

SECTION 7- STORM SEWER

7.1.	STORM SEWERS.....	7-1
7.2.	SUMP DRAINS.....	7-3
7.3.	CATCH BASINS.....	7-3
7.4.	MANHOLES.....	7-4
7.5.	STORM SEWER CALCULATIONS.....	7-4
7.6.	CULVERTS AND BRIDGES.....	7-5
7.7.	OPEN CHANNELS.....	7-6
7.8.	TRENCH EXCAVATION.....	7-6
7.9.	PIPE BEDDING.....	7-7
7.10.	LAYING PIPE.....	7-8
7.11.	BACKFILLING PIPELINE TRENCHES.....	7-8
7.12.	SETTLEMENT OF TRENCHES.....	7-9
7.13.	RESPONSIBILITY FOR MAINTENANCE.....	7-9

7.1. STORM SEWERS.

- 7.1.1. Storm sewers shall be designed such that they will not surcharge from runoff caused by the 10-year, 24-hour storm. The hydraulic grade line (HGL) of the storm sewer shall be below the gutter flow line of the overlying roadway throughout its entire length; or below the top of drainage structures outside the roadway, during a 25-year, 24-hour storm. HGL checks shall also be performed and submitted for 25-year events. The system shall be designed to handle the flow from the contributory area within the proposed development.
- 7.1.2. Stormwater systems shall be designed to accommodate sump drain systems.
- 7.1.3. Existing stormwater management features are to be shown a minimum of 250 feet downstream of the proposed development unless the ultimate outfall system is a lesser distance.
- 7.1.4. The minimum inside diameter of pipe to be used in public storm sewer systems shall be 12 inches.
 - 7.1.4.1. The minimum recommended pipe size for private stormwater systems is 12 inches.
- 7.1.5. The minimum slopes shown in Table 18 apply when designing storm sewer systems.

Table 18 - Minimum Slopes for Storm Sewer Systems

Sewer Size (In.)	Minimum Slope (%)
12	0.44
15	0.32
18	0.25
21	0.21
24	0.17
27	0.15
30	0.13
36	0.10
42	0.08
48	0.07
54	0.06
60	0.05
72	0.04
78	0.04
84	0.03
90	0.03
96	0.03

- 7.1.6. In all practical cases, storm sewers shall meet crown-to-crown in manholes.
- 7.1.7. All piped storm sewer systems shall be designed and constructed to produce a minimum velocity of 3.0 feet per second (fps) when flowing full. No storm sewer system or portion thereof shall be designed to produce velocities in excess of 12 fps, unless approved by the City Engineer.
 - 7.1.7.1. On a case-by-case basis, the City Engineer will review situations where flow velocities need to exceed 12 fps, however in such a case, the outlet ends shall have sufficient energy dissipaters and erosion protection to maintain downstream safety and erosion control.
- 7.1.8. Table 19 lists the maximum spacing that shall be used when locating access structures of any type.

Table 19 - Maximum Structure Spacing

Pipe Size	Structure Spacing
12 to 21 inches	300 feet
24 inches and larger	400 feet

- 7.1.9. All storm sewer systems shall be designed to account for the tailwater elevation of the receiving facility or body of water. The tailwater elevation used shall be based on the design storm frequency.
- 7.1.10. Only the following pipe materials shall be acceptable for use as public storm sewer pipe:
 - 7.1.10.1. ODOT Item 706.02 Gasketed reinforced concrete pipe.
 - 7.1.10.1.1. Pipe class shall be as per ODOT guidelines.
 - 7.1.10.1.2. Required for all pipes located in the Public Right-of-Way.
 - 7.1.10.1.3. Gaskets shall be in accordance to ODOT Item 706.11
 - 7.1.10.2. ODOT Item 707.33 (ADS N-12 type) smooth interior double-walled corrugated polyethylene pipe may be allowed only when the following conditions are met:
 - 7.1.10.2.1. Pipes outside of the Public Right-of-Way.

- 7.1.11. Unless otherwise approved by the City Engineer, the minimum cover for storm sewers within the right-of-way shall be three feet measured from the bottom of underdrain at the back of curb to the top outside of pipe. Should underdrains not be required or present, the minimum cover shall be three feet measured from the top of subgrade at the back of curb to the top outside of pipe. Outside rights-of-way, a minimum two feet of cover shall be provided measured from the top of finished ground surface to the top outside of pipe.
- 7.1.12. The inverts of all curb inlets, manholes, yard inlets, and other structures shall be formed and channeled to minimize turbulence.
- 7.1.13. Storm inlet or catch basin grates shall be of a type designed to permit safe crossing by bicycles as approved by the City Engineer.
- 7.1.14. The maximum distance for overland flow shall be 300 feet before entering a storm water structure; except that, in no case shall the maximum overland drainage area tributary to the storm water structure be greater than 1.5 acres.
- 7.1.15. The maximum spacing of curb inlets shall be the spacing that limits the spread of water flowing in the gutter to not more than the maximum permissible spread according to ODOT Drainage Design Manual, Volume Two, or 300 feet whichever is smaller.
- 7.1.16. Full headwalls are required at all storm sewer inlets and outlets to and from open channels, lakes, or other bodies of water. In some cases, half-height headwalls may be permissible. This will be reviewed on a case-by-case basis.
- 7.1.17. Prior to final acceptance, a video inspection of all storm sewers shall be conducted at the Contractor's expense by a professional inspection firm in accordance with the requirements set forth in Section 2.13. Copies of all video and written reports shall be provided to the City of Lebanon for review and approval prior to the acceptance of the improvements or the release of bonds.

7.2. SUMP DRAINS

- 7.2.1. Sump drains shall be provided in all residential developments and in commercial and industrial developments where deemed necessary by the City Engineer.
- 7.2.2. Sump drains shall be placed approximately one foot (1') behind the back of curb.
- 7.2.3. All sump drains shall be tied in to the nearest storm sewer structure. Sump drains shall not be tapped into storm sewer pipe unless the appropriate tapping saddle is used.
- 7.2.4. Sump drains shall be constructed of gasketed SDR-35 PVC pipe as described in Section 4.5.5.
- 7.2.5. Individual taps into the sump drain system shall be performed utilizing the appropriately sized gasketed PVC tee fitting.
- 7.2.6. Cleanouts shall be provided at the upstream end of the sump drain system, at 150 foot intervals and at all bends. Cleanouts shall be provided with a cleanout cover marked "Drain Cleanout". The cleanout cover shall be Model 1578 manufactured by East Jordan Iron Works, Model R-1976 manufactured by Neenah Foundry Company, or approved equal. Cleanout cover shall be installed flush with finished grade.
- 7.2.7. The following pipe sizes shall be utilized for sump drain systems:
 - 7.2.7.1. Four inch (4") for a sump drain to serve an individual structure.
 - 7.2.7.2. Eight inch or greater (≥ 8 ") for systems that will serve more than one structure.

7.3. CATCH BASINS

- 7.3.1. All catch basins shall be precast concrete.

- 7.3.2. Bottoms of catch basins shall be formed and channelized using concrete. Mortar is not acceptable.
- 7.3.3. Concrete collars shall be provided at all pipe penetrations.
- 7.3.4. All castings and grates shall be grey or ductile iron and shall be in accordance with ODOT Standards.
- 7.3.5. All castings shall have the standard fish logo stating “Dump No Waste Drains to Waterways” cast in raised letters on the top.
- 7.3.6. Curb inlets shall be ODOT CB-3 or CB-3A (regular or modified) unless otherwise approved by the City Engineer.
- 7.3.7. Field inlets shall be ODOT Standard types and shall be appropriately sized for the pipe sizes involved and for anticipated flows.

7.4. MANHOLES

- 7.4.1. Manholes shall be of the pre-cast concrete type. Manhole lift holes and grade adjustment rings shall be sealed with non-shrinking grout or other material approved by the City of Lebanon. Refer to the standard drawing found in the Appendix.
- 7.4.2. Inlet and outlet pipes shall be joined to the manhole with a gasketed, flexible, watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.
- 7.4.3. Concrete collars shall be provided at all pipe penetrations.
- 7.4.4. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.
- 7.4.5. Manholes shall be installed: at all changes in grade, size or alignment; at all intersections; and at distances not greater than 300 feet for sewers 30 inches or less, or as approved by the City Engineer. Greater spacing may be permitted in larger sewers.
- 7.4.6. The minimum diameter of manholes shall be 48 inches (48”). Larger diameter manholes are preferable for large diameter sewers. A minimum access diameter of 24 inches (24”) shall be provided.
- 7.4.7. The flow channel straight through a manhole shall be made to conform as closely as possible in shape and slope to that of the connecting sewers. The channel walls shall be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers. Only concrete shall be used in forming the bottom channel. Mortar is not acceptable
- 7.4.8. A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench shall be sloped no less than ½ inch per foot (4 percent).
- 7.4.9. Manhole steps shall be constructed and installed as shown in the Standard Drawings.
- 7.4.10. Only concrete grade rings shall be used. Plastic grade rings are not permitted.
- 7.4.11. Adjustable riser rings shall not be used on new manholes. Adjustable riser rings shall only be used on existing manholes with written permission from the City Engineer.

7.5. STORM SEWER CALCULATIONS

- 7.5.1. Storm sewer calculations shall be provided for all storm sewer systems. Calculations shall be conducted in the format shown in the appendix to this chapter.
- 7.5.2. The following Manning’s ‘n’ values shall be used for stormwater calculations for public systems:

Reinforced concrete pipe	0.013
Closed profile ADS pipe	0.013

- 7.5.3. Mannings ‘n’ values for pipes in private storm sewer systems shall be documented and are subject to review and approval by the City Engineer.
- 7.5.4. Manning’s ‘n’ values for existing pipe types not listed in Paragraph 7.5.2. are subject to the approval of the City Engineer.
- 7.5.5. The hydraulic grade line for the storm sewer system shall be computed with consideration for each of the following:
- 7.5.5.1. the design tailwater on the system as defined in the Stormwater Management Plan,
 - 7.5.5.2. energy losses associated with entrance into and exit from the system,
 - 7.5.5.3. friction through the system,
 - 7.5.5.4. turbulence in the individual manholes, catch basins, and junctions within the system.

7.6. CULVERTS AND BRIDGES

- 7.6.1. Roadway stream crossings other than bridges shall be designed to convey the stream's flow for the 100-year, 24-hour storm such that the flow does not encroach upon the roadway pavement in accordance with the ODOT Location and Design Manual, Volume 2.
- 7.6.1.1. In the case of a one-way in/one-way out development, the roadway shall be treated as a freeway with limited access for the design year frequency selection.
- 7.6.2. The minimum inside diameter of pipes to be used for culvert installations under roadways, driveway crossings, or at any other required location shall be 15 inches.
- 7.6.3. The allowable maximum slope shall be a slope that produces a 10-fps velocity within the culvert barrel. Erosion protection and/or energy dissipaters shall be required to properly control entrance and outlet velocities.
- 7.6.4. All culvert installations shall be designed with consideration for the tailwater of the receiving facility or body of water. The tailwater elevation used shall be based on the design storm frequency.
- 7.6.5. The allowable headwater of a culvert installation shall be set by the designer to achieve an economical installation. When end walls are used, the headwater shall not exceed the top of the end wall at entrance. If calculations show that the top of the end wall is unavoidably inundated, special protection of the roadway embankment and/or ditch slope will be necessary for erosion protection.
- 7.6.6. The determination of the required size of a culvert installation may be accomplished by mathematical analysis or by the use of design nomographs.
- 7.6.7. Headwalls are required at all culvert inlets and outlets.
- 7.6.8. The minimum cover for culverts within the right-of-way shall be two feet measured from the bottom of underdrain at the back of curb to the top outside of pipe. Should underdrains not be required or present, the minimum cover shall be two feet measured from the top of subgrade at the back of curb to the top outside of pipe. Outside street rights-of-way, a minimum two feet of cover shall be provided measured from the top of finished ground surface to the top outside of pipe.
- 7.6.9. The structural design criteria for culverts and bridges shall be the same as that required by the Ohio Department of Transportation.

- 7.6.10. Bridges shall be designed so that the hydraulic profile through the bridge shall be one foot (1') below the bottom chord of the bridge for either the 100-year, 24-hour storm, or the 100-year flood elevation as determined by FEMA, whichever is more restrictive.

7.7. OPEN CHANNELS

- 7.7.1. Open channels shall be designed with erosion protected banks designed to carry the 10-year, 24-hour stormwater runoff from contributing upstream areas. The City Engineer may increase the design storm should conditions require it.
- 7.7.2. Channels within FEMA floodplains shall be designed according to the requirements of Chapter 1308 of the Lebanon Code of Ordinances.
- 7.7.3. Together with the other requirements contained in this chapter, all open channels shall be designed with one foot of freeboard above the design water surface elevation of the open channel flowing full.
- 7.7.4. Flood relief channels shall be designed to convey the runoff from the 100-year, 24-hour storm, so that a positive discharge of this runoff to an adequate receiving stream or conveyance system results, without encroachment into proposed or existing residential dwellings, places of business, other significant or valuable buildings or structures, or historical or environmentally sensitive areas.
- 7.7.5. The City Engineer may require that roadside ditches along existing roadways be enclosed, if ODOT standards for safety and maintenance cannot be satisfied.
- 7.7.6. The City of Lebanon assumes no legal obligation for the maintenance and upkeep of open channels. The maintenance and upkeep of open channels within developments shall be the responsibility of the Development (HOA, etc.). If no HOA exists, the maintenance and upkeep of open channels shall be the responsibility of the property owner.

7.8. TRENCH EXCAVATION

- 7.8.1. Unless specifically directed otherwise by the City Engineer, not more than 500 feet of trench shall be opened ahead of the pipe laying work of any one crew and not more than 500 feet of open ditch shall be left behind the pipe laying work of any one crew.
- 7.8.2. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged. Excavated materials shall be disposed of so as to cause the least interference.
- 7.8.3. Trenches in which pipes are to be laid shall be excavated via open cut to the depths shown on the approved plans. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus eight inches (8"). Where rock is encountered, it shall be removed to a minimum depth of four inches below the pipe bells.
- 7.8.4. Unless specifically authorized by the City Engineer, trenches shall in no case be excavated or permitted to become wider than two feet six inches (2' - 6"), plus the nominal diameter of the pipe at the level of or below the top of the pipe.
- 7.8.5. All excavation materials shall be placed a minimum of two feet (2') back from the edge of the trench.
- 7.8.6. Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed to provide safe working conditions and to prevent damage of work.
- 7.8.7. It is the Contractor's sole responsibility to maintain safe working conditions on the job site and to conform to "Specific Safety Requirements Relating to Construction of the Industrial Commission

of Ohio", "Construction Safety and Health Regulations, Part 1926, Subpart P "Occupational Safety and Health Administration, U. S. Department of Labor, and all local laws, ordinances, and regulations.

7.8.8. Trenches shall be kept free of water during the laying of pipe until the pipeline has been backfilled.

7.8.9. Obstructions

7.8.9.1. In cases where storm sewers, sanitary sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced or disturbed unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible.

7.8.10. Shoring, Sheeting, and Bracing

7.8.10.1. The shoring, sheeting and bracing of excavations shall be performed by the Contractor in compliance with applicable safety codes and OSHA requirements.

7.8.10.2. Where unstable material is encountered or where the depth of excavation in earth exceeds five feet (5'), the sides of the trench or excavation shall be supported by substantial sheeting, bracing and shoring, or the sides shall be sloped to the angle of repose. Sloping the sides of the ditch to the angle of repose will not be permitted in streets, roads, narrow rights-of-way or other constricted areas unless otherwise specified. The design and installation of all sheeting, sheet piling, bracing and shoring shall be based on computations of pressure exerted by the materials to be retained under construction conditions. Adequate and proper shoring of all excavations shall be the entire responsibility of the Contractor; however, the City Engineer may require the submission of shoring plans (accompanied by supporting computations) for review prior to the Contractor undertaking any portion of the work. Submitted plans shall be signed and stamped by a Professional Engineer registered in the State of Ohio.

7.8.10.3. Excavations to be made below the depth of an existing foundation, shall be supported by shoring, bracing or underpinning as long as the excavation shall remain open, or thereafter if required to insure the stability of the structure supported by the foundation. The Contractor shall be held strictly responsible for any damage to said foundation.

7.8.10.4. Solid sheeting will be required for wet or unstable material.

7.8.10.5. Care shall be taken to avoid excessive backfill loads on the completed pipelines. The requirements that the width of the ditch at the level of the crown of the pipe be no more than two feet six inches (2' - 6") plus the nominal diameter of the pipe shall be strictly observed.

7.8.10.6. Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.

7.8.10.7. All sheeting, planking, timbering, bracing and bridging shall be placed, renewed and maintained as long as necessary.

7.9. PIPE BEDDING

7.9.1. All storm sewer pipe shall be bedded in accordance with the standard detail contained in the Appendix.

7.9.2. In all cases, the foundation for storm sewer mains shall be prepared so that the entire load of the backfill on top of the sewer pipe will be carried on the barrel of the pipe so that none of the load will be carried on the bells.

7.9.3. The depth at the bottom of the bells of the pipe will be at least four inches (4") above the bottom of the trench as excavated. Supporting of sewer pipe shall be as set out herein, and in no case shall the sewer pipe be supported on blocks.

7.10. LAYING PIPE

- 7.10.1. All pipe shall be laid with ends abutting true to line and grade as shown on the plans. Supporting of pipe shall be as specified under 4.10. specified herein and in no case shall be supported on blocks.
- 7.10.2. Fittings for the sewer mains shall be provided and placed as shown on the plans. All open ends of pipes and branches shall be sealed or plugged.
- 7.10.3. Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned and inspected for defects. Any piece of pipe or fitting which is known to be defective shall not be laid or placed. Any defective pipe or fitting discovered after the pipe is laid shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth edge at right angles to the longitudinal axis of the pipe.
- 7.10.4. Granular bedding material as specified herein, shall be used to correct irregularities in the earth trench subgrade.
- 7.10.5. The interior of the pipe shall be maintained clean. When laying pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plug fitted into the pipe bell, so as to exclude earth or other material.
- 7.10.6. No backfilling (except for securing pipe in place) over pipe will be allowed until the City of Lebanon has made an inspection of the joints, alignment and grade in the section laid.
 - 7.10.6.1. Inspections shall not relieve the Contractor of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are identified later.
- 7.10.7. Upon the completion of a section of storm sewer, inverts and slopes shall be checked and the results shall be provided in writing to the City of Lebanon. The information, at minimum, shall include:
 - 7.10.7.1. Upstream junction information (manhole number, etc.)
 - 7.10.7.2. Upstream plan invert
 - 7.10.7.3. Upstream installed invert
 - 7.10.7.4. Downstream junction information (manhole number, etc.)
 - 7.10.7.5. Downstream plan invert
 - 7.10.7.6. Downstream installed invert
 - 7.10.7.7. Plan Slope
 - 7.10.7.8. Installed Slope
 - 7.10.7.9. Pipe Material
 - 7.10.7.10. Bedding Material
 - 7.10.7.11. Backfill Material
 - 7.10.7.12. Contractor certification indicating that the information shown is true and correct.

7.11. BACKFILLING PIPELINE TRENCHES

- 7.11.1. All backfilling shall be accomplished in accordance with the details shown on the Standard Drawings and the requirements of this Section. Any variances must be approved in writing by the City Engineer.
- 7.11.2. When directed by the City of Lebanon, the Contractor shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is compacted. The Contractor shall obtain a

compaction of the backfill of at least 95 percent of standard Proctor density (ASTM D698) where mechanical compacting of backfill is required. Copies of all testing reports shall be provided to the City Engineer.

- 7.11.3. In all cases, walking or working on the completed pipelines except as may be necessary in compacting or backfilling will not be permitted until the trench has been backfilled to a point one foot (1') above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

7.12. SETTLEMENT OF TRENCHES

- 7.12.1. The Contractor shall be responsible for any trench settlement that occurs within two years from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the Contractor. Repair of settlement damage shall meet the approval of the City of Lebanon.

7.13. RESPONSIBILITY FOR MAINTENANCE

- 7.13.1. Prior to formal acceptance of the Improvements by the City of Lebanon, the Contractor and/or Owner/Developer shall be responsible for the maintenance and repair of the Improvements in compliance with these specifications for a period of two years after construction completion and acceptance by the City of Lebanon.

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