc.

C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.

D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.
1.3 SUBMITTAL PROCEDURES

A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

   a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:

   1. Date of Submission
   2. Name of Project
   3. Location
   4. Section Number of Specification
   5. State Project Number
   6. Name of Submitting Contractor
   7. Name of Subcontractor
   8. Indicate if Item is submitted as specified or as a substitution

1.4 SHOP DRAWINGS

A. Comply with the General Conditions, Article 3.2.

B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:

   1. Dimensions
   2. Identification of products and materials included by sheet and detail number
   3. Compliance with specified standards
   4. Notation of coordination requirements
   5. Notation of dimensions established by field measurement
   6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½”x11” but no larger than 36”x48”.
1.5 PRODUCT DATA

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer’s installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:
   a. Manufacturer’s printed recommendations
   b. Compliance with Trade Association standards
   c. Compliance with recognized Testing Agency standards
   d. Application of Testing Agency labels and seals
   e. Notation of dimensions verified by field measurement
   f. Notation of coordination requirements

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.6 SAMPLES

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer’s sample including the following:
   a. Specification Section number and reference
   b. Generic description of the Sample
   c. Sample source
   d. Product name or name of the Manufacturer
   e. Compliance with recognized standards
   f. Availability and delivery time

2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
   a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
   b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.

d. Samples not incorporated into the Work, or otherwise designated as the Owner’s property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.

3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.
   a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

1.7 QUALITY ASSURANCE DOCUMENTS

A. The Contractor shall comply with the General Conditions, Article 3.2

B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer’s instructions, manufacturer’s field reports, and other quality-control submittals as required under other Sections of the Specifications.

C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.
   1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.

D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.

E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.
   1. The Contractor shall submit two (2) sets of prints, black and white, glossy; 8”x10” size; mounted on 8½”x11” soft card stock with left edge binding margin for 3-hole punch.
   2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
   3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.
   4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES

A. The Contractor shall submit all required manufacturer’s operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)
## PART 3 - EXECUTION

### 3.1 REQUIRED SUBMITTALS

A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

<table>
<thead>
<tr>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>TYPE OF SUBMITTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>013100</td>
<td>Contractors’ Key Personnel Staff Names and Assignments</td>
<td>Shop Drawings: X</td>
</tr>
<tr>
<td></td>
<td>Due 10 Days after Notice To Proceed</td>
<td>Product Data: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sample: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Certifications: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturer Instructions: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test Report(s): X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inspection Report(s): X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wiring Diagrams: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Record Photographs: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintenance Data: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating Instruction: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receipt(s) for Materials Used: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional Material/Equipment Warranty: X</td>
</tr>
<tr>
<td>013200</td>
<td>Construction Schedule</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Due 10 Days after Notice to Proceed</td>
<td></td>
</tr>
<tr>
<td>007213</td>
<td>OSHA 10 hr Construction Safety Certifications for all (Gen/Sub) On-Site Workers</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Due 10 Days after Notice to Proceed</td>
<td></td>
</tr>
<tr>
<td>013513</td>
<td>Health and Safety Plan</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Due 10 Days after Notice to Proceed</td>
<td></td>
</tr>
<tr>
<td>015723</td>
<td>SWPPP</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Due 10 Days after Notice to Proceed</td>
<td>X</td>
</tr>
<tr>
<td>033000</td>
<td>Cast-In-Place</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>260000</td>
<td>Electrical Materials and Methods</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>260020</td>
<td>Control Panels</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>310000</td>
<td>Earthwork</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>311000</td>
<td>Site Clearing</td>
<td></td>
</tr>
<tr>
<td>312000</td>
<td>Excavating and Backfilling Trenches</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>313526.16</td>
<td>Geoliner Membrane</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1+5* Yrs Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>312500</td>
<td>Permanent Erosion Control &amp; Landscaping</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>323100</td>
<td>Chain-Link Fencing and Gates</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: 1 Yr</td>
</tr>
<tr>
<td>331100</td>
<td>Water Supply Wells</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: X</td>
</tr>
<tr>
<td>331400</td>
<td>Water Distribution Piping</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Yr Installation Warranty: X</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Column 1</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>333000</td>
<td>Sanitary Sewerage</td>
<td>X</td>
</tr>
<tr>
<td>333200</td>
<td>Sanitary Sewer Pumping Station</td>
<td>X</td>
</tr>
<tr>
<td>333400</td>
<td>Lagoon Earthwork and Structures</td>
<td>X</td>
</tr>
</tbody>
</table>

END OF SECTION 013300
SECTION 013513.22 – SITE SECURITY AND HEALTH REQUIREMENTS (DYS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUBMITTALS

A. List of required submittals:
   1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
   2. Schedule of proposed shutdowns of utilities, roadways, etc.
   3. Submit names, date of birth, and social security numbers for all personnel for security clearance checks.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL RULES OF THE FACILITY

A. The Contractor shall be aware that the youth center residents are circulating upon the grounds at all times. The Contractor shall take necessary steps to prevent the residents from having unauthorized contact with equipment, tools, or work areas.

B. Prior to commencing with any work, the Contractor shall consult with the Construction Representative and facility representative regarding aspects of completion of this work in relation to resident’s safety and to establish the procedures for the controlled entry of construction personnel, equipment, and materials into the work area.

C. Materials, tools, and construction apparatus shall be kept inaccessible to residents during non-working hours. During working hours, these items shall be under the Contractor’s observation or in personal possession at all times.

D. The Facility will not be responsible for the Contractor’s tools, equipment, or materials. The Contractor shall report any missing tools or materials to the facility immediately.

E. No firearms or other weapons, explosives, intoxicating beverages, narcotics or other controlled substances shall be carried on or used on the Youth Center property.

F. No prescription drugs above one day’s supply shall be carried on the Youth Center property.

G. Construction personnel shall not fraternize with the youths.

H. All Contractor’s vehicles shall be locked at all times and shall have keys removed from the vehicles.

I. Any vehicle or individual will be subject to search at any time while on the Facility grounds.
J. Smoking is not permitted in State-operated buildings. Smoking on grounds shall be in accordance with the local facility regulations.

K. The Contractor shall establish regular working hours with Facility officials. Working hour changes or overtime are to be reported and approved (48) hours ahead of time. Emergency overtime is to be reported as soon as it is evident that overtime is needed. All work after dark must receive special approval.

L. The Contractor shall provide the name and phone number of the individual(s) who is in charge on-site and who can be contacted in case of an emergency. This individual(s) must be able to furnish names and addresses of all construction personnel upon request.

3.2 FIRE PROTECTION, SAFETY AND HEALTH CONTROLS

A. The Contractor shall be responsible and take all necessary precautions to guard against and eliminate possible fire hazards. On site burning is prohibited.

B. Store all flammable or hazardous materials in proper container located outside the buildings or offsite, if possible.

C. Provide and maintain in good order, during construction, all fire extinguishers as required by the National Fire Protection Association. In areas of flammable liquids, asphalt, or electrical hazards, extinguishers of the 15-pound carbon dioxide type or 20-pound chemical type shall be provided.

D. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times unless written approval is received from the Construction Representative and the appropriate Facility Representative at least (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.

E. Conduct operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Do not obstruct streets or walks without permission from the facility.

F. Construction personnel shall not exceed the facility speed limit of 15mph unless otherwise posted.

G. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment use during construction. Keep volatile wastes in covered containers. Do not dispose of volatile wastes or oils in storm or sanitary drains.

H. Keep project neat, orderly, and in a safe condition at all times. Immediately remove all hazardous waste. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish and dispose of it at frequent intervals during progress of work.

I. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.

J. Intoxicating beverages or narcotics shall not be brought upon the premises nor shall Contractor’s personnel be under the influence of these substances while on the premises.
3.3 REQUIRED CRIMINAL BACKGROUND AND WANTS & WARRANTS CHECK

A. Each employee of the General Contractor, of the Subcontractor(s), supplier, testing agencies, etc. that need to enter or access the construction site, inside and/or outside shall be required to have a criminal background check completed that is no more than 30 days old prior to accessing the construction site.

B. The General Contractor shall be responsible for submitting all employees’ names (individually) to the Missouri State Highway Patrol online system known as the Missouri Automated Criminal History System, or “MACHS”; and shall include payment of $13.00 for each employee submission. The system can be accessed at:

https://www.machs.mshp.dps.mo.gov/MocchWebInterface/home.html.

C. The Contractor will receive results immediately for individuals without a record, and within no more than 5 days for anyone who has a criminal history. The Contractor shall forward the results of the background check via email to Paula.Jacobs@oa.mo.gov at the Division of Facilities Management, Design & Construction (FMDC), and will also include:

- Full legal name as displayed on their Driver’s License
- Full Social Security number
- Driver’s license number
- Driver’s license state of issuance

D. Upon receipt of this information, Paula Jacobs will process a “Wants and Warrants” check and will notify the Project Manager via email when the Contractor’s employees are approved to access the State facilities. Upon approval, individuals are cleared for access for a period of one year only. Time periods in excess of one year require repeating the process, as this is an annual requirement.

E. If an issue is discovered as part of the background or wants & warrants check that precludes any person from entering or accessing the construction site, the Facility shall be notified by FMDC. It shall be the discretion of Facility as to what person(s) will be prohibited from entering or accessing the site.

3.4 DISRUPTION OF UTILITIES

A. The Contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.

B. The contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives and shall make temporary access available if possible. Do not obstruct streets, walks, or parking.

END OF SECTION 013513.22
SECTION 260000 – ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes the following:
      1. Electrical Service
      2. Conduit
      3. Outlet boxes
      4. Junction and pull boxes
      5. Wiring and Cable.
      6. Wall switches.
      7. Receptacles.
      8. Device plates and covers
     10. Motor starters
     11. Disconnect switches
     12. Surge protection devices
     13. Grounding and bonding
   B. Referenced Standards include the following:
      1. ANSI/UL 651-Specifications for Rigid PVC Conduit.
      2. NEMA - National Electric Manufacturers Association.
      3. NEC - National Electrical Code

1.2 DEFINITIONS
   A. AWG - American Wire Gauge.

1.3 SUBMITTALS
   A. Product Data: provide detailed product data for all products specified, including manufacturer, manufacturer's catalog number, type or class and wiring diagram.
   B. Shop Drawings: provide detailed shop drawings showing locations and sizes of conduit and wire; provide wiring diagrams for all panels and controls.

1.4 QUALITY ASSURANCE
   A. All electrical products shall be selected and installed in accordance with the requirements of the latest edition of the National Electric Code (NEC), and all applicable local codes and ordinances.
   B. Products shall be tested, approved and labeled by Underwriter's Laboratories, Inc. (U.L.). All fixtures shall carry the U.L. label.
   C. All electrical equipment and materials shall be new and within one year of manufacture, complying with all the latest codes and standards. No used, re-sold through third party, re-built, refurbished and/or re-manufactured electrical equipment or materials shall be furnished on this project.

1.5 ELECTRICAL SERVICE
   A. Contractor shall coordinate with local power company provider for the installation of a new 100Amp- 277/480 Volt, 3 phase, 4-wire electrical service for pump station.
B. Contractor shall provide and install all metering equipment, service conduits, wire and/or cable, transformer pads, protective transformer barrier and all related service electrical apparatus required and not furnished and/or installed by local power company provider for complete electrical service installation.

1.6 DELIVERY AND STORAGE

A. Deliver materials to site in unopened cartons or bundles as appropriate, clearly identified with manufacturer's name, Underwriter's or other approved label, grade or identifying number.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Conduit above ground shall be schedule 80 PVC conforming to National Electrical Code and bearing U.L. Label, and painted with two coats of white, water based, outdoor latex paint:

1. PVC: ANSI/UL Standard 681

B. Conduit within buildings shall be thin wall or rigid.

1. Thin Wall conduit fittings shall be compression type.

C. Buried conduit shall be PVC schedule 40, PVC schedule 80, or rigid metal.

D. Conduit in concrete slabs shall be PVC schedule 40, PVC schedule 80, or rigid metal conduit with minimum 2” of cover.

E. Flexible metal conduit: Steel or aluminum liquid-tight, interlocking single-strip type with overall molded jacket to exclude moisture.

1. Fittings: clamp on or screw-in type fittings.
2. Connectors: galvanized steel with integral insulating throat.
3. Used for flexibility only to rotating machinery, equipment, or lighting fixtures.
4. Not to exceed 6’ in length.
5. Shall not be used in damp or wet locations

F. Liquid-tight Flexible Conduit: Flexible metal conduit with PVC jacket.

1. Fittings: listed for use for liquid-tight flexible metal conduit with PVC jacket.
2. Connectors: listed for use for liquid-tight flexible metal conduit with PVC jacket.
3. Used for flexibility only to rotating machinery, equipment, or lighting fixtures.
4. Not to exceed 6′ in length.
5. Shall be used in damp or wet locations.

G. Fittings and conduit bodies: NEMA FB 1. (Inside) and NEMA 4x stainless steel (outside).

H. Supports and Attachments:

1. Clamps, straps and supports: steel or malleable iron. (inside) and stainless steel (outside).
2. Hanger rods: 1/4-inch minimum, hot dip galvanized.

I. Bushing and locknuts: shall be made of galvanized malleable iron and shall have sharp, clean-cut threads.

J. Conduit sealer: Shall be UL Listed, asbestos free, gray in color, permanently soft, nontoxic compound which will adhere to clean dry surfaces, will not harm polyethylene sheath conductors, will not adversely affect other plastic materials or corrode metals, and has temperature rating of -20°F to 350°F.

K. Conduit Hubs: Shall be NEMA Type 4X stainless steel with captive o-ring gasket, insulated throat, NPL male thread, UL Listed.
2.2 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer.

C. Outlet Boxes In Dry Locations: galvanized, Sherardized, or electro-plated sheet steel.
   1. Use 4-inch square by 1-1/2-inch deep, or larger, boxes unless otherwise shown or required by code to accommodate the number of conductors required.
   2. Provide box covers and rings of type to suit installation conditions.
   3. Outlets exposed to the weather: Type FS or FD for switches, receptacles and similar devices and type SE or GS for lighting fixtures
   4. Use gang type outlet where devices are shown close together unless otherwise noted.

D. Outlets In Damp Or Wet Locations: FS or FD cast metal outlets with cast metal covers and gasketed hinged door for switches or receptacles. Type GS cast metal outlets for fixtures unless a cast outlet is furnished as part of the fixture.

E. Supports: channel type hangers or bar type hangers.

2.3 JUNCTION AND PULL BOXES

A. Inside:
   1. Boxes: Provide machine screw attached cover type, Hubbell, Circle A-W Products, or approved equal.
   2. Flush Mounted Boxes: Equipped with covers which overlap box sides 3/4 inch.
   3. Surface Mounted Boxes: Equipped with covers of same size as box.
   4. Pull Boxes: Provide boxes as required to comply with NEC for conduit routes selected by the Subcontractor to accommodate conditions which influence routes.
   5. Hinged Access Doors: Provided where boxes would otherwise be inaccessible.

B. Outside:
   1. Junction boxes: NEMA 4X fabricated from 14 gauge type 304 stainless steel with external mounting feet, cover and outside of enclosure shall be smooth grained finish.
   2. Pull boxes: High density polyethylene construction suitable for in-ground installations with polymer concrete lid, hex head stainless steel lid fastening bolts, and lid marked “ELECTRIC”.

2.4 WIRE AND CABLE

   1. Control Circuits: No. 14 AWG or larger.
   2. Home run circuits over 50 feet from Panelboard to first outlet: No. 10 AWG or larger.
   3. Other Circuits: No. 12 AWG or larger.

B. Conductors No. 10 AWG and smaller may be solid or stranded.

C. Conductors No. 8 AWG and larger shall be stranded.

D. Insulation: Power and lighting conductors shall be 600 volt of type indicated below:
   1. Power and lighting conductors: THWN or THHN.
   2. Wet locations: THWN.
   3. Cables in contact with ground: UF or USE.
   4. Feeders to panelboards: THWN or THHN

E. Color coding:
   1. No. 8 AWG and smaller: colored insulation.
2. Larger than No. 8 AWG: one-inch colored cloth or plastic colored adhesive tape on each end of cable. Wrap tape not less than two full turns around conductor.

3. Colors:
   a. Phase A - 480/277 (Brown), 208/120 (Black).
   b. Phase B - 480/277 (Yellow), 208/120 (Red).
   c. Phase C - 480/277 (Purple), 208/120 (Blue).
   d. Neutral - 480/277 (Gray), 208/120 (White).

4. Any conductor intended solely for equipment grounding purposes shall be green in color. Conductors white or gray in color shall be used only for the grounded neutral conductors.

F. Cable Connectors:
   1. Shall be watertight NEMA 4X stainless steel strain relief mesh type, with an N.P.T. and PG threaded body, internal neoprene bushing, and UL listed.

2.5 WALL SWITCHES
   A. Single pole, three, and four-way wall switches for lighting circuits: Industrial grade AC switch with toggle handle, rated 20A and 120-277VAC.
      1. Handle color: Gray.
      2. Wall switches shall be Bryant, General Electric, Leviton or approved equal.

2.6 RECEPTACES
   A. Industrial grade, 20A, 125V, 2-pole, 3-wire, NEMA 5-20R duplex for multi-outlet 20A branch circuits or where only one receptacle is connected to a 20A branch circuit. Bryant, General Electric, Leviton or approved equal.
      1. Color: Gray
      2. Receptacles shall be Bryant, General Electric, Leviton or approved equal.

2.7 DEVICE PLATES AND BOX COVERS
   A. Wall plates and box covers shall match the type of box and device it is to be mounted on.
      1. Interior Wall plates: stainless steel unless noted otherwise on drawings.
      2. Exterior wall plates: Weatherproof gasketed cast metal with hinged gasketed device cover.
      3. Box covers shall be zinc galvanized, corrosion protected, and UL listed.
   B. Use jumbo size plates for devices installed in masonry walls if required for complete cover of opening.

2.8 PANELBOARDS
   A. Bus and Hardware: Panel boards shall be completely factory assembled fully rated dead front safety type for the short circuit current available and equipped with fully rated neutral bus. Service panelboards shall include combination neutral and equipment grounding bus suitable for bolting to enclosure. Feeder panels shall include fully sized insulated neutral bus and uninsulated equipment ground bus suitable for bolting to enclosure, type, size and number of bolt on branch circuit breakers as required for complete installation. Panelboards shall be designed with 20% spare breaker capacity.
   B. Circuit Breakers: U.L. listed magnetic molded case circuit breakers, bolt on type, integral thermal and instantaneous magnetic trip in each pole with common trip handle for all poles rated for the load connected and minimum of 10,000 amperes interrupting capacity.
   C. Cabinets (boxes): shall meet the requirements of the “Enclosures for Electrical Equipment” of the Underwriters’ Laboratories and the following:
      1. Minimum size: 20-inches wide by 4 ½-inches deep by sufficient height to enclose main and branch circuit breakers, buses, equipment and wire gutter.
2. Box Material: Code-gauge galvanized or galvanized-annealed steel, unless noted otherwise.
3. Front Material: cold rolled furniture steel, rustproof, unless noted otherwise.
4. Finish: ANSI-61 light grey baked enamel, unless noted otherwise.

D. Enclosure: NEMA Type as indicated on plans or in specifications, or as required by NEC for type of environmental location.
   1. Enclosures shall be NEMA 1, NEMA 12, NEMA 3R, NEMA 4, or NEMA 4X.
   2. NEMA 1, 12 or 3R enclosures shall be painted with the manufacturer’s standard light gray ANSI 61 paint.
   3. NEMA 4 or 4X shall be stainless steel, non-painted.
   4. Door-in-door construction: full-length butt or piano hinge and latch; doors over 30-inches in height shall have a 3-point latch.

2.9 FULL VOLTAGE MAGNETIC MOTOR STARTERS

A. All full voltage magnetic motor starters and associated controls shall be provided with engraved laminated nameplate per Section 3.8 of this Division

B. All full voltage magnetic motor starters shall be AC general-purpose, Class A, magnetic controller for induction motors rated in horsepower as indicated, unless specified or noted otherwise.

C. Contacts: Provide silver, cadmium oxide alloy, double break, non-welding contacts which will not require filing, dressing or cleaning throughout the life of the control equipment.

D. Provide starter types as specified or noted on drawings.

E. Coils: Pressure molded, 120 volts, 60 hertz, unless specified or noted otherwise. Provide integral control transformer, unless noted otherwise.

F. Overload Relay: Provide bimetal overload relays in all three phases for three phase full voltage starters, in ungrounded phases for single-phase full voltage starters and in all six legs for two-speed full voltage starters. Provide overload relays of the hand reset, trip-free variety so that blocking the reset mechanism in the reset position will not prevent the motor controller from dropping out if the motor is overloaded. Capability to field convert overload relays from hand to automatic reset is unacceptable.

G. Auxiliary Contacts: Provide each starter with the required auxiliary contacts for the control functions indicated and required, including the holding interlock and pilot light interlocks plus two additional contacts, field convertible to normally closed or normally open NEMA ICS 2 controls. Provide capability to add auxiliary contacts without removing existing wiring or removing the controller from its enclosure.

H. Selector Switches: HAND/OFF/AUTO for single-speed motors in front cover as required. Hand position shall bypass automatic controls but not safety interlocks.

I. Indicating Lights: RUN; green for single-speed motors; FAST/SLOW; green/amber for two-speed motors (push to test type) in front cover. Operate pilot lights by separate interlock not placed across the holding coil.

J. Control Power Transformers: Provide integral 120 volt secondary control transformer with both primary and secondary fuses for each controller, unless specified or noted otherwise.

K. Enclosure: NEMA Type as indicated on plans or in specifications, or as required by NEC for type of environmental location.
   1. Enclosures shall be NEMA 1, NEMA 12, NEMA 3R, NEMA 4, or NEMA 4X.
   2. NEMA 1, 12 or 3R enclosures shall be painted with the manufacturer’s standard light gray ANSI 61 paint.
   3. NEMA 4 or 4X shall be stainless steel, non-painted.

2.10 REDUCED VOLTAGE MOTOR STARTERS
A. Shall be Solid State Motor Starters for induction motors rated in horsepower as indicated, unless specified or noted otherwise.

B. Provide accessible terminals for wiring directly from the front of the starter.

C. Contacts: Provide silver, cadmium oxide alloy, double break, non-welding contacts which will not require filing, dressing or cleaning throughout the life of the control equipment.

D. Provide starter types as specified or noted on drawings.

E. Coils: Pressure molded, 120 volts, 60 hertz, unless specified or noted otherwise. Provide integral control transformer.

F. Overload Relay: Provide ambient compensated overload relays in all three phases, loss of phase protection, under and overcurrent protection, and extra-quick-trip overload relay. Provide overload relays of the hand reset, trip-free variety so that blocking the reset mechanism in the reset position will not prevent the motor controller from dropping out if the motor is overloaded.

G. Auxiliary Contacts: Provide each starter with the required auxiliary contacts for the control functions indicated and required, including the holding interlock and pilot light interlocks plus two additional contacts, field convertible to normally closed or normally open NEMA ICS 2 controls. Provide capability to add auxiliary contacts without removing existing wiring or removing the controller from its enclosure.

H. Selector Switches: mounted in front cover as required.

I. Indicating Lights: RUN; green for single-speed motors; FAST/SLOW; green/amber for two-speed motors (push to test type) in front cover. Operate pilot lights by separate interlock not placed across the holding coil.

J. Control Power Transformers: Provide integral 120 volt secondary control transformer with both primary and secondary fuses for each controller, unless specified or noted otherwise.

2.11 DISCONNECT SWITCHES

A. Shall be NEMA classification as shown on drawings, Heavy Duty rated and meet or exceed NEMA Standard KS1.

B. Shall be horsepower rated.

C. Shall have the following features:
   1. Switch mechanism shall be the quick-make, quick-break type.
   2. Copper blades, visible in the OFF position.
   3. An arc chute for each pole.
   4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
   5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
   6. Fuse holders for the sizes and types of fuses specified.
   7. Electrically operated switches shall only be installed where shown on the drawings.
   8. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
   9. Ground Lugs: One for each ground conductor.
   10. Fused switches shall be furnished complete with fuses.

D. Enclosures: NEMA Type as indicated on plans or in specifications, or as required by NEC for type of environmental location.
   1. Enclosures shall be NEMA 1, NEMA 12, NEMA 3R, NEMA 4, or NEMA 4X.
   2. NEMA 1, 12 or 3R enclosures shall be painted with the manufacturer’s standard light gray ANSI 61 paint.
   3. NEMA 4 or 4X shall be stainless steel, non-painted.

2.12 SURGE PROTECTION DEVICES (TRANSIENT VOLTAGE SURGE SUPPRESSION)
A. Provide surge protection device (SPD) designed for the specific type voltage and phase of electrical service as shown on drawings, or identified in specifications. Provide SPD on supply (line side) of main service disconnect and transfer switch (from generator), load side of OCPD for motor control centers, motor starters, VFD’s, and PLC’s.

B. UL 1449 Listed-Latest Edition

C. Provide suppression for both normal mode (L-N) and common mode (L+N+G).

D. Minimum surge current rating as required per phase and neutral.

E. Minimum short circuit rating as required by Article 285.6 of the National Electric Code.

F. Normal discharge current of 20Ka

G. Shall meet the general, installation, and connection requirements of Article 285 of the latest edition of the NEC.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all electrical components including conduit, wiring, panels and other electrical equipment in accordance with latest edition of the NEC or all applicable local codes and ordinances.

B. Coordinate installation of conduit, panels and other electrical equipment with block wall installation, plumbing and other work to ensure that the work will not interfere with each other.

3.2 CONDUIT INSTALLATION

A. All wires shall be installed in continuous conduit or wiring raceways from the panels to outlets, switches, and equipment. Size raceways per NEC Chapter 9-Tables 1 through 5 and Tables C.1, through C.12, unless shown otherwise on the drawings.

B. All conduit, raceways, junction boxes and device back boxes shall be run concealed, except as shown or noted otherwise and may be exposed in unfinished areas.

1. Where exposed, run parallel with walls or structural elements.

C. Install vertical conduit to outlets and outlet boxes within walls.

D. Install horizontal conduit out of site, anchored to walls above panel ceilings or attached to joists or trusses above ceilings.

E. Securely fasten conduits at intervals of not more than 7-feet, or as required by NEC, with suitable clamps and fasteners to provide a mechanically rigid and secure installation. Space conduit supported by concrete structure at least 1/4-inch using malleable straps or framing channels.

F. Support conduits on each side of bends and not more than three feet from an enclosure where a straight run of conduit ends.

G. Provide flexible metal conduit to suspended lighting. Provide liquid-tight flexible conduit from outlet to final connection to transformers and rotating or vibrating equipment. Flexible conduit shall not exceed six feet in any application.

H. Empty conduit in which wire is to be installed by others shall have pull lines installed with no less than 24 inches of slack at either end. Mark each end with the location of other end.
I. Where conduits enter boxes, rigidly clamp the conduit to the box using listed conduit connector and insulated bushing. Threaded conduit shall be secured to box with locknut on the inside and locknut on the outside and insulated bushing; the conduit shall enter the box squarely.

J. Conduits which enter into a panelboard, motor control center, control panel, disconnect switch, transfer switch, junction box, or any other electrical enclosure from underground or from outside a building shall be sealed at point of entry into the enclosure in accordance with article 300.5(G) of the NEC. Sealants shall be identified for use with the cable and/or conductor insulation, shield, or other components.

3.3 BOX INSTALLATION

A. Install electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

C. Locate and install boxes to allow access. Where installation is inaccessible, coordinate with locations and sizes of required access doors. Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaries.

D. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

E. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface-finish thickness if required.

F. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation.

G. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

H. Use adjustable steel channel fasteners for hung ceiling outlet box. Do not fasten boxes to ceiling support wires.

I. Support boxes independently of conduit, except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box. Fasten boxes with screws or support with hangers.

J. Use multiple-gang boxes where two or more devices are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

K. Use gang box with plaster ring for single device outlets.

L. Use cast outlet box in exterior locations exposed to the weather and wet locations.

M. In masonry walls, locate boxes so as to limit cutting more than one masonry unit corner. Coordinate masonry cutting to achieve neat openings for boxes.

N. Provide listed knockout closures for unused openings.

O. Coordinate mounting heights and locations of outlets mounted above counters, benches, and back splashes.

3.4 PANELBOARD Installation

A. Install panelboards plumb in conformance with NEMA PB 1.1. Where surface mounted, provide suitable supports and rack all branch circuit conduits.

B. Install ½" steel spacers behind panel where mounted on concrete wall.

C. Install top of trim 78 inches above finished floor unless otherwise noted.

D. Nameplate: provide neatly typed list on the inside front panel of each panelboard giving the circuit number, size and the location/type of electrical devices, fixtures, and equipment served.
3.5 WIRE INSTALLATION
A. All wiring shall be installed in appropriate raceways or conduit and in compliance with the National Electric Code, latest edition.
B. Splices and taps in conductors and to lighting fixtures shall be screw on pressure cable type, with integral insulation unless noted otherwise on drawings. Cover soldered and bolted splices with high-grade rubber tape and a layer of friction tape, then paint with black insulating paint or use listed and approved covering device in lieu of taping.

3.6 DEVICE AND OUTLET INSTALLATION
A. Install devices and wall plates flush and level. Plates shall be plumb and with all edges in continuous contact with adjacent finished surfaces.
B. Install wall switches 48 inches above floor, OFF position down.
C. Install convenience receptacles 16 inches above floor, 12 inches above counters with grounding receptacle pole on top.
D. Install specific use receptacles at heights, shown on construction drawings or as approved by the Engineer.
E. Provide weatherproof cover plates on flush mounted devices where shown, gasketed, type and configuration to suit flush device and its orientation.
F. Install blank and device cover plates on switches, receptacles and boxes.
G. Provide GFCI protected 20Ampere receptacles in accordance with NEC - "Ground Fault Protection for Personnel".

3.7 GROUNDING AND BONDING
A. Install a grounding electrode system in accordance with N.E.C. Article 250 and as required by the local inspecting authority.
B. Install a green bonding jumper between the outlet box and the receptacle grounding terminal on all flush mounted receptacles.
C. An insulated ground wire shall be installed in all feeder and branch circuit raceways. Ground wire shall be sized in accordance with NEC Article 250.122
D. Grounding bushings shall be utilized on each conduit which is not bonded to a grounded enclosure by means of properly installed conduit nuts, one on each side of the enclosure panel and properly tightened such as to cut through the panel paint and make bare metal to metal contact.
E. Ground all step down transformers in accordance with NEC Article 250.30 for Grounding Separately Derived Alternating Current Systems.
   1. The bonding jumper shall be directly connected to a grounding electrode.
   2. Transformer case shall be bonded to the grounding electrode conductor, but shall not be used as the grounding electrode.
   3. Grounding electrode conductor shall be protected within conduit.
F. Install grounding bonding jumper across all building expansion joints, conduit, busway, and cable tray expansion fittings.

3.8 IDENTIFICATION FOR ELECTRICAL SYSTEMS
A. Nameplates shall be provided on all major equipment, including the following:
   a. Primary switches
b. Circuit breakers and switches in distribution panels  
c. Panelboards  
d. Motor starters  
e. Motor controls  
f. Motor control centers  
g. Transformers  
h. Contactors  

B. Nameplates shall be plastic laminate, white face with black engraved letters, numbers, etc., attached with stainless steel screws.  

C. Provide “Arc Flash Warning” label on face of all switchboards, panelboards, control centers disconnect switches, meter socket enclosures, and motor control centers as required by Article 110.16 of the NEC.  

3.9 PROTECTION OF EQUIPMENT  
A. Care shall be taken to avoid damage to equipment or electrical components of any kind. All equipment shall be protected from dust and moisture prior to and during construction.  

B. Contractor shall repair or replace any damaged equipment, including scratches or defects in finish to the satisfaction of the Owner.  

3.10 WARRANTY  
A. The Project 1 Year Warranty period shall apply to Section 260000 - Electrical Materials and Methods.  

END OF SECTION 260000
SECTION 260200 – CONTROL PANEL

PART 1 - GENERAL

1.1 SUMMARY

A. Work under this section shall include the furnishing of all labor, materials, tools, equipment, and other items necessary for the supply and installation of the control panel as specified herein.

B. The control panel manufacturer shall provide an enclosure that can be free standing. Mounted to a post and beam structure or a wall without field modifications to the enclosure that would compromise the rating of the enclosure.

C. The control panel installer shall provide the mounting hardware and fittings necessary to ensure that the enclosure is mounted securely, and that such openings made to the enclosure for conduit or any other entry are of the same NEMA rating as the enclosure so as not to compromise such rating.

1.2 SUBMITTALS

A. The Control Panel Supplier shall furnish a submittal package to the Engineer for approval prior to fabrication. Submittals shall include proposed layout drawing(s) detailing appurtenances and escutcheon plates, a one-line diagram of panels and interconnecting wiring and a circuit diagram of each panel and shall include a bill of materials with catalog cuts.

B. Upon engineer's approval of shop drawings, the contractor shall submit equipment "Installation, Operation, and Maintenance Manuals" (I.O.M). The I.O.M. manuals shall detail all components and include installation instructions, start-up procedures, and normal operation and maintenance procedures.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. The control system shall consist of a lockable NEMA 4X enclosure suitable for (outdoor/indoor) use.

B. The enclosure shall be as manufactured by English Electric (Vynckier), Hammond Manufacturing, Hoffman Engineering, Stahlin (Robroy Industries) Wiegmann Manufacturing, Tanco, Inc., Eurobex, or equivalent.

C. Refer to the Technical Data Sheet for number of motors, horsepower of each motor, and electrical information.

D. The enclosure assembly shall comply with UL 508 standards for safety and shall be assembled in such a manner that if required it could be UL inspected and listed as such without any modifications.

E. Control voltage shall be 120 volts AC, and shall be derived from a primary and secondary fused isolating control power transformer (CPT). The CPT shall have a minimum excess capacity of 15% and shall have a grounded secondary. Glass or ceramic tube fuses are unacceptable. Control power transformers shall be as manufactured by Fern Electric (Cincinnati) Types A-D and N, G.E. Type IP, Hammond Types MH or MT, Sola Hevi-Duty Type E or Type Y, and Westinghouse types MTA or MTC or equal.

F. Selector switches, pilots, and push buttons (if applicable) shall be of modular design, with field replaceable contact sets and lamps. These devices shall be AEG Type D22/D30, Allen-Bradley Bulletin 800-H or 800-F or 800-T, Cutler-Hammer File 10250T, GE Type CR104, Idec Type TWTD, Square-D Class 9001 Types K or T, Telemechanique Type XB3 or equal. Any type used must be UL listed. Component recognized units shall not be acceptable.

G. Fuse blocks/holders and fuses shall not be sized to carry in excess of 80% of their rating and shall be as manufactured by Bussman Division, Cooper Industries; Power Fuse Division, Littel Fuse; Ferraz-Shawmut, Marathon Special Products or equal.

H. All internal components shall be legibly and permanently marked and coincide with the drawings and bill of materials. All external devices shall have engraved escutcheon plates affixed above the device with high quality 2-sided tape or stainless steel screws.
I. All control wiring shall be 18 awg (min.) type MTW. All neutral or grounded conductors shall have white insulation. In a case where white is not available for a particular use, the wire shall be coded at each end by wrapping with white electrical tape. All such coded non-white neutral conductors shall also be coded every 610mm (24 inches), when applicable, with white tape wrap. All control wires shall be numbered at both ends with a suitable, high quality, permanent wire numbering product. Control wires 100mm (4 inches) or less may be numbered at one end only. Individual wire numbering tapes or other products, which unravel or easily fall off are not acceptable. Wire marking shall be as manufactured by Thomas & Betts (T&B) Shur-Code, the 3M company Scotch Code wire marking systems, or Brady Datab, Laser Tab, Omni-grip, Brady, Panduit, or Sleeve wire marking systems.

J. Enclosure interconnect control and power wiring shall terminate in permanently marked terminals or blocks, with one (1) wire per terminal, unless the device is designed for multiple terminations. Barrier strips are acceptable only if covers are also provided and wires are terminated in a SEMS self-lifting type pressure pad or listed crimp terminal. There shall be at least 10% extra unmarked terminals provided in each enclosure. Jumpering of adjacent terminals shall be accomplished with terminal manufacturer supplied jumpers intended specifically for use with that product.

K. Acceptable terminal blocks are Entrelec Series 5000, Buchanan 300 and 600-volt medium to heavy-duty sectionals, Marathon Special Products 3/8" and 7/16" 600 volt sectionals, Schlegal Elektrokontakt IK, and WAGO Cage-Clamp 2xx series, Allen Bradley 1492-J Series, or equal. The acceptable barrier type strips are Kulka 601 or larger series, or Marathon 200HB, 300, 400 series.

L. Disconnect equipment shall be Allen-Bradley Bulletin 194R or 1494R, Cutler-Hammer File C362, Selzer Series H or S switches, Square-D Class 9422, Westinghouse Type DS and Visi-Flex, or Allen-Bradley OS Series or OES Series.

M. Main breakers, if used in lieu of a listed fused switch, shall be UL listed F, J, or K frame units with minimum 22k AIC symmetrical interrupt rating at operating voltage. Supplementary breakers, such as control and motor branch circuit protection devices, if used in lieu of listed fuses, shall be any UL listed unit with minimum interrupt rating of 5k AIC symmetrical at the operating voltage.

N. Motor controllers (starters) shall be IEC rated magnetic, rated with a minimum of 1 size hp higher. Acceptable units are Allen-Bradley 100-C Series and Allen-Bradley 100-D Series.

O. Plug-in (standard 8- or 11-pin octal) or can-type timing/relay/logic devices shall be as manufactured by Diversified, Eagle Signal, Idec, Infitec, NCC, SSAC, R&K, Allen-Bradley, or Motor Saver.

P. Enclosure shall contain the power distribution and logic components, and any indicating devices. It shall be door-in-door type, with the outer door pad-lockable. Inner door shall be interlocked by the disconnecting means. No devices shall be mounted on the outer door. All indicating devices shall be visible without shutting off power.

Q. The indoor swing-out door shall have mounted on and include but not be limited to:
   1. Thru-door operated fusible main disconnect switch or main circuit breaker operator handle, clearly indicating and pad-lockable in the "off" position with inner-door interlock.
   2. A 4-digit plus 10ths, non-resettable hour meter for each motor. Battery operated types not acceptable.
   3. A circuit wiring print pocket on the inside of outer door.

R. Mounted on the side of the main enclosure shall be (but not limited to) the following NEMA 4 devices installed such that the wiring for the devices is behind the closed inner door:
   1. There should be a green pilot light to indicate which motor is running.
   2. There should be a red pilot light for each motor to indicate overload (OL) relay trip. Pilot to remain lit until OL Reset button pressed.
   3. There should be a one push button to test all pilot lights.

S. Enclosure internal to include but not be limited to the following:
   1. Main fused disconnect switch or breaker as mentioned above, with operating mechanism. If fused, switch fuses shall be included and be the rejection type.
   2. Full-voltage magnetic starter(s) with overload relay. Starters may be of the IEC design but shall be sized and rated to NEMA standards. Overload elements (heaters) in each ungrounded phase, to be direct-heated bi-metal design and must be sensitive/reactive to single phasing condition (running loss of phase).
Overload relay must be field adjustable for manual or automatic reset. The contactors shall have field-replaceable power pole contacts.

3. Individual motor branch circuit, short-circuit, and over-current protective devices shall be provided in accordance with NEC section 430. Such devices may consist of listed rejection type fuses, inverse-time thermal magnetic, or instantaneous-trip circuit breakers sized in accordance with NEC tables 430-150 and 430-152.

4. Also acceptable would be UL type 508 combination starters consisting of a combination short-circuit/over-current/running overload protection device, and a magnetic contactor of suitable capacity. Such combinations shall have been evaluated and listed by UL for this purpose.

T. The main breaker or fuse arrangement may serve as the backup SC/OC protection for motor grouping.

U. Control Power Transformer (CPT).

1. Plug-in (octal) style logic devices required for function as outlined in this document. Include as standard a phase-monitor (PM) wired after the main fuses or breaker to sense loss of phase, improper phase sequence, and low line voltage or imbalance. The PM should be of the automatic reset type with adjustable dropout voltage. PM sensed condition to lock out all motor function and automatically restart when condition returned to normal.

V. Terminals with adequate current rating for line and field connections as required.

W. Motor starting and stopping operators and the individual motor safety/service disconnect switches.

X. Individual motor safety/service disconnect switch operators, clearly indicating, pad-lockable in the "off" position.

Y. Hand - Off - Auto selector switches for each motor. System must re-start automatically subsequent to loss and restoration of power.

Z. Individual motor safety/service switches, on/off, horsepower rated, 3-pole, UL listed.

AA. Terminals are required for 120V AC control circuitry.

BB. Heavy-duty terminals for motor power/disconnect if the switches are not a feed-thru top accessible type. Connections shall be able to be made without removing the switch.

CC. Timer control for each motor is required.

2.2 SPARE PARTS

A. The panel builder shall include at least one complete set of spare fuses for each fuse-holder in the control. At least one spare lamp shall be included for each pilot, and 2 spare SS/PB contacts of each unique block combination shall be provided.

B. If the contactors DO NOT have field replaceable contact sets, one spare contact shall be included for every four starters in the enclosure.

C. If the contactors DO have replaceable contacts, one complete spare set of power pole contacts and one spare operating coil shall be provided for every four starters in the enclosure.

PART 3 - EXECUTION

3.1 GENERAL

A. The control panel shall be protected during fabrication and installation from ingress of metal chips, debris or other foreign material from entering the components whereby such ingress would degrade or otherwise cause failure.

B. All internal wiring shall be neatly bundled or routed in wire duct or channels.

C. The contractor shall provide a method of protecting the panel until start-up and any marks shall be refinished to the approval of the engineer.
3.2 CONTROL PANEL

A. Application Type:
   1. Wastewater Treatment

B. Enclosure Type:
   1. NEMA 4X

C. List of Motors:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>Capacity of Each (HP)</th>
<th>Voltage (Volts)</th>
<th>Phase</th>
<th>Cycle (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submersible Wastewater Pump</td>
<td>2</td>
<td>20</td>
<td>460</td>
<td>3</td>
<td>60</td>
</tr>
</tbody>
</table>

D. Features:
   1. Main Disconnect.
   2. ON (RUN)-OFF AUTO Switch.
   3. Non-resettable hour meter.
   4. Timer Control.
   5. Once push button to test all pilot lights.
   7. Pump motors shall not operate simultaneously in either Hand (ON) or Auto Mode.

3.3 WARRANTY

A. The Project 1 Year Warranty period shall apply to Section 260200 – Control Panel.

END OF SECTION 260200
SECTION 312000 – EXCAVATING & BACKFILLING TRENCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Trenching for piped and buried utilities.
   2. Backfilling of trenches.

B. Related Sections include the following:
   1. Section 015723 – Temporary Storm Water Pollution Prevention / Erosion Control.
   2. Section 311000 – Site Clearing.

C. Referenced Standards include the following:
   2. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN·m/m³)); American Society for Testing and Materials; 2000a.
   7. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System); American Society for Testing and Materials; 2000.

1.2 UNIT PRICES

A. Embedment Material:
   1. Measurement method: linear foot of pipe or utility material installed.
   2. Unit prices for embedment materials shall be included in unit price for pipe materials.
B. Backfill Material:
   1. Measurement method: linear foot of pipe or utility material installed.
   2. Unit prices for backfill materials shall be included in unit price for pipe materials.

C. Rock Excavation:
   1. Measurement method: cubic yard of rock, measured in original position, but not to exceed a depth of 6 inches beneath the bottom of the pipe and a width equal to the nominal pipe diameter plus 24 inches.
   2. Unit prices, where applicable, for rock excavation include the cost of replacement with approved materials. Refer to paragraph 3.4.A.

1.3 DEFINITIONS

A. Bedding: Material placed from the excavated subgrade material to the flow line of the pipe.

B. Haunching: Material placed from the flow line of the pipe to the spring line of the pipe.

C. Embedment: Includes bedding, haunching, and initial backfill.

D. Backfill: Material used to fill the excavation of a trench.
   1. Initial Backfill: Material placed from the spring line of the pipe to a minimum of 12 inches above the top of the pipe or as shown on the Plans.
   2. Final Backfill: Material placed from the top of initial backfill to the top of the trench or to the bottom of an improved surface.

E. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

F. Improved Surface: Any existing or proposed surface including roads, parking lots, curbs, slabs, sidewalks or other manmade surface courses designated to receive vehicular or pedestrian traffic or other loading; does not include lawns or landscaped areas, which are not designed or designated to receive traffic loading.

G. NPS: Nominal Pipe Size.

H. Spring Line: The elevation equal to the horizontal centerline of a pipe.

I. Subgrade:
   1. Surface or elevation at the bottom of an excavation.
   2. The top surface of backfill immediately below pavement base, subbase, drainage fill, or topsoil materials.

J. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for trench and pit excavation that cannot be removed by excavating equipment without systematic drilling, ram hammering, ripping, sawing or blasting, when permitted.

1.4 SUBMITTALS

A. Material Test Reports: Submit from a qualified testing agency indicating and interpreting test results for compliance with Section 3.18 and the following:
   1. Soil Classifications.
   2. Gradation Tests.
   3. Moisture-Density Relations (Proctor).
4. In-Place Field Density Tests.

   B. Flowable Backfill Mix Design: Include mix proportions by weight and laboratory trial mix results or field test data.

      1. Indicate amounts of mix water to be withheld for later addition at Project site.

1.5 QUALITY ASSURANCE

   A. Comply with applicable requirements of NFPA 495, "Explosive Materials Code" or local requirements, whichever is more restrictive.

   B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures shall perform the following services:

      1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent or nearby properties.

      2. Seismographic monitoring services during blasting operations.

   C. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

   A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:

      1. Notify Engineer not less than two days in advance of proposed utility interruptions.

      2. Do not proceed with utility interruptions without 24 hours notice to property owner and Engineer’s permission.

      3. Contact utility-locator service for area where Project is located before excavating.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

   A. General: Provide borrow materials when sufficient satisfactory soil materials are not available from excavations.

   B. Satisfactory Soils: Shall be free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, organic materials, and other deleterious matter and as specified below:

      1. Embedment: ASTM D 2487 soil classification groups GW, GP, SW, SP and with fines content (% passing No. 200 sieve) not to exceed 5%.

      2. Final Backfill: ASTM D 2487 soil classification groups CL, ML-CL, GC, SC, ML, MH, GW, GP, GM, SM, SP and SM, a combination of these group symbols, as limited elsewhere in these specifications.

   C. Unsatisfactory Soils:


      2. Final Backfill: ASTM D 2487 soil classification groups CH, OL, OH, and PT.

      3. Unsatisfactory soils include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
D. Granular Embedment Material: Embedment material shall conform to Class IA, IB, or II as specified in ASTM D 2321 and as follows:

1. Class IA materials shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>65-100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>47-77</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>33-57</td>
</tr>
<tr>
<td>#4</td>
<td>0-10</td>
</tr>
<tr>
<td>#200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

   a. Pre-approved Class IA materials include the following:

      1) No pre-approved materials

2. Class IB materials shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>65-100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>47-80</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>33-71</td>
</tr>
<tr>
<td>#4</td>
<td>0-50</td>
</tr>
<tr>
<td>#200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

   a. Pre-approved Class IB materials include the following

      1) Grade 5 Aggregate for Drainage, as specified in Missouri Standard Specifications for Highway Construction (1999) Section 1009.

3. Class II materials shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>65-100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>47-100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>33-100</td>
</tr>
<tr>
<td>#4</td>
<td>0-100</td>
</tr>
<tr>
<td>#200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

   a. Pre-approved Class II materials include the following:

      1) Type 4 Aggregate for Base, as specified in Missouri Standard Specifications for Highway Construction (1999) Section 1007.

      2) Type 1 Aggregate for Base and Type 5 Aggregate for Base, as specified in Missouri Standard Specifications for Highway Construction (1999) Section 1007, may be used PROVIDED that the production of the product is controlled to provide a Maximum of 5% by weight of material passing a No. 200 sieve.

4. Use of a material not pre-approved may be acceptable only after obtaining written approval from the Engineer prior to use. The following is the minimum required information to be submitted to the Engineer for approval:

   a. Name, address and phone number of Supplier

   b. Name of material (include respective ASTM class designation)

   c. Grain Size Analysis Tests, according to ASTM C 136.

   d. Representative samples of the material(s) (1 cubic foot minimum).
2.2 CONCRETE

A. Concrete: ASTM C 94, and the following:
   1. Cement: ASTM C 150, Type I/II,
   3. Coarse Aggregate: ASTM C33, #57 or 67

B. Flowable Backfill Portland Cement Mix Design: 40-psi minimum and 80 psi maximum compressive strength.
   1. Air entrainment admixtures may be used as approved by the Engineer.

C. Concrete Fill or Encasement Portland Cement Mix Design: 3000-psi minimum compressive strength.
   1. Air entrainment admixtures may be used as approved by the Engineer.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Potable Water systems.
   5. Green: Sanitary Sewer systems.

B. Locator Wire: No. 12 vinyl-coated copper wire placed on top of pipe and inserted into valve boxes.

2.4 STEEL CASING

A. Steel casing shall be new welded steel pipe with minimum yield strength of 35,000 psi. The minimum wall thickness of steel casing shall be as shown on the following table:

<table>
<thead>
<tr>
<th>Carrier Pipe Nominal I.D. (in)</th>
<th>Minimum Casing I.D. (in)</th>
<th>Steel Casing Pipe Wall Thickness (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highway and Field Borings</td>
<td>Railroad Borings</td>
</tr>
<tr>
<td>8</td>
<td>0.250</td>
<td>0.312</td>
</tr>
<tr>
<td>10</td>
<td>0.281</td>
<td>0.375</td>
</tr>
<tr>
<td>12</td>
<td>0.281</td>
<td>0.375</td>
</tr>
<tr>
<td>15</td>
<td>0.312</td>
<td>0.348</td>
</tr>
<tr>
<td>18</td>
<td>0.344</td>
<td>0.563</td>
</tr>
<tr>
<td>21</td>
<td>0.344</td>
<td>0.563</td>
</tr>
<tr>
<td>24</td>
<td>0.375</td>
<td>0.625</td>
</tr>
<tr>
<td>27</td>
<td>0.438</td>
<td>0.625</td>
</tr>
<tr>
<td>36</td>
<td>0.438</td>
<td>0.719</td>
</tr>
<tr>
<td>48</td>
<td>0.500</td>
<td>0.750</td>
</tr>
</tbody>
</table>
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to lower and maintain water level below pipe flowline and to convey ground water away from excavation work areas. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
   1. Do not damage adjacent structures, property, or site improvements or weaken the bearing capacity of rock subgrade when using explosives.

3.4 EXCAVATION FOR UTILITY TRENCHES

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions shall be unclassified excavation.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil or granular materials.

B. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. Four hundred (400) feet shall be the maximum length of open trench on any line under construction.

C. Excavate trenches to indicated grades, alignments, depths, and elevations.
   1. Minimum depth of trench excavation shall be such that there is three feet of fill above the top of the pipe.

D. Use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts or other existing property, utilities or structures above or below ground. In all such locations, hand excavation methods shall be used.

3.5 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.
3.6 STORAGE OF SOIL MATERIALS
   A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without 
      intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
      1. Stockpile soil materials away from edge of excavations. Do not store within drip line of 
         remaining trees.

3.7 TRENCH WIDTH
   A. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
   B. Excavate trench walls vertically from trench bottom to 6 inches higher than top of pipe or conduit, unless 
      otherwise indicated.
   C. The minimum trench width shall be as follows where trench walls are stable:
      1. NPS up to 24 inches: outside diameter of pipe plus 16 inches, but not less than 18 inches.
      2. NPS greater than 24 inches: outside diameter of pipe plus 24 inches.
      3. Where trench walls must be supported, increase the trench width sufficiently to allow the same 
         amount of clearance as required above.
   D. Where unstable native soil conditions exist, the minimum trench width shall be as follows:
      1. NPS up to 10 inches: three times the pipe diameter.
      2. NPS greater than 10 inches: three times the pipe diameter, or the pipe diameter plus four feet, 
         whichever is greater.

3.8 FOUNDATIONS
   A. If Engineer determines that unsatisfactory soil is present and that foundations are required, continue 
      excavation and replace with timber, concrete or other material as directed by the Engineer. Additional 
      excavation and replacement material such as timber, concrete, or other foundation will be paid for 
      according to Contract provisions for changes in the Work.

3.9 GROUNDWATER BARRIERS
   A. Where native soils consist of low permeable soils such as clays or bedrock, construct groundwater barriers 
      to minimize the flow of groundwater though the finished trench. Native soils consisting of high 
      permeable soils such as sands may not require groundwater barriers if approved in writing from the 
      Engineer.
   B. Groundwater barriers shall be constructed as follows:
         may be finely divided suitable job excavated material, free from stones, organic matter and 
         debris.
      2. Frequency: Construct Groundwater Barriers at a minimum of 1,000-foot intervals. Where 
         1,000-foot interval falls within an improved surface, construct groundwater barrier to less than 
         the 1,000-foot interval outside of the improved surface.
      3. Depth: Groundwater barriers shall be compacted the full depth of granular embedment material 
         from the subgrade or foundation to an elevation one foot above the top of the granular 
         embedment material, but not less than four (4) feet.
      4. Width: shall extend the full width of the trench.
      5. Thickness: shall be a minimum of four (4) feet thick measured along the length of the pipe.
3.10 TRENCH BOTTOMS AND BEDDING

A. Pressure piping: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Where rock or other unyielding bearing material exists at the trench bottom, over excavate a depth equal to one forth the outside pipe diameter but not less than 6 inches deeper than elevation required to allow for bedding course. Place and compact bedding material on trench bottom and where indicated. Shape bedding material to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Gravity piping: Excavate trench bottom to a depth equal to one forth the outside pipe diameter, but not less than 6 inches below the required flow line elevation to allow for bedding. Place and compact bedding on trench bottom. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.


2. If compaction of the bedding material can not be obtained due to natural unyielding or poor subgrade material, a foundation course may be required. Cease work and notify Engineer immediately to inspect the subgrade and recommend further action.

3.11 HAUNCHING

A. Carefully compact, as required, haunching material under pipe, bring up evenly on both sides of the pipe and along the full length of pipe to the spring line of the pipe to avoid damage or displacement of piping.

B. Pressure piping: use the following materials:

1. When bedding is not required; compacted satisfactory soil embedment material.

2. When bedding is required; Granular Embedment Material, compacted as required.

C. Gravity piping haunching material shall be as follows:

1. Granular Embedment Material, compacted as required.

3.12 BACKFILL GENERAL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Survey placed or constructed underground utilities as required for record documents.

2. Remove trash and debris.

3. Remove temporary shoring and bracing, and sheeting.

4. Where compacted backfill is required, place the material in horizontal layers less than eight (8) inches in depth of loose measure.

5. Moisture content shall be such that the required degree of compaction can be obtained.
6. Compact each layer by hand, machine tampers, or by other suitable equipment to the required compaction.

B. Fill voids with approved initial backfill materials while shoring and bracing, and as sheeting is removed.

C. Install warning tape directly above utilities as specified elsewhere in these specifications, 12 inches below finished grade and 6 inches below improved surfaces.

### 3.13 INITIAL BACKFILL

A. Initial backfill shall be carefully placed and compacted as required to 12 inches above the top of the pipe to prevent damage to the pipe.

B. Unimproved surfaces: Use the following materials for initial backfill under unimproved surfaces:
   1. Pressure piping: Satisfactory Soil Embedment Material, compacted as required.
   2. Gravity piping: Granular Embedment Material, compacted as required.

C. Improved surfaces: Use the one of the following materials for initial backfill under improved surfaces:
   1. Granular Embedment Material, compacted as required.
   2. Flowable backfill.

### 3.14 FINAL BACKFILL

A. Unimproved surfaces: Use satisfactory soil backfill.

B. Improved surfaces: Use the one of the following materials for initial backfill under improved surfaces:
   1. Granular embedment material, compacted.
   2. Flowable backfill.

### 3.15 COMPACTION REQUIREMENTS

A. Bedding and Haunching: Compact embedment materials for bedding and haunching to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   1. Satisfactory soil embedment material: 90%.
   2. Granular embedment material: 90%.

B. Backfill under unimproved surfaces: Compact embedment and backfill materials for initial and final backfill to be placed under unimproved surfaces to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   1. Initial backfill:
      a. Satisfactory soil embedment material: 85%.
      b. Granular embedment material: 85%.
      c. Compaction of initial backfill under unimproved surfaces may be waived by the Engineer for part or the entire project. Compaction shall be required unless written approval has been obtained from the Engineer.
   2. Final backfill: adequate compactive effort shall be applied to satisfactory soil material to ensure no substantial settlement of the final backfill.

C. Backfill under improved surfaces: Compact embedment and backfill materials for initial and final backfill to be placed under improved or proposed improved surfaces to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   1. Granular Embedment Material: 95%.
D. Groundwater Barriers: Compact groundwater barrier materials under unimproved surfaces to not less than the following Percentages of maximum dry unit weight according to ASTM D 698:
   1. Groundwater Barrier Material: 90%.

E. Class IA Granular Embedment Material shall not require compaction.

F. Waiving of Compaction Testing Requirements: Class IB Granular Embedment Material compaction testing may be waived if gradation analyses reveals that the material is sufficiently open graded and that compactive efforts by either mechanical or hand compaction operations do not produce an effective increase in percent compaction. Materials proposed to be waived for compaction testing shall be approved by the Engineer prior to use on this project. The following materials have been pre-approved and do not require compaction testing:
   1. No materials have been pre-approved.

G. Initial Compaction Testing shall be performed on each compacted embedment and backfill material layer within the first fifty (50) linear feet of pipe installed. This testing procedure is to provide a demonstration of the compactive effort required to achieve the specified density. Repeat this testing for each new embedment or backfill material used throughout the project.

H. Periodic Compaction Testing shall be provided on each compacted embedment and backfill material a minimum of once per week and/or once every 3,000 feet of trench being excavated. The Engineer shall have the authority to order additional tests at anytime if he feels the compactive effort is not being properly duplicated, or to reduce the frequency of testing if the compactive effort has been adequately duplicated.

3.16 FLOWABLE BACKFILL

A. All required submittals shall be approved by the Engineer prior to use of Flowable backfill.

B. Flowable backfill may be used in lieu of compacted granular embedment material for initial and final backfill under improved surfaces.

C. Flowable Backfill shall not be placed in lifts greater than three (3) feet in depth. Additional layers shall not be placed until the flowable backfill has lost sufficient moisture to be walked on without indenting more than two inches. Any damage resulting from placing flowable backfill in layers that are too thick or from not allowing sufficient time between placement of layers shall be repaired at the Contractor’s expense.

D. Flowable backfill shall be sufficiently consolidated. Consolidation may be achieved by using vibration or other approved methods.

E. Provisions shall be made to allow bleed water to drain from the excavation.

3.17 GRADING

A. General: Uniformly grade disturbed areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and trenches and to prevent ponding. Finish subgrades to match pre-existing elevations.
3.18  DIRECTIONAL BORING

A.  Boring shall be by an approved bore method from ditch line to ditch line, or as shown on the plans or approved by Engineer.

3.19  FIELD QUALITY CONTROL

A.  Testing Agency: The Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.

B.  Allow testing agency to inspect and test subgrades and each backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.

C.  Testing agency shall perform tests to ensure that embedment and backfill materials and their placement comply with specified requirements. The following tests shall be required and reported to Engineer:

1.  Soil Classification: One initial soil classification test, ASTM D 2487 for each type of satisfactory soil embedment or backfill material and one additional test for each 10,000 cubic yards placed of each material.
   a.  Initial Soil Classification test shall be reported to the Engineer and approved prior to use of material on project.

2.  Gradation Test: One initial gradation test, ASTM D 422 for each type of granular embedment or backfill material and one additional test for each 10,000 cubic yards placed of each material.
   a.  Initial gradation tests shall be reported to the Engineer and approved prior to use of material on project.

3.  Moisture-Density Relations (Proctor): One standard proctor compaction test, ASTM D 698, for each type of material proposed, and one additional test for each 10,000 cubic yards placed of each material.

4.  In place field density tests of embedment and compacted backfill shall be made as specified elsewhere in this section and according to ASTM D 2922.

D.  Sample material tests such as soil classification, gradation and proctor tests shall be conducted no more than 15 days prior to submittal to the Engineer for approval. When material sample submittals are required, the testing agency shall obtain a sample of adequate size, split the sample by approved methods, perform testing on portions of the sample and return a portion of the sample to the Contractor for submittal to the Engineer.

E.  Material samples shall be clearly labeled and shall be submitted along with the written reports of testing conducted on that sample. Test reports conducted prior to the Work shall not be accepted unless the material is pre-approved and current certification is provided indicating that the material meets all requirements of the certifying agency.

F.  Testing Agency shall prepare and submit written reports at least once a week. Reports shall detail the material tested, the location test, the lift or elevation of material tested, the percent compaction and moisture content. Test results shall be submitted to the Contractor and Engineer.

G.  When testing agency reports that embedment and backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

1.  A written notice of failure to meet compaction shall be given to the Contractor and Engineer within 24 hours of said test. The report shall detail the location of work, type of material, and the tested percent compaction and moisture content.
3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape, re-compact, and seed & mulch.

C. Where settling occurs before Project 1 Year Warranty period elapses, remove finished surfacing, backfill with additional soil material, compact, reconstruct surfacing, and seed & mulch.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property or to an offsite property as approved by Engineer and written authorization of property owner. Stockpile or spread soil on owners property as directed by Engineer.

   1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner’s property.

END OF SECTION 312000
SECTION 312500 – PERMANENT EROSION CONTROL AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Seeding
   2. Mulching
B. Referenced Sections include the following:
   1. Section 015723 – Temporary Storm Water Pollution Prevention / Erosion Control.
   2. Section 311000 – Site Clearing.
C. Referenced Standards include the following:

1.2 DEFINITIONS
A. Finish Grade: Elevation of finished surface of planting soil.
B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.3 SUBMITTALS
A. Tree Planting Plan: Submit detailed layout and arrangement of proposed tree plantings.
B. Material Certificates for the following:
   1. Seed
   2. Mulch Overspray
   3. Erosion Control Blankets

1.4 QUALITY ASSURANCE
A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
   1. Installer’s Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
1.6 **SCHEDULING**

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

B. Season: Plant seed/seedlings during seasons that will best ensure permanent establishment of grass/trees.
   1. Cool season grasses: If planting is performed during the months of June, July, October or November, plant only 75 percent of the specified quantity of seed and then overseed during the months of August, September, December, January or February. If planting is performed during the months of December through May, August, or September, all seed may be planted at one time. Contractor will still be responsible for overseeding areas that may not establish.

1.7 **LAWN MAINTENANCE**

A. Begin maintenance immediately after each area is planted and continue until plants are established, but for not less than the following periods:
   1. Seeded Lawns: 60 days following completion of seeding activities.
      a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
   1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

**PART 2 - PRODUCTS**

2.1 **SEED**

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the requirements of the Missouri Seed Law. The percentages for purity and germination or pure live seed shall conform to Missouri Standard Specification for Highway Construction Section 805.

B. Seed Species Mixes: State-certified seed of grass species, as follows:
   1. Tall Fescue Mix:
      a. 55 lbs/acre Tall Fescue
      b. 15 lbs/acre Annual Rye
      c. 5 lbs/acre White Clover
   2. Native Grasses Mix:
      a. 30 lbs/acre Wheat
      b. 8 lbs/acre Tall Fescue
      c. 6 lbs/acre Big Bluestem
      d. 6 lbs/acre Little Bluestem
      e. 3 lbs/acre Sideoats Grama
      f. 6 lbs/acre Indiangrass
      g. 1 lbs/acre Switchgrass
2.2 TOPSOIL
A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.
   1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

2.3 INORGANIC SOIL AMENDMENTS
A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
   1. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
   2. Application Rate: 1000 lb per acre, or other application rate based on a soil analysis, as approved by the ENGINEER.

2.4 FERTILIZER
A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Tall Fescue Mix:
      a. Nitrogen: 80 lbs per acre.
      b. Phosphoric acid: 160 lbs per acre.
      c. Potash: 160 lbs per acre.
   2. Native Grass Mix:
      a. Nitrogen: 40 lbs per acre.
      b. Phosphoric acid: 80 lbs per acre.
      c. Potash: 80 lbs per acre.

2.5 MULCHES
A. Vegetative Mulch with an Overspray for Seeded Areas
   1. Mulch: Prairie hay (any combination of Big Bluestem, Little Bluestem, Indeangrass, Sideoats Grama, native wildflowers) or straw (from oats, ry, wheat or barley). Mulch shall be clean and bright, relatively free of foreign material and dry enough to spread properly. Mulch shall be free of prohibited weed seed as stated in the Missouri Seed Law and shall be relatively free of all other noxious and undesirable seed.
   2. Overspray: Virgin wood cellulose fibers or recycled slick paper conforming to requirements of Section 802 of Missouri Standard Specifications for Highway Construction. Material must not contain any germination-inhibiting or growth-inhibiting substances. Overspray shall be green in color after application and shall be evenly dispersed and suspended when agitated in water. Fibers shall not be water soluble.
B. Embedded Mulch for Seeded Areas
   1. Mulch, as specified in 2.5(A)(1) above, embedded into the soil by use of a disk-type roller having flat serrated disks spaced not more than 10 inches.

2.6 EROSION-CONTROL BLANKETS
   A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer’s recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas to receive grass and trees for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   B. B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SUBGRADE PREPARATION
   A. Limit subgrade preparation to areas to be planted.
   B. Newly Graded Subgrades: Remove stones larger than 2-inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner’s property. Apply 3 inches (plus/minus 1 inch) of topsoil on all newly graded subgrades to be planted. Incorporate topsoil by disking to a depth of 5 inches from the final surface.
      1. Apply fertilizer and lime to topsoil before disking.
         a. Delay mixing fertilizer with soil if planting will not proceed within a few days.
         b. Mix lime with dry soil before mixing fertilizer.
      2. If planting soil mix is used, spread mix to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
         a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil mix.
   C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus ½ inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
   D. Restore areas if eroded or otherwise disturbed after finish grading and before planting.
3.4 SEEDING

A. Application: Use the seed species mix as defined in Paragraph 2.1 of this Section for each of the following applications:
   1. Within 20 feet of Edge of Pavement: Tall Fescue Mix.
   2. Residential or commercial lawns: Tall Fescue Mix.
   3. Natural fields or pastures: Native Grasses Mix.
   4. Cultivated fields or grazing pastures: as approved by property owner and Engineer to minimize conflicts with exiting or proposed crop.

B. Sow seed with spreader or seeding machine (hydraulic seeding methods not allowed). Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.

C. Sow seed at the rates given in Paragraph 2.1.B of this Section.

D. Rake seed lightly into top 1/8 inch of topsoil and roll lightly.

E. Protect seeded areas with slopes steeper than 3H:1V with embedded mulch or erosion-control blankets installed and stapled according to manufacturer's written instructions.

F. Protect seeded areas with slopes steeper than 6H:1V by use of embedded mulch or vegetative mulch with overspray.

3.5 SATISFACTORY ESTABLISHMENT OF GRASSES

A. Grasses
   1. At end of Project 1 Yr Warranty period, a healthy, uniform, close stand of grass shall have been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
   2. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.6 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove temporary erosion-control measures, as required, after grass establishment period.

END OF SECTION 312500
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 313526.16 – GEOLINER MEMBRANE

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers high density polyethylene (HDPE) geomembranes with a formulated sheet density of 0.940 g/ml, or higher, in the thickness range of 0.75 mm (30mils) to 3.0mm (120 mils). Both smooth and textured geomembrane surfaces are included.

B. This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the geomembrane being manufactured. In a few cases a range is specified.

C. In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

D. This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete speciation in a specific situation. Additional tests or more restrictive values for test indicated, may be necessary under conditions of a particular application.

Note 2: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
2. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
3. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
4. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
5. D 1603 Test Method for Carbon Black in Olefin Plastics
12. D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
13. D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
17. D 7240 Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)
18. D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes

B. Geosynthetic Research Institute
1. GRI GM 10 Specification for the Stress Crack Resistance of Geomembrane Sheet
2. GRI GM 11 Accelerated Weathering of Geomembranes using Fluorescent UVA-Condensation Exposure Device
3. GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
4. GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low-Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
ADDENDUM #4 (New Section added due to change from Bentonite Seal to Geoliner Membrane)

1.3 DEFINITIONS

A. Lot - A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished roll will be identified by a roll number traceable to the resin lot used.

B. Construction Quality Assurance Consultant (CONSULTANT) - Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

C. ENGINEER - The individual or firm responsible for the design and preparation of the project’s Contract Drawings and Specifications.

D. Geomembrane Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geomembrane rolls.

E. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY) - Party, independent from the OWNER, MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.

F. INSTALLER - Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

G. Panel - Unit area of a geomembrane that will be seamed in the field that is larger than 100 ft².

H. Patch - Unit area of a geomembrane that will be seamed in the field that is less than 100 ft².

I. Subgrade Surface - Soil layer surface which immediately underlies the geosynthetic material(s).

J. Manufacturing Quality Control – A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications.

K. Manufacturing Quality Assurance - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project.

L. Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For HDPE polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

1.4 SUBMITTALS POST-AWARD

A. Submit under provisions of Section 013300, Submittal Procedures.

B. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:

1. Documentation of manufacturer's qualifications.
2. Manufacturer's Quality Control program manual or descriptive documentation.
3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.
4. Sample of the material.
5. Documentation of Installer's qualifications.
   a. Submit a list of at least ten completed facilities. For each installation, provide: name and type of facility; its location; the date of installation; name and telephone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
   b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
   c. Quality Control Program.
7. Resin Supplier's name, resin production plant identification, resin brand name and number, production date of the resin, resin Manufacturer’s quality control certificates, and certification that the properties of the resin meet the requirements for the project.

C. Shop Drawings
1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow the direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner’s Representative. Butt seams on a slope, if allowed, should be staggered.
2. Placement of geomembrane will not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

D. Additional Submittals (In-Progress and at Completion)
1. Manufacturer's warranty.
2. Geomembrane installation warranty.
3. Daily written acceptance of subgrade surface.
4. Low-temperature seaming procedures if applicable.
5. Prequalification test seam samples.
6. Field seam non-destructive test results.
7. Field seam destructive test results.
8. Daily field installation reports.
9. Installation record drawing.

1.5 QUALITY ASSURANCE
A. The OWNER will engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

1.6 QUALIFICATIONS
A. Manufacturer's Qualifications: The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 1,000,000 M2 (10,000,000 FT2) of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications
1. The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner’s Representative to install the geomembrane.
2. The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of (5,000,000FT2) of the specified type of geomembrane or similar during the last three years.
3. Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of (5,000,000 FT2) of geomembrane of the type specified or similar product.
4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of (3,000,000 FT2) of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.
5. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.7 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING
A. Labeling - Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:
1. Manufacturer’s name
2. Product identification
3. Thickness
4. Length
5. Width
6. Roll number
ADDENDUM #4 (New Section added due to change from Bentonite Seal to Geoliner Membrane)

B. Delivery- Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for geomembrane material, provided by the CONTRACTOR to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for shall have the following characteristics:
   1. Level (no wooden pallets)
   2. Smooth
   3. Dry
   4. Protected from theft and vandalism
   5. Adjacent to the area being lined

D. Handling- Materials are to be handled so as to prevent damage.

E. Rolls shall not be stacked more than three high.

1.8 WARRANTY
A. Material shall be warranted, on a pro-rata basis against Manufacturer’s defects for a period of 5 years from the date of geomembrane installation.

B. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

1.9 GEOMEMBRANE CLASSIFICATION AND FORMULATION
A. Material shall be smooth/textured polyethylene geomembrane as shown on the drawings.

B. This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

C. Geomembrane Rolls
   1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
   2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
   3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width, and MANUFACTURER.
   4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in section 1.09 D and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.

E. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.

F. No post consumer resin (PCR) of any type shall be added to the formulation.

1.10 PHYSICAL, MECHANICAL, AND CHEMICAL PROPERTY REQUIREMENTS
A. The geomembrane shall conform to the test property requirements prescribed in Tables 1.1 and 1.2. Table 1.1 is for smooth HDPE geomembranes and Table 1.2 is for single and double sided textured HDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

1. The tensile strength properties in this specification were originally based on ASTM D 638 which uses a laboratory testing temperature of 23°C ± 2°C. Since ASTM Committee D35 on Geosynthetics adopted ASTM D 6693 (in place of D 638), this GRI Specification followed accordingly. The difference is that D 6693 uses a testing temperature of 21°C ± 2°C. The numeric values of strength and elongation were not changed in this specification. If a dispute arises in this regard, the original temperature of 23°C ± 2°C should be utilized for testing purposes.

2. There are several tests often included in other HDPE specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:
   a. Volatile Loss
   b. Water Absorption
   c. Dimensional Stability
   d. Ozone Resistance
ADDENDUM #4 (New Section added due to change from Bentonite Seal to Geoliner Membrane)

3. There are several tests which are included in this standard (that are not customarily required in other HDPE specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:
   a. Oxidative Induction Time
   b. Oven Aging
   c. Ultraviolet Resistance
   d. Asperity Height of Textured Sheet
4. There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:
   a. Thickness of Textured Sheet
   b. Puncture Resistance
   c. Stress Crack Resistance
   d. Carbon Black Dispersion (in the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).
5. There are several GRI tests currently included in this standard. Since these topics are not covered in ASTM standards, this is necessary. They are the following:
   a. UV Fluorescent Light Exposure
   b. Asperity Height Measurement

B. The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

C. The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.

1.11 WORKMANSHIP AND APPEARANCE

A. Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties of the geomembrane.

B. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

C. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

1.12 MQC SAMPLING

A. Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

B. The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

C. The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence values listed are the minimum average values and are designated as "min. avg."

1.13 MQC RETEST AND REJECTION
ADDENDUM #4  (New Section added due to change from Bentonite Seal to Geoliner Membrane)

A. If results of any test do not conform to requirements of this specification, retesting to determine conformance or rejection should be done in accordance with manufacturing protocols set forth in the manufacturer’s quality manual.

Table 1.1: High Density Polyethylene - Smooth Geomembrane

<table>
<thead>
<tr>
<th>TESTED PROPERTY</th>
<th>TEST METHOD</th>
<th>FREQUENCY</th>
<th>MINIMUM AVERAGE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, (minimum average) mil (mm)</td>
<td>ASTM D 5199</td>
<td>every roll</td>
<td>30 (0.75) 27 (0.69) 40 (1.00) 36 (0.91) 60 (1.50) 54 (1.40) 80 (2.00) 72 (1.80) 100 (2.50) 90 (2.30)</td>
</tr>
<tr>
<td>Lowest individual reading (-10%)</td>
<td></td>
<td></td>
<td>30 (0.75) 27 (0.69) 40 (1.00) 36 (0.91) 60 (1.50) 54 (1.40) 80 (2.00) 72 (1.80) 100 (2.50) 90 (2.30)</td>
</tr>
<tr>
<td>Density, g/cm²</td>
<td>ASTM D 1505</td>
<td>200,000 lb</td>
<td>0.94 0.94 0.94 0.94 0.94</td>
</tr>
<tr>
<td>Tensile Properties (each direction)</td>
<td>ASTM D 6693, Type IV</td>
<td>20,000 lb</td>
<td>120 (21) 152 (26) 243 (42) 327 (57) 410 (71)</td>
</tr>
<tr>
<td>Strength at Break, lb/in-width (N/mm)</td>
<td></td>
<td></td>
<td>700 700 700 700 700</td>
</tr>
<tr>
<td>Yield, lb/in-width (N/mm)</td>
<td></td>
<td></td>
<td>13 13 13 13 13</td>
</tr>
<tr>
<td>Elongation at Break, %</td>
<td></td>
<td></td>
<td>700 700 700 700 700</td>
</tr>
<tr>
<td>Elongation at Yield, %</td>
<td></td>
<td></td>
<td>13 13 13 13 13</td>
</tr>
<tr>
<td>Tear Resistance, lb (N)</td>
<td>ASTM D 1004</td>
<td>45,000 lb</td>
<td>21 (93) 28 (124) 42 (186) 58 (257) 73 (324)</td>
</tr>
<tr>
<td>Puncture Resistance, lb (N)</td>
<td>ASTM D 4833</td>
<td>45,000 lb</td>
<td>65 (289) 84 (378) 132 (23) 177 (30) 212 (37)</td>
</tr>
<tr>
<td>Stress Crack Resistance(3)</td>
<td>ASTM D 5397</td>
<td>Per GRI-GM10</td>
<td>300hr. 300hr. 300hr. 300hr. 300hr.</td>
</tr>
<tr>
<td>Carbon Black Content, % (Range)</td>
<td>ASTM D 603*/421</td>
<td>20,000 lb</td>
<td>2.0 - 3.0 2.0 - 3.0 2.0 - 3.0 2.0 - 3.0 2.0 - 3.0</td>
</tr>
<tr>
<td>Carbon Black Dispersion</td>
<td></td>
<td></td>
<td>Note(1) Note(1) Note(1) Note(1) Note(1)</td>
</tr>
<tr>
<td>Notched Constant Tensile Load, hr</td>
<td>ASTM D 5397, Appendix</td>
<td>45,000 lb</td>
<td>1000 1000 1000 1000 1000</td>
</tr>
<tr>
<td>Oxidative Induction Time, min</td>
<td>ASTM D 3895, 200°C; O₂, 1 atm</td>
<td>200,000 lb</td>
<td>&gt;140 &gt;140 &gt;140 &gt;140 &gt;140</td>
</tr>
<tr>
<td>Oven Aging at 85°C [4][5]</td>
<td>ASTM D 5721</td>
<td>Per Each Formulation</td>
<td>55% 55% 55% 55% 55%</td>
</tr>
<tr>
<td>(a) Standard OIT (min. ave.) - % Retained after 90 days</td>
<td>ASTM D 3895</td>
<td></td>
<td>80% 80% 80% 80% 80%</td>
</tr>
<tr>
<td>(b) High Pressure OIT (min. ave.) - % Retained after 90 days</td>
<td>ASTM D 5885</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Standard OIT (min. ave.) - % Retained after 90 days</td>
<td>ASTM D 3895</td>
<td></td>
<td>50% 50% 50% 50% 50%</td>
</tr>
<tr>
<td>(b) High Pressure OIT (min. ave.) - % Retained after 90 days(8)</td>
<td>ASTM D 5885</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2: High Density Polyethylene - Textured Geomembrane

<table>
<thead>
<tr>
<th>TYPICAL ROLL DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll Length(2), ft (m)</td>
</tr>
<tr>
<td>Roll Width(2), ft (m)</td>
</tr>
<tr>
<td>Roll Area, ft² (m²)</td>
</tr>
</tbody>
</table>

NOTES:

1. DISPERSION only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
2. Roll lengths and widths have a tolerance of ± 1%.
3. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer’s mean value via MQC testing.
4. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
5. It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
6. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
7. Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
8. UV resistance is based on percent retained value regardless of the original HP-OIT value.
## ADDENDUM #4  (New Section added due to change from Bentonite Seal to Geoliner Membrane)

### TABLE 313526.16 - Geoliner Membrane

<table>
<thead>
<tr>
<th>Tested Property</th>
<th>Test Method</th>
<th>Frequency</th>
<th>Minimum Average Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, (minimum average) mil (mm)</td>
<td>ASTM D 5994</td>
<td>every roll</td>
<td>30 (0.75) 27 (0.69)</td>
</tr>
<tr>
<td>Lowest individual reading (-10%)</td>
<td></td>
<td></td>
<td>40 (1.00) 36 (0.91)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 (1.50)</td>
<td>72 (1.80)</td>
</tr>
<tr>
<td>Density, g/cm³</td>
<td>ASTM D 1505</td>
<td>200,000 lb</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.94</td>
</tr>
<tr>
<td>Tensile Properties (each direction)</td>
<td>ASTM D 6693, Type IV Dumbell, 2 ipm</td>
<td>20,000 lb</td>
<td>66 (11)</td>
</tr>
<tr>
<td>Strength at Break, lb/in-width (N/mm)</td>
<td></td>
<td></td>
<td>68 (11)</td>
</tr>
<tr>
<td>Stress Crack Resistance(3)</td>
<td>G.L. 2.0 in (51 mm)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G.L. 1.3 in (33 mm)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Tear Resistance, lb (N)</td>
<td>ASTM D 1004</td>
<td>45,000 lb</td>
<td>24 (106)</td>
</tr>
<tr>
<td>Puncture Resistance, lb (N)</td>
<td>ASTM D 4833</td>
<td>45,000 lb</td>
<td>65 (289)</td>
</tr>
<tr>
<td>Stress Crack Resistance(3)</td>
<td>ASTM D 5397 (App.)</td>
<td>Per GRI-GM10</td>
<td>300hr.</td>
</tr>
<tr>
<td>Carbon Black Content, % (Range)</td>
<td>ASTM D 1 603*/421 8</td>
<td>20,000 lb</td>
<td>2.0 - 3.0</td>
</tr>
<tr>
<td>Carbon Black Dispersion</td>
<td>ASTM D 5596</td>
<td>45,000 lb</td>
<td>Note(1)</td>
</tr>
<tr>
<td>Notched Constant Tensile Load, hr</td>
<td>ASTM D 5397, Appendix</td>
<td>200,000 lb</td>
<td>1000</td>
</tr>
<tr>
<td>Oxidative Induction Time, min</td>
<td>ASTM D 3895, 200° C, O₂, 1 atm</td>
<td>200,000 lb</td>
<td>&gt;140</td>
</tr>
<tr>
<td>Oven Aging at 85 C (110)</td>
<td>ASTM D 5721</td>
<td>Per Each Formulation</td>
<td>55%</td>
</tr>
<tr>
<td>Retained after 90 days</td>
<td>ASTM D 3895</td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>Retained after 90 days</td>
<td>ASTM D 5885</td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>UV Resistance(6)</td>
<td>GM 11</td>
<td>Per Each Formulation</td>
<td>N.R. (7)</td>
</tr>
<tr>
<td>Retained after 90 days</td>
<td>ASTM D 3895</td>
<td></td>
<td>N.R. (7)</td>
</tr>
<tr>
<td>Retained after 90 days</td>
<td>ASTM D 5885</td>
<td></td>
<td>N.R. (7)</td>
</tr>
<tr>
<td>Asperity Height mils (min. ave.) (9)</td>
<td>GM 12</td>
<td>Every 2nd roll (2)</td>
<td>10 mil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 mil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 mil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 mil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 mil</td>
</tr>
</tbody>
</table>

### TYPICAL ROLL DIMENSIONS

<table>
<thead>
<tr>
<th>Roll Length(2), ft (m)</th>
<th>Double-Sided Textured</th>
<th>Single-Sided Textured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>830 (253)</td>
<td>700 (213)</td>
</tr>
<tr>
<td></td>
<td>840 (256)</td>
<td>650 (198)</td>
</tr>
<tr>
<td></td>
<td>520 (158)</td>
<td>420 (128)</td>
</tr>
<tr>
<td></td>
<td>400 (122)</td>
<td>320 (98)</td>
</tr>
<tr>
<td></td>
<td>330 (101)</td>
<td>250 (76)</td>
</tr>
<tr>
<td>Roll Width(3), ft (m)</td>
<td>Double-Sided Textured</td>
<td>Single-Sided Textured</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>22.5 (6.89)</td>
<td>22.5 (6.89)</td>
</tr>
<tr>
<td></td>
<td>22.5 (6.89)</td>
<td>22.5 (6.89)</td>
</tr>
<tr>
<td></td>
<td>22.5 (6.89)</td>
<td>22.5 (6.89)</td>
</tr>
<tr>
<td>Roll Area, ft² (m²)</td>
<td>Double-Sided Textured</td>
<td>Single-Sided Textured</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>18,675 (1,735)</td>
<td>15,750 (1,463)</td>
</tr>
<tr>
<td></td>
<td>18,900 (1,755)</td>
<td>14,625 (1,359)</td>
</tr>
<tr>
<td></td>
<td>11,700 (1,087)</td>
<td>9,450 (878)</td>
</tr>
<tr>
<td></td>
<td>9,000 (836)</td>
<td>7,200 (669)</td>
</tr>
<tr>
<td></td>
<td>7,425 (690)</td>
<td>5,625 (523)</td>
</tr>
</tbody>
</table>

### NOTES:

- (1) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2) Roll lengths and widths have a tolerance of ± 1%.
- (3) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer’s mean value via MQC testing.
- (4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
- (6) The condition of the test should be 20 hr. UV cycle at 75° C followed by 4 hr. condensation at 60° C.
- (7) Not recommended since high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
- (8) UV resistance is based on percent retained value regardless of the original HP-OIT value.
- (9) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils.
- *Modified.

### 1.14 SUBGRADE PREPARATION

A. The subgrade shall be prepared in accordance with the project specifications. The geomembrane subgrade shall be uniform and free of all sharp or angular objects that may damage the geomembrane prior to installation of the geomembrane.

B. The Geomembrane Installer and Owner’s Representative shall inspect the surface to be covered with the geomembrane on each day’s operations prior to placement of geomembrane to verify suitability.
C. The Geomembrane Installer and Owner’s Representative shall provide daily written acceptance for the surface to be covered by the geomembrane in that day’s operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.

D. All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be approved by the Owner’s Representative and the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

1.15 GEOMEMBRANE PLACEMENT

A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in subsection 1.03 of this Section are submitted to and approved by the Owner’s Representative. Should geomembrane material be deployed prior to approval by the Owner’s Representative it will be at the sole risk of the Geomembrane Installer and/or Contractor. If the material does not meet project specifications it shall be removed from the work area at no cost to the owner.

B. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.

C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F) unless otherwise approved by the Owner’s Representative. The specified minimum temperature for material deployment may be adjusted by the Owner’s Representative based on recommendations by the manufacturer. Temperature limitation should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

D. No vehicular traffic shall be traveled on the geomembrane other than an approved low ground pressure All Terrain Vehicle or equivalent.

E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably – expected wind conditions. Sand bag material shall be sufficiently close-knit to prevent soil fines from working through the bags and discharging on the geomembrane.

F. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations should be defined in the preconstruction meeting.

G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.

H. The geomembrane shall not be allowed to “bridge over” voids or low areas in the subgrade. In these areas, the geomembrane shall be allowed to rest in intimate contact with the subgrade.

I. Wrinkles caused by panel placement or thermal expansion should be minimized.

J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade unless geometry requires seaming at such locations and if approved by the Owner’s Representative.

K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to effect a good weld and allow for proper testing. In no case shall this overlap be less than 3in.

1.16 FIELD SEAMING

A. Seams shall meet the following requirements:
   1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
   2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
   3. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.
   4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CONSULTANT and INSTALLER.
   5. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested.

B. During Welding Operations
   1. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

C. Extrusion Welding
   1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
   2. Clean geomembrane surfaces by disc grinder or equivalent.

D. Hot Wedge Welding
1. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
2. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.
3. Protect against moisture build-up between sheets.

E. Trial Welds
1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
3. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
4. Cut four, one-inch wide by six-inch long test strips from the trial weld.
5. Quantitatively test specimens for peel adhesion, and then for shear strength.
6. Trial weld specimens shall pass when the results shown in the following tables for HDPE and LLDPE are achieved in both peel and shear test.

Table 1.12.6A: Minimum Weld Values for HDPE Geomembranes

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>30 (0.75)</th>
<th>40 (1.0)</th>
<th>60 (1.5)</th>
<th>80 (2.0)</th>
<th>100 (2.5)</th>
<th>120 (3.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peel Strength (fusion), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>49 (8.6)</td>
<td>65 (11.4)</td>
<td>98 (17.2)</td>
<td>130 (22.8)</td>
<td>162 (28.4)</td>
<td>196 (34.3)</td>
</tr>
<tr>
<td>Peel Strength (extrusion), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>39 (6.8)</td>
<td>52 (9.1)</td>
<td>78 (13.7)</td>
<td>104 (18.2)</td>
<td>130 (22.8)</td>
<td>157 (27.5)</td>
</tr>
<tr>
<td>Shear Strength (fusion &amp; ext.), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>61 (10.7)</td>
<td>81 (14.2)</td>
<td>121 (21.2)</td>
<td>162 (28.4)</td>
<td>203 (35.5)</td>
<td>242 (42.4)</td>
</tr>
</tbody>
</table>

Table 1.2.6B: Minimum Weld Values for LLDPE Geomembranes

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>30 (0.75)</th>
<th>40 (1.0)</th>
<th>60 (1.5)</th>
<th>80 (2.0)</th>
<th>100 (2.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peel Strength (extrusion), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>36 (6.3)</td>
<td>48 (8.4)</td>
<td>72 (12.6)</td>
<td>96 (16.8)</td>
<td>120 (21.0)</td>
</tr>
<tr>
<td>Peel Strength (fusion), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>38 (6.7)</td>
<td>50 (8.8)</td>
<td>75 (13.1)</td>
<td>100 (17.5)</td>
<td>125 (21.9)</td>
</tr>
<tr>
<td>Shear Strength (fusion &amp; ext.), ppi (kN/m)</td>
<td>ASTM D 6392</td>
<td>45 (7.9)</td>
<td>60 (10.5)</td>
<td>90 (15.8)</td>
<td>120 (21.0)</td>
<td>150 (26.3)</td>
</tr>
</tbody>
</table>

6. (Continued)
   a. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).
   b. The break is ductile.
7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.

F. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.
1. Seaming shall not be allowed at temperatures under 32˚ F
2. Seaming shall not take place when the temperature of the geomembrane material is in excess of 170˚ F, as measured by an infrared thermometer.

G. Defects and Repairs
1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

1.17 FIELD QUALITY ASSURANCE

The Owner’s Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre-construction meeting.

A. Prequalification Test Seams
1. Test seams shall prepared and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the
ADDENDUM #4 (New Section added due to change from Bentonite Seal to Geoliner Membrane)

same equipment and operator combination as production seaming. The test seam shall be approximately 10 ft long for fusion welding and 3 ft long for extrusion welding with the seam centered lengthwise. At a minimum, test seams should be made by each technician 1 time every 4-6 hours; additional tests may be required with changes in environmental conditions.

3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld, “Film Tear Bond” (F.T.B. failure). Seam separation equal to or greater than 10% of the track width shall be considered a failing test.

4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.05.C.4 of this Section. All four specimens shall pass for the test seam to be a passing seam.

5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.

6. A sample from each test seam shall be labeled. The label shall indicate the date, a geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner’s Representative for archiving.

B. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner’s Representative.

2. Testing should be done as the seaming work progresses, not at the completion of all field seaming unless agreed to in advance by the Owner’s Representative. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.

3. Non-Destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.

4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner’s Representative all test methods to verify the test procedures are valid.

5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:

   a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings; a plastic bucket; wide paint brush or mop; and a soapy solution.

   b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).

   c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 12 in by 48 in (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:

   a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.

   b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and
ADDENDUM #4  (New Section added due to change from Bentonite Seal to Geoliner Membrane)

the valve closed. Allow 2min for the injected air to come to equilibrium in the channel, and sustain pressure for 5mins. If pressure does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

c.  If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.

d.  Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C.  Destructive Field Seam Testing

1.  One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.

2.  All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.

3.  The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.

4.  For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 10% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.

5.  If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRI GM 6.

6.  Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.

7.  For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall then be taken by the Geomembrane Installer at locations indicated by the Engineer, typically 3 m (10 ft) on either side of the failed sample and laboratory seem tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be nondestructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D.  Identification of Defects

1.  Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

E.  Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in this specification. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1.  If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.

2.  Defective seams, tears or holes shall be repaired by reseaming or applying an extrusion welded cap strip.

3.  Reseaming may consist of either:
   a.  Removing the defective weld area and rewelding the parent material using the original welding equipment; or…
   b.  Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.
4. Blister, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6in) beyond all edges of the defects.
5. All repairs shall be measured, located and recorded.

F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:
   1. Total amount and location of geomembrane placed;
   2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
   3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive testing;
   4. Results of pre-qualification test seams;
   5. Results of non-destructive testing; and
   6. Results of vacuum testing of repairs.

H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

1.18 REPAIR PROCEDURES
   A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
   B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.
   C. INSTALLER shall be responsible for repair of defective areas.
   D. Agreement upon the appropriate repair method shall be decided between CONSULTANT and INSTALLER by using one of the following repair methods:
      1. Patching- Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
      2. Abrading and Re-welding- Used to repair short section of a seam.
      3. Spot Welding- Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
      5. Flap Welding- Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
      6. Remove the unacceptable seam and replace with new material.
   E. The following procedures shall be observed when a repair method is used:
      1. All geomembrane surfaces shall be clean and dry at the time of repair.
      2. Surfaces of the polyethylene which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
      3. Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
   F. Repair Verification
      1. Number and log each patch repair (performed by CONSULTANT).

1.19 MEASUREMENT AND PAYMENT
   A. Payment for geomembrane installation will be as per contract unit price per square foot, as measured parallel to liner surface, including designed anchor trench material and is based upon net lined area.
   B. Net lined area is defined to be the true area of all surfaces to be lined plus designed burial in all anchor trenches, rub-sheets, and sacrificial layers.
   C. Prices shall include full compensation for furnishing all labor, material, tools, equipment, and incidentals.
   D. Prices also include doing all the work involved in performing geomembrane installation completely as shown on the drawing, as specified herein, and as directed by the ENGINEER.

END OF SECTION 170700
SECTION 323100 – CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   2. Galvanized steel framework.
   4. Signs.

B. Referenced Sections include the following:
   1. None.

C. Referenced Standards include the following:
   1. ACI 301 - Specifications for Structural Concrete; American Concrete Institute; 1999.
   2. ASTM A 53 - Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   3. ASTM A 121 - Specifications for Zinc-Coated (Galvanized) Steel Barbed Wire.
   4. ASTM A 392 - Specifications for Zinc-Coated Steel Chain Link Fence Fabric.
   5. ASTM A 824 - Specifications for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence.
   8. ASTM C 387 - Specifications for Packaged, Dry, Combined Materials for Mortar and Concrete.
   10. ASTM F 567 - Practice for Installation of Chain Link Fence.

1.2 DEFINITIONS

A. CLFMI: Chain Link Fence Manufacturers Institute.

B. Zn-5-Al-MM Alloy: Zinc-5 percent aluminum-mischmetal alloy.
1.3 SUBMITTALS

A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:
   1. Fence and gate posts, rails, and fittings.
   2. Chain-link fabric, reinforcements, and attachments.
   3. Gates and hardware.
   4. Barbed wire.

B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer's written permission.

B. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. Steel Chain-Link Fence Fabric: Height indicated on Drawings. Provide fabric fabricated in one-piece widths for fencing in height of 12 feet and less. Comply with CLFMI's "Product Manual" and with requirements indicated below:
   1. Mesh and Wire Size: 2-inch mesh, 9 gage.
   2. Zinc-Coated Fabric: ASTM A 392, with zinc coating applied to steel wire mesh fabric after weaving with the following minimum coating weight:
      a. Class 1: Not less than 1.2 oz./sq. Ft. of uncoated wire surface.
      b. Class 2: Not less than 2 oz./sq. Ft. of uncoated wire surface.
   3. Coat selvage ends of fabric that is metallic coated during the weaving process with manufacturer's standard clear protective coating.
2.2 INDUSTRIAL FENCE FRAMING

A. Round Steel Pipe: Standard weight, Schedule 40, galvanized steel pipe complying with ASTM F 1083. Comply with ASTM F 1043, Material Design Group IA, external and internal coating Type A, consisting of not less than 1.8-oz./sq. Ft. zinc; and the following strength and stiffness requirements:
   1. Line, End, Corner, and Pull Posts and Top Rail: Per requirements for Light Industrial Fence.
   2. Line, End, Corner, and Pull Posts and Top Rail: Per requirements for Light Industrial Fence.

B. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.

C. Top Rails: Fabricate top rail from lengths 21 feet or longer, with swedged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric.

D. Extended Members: Extend posts above top of chain-link fabric as required to attach barbed wire assemblies.

2.3 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:
   1. Location: Extended along bottom of fence fabric.

B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 824 and the following:
   1. Coating: Type II, zinc coated (galvanized) by the hot-dip process, with the following minimum coating weight:

2.4 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for the following swing-gate types:
   1. Double gate.

B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.

C. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F 900.

D. Frame Corner Construction: As follows:
   1. Welded or assembled with corner fittings and 5/16-inch- diameter, adjustable truss rods for panels 5 feet wide or wider.

E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and weight according to ASTM F 900 for the following gate fabric heights and leaf widths:

F. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as required to attach barbed wire assemblies.
G. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and, for each gate leaf more than 5 feet wide, keepers. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
   1. Provide chains as needed.
   2. Provide and maintain temporary locks until facilities are released to the Owner. Coordinate the switching of locks with the Owner to ensure that facilities remain secure.

2.5 INDUSTRIAL HORIZONTAL SLIDE GATES

A. General: Comply with ASTM F 1184 for the following slide-gate types:
   1. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
   2. Classification: Type II Cantilever Slide, Class 2 with internal roller assemblies.

B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.

C. Frames and Bracing: Fabricate from round galvanized steel tubing with outside dimension and weight according to ASTM F 1184.

D. Frame Corner Construction: As follows:
   1. Type II Cantilever Slide Gates: Welded.

E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and minimum weight according to ASTM F 1184.

F. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as required to attach barbed wire assemblies.

G. Guide Posts and Roller Guards: As required per ASTM F 1184 for Type II, Class 1 gates.

H. Hardware: Latches permitting operation from both sides of gate, locking devices, hangers, roller assemblies and stops fabricated from galvanized steel. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
   1. Provide chains as needed.
   2. Provide and maintain temporary locks until facilities are released to the Owner. Coordinate the switching of locks with the Owner to ensure that facilities remain secure.

2.6 FITTINGS

A. General: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F 626.

B. Pipe Sleeves: For posts set into concrete, provide preset hot-dip galvanized steel pipe sleeves complying with ASTM A 53, not less than 6 inches long with inside dimensions not less than ½ inch more than outside dimension of post, and flat steel plate forming bottom closure.
2.7 **BARBED WIRE**

A. **Zinc-Coated Steel Barbed Wire:** Comply with ASTM A 121, Chain-Link Fence grade for the following three-strand barbed wire:

1. **Standard Size and Construction:** 12 gauge wire with, 3-point round barbs spaced not more than 5 inches on center.

2.8 **CAST-IN-PLACE CONCRETE**

A. **General:** Comply with ACI 301 for cast-in-place concrete.

B. **Materials:** Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.

1. **Concrete Mixes:** Normal-weight concrete with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

C. **Materials:** Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer’s written instructions.

2.9 **GROUT AND ANCHORING CEMENT**

A. **Nonshrink, Nonmetallic Grout:** Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. **Erosion-Resistant Anchoring Cement:** Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

2.10 **SIGNS**

A. Signs shall meet or exceed the minimum standards given in the Missouri Standard Specifications for Highway Construction Section 1041 entitled Construction Signs, and all referenced standards therein.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by Engineer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
3.3 INSTALLATION, GENERAL

A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
   1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set line posts per ASTM F 567 is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
   1. Dimensions and Profile: As indicated on Drawings.
   2. Concealed Concrete Footings: Top of footings shall be 2 inches below grade to allow covering with surface material.
   3. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
   4. Posts Set into Concrete in Voids: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

B. Line Posts: Space line posts uniformly at 8 feet on center.

C. Post Bracing Assemblies: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two-thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

D. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.
   1. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same gage and type of wire.

E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
F. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

G. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.

H. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

I. Barbed Wire: Install barbed wire uniformly spaced as indicated on Drawings. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.

3.5 GATE INSTALLATION

A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.7 WARRANTY

A. The Project 1 Year Warranty period shall apply to Section 323100 - Chain Link Fencing and Gates.
SECCTION 331100 – WATER SUPPLY WELLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes materials and procedures for drilling and developing water supply wells in consolidated formations, including the following:
   1. Test holes.
   2. Drilling.
   5. Draw down Testing.
   6. Pump base pedestal.

B. Referenced Sections include the following:
   1. Section 013200 – Schedule.

1.2 DRILLER’S EXPERIENCE

A. The Contractor shall submit evidence that he has adequate qualifications to complete all items of the Contract. This shall include the proper drill rigs, compressors, trucks, trailers, pump service rigs, testing equipment, and at least six references of previously completed state approved, pressure grouted, wells of similar size and depths covered by these plans and specifications. Preferably, the referenced wells shall have been drilled by the same Driller the Contractor intends to use on this project.

B. The work of drilling, casing and testing the well shall be performed by careful, efficient, and skilled mechanics in the normal full-time employment of the Contractor. All work is to be done by the same Contractor. No subcontracting will be allowed.

1.3 SUBMITTALS

A. Schedule: Submit a Preliminary Construction Schedule and Submittal Schedule according to Division 01 Section 013200 – Schedule.

B. The Contractor shall submit the following submittals:
   1. Drilling fluid product data sheets.
   2. Additive product data sheets.
   3. Test Hole Report.
   4. Operation and Maintenance materials.

PART 2 - PRODUCTS

2.1 CASING

A. The well shall be cased with new steel or wrought iron pipe meeting AWWA Standard A-100, ASTM or API specifications for water well construction, having full circumferential welds or threaded coupling joints, and installed in a water tight manner. If threaded joints are used, long recessed couplings shall be required and the completed joint shall have no more than two (2) exposed threads. The casing pipe shall have the minimum weight and thickness indicated below:
### 2.2 LINERS

A. Well liners, if required, shall be of new steel or wrought iron pipe with a minimum wall thickness of 0.322 inches and shall be installed as directed by the State Geologist.

### 2.3 GROUT

A. The cement grout shall be mixed at the site and shall be mixed to weigh at least fourteen pounds per gallon and shall conform to ASTM C150 with not more than six gallons of water per sack of cement.

### PART 3 - EXECUTION

#### 3.1 GENERAL INSTRUCTIONS

A. At least one week before starting to drill the well, the Contractor shall send a written request (copy to Engineer) to the State Geologist who will furnish a set of small sample sacks, a drill record book, and a letter of instructions regarding the collection and handling of drill cuttings. The Contractor shall request these items from:

1. Department of Natural Resources - Geological Survey and Resource Assessment Division (GSRAD)
   
   P. O. Box 250
   
   111 Fairgrounds Road
   
   Rolla, Missouri 65401
   
   (573-368-2100).

B. The well driller shall save a sample of cuttings from every five (5) feet of well depth and shall place the samples in properly labeled sacks. The cuttings shall be taken from the bailer or the well head, and not from the slush pit. The sacks containing the cuttings shall be sent, prepaid, to the State Geologist at Rolla, Missouri, for examination each day until the casing is set. After the casing is set, the samples shall be submitted weekly. A copy of the driller's log for the particular period shall accompany the samples.

C. The driller shall note in the drill record book, the identification of soil and rock formations encountered, and the location and depth of any openings, crevices, soft or broken ground, or discontinuities. The driller shall also note in the drill record book, the depth at which water is encountered, and the static water level as the drilling progresses and at the completion of the well. The drill record book shall also contain complete information as to the depth of casing, methods of sealing same, and seal test results.

D. When well drilling is completed, the driller shall forward all samples of cuttings not previously submitted and the drill record book to the State Geologist. Before final submittal to the State Geologist, the drill record book and the cuttings shall be accessible to the Engineer at all times.

#### 3.2 PLUMBNESS AND ALIGNMENT

A. The well shall be sufficiently straight and plumb to permit installation of the casing without binding and to permit satisfactory operation of the deep well pump. To demonstrate this fact, the Contractor shall furnish tools, labor, and equipment, at his expense, for testing plumbness and alignment. Tests shall be made after construction of the well is complete and before its acceptance. Additional tests, however, may and should be made by the
Contractor during performance of the work. The following method shall be used to verify the plumbness of the
well:

1. A dummy casing forty (40) feet long and having an external diameter of not more than one-half (1/2) inch
smaller in diameter than the inside diameter of the grouted casing shall be lowered throughout the depth of
the well without binding.

2. Should the dummy casing fail to move freely throughout the length of the well, or should the well vary from
the vertical in excess of two-thirds of the smallest inside diameter of that part of the well being tested per
100 feet of depth, the Contractor shall correct the plumbness and alignment of the well at his own expense.
Should the Contractor fail to correct such faulty alignment or plumbness, the Engineer may refuse to accept
the well. The Engineer may waive the requirements of this paragraph if, in his judgement;
   a. The Contractor has exercised all possible care in constructing the well and the defect is due to
circumstances beyond his control.
   b. The utility of the completed well will not be materially affected.
   c. The cost of necessary remedial measures will be excessive.

B. In no event will the provisions of this paragraph with respect to alignment be waived.

3.3 GROUTING

A. After the casing has been installed to the proper depth, centered, and plumbed, it shall be raised approximately
one foot and held securely in that position. Before the cement grout is introduced, water shall be circulated
upward through the annular space and forced to the ground surface. A satisfactory casing seal shall be made by
filling the entire annular space between the casing and the drill hole with neat cement grout, which shall be
introduced through a conductor pipe within the casing and forced upward under pressure from the bottom of the
casing in one continuous operation until the grout emerges at the ground surface on the outside of the casing.
The conductor pipe shall be connected to a suitable plug at the bottom of the casing by means of a valved fitting.
Methods utilizing the well casing for conducting grout shall not be used. After grout is applied, work on the well
shall be discontinued for at least 72 hours or until the grout has properly set.

B. Where crevices or fractured formations make it impossible to circulate water through the annular space to the
ground surface, bentonite or similar materials may be added to the circulating water to seal the formation before
grouting is commenced. If, in the opinion of the Missouri Department of Natural Resources, it is impossible to
seal such openings in this manner, the annular space shall be cemented as far as possible with grout introduced
from the bottom of the casing and the remainder of the annular space shall be cemented by introducing grout
from the top of the ground through a one (1) inch pipe inserted in the annular space. The pipe shall extend to
within a few inches of the grout surface and, as the grout is introduced, the grout pipe shall be raised.

3.4 STATIC WATER LEVEL

A. The static water level in the drill hole shall be accurately determined before the casing is set and again after the
casing seal is completed. Both determinations shall be recorded in the drill record book.

3.5 DEVELOPMENT

A. A temporary pump with a capacity in excess of the anticipated lift and final production capacity of the well, or
other adequate equipment shall be installed for the purpose of developing the well and making a capacity test to
determine the hydraulic conditions of the well. The well water shall be thoroughly developed, cleaned, and
tested, and the well water shall be clear of sand before the permanent pump is installed. The Contractor shall
meet the following development criteria:

1. Sand content shall be less than 5 mg/L for a minimum of a 2 hour time period
2. There shall be no significant increase in specific capacity, the ratio of discharge rate to the unit of drawdown it produces, during the duration as set forth in the Testing Section herein.

3.6 YIELD AND DRAWDOWN TEST

A. Yield and drawdown tests shall be performed prior to placement of the permanent pump. To perform the test, the Contractor shall furnish the equipment necessary to pump the well at a minimum capacity of 1.5 times the design capacity at the maximum anticipated drawdown. The Contractor shall also provide the equipment necessary to measure the flow and water level in the well. The equipment shall include, but not be limited to, a pump capable of 1.5 times the design flow with sufficient piping to place the pump at the design setting, throttling devices to reduce the discharge, flow meter, air line complete with gage, hand pump, and check valve. The Contractor shall provide for continuous, uninterrupted pumping throughout each stage of the testing.

B. The yield and drawdown test shall be conducted in two stages. During Stage 1, the well shall be pumped at 1.5 times the design pumping rate until stabilized drawdown in the well has continued for at least four hours. The total duration of this stage of the test shall be no less than 8 hours and no more than 24 hours, unless otherwise directed by the Engineer, in which case payment for additional testing shall be made at the unit rate provided in the bid.

C. After completion of Stage 1, Stage 2 shall include the well being pumped at the design rate and against a pressure approximately equal to the total dynamic head produced by the system until stabilized drawdown has continued for at least eight hours. The duration of this stage of the test shall not exceed 24 hours, unless otherwise directed by the Engineer, in which case payment for additional testing shall be made at the unit rate provided in the bid.

D. Stage 1 and Stage 2 may be conducted consecutively or as two separate events, at the discretion of the Contractor. If pumping is stopped for any duration of time between Stage 1 and Stage 2, the Contractor shall wait until the water level in the well has recovered to within one foot of the pre-pumping level before initiating pumping for Stage 2. After completion of the pumping test(s), Contractor shall monitor rebound of the water level in the well for four hours, or until the water level has rebounded to within 2 feet of the pre-pumping level.

E. After completion of Stage 1 and Stage 2, the Contractor shall supply all information necessary to size the permanent pumping equipment. Water level measurements shall be made according to the schedule found on the enclosed “Aquifer Test Data” form found at the end of this section, or similar form to record water level readings and pump test data. The Contractor shall complete the “Well and Pump Data” sheet also enclosed at the end of this section. Both forms shall be submitted to the Engineer.

F. The Contractor shall provide the following to the Engineer and the Missouri Department of Natural Resources upon completion of the yield and drawdown tests:

1. Test pump capacity-head characteristics.
2. Static water level.
3. Depth of test pump setting.
4. Time of starting and ending each test cycle.

G. The Contractor shall also provide recordings and graphic evaluation of the following at one-hour intervals to the Engineer and the Missouri Department of Natural Resources upon completion of the yield and drawdown tests:

1. Pumping rate.
2. Pumping water level.
3. Drawdown.
4. Water recovery rate and levels.
3.7 PUMP BASE

A. A concrete pump base shall be constructed as shown on the drawings. The top of the base shall be at the elevation shown, and the base shall extend deep enough to rest on ground that will give adequate support. The concrete shall be poured in place and shall have a 28-day compressive strength of at least 3,000 PSI. The top of the base shall be sloped downward toward the sides, and all corners shall be chamfered. All exposed surfaces shall be troweled or rubbed smooth and kept clean.

3.8 DISINFECTION

A. After the well has been completely constructed, it shall be thoroughly cleaned of all foreign substance, including tools, timber, rope, and debris of any kind, cement, oil, grease, joint dope, and scum. The casing pipe shall be thoroughly swabbed, using alkalis if necessary, to remove oils, grease, or joint dope.

B. In the case where the Well Driller Contractor is the same as the Well Pump Installer, disinfection is not required until after the permanent pump is installed.

C. Otherwise, the well shall be disinfected with a 25-ppm chlorine solution. With the temporary pump installed, the chlorine solution shall be poured into the well, and the well shall be agitated to accomplish mixing and then let stand for 24 hours. At the end of the 24-hour period, the well shall be pumped, and a chlorine residual test shall be run on the discharge. A chlorine residual of at least 0.5 ppm will be required to insure disinfection. After disinfection is accomplished to the satisfaction of the Engineer, the well shall be pumped to waste until all chlorine is removed.

3.9 BACTERIOLOGICAL, CHEMICAL, AND RADIOLOGICAL TESTING

A. The Contractor shall arrange for water testing from the completed well for bacteriological and chemical analysis. Test results must be submitted to the Engineer prior to release of final payment. The Contract has the option to submit samples to a private lab, or to the Water Supply Program, Missouri Department of Natural Resources, for bacteriological and chemical analyses. The Contractor shall be fully responsible for any delays caused by sampling or testing of the water.

B. The well shall not be put in service until the analyses are completed and the water supply is approved by the state. Such approval shall not affect the acceptance of the well or payment to the Contractor.

C. The well shall be tested for radiological activity as required by the Missouri Department of Natural Resources.

3.10 WELL HEAD PROTECTION

A. Contractor shall provide protection to prevent tampering with the well or the introduction of foreign materials into the aquifer at all times during the construction. Caps shall be provided to seal the top of the well head. A threaded cap or a welded steel plate shall be used to seal the well during periods during the construction when the well will be left unattended for more than three calendar days. A properly fitted, firmly driven, wooden plug may be used as a temporary cap for periods less than three calendar days.

B. Contractor shall identify the location of all potential sources of pollution within a 1000 foot radius of the well and shall take all reasonable measures to prevent contamination from these sources. The Contractor shall provide a report of site reconnaissance, a sketch identifying the location of identified sources, and a record of actions taken to prevent contamination.

C. The permanent connection of the pump motor to the well casing shall include a bolted and gasketed connection between the motor base and the well casing to prevent contamination of the well.

D. The well casing shall terminate 4 feet above the 100-year flood elevation.
3.11 DISPOSAL OF WATER AND CUTTINGS
A. During the drilling and test pumping, the Contractor shall discharge all water and cuttings into an earth pit where the cuttings can be separated from the water so as to minimize discharge of the cuttings to the natural drainage course. A 90 degree v-notch weir shall be installed at the outlet of the earth pit to measure flow rates during the drilling operation for the air rotary drilling method.
B. The method and location of disposal shall be approved by the Owner. The contractor shall furnish all labor, materials, and equipment for constructing ditches or laying pipe and the cost of all such work shall be paid for by the Contractor. All ditches and pits dug by the Contractor shall be filled in to the satisfaction of the Owner upon completion of work.

3.12 PROTECTION OF THE SITE
A. Except as otherwise provided, the Contractor shall protect all structures, such as walks, pipelines, trees, shrubbery, and lawns during the progress of his work. Upon completion of the work, the Contractor shall remove all debris and unused materials and shall restore the site as nearly as possible to its original condition, including the replacement, at the Contractor's sole expense, of any facility or landscaping which has been damaged or destroyed.

3.13 CLEANUP
A. When the well has been completed, the Contractor shall remove all his equipment, material, etc. from the site and remove or dispose of all rubbish or other unsightly material caused by his operations. He shall restore the site to at least its original condition.

3.14 WELL ABANDONMENT
A. Well abandonment, if required, shall be completed in accordance with the rules set out in 10 CSR 23-3.110. The Contractor shall be responsible for registering the abandoned well with the Missouri Department of Natural Resources.

3.15 MEASUREMENT
A. The total depth of the drilled well shall be accurately measured from the surface of the ground at the well site to the bottom of the well and to points where the size of the hole is reduced. The lengths of casing (and liners, if any) set shall also be measured. All measurements shall be made to the nearest foot by the Contractor in the presence of the Engineer.

3.16 PAYMENT
A. Payment for drilling and completing the production well and testing will be made as follows: Total payment amount is based on assumed aquifer characteristics. Total payment amount shall be adjusted prior to payments being made based on the results of the test hole and unit prices provided in the bid. Upon successful completion of the Drawdown Testing and acceptance of the results by the Engineer and Owner, and completion of all disinfecting, water quality testing, and cleanup, payment shall be made at one hundred (100) percent of the total lump sum amount for each well. No partial payments will be made to the Contractor. Section 19.1 and 19.2 of the General Conditions do not apply to this Contract.
B. Payment will not be contingent upon completion of the chemical analysis results, but chemical samples must have been collected prior to payment.

3.17 WARRANTY
A. The Project 1 Year Warranty period shall apply to Section 331100 - Water Supply Wells.

END OF SECTION 331100
SECTION 331400 – WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Special Provisions apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and specialties outside the building for the following:
   1. Water services
   2. Water mains
   3. Fire services
   4. Process Piping

B. Referenced Sections include the following:
   1. Section 312000 - Excavating and Backfilling Trenches.

C. Referenced Standards include the following:
   1. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water Distribution; American Water Works Association; 1997.
   2. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. (76 mm through 1,219 mm), for Water; American Water Works Association; 1998.
   7. AWWA C540-02 - Standard for Power-Actuating Devices for Valves and Slide Gates; American Water Works Association; 2003
1.3 DEFINITIONS

A. Fire-Service Main: Exterior fire-suppression-water piping.
B. Water Main: Exterior water distribution system piping.
C. Water Service: Exterior domestic-water piping.
D. Process Piping: Piping used within treatment facilities or used to connect treatment processes.
E. The following are industry abbreviations for piping materials:
   1. PVC: Polyvinyl chloride plastic.
   2. DIP: Ductile iron pipe.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Piping
   2. Fittings
   3. Meters
   4. Meter boxes
   5. Valves

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and
   are based on the specific system indicated.
B. Regulatory Requirements:
   1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
   2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
D. NSF Compliance:
   1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
   2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.
B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

1.8 PERMITS

1. Contractor shall refer to utility company to obtain all required permits and pay any associated permitting fees prior to commencement of work.

1.9 COORDINATION

A. Coordinate service connections to water main with utility company.

PART 2 - PART - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron Pipe: AWWA C151, Class 53 with mechanical-joint, push joint, or flanged joint as indicated. Inside of pipe and fittings shall be lined with cement mortar complying with ANSI A21.4 with a minimum thickness of 1/16th inches.

1. Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern – Mechanical joint or flanged joint as indicated.

a. Joint Restraint: All buried valves and fittings used on this project shall have restrained mechanical joints. For pipe 4" and larger use the Megalug Series 1100 produced by EBAA Iron Inc. or approved equal. For pipe smaller than 4" use a knuckle type joint and restraint such as that manufactured by HARCO (Harrington Corporation of Lynchburg, Virginia) or approved equal.

B. Ductile-Iron Flexible Expansion Joints: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
C. Ductile-Iron Deflection Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

D. Ductile-Iron Expansion Joints: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

E. Exposed Ductile Iron Pipe and Fittings: The coatings on all exposed piping inside buildings or structures shall be un-coated and suitable for painting.

2.3 COPPER TUBE AND FITTINGS
A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 PVC PIPE AND FITTINGS
A. PVC Pressure Pipe: Class 200, SDR 21, for rubber gasketed joints. PVC pressure pipe shall meet the following:
   2. PVC Pressure Rate Pipe: ASTM D 2241.
   4. Fittings shall be Ductile Iron

B. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket and spigot end.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
      a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 GATE VALVES
A. AWWA, Cast-Iron Gate Valves: Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
   2. End Connections: Mechanical joint.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES
A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5 inch diameter barrel.
   1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7 CHECK VALVES
A. Check valves shall have openings or waterways at least equivalent to the full area of the connecting pipes. They shall be of the single balanced disc, swing pattern type, with an outside spring lever, fully bronze mounted, with flanged, or mechanical joint ends as the nature of the connection shall require. In general ruggedness of design and construction, and in materials and workmanship, they shall correspond to the gate valves specified herein. The bottom of the cases shall have no pockets in which gravel, stones, or grit can collect. All internal working parts shall be readily accessible and removable through flanged covers. All check valves shall be checked for water-tightness and shall be tight against a back pressure of not less than 150 psi. Quality shall be equal to the Mueller A-2600 Series or the Clow F5380 Series check valves.

B. Silent check valves shall be installed where indicated on the plans. Silent check valves shall be the globe style, silent type with semi-steel bodies and bronze or stainless steel trim. They shall be of the wafer design with easily replaceable parts. The silent check valves shall perform equally well in all positions. The silent check valves shall be Val-Matic Silent Check Valves as manufactured by the Val-Matic Valve and Manufacturing Corporation or approved equal.

2.8 BUTTERFLY VALVES

A. Butterfly valves shall be cast or ductile iron body, rubber-seated; with bronze or stainless steel mountings. Butterfly valves shall be manufactured in full compliance with AWWA C504. Valves shall have standard flange, wafer, or mechanical joint ends, as the nature of the connections shall require. The operating stem shall be equipped with coupling nuts for extension stem. Quality shall be equal to the Dresser 450 Series or Clow F5300 Series butterfly valves. Extension stems and cast iron valve boxes shall be provided as shown on the plans. Floorstands shall be provided where shown on the plans.

2.9 ELECTRIC VALVE ACTUATORS

A. All electric actuators shall conform to AWWA C540-02 containing the following:

1. motor
2. gearing
3. manual over-ride
4. limit switches
5. torque switches
6. drive coupling
7. integral motor controls
8. position feedback transmitter
9. mechanical dial position indicator

B. Motor: Induction type with class F insulation protected by means of thermal switches imbedded in the motor windings. The motor shall be specifically designed for actuator service.

1. Electrical: 120 Volt, single phase, 60 hertz.

C. Motor Enclosure: NEMA 4 (watertight), totally enclosed, non-vented.

D. Gearing: grease lubricated designed to withstand full torque of motor.

E. Manual Over-ride: manual operation shall be via power gearing to minimize rim pull and facilitate easy change-over from motor to manual operation when actuator is under load. Return to electric operation mode shall be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.

1. Operator: Hand Wheel (or Chain drive if over 6’-6” above standing surface).

F. Limit Switches: shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation and shall be driven by counter-gear. Adjustment of limit switches shall require no more than five (5)
turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts shall be provided each end of travel. Contacts shall be silver and capable of reliably switching low voltage DC source from the control system.

G. Torque Switches: Each end of travel shall be equipped with a mechanically operated torque switch to trip when the valve load exceeds the torque switch setting. Torque switch adjustment device shall be calibrated directly in engineering units of torque.

H. All wiring shall be terminated at plug and socket connectors.

I. Quarter turn actuators shall be furnished with mechanical stops that restrict the valve/actuator travel.

J. Actuator shall be capable of valve closing times of: 60 seconds.

K. Operating temperature range: -20 to 160 degrees F with motor controls.

L. Open/Close Actuators: Integral motor controls shall consist of:
   1. reverse starters
   2. control transformer
   3. phase discriminator
   4. monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure)
   7. Indicator lights: red and green.
   8. Control system interface with optical isolators to separate incoming voltage signals from the internal motor controls.

M. Modulating Actuators: Dynamic valve torque shall be no more than 60% of the electric actuator’s maximum rated breakaway torque. Power gearing in modulating actuators shall have zero backlash between the motor and the actuator output. Integral motor controls shall consist of:
   1. Feedback potentiometer
   2. reverse starters
   3. control transformer
   4. phase discriminator
   5. monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure)
   8. Indicator lights: red and green.
   9. Positioner capable of accepting a 4-20 mA DC command signal and positioning valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator.
   10. The positioner shall be field adjustable to fail to the “Open”, “Closed” or “Last” position on loss of 4-20 mA DC command signal.

2.10 AIR RELEASE VALVES

A. Air release valves shall be of the simple lever type and shall be capable of automatically releasing accumulated air from a fluid system while that system is in operation and under pressure. To assure drop tight shut-off, a viton orifice button shall be used to seal the valve discharge orifice when the valve is in a closed position. The orifice diameter will be sized for use within a given operating pressure range to insure maximum discharge
capacity. The body and cover shall be of cast iron. With the exception of the viton orifice button, the leverage mechanism, float, and all other internal trim shall be of stainless steel. The stainless steel float shall be designed to and capable of withstanding a pressure in excess of 1,000 psi. Quality shall be equal to the Val-Matic Models #15, #22, or #25.

2.11 PRESSURE RELIEF VALVES

A. Pressure relief valves shall bypass or relieve excess pressures that may occur in the system. It shall be the hydraulically operated, pilot controlled, diaphragm type and shall have a single removable seat and resilient disc. No external packing glands will be allowed and the diaphragm shall not be used as a seating surface. The pilot control shall be a direct acting, adjustable, spring loaded, diaphragm valve designed to permit flow when the controlling pressure exceeds the spring setting. The pilot control system shall operate such that as excess line pressure is dissipated, the main valve will gradually close to a positive, drip tight seating. The valve shall be the globe type and shall be rated for a pressure range of 20 to 200 psi. The valve shall be a Clayton 50 Pressure Relief Valve as manufactured by the Cla-Val Company or an approved equal.

2.12 FREE STANDING FIRE HYDRANTS

A. Dry-Barrel, High-Pressure Fire Hydrants: AWWA C502, one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure, and 250-psig minimum working-pressure design.

1. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
2. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
3. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.

2.13 WATER METERS

A. Water meters shall be purchased through, and as required by the local utility company.
B. Description: AWWA C700, displacement-type, bronze main case. Register flow in gallons unless cubic feet are indicated.
C. Description: AWWA C701, turbine type. Register flow in gallons unless cubic feet are indicated.
D. Description: AWWA C702, compound-type, bronze case. Register flow in gallons unless cubic feet are indicated.

2.14 METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter with lettering "WATER METER" in cover; and slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, or other pipe approved by the Engineer.
B. Description: Cast-iron body and double cover for disc-type water meter with lettering "WATER METER" in top cover; separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
C. Description: Polymer-concrete body and cover for disc-type water meter with lettering "WATER" in cover; and slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.
2.15 EXTERIOR PIPE COATINGS

A. Buried Ductile-iron Pipe: Bituminous coated with either coal tar or asphalt base of approximately one mill thickness.

B. Exposed pipe: Three coat Alkyd Enamel system.

PART 3 - PART - EXECUTION

3.1 GENERAL

A. Refer to Section 312000 - Excavating and Backfilling Trenches for excavating, trenching, and backfilling.

B. Field check all dimensions shown on the plans and the "certified" equipment shop drawings and rectify any discrepancies before starting the work. All existing dimensions shall be verified in the field. Interferences shall be brought to the attention of the Engineer in writing.

C. Elevations of underground piping, uniform slope in direction of flow, and installation details shall be as shown on the plans and as specified in the Technical Specifications.

D. Any damage caused, directly or indirectly, to structures, buildings, equipment, utilities, roadways, and/or sidings shall be repaired or replaced to the satisfaction of the Engineer.

E. When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plans is required, the Owner, through the Engineer, will alter the plans or order a deviation in line and grade or arrange for removal, relocation, or reconstruction of the obstructions.

F. When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Owner, to provide clearance as required by federal, state, or local regulations or as deemed necessary by the Owner to prevent future damage or contamination of either structure.

3.2 SEPARATION OF WATER MAINS AND SANITARY SEWERS

A. Horizontal Separation: Where potable water lines are to be laid parallel to existing or proposed sanitary sewers, it will be necessary to maintain at least ten (10') feet horizontal separation, edge of pipe to edge of pipe, between the gravity and pressure sewer lines and water lines. Pressure sewer line and water lines shall be laid in separate trenches.

1. In cases where the minimum horizontal separation cannot be obtained, water mains shall be laid in a separate trench or on an undisturbed earth shelf at such elevation where the bottom of the water main shall be at least eighteen inches (18") above the top of the sewer line. The Contractor shall notify the Engineer when minimum horizontal separations cannot be attained.

B. Vertical Separation: Water mains crossing sewers either above or below shall have a minimum of eighteen inches (18") vertical separation from edge of pipe to edge of pipe.

1. In cases where the minimum vertical separation cannot be obtained, water mains shall be constructed of mechanical joint PVC or ductile iron pipe with joints at least ten (10') feet each direction from the crossing point or cased in continuous casing that extends at least 10 feet (10') in each direction of the crossing point. The Contractor shall notify the Engineer when minimum vertical separations cannot be attained.

C. Separation from Sewer Manholes: Water lines shall be laid with a minimum horizontal clearance of ten feet (10') to any sewer manhole. The Contractor shall notify the Engineer if field conditions are such that the minimum separation cannot be obtained before continuing with construction.
3.3 **PIPING APPLICATIONS**

A. **General:** Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. **Use full lengths of pipe where length between fittings is less than the Mill-random lengths of pipes. Extra joints shall be avoided.**

C. **Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.**

D. **Do not use flanges, unions, or keyed couplings for underground piping.**

E. **Underground Water Service Piping:** Use the following:
   1. **Use NPS 3/4 to NPS 2-1/2:** Soft copper tube, Type K; wrought-copper fittings; and soldered joints.
   2. **NPS 4:** Ductile-iron or PVC push joint or mechanical joint pipe.

F. **Underground Water Distribution Piping:** Use pipe as designated on the plans, or one of the following:
   1. **Ductile-iron, push joint or mechanical-joint pipe.**
   2. **PVC, SDR 21 Class 200 pipe listed for fire-protection service; Mechanical Joint, Ductile Iron fittings of same class as pipe; and gasketed joints.**

G. **Above Ground Piping:** Use pipe as designated on the plans, or one of the following:
   1. **Ductile-Iron, flanged joints and fittings.**
   2. **PVC, C900, flanged joints and ductile iron flanged fittings.**

3.4 **VALVE APPLICATIONS**

A. **Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:**
   1. **Underground Valves, NPS 3 and Larger:** AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.

3.5 **JOINT CONSTRUCTION**

A. **Make pipe joints according to the following:**
   1. **Copper Tubing Soldered Joints:** ASTM B 828. Use flushable flux and lead-free solder.
   2. **PVC Piping Gasketed Joints:** Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to or ASTM D 3139 and pipe manufacturer's written instructions.
   3. **Dissimilar Materials Piping Joints:** Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.6 **PIPING INSTALLATION**

A. **Inspect each pipe for defects:**
   1. **Rung ductile iron pipe with a light hammer to detect cracks.**
   2. **Examine PVC pipe for visible cracks, holes, or foreign materials.**
   3. **All defective, damaged, or unsound pipe and fittings shall be rejected and removed from the site.**

B. **The trench shall be so excavated that the pipe, when laid, shall have a true and even bearing on its full length. Excavation of bell holes will be required such that even bearing is achieved. Pipe, fittings, and valves shall be placed in the trench with care and under no circumstances shall pipe or other materials be dropped or dumped into the trench.**
C. Field cutting ductile iron pipe:
   1. Use Mechanical pipe cutters.
   2. Cuts shall be smooth, straight, and at right angles to the pipe axis.
   3. Cutting shall not damage the pipe or lining.

D. Field cutting PVC pipe:
   1. Bevel exterior edge of pipe cuts to prevent damage to gasket.

E. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
   1. Under Driveways: With at least 36 inches cover over top.
   2. Under Railroad Tracks: With at least 48 inches cover over top.
   3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

F. Install copper tube and fittings according to CDA’s "Copper Tube Handbook."

G. Comply with NFPA 24 for fire-service-main piping materials and installation.

H. Extend water-service piping and connect to water-supply source, terminating 10 feet outside building line in locations and pipe sizes indicated.
   1. Terminate piping with caps, plugs, or flanges as required for piping material.
   2. Connect water-service piping to building distribution piping when systems are in place.

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joints as specified above.

J. Anchor service-entry piping to building wall.

3.7 UNFORESEEN OBSTRUCTIONS

A. Notify the Owner through the Engineer of any obstructions encountered, which are not shown on the plans and interfere so that an alteration of the plans is required. The Owner through the Engineer will alter the plans or order a deviation in line and grade or arrange for the removal, relocation, or reconstruction of the obstruction.

3.8 FLANGED SYSTEMS

A. All piping that is not to be buried shall be constructed with flanged joints and fittings unless otherwise specified on the plans.
   1. Bolts, gaskets and installation shall conform to AWWA C110, Appendix A.
   2. Use one gasket per joint.
   3. Tighten bolts using the crossover method to ensure even gasket load.
   4. Torque wrenches shall be used where required to uniformly torque bolts.
   5. Lubricate bolts with oil and graphite at the time of installation except when buried.

B. Provide all necessary pipe supports required by the piping and valves as shown on the plans as well as any additional supports necessary to properly support piping and equipment during construction.

C. Where piping passes through walls, floors, or roofs, provide all grout, sleeves, plates, flashings, seals, caulking and any other penetration requirements as shown on the plans or as necessary to properly seal the penetration.

D. Core drill wall, ceiling, or floor penetrations to install pipe as shown on the plans, or where necessary and prior written approval has been received from the Engineer.
3.9 EXPOSED PIPE FINISHING

A. Ductile-iron Pipe: all DIP to remain exposed shall be sandblasted to remove the bituminous coating and painted.
   1. Color shall be as indicated or as selected by the Owner.

B. Non-coated pipe need not be sandblasted provided that it is factory primed and free of rust or other deleterious substances.

3.10 LAYING PIPE ON CURVES

A. Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints for most "rigid" pipe and in the pipe for most "flexible" pipe. If the pipe is shown curved on the plans and no abrupt change in alignment is shown, it may be assumed that the curves can be made by deflection of the joints with standard lengths of pipe. It may be required to decrease laying lengths to construct deflection at a reduced radius of curvature.

B. Where field conditions require deflection of curves not anticipated by the plans, the Engineer will determine the methods to be used. No additional payment will be made for laying pipe on curves as shown on the plans, nor for field changes involving standard lengths of pipe deflected at the joints.

C. Maximum deflections at pipe joints and laying radius for the various pipe lengths are as found in the following standards (latest revisions):

D. When rubber gasket pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

3.11 ANCHORAGE INSTALLATION

A. Use restrained-joints as specified above.

B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.12 VALVE INSTALLATION

A. Inspect all gate valves and fittings upon delivery in the field to insure proper working order before installation. They shall be set and jointed to the pipe in accordance with the latest revisions of AWWA Standards for the type of connection ends furnished.

B. Buried valves shall be installed in a vertical position and be provided with a standard cast iron valve box so arranged that no shock will be transmitted to the valve. The box shall be vertically centered over the operating nut and the cast iron box cover shall be set flush with the road bed or finished surface. A concrete base shall be poured around the valve box cover as detailed on the plans.

C. After installation, all valves shall be subjected to the field test specified herein. Should any defects in materials or workmanship appear during these tests, correct such defects with the least possible delay and to the satisfaction of the Engineer.

3.13 WATER-METER INSTALLATION

A. Arrange with utility company to install water-meters as shown on the plans. Contractor shall be responsible for cost of materials and permits required.
3.14 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA-Type Fire Hydrants: Comply with AWWA M17.

3.15 CONNECTIONS

A. Water-Main Connection: Arrange with utility company to install water taps into existing mains. Contractor shall be responsible for cost of materials and permits required to make connections.

B. Connect all other piping to existing and proposed systems as shown on the plans.

3.16 FIELD QUALITY CONTROL

A. Piping Tests: The Contractor shall conduct piping tests on all piping systems before joints are covered and after thrust blocks have hardened sufficiently. Piping equipment and instruments which will not safely withstand the test pressures shall be isolated or removed before testing. Provide spool pieces for any piping, equipment, or instruments removed for testing. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Perform all tests in the presence of the Engineer or the Engineer’s authorized representative.

C. Hydrostatic Tests: Test at 1-1/2 times working pressure (but not less than 150 psi) for 2 hours. Test pressure to be maintained within 5 psi of 1-1/2 times working pressure.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 2 hour; decrease to 0 psig. Maximum allowable leakage is determined by utilizing the following formula:

\[ L = \frac{ND\sqrt{P}}{7400} \]

Where; \( L \) = allowable leakage, in gallons per hour
\( N \) = number of joints in the length of pipeline tested
\( D \) = nominal diameter of the Pipe, in inches
\( P \) = average test pressure during leakage test, in pounds per square inch (psi)

2. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. It is the intent of this specification that all joints shall be watertight and free from visible leaks. Any leak discovered within one (1) year after the date of final acceptance of the work shall be repaired by, and at the expense of, the Contractor.

E. Prepare a test report based on the satisfactory completion of the hydrostatic test of each piping system or portion of the system. The report shall establish the exact limits of the test. This report shall contain the following:

1. Test pressure at the beginning and end of the test.
2. Time interval of the test.
3. Marked-up set of flow diagrams:
   a. Sections of pipe shall be yellowed-out and initialed by the Contractor and Engineer, or his representative, as they are tested.
   b. The Contractor shall be responsible for maintaining this set of flow diagrams, which shall be given to the Engineer at the completion of the job.
3.17 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See 312000 - Excavating and Backfilling Trenches for underground warning tapes.

B. Install locator wire immediately above pipe to valves and risers at buildings.

3.18 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

C. Flushing

1. After installation and before use by the public, the Contractor shall disinfect the potable water lines. Sections of pipe to be disinfected shall first be flushed to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a tap should be provided large enough to develop a velocity of at least two and five-tenths (2.5) feet per second in the main. One two and one-half (2 1/2) inch hydrant opening will, under normal pressures, provide this velocity in pipe sizes up to and including twelve inches.

2. All taps required for chlorination or flushing purposes, or for temporary or permanent release of air shall be provided for by the Contractor as a part of the construction of water mains.

D. Chlorine Requirements

1. Before being placed into service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than twenty-five (25) mg/l remains in the water after standing twenty-four (24) hours in the pipe.

2. A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine.

3. A mixture of water and high-test calcium hypochlorite (HTH, 60 - 70% Chlorine) may be substituted for the chlorine gas water mixture. The dry powder shall first be mixed as a paste and then thinned to a one (1) percent chlorine solution by adding water to give a total quantity of seven and five-tenths (7.5) gallons of
ADDENDUM #4

SECTION 331400 – WATER DISTRIBUTION PIPING

water per pound of dry powder. This solution shall be injected in one end of the section of main to be
disinfected while filling the main with water in the amounts as shown in the following table:

Chlorine requirements to produce 50 mg/l
Concentration in 100 feet of pipe (by diameter)

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>100% Chlorine, lbs.</th>
<th>1% Solution, Gals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.027</td>
<td>0.33</td>
</tr>
<tr>
<td>6</td>
<td>0.061</td>
<td>0.73</td>
</tr>
<tr>
<td>8</td>
<td>0.108</td>
<td>1.30</td>
</tr>
<tr>
<td>10</td>
<td>0.170</td>
<td>2.04</td>
</tr>
<tr>
<td>12</td>
<td>0.240</td>
<td>2.88</td>
</tr>
</tbody>
</table>

4. Tablet disinfection is best suited to short extensions (up to 2500 ft.) and smaller diameter mains (up to 12
inch). Because preliminary flushing must be eliminated in using this method, it should be utilized only
when scrupulous cleanliness has been used in construction. It shall not be used if trench water or foreign
material has entered the main or if the water is below 41°F.

5. Tablets should be placed in each section of pipe, hydrants, hydrant branches, and other appurtenances.
Tablets must be at the top of the main, and shall be attached by an adhesive such as Permatex Number 1,
or any alternative approved by the Engineer. Tablets in joints between pipe sections, hydrants, hydrant
branches, or appurtenances shall be crushed and placed inside the annular space or rubbed like chalk in
butt ends of sections to coat them if the type of assembly does not permit crushing.

6. When using the tablet method, water velocity shall be less than one (1) foot per second during the filling of
the section of piping with water.

Number of 5-Grain Hypochlorite Tablets Required
for a Dosage of 50 mg/l per Length of Pipe Section

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Length of Pipe Section (Feet)</th>
<th>Up to 13</th>
<th>18</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>14</td>
</tr>
</tbody>
</table>

7. Disinfectant Application
   a. The preferred point of application of the disinfectant is at the beginning of the pipe line extension or
      any valved section of it, and through a corporation stop inserted in the pipe. The water injector for
delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the
pressure side of the gate valve controlling the flow into the pipe line extension. Alternate points of
application may be used when approved or directed by the Engineer.
   b. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow
      back into the line supplying the water. Check valves may be used if desired.
   c. Treated water shall be retained in the pipe for at least twenty-four (24) hours. After this period, the
      chlorine residual at pipe extremities and at other representative points shall be at least twenty-five
      (25) mg/l.
   d. In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while
      the pipe line is filled with the chlorinating agent and under normal operating pressure.
8. Final Flushing and Testing
   a. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its length shows upon test, a chlorine residual of less than 1 mg/l. In the event chlorine is normally used in the source of supply, then the tests shall show a residual of not in excess of that carried in the system.
   b. After flushing, water samples collected on two (2) successive days from the treated piping system, as directed by the Engineer, shall show satisfactory bacteriological results. Bacteriological analysis must be performed by a laboratory approved by the Missouri Department of Natural Resources. The Contractor shall be responsible for securing, delivering, and testing of all samples.
   c. Should the initial treatment result in an unsatisfactory bacteriological test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained.

3.19 WARRANTY
   A. The Project 1 Year Warranty period shall apply to Section 331400 – Water Distribution Piping work.

END OF SECTION 331400
ADDENDUM #4

SECTION 333000 – SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and Special Provisions apply to this Section.

1.2 SUMMARY
A. This Section includes sanitary sewerage outside of buildings.
B. Referenced Sections include the following:
   1. Section 312000 - Excavating and Backfilling Trenches.
C. Referenced Standards Include the Following:
   1. ACI 318 / 318R - Building Code Requirements for Structural Concrete & Commentary; American Concrete Institute; 1999.
   2. ACI 350R - Environmental Engineering Concrete Structures; American Concrete Institute; 1989.
   7. ASTM A 746 - Specifications for Ductile Iron Gravity Sewer Pipe.
   9. ASTM C 76 - Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   11. ASTM C 361 - Specifications for Reinforced Concrete Low-Head Pressure Pipe.
   15. ASTM C 497 - Methods of Testing Concrete Pipe, Manholes Sections, or Tile.
24. ASTM F 794 - Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
25. AWWA C 301 - Prestressed Concrete Pressure Pipe, Steel Cylinder Type.
27. AWWA C 900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 inch - 12 inch., for Water Distribution.
28. AWWA C 907 - Polyvinyl Chloride (PVC) Pressure Fittings for Water - 4 inch through 8 inch.

1.3 DEFINITIONS
A. NPS: Nominal Pipe Size, given in inches.
B. PE: Polyethylene plastic.
C. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS
A. Gravity Flow, Non-pressure Piping: Pass a 5.0% mandrel test and a low pressure air test.
B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig.

1.5 SEPARATION OF WATER AND SEWER LINES
A. Where sanitary sewers are to be laid parallel to existing potable water lines, it will be necessary to maintain at least ten (10') feet horizontal separation between the sewer and water lines. At points where sewers cross under water mains with less than two (2') feet of vertical separation, sewers shall be constructed of ductile iron pipe with mechanical joints for ten (10') feet each direction from the crossing point.

1.6 SUBMITTALS
A. Product Data: For the following:
   1. Each type of piping material
   3. Manhole frame and cover.
B. Shop Drawings: Include plans, elevations, details, and attachments for the following:
   1. Precast concrete manholes, including frames and covers.
   2. Cast-in-place concrete manholes and other structures, including frames and covers.
C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Do not store plastic structures, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle precast concrete manholes and other structures according to manufacturer’s written rigging instructions.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer’s written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

B. Each pipe or fitting shall have plainly and permanently marked thereon:
   1. Pipe class (and profile if applicable).
   2. Manufacturer’s name or trademark.
   3. Nominal pipe size.
   4. Date of manufacture.

2.2 PIPES AND FITTINGS

A. Ductile-Iron Sewer Pipe: ASTM A 746, for push-on joints.
   1. Standard-Pattern, Ductile-Iron Fittings: AWWA C110, ductile or gray iron, for push-on joints.
   2. Compact-Pattern, Ductile-Iron Fittings: AWWA C153, for push-on joints.

B. PVC SDR Pressure Pipe: Class 200, SDR 21 according to ASTM D 2241 and ASTM D 1784.
   2. All fittings shall be ductile iron.

C. PVC AWWA Pressure Pipe: AWWA C900, Class 150, for gasketed joints.
   1. PVC Pressure Fittings: AWWA C907, for gasketed joints.

D. PVC Sewer Pipe and Fittings: According to the following:
   1. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, for gasketed joints.
   2. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, bell and spigot for gasketed joints.

E. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794, open and closed profile, bell and spigot for gasketed joints.
F. Prestressed Concrete Cylinder Pipe: ANSI/AWWA C 301, bell and spigot or tongue and groove for welded and gasketed joints.
   2. Joints: bell and spigot or tongue and groove ends formed by steel joint rings welded to the steel cylinder, and sealed by rubber gasket.
   3. Cement: ASTM C 150, modified Portland Cement, Type II.
   4. Length: sections shall be a minimum of sixteen (16) feet except for closure lengths, and less than four (4) feet at connections to manholes.
   5. Protective coating: One- or two-coat, coal-tar epoxy; 10-mil minimum thickness, unless otherwise indicated; factory or field applied to the interior surface of all pipe including surfaces at joints not covered by resilient rubber end rings.

2.3 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with preformed butyl mastic sealant joints.
   1. Diameter: 48 inches minimum, unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   6. Gaskets: Use two each, 1-inch by 1-inch, preformed butyl mastic joint sealant meeting ASTM C990. Sealant shall be Bidco C-56 or approved equal.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
   8. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101, or Cast iron Neenah R-1980-J or approved equal. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 42 inches deep.
   9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section. A-Lock or approved equal.

B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
   1. Ballast: Increase thickness of concrete, as required to prevent flotation.
   2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
   3. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101, or Cast iron Neenah R-1980-J or approved equal. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 42 inches deep.
C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "SANITARY SEWER" cast into cover.

2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 3000-psi minimum, with 0.45 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000-psi minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. Invert Slope: 2.5 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
   a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000-psi minimum, with 0.58 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.5 PROTECTIVE COATINGS

A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:


2.6 CLEANOUTS AND LAMPHOLES

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. The cover should consist of “Neenah #R-1976 or equal” Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.
2. Medium Duty: In paved foot-traffic areas.
3. Heavy Duty: In vehicle-traffic service areas.
4. Sewer Pipe Fitting and Riser to Cleanout: PVC or ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.7 AIR/VACUUM VALVES

A. Air/Vacuum Valves shall be of the type that automatically exhausts large quantities of air during the filling of a pipeline and allows air to re-enter during the draining or when a negative pressure occurs.
B. Valves shall have connections and valving for backwash operations. Valves shall be equipped with quick connect couplings and a six foot hose for connecting to backwash water.

C. All Air/Vacuum valves shall be equal to Val-Matic Models #301BW or approved equal.

2.8 SPRINKLERS

A. Sprinklers shall be constructed of a heavy duty brass or stainless steel.

B. The nozzles shall be interchangeable and easily replaced.

C. The sprinklers shall have a 1 1/4" full circle sprinkler head with a 3/8" nozzle. The sprinkler shall be capable of producing differing gpm at a nozzle pressure of minimum 25 psi. The sprinklers shall be a Rainbird model 80E or an approved equal capable of producing differing radii.

D. Sprinkler Head Supports: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
   3. The sprinkler and supply line shall be securely attached to a 5 foot tall, 12 inch by 12 inch or 12 inch diameter concrete pedestal. The post shall be securely set into the ground and the top 12 inches shall be painted bright orange for easy visibility. Concrete pedestals shall be numbered by etching or engraving the numbers into the pedestals.

E. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 - Excavating and Backfilling Trenches.

3.2 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 - Excavating and Backfilling Trenches. Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:
   1. NPS 4 to NPS 6: PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
   2. NPS 8 to NPS 15: PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.

D. Pressure-Flow Piping: Use the following:
   1. NPS 4 to NPS 8: PVC Pressure Pipe for gasketed joints.
3.4 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow service piping of sizes and in locations indicated. Terminate service piping 10 feet inside front property line at low side of property as indicated below.
   1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
   2. Install piping with 36-inch minimum cover.

F. Install force-main piping between and connect to sewage pump station outlet and termination point indicated.
   1. Install piping with restrained joints at horizontal and vertical changes in direction. Use cast-in-place concrete supports and anchors or corrosion-resistant rods and clamps.
   2. Install piping with 36-inch minimum cover.

G. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.


C. PE Pipe and Fittings: As follows:
   1. Join pipe, tubing, and gasketed fittings with gaskets for watertight joints according to ASTM D 2321 and manufacturer's written instructions.
   2. Install according to ASTM D 2321 and manufacturer's written instructions.
   3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

D. PVC Pressure Pipe and Fittings: Join and install according to AWWA M23.

E. PVC Sewer Pipe and Fittings: As follows:
   1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
   2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
   3. Install according to ASTM D 2321.
F. System Piping Joints: Make joints using system manufacturer’s couplings, unless otherwise indicated.

G. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

H. Install with top surfaces of components, except piping, flush with finished surface.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

E. Construct cast-in-place manhole sections as indicated.

3.7 LAMPHOLE INSTALLATION

A. Lampholes shall be installed in accordance with the details shown on the Plans. The wye branch and riser pipe shall be of the same material as that used for the line that runs out of the lamphole. The top of the riser pipe shall be covered by a cast iron frame and cover set in concrete. The top of the cover shall be set so that groundwater cannot enter the sewer line.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R and ACI 350R.

3.9 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and fasten wye fitting to pipe with stainless steel band and stainless steel screws, or encase the entire fitting, plus a 6-inch overlap, with not less than 6 inches of concrete with a 28-day compressive strength of 3000 psi.

C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.10 SPRINKLER INSTALLATION

A. General: Install sprinklers as per manufacturers written recommendations.

B. The sprinklers shall be connected to the force main by a Ford, or an approved equal, stainless steel service saddle and a ford, or an approved equal, corporation stop, also to include bushing for connection between corporation stop and sprinkler.

3.11 CLEANOUT INSTALLATION

A. Install cleanouts, and riser extension from sewer lateral/service line to grade. Use PVC pipe fittings in sewer laterals at branches for cleanouts and PVC pipe for riser extensions to grade. Install piping so cleanouts are parallel with finished grade.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in gravel, asphalt, or concrete pavement with tops flush with pavement surface.
3.12 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Structures: Excavate around structure as required and use one procedure below:

1. Remove structure and close open ends of remaining piping.
2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
3. Backfill to grade according to Section 312000 - Excavating and Backfilling Trenches.

3.13 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of cylinder of size not less than 95 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. All testing shall be done in the presence of a representative of the Engineer and/or the authorities having jurisdiction.
5. Submit separate reports for each test.
6. If authorities having jurisdiction do not have published procedures, perform tests as follows:
   a. All testing shall be done only after all piping has been installed and backfilled for a minimum period of thirty (30) days.
   b. All Gravity Sanitary Sewerage Piping: Perform low pressure air test according to the following:
1) Contractor shall supply all equipment necessary to conduct the test.
2) Install plugs at each end of the line to be tested in a manner to withstand the internal pressure during testing. External blocking or bracing will not be allowed.
3) Introduce low pressure air to the sealed line until the internal pressure reaches 4.0 psig plus an additional 1.0 psig for every 2.3 feet of groundwater above the pipe as determined by the Engineer.
4) Allow 2 minutes for the air pressure to stabilize.
5) Disconnect the air hose from the control panel to the air supply.
6) The line shall be termed “Acceptable” if the time required in minutes for the pressure to decrease 1.0 psig is not less than the time shown for the given diameters as follows:

<table>
<thead>
<tr>
<th>Pipe Dia. (In.)</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>4.0</td>
</tr>
<tr>
<td>10</td>
<td>5.0</td>
</tr>
<tr>
<td>12</td>
<td>5.5</td>
</tr>
<tr>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td>18</td>
<td>8.5</td>
</tr>
<tr>
<td>21</td>
<td>10.0</td>
</tr>
<tr>
<td>24</td>
<td>11.5</td>
</tr>
<tr>
<td>27</td>
<td>13.0</td>
</tr>
<tr>
<td>36</td>
<td>17.0</td>
</tr>
<tr>
<td>48</td>
<td>22.5</td>
</tr>
</tbody>
</table>

7) Leaks and loss in test pressure constitute defects that must be repaired.
8) Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

c. Flexible Gravity Sanitary Sewerage Piping: Perform mandrel test to demonstrate that not more than 5% deflection exists as follows:
1) Flush line with water to assure that no mud or trash is in the line.
2) A rope shall be passed through the pipe (from one manhole to the other).
3) A mandrel with diameter equal to 95% of the inside diameter of the pipe shall be attached to the line and placed at the entrance to the pipe.
4) A second rope of sufficient length shall be attached to the other end of the mandrel.
5) Draw the mandrel through the sewer line.
6) Any resistance to the movement of the mandrel through the pipe shall be considered evidence of excessive deflection.
7) The deflected portion of the line shall be exposed and repaired.
8) The entire line shall be retested until no resistance to the movement of the mandrel through the entire line is encountered.

D. Acceptance Testing of Manholes:
1. Each manhole shall meet the requirements of the following acceptance test. A vacuum test shall be performed on each manhole in accordance with the following procedures in order to assure that each manhole is watertight. The Contractor shall furnish all necessary labor, equipment, and appurtenances to perform the acceptance tests. All defects shall be repaired to the satisfaction of the Engineer until acceptable test results are achieved.
2. Each manhole shall pass two (2) tests. The first test shall be conducted after assembly of the manhole but prior to backfilling; and the second test shall be conducted after backfilling.
3. The vacuum test shall include testing of the seal between the cast iron frame and the concrete cone, slab, or grade rings.

4. Plug all pipes entering the manhole at least eight (8) inches into the sewer pipe. The plug must be inflated at a location past the manhole/pipe gasket.

5. Brace all plugs to prevent the plug or pipe from being dislodged and drawn into the manhole.

6. A vacuum of at least 10.5 inches of mercury shall be drawn on the manhole. Shut the valve on the vacuum line to the manhole and then disconnect the vacuum line from the vacuum pump. Open the vacuum line valve and adjust the vacuum in the manhole to 10.0 inches of mercury.

7. The vacuum pressure shall be determined by a liquid-filled pressure gage having a 3.5-inch diameter face with a reading from 0 to 30 inches of mercury. The vacuum test equipment shall be capable of having two (2) gages connected. The gage supplied with the test equipment shall match the reading of a gage furnished by the Engineer. The gage reading shall be verified on each project with a frequency as determined necessary by the Engineer.
   a. The time lapse for the vacuum reading to drop from 10.0 inches of mercury to 9.0 inches of mercury shall not be less than the following times for a manhole to be considered as passing the vacuum test:
      b. Manhole depth less than 10 feet; 2.0 minutes.
      c. Manhole depth 10 to 15 feet; 2.5 minutes.
      d. Manhole depth 15.1 to 25 feet; 3.0 minutes.

8. If a manhole fails the vacuum test, the manhole shall be uncovered and patched on the exterior of the manhole; retested prior to backfilling; and then retested again after backfill is completed.

3.14 WARRANTY

   A. The Project 1 Year Warranty period shall apply to Section 333000 – Sanitary Sewerage work.

END OF SECTION 333000
SECTION 333200 – SANATORY SEWAGE PUMPING STATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes sanitary sewerage pumping stations including:
   1. Wet wells.
   2. Valve Vaults.
   3. Pumping Equipment.
   4. Controls.

B. Referenced Sections include the following:
   1. Section 333000 – Sanitary Sewerage.
   2. Section 323100 – Chain-Link Fences and Gates.

C. Referenced Standards Include the Following:
   1. ACI 318 - Building Code Requirements for Structural Concrete.
   2. ASTM A 48 - Specifications for Grey Iron Castings.
   3. ASTM A 185 - Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
   4. ASTM A 615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

1.2 GENERAL

A. The Contractor shall furnish and install the pumping system complete, to include two submersible non-clog wastewater pumps with discharge connection elbows, motors, pump rail guides, pump mounting plates with discharge elbow and rail supports, access frames with covers and guide rail supports, pump lifting chains with hooks, portable manual hoist for lifting pumps, wiring channel, weatherproof control enclosure, exhaust blower, de-humidifier, electrical pump panel, float switch type level sensors, valve box, wet well and valve box top slap, access hatches, and all piping, valves, and related items as shown on the Plans and as described herein. The submersible pump system shall be complete to provide for automatic operation as specified. All system components shall be as manufactured by Flygt Corporation, or approved equal.

1.3 DEFINITIONS

A. ACC: Automatic Control Center.

B. H-O-A: hand-off-automatic switch.

1.4 DESIGN OPERATING CONDITIONS

A. Pump requirements:
1. Total Dynamic Head: 132 feet.
2. Pump capacity: 437.7 gpm (each).
3. Pump speed: 1755 rpm.
4. Minimum solid diameter: 3 inches.
5. Pump discharge diameter: 4 inches.
6. Discharge piping diameter: 4 inches.

B. Electrical service and motor requirements:
1. Voltage: 460 volts.
2. Phases: 3.
3. Frequency: 60 hertz.

1.5 SUBMITTALS

A. Shop Drawings and Product Data shall be submitted for the following items:
1. Valves.
2. Pipe and fittings.
3. Electrical controls.
4. Pumping Equipment.
5. Precast Concrete structures.
6. Hatches and other hardware.

B. The following information shall be included at a minimum.
1. Pumps:
   a. Name of Manufacturer.
   b. Type of model, including all dimensions.
   c. Design rotative speed.
   d. Minimum required submergence.
   e. Discharge connections.
   f. Weight of complete pump assembly, including motor.
   g. Mounting materials and details.
   h. Certified performance curves showing capacity, head, NPSH requirements, efficiency, and bhp requirements.

2. Pump motors:
   a. Name of manufacturer.
   b. Type and model.
   c. Rated size of motor (hp).
   d. Starting current.
   e. No-load current.
   f. No-load power factor.
   g. Locked rotor current.
   h. Locked rotor power factor.
   i. Current, power factor, and efficiency at full, 3/4, and ½ load.

3. Electrical Controls:
   a. Name of manufacturer.
   b. Detailed views of enclosures, inside and outside.
c. Detailed parts list.
d. Size of breakers, fuses, etc.
e. Detailed description of meters and switches.
f. Wiring diagrams.

C. Operation and Maintenance Information:

1. The Contractor shall submit, to the Engineer, operation and maintenance information prepared by the equipment manufacturer or supplier of the following equipment:
   a. All valves
   b. Electrical Controls
   c. Pumping Equipment

2. The O&M information shall cover:
   a. Equipment function, normal operating characteristics, and limiting conditions.
   b. Assembly, installation, alignment, adjustment, and checking instructions.
   c. Operating instructions for start-up, routine and normal operation, regulation and control.
   d. Maintenance instructions.
   e. Guide to "troubleshooting."
   f. Parts lists and predicted life of parts subject to wear.
   g. Outline, cross sections, assembly drawings, and other Engineering data.
   h. Test data and performance curves, where applicable.

3. The Contractor shall submit to the Engineer, six (6) copies of operation and maintenance information in addition to any instructions or parts lists packed with or attached to equipment when delivered. The O&M information shall be submitted unbound, unperforated so that the Engineer can bind the material in specially prepared Operation and Maintenance Manual. Payment for the equipment will not be made to the Contractor until the O&M information is received and approved by the Engineer.

PART 2 - PRODUCTS

2.1 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 3000-psi minimum, with 0.45 maximum water-cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.2 PROTECTIVE COATINGS

A. Concrete Exteriors: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
   1. Concrete wet wells, storage basins, and vaults: On exterior surface.

B. Exposed Piping: Three coat Alkyd Enamel Paint System
C. Interior Valve Vault: Two coat Epoxy Masonry Paint System.
   1. First Coat: Epoxy Masonry Filler.
   2. Color: off white.

2.3 ACCESS FRAMES AND COVERS
A. Aluminum door access frame assembly (ies) shall be provided over the pumps and valve vault as shown on
   the Plans. The frame(s) shall support the guide rails, electrical wiring channel, and the hoist socket. The
   hinged cover(s) shall be provided with lifting handles, locking hasps, and safety latches to hold the covers in
   an open position. The frame(s) shall be waterproof. The required galvanized carbon steel lifting chains and
   Flygt Grip Eye Stem apparatus (or equal) shall also be provided.
B. Door leaves shall be 1/4-inch thick aluminum diamond plate reinforced respectively for a 300 p.s.f. live
   load. The frame shall be extruded aluminum with an integral anchor flange and door seat on all four sides.
   The access door shall be equipped with a flush lifting handle that does not protrude above the cover, and
   316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts. A staples for a padlock
   shall be supplied for security. An adhesive backed vinyl material that protects the product during shipping
   and installation shall cover the entire top of the frame covers. Installation shall be in accordance with
   manufacturer’s attached instructions. The door shall be manufactured and assembled in the United States.
   Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten
   years. The access hatch shall supplied for the following additional features: Stainless steel horizontal
   springs for easy opening, 316 stainless steel watertight slamlock, and bituminous coating on frame surface
   in contact with concrete.

2.4 PIPING, VALVES, AND FITTINGS
A. Refer Section 333000 – Sanitary Sewerage for pipe, valve, and fitting material for gravity and pressure
   sewer piping.
B. The discharge connection elbow shall be permanently installed in the wet well along with the discharge
   piping. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined
   metal-to-metal watertight contact.

2.5 PUMP INSTALLATION SYSTEMS
A. All pump and motor units shall be easily installed and removed without having to enter the wet well. Pump
   installation shall be by a simple linear downward motion guided by not less than two guide bars. The pump
   discharge flange shall automatically and firmly connected with the discharge line without the need of
   adjustment, fasteners, clamps or similar devices, and without having to tilt or rotate the motor. Unit
   removal shall be by simple linear upward motion.
B. A manually operated, portable winch shall be provided to facilitate installation and removal of the pump
   units. The winch shall be mountable into an access frame or surface mounted socket. If a surface mounted
   socket is installed, a removable cover plate shall be provided to keep the socket free of dirt, rocks, and silt.
   The hoist bases shall be located to allow the winch to extend over and remove either pump in the wetwell.
C. Mounting Bases: A separate discharge elbow and base shall be furnished for each pump. These plates shall
   include adjustable guide rail supports and discharge elbow with flange to align with the pump sealing
   flange. Plates and fittings shall be coated with a tar base epoxy paint. The base shall be anchored to the
   concrete slab (wet well bottom) with stainless steel threaded anchor bolts and removable hex nuts. The
discharge elbows shall have 125-pound standard flanges. The discharge piping shall be as shown on the plans. No portion of the pump shall bear directly on the sump floor.

D. Rail Supports: The Contractor shall furnish and install two pump guide rails (304 stainless steel Schedule 40 pipe) for each pump. The rails shall be of sufficient length to extend from the lower guide connections on the pump discharge base to the upper guide connections on the access frames. The guide rail diameter shall be set by the pump manufacturer. In addition to the mounting base rail supports and the access frame rail supports, intermediate rail supports shall also be provided to stiffen the guide rails if the wet well is over 20 feet deep.

2.6 PUMPS

A. General: Pumps shall be submersible non-clog wastewater pumps.

B. Materials: Major pump components shall be grey cast iron with smooth surfaces free of irregularities. Materials shall conform to the following:

1. Pump bowl and casing: ASTM A 48, grey cast iron.
2. Impellers: ASTM A 532 (Alloy IIIA) 25% chrome cast iron.
4. Impeller wear ring: ASTM A 532 (Alloy III A) 25% chrome cast iron
6. Shaft seals: double mechanical type; tungsten carbide/carbon
   b. Lower: tungsten carbide.
7. Exposed bolts, nuts, clamps, and other mounting hardware: ANSI 304 stainless steel.

C. Pump impellers: non-clog design, dynamically balanced type capable of passing a three inch minimum spherical solid, fibrous material, heavy sludge, and other matter normally found in sewage.

D. Pump shaft seals: Each pump shall be provided with a double, mechanical, mounted in tandem, rotating shaft seal system. The upper seal shall run in an oil reservoir located between the pump and motor chambers. The lower seal shall operate in the pumped media. Each seal shall function independently of the other. The seals shall require neither maintenance nor adjustment and shall be easily inspected and replaceable. The seals shall include stationary and positively driven tungsten carbide rings. Each seal interface shall be held in contact by its own spring. The seals shall operate with negligible leakage following slight initial leakage at start-up. The stator chamber shall be provided with a seal failure sensor to automatically detect and signal excess water in the bottom of the motor chamber. This sensor shall activate a warning light in the individual pump control circuit if excess moisture is detected. Mechanical seals requiring constant differential pressure for effective sealing are not acceptable.

E. Other seals: All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. The fitting shall accomplish sealing by metal-to-metal contact between machined surfaces, resulting in controlled compression of the O-rings in two planes without requiring specific torque limits to cause positive sealing.

F. Cable entry seal: shall be watertight without relying on specific torque requirements. Epoxies, silicones, and other secondary sealing systems shall not be acceptable. The cable entry junction chamber and motor
shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top.

G. Pump shaft: The pump shafts shall rotate on two permanently lubricated bearings. The upper bearing shall be a single row deep groove ball bearing; the lower bearing, a two-row angular contact ball bearing. The shaft shall have a threaded fastener for the impeller and a sliding fit with one key.

2.7 PUMP MOTOR

A. General: The pump motors shall be sized by the manufacturer to operate the equipment at the appropriate speed and over the full range of the impeller without exceeding the nameplate horsepower rating. The motors shall be the squirrel-cage, induction, shell type housed in an air filled, watertight chamber. The motors shall be capable of continuous duty, sustaining a minimum of fifteen starts per hour, and operating in a totally, partially, or non-submerged condition. The motor shall meet the electrical requirements of Paragraph 1.3B of this Section.

B. Stator: winding and leads shall be insulated with moisture resistant Class H insulation, which will resist a temperature of 180 degrees Centigrade (311 degrees Fahrenheit).

C. Temperature control: Thermal sensors shall be used to monitor stator temperatures. The thermal sensors/switches shall be used in conjunction with, and supplemental to, external motor over-protection to automatically shut off the motor when excessive temperatures are sensed.

D. Cables: Each pump motor shall have the necessary power and control cables. The cable shall be Hypalon jacketed Type SPC to exceed ASTM D4247. The manufacturer’s code shall be permanently embossed on the cable exterior. Cable sizing shall conform to NEC specifications for pump motors. Each cable shall be as long as necessary to properly connect the pump to its power and control circuits.

2.8 PUMP CONTROLS

A. Automatic Control Center (ACC) Enclosure: shall be rated NEMA 4X Stainless Steel mounted as shown on the plans. The enclosure shall meet the following:

1. Shall be as manufactured by:
   b. Boss.
   c. Wigman.
   d. Flygt Corporation.
   e. Healy-Ruff/Pumpak.
   f. Mini-Cas
   g. Multitrode
   h. Or approved equal.

2. Shall meet the following at a minimum:
   a. All exposed surfaces: 14 gauge stainless steel.
   b. Interior shall have a full deadfront covering entire control panel.
   c. Dead front and backplate: 14 gauge cold rolled steel.
   d. All materials shall be predrilled and finished after cutouts have been made.
   e. All surfaces shall be degreased, phosphatized, and primed with white primer paint prior to being finished.
   f. Final coat: interior surfaces shall be white baked enamel.
g. The enclosure shall also provide for and include the following mechanical and electrical facilities:

1) Inner Swing Panel - Provision of a “dead front” feature shall be provided using a full size hinged inner door to mount all operator devices. Material shall be .125” aluminum with turned down flanges on all four sides for added rigidity. The inner door and components shall have a “dead back” feature in order to avoid accidental shock hazard. The inner door shall be large enough to fill the entire opening of the enclosure. The inner swing door shall be mounted on an adjustable slide rail that allows adjustment of the location throughout the depth of the enclosure. Mounting hardware which penetrates the enclosure and violates the environmental rating of the enclosure shall not be allowed. All hardware shall be corrosion resistant. Quarter-turn latches shall be provided for securing the inner door in the closed position; captive screws are not acceptable. In addition, an inner door handle shall be provided for operator convenience.

2) Exterior Mounting Plate - The enclosure shall incorporate a minimum 3/16” thick marine aluminum plate mounted on a vertical stainless steel strut covering the entire back of the panel enclosure for the purposes of mounting the Utility Meter and Service Entrance Main Disconnect. There shall be a minimum ½” clearance between the rear of the control panel enclosure and the mounting plate.

3) Condensation Heater - A 100 watt (minimum), 120 VAC heater shall be provided to protect the enclosure from the harmful effects of condensation, corrosion and low temperatures. The heater shall be complete with an adjustable thermostat. Branch protection shall be provided.

B. High Voltage

1. Main Disconnect Switch - As previously specified, a main disconnect switch shall be provided to allow the operator to disconnect the main pump control panel power before opening the inner door. The switch handle shall interlock the inner swing door. The handle shall have a defeatable feature allowing the inner door to be opened without disconnecting the power for troubleshooting and maintenance. A separate Fused Service Entrance Disconnect Switch shall be provided and installed by others.

2. Individual Branch Disconnect and Short Circuit Protection - Each pump shall have a thermal magnetic type circuit breaker and starter sized for the pump motor to be supplied. The starter shall be NEMA and UL Listed, full voltage non-reversing type complete with an electronic, adjustable Class 10 overload relay. The overload shall be sized based on the actual pump full load amps and service factor, NOT, the NEC Table 430-150.

3. Power Distribution System - Associated with this installation will require the individual branch disconnect and short circuit protection to have a U.L. interrupting rating of 14 kA at 460 VAC.

4. Control Power - The 120 VAC, single-phase power shall be derived from a 3kVA transformer. The transformer shall have circuit breakers for both primary and secondary overcurrent protection. Branch circuit breakers shall be provided for control, alarms, and the 15A GFI outlet.

5. Lightning Arrester - The system shall be protected by a lightning arrester for the electrical service and shall be capable of handling up to 600vac. It shall be parallel MOV design and provide protection for Category C Transient Surges as defined in ANSI/IEEE C62.41 without degradation of components. The arrester shall provide protection between each phase line and the ground line. The arrester shall be UL listed as a Secondary Surge Arrester, UL category OWHX. The enclosure shall be molded UV resistant polycarbonate or equal material. All electrical connectors shall be sealed in a UL component
recognized epoxy to exclude moisture, dirt and corrosion. A one-half inch conduit nipple and lock nut shall be provided. Leads shall be color coded and a minimum of 18 inches long. It shall be provided loose for mounting on the exterior of the Utility Service Entrance Disconnect by the installing contractor.

6. Ground Lugs - Ground lugs shall be provided for both incoming service and for each motor.

C. ACC Controls: shall be Flygt model F-3000 or Healy-Ruff/Pumpak Duplex control panel or approved equal, and shall contain the following at a minimum:

1. Main breaker.
2. Individual pump motor breakers.
3. Control circuit breakers.
4. Short circuit protection.
5. Thermal overload protection.
8. Auxiliary contacts.
9. Control transformer.
11. Automatic transfer to non-operating pump (in the event of overload or operating pump failure).
12. Overload reset.
14. Loss of phase and high/low voltage protection (each pump).
15. Surge and transient protection equal to the Zone Defender by Atlantic Scientific Corporation.
16. Hand/off/automatic operators (each pump).
17. Lights:
   a. Run lights; Red.
   b. Power on; Green.
   c. Warning; Amber.
      1) High motor temperature.
      2) Pump seal failure.
   d. High or low water level; Flashing Red.
18. Exterior top mounted flashing red light and alarm horn for all alarm conditions.
19. Running time meters.
21. 120 Volt duplex receptacles.
22. Panel heater (sized for panel).
23. Battery and battery charger for alarm system.

D. All electrical and control components shall be properly sized for operating conditions, and shall be Square-D or approved equal.

E. Running time meters for each pump shall be mounted on the face of the control panel, record to seven places, automatically totalize pump running time in hours and tenths of hours, and NOT be capable of being manually reset.
F. **Labels:** engraved on black-on-white laminated phenolic in letters 3/8 inches high all units by function including all switches, starters, panels, sub-panels, breakers, timers, relays, lights, and meters (e.g., “PUMP NO. 1 – MAGNETIC STARTER”).

G. **Components:** Operator control devices shall be 22mm, NEMA and U.L. listed for Types 1, 12, 3R, 4 and 4X. Contact blocks shall be self-wiping and color coded bridge type rated at 10 A. Must have a rated insulation of 600 V. Terminal connections shall be suitable for two 14 AWG control wires. All control relays shall be DPDT rated 10A @ 120VAC, 8-pin socket mount type. Sockets shall have pressure plate terminals that accept two 14 AWG wires and shall be rated a minimum of 300V. All terminal blocks supplied shall be box lug type rated at the proper voltage/amperage and shall accept two 14 AWG wires. All control wiring shall be MTW and shall be color coded in accordance with all applicable codes and laws. Spiral wrap, tie wrap, fasteners and wire duct shall be provided as required for aesthetics and safety. All components mounted on the door and/or inner swing panel shall be wired with insulated connectors (where "finger proof" terminals are not provided) to prevent accidental shock hazards. All components on the back panel shall be mounted on DIN rail or fastened via drilled and tapped screws to facilitate easy component replacement. Pop rivets shall not be allowed. Ammeter loops shall be provided between the disconnect switch and combination starter for better heat dissipation and an easy means of meter readings. Self-adhesive Brady B-498 System vinyl cloth printed adhesive wire markers shall be supplied at both ends of every wire. All components on the back panel shall be identified by a Brady B-498 System polyester printed adhesive label. Dymo labels are not acceptable. These labels shall include all pertinent data applicable to ratings and sizes. Components on the door of the enclosure shall be identified with custom engraved plastic legend plates. Voltage identification labels and comprehensive warning labels shall also be provided.

H. **Alternating Relay:** The pump control system shall provide for automatic lead pump alternation after each run cycle. The duplex alternating relay shall be an X (cross) wired relay, double pole as manufactured by Time Mark 261-DXT-120 and be complete with LED indicating lights showing the status of the internal relay and a lead selector toggle switch which will allow the alternation to be canceled and omit a disabled pump. Contacts shall be rated 10 A at 120VAC.

I. **Mode Select:** Method of operation shall be by a three position green illuminated maintained “Hand-Off-Auto” selector switch which shall provide for mode selection and run indication.

J. **Pump Monitoring and Control:** One Mini-Cas 120 unit shall be supplied for each pump to monitor the pump for overtemp and leakage. The unit shall be an 11-pin mounting style and shall be mounted in the inner door by utilizing an 11-pin reverse socket. The unit shall be powered by 120VAC and shall contain LED indication for power on, overtemp and leakage conditions. The unit shall contain and overtemp reset pushbutton to reset the unit after the fault has cleared, as well as a selector switch that allows the selection of manual or auto reset. The Mini-Cas 120 unit shall be model 14-407129 as manufactured by Flygt Corporation (or approved equal).

**Level Control Equipment:** Water level sensing shall consist of conductivity sensors mounted integral in a single probe. The probe length shall be 2.0 meters, with a minimum of 10 sensors. Provide 33 feet of cable integral to the probe. Relays shall be provided for 120VAC operation.

The probe shall be constructed from Unplasticized-PVC (U-PVC) 32mm tubing with molded sensor units at regular intervals along the probe and shall be Multitrode Model 1.5/10-10 (or equal). Each sensor unit will be U-PVC injected to prohibit ingress of moisture, and the sensor material will be Avesta (or equal) SMO254 stainless steel. The probe will be mounted in a turbulent area of the wet well, suspended on its own cable and connected to a 6mm stainless steel hook which would hang from a 30mm stainless steel angle.
containing a polyurethane squeegee pad positioned min the opening into the wet well, so that the probe can be removed without entering the wet well. The squeegee will have a 30mm hole and slot, enabling the probe to be pulled through and cleaned. Probe cable shall be run in a separate conduit away from any high voltage cables. Ten (10) sensors will be spaced along the length of the probe assembly, and each will be individually connected to a correspondingly numbered U-PVC/PVD .75mm flexible cable. The molded sensor unit will contain two Avesta sensors (or equal) mounted on opposite sides of sensor unit. Each Avesta sensor (or equal) will be 24mm high and no wider than 2mm, and will protrude from the surface of the PVC. The probe shall be pressure injected with an epoxy resin to encapsulate all internal components and connections to form a rigid, homogenous unit. Each sensor unit containing the two Avestas sensors (or equal) will be rotated 90 degrees to the previous sensor unit to eliminate tracking between sensors. The cable will be encoded with number and text along the entirety of the cable and at intervals not greater than 200mm, for identification. This cable will be dark blue in color, with the cores light blue. The flexible cables shall be capable of supporting the weight of the probe and able, without the need for additional support. The cable shall be secured to the top of the probe by a synthetic rubber compression fitting. The probe shall be covered by a ten-year manufacturer warranty.

The level/alarm control relays shall be solid-state electronic modules in a high impact plastic case with a DIN rail attachment on the back. The relays are to be matched with the level sensing probe which works in conjunction with the relay and uses the conductivity of the liquid to complete and electrical circuit. The level/alarm control relays shall be Multitrode models MTR/MTRA (or equal).

K. Elapsed Time Meter(s): A six digit non-resettable type elapsed time meter to record hours of operation shall be provided for each pump. They shall be wired with insulated connectors to prevent accidental shock hazards.

L. Intrinsically Safe Barrier: An intrinsically safe barrier shall provide a barrier between a 10 channel conductance probe located in a hazardous location and the conductance relay in a non-hazardous location. The barrier shall be designed to pass the level sensing signal of the conductance relay through unchanged. The barrier shall clamp voltage and current levels at a safe level. The barrier shall be a UL913 listed intrinsically safe device and shall be installed per NFPA and UL698A standards. The unit shall be Multitrode model MTISB-10 (or approved equal).

M. Convenience Outlet: A Duplex GFI outlet rated 15A and mounted on the inner swing door of the control panel enclosure. A 15A branch circuit breaker shall be provided for this outlet.

N. Lighting: Contractor to provide outdoor weatherproof LED dust to dawn light fixture powered by a circuit breaker in the pump control panel. This light shall be mounted to the unistrut equipment rack.

O. Alarms: Alarm power shall be derived from a 120VAC Power. A weatherproof red flashing incandescent alarm light and a horn rated 90dB at ten feet shall be provided to indicate a high level, power failure and/or pump failure alarm condition. They shall be mounted on the exterior of the Pump Control Panel and shall be UL recognized for NEMA 4 to maintain the environmental rating of the enclosure.

2.9 BASIC OPERATION

A. The pumps shall be operated automatically or manually as a pump down, lead/lag, common off system. Each pump shall be controlled primarily through "Hand-Off-Auto" three position maintained selector switches as well as other divisions within this specification.

1. Position Commands
   a. OFF- In this position the applicable pump will not run under any circumstance.
b. Hand - In this position the applicable pump shall run without regard for the level sensing commands and will rely on operator discipline to run and stop. The controls shall be designed so that only one pump may run in either the “hand” or “auto” mode.

c. Auto - In this position both pumps shall be controlled by the level probe equipment. The controls shall be designed so that only one pump may run in either the “hand” or “auto” mode.

2. Pump Sequence:
   a. Level Probe Set Point 3 - High Level Alarm.
   b. Level Probe Set Point 2 - Start Lead Pump; shall alternate on each call.
   c. Level Probe Set Point 1: Off/Low; all pumps stop.

3. The Level Probe Shall be supplied with a total of 10 set points to allow for future operator adjustment.

B. Float Test: a pump test panel shall be mounted in the ACC near the H-O-A switches and shall have an “Open-Auto-Closed” switch and LED for each float. A 1-2/Auto/2-1 sequence selector switch with lead pump position indicating LED’s shall be included. LED colors shall be as follows:

   1. Alarm LED’s; Red.
   2. Start LED’s; Green.
   3. Stop LED’s; Amber.

   C. All LED, selector switch, and timer functions shall be silkscreened on the chassis.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

A. The pumping system shall be equipped with all piping, valves, and fittings as shown on the plans and specified herein. All piping shall be cement-lined ductile iron except where noted otherwise on the plans.

B. Refer to Section 333000 – Sanitary Sewerage for product and installation requirements for gravity and pressure sewer piping, fittings, and valves.

C. All piping shall be installed true to line and grade in a neat and skillful manner and be made watertight throughout. The openings where piping passes through the wetwell or valve box walls shall be neatly grouted, full depth, and waterproofed on the outside with the same material as is used to waterproof the wetwell and valve box structures. All exposed piping shall be painted and left clean. Pipe supports shall be provided as needed to support the piping within the valve vault.

D. If the Contractor encounters utility lines in his trench line, he will see that an appropriate utility representative is on hand to direct him in his excavation. If the Contractor cuts or damages these lines, it shall be his responsibility to repair or have the utility employee repairs the lines at the Contractor’s expense, including materials and labor of such repair, to its original condition.

E. All exposed piping shall be painted with three coats of an Alkyd Enamel Paint System. Piping color shall be grey. All interior concrete surfaces shall be painted with two coats of an Epoxy Masonry Paint System. The first coat shall be an Epoxy Masonary Filler. Interior concrete color shall be off-white.

3.2 REMOVAL OF WATER

A. The Contractor shall provide and maintain equipment to remove and dispose of all water, surface water and groundwater, entering the excavations, and shall keep the excavations dry until the structures to be built therein are completed. No reinforcing steel shall be placed in water, and no water shall be allowed to
rise over any reinforcing steel before the concrete has been placed. No water shall be allowed to come into contact with any concrete within twenty-four hours after placing unless authorized by the Engineer. The cost of removing any surface water or groundwater shall be considered an incidental part of construction and no additional payment will be allowed.

3.3 ADAPTATION OF PIPING AND EQUIPMENT

A. The Contractor shall furnish equipment readily adaptable for installation and operation in the structure shown on the plans and specified herein. He shall assume full responsibility for alteration of any planned structure to accommodate other types of equipment. Any equipment which requires alteration of the structure will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. The Contractor shall provide all such alterations at no extra cost to the Owner.

3.4 START-UP AND CORRECTION PERIOD

A. All workmanship and materials throughout shall be of the highest quality and shall be subject to the approval of the Engineer. The manufacturer of the pump station shall furnish factory-trained personnel to supervise installation, make any necessary adjustments, place in operation, and instruct the Owner’s operator in the proper care and maintenance of the equipment.

B. The manufacturer shall correct any defects in design, materials, and workmanship for one year following the date of start-up.

3.5 SPARE PARTS

A. The Contractor shall a complete set of pilot lights, and one spare starter for the station.

3.6 LANDSCAPING

A. After the pump station has been completed, all debris, construction wastes, etc. shall be removed from the site, and all disturbed areas shall be graded to final grade, smoothed, and dressed. Fencing shall then be installed as shown on the plans and according to Section 323100 – Chain-Link Fences and Gates, and compacted chat shall be placed 6" thick around the pump station site. A black 10-mil polyethylene sheet shall be placed below the chat. The chat shall be smooth and uniform throughout the fenced area. All disturbed areas outside the fence shall be smoothed to match the existing ground, cleaned of all debris, tilled, fertilized, limed, and seeded according to the Division 03 Section 312500 – Permanent Erosion Control and Landscaping.

3.7 SIGNS

A. Install a minimum of one sign per side on the outside of the fencing facing away from the sewage pump station.

B. The sign wording and geometry shall be as shown on the plans or as specified by the engineer, materials shall be as specified in Section 323100 – Chain-Link Fences and Gates.

C. An embedded metal ruler shall be installed within the wet well. Elevation shall be in half-foot intervals and shall correspond with the lowest elevation of the lagoon cell and increase in value.

3.8 WARRANTY

A. The Project 1 Year Warranty period shall apply to Section 333200 - Sanitary Sewage Pumping Station.

END OF SECTION 333200
PART 1 – GENERAL

1.1 SCOPE

A. This section covers earthwork construction for, lagoon levees, side slopes and fill at the wastewater treatment facilities site. Construction and installation of lagoon structures and miscellaneous lagoon equipment are also covered in this section. Excavation and backfilling for structures and underground piping shall be performed in accordance with the Sections entitled 312000 Excavating and Backfilling Trenches and 333000 Sanitary Sewerage of these Technical Specifications.

B. Referenced Sections include the following:
   1. Section 033000 – Cast-In-Place Concrete
   2. Sections 312000 – Excavating and Backfilling Trenches.
   3. Section 323100 – Chain-Link Fences and Gates.
   4. Section 333000 – Sanitary Sewerage.

1.2 GENERAL

A. All work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations and embankments shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete structures.

B. Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill, fill, or embankment.

C. The Contractor shall confine all operations inside the property lines and shall be responsible and liable for all damage outside of the property lines. The Contractor shall be responsible for organizing his operations to perform within the property lines shown on the Plans.

1.3 EXCAVATION AND EMBANKMENT CONSTRUCTION

A. Preparation of Subgrade for Compacted Fill

   1. In compacted fill areas where organic matter is present, the top six (6") inches of topsoil shall be stockpiled for finish grading operations.
   2. No fill shall be placed on frozen soil. Immediately before depositing fill, the areas where lagoon berms or road embankment are to be constructed, the surface shall be plowed to a depth of six (6") inches and dragged with a disk harrow until well pulverized. The first layer of new material shall not be over six (6") inches in depth in an uncompacted state and shall be compacted in such a manner as not to leave a dividing plane. Following layers shall not exceed nine (9") inches in an uncompacted state.

1.4 COMPACTED FILL

A. Material for compacted fill will be obtained from the area of the proposed lagoon excavation, as shown on the plans. All lagoon excavation used for an embankment or structure backfill shall be compacted.

B. Compaction shall begin at the bottom and shall be carried to the top in uniform lifts that are of full width and shape of the proposed levees. The material shall be free from lumps over six (6") inches in size. The layer shall be disked or otherwise treated, if necessary, to break up large lumps and no unusual segregation of different types of material shall be allowed. Maximum rock size shall not exceed one-half the thickness of the compacted lift.

C. Care shall be taken to prevent dividing places between layers of the compacted fill. Scarification shall be used to remove any smooth surfaces which would cause such conditions.
D. When embankment is to be placed on hillsides or against existing embankments, the existing slopes which are steeper than 6 to 1 shall be continuously benched in not less than twelve (12") inch rises over these areas where required, as the work is brought up in layers. Benching shall be of sufficient width to permit placing and compacting operations. Each horizontal cut shall begin at the intersection of the ground line and the vertical side of the previous bench. Fill shall be placed in horizontal layers not less than 100 feet in length and not exceeding nine (9") inches in depth of loose measure and shall have a moisture content such that the required degree of compaction may be obtained.

E. To ensure that the fill is being compacted properly, the Contractor shall secure the services of an independent testing laboratory to provide certified tests on in-place density. Testing methods, frequency, and minimum standards are listed below in Part 2 - Quality Control of this Section.

1.5 UNAUTHORISED EXCAVATION

A. Except where authorized, shown, or specified, all material excavated below the bottom of the required subgrade shall be replaced by and at the expense of the Contractor with specified fill material.

(Prior paragraphs 1.6, 1.7, 1.8, 1.9 deleted due to change from Bentonite Seal to Geoliner Membrane - per ADDENDUM #4)

PART 2 – QUALITY CONTROL

2.1 GENERAL  (Revised per ADDENDUM #4)

A. The Contractor shall secure the services of an independent Testing Laboratory directed by a Professional Engineer to oversee the testing program. The Testing Laboratory shall perform the required tests and shall provide test reports to the Project Engineer within 24 hours of the completion of the tests. The Professional Engineer in charge of the Testing Laboratory shall certify the test reports. He shall provide a weekly report to the Project Engineer which includes the following:

1. Assurance that materials met or exceeded the design specifications.
2. Assurance that density/moisture test results met or exceeded design specifications.
3. Assurance that all testing was performed by or under the direction of the Testing Laboratory’s Professional Engineer.
4. A listing of deviations from design standards.

(Prior item 2.1.A.3 deleted due to change from Bentonite Seal to Geoliner Membrane - per ADDENDUM #4)

B. Any deviations from minimum design standards shall be reported to the Project Engineer immediately. Upon completion of the levees, the Professional Engineer in charge of the Testing Laboratory shall provide a report to the Project Engineer assuring that the levee has been constructed as specified or listing deviations from design standards. The Project Engineer will then forward this report to the Missouri Department of Natural Resources Poplar Bluff Regional Office.

C. Following is a listing of required tests, test frequencies, and minimum standards:

1. Standard Proctor (ASTM D-698) - 1 test at beginning of levee construction and additional tests when material changes are noted.
2. Unified Classification (ASTM D-2487) - One (1) test for every 5000 cubic yards. Minimum Design Standard - Materials shall classify as CH, CL, SC, or GC.
3. Liquid Limit/Plasticity Index (ASTM D-4318) - One (1) test for every 5000 cubic yards of material. Minimum Design Standard - Liquid Limit equal to or greater than 30, Plasticity Index equal to or greater than 20.
4. Percent Passing No. 200 Sieve (ASTM D-1140) - One (1) test for every 5000 cubic yards of material. Minimum Design Standard - Percent Passing No. 200 Sieve shall be equal to or greater than 50%.
5. Compacted Permeability (U.S. Army Publication EM-1110-2-1906 - "Falling Head Permeability Test") - One (1) test for every 5000 cubic yards of material. Minimum Design Standard - permeability shall be less than 1.0 X 10^-7 centimeters per second.
6. Field Density for Embankment and Structural Fill (ASTM D-2292) - 4 tests per acre per lift including base below fill areas. Minimum Design Standards - Percent Compaction equal to or greater than 95%
7. **Moisture Content for Embankment and Structural Fill (ASTM D-3017)** - 4 tests per acre per lift including base below fill areas. Minimum Design Standards - Moisture content between -2% and +4% of optimum. (Prior item 2.1.C.8-10 deleted due to change from Bentonite Seal to Geoliner Membrane - per ADDENDUM #4)

### 2.2 EXCESS EXCAVATED MATERIAL

A. Lagoon excavated fill material not used for levee or rock filter closure shall be the responsibility of the Contractor to remove and dispose of the excess material from the project site.

### 2.3 DEWATERING

A. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all water entering excavations, trenches, or other parts of the work. Each excavation shall be kept as dry as possible during subgrade preparation and continually thereafter until the structure to be built, pipe to be installed, or excavation is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

B. All excavation for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations twelve (12") inches or more below the bottom of the excavation.

C. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practical without causing damage to adjacent property.

D. If it is determined by the Contractor that the excavation cannot be kept dry, he shall request from the Engineer permission to construct under wet conditions. Permission to construct under wet conditions shall not in any way be considered to relieve the Contractor from full responsibility for the proper construction of the structure to be built or the pipe to be installed. Construction under wet conditions shall not result in damages from hydrostatic pressure or flotation. Construction under wet conditions shall result in a final product equal to that constructed under dry conditions.

E. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes and all such pipes or conduits shall be left clean and free of sediment.

F. Dewatering at the lagoon site will not be paid for separately; but, shall be considered incidental to the cost of the lagoon excavation and embankment.

### 2.4 RIP-RAP

A. **Submittal of Rip-rap Samples**
   1. The Contractor shall furnish to the Owner at the site of the work, without cost to the Owner, such samples of rock materials for testing as may be required by the Owner from proposed quarry sites and from rock materials delivered to the site of the work.
   2. Rock for rip-rap may be obtained from any source approved by the Engineer.
   3. If rip-rap is to be obtained from a source not previously tested by the Owner, the Contractor shall submit representative samples for testing at least 30 days before the rip-rap is required for use. The samples shall consist of three or four rock fragments totaling 200 pounds.
   4. The Engineer reserves the right to make inspections of quarry sites and quarries. The approval by the Owner of some rock fragments from a particular quarry site shall not be construed as constituting the approval of all rock fragments taken from the quarry, and the Contractor will be held responsible for the specified quality gradation of rock fragments delivered to the work site. All rock fragments not meeting the requirements of these specifications, as determined by tests and/or inspection at the quarry and work site, will be rejected.

B. **Rip-rap Characteristics**
   1. Individual rock fragments shall be dense, sound, and resistant to abrasion and shall be free from cracks, seams, and other defects that would cause significant deterioration by water and frost action.
   2. The rip-rap shall be such that at least 90% of the rock is well graded between 3" and 8" least dimension.
C. Placement of Rip-rap

1. The areas to receive rip-rap or slope protection of any kind shall be dressed smooth to the slopes or shapes called for on the Plans and shall be free from stumps, organic matter, or waste material. Generally, a toe trench should be provided in which to key the bottom course of rip-rap.

2. The rip-rap does not need to be compacted; however, it shall be placed to grade in a manner to ensure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments which will result in well-keyed, densely placed, uniform layers of rip-rap. Hand placing will be required only to the extent necessary to secure the results specified above. Rip-rap shall be placed over a 10 mil black plastic vegetation barrier. Care shall be taken not to damage the barrier during placement of the rock.

(Prior paragraph 2.5 deleted due to change from Bentonite Seal to Geoliner Membrane - per ADDENDUM #4)

2.5 INFLUENT AND EFFLUENT STRUCTURES

A. General

1. The influent and effluent structures shall be constructed as shown in the Plans. All poured-in-place concrete shall conform to Section 033000 Cast-In-Place Concrete of these Technical Specifications. All concrete shall have a minimum 28-day compressive strength of 4000 psi. All reinforcement steel shall conform to ASTM A-615 and only deformed type, made of intermediate grade billet steel shall be used.

2. All joints and openings around pipes shall be sealed watertight with expanding concrete and bituminous joint compound.

B. Transfer Structure

1. Contractor shall provide piping, valves, valve stems, valve boxes, concrete splash pads, and grating over the end of the pipes and any other items necessary to provide the transfer of waste from cell 1 to cell 2 and from cell 2 to cell 3 in order to provide a complete and functional project according to Section 333000 “Sanitary Sewerage.”, as shown on the plans, or approved by the Engineer.

C. Effluent Structure

1. Place pre-cast four foot diameter wet well at the location and grade as shown on the plans. Piping, concrete splash pads, and grating shall be placed to the elevation and grade as shown on the plans or approved by the Engineer.

D. Pipe, Fittings, & Valves

1. The type of pipe to be used is shown on the Plans. All fittings shall be compatible with and equal in quality to the pipe they are used with. All pipe, fittings, valves, and flap gates shall comply with Section 333000 Sanitary Sewerage of these Technical Specifications.

2.6 LAGOON SITE AND APPLICATION AREA PERIMETER FENCING

A. All lagoon and application area perimeter fencing shall comply with Section 323100 Chain-Link Fences and Gates.

2.7 LAGOON FENCING AND APPLICATION AREA SIGNS

A. The Contractor shall furnish and install 20 gauge steel signs attached to the lagoon and application area site fencing in the locations shown on the Plans. The signs shall be securely attached to fence posts. The lettering for the signs is shown on the Plans.

2.8 LOCKS AND KEYS

A. The Contractor shall provide all locks to be used on the gates, disconnect enclosures, miscellaneous enclosures, etc. The locks shall be heavy duty, high quality locks, all keyed alike. A minimum of ten keys shall be provided with the locks.
2.9 MISCELLANIOUS PAINTING

A. All exposed metal surfaces throughout the treatment facilities shall be primed as recommended by the manufacture and followed by two finish coats of epoxy paint.

1. The color to be selected by the Owner from a full list of colors provided by the manufacturer.

2.10 WARRANTY

A. The Project 1 Year Warranty period shall apply to Section 333400 - Lagoon Earthwork & Structures.
APPENDIX NO. 4

Sludge Sample Results for WESYC’s Three (3) Wastewater Treatment Lagoons
Smith & Company

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic by ICP</td>
<td>14</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt; 0.30</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Chromium</td>
<td>15.4</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Copper</td>
<td>66.4</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Ammonia Nitrogen, Distilled</td>
<td>378</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Mercury by Cold-Vapor Technique</td>
<td>&lt; 0.10</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Metals Flame-AA Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Metals ICP Sample Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Potassium</td>
<td>204</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Kjeldahl Nitrogen</td>
<td>2,340</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Molybdenum by ICP</td>
<td>2.9</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nitrate/Nitrite as Nitrogen</td>
<td>&lt; 0.323</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt; 1.5</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Organic Nitrogen</td>
<td>1,960</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>PAN - Subsurface Application</td>
<td>770</td>
<td>ppm</td>
</tr>
<tr>
<td>PAN - Surface Application</td>
<td>656</td>
<td>ppm</td>
</tr>
<tr>
<td>Lead by ICP</td>
<td>25</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Selenium by ICP</td>
<td>&lt; 2.0</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>971</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Solids</td>
<td>34.0</td>
<td>% w/w</td>
</tr>
<tr>
<td>Zinc</td>
<td>156</td>
<td>mg/Kg</td>
</tr>
</tbody>
</table>

2410933 WE Sears #2 10/31/2019

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic by ICP</td>
<td>4.2</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt; 0.30</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Chromium</td>
<td>11.4</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Copper</td>
<td>23.2</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Ammonia Nitrogen, Distilled</td>
<td>220</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Mercury by Cold-Vapor Technique</td>
<td>&lt; 0.10</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Metals Flame-AA Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Metals ICP Sample Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Potassium</td>
<td>154</td>
<td>mg/Kg</td>
</tr>
</tbody>
</table>

All results are preliminary and pending quality control review. Final report to follow.
<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kjeldahl Nitrogen</td>
<td>373</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Molybdenum by ICP</td>
<td>&lt; 2.4</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nitrate/Nitrite as Nitrogen</td>
<td>1.24</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt; 1.5</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Organic Nitrogen</td>
<td>153</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>PAN - Subsurface Application</td>
<td>251</td>
<td>ppm</td>
</tr>
<tr>
<td>PAN - Surface Application</td>
<td>185</td>
<td>ppm</td>
</tr>
<tr>
<td>Lead by ICP</td>
<td>3.8</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Selenium by ICP</td>
<td>&lt; 2.0</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>343</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Solids</td>
<td>42.3</td>
<td>% w/w</td>
</tr>
<tr>
<td>Zinc</td>
<td>19.1</td>
<td>mg/Kg</td>
</tr>
</tbody>
</table>

2411001      WE Sears #3       10/31/2019

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic by ICP</td>
<td>44</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt; 0.30</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Chromium</td>
<td>10.9</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Copper</td>
<td>16.4</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Ammonia Nitrogen, Distilled</td>
<td>106</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Mercury by Cold-Vapor Technique</td>
<td>&lt; 0.10</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Metals Flame-AA Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Metals ICP Sample Digestion</td>
<td>1</td>
<td>Prep</td>
</tr>
<tr>
<td>Potassium</td>
<td>60.1</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Kjeldahl Nitrogen</td>
<td>306</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Molybdenum by ICP</td>
<td>3.9</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nitrate/Nitrite as Nitrogen</td>
<td>0.780</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt; 1.5</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Organic Nitrogen</td>
<td>200</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>PAN - Subsurface Application</td>
<td>146</td>
<td>ppm</td>
</tr>
<tr>
<td>PAN - Surface Application</td>
<td>114</td>
<td>ppm</td>
</tr>
<tr>
<td>Lead by ICP</td>
<td>32</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Selenium by ICP</td>
<td>&lt; 2.0</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>354</td>
<td>mg/Kg</td>
</tr>
<tr>
<td>Total Solids</td>
<td>61.6</td>
<td>% w/w</td>
</tr>
<tr>
<td>Zinc</td>
<td>18.3</td>
<td>mg/Kg</td>
</tr>
</tbody>
</table>
W.E. SEARS YOUTH CENTER
WATER & WASTEWATER
SYSTEMS UPGRADE
POPLAR BLUFF, MISSOURI

OWNER: STATE OF MISSOURI
MICHAEL L. PARSON,
GOVERNOR

DEPARTMENT OF SOCIAL SERVICES
-DIVISION OF YOUTH SERVICES

PROJECT
MANAGEMENT: OFFICE OF ADMINISTRATION
-DIVISION OF FACILITIES MANAGEMENT,
DESIGN AND CONSTRUCTION

DESIGNER: DOMINIC THOMPSON, P.E.
PH#: (573)785-9621 (573)429-1894
EMAIL: domt@shsmithco.com

PROJECT NUMBER: H1610-01

SHS PROJECT NUMBER: P160201

SITE NUMBER: 5701
FACILITY NUMBER: 5701-04 (WATER SYSTEM)
5701-05 (WASTEWATER SYSTEM)

MISSOURI STATE CERTIFICATE OF AUTHORITY
#E-616-D

G-001
NOTE:

EXISTING UTILITIES NOTE:

C-101
1 OF 15 SHEETS
JUNE, 2019

JUNE, 2019

CONTRACTOR TO CAP EXISTING PIPING AT WELL HEAD AND REMOVE PIPING FROM WELL HEAD TO ASPHALT PARKING LOT CAPPING EACH END.

EXISTING WELL #1 REMAINS WELL #1

EXISTING WELL #1 REMAINS WELL #1

CONTRACTOR TO REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.

CONTRACTOR SHALL REMOVE ABANDONED WATERLINE FROM ASPHALT PARKING LOT TO VALVE VAULT CAPPING EACH END.
-0+00
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
0+00
1+00
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
8+57
0+00
1+00
0+00
1+00
2+00
10+00
11+00
12+00
13+00
14+00
15+00

6" DUCTILE IRON EFFLUENT PIPE
STA: 7+57 PERFORATED PIPE
SEE DETAIL SHEET C-111

STA: 13+89 PERFORATED PIPE
SEE DETAIL SHEET C-111

MIN. 3' COVER

7+00
6" GATE VALVE
STA: 2+90.00

6" GATE VALVE
STA: 11+22.00

6" GATE VALVE
STA: 11+42.00

6" GATE VALVE
STA: 12+25.00

GROUND APPLICATION LINE 2 SEE SHEET C-108

MATCHLINE A STA:10+50

MATCHLINE A STA:10+50

SPRINKLER HEAD 1-1
STA: 2+07.04
N: 373191.08
E: 816941.59

SPRINKLER HEAD 1-2
STA: 3+04.12
N: 373191.08
E: 816941.59

SPRINKLER HEAD 1-3
STA: 4+59.78
N: 372989.08
E: 816801.45

SPRINKLER HEAD 1-4
STA: 6+20.90
N: 372836.03
E: 816751.08

SPRINKLER HEAD 1-5
STA: 7+62.51
N: 372713.70
E: 816679.74

SPRINKLER HEAD 1-6
STA: 8+93.22
N: 372726.49
E: 816549.65

SPRINKLER HEAD 1-7
STA: 10+44.71
N: 372772.55
E: 816405.34

SPRINKLER HEAD 1-8
STA: 12+16.39
N: 372900.03
E: 816290.35

SPRINKLER HEAD 1-9
STA: 13+85.17
N: 373064.33
E: 816328.98

SPRINKLER HEAD 1-10
STA: 15+42.26
N: 373213.72
E: 816377.54

LEGEND:

NOTE:

PERFORATED PIPE IS TO ALLOW FORCEMAIN TO DRAIN DURING FREEZING CONDITIONS.

5701-04 0+00
5701-05 0+00
0x0 0+00

THOMPSON PE-2008019610

NUMBER

DOMINIC D

ST

TA

TO

MI

SO

URE

AL

EN

G

IN

E

E

F

E

F

6/21/19

SPRINKLER HEAD 1-10
STA: 15+42.26
N: 373213.72
E: 816377.54

SPRINKLER HEAD 1-9
STA: 13+85.17
N: 373064.33
E: 816328.98

SPRINKLER HEAD 1-8
STA: 12+16.39
N: 372900.03
E: 816290.35

SPRINKLER HEAD 1-7
STA: 10+44.71
N: 372772.55
E: 816405.34

SPRINKLER HEAD 1-6
STA: 8+93.22
N: 372726.49
E: 816549.65

SPRINKLER HEAD 1-5
STA: 7+62.51
N: 372713.70
E: 816679.74

SPRINKLER HEAD 1-4
STA: 6+20.90
N: 372836.03
E: 816751.08

SPRINKLER HEAD 1-3
STA: 4+59.78
N: 372989.08
E: 816801.45

SPRINKLER HEAD 1-2
STA: 3+04.12
N: 373191.08
E: 816941.59

SPRINKLER HEAD 1-1
STA: 2+07.04
N: 373191.08
E: 816941.59

G.A. LINE 1 PROFILE VIEW (CON'T)
CAPPED W/ THRUST BLOCK
STA: 8+14.00
ADD PERFORATED PIPE
SEE DETAIL SHEET C-111
MIN. 3' COVER
6" FORCEMAIN
STA: 2+85
PERFORATED PIPE
SEE DETAIL SHEET C-111
STA: 4+32
PERFORATED PIPE
SEE DETAIL SHEET C-111
MIN. 3' COVER
AIR RELEASE VALVE
STA: 3+23.50
6" FORCEMAIN

LEGEND:

NOTE:
PERFORATED PIPE IS TO ALLOW FORCEMAIN TO DRAIN DURING FREEZING CONDITIONS.
NOTE:
1. STEPS TO BE INSTALLED IN A VERTICAL ROW ON 16" CENTERS.
2. MANHOLE STEPS MUST BE IN COMPLIANCE WITH O.S.H.A. & A.S.T.M. REGULATIONS.

NOTE:
1. GFCI DUPLEX OUTLET, 110 VAC, 1 PHASE, 20 AMP OUTLET TO BE INCLUDED WITHIN ELECTRICAL PANEL.

NOTE:
PUMPS SHALL NOT OPERATE SIMULTANEOUSLY.

NOTE:
TRASH BASKET
WELL-1 INTERIOR LAYOUT

MOTOR CONTROLLER AND REWIRE 'P1' AS SHOWN

BOOSTER PUMP BUILDING ELECTRICAL PLAN

WELL-1 MOTOR SCHEMATIC

1. REMOVE ALL WIRING FROM EXISTING MS AND REWIRE AS SHOWN.
2. INSTALL H-O-A SELECTOR SWITCH AND PILOT LIGHT IN FACE OF EXISTING...
3. VERIFY EXISTING THERMAL O/L'S ARE PROPERLY SIZED FOR WELL PUMP...
4. CHANGE EXISTING MS COIL TO 120V.
5. FUSES.
6. ALL APPROVED CHANGES MUST BE DRAWN AND NOTED, BY...

GFI

ELECTRICAL CONTRACTOR ON A CLEAN COPY OF THE DRAWING(S).

WARNING LABEL ON FACE OF ALL SWITCHBOARDS, PANELBOARDS, BOXES, DISCONNECT SWITCHES, CONTROL PANEL, AND...

RESTORED TO ORIGINAL CONDITION.

DISTURBED ROADWAYS, DRIVEWAYS, AND PARKING LOTS SHALL BE...

WELL #1

EXISTING METAL ENCLOSURE HOUSING

AND REWIRE IN ACCORDANCE WITH WELL PUMP #1 ELECTRICAL SCHEMATIC.

THE ENGINEER OF ANY DISCREPANCIES BETWEEN THE DRAWINGS...

PUMPS.

WARNING - POWER FED

CONSTRUCTION:" THICK LAMINATED PLASTIC, BLACK BACKGROUND

"X2" (MINIMUM SIZE) ARC FLASH

DA víde GFI

Pump #1

Pump #2

EXISTING METAL ENCLOSURE

EXISTING METAL ENCLOSURE (EXISTING) FOR WELL #1 CONTROLS

EXISTING ELECTRICAL SCHEMATIC

SYSTEM CONTROL PANEL 'CP-1'

EXISTING METAL ENCLOSURE HOUSING ASSOCIATED WITH WELL #1

SET TO 10

SELECTED

LOW LEVEL

PL1

PUMP

1

PUMP

2

PUMP

1

PUMP

2

EXHIBIT PHOTO

E-101

E-101

PUMP AND 120V SECONDARY WITH INTEGRAL PRIMARY AND SECONDARY

WELL-1

WELL PUMP-1

MOTOR SCHEMATIC

NOTE TO PROJECT

PERMITTED ELECTRICAL WORKING PERSONNEL ARE TO USE THEIR OWN ARC...
E-102

State of Missouri
Michael L. Parson,
Governor

Office of Administration
Division of Facilities Management, Design and Construction

Department of Social Services
Division of Youth Services

Project Title: W.E. Sears Youth Center
Water and Wastewater Systems Upgrade
W.E. Sears Youth Center
Poplar Bluff, MO

Project # H1600-01
Site # 5701
Facility # 5701-04
3701-08

Revision: 1

Issue Date: 6-21-2019

CADD Drawing Control No.

Sheet Title: Sanitary Sewer Details

Sheet Number: E-102

3 of 13 Sheets

June 2019

Sanitary Sewer Details

1. All ground fault current shall be in accordance with the latest edition of the National Electrical Code (NEC).
2. All disconnect switches, junction boxes, and metal support structures shall be grounded and bonded in accordance with NEC requirements.
3. Coordinates electrical service installation with local power company.
4. All conduit shall have minimum short circuit current ratings as required by the latest edition of the National Electrical Code (NEC) or the electrical contractor panel service transformer, and service disconnect switch shall be selected to meet minimum short circuit current rating requirements.
5. Local utility service disconnect shall be increased in size where necessary to allow for service drop.
6. All installation equipment shall be field tested with equipment used in accordance with NEC requirements.
7. Available fault current ratings shall be field tested with equipment used in accordance with NEC requirements.
8. All conduit shall be tested with equipment used in accordance with NEC requirements.
9. All conduit shall be tested with equipment used in accordance with NEC requirements.
10. All conduit shall be tested with equipment used in accordance with NEC requirements.
11. Contractor shall furnish a 1 1/2" insulated, 2裸 conductors, with a minimum of 2" of insulation, for communication purposes, and shall install all conduit in accordance with NEC requirements.