1 General

1.1 The storm and sanitary sewer systems are separated on the majority of campus. However due to constraints, certain sections of the campus remain as combined sewers. The majority of campus storm sewers discharge to an onsite retention pond.

1.2 Materials and installations shall be in accordance with the following industry and association standards.

- ASTM – Material Specifications
- Recommended Standards for Sewage Works Great Lakes – Upper Mississippi River Board of State Sanitary Engineers (10 State Standards) – Latest Edition
- Model Specifications for Water & Sewer Main Construction in Indiana – Latest Edition
- Environmental Protection Agency (EPA) – National Pollutant Discharge Elimination System (NPDES) Standards
- City of West Lafayette Sewer Standards, Specifications & Details – Latest Edition
- Indiana Department of Environmental Management (IDEM) Regulations in Indiana Administrative Code, Title 327 – Water Pollution Control Division
- Indiana Plumbing Code
- Indiana Fire Code
- National Sanitation Foundation Standards 60 and 61.
- New Specifications: In the event new editions supersede any of the herein mentioned standards, the latest edition shall apply.

1.3 Storm Sewer Design Conditions:

1.3.1 The condition of existing sewer systems must be verified for each project. Purdue will televise upon request.

1.3.2 A&E Consultants are to provide peak and average daily storm sewer design flows for each project. These flows will be input into the campus storm water model. AE to review model to understand any capacity issues for the project area.

1.3.3 Purdue University Campus has implemented NPDES Phase II Storm Water Standards on all campus projects.

1.3.4 Current West Lafayette Storm Water Ordinance requirements and Technical Standards shall be implemented in the design and construction of all site development. http://www.westlafayette.in.gov/department/division.php?structureid=93

1.3.5 The A&E Consultants are responsible for filling out all required permit forms and filling out the Notice of Intent for the project.

1.3.6 The NPDES Best Management Practices shall be evaluated to improve storm water runoff quality and reduce quantity to the receiving storm water collection system. Provide post construction design flows for use in updating the Purdue Storm Water flow model.

1.3.7 For parking garages, the top exposed deck may drain directly to the storm sewer, but the covered decks must pass thru an oil-water separator before discharging to the storm sewer system.

1.3.8 Drainage structures shall be designed to handle at least H20 Highway Traffic loading as a minimum.

1.3.9 Separation of water mains and sewers shall meet the requirements of IAC 327.

1.3.10 Manholes are to be installed at all changes of direction.

1.3.11 Bench walls and flow lines shall be installed where necessary to ensure proper flow through the manhole.

1.3.12 All pipes entering a manhole shall be detailed such that shear planes are eliminated.

1.3.13 Sewers shall slope in accordance with the following table:

<table>
<thead>
<tr>
<th>Sewer Size</th>
<th>Minimum Slope (feet per 100 feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8”</td>
<td>0.45</td>
</tr>
<tr>
<td>10”</td>
<td>0.33</td>
</tr>
<tr>
<td>12”</td>
<td>0.27</td>
</tr>
<tr>
<td>15”</td>
<td>0.20</td>
</tr>
<tr>
<td>18”</td>
<td>0.17</td>
</tr>
<tr>
<td>24”</td>
<td>0.12</td>
</tr>
<tr>
<td>30” – 48”</td>
<td>0.10</td>
</tr>
</tbody>
</table>

1.3.14 Consult Utilities Engineering if an application is believed to be outside of these conditions.
2 Materials & Equipment

2.1 Piping Materials

2.1.1 Storm sewers shall be Reinforced Concrete Pipe (RCP), PVC plastic or Ductile Iron as determined with Utilities Engineering. Typically storm sewers shall be ductile iron up to 12" diameter and shall be RCP for 12" and larger.

2.1.2 Reinforced Concrete Pipe (RCP): ASTM C76, Class III in grassy areas and Class IV in paved areas. Joints for circular concrete sewer pipe shall utilize rubber gaskets (ASTM C443).

2.1.3 Ductile Iron Pipe: AWWA C151 Thickness Class 50 with Push-On Joints conforming to AWWA C111.

2.1.4 PVC: ASTM D3034 SDR 35 is suitable for depths up to 15 ft., and SDR 26 for depths greater than 15 ft. Joints shall be gasketed. In some situations, SDR 25 water grade PVC is allowed.

2.2 Manholes & Catch Basins

2.2.1 Manholes and catch basins shall be constructed of ASTM C478 precast reinforced concrete sections. Joining of pipes to new manholes shall be made thru rubber gaskets cast integrally in the manhole wall and located as required.

2.2.2 Castings shall be grey iron unless otherwise indicated. Manhole frame and lid shall be heavy duty with appropriate designation cast in lid.

2.2.3 A Fish logo and the message “Dump No Waste, Drains to River” shall be cast into every storm casting. See West Lafayette City Standards.

2.2.4 Furnish and install manhole steps meeting the requirements of OSHA for all manholes and catch basins. Steps shall be cast in the concrete.

2.2.5 Provide smooth transition at bottom of manhole where invert are at different elevations.

2.2.6 Coat exterior of manholes per West Lafayette Recommendations.

2.2.7 Downspout boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48 Class 30B or 35B.

2.2.8 Preferred Manufacturers
   - East Jordan
   - Neenah

3 Installation Guidelines

3.1 Piping

3.1.1 Sewers shall be laid with a minimum slope as noted on the drawings. All sewer grades and pitch shall be established by use of a surveyor’s level and a uniform grade provided in all sewers.

3.1.2 All work shall be in accordance with utility company and OSHA regulations.

3.1.3 All sewer pipe shall be laid to the lines and grades as shown on the Drawings, unless otherwise directed by the Superintendent. All pipes shall be bedded firmly on compacted bedding, carefully trimmed to fit the bottom of the pipes for first class pipe laying method. No blocking under pipes will be permitted.

3.1.4 The supporting strength of the pipe is dependent upon the foundation and trench width. To develop normal strength, the pipe shall have a firm uniform foundation under the lower quadrant of the barrel.

3.1.5 All pipes and fittings shall be carefully inspected before being laid and no cracked, broken, or defective pipe or fittings shall be used in the work. All pipe shall be laid with the bell ends upstream. The spigot shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom of the pipes and so that there is a uniform joint space all around. Fill all voids under the bell after the joint is made and before backfilling.

3.1.6 The interior of the sewer shall, as the work progresses, be cleared of all dirt and superfluous materials of every description. During the process of the laying, care shall be taken to protect pipes from disturbance, and the trench shall be kept free from water. All debris shall be promptly and completely removed from the interior of the pipes.

3.1.7 The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe laying is stopped for any reason.

3.1.8 Make connections to new and existing manholes and sewers as approved by the Project Manager. All connections shall be made with properly engineered adapter fittings, gaskets, or cast-in connectors to result in a sealed connection to the manholes.
3.1.9 Field cutting into pipe shall not be permitted. Pipe connections to existing pipe and manholes must be provided. Wyes for branch connections must be provided.

3.1.10 Each pipe section shall be handled into its position in the trench only in such a manner and by such means as approved. The Contractor will be required to furnish slings, straps and other approved devices for support and proper handling of the pipe.

3.1.11 Provide at least 30" of cover over the top of the pipe before the trench is wheel loaded. Provide at least 48" of cover before using mobile trench compactors of the hydrohammer or impactor type.

3.1.12 Revise and reset all existing manholes and catch basins, in the area of work as required to meet the grades shown.

3.2 Manholes & Catch Basins

3.2.1 Construct and install manholes, catch basins and other appurtenances as shown on the Drawings to suit invert elevations and with tops to suit final grades.

3.2.2 Where new manholes are located over existing sewers, remove existing sewer pipe as required to install new manholes and make connections with new pipe and fittings as required.

3.2.3 Seal all manholes water tight, per West Lafayette Standards.

4 Testing Guidelines

4.1 Perform all testing in accordance with local requirements.

4.2 Test piping systems prior to concealment. Keep written field records of all tests. Each record shall contain, as a minimum, the date of the test, system or subsystem tested, test medium and pressure, duration of test, test results, name and signature of individual performing test, and the name and signature of witness to the test.

4.3 All tests must be done to the satisfaction of the Owner’s representative and local authorities having jurisdiction, before covering. It shall be the responsibility of the Contractor to properly notify the Owner’s Representative and local authorities before the work is tested. Testing shall be performed at a time mutually agreed upon.

4.4 Furnish all instruments required for testing. Contractor shall be responsible for furnishing all equipment, plugs and water necessary for the required tests and for proper disposal of the water upon completion of the tests.

4.5 Any visible leakage or appreciable pressure drop during the test will cause for rejecting the test. Additional tests will be required after corrective measures have been taken until satisfactory results are obtained.

4.6 All storm sewers constructed of PVC will be subject to a 5% go/no-go mandrel deflection test conforming to 10 State Standards and IDEM standards.

4.7 Test all storm sewers with standing water test of 10 ft. Water level at the top of the test head shall not drop for at least 15 minutes.

4.8 All storm sewers will be subject to a low pressure air test conforming to ASTM F1417 standard.

4.9 Storm sewer manholes shall be air tested according to ASTM C1244. Standard test method for concrete sewer manholes shall be the negative air pressure (vacuum) test. Manhole vacuum tests shall include installed casting.

4.10 All storm sewers are to be televised using West Lafayette standards. A copy of the tape or CD and printed report shall be given to the owner.

4.11 No storm discharge shall be allowed into newly constructed mains until the 30 day settlement period has expired, all testing and structure inspections have been completed and passed, and a certified copy of the as-built has been given to the owner without prior approval of the owner.

4.12 Reports shall use typical NASSCO sewer standards but be aware that Utilities Engineering has jurisdiction. Reports shall include:

- Compaction and density
- Excavation and backfill for Utilities
- All quality control tests including:
  - Air pressure/water leakage tests
  - Televising of the sewers
  - Mandrel/deflection tests
5 Rejection of Construction

5.1 Unacceptable conditions will be corrected by the contractor at no additional cost to Purdue, including but not limited to:

- Cracked or faulty pipe
- Debris in line
- Excessive gaps at joints
- Rolled joint gaskets
- Protruding taps
- Improper pipe repair
- Misaligned or deformed pipe
- Root infiltration
- Infiltration or exfiltration
- Failure of air test
- Failure of mandrel test
- Failure of vacuum test