

**ENGINEERING DESIGN STANDARDS**

**FOR**

**PUBLIC IMPROVEMENTS TO THE  
WATER DISTRIBUTION SYSTEM,  
SANITARY COLLECTION SYSTEM AND  
STORM WATER COLLECTION SYSTEM**

**AND**

**REQUIREMENTS FOR STORM WATER MANAGEMENT  
AND EROSION CONTROL**



**City of Dayton  
Department of Water  
Division of Water Engineering  
320 West Monument Avenue  
Dayton, Ohio 45402  
(937) 333-3725**

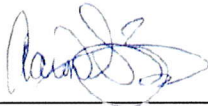
**October 2020**

## INTRODUCTION

These design standards, in conformance with established practice by the City of Dayton, apply to all commercial, residential, multi-family developments, and capital improvements involving the construction, modification, addition, or removal of public infrastructure including, but not limited to the water distribution system, sanitary collection system, storm water collection system, storm water management and erosion control (both temporary and permanent).

It should be used in conjunction with City of Dayton Construction and Material Specifications (latest edition). All plans and calculations prepared for signature or review by the Department of Water shall be prepared by a professional engineer licensed in the State of Ohio.

APPROVED:



\_\_\_\_\_  
Aaron Zonin, P.E., Deputy Director  
Division of Water Engineering

12/08/2020

Date



\_\_\_\_\_  
Michael Powell, Director  
Department of Water

12/08/2020

Date

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## SECTION 1 – General Requirements

The following are general construction plan requirements that need to be adhered to for Department of Water review and approval.

### **Section 1.1 Review and Approval:**

1. The Department of Water’s approval is subject to conditions imposed by the Ohio Environmental Protection Agency for all applicable facilities. The Developer or contractor shall be responsible to obtain all necessary permits including but not limited to Ohio EPA Permit to Install (PTI) and Notices of Intent (NOI), City of Dayton Building Permits, U.S. Army Corps of Engineers 401/404 permits, etc.
2. Approval of plans signed by the Department of Water shall become void if construction has not commenced within twelve (12) months from the date approved. In addition, the plans shall become void if construction is not completed within two (2) years from the date approved.
3. All public improvement plans for sanitary sewer, storm sewer, and water shall be submitted and approved prior to approval of any private improvement plans. In addition, the following requirements must be met:
  - a. Signed, notarized easement deeds
  - b. Executed record plan approval.
  - c. Street cut permit
  - d. OEPA approval or verification of plan submission and review fee paid
  - e. Waiver letter signed by owner/developer
  - f. OEPA Sanitary PTI application
  - g. OEPA water supply data application
4. All public improvements involving the construction, modification, addition, or removal of public infrastructure including, but not limited to: water mains, sanitary sewers, and storm sewers shall be submitted for review and approval to: Department of Water, Division of Water Engineering, 320 West Monument Avenue, Dayton, Ohio 45402. Phone (937) 333-3725. Fax (937) 333-6768, or may be emailed to [waterplanreview@daytonohio.gov](mailto:waterplanreview@daytonohio.gov)
5. All private improvements involving the construction, modification, addition, or removal of detention/retention facilities and erosion and sedimentation pollution control plans shall be submitted for review and approval to: One Stop Permit Center, 371 West Second Street, Dayton, Ohio 45402. Additional information regarding the building permit process can be obtained by contacting the One Stop Permit Center at (937) 333-6804.
6. The Department of Water, Division of Water Engineering recommends that prior to any submittal involving either public improvements or private improvements the applicant contact Water Engineering at 333-3725 or [waterplanreview@daytonohio.gov](mailto:waterplanreview@daytonohio.gov) to arrange a “pre-submittal” meeting to discuss proposed plans and submittal procedures.
7. At the time of construction plan approval and signature by the Department of Water, the engineer of record shall provide to the Department of Water an electronic file of those

improvements approved. The electronic file shall be in Micro Station, AutoCAD or DXF accessible format. Digital files may be delivered via CD-Rom or e-mail.

8. Any deviation from approved plans and specifications or any design change shall be approved by the Department of Water before such changes are made. These revisions, not included on approved plans, shall be submitted well in advance of construction. Revised plans showing such changes shall be submitted before construction is to continue. Engineer of record shall be required to certify as-built condition of water, sanitary and storm inclusive of revised plans where needed.

**Section 1.2 General Construction Plan Requirements:**

1. The plans should be presented (scale and sheet size) so that the proposed improvements are clear and concise. They shall be drawn to scale that will permit all necessary information to be plainly shown. Generally, plans should not be larger than 30x42 inches.
2. Detail plans shall consist of: plan views, elevations, sections, and supplementary views, which together with the specifications and general layouts, provide the working information for the contract and construction of the facilities. Plan and profile for water mains, sanitary sewers, and storm sewers shall be shown on the same sheet.
3. All existing structures in the street or easement shall be shown in both plan and profile. Sizes, locations, dimensions, and elevations shall be included. All existing structures should be field located and incorporated into the proposed construction plans. Record information shall only be used as informational purposes and should not be included as part of the proposed construction plans.
4. The type of pipe material, joints, and strength shall be shown in the profile for water mains, sanitary sewers, and storm sewers using applicable specifications. A profile should be shown for all sanitary sewers, storm sewers, and large water services (3" and larger). The plan and profile should be shown on the same sheet.
5. The location, description, and elevation of all benchmarks used in connection with the project shall appear on the plans.
6. Proposed Construction Plans shall not have any objects, dimensions, elevations, grades, etc. crossed out. They must be erased from the drawing.
7. The construction plans shall include the names and contacts for all utility companies known to be located within the project limits.
8. Bearings and distance shall be based on and referenced to the State Plane Coordinate System. The references shall be physically tied into known survey control monuments (e.g., Montgomery County, City of Dayton, U.S. Geological Survey).
9. Any construction plans, specifications, or other documents approved by the Department of Water shall be constructed in accordance with all applicable state or federal permit requirements of the Ohio EPA, Ohio DNR, and/or U.S. Army Corps of Engineers. No construction activity shall commence prior to obtaining applicable permits from these agencies.

**Section 1.3 References:**

The following documents are referenced in the design standards.

- ADA Regulations 2.2.12
- ANSI
- ASTM Testing Standards
- AWWA
- City of Dayton Construction and Material Specifications
- City of Dayton Fire Department Specifications
- City of Dayton Public Works “Rules and Regulations for Making Openings in a Public Way”
- City of Dayton Sanitary Sewer Master Plan
- City of Dayton Storm Sewer Master Plan
- City of Dayton Water Master Plan
- City of Dayton Standards for Taps, Services, Meters, and Backflow Prevention
- Montgomery County Intensity Duration Frequency Curves
- Ohio Department of Transportation Standard Specifications
- Rainwater & Land Development, by Ohio DNR
- USGS Reports
- Ohio EPA Permit No. OHC000002 (Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System)

**SECTION 2 – Notes**

**Section 2.1 General Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval.

1. All existing utilities are shown in their approximate location according to the best available information. The contractor shall be required to field locate exact locations and elevations of existing underground utilities prior to setting grade and alignment. The City of Dayton and the Department of Water assumes no responsibility for the accuracy or depth of the underground facilities shown on the approved construction drawings. If damage is caused, the contractor shall be responsible for repair of the same and for any resulting contingent damage. The contractor shall assume responsibility for protection of all existing utilities during construction. All cost for locating, removing and replacing or relocating these utilities shall be incidental to construction. All utilities damaged during construction shall be repaired to the Utility Owner's satisfaction. The exact location of existing utilities shall be determined by hand digging.
2. Location, support, protection, and restoration of all existing utilities and appurtenances, whether or not shown on the approved construction drawings, shall be the responsibility of the contractor.
3. When unknown or incorrectly located underground utilities are encountered during construction, the contractor shall immediately notify the utility owner and the Department of Water.
4. All work shall conform to the City of Dayton, Construction and Material Specifications (latest edition).
5. No construction shall commence until City of Dayton permits have been issued as required.
6. All project orders (field or office), requests, changes, additions or deletions pertaining to public water main, storm sewer, and sanitary sewer facilities shall be only by direction or request of the Department of Water.
7. The contractor shall notify residents and businesses affected by street closures a minimum of 48 hours in advance of the actual street closing.
8. Roadway restoration within the City of Dayton corporation limits shall be done in compliance with the Department of Public Works "Rules and Regulations for Making Openings in a Public Way" (latest edition).
9. Forty-eight hours prior to any construction, excavation or digging, the contractor shall call and notify the Ohio Utilities Protection Services (OUPS) at 1-800-362-2764. All other agencies, which might have underground utilities in this area and are not members of OUPS, shall be notified directly by the contractor.
10. Approval of plans by the Department of Water does not relieve the designer, owner, or person in control of the property from liability for injury to persons or property.

11. Approval of the plans shall become void if construction has not commenced within twelve (12) months from the date approved by the Department of Water. In addition, the plans shall become void if construction is not completed within two (2) years from the date approved by the Department of Water.
12. All fills (including trench bedding and backfill) intended to support a water main, sanitary sewer, storm sewer or drainage channel shall be compacted to not less than 90% maximum density (Modified Proctor Test ASTM D1557), unless otherwise noted. Field verification and formal result submittals may be requested (as necessary) by the Department of Water.
13. In addition to the notes on this sheet, contractor's attention shall be directed to the notes on the attached sheets as well.
14. Compacted fills are to be made to a minimum of three feet above the crown of any proposed water line, sanitary or storm sewer lines prior to cutting of trenches for placement of said lines. All fills shall be controlled, compacted and inspected.

**Section 2.2 Water Distribution System Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval.

1. Water mains, bends and fittings shall be ductile cast iron pipe and conform to ANSI A-21.51 (AWWA C151), class 51 (unless otherwise noted).
2. Thrust Blocks are required at all Fittings.
3. The length of restrained joint requirements are indicated on each plan and profile sheet.
4. Welding of pipe and/or appurtenances is not permitted without written approval of the City of Dayton, Department of Water.
5. Water mains shall have a minimum cover of 4 feet, 6 inches. Water mains shall have a minimum of 10 feet horizontal separation (out-to-out) from any storm or sanitary sewer.
6. Water mains crossing any and all sewers shall have a minimum vertical separation of 18 inches between the outsides of the pipes (out to out). Also, one full length of water main pipe shall be centered at the point of crossing such that both joints will be of equal distant and as far from the sewer as possible. If water main crosses below sanitary sewers, the sanitary sewer must be water main material for that span.
7. Only City of Dayton personnel shall operate main line water valves within the Dayton Corporation Limits.
8. All valve-operating nuts shall be set at a maximum depth of 6 feet. The contractor shall furnish and install approved extensions as required.
9. The contractor shall be advised that any closure pieces or sleeves required to connect sections of the concrete main line or ductile iron connections, other than those specifically shown on the construction drawings, shall be at his expense.

10. All taps to existing water mains will be made by the City of Dayton at the contractor's expense. This work will include furnishing and installing the tapping sleeve and valve and making the tap. All other work including excavation, backfill, and restoration over the tapped main shall be by the contractor. Contact Water Engineering at (937) 333-3742.
11. Service connections shall not be made to the water main until the main line has been inspected, tested, disinfected and released for taps. All water service connections shall be a minimum of 1" diameter and minimum of 5/8" water meter and conform to the City of Dayton Standards for Taps, Services, Meters, and Backflow Prevention, (latest edition).
12. No water service branch shall be laid in the same trench with a sanitary sewer lateral.
13. Fire hydrants shall be located 3-feet from the face of the curb or edge of the pavement and 4-inch opening to face the street. Fire hydrants located within the walk must comply with ADA regulations.
14. No additions, deletions, or revisions to the water main are to be made without written approval by the Department of Water.
15. Department of Water personnel will inspect the water main installation.
16. All water main construction and material shall be in accordance with the City of Dayton Construction and Material Specifications (latest edition) and Department of Water Engineering Standards for Water, Sanitary Sewer, and Storm Sewer Facilities (latest edition).

**Section 2.3 Sanitary Collection System Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval.

1. *{Include sanitary sewer pipe/fittings specifications}*. [See City of Dayton, Construction and Material Specifications, (latest edition)].
2. *{Include sanitary sewer joint specifications}*. [See City of Dayton, Construction and Material Specifications, (latest edition)].
3. Sanitary Sewers shall conform to the following applicable ASTM Testing Standards:

<b>Item</b>	<b>Leakage Test</b>	<b>Deflection Test</b>
PVC-Corrugated	D3212	D2321
PVC – SDR 35	F1417	D2321
PVC-Composite	F1417	N/A
Vitrified	C828	N/A
Reinforced Concrete	C924	N/A
Concrete Manholes	C1244	N/A

4. The exfiltration or infiltration leakage test shall not exceed 50 gallons/inch/mile/day for any section of the system.
5. Sanitary manholes shall be equal to ASTM C-478, City of Dayton Type "A" manhole.

6. For sanitary manholes, joints between precast sections shall conform to ASTM C-443, "Joints for Circular Concrete Sewer and Culvert Pipe."
7. Where precast bases are used for sanitary manholes, pipe connections shall conform to ASTM C-923, "Resilient Connections for Reinforced Concrete Manhole Structures and Pipes".
8. Channel bottoms of all manholes.
9. All connections to existing sanitary manholes shall be made using a diamond core drill and the joint sealed with "Dura Seal" rubber gasket or approved equal.
10. Sanitary wye connections shall be factory fabricated
11. Roof drains; foundation drains or other "clean water" connections to the sanitary sewer system are prohibited.
12. Within the public Right-of-Way, all laterals to existing sanitary sewers will be installed by the City of Dayton at the contractor's expense. This work will include furnishing and installing the fittings and making the connection. All work including excavation, backfill, and restoration shall be by the contractor. Contact Water Engineering (937) 333-3742.
13. No additions, deletions, or revisions to the sanitary sewer are to be made without written approval by the Department of Water.
14. Department of Water personnel will inspect the sanitary sewer installation.
15. All sanitary laterals require inspection and a permit from the City of Dayton Division of Building Inspection.
16. All sanitary sewer construction and material shall be in accordance with the City of Dayton Construction and Material Specifications (latest edition) and Department of Water Engineering Standards for Water, Sanitary Sewer, and Storm Sewer Facilities (latest edition).

**Section 2.4 Storm Water Collection System Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval.

1. All storm sewers and catch basin laterals shall be Reinforced Concrete ASTM Specification Number C-76, Class 4 (unless otherwise noted).
2. Storm manholes shall be equal to ASTM C-478, City of Dayton Type "A" manhole.
3. Channel bottoms of all manholes.
4. All connections to existing storm sewer manholes shall be made using a diamond core drill.

5. All catch basins to be City of Dayton Type “3” or “3A” with “V” type grates (unless otherwise noted).
6. All field tile encountered shall be replaced or connected to the storm sewer system with approval from the City of Dayton, Department of Water.
7. No additions, deletions, or revisions to the storm sewer are to be made without written approval by the Department of Water.
8. Department of Water personnel will inspect the storm sewer installation within the public Right-of-Way or in an easement. The Division of Building Services will inspect all private storm sewer installations.
9. All storm sewer construction and material shall be in accordance with the City of Dayton Construction and Material Specifications (latest edition) and Department of Water Engineering Standards for Water, Sanitary Sewer, and Storm Sewer Facilities (latest edition).

**Section 2.5 Erosion Control Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval.

1. Forty-eight hours prior to any earth disturbing work, the contractor shall notify the Department of Water at (937) 333-3739 (Field Bureau).
2. Erosion and sediment control measures are to be placed prior to, or as the first step in, construction. Sediment control practices shall be applied as a perimeter defense against any transporting of silt off the site. All runoff resulting from construction operations must be filtered by approved methods prior to discharging to the storm sewer system.
3. All sediment and erosion control measures shall be inspected by the contractor and repaired once a week and after every ½” of rain. Records of such inspection shall be kept at the job site and be available for immediate review upon request.
4. In addition to any temporary erosion, sediment, and debris control details and notes shown on the plans, the contractor shall construct temporary sediment basins, earth dikes, temporary or permanent seeding, mulching and/or mulch netting or any other generally accepted methods to prevent erosion, mud and debris from being deposited on other property, on newly constructed or existing roads, or into existing sewers or new sewers within the development.
5. All ground surface areas that have been exposed or left bare as a result of construction and are to final grade and are to remain so shall be seeded and mulched as soon as practical. Disturbed areas that lie dormant for 21 days or more shall be seeded or protected within 7 calendar days of the disturbance. Other sediment controls that are installed shall be maintained until vegetative growth has been established. The contractor shall be responsible for the removal of all temporary sediment devices at the conclusion of construction but not before growth of permanent ground cover.
6. Until improvements in the development have been completed, the contractor shall take such measures as are necessary to prevent erosion of graded surfaces onto roadways, into

drainage courses, storm sewers, or onto adjoining land. For any earth disturbance or any development approved by the Department of Water, the contractor shall clean any mud or debris deposited on roadways, drainage courses, or adjoining property when the mud and debris originates from the earth moving operations.

7. All mud/dirt tracked onto roads from the site, due to construction, shall be promptly (within 24 hours) removed.
8. For development sites, erosion control measures shall be enforced on individual or residential lots. This shall include a construction entrance (refer to detail – ER-8) and silt fence across the frontage of each property and a temporary diversion ditch on each lot.
9. This project is subject to inspection by the Department of Water personnel for compliance with the City’s storm water ordinance during and after construction. This includes but is not limited to inspection of erosion control facilities, surface drainage, and detention/retention facilities. Additional measures may be required if violations of the ordinance occur and Water Department personnel deem it necessary. All measures shall comply with City of Dayton Standards and “Rainwater and Land Development, Ohio’s Standard for Storm water Management, Land Development, and Urban Stream Protection”, (latest edition).

**Section 2.6 Source Water Protection Notes:** The following notes shall be included, as applicable, on the construction plans submitted for Department of Water review and approval. Please contact the division of Environmental Management at 937-333-3725 with any questions you may have regarding the Source Water Protection Area, including the Total Maximum Daily Inventory noted below. Additional information is available at <https://www.daytonohio.gov/154/Source-Water-Protection-Program>.

The following notes shall be included on plans located within the 1-Year time-of-travel boundary (red line) on the source Water Protection Area Map available at <https://www.daytonohio.gov/154/Source-Water-Protection-Program>

- 1- **Pollution Prevention Statement:** Spills or releases of potential environmental contaminants will be immediately attended to, contained and cleaned up. A spill of any size will be reported to the Department of Water at 937-333-3725 or 937-333-4905. Spills greater than 25 gallons must be reported to the spill prevention hotline at 1-800-282-9378.
- 2- **Sensitive Water Resource Area Statement:** This project occurs within the City of Dayton Source Water Protection Area. The Total Maximum Daily Inventory (TMDI) of Regulated Substances is \_\_\_ pounds. The TMDI plus additional 400 pounds will not be exceeded during the construction phase of this project. The additional 400 pounds will be immediately removed after construction is completed and the TMDI will not be exceeded thereafter.

The following notes shall be included on plans located within the 5-Year time-of-travel boundary (green line) on the Source Water Protection Area Map available at <https://www.daytonohio.gov/154/Source-Water-Protection-Program>

- 1- Sensitive Water Resource Area Statement:** This project occurs within the Water Resource (WR) sensitive groundwater area of the City of Dayton.
- 2- Pollution Prevention Statement:** Spills or Releases of potential environmental contaminants will be immediately attended to, contained and cleaned up. A spill of any size will be reported to the Department of Water at 937-333-3725 or 937-333-4905. Spills greater than 25 gallons must be reported to the spill prevention hotline at 1-800-282-9378.

### SECTION 3 – Water Distribution System Requirements

All proposed water distribution system projects (including modifications to the existing system) require Water Department review/approval and signature. All water main installation shall be consistent with the current City of Dayton Water Master Plan.

The Department of Water requires that hydraulic calculations within new plats (or as Department of Water deems necessary) be submitted by the Developer/Engineer to determine if adequate pressures and flows can support both domestic and fire demands. All planned uses shall meet City of Dayton, Fire Department specifications for required fire flows.

The following requirements should be used when designing water distribution facilities within the City of Dayton:

- Main line extensions shall be sized to provide the required fire flow, but in no case shall be less than 8-inches in diameter.
- Water main shall be designed to limit vertical bends and horizontal bends (as much as practical given certain project constraints).
- All public water mains located outside the public “Right-of-Way” limits shall be included within a *minimum* 20-ft wide easement. The water main must be centered in the easement. Wider easements may be necessary on water mains exceeding 10-ft in depth. See Appendix A for example Deed of Easement.
- Water mains shall be installed across the entire frontage of the parcel affected/developed.
- All structures shall be a minimum distance of 10 ft from water mains. No structures shall be permitted within water main easements. Water mains shall have a minimum of 10 feet horizontal separation (out-to-out) from any storm or sanitary sewer.
- Fire Hydrants shall be connected only to water mains adequately sized to carry fire flows.
  - a. All fire hydrants shall be located not less than 3 feet from the back of curb (as shown within the standard drawing).
  - b. The maximum distance permitted on a fire hydrant branch is 50 feet.
  - c. No domestic service shall be connected to a fire hydrant branch.
  - d. Spacing between fire hydrants shall not exceed 500 feet in single-family residential development and shall not exceed 300 feet in multi-family residential, industrial, and commercial areas.
  - e. The City of Dayton, Department of Fire should be contacted to determine required fire flows or if additional requirements may be necessary
- The design engineer should provide details for thrust block and/or restrained joints as required by design and individual project constraints. Standard Drawings located within the appendix of this document should be used as *minimum* requirements for restrained joint lengths and thrust blocking.

- Dead ends shall be minimized by looping all public mains (when applicable). When dead ends are approved, they shall be provided with a fire hydrant for flushing purposes at end of line.
- Main line valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located at intersections, at not more than 500-foot intervals in commercial districts and not more than 800-foot in other districts. For 16” and larger transmission mains, valves shall be located at not more than 1,500-foot intervals.
- City of Dayton requires all valves “open right”. Valves shall be resilient wedge type and conform to AWWA C509 Standards.
- A description of the character of the soil through which water mains are to be laid shall be presented for Department of Water review when requested. Soils shall be evaluated using the “10-Point System” defined in Appendix A of ANSI/AWWA C105/A21.5 and the Appendix of ASTM A674. If soils are found to be aggressive, take necessary action to protect the water main, such as by encasement of the water main in polyethylene or providing cathodic protection.
- The approximate elevation of ground water in relation to subsurface structures should be evaluated.
- All water mains, including those not designated to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow.
- Sewer and water services must have 10 feet minimum horizontal separation. If this is not attainable, a minimum 12” vertical separation with the water service above the sewer service (shelved in trench). Fire and domestic water service lines must have a minimum 3 feet horizontal separation.
- Service lines shall not be installed such that they cross through one property to serve another. Service lines shall not cross property lines.

**SECTION 4 – Sanitary Collection System Requirements**

All proposed sanitary collection system projects (including modifications to the existing system) require Water Department review/approval and signature. All sanitary sewer installation shall be consistent with the current City of Dayton Sanitary Master Plan.

The Department of Water requires that hydraulic calculations within new plats (or as Department of Water deems necessary) be submitted by the Developer/Engineer to determine if existing and proposed facilities have adequate capacity for particular development uses.

The following requirements should be used when designing sanitary collection facilities within the City of Dayton:

- Minimum sewer slope:

Size (inch)	Minimum Slope (%)
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
33	0.046
36	0.041
42	0.037

- Main line extensions shall be a minimum of 8-inches in diameter
- Maximum distance between manholes shall be 400-ft.
- Manholes shall be located at all mainline intersections, and changes in line or grade.
- Sanitary laterals shall not connect directly to Manholes. Lateral connections to existing sanitary sewers shall be made by Sewer Maintenance.
- All main line sanitary sewers shall be located within the public Right-of-Way where practical. Otherwise, main line sewers shall be located within a minimum 20-ft wide easement. The sanitary sewer main must be centered in the easement. Wider easements may be necessary on sanitary sewer mains exceeding 10-ft in depth. See Appendix A for example Deed of Easement.
- Sanitary sewer mains at a slope greater than 20.0% must be constructed of appropriately lined Ductile Cast Iron (DCI) restrained joint pipe in accordance with the material

specification section with concrete anchors per OEPA sanitary sewer design and installation guidelines.

- The type of pipe numbers must appear on the plans and profiles. Also, the pipes shall be stamped prior to shipment for field activities.
- Sanitary sewers in newly developed areas should be designed for the estimated ultimate tributary population, except in considering parts of the systems that can be readily increased in capacity. OEPA recommended sewage flows should be used. Calculations shall be based on a 5 year, 6 hour design storm. In addition, City of Dayton Peak Flow Curves (Modified Tolles) (for residential) and CFS Per Acre (for commercial and industrial) should be used for sewage flows in areas that have been fully developed.
- Sanitary sewer mains shall be installed across the entire frontage of properties within areas that have potential for future public sanitary sewer service.
- The Water Department must accept sanitary sewers before any service connections are made.
- At the determination of the Water Department, the contractor may be required to perform a TV inspection of the sanitary sewer prior to final acceptance. This work shall be completed by the contractor at their expense.
- No sanitary sewer mains or laterals are to be located within 20 feet of any detention or retention basin, as measured from the top of the overflow elevation of any retention or detention area.
- Laterals shall not be installed such that they cross through one property to serve another. Laterals shall not cross property lines.

## **SECTION 5 – Storm Water Requirements**

This section is premised on the intent that land uses and developments that increase the runoff rate or volume shall be required to control the discharge prior to its release to off-site property. The purposes of these standards are to:

- Permit development without increasing the flooding of other lands.
- To protect the storm sewer system and the receiving streams from impairment of their capacity and quality, which may be caused by increases in the quantity and rate of runoff discharged.
- Establish a basis for design of a storm drainage system on lands below undeveloped areas that will preserve the rights of property owners and assure the long-term adequacy of storm drainage systems.

These runoff control standards apply to all land developments not specifically exempt in the authorizing legislation of City Ordinance Chapter 54.

The Standards are intended to establish guidelines for the protection of existing and proposed developments from damage and/or inundation resulting from an overflowing watercourse. Provisions must be made to convey storm waters (both those originating outside, as well as, inside the tract) through the development with facilities of sufficient capacity to permit the ultimate development of the upstream tributary area.

It is also the responsibility of the owner/developer to discharge storm waters (originating within the developed area or conveyed through the developed area) to as near pre-development conditions as possible. This does not imply that the owner/developer be required to make extensive or unreasonable downstream improvements to existing inadequate drainage facilities. It does, however, require the owner/developer to investigate the effect of said proposed improvements on the downstream drainage system.

### **Section 5.1 Design of Drainage Facilities:**

A. Hydrologic Design. All drainage ways shall be designed in accordance with the following criteria:

- 1) Major Waterways: Major waterways are defined as those with a tributary area in excess of 4 square miles. Such major waterways shall be designed for an average recurrence interval of 100 years.
- 2) Secondary Waterways: Secondary waterways are defined as those with a tributary area of between 1 and 4 square miles. Such secondary waterways shall be designed for an average recurrence interval of 50 years.
- 3) Minor Waterways: Minor waterways are defined as those with 1 square mile or less of tributary area. Such minor waterways shall be designed for an average recurrence interval of 25 years for open channels.

- 4) Closed Systems: For all developments, the design storm shall have an average recurrence interval of 10 years and pipe design shall be based on full flow. In the central business district (CBD) the average recurrence interval shall be 20 years. Lot grading, site drainage, and street improvements for all improved areas should be designed so that floods having an average recurrence interval of 100 years or less will not cause inundation or damage to any occupied structures. A grading plan for each improved area will be required to define the site drainage.

Publicly maintained conduits and other structures located outside the public right-of-way should be contained in suitable public easements.

Design flows for secondary and minor drainage facilities shall be computed by a licensed professional engineer within the State of Ohio using the U.S. Geological Survey (U.S.G.S.) Report 89-4126, "Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio," U.S.G.S. Report 86-4197, "Estimating Peak Discharges, Flood Volumes, and Hydrograph Shapes of Small Ungaged Urban Streams in Ohio", TR-20, or TR-55 methodologies.

B. Hydraulic Design. The hydraulic design of the development shall be such that after accumulating all energy losses, such as pipe friction, manhole losses, losses at bends, etc., along the various drainage transmission lines within the development, the hydraulic grade line shall not exceed grate or rim elevations for a storm with a 10-year recurrence interval (except in the CBD where the average recurrence interval shall be 20 years). The depth of flow or ponding for a 100-year average recurrence interval storm shall not exceed a level, which would cause inundation or damage to any existing structure or any proposed structure, constructed within the improved area.

The hydraulic grade line for culverts shall be 12" below pavement elevation for a 25-year storm and shall not exceed the pavement elevation for a 100-year storm. Appropriate culvert hydraulic calculations should be supplied (as specified within HY-8 or other approved methodologies).

The hydraulic grade line for the storm sewer system shall not exceed grate or rim elevations throughout the system.

C. Drainage Facilities. Catch basins, manholes, inlet structures, etc., placed within the improvement area shall conform to standard plans and specifications maintained by the City of Dayton, Department of Water. Drainage facilities shall be subject to the approval of the Department of Water.

- 1) Each channel constructed within the improvement area shall have side slopes of 3:1 or flatter. Bank stabilization and streambed stabilization, along constructed or natural channels, will be required if the channel velocities are sufficient to cause bank or invert erosion. The top of bank shall be so graded that side drainage will enter channels only at points where structures are provided to prevent bank erosion.
- 2) Closed Conduits: The minimum conduit size for a storm mainline shall be 15 inches in diameter. The minimum lateral size shall be 12 inches in diameter.

Minimum clearance between top of pipe and top of surface shall be 2 feet. The alignment of closed conduits shall be as nearly straight as practicable without undue bends and angle points; manholes shall be provided at all angle points and at intervals not to exceed 400 feet. Inverted siphons shall not be permitted.

All pipes part of the Public Storm Sewer System shall be reinforced concrete pipe (C-76) class 4 (unless otherwise noted).

- 3) Open drainage ditches with improved cross-sections are permitted where the physical conditions are such that the open ditches will not result in health hazards and where proper safety measures are taken.

D. Storm Water Runoff Control Criteria. Where land uses and developments increase the runoff rate and volume, structures are required to control the discharge prior to its release off-site. The following procedures shall be considered:

- 1) Any increase in the volume of site surface drainage water resulting from accelerated runoff caused by site development shall be controlled so that the post-development peak rate of runoff does not exceed that of the pre-development stage, for all 24-hour storms between a one-year frequency and the critical storm as determined below. For all storms less frequent than the critical storm, the post-development peak rate of runoff shall not exceed the pre-development peak rate of runoff. The method by which an applicant shall determine changes in rates and volumes of runoff is presented in the U.S. Department of Agriculture, Engineering Division of the Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, June 1986 or most current edition.

To find the critical storm frequency, for which additional control will be needed, the applicant shall:

- a. Determine the percent increase in runoff volume for a one-year frequency, 24-hour storm occurring on the development area.
- b. Determine the critical storm frequency for which additional control is needed by using the percent increase in runoff volume.
- c. Control the post-development storms of a frequency between one-year and the critical storm determined in (b), so as to be equal to, or less than, the pre-development peak runoff rate for a 24-hour, 1-year frequency storm.
- d. Control the post-developed storms less frequent than the critical year storm to be equal to, or less than, the pre-developed peak runoff rates for a 24-hour storm.
- e. Alternate methods for calculating detention volumes and allowable peak discharges may be approved by the Director of Water on a case-by-case basis.

**Critical Year Storm Table**

Percent increase in runoff volume from a 1-Year Frequency 24-hour storm		Critical Year Storm  (Years)
Equal or Greater Than (Percent)	Less Than (Percent)	
--	10	1
10	20	2
20	50	5
50	100	10
100	250	25
250	500	50
500	--	100

**Section 5.2 Drainage Plans:**

A drainage map and supporting calculations shall include sufficient data for the Department of Water to verify the feasibility of the drainage system as proposed by the owner/developer. The following data shall be provided:

A. Hydrologic Calculations

- 1) Drainage areas delineated on a map (pre- and post-developed)
- 2) Times of concentration (include flow path for both pre- and post-developed)
- 3) Rainfall information
- 4) Runoff Curve Numbers
- 5) Allowable Peak Discharges (APD)
- 6) Pipe/Channel capacity, hydraulic grade, and velocity calculations
- 7) Detention Routing calculations
- 8) A table should be included for each drainage basin or sub area (as applicable) for each storm event which defines:

<b>Event (YR)</b>	<b>Pre- developed Discharge (CFS)</b>	<b>Post- Developed Discharge (CFS)</b>	<b>Allowable Peak Discharge (CFS)</b>	<b>Pond Discharge (CFS)</b>	<b>Pond Elevation (FT)</b>	<b>Pond Volume (AC-FT)</b>
1						
2						
5						
10			<b>EXAMPLE</b>			
25						
50						
100						

**B. Hydraulic Calculations**

- 1) Sufficient documentation to indicate the results of the investigation into the adequacy of the downstream drainage system to handle the runoff from the proposed developed conditions is necessary. This may determine the maximum allowable release rate for the proposed development as opposed to the method described in SECTION 6.1(d) and, in turn, the amount of storm water storage that will be required.
- 2) Sizes and types of drainage improvements, including special structures, typical sections, right-of-way width.
- 3) Supporting calculations for upstream and downstream channel capacities as they affect overflow, erosion, or backwater within the subdivision. Such calculations shall be substantiated by such additional information as is required to determine profile and cross-section of the upstream and downstream channel reaches under consideration.
- 4) Sufficient contours and grading details to indicate proposed grades and elevations throughout the proposed development.

**Section 5.3 Construction Plans:**

The final construction plans for drainage within the area to be developed shall conform to the above provisions and to any special conditions as required by the Department of Water. Such construction plans for drainage shall be approved by the Department of Water prior to construction of any drainage facility within the development. A grading plan shall be submitted along with the construction plans to identify the site grading and site drainage planned for the development. All work within the ROW requires approval of the City Engineer, with all appropriate permits being acquired. All permits can be applied for at the public works business office.

## **Section 5.4 Detention/Retention Basins:**

As urban development continues to transform pervious watersheds into highly impervious urban areas, the problem of handling the ever-increasing storm water runoff on these watersheds is becoming more pronounced. In recent years, much attention has been focused on detention and retention basins as a means of controlling the storm water runoff by detaining and retaining the storm water in the basin and releasing it at a rate compatible with downstream conditions.

The detention and/or retention basin can be designed so as to obtain the maximum aesthetic benefits for the surrounding community while serving as an effective flood control mechanism.

### **A. Planning Guidelines**

- 1) Detention basins serve to capture and temporarily store the surface water runoff that results from urban development. This temporary storage allows for the release of the storm runoff at discharge rates that are acceptable to the receiving waterway.
- 2) On-site provision for detention storage should follow these approaches:
  - a. Post development peak runoff rate, for on-site drainage, shall not exceed the one-year pre-developed runoff rate, for all 24-hour storms between a one-year frequency and the critical storm frequency. All storms less frequent than the critical year storm shall not exceed pre-developed runoff rates.
  - b. For commercial/industrial sites, the pond will detain only on-site runoff; i.e., the runoff upstream from the development should bypass the detention pond.
  - c. Overflow and emergency spillway are required. The emergency spillway discharge is to be routed safely downstream to an existing defined watercourse or drainage system.
  - d. The basin, inlet structures, and lines shall be the property of the owner/developer and shall be maintained by the same and reflected by notes on the record plan unless specified otherwise.
- 3) A State of Ohio Construction Permit for construction of a detention/retention basin is not required for:
  - a. A dam, which is or will be less than ten feet in height and which has or will have a storage capacity of not more than fifty acre-feet at the elevation of the top of the dam.
  - b. A dam, regardless of height, which has or will have a storage capacity of not more than fifteen acre-feet at the elevation of the top of the dam.
  - c. A dam, regardless of storage capacity, which is or will be six or less feet in height.

- 4) Detention and/or retention basins are to be privately maintained.
- 5) A release structure is required in all retention/detention basins. A primary spillway system must be provided with every retention/detention basin to provide for passage of storm water overflow in the event of plugging or partial plugging of the openings in the side of the release structure with debris. An emergency spillway is required with every retention basin to provide for passage of storm water overflow in the event of plugging or partial plugging of the openings in the release structure.
- 6) The pond/basin must be accessible for sediment cleanout after the rest of the site has been stabilized.
- 7) A permanent maintenance width around the perimeter of the basin/pond is recommended.
- 8) The phasing of operations must permit the pond to be constructed and operational prior to disturbance of the site area contributing runoff to the pond.

B. Recommendations for Dry Detention Basins

- 1) Dry detention basins should be designed to minimize ponding so that water does not remain standing in the bottom; thereby harboring insects and limiting the potential use of the basin. This could be accomplished by means of a concrete low flow channel along the bottom of the basin. Minimum slope shall be no less than 0.50%. An acceptable alternative to a concrete low flow channel will be an underdrain system. In this case, a minimum 0.50% slope shall exist along the bottom of the basin, and the surface above the underdrain shall be grass reinforced by a fabric mesh. If an underdrain system is proposed, an appropriate soil investigation is necessary. If a low flow channel or underdrain system is not used the basin should be designed so that the slope along the bottom of the basin is at a minimum of 2.00%.
- 2) The detention basin may be designed to have a multi-purpose function.
- 3) Side slopes shall be 3(Horizontal) to 1(Vertical) or flatter.
- 4) There shall be a minimum of a 10-foot berm at 2 percent slope between right-of-way and top of basin.

C. Recommendations for Basins Containing Permanent Water

- 1) In order to provide better management for water quality, retention basins containing permanent lakes should have a water area of at least one-half acre. The lake area should be an average depth of at least approximately 4 feet to inhibit weed and insect growth, and should have no extensive shallow areas. A system to augment storm flows into the lake with water from other sources should be provided to enhance the water quality, if necessary.
- 2) In excavated lakes, the underwater side slopes in the lakes should be stable.

- 3) A safety ledge 5 feet in width is recommended and should be installed in all lakes approximately 30 to 36 inches below the permanent water level to provide a footing in emergency situations. In addition, there shall be a minimum of a 5-foot berm at 2.00% slope beginning at least 1 foot above normal pond elevation. The slope between two ledges should be stable and of a material which will prevent erosion due to wave action. Walkways consisting of a non-erosive material should be provided. One area in particular would be along the shoreline of a heavily fished lake. Side slopes above the berm shall be 3 to 1 or flatter.
- 4) Side slopes below normal pool elevation shall be 2 to 1 or flatter (per geotechnical engineer's recommendation).
- 5) To obtain maximum recreational benefits from developed water areas and provide for insect control, ponds should be stocked with fish. For best results, stocking should follow recommendations for warm water sport fishing by the Ohio Department of Conservation, Division of Fisheries, or similar organizations.
- 6) Periodic maintenance will be required in lakes to control weed and larval growth. The basin should also be designed to provide for the easy removal of sediment that will accumulate in the lake during periods of basin operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather is also recommended.
- 7) Water budget calculations are required for all permanent pond facilities and should consider performance for average annual conditions. The water budget should consider all significant inflows and outflows including, but not limited to, rainfall, runoff, infiltration, exfiltration, evaporation, and outflow.
- 8) Aeration devices such as fountains are recommended to reduce or prevent water stagnation.
- 9) A valve shall be provided to drain the permanent pool volume for removal of accumulated sediment.

D. Recommendations Common to Either Dry Detention Basins or Retention Basins with Permanent Water

- 1) All basins shall have an emergency overflow.
- 2) When conduits are used for the outlet of the reservoir, they shall be protected by bar screens or other suitable provision so that debris or similar trash will not interfere with the operation of the basin.
- 3) Safety screens should also be provided for any pipe or opening to prevent children or large animals from crawling into the structures. For safety, a suggested maximum opening is 6 inches.
- 4) Danger signs should be mounted at appropriate locations to warn of deep water, possible flood conditions during storm periods, and other dangers that exist. Life preservers should also be placed at appropriate locations. Fencing as a security device

may be used, but experience has shown that its ease in being scaled or underpassed tends to invalidate its purpose. Also, it may block operations when immediate access to the basin is necessary.

- 5) Grass or other suitable vegetative cover should be maintained throughout the entire reservoir area. Grass should be cut regularly.
- 6) Debris and trash removal and other necessary maintenance should be performed after each storm to assure continued operation in conformance to the design.
- 7) The discharge pipe shall be extended from the release structure to the toe of slope and terminate with a headwall.
- 8) Rock channel protection or other type of energy dissipaters are to be placed at the outlet ends as required
- 9) Watertight pipe joints and anti-seep collars should be considered where applicable.

E. Inspection of Basins

- 1) “As-built drawings will be required for all basins to assure compliance with all applicable requirements.
- 2) Water Department personnel will inspect all drainage facilities.

**Section 5.5 Storm Sewer Requirements:**

All proposed storm water collection system projects (including modifications to the existing system) require Water Department review/approval and signature. All storm sewer installation shall be consistent with the current City of Dayton Storm Master Plan.

The Department of Water requires that hydrologic & hydraulic calculations within new plats (or as Department of Water deems necessary) be submitted by the Developer/Engineer to determine if existing and proposed facilities have adequate capacity for particular development uses.

The following requirements should be used when designing storm sewers within the City of Dayton:

- Storm Sewer calculations shall be based on the modified rational formula ( $Q=CIA$ ) where:

Q=peak discharge, cfs  
C=runoff coefficient

I=intensity, in/hr  
A=drainage area, acres

- The rainfall intensity should be based on the intensity-duration-frequency curves for Montgomery County (see Appendix A). A 10 year-10 minute intensity should be used to begin storm sewer calculations in new subdivisions and plats.
- Runoff Coefficients should be based on a “weighted” value calculated from individual drainage areas. The following coefficients are recommended:

**Runoff Coefficients**

TYPE OF AREA	RUNOFF COEFFICIENT
Impervious	0.98
Pervious	0.35

Note: The coefficients listed are recommended values and may be revised as necessary depending on individual site characteristics.

- Provide calculations for storm sewer sizing and Hydraulic Grade Line (HGL) calculations.
- Storm sewers should be designed to maintain a minimum “full flow” cleanout velocity of 2.50 ft/sec.
- The type of pipe and numbers must appear on the plans and profiles. Also, the pipes shall be stamped prior to shipment for field activities.
- Catch basins shall be located upstream of all crosswalks and roadway intersections and shall be located at roadway low sag areas and at all low point cul-de-sacs. Catch basins will be spaced at intervals of 300 feet.
- Maximum velocity in storm sewer pipe shall not be more than 16 feet per second when flowing full for the ten (10) year design storm, except that the velocity in the last section of storm sewer pipe at the outlet end shall not exceed 12 feet per second based on the hydraulic gradient slope for the 10 year design storm. Rock channel protection at the inlet and outlet ends must be provided for erosion control. Storm sewer pipe slopes greater than 15% will require special pipe and/or key blocking to protect the pipe against erosion and displacement.
- Main line extensions shall be a minimum of 15-inches in diameter.
- Storm sewer laterals shall be a minimum of 12-inches in diameter. Private storm sewer lateral shall be connected to the back of a catch basin.
- Maximum distance between manholes shall be 400-ft.
- Manholes shall be located at all intersections and changes in line or grade.
- All main line sewers shall be located within the public Right-of-Way where practical. Otherwise, main line sewers shall be located within a *minimum* 20-ft wide easement. The storm sewer main must be centered in the easement. Wider easements may be necessary on storm sewer mains exceeding 10-ft in depth. See Appendix A for example Deed of Easement.
- Storm sewer mains shall be installed across the entire frontage of properties within areas that have potential for future public storm sewer service.
- Dry wells, in general, shall not be permitted. However, in certain circumstances within the City of Dayton limits, the Department of Water will approve the use of dry wells if the following requirements are met.

- a. Economic hardship (to construct public facilities) is agreed upon by the Director of Water. The owner/developer shall prepare documentation and submit detailed information to the Director of Water.
  - b. A professional engineer licensed in the State of Ohio shall complete runoff calculations. Calculations should include peak rates of runoff and volume for the 10-year storm event for the critical duration based on modified rational methodologies. Maximum ponding depths should be calculated within each lot and shown on the plans for the critical duration determined by the engineer and approved by the Department of Water.
  - c. A qualified geotechnical engineer shall complete a soil investigation so the findings may be incorporated into the design calculations for the dry wells. The geotechnical engineer should determine/recommend if dry wells are suitable for the project in question.
  - d. The property owner shall acknowledge that the dry wells will be “privately maintained” and periodic maintenance is typically required of dry wells. Any damage to adjacent property (both private and/or public) from the dry wells will be the property owner’s sole responsibility.
- Stringing more than 2 catch basins is not permitted.

### **Section 5.6 Post Construction Design Requirements**

The Post Construction Storm Water Management requirements are included as a subsection under the Storm Water Pollution Prevention Plan (SWP3), Part III of the Ohio EPA Permit No.: OHC000002, “Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollution Discharge Elimination System”, (herein after referred to as the Permit).

#### **A. General Requirements**

The purpose of the Post Construction Storm Water Management requirements is to ensure protection of the receiving stream’s physical, chemical, and biological characteristics and to ensure the stream’s functions are maintained.

The SWP3 must include the following:

- A description of post construction BMPs that will be implemented for a construction site.
- The basis for their selection addressing the projected impacts on the channel, floodplain morphology, hydrology and water quality.
- Detail drawings and maintenance plans that ensure pollutants collected from the BMP practice are disposed of in accordance to local, state and federal regulations.
- Erosion Control Requirements from Section 6 of the City of Dayton Engineering Design Standards.

Two copies of an “Operations and Maintenance Manual” shall be submitted for all Post Construction BMP’s. One copy will be approved and provided to the site owner, and one copy will be retained by the City for use in annual inspections. The “Operations and Maintenance Manual” shall include:

- Title sheet identifying the location of the site
- Table of Contents

- Owner's name and contact information
- A site map clearly showing the location of all post construction storm water practices and BMP's.
- Detailed information about the design and operation of all post construction storm water practices and BMP's.
- Detailed information about the required maintenance of all post construction storm water practices and BMP's.
- Detailed information about the required cleaning of all post construction storm water practices and BMP's.
- Operation & Maintenance Owner's Agreement detailing the responsibility for the storm system owner. (Appendix A)
- Inspection checklist detailing all items required to be maintained, and the required action to maintain them. (Appendix A)
- Inspection and maintenance log (Appendix A)

Operation and Maintenance of post construction practices by the permittee (except for those regulated under the small MS4 program) are required only through the valid expiration date of the Permit.

Construction projects that are linear in nature and do not result in a net increase in impervious surface, such as road resurfacing projects, are excluded from the requirements listed in Part III.G.2 of the Permit, provided the project is designed to minimize stream crossings and disturbance.

See Appendix B for additional information for design of Post Construction Storm Water Requirements.

## B. Requirements for Large Construction Activities

Large construction includes activities involving a disturbance of five acres or more of land or involving a disturbance of less than five acres but is part of a larger plan of development which totals more than five acres of land.

Post-construction BMPs for large construction activities:

- Must demonstrate the ability to detain storm water runoff to protect stream channels, stream erosion control, and improve water quality.
- Must be sized to treat the water quality volume (WQv) and must be in compliance with Ohio's Water Quality Standards in OAC Chapter 3745-1.
- The WQv shall be equivalent to the volume of runoff from a 0.75-inch rainfall, (for approved computation methods see Part III.G.2.e of the Permit).
- The BMP shall incorporate an additional volume equal to 20 percent of the WQv to allow for sediment storage and/or reduced infiltration capacity.
- BMPs should be designed according to the methodology included in the Rainwater and Land Development manual or a manual accepted for Ohio EPA use.
- BMPs shall be designed such that the draw down time is long enough to provide treatment but short enough (average of 24-48 hours) to provide storage available for consecutive rainfall events (Refer to Table 2 of Part III.G.2.e of the Permit for specific BMP draw down times).

Any redevelopment project shall implement BMPs such that a 20 percent net reduction of impervious area is achieved, such that at least 20 percent of the WQv is treated, or provide a combination of the two.

## C. Requirements for Small Construction Activities

Small construction includes activities involving a disturbance of one acre or more but less than five acres of land and is not included in a larger plan of development totaling more than five acres of land.

Structural measures (including velocity dissipation devices) shall be placed on uplands to the "degree attainable". Refer to "*Small Construction Activities*" in Part III.G.2.e of the Permit for specific practices.

## D. BMP's for Public Improvements

BMP's for public improvements must be coordinated with the Department of Water.

## E. Maintenance Requirements

It is required for each site owner to submit a post construction quarterly report of performed maintenance to the Department of Water. The Department of Water is then required to perform an annual inspection to confirm compliance.

The quarterly reporting periods are as detailed below, as well as the due date to submit the report to the Department of Water:

<b>Quarter Period</b>	<b>Due Date</b>
January 1 – March 31	April 7
April 1 – June 30	July 7
July 1 – September 30	October 7
October 1 – December 31	January 7

The quarterly report will be submitted to the Ohio EPA on the 15<sup>th</sup> after the due date. The quarterly reports may be emailed to [postconstruction@daytonohio.gov](mailto:postconstruction@daytonohio.gov) or mailed to:

City of Dayton, Department of Water  
 Plan Review Bureau  
 320 West Monument Avenue  
 Dayton, OH 45402

### **Section 5.7 Non-Storm Runoff Requirements:**

A Non-Storm Water Discharge Application is required for each point of discharge to the storm sewer system that does not originate from storm water. Examples would include: geothermal heating/cooling system, non-contact chiller, foundation drains, decorative water features, and other non-storm sources of flow.

Please be aware that the MS4 is designed specifically to convey surface runoff and that the Non-Storm Water Discharges acknowledged as part of the completed application are considered a special privilege based on individual site characteristics and downstream capacity of the existing MS4. As outlined within the Application Instructions, extreme flooding events less frequent than the design storm may cause capacity limitations within the existing MS4. Under these conditions, the City of Dayton may require that non-storm water discharges to the MS4 be temporarily terminated during the flooding event.

The City of Dayton is required by the Ohio EPA to monitor water quality of the MS4. If at any time the discharge violates City of Dayton ordinance, state, or federal water quality standards, the City of Dayton reserves the right to limit the non-storm water discharge to the MS4.

The following conditions apply to all Non-Storm Discharge Permits

- The Director of Water is authorized to regulate discharge to the MS4 under Section 54.09 of the Revised Code of General Ordinances.
- Future fees may be assessed at the discretion of the Director of Water and in keeping with Section 54.04 of the Revised Code of General Ordinances and other provisions as provided by law. The Owner will also be responsible for any costs of labor and equipment incurred by the City of Dayton for activities associated with maintenance or repairs to the MS4 that are not part of a routine maintenance program as a direct result from the non-storm water discharges approved herein.
- The waters must be discharged to the designated storm sewers approved by the Director of Water. This acceptance is for discharge to the *City of Dayton MS4 Facilities*. No City of Dayton authorization is given to private entities to access public manholes. (*If access to the City of Dayton sewer system is required, it must be coordinated through – or performed by – the Division of Sewer Maintenance, at 937-333-4915*)
- The discharge shall not be in such amounts or rates, or at such times, that the addition of the waters would likely cause or contribute to exceeding the hydraulic capacity of the sewer system.
- Only **CLEAN** pollutant free water is permitted to be discharged to the MS4. Chemicals including, but not limited to cleaners, antifreeze, neutralizing acids or bases added to process water **CANNOT** be discharged to the MS4. Discoloration or suspended solids in the storm sewer discharge are not permitted. Any modifications or changes to the information provided herein shall be reported to the Department of Water *immediately*. Modifications may require re-application.
- All non- storm discharges parameters (including temperature and pH) must meet the Ohio EPA General Permit requirements as determined for each site.
- The discharge must not cause solids build-up or blockage in the MS4.
- Should the actual discharge present unforeseen problems; additional control measures may be required of the Owner. The City of Dayton reserves the right to modify the acceptance

of this non-storm water discharge approval if the discharges are ever found to be incompatible with the efficient pollutant free operation of the MS4. This acceptance does not imply that the Owner is freed of liability for any unforeseen consequences of the discharge.

- This acceptance of the discharge does not relieve the Owner of complying with all applicable federal, state, and local laws, ordinances, rules and regulations.
- The Owner shall indemnify, defend and hold free and harmless the City of Dayton, its agents, officers, and employees, from and against any and all actions, claims, liabilities, assertions of liabilities, losses, costs and expenses whatsoever, including but not limited to attorney's fees, which in any manner may arise or be alleged to have arisen or resulted or alleged to have resulted from the discharge or release of any nature whatsoever by the Owner, of hazardous substances or pollutants to the City of Dayton MS4.

**SECTION 6 – Erosion Control Requirements**

This section is premised on the intent that the earth-disturbing activities that increase the rate of soil erosion and sediment pollution shall be managed to protect drainage ways and the municipal separate storm sewer system (MS4).

1. All soil and erosion control measures shall conform to the Ohio Department of Natural Resource's (ODNR) Rainwater and Land Development, Ohio's Standards for Storm water Management, Land Development, and Urban Stream Protection", (latest edition).
2. For operations larger than 1.0 acre the contractor or developer is responsible for submitting a Notice of Intent (NOI) to be reviewed and approved by the Ohio EPA. The contractor should provide a copy of the NOI and date submitted to Ohio EPA or a copy of Ohio EPA Director's approval letter.
3. Stabilize disturbed soils when earth-disturbing work has ceased.
4. Control stormwater volume and velocity within the site to minimize soil erosion.
5. Minimize the amount of soil exposed.
6. Control stormwater discharge leaving the site to prevent channel and streambank erosion and erosion at outlets.
7. Preserve topsoil and natural vegetation.
8. Minimize soil compaction by construction equipment in areas that will not contain permanent structures or where compaction is not necessary for structural integrity.
9. Provide and maintain natural buffers around surface waters.
10. Minimize disturbance of steep slopes.
11. Divert stormwater that runs onto the site away from disturbance areas of the site.
12. Control sediment using perimeter control measures (BMPs) such as diversion dikes, storm drain inlet protection, filter berms, and silt fencing.
13. Remove any sediment and other pollutants, including construction materials, from paved surfaces daily to minimize discharges from the site. Washing sediments and other pollutants off paved surfaces into storm drains is prohibited unless those storm drains discharge to a sediment basin or other sediment control on the site.
14. Prohibit the discharges of construction waters, trash, and sanitary waste in stormwater.
15. A storm Water Pollution Prevention Plan (SWP3) shall be included for any development. This plan must be made available at the project site at all times. The design of erosion control systems shall follow the requirements of Ohio EPA Item 207 of Ohio Department of Transportation Standard Specifications, and ODNR Rainwater and Land Development. Projects that contain 1.0 acre or more of earth disturbance are required to have an SWP3 approved by the Department of Water. The SWP3 shall be submitted prior to plan approval.

## 16. The SWP3 should contain the following:

- a. **Vicinity Map** – Location map showing site in relation to surrounding area. Clearly indicate location of receiving streams/surface waters.
- b. **Clearing and Grading Plan** – Indicate the limits and show the acreage of earth disturbing activity. Show borrow, spoil and topsoil stockpile areas. Include before and after contours with appropriate contour intervals. Delineate drainage watersheds indicating acreage of each.
- c. **Project Description** – Briefly describe the nature, purpose and scope of the land disturbing activity. This may be self evident from the plan. Include the total area of the site and acreage of individual phases if applicable. Also include a narrative describing the overall sediment and erosion control scheme for the site.
- d. **Soils Information** – Show locations of bedrock, unstable or highly erodible soils as determined by the Montgomery County soil survey and/or soil tests. Soil surveys are available from the Soil and Water Conservation District. Other soils information such as permeability, perched water table, etc., may be mentioned.
- e. **Surface Water Locations** – Show locations of all lakes, ponds, surface drainage, patterns, wetlands, springs, etc., on or within 200 feet of the site. If storm waters will be discharging into a municipal separate storm sewer system (MS4) or into a storm water management structure such as a detention basin, which is off site, clearly indicate this on the plans.
- f. **Site Development** – Show locations of all existing and proposed buildings, roads, utilities, parking facilities, etc.
- g. **Schedule of Construction Activity** – Included in this should be a schedule for implementing temporary and permanent erosion and sediment control practices and storm water management facilities. The National Pollutant Discharge Elimination System (NPDES) permit requires that all sediment ponds and perimeter barriers be implemented within 7 days of first grubbing. All sediment control structures must remain functional until upland areas are stabilized.
- h. **Location of Practices** – Show locations of all erosion and sediment controls and storm water management practices. Water ponding facilities should be drawn to scale, with their volumes and area of the contributing watershed given.
- i. **Detail Drawings** – All structural practices should be explained with detail drawings and specifications. Installation specifications may also be necessary to aid contractors. Included should be outlet structures for retention or detention facilities and any special modification to these structures to aid in improved sediment trapping capability.
- j. **Land Stabilization Measures** – Provide specifications for temporary and permanent seeding, mulching, blanketing, etc., and also the installation schedule for each practice. The NPDES permit requires that all areas at final grade or where construction activity will cease for 21 days or longer be stabilized within 7 days of last activity. Velocity dissipation devices should be placed at the outfall of all detention or retention structures and along the length of any outfall channel as necessary to provide a non-erosive flow velocity from the structure to a watercourse. Erosion control blankets and matting should be used to stabilize channels where the flow velocity is greater than 3.5 ft/s, on steep slopes, on highly erosive soils and on areas slow to establish a vegetative cover.

- k. **Special Notes for Critical Areas** – Include pertinent information regarding stream bank stabilization, riparian corridors, buffer areas, stream restoration plans and wetland areas.
  - l. **Maintenance and Inspections** – provide notes and information regarding maintenance of each practice to assure continued performance. The NPDES permit requires that sediment and erosion controls be inspected once every 7 days and within 24 hours of 0.5” or greater rainfall. A written log of these inspections must become part of the SWP3. This log should indicate the dates of the inspections, name of the inspector, weather conditions, observations, actions taken to correct any problems and the date the action was taken.
  - m. **Storm Water Runoff Considerations and Post-Construction Best Management Practice (BMP’s)** - Show the pre and post-construction coefficients including method used to calculate runoff. Include a narrative description describing post-construction storm water management BMPs such as detention basins, grassed filter strips or wetlands and show the location of all such storm water management facilities. Include vegetation to remain (trees, buffer areas, etc.). Refer to Section 5.6 of the Engineering Design Standards
  - n. **Location and Volume of Sediment Ponds** – These calculations should be shown for all temporary or permanent sediment traps/ponds and any retention/detention facilities to be used for this purpose. All ponds used for the purpose of trapping sediments must have a volume of 67 cubic yards per acre of total drainage area to the pond (not disturbed area). Although there is no stipulated standard, trapping efficiency should be at least 75%.
  - o. **Off-site Sediment Tracking** – Minimize vehicles tracking sediment off-site by installing gravel construction entrances. The contractor shall schedule street sweeping or other cleaning methods if off-site tracking becomes a concern.
17. If the developer decides to build structures within the development or opts to maintain permit responsibility on lots where structures are being built, a detail drawing of a typical subplot showing standard BMPs with notes specifying measures for critical areas that must be included in the SWP3.
18. Once a site reaches final stabilization, a permittee must file a Notice of Termination (NOT). A NOT is to be filed when all of the following criteria are met on all disturbed areas within the development for which the NOT has been filed:
- a. A perennial, vegetative cover (or other comparable permanent stabilization practice) has grown to a 70% density throughout the entire disturbed area;
  - b. All temporary sediment and erosion controls have been removed and disposed of properly;
  - c. All trapped sediment has been permanently stabilized to prevent further erosion;
  - d. All construction activities have ceased.

The NOT is to be filed within 45 days of when a site reaches final stabilization.

**SECTION 7 – Demolition Plans**

Demolition plans are required in order to protect existing utilities, and to ensure that the final condition of the site does not have a negative impact on the right-of-way or adjacent properties. All plans must be in accordance with City of Dayton Construction Materials and Specifications (Latest Edition), and Department of Water Engineering Design Standards (Latest Editions). The requirements below constitute a general set of requirements, but additional requirements may or may not apply, depending the project and site conditions.

- Plans submitted with the demolition permit must be prepared in accordance with Section 1 of the Water Engineering Design Standards.
- Plans must be prepared and stamped by a licensed Professional Engineer.
- Plans must be to scale.
- The plans must include an existing site plan, including topographic survey showing location of all utilities.
- Plans must show the protection of any public utilities, including protection of private drainage structures connected to the public storm sewer. If any changes, including disconnection, are to be made to utility service connections they must be clearly labeled.
  - Modifications of any public utilities must be submitted as a public improvement plan.
- The applicable General Notes from Section 2 of the Engineering Design Standards must be shown on the plans.
- An erosion control plan in accordance with Section 6 of the Engineering Design Standards.
  - This is required even if the demolition only consists of the removal of structures. The plans must show how the public storm sewer will be protected from debris, and how debris will be prevented from leaving the site.
  - The contractor is also required to maintain a SWP3 on site at all times if the site is over 1 acre.
- A proposed site plan showing the condition of the site after the project is complete. The plan must show how storm water runoff will be addressed. This includes storm water calculations as required in Section 5 of the Water Engineering Design Standards.
- A copy of the Notice of Intent must be submitted prior to permit approval for sites over 1 acre.

**APPENDIX A**  
**SAMPLE DOCUMENTS**



**IN TESTIMONY WHEREOF**, the said PROPERTY OWNER have hereunto set their hands this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

WITNESSES:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

STATE OF OHIO, MONTGOMERY COUNTY, SS:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, before me, in and for said County, personally came \_\_\_\_\_, the Grantors in the foregoing deed, and acknowledged the signing thereof to be their voluntary act and deed.

Witness my official signature and seal on the day and year last above written.

\_\_\_\_\_  
Notary Public

Prepared By:

SURVEYOR  
COMPANY NAME  
ADDRESS  
CITY, STATE, ZIP

**AN 8 1/2" X 11" EXHIBIT OF THE LEGAL DESCRIPTION IS REQUIRED (SIGNED AND SEALED BY A PROFESSIONAL SURVEYOR LICENSED IN THE STATE OF OHIO)**



**IN TESTIMONY WHEREOF**, the said PROPERTY OWNER have hereunto set their hands this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

WITNESSES:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

STATE OF OHIO, MONTGOMERY COUNTY, SS:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, before me, in and for said County, personally came \_\_\_\_\_, the Grantors in the foregoing deed, and acknowledged the signing thereof to be their voluntary act and deed.

Witness my official signature and seal on the day and year last above written.

\_\_\_\_\_  
Notary Public

Prepared By:

SURVEYOR  
COMPANY NAME  
ADDRESS  
CITY, STATE, ZIP

**AN 8 1/2" X 11" EXHIBIT OF THE LEGAL DESCRIPTION IS REQUIRED (SIGNED AND SEALED BY A PROFESSIONAL SURVEYOR LICENSED IN THE STATE OF OHIO)**

**OEPA WAIVER LETTER**  
Sample

**DATE**

Director of Water  
City of Dayton, Department of Water  
320 West Monument Avenue  
Dayton, OH 45402

**RE: Project**

Dear [REDACTED]:

Please consider this letter an addendum to the water and/or sanitary sewer engineering plans submitted by **ENGINEER** for the above referenced project.

We request permission to proceed with construction, although the final engineering plans have not been approved by the Ohio EPA. We agree that if there are any changes per the Ohio EPA review they will be completed by **OWNER** within sixty (60) days of said notice. We understand that our letter of credit will not be released until all EPA items and the construction plans are revised per OEPA comments.

Respectfully submitted,

**OWNER**

**Rainfall Intensity Table**  
**10 – YEAR STORM**  
 BASED ON USWB RECORDS

TIME MIN.	I IN/HR	TIME MIN.	I IN/HR	TIME MIN.	I IN/HR
10.0	5.5	20.0	4.0	30.0	3.2
10.5	5.4	20.5	3.9	30.5	3.1
11.0	5.3	21.0	3.9	31.0	3.1
11.5	5.2	21.5	3.8	31.5	3.1
12.0	5.1	22.0	3.8	32.0	3.0
12.5	5.0	22.5	3.7	32.5	3.0
13.0	5.0	23.0	3.7	33.0	3.0
13.5	4.9	23.5	3.6	33.5	2.9
14.0	4.8	24.0	3.6	34.0	2.9
14.5	4.7	24.5	3.5	34.5	2.9
15.0	4.6	25.0	3.5	35.0	2.8
15.5	4.5	25.5	3.5	35.5	2.8
16.0	4.5	26.0	3.4	36.0	2.8
16.5	4.4	26.5	3.4	36.5	2.8
17.0	4.3	27.0	3.4	37.0	2.7
17.5	4.2	27.5	3.3	37.5	2.7
18.0	4.2	28.0	3.3	38.0	2.7
18.5	4.1	28.5	3.3	38.5	2.7
19.0	4.1	29.0	3.2	39.0	2.7
19.5	4.0	29.5	3.2	39.5	2.7

# EARTH DISTURBANCE APPLICATION

## CITY OF DAYTON, DEPARTMENT OF WATER

320 West Monument Avenue Dayton, OH 45402 (937) 333-3725 (Phone) (937) 333-6768 (Fax)	One Stop Permit Center 371 West Second Street Dayton, OH 45402 (937) 333-6804 (Phone)
--	--

### 1. APPLICANT INFORMATION

	NAME	STREET ADDRESS	CITY, STATE	STATE	PHONE
OWNER & Contact Name:					
CONTRACTOR & Contact Name:					
ENGINEER & Contact Name:					

### 2. PROJECT INFORMATION

Project Title: \_\_\_\_\_

Address: \_\_\_\_\_

Type of Project (Circle one):    Residential    Commercial    Industrial

### 3. EARTH DISTURBANCE ACTIVITY

Area of Earth Disturbance (in acres): \_\_\_\_\_

Has NOI application for coverage under Ohio EPA's general permit been submitted to Ohio EPA for Construction Site Storm Water (circle one):    YES    NO    N/A

Erosion and Sedimentation Pollution Control Plan prepared (circle one):    YES    NO

The owner of the development and/or designated representative, do hereby agree to comply with all the laws of the State of Ohio and the regulations of the City of Dayton, pertaining to earth movement (including erosion and sediment controls) and the said construction will be in accordance with plans and specifications submitted herewith and certify that the information and statement given on this application are true.

APPLICATION SUBMITTED BY: \_\_\_\_\_  
(print name and title)

COMPANY: \_\_\_\_\_                      PHONE: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_                      DATE: \_\_\_\_\_

**INSTRUCTIONS  
For  
EARTH DISTURBANCE APPLICATION**

**1. APPLICANT INFORMATION** (To be completed by the Applicant)

Please provide applicable information about the owner, contractor, and engineer.

**2. PROJECT INFORMATION** (To be completed by the Applicant)

Please provide a project title, address, and type of project.

**3. EARTH DISTURBANCE ACTIVITY** (To be completed by the Applicant)

Please provide the total area of earth disturbance that will result from the proposed development **OR** demolition activities.

For operations larger than 5 acres, the application for the NOI must be submitted to the OEPA prior to the Department of Water review and approval of this application. Please provide a copy of the completed NOI and date submitted to the OEPA. If the general permit has been issued please provide a copy with this application.

A professional engineer licensed in the State of Ohio should submit an Erosion and Sedimentation Pollution Control Plan. The Erosion and Sedimentation Pollution Control Plan should be prepared following guidelines outlined within “Rainwater and Land Development, Ohio’s Guide for Storm water Management, Land Development, and Urban Stream Protection” (latest edition) and City of Dayton Engineering Standards for Water, Sanitary Sewer, and Storm Sewer Facilities. The plan shall at a minimum address catch basin protection, perimeter protection, and maintaining dirt free roads.

The owner should read, sign, and date the application and submit to One Stop Permit Center, Department of Water, Division of Water Engineering located at 371 West Second Street, Dayton, OH 45402.

# NON-STORM WATER DISCHARGE APPLICATION

## CITY OF DAYTON, DEPARTMENT OF WATER

320 West Monument Avenue Dayton, OH 45402 (937) 333-3725 (Phone) (937) 333-6768 (Fax)	One Stop Permit Center 371 West Second Street Dayton, OH 45402 (937) 333-6804 (Phone)
--	--

### 1. APPLICANT INFORMATION

	NAME	STREET ADDRESS	CITY	STATE	PHONE
OWNER					
ENGINEER					
CONTRACTOR					
OPERATIONAL CONTACT					

### 2. PROJECT INFORMATION

- a. Project Title: \_\_\_\_\_
- b. Address of Project: \_\_\_\_\_
- c. Location of connection to MS4 (coordinates or description): \_\_\_\_\_
- d. Type of Project (Check one):
- Residential    
  Commercial    
  Industrial    
  Other \_\_\_\_\_

### 3. OUTFALL INFORMATION

- a. City of Dayton Outfall Number: \_\_\_\_\_
- b. Volume of Discharge to the storm sewer in cubic feet per second (cfs): \_\_\_\_\_
- in gallons per day (gpd): \_\_\_\_\_
- c. Duration of Discharge (include hours/day, days/month, months/year): \_\_\_\_\_
- d. Describe the type of non-storm water discharge and its source:
- Open Loop Geothermal    
 Non-Contact Cooling    
 Chiller Condensate    
 Other \_\_\_\_\_

### 4. PERMIT INFORMATION

- a. Attach your Notice of Intent (NOI) for coverage under Ohio EPA's NPDES Non-Contact Cooling Water (if more than 100,000 gallons/day) or Geothermal System discharge permit program.

or

List your current NPDES Permit Number: \_\_\_\_\_

Issue Date: \_\_\_\_\_

- b. Attach the Water Withdrawal Registration form that was submitted to the Ohio Department of Natural Resources (only if you plan to withdraw more than 100,000 gallons/day).

The owner of the property and/or designated representative, do hereby agree to comply with all the laws of the State of Ohio and the regulations of the City of Dayton, pertaining to non-storm water discharges to the MS4 and that said discharge will be in accordance with plans and specifications submitted herewith and certify that the information and statement given on this application are true.

**APPLICATION SUBMITTED BY:**

**NAME:** \_\_\_\_\_

**TITLE:** \_\_\_\_\_

**COMPANY:** \_\_\_\_\_

**PHONE:** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**INSTRUCTIONS**  
**For**  
**NON-STORM WATER DISCHARGE APPLICATION**

The City of Dayton has a municipal separate storm sewer system (MS4) that allows rainwater from streets and storm drains to drain to area rivers. The City of Dayton's stormwater ordinance and permit from Ohio EPA require management of the MS4. In accordance with this, the City requires an application for a connection to the MS4 for the discharge of any non-stormwater flows. Below are instructions for completing the application.

**1. APPLICANT INFORMATION**

Provide applicable information about the owner, contractor, engineer, and day-to-day operational contacts.

**2. PROJECT INFORMATION**

Provide a project title, address, location of connection to the storm sewer, and type of project.

**3. OUTFALL INFORMATION**

- Identify the pre-determined City of Dayton outfall number. The applicant can contact the Department of Water, Division of Environmental Management for this information at 333-3725.
- Define the volume (in cubic feet per second and gallons per day) to the Municipal Separate Storm Sewer System (MS4). Define the duration of discharge.
- Describe the type of non-storm water discharge and its source.

**4. PERMIT INFORMATION**

- Show that application for coverage under Ohio EPA's permit for non-storm water discharges has been submitted to Ohio EPA. Provide a copy of the permit, copy of the Notice of Intent (NOI), or National Pollutant Discharge Elimination System (NPDES) application.
- Provide your Water Withdrawal Registration form that was submitted to the Ohio Department of Natural Resources (ODNR), if you plan to discharge more than 100,000 gallons per day.

**5. SUBMISSION OF APPLICATION**

- The owner should read, sign, and date the application and submit to the One Stop Permit Center, Department of Water, Division of Water Engineering located at 369 West 2<sup>nd</sup> Street, Dayton, OH 45402.

**By signing this application the owner acknowledges the following:**

- Only **CLEAN**, pollutant free water is permitted to be discharged to the MS4. Chemicals including, but not limited to, cleaners, antifreeze, neutralizing acids or bases added to process water **CANNOT** be discharged to the MS4. Discoloration or suspended solids in the storm sewer discharge are not permitted.
- Any modifications or changes to the information provided herein shall be reported to the Department of Water **immediately**. Modifications may require reapplication. Changes include but are not limited to: significant increases or decreases in discharge, cessation of discharge, temporal changes to discharge, or sale of property to a new owner.
- The owner should be aware that during extreme flooding events the City of Dayton may operate existing flood gates as part of standard operational and maintenance procedures. Through this process the MS4 may not function as under normal conditions and the City of Dayton reserves the right to limit non-storm water discharges to the MS4.
- If at any time the discharge violates City of Dayton Ordinance No. 29358-97, state, or federal water quality standards the City of Dayton reserves the right to limit the non-storm water discharge to the MS4.

**Information and Resources List**

Ohio EPA Storm Water Program:

<http://www.epa.ohio.gov/dsw/storm/index>

Ohio EPA NPDES General Permit Notice of Intent (NOI) application via STREAMS eBusiness Center:

<https://ebiz.epa.ohio.gov/login.html>

Ohio EPA Permit Application Guidance for Geothermal System Discharges:

[http://epa.ohio.gov/portals/35/edmr/doc/STREAMSGuide\(Geotherm\).pdf](http://epa.ohio.gov/portals/35/edmr/doc/STREAMSGuide(Geotherm).pdf)

Ohio EPA Permit Application Guidance for Non-Contact Cooling Water:

[http://epa.ohio.gov/portals/35/edmr/doc/STREAMSGuide\(NonContactCW\).pdf](http://epa.ohio.gov/portals/35/edmr/doc/STREAMSGuide(NonContactCW).pdf)

ODNR Water Withdrawal Registration:

<http://water.ohiodnr.gov/water-use-planning/water-withdrawal-facilities-registration>

City of Dayton MS4 Stormwater Information:

<https://daytonohio.gov/409/Storm-Water-Management-Program>

Month day, year

Applicant Name

Applicant Company  
 Applicant Address  
 Applicant Address

**RE: Facility Name  
 Non-Storm Water Discharge**

Dear xxxx:

The Department of Water, Division of Water Engineering is in receipt of the completed Non-Storm Water Discharge Application forms for **[facility name]**. Per your **[month day, year]** application of request (attached), this specific discharge will be accepted by the City of Dayton Municipal Separate Storm Sewer System (MS4). Based on the information submitted, the Department of Water acknowledges that **[facility name/owner]** will discharge a maximum peak flow of **[x.xx]** cubic feet per second (cfs) to the MS4 owned and operated by the City of Dayton. The locations of discharge are restricted to **[location]**.

Please be aware that the MS4 is designed specifically to convey surface runoff and that the Non-Storm Water Discharges acknowledged as part of the completed application are considered a special privilege based on individual site characteristics and downstream capacity of the existing MS4. As outlined within the Application Instructions, extreme flooding events less frequent than the design storm may cause capacity limitations within the existing MS4. Under these conditions, the City of Dayton may require that non-storm water discharges to the MS4 be temporarily terminated during the flooding event.

Additionally, the City of Dayton is required by the Ohio EPA to monitor water quality of the MS4. If at any time the discharge violates City of Dayton ordinance, state, or federal water quality standards, the City of Dayton reserves the right to limit the non-storm water discharge to the MS4.

Please note the following:

- The waters must be discharged to the designated storm sewers approved by the Director of Water. This acceptance is for discharge to the City of Dayton MS4 Facilities. No City of Dayton authorization is given to private entities to access public manholes. (If access to the City of Dayton sewer system is required, it must be coordinated through – or performed by – the Division of Sewer Maintenance)
- The discharge shall not be in such amounts or rates, or at such times, that the addition of the waters would likely cause or contribute to exceeding the hydraulic capacity of the sewer system.
- Only CLEAN pollutant free water is permitted to be discharged to the MS4. Chemicals including, but not limited to cleaners, antifreeze, neutralizing acids or bases added to process water CANNOT be discharged to the MS4. Discoloration or suspended solids in the storm sewer discharge are not permitted. Any modifications or changes to the information provided herein shall be reported to the Department of Water *immediately*. Modifications may require re-application.
- Future fees may be assessed at the discretion of the Director of Water and in keeping with Section 54.04 of the Revised Code of General Ordinances and other provisions as provided by law. The **[owner]** will also be responsible for any costs of labor and equipment incurred by the City of Dayton for activities associated with maintenance or repairs to the MS4 that are not part of a routine maintenance program as a direct result from the non-storm water discharges approved herein.

- Should the actual discharge present unforeseen problems; additional control measures may be required of the **[owner]**. The City of Dayton reserves the right to modify the acceptance of this non-storm water discharge approval if the discharges are ever found to be incompatible with the efficient pollutant free operation of the MS4. This acceptance does not imply that **[facility]** is freed of liability for any unforeseen consequences of the discharge.
- This acceptance of the discharge does not relieve **[owner]** of complying with all applicable federal, state, and local laws, ordinances, rules and regulations.

**[owner]** on behalf of itself, its employees, and agents, releases the City of Dayton, its agents, officers, and employees from any and all known and unknown causes of action, damages, liabilities, costs, expenses and claims and demands of whatsoever kind or nature which, **[owner]** has or may ever have against the City which result from the discharge or release of hazardous substances or pollutants placed in the City of Dayton MS4 by **[owner]**

We will keep your application on file and provide updates as they become necessary. Please notify this office of any revisions to information provided on the original application. If you have any questions concerning this matter please contact **[chief engineer-design]** at 333-xxxx.

Sincerely,

**[Director]**, Director  
Department of Water

Attachments

cc: **[consultant/engineer]**  
**[sewer maintenance manager]**, City of Dayton  
**[environmental management manager]**, City of Dayton  
**[water engineering manager]**, City of Dayton

**Sample Stormwater System  
Inspection Checklist**

Owner: \_\_\_\_\_

Inspector: \_\_\_\_\_

Date/Time: \_\_\_\_\_

<b>General Conditions</b>	
<b>Maintenance Item</b>	<b>Required Action</b>
Encroachment into Stormwater System	Check area for unpermitted construction that affects system, contact owner to remedy situation.
Complaints from residents	Review and investigate complaints, take necessary actions, respond to resident.
Public Hazards (describe below)	Identify any public hazards in and around the stormwater system, notify county engineer.
Street Cleanliness	Determine date of last street cleaning, schedule cleaning if necessary
Condition of Vegetation	Check for damaged or dying plantings, check length of grass, schedule remedial actions if necessary

Specific Comments:

Str No:	Comments
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
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**Sample Stormwater System (Cont.)  
Inspection Checklist**

<b>Manholes</b>	
<b>Maintenance Item</b>	<b>Required Action</b>
1. Presence of Trash	Remove all trash, determine source and remedy cause
2. Presence of petroleum products	Remove petroleum products with absorbent material, determine source and remedy cause
3. Presence of sediment	Schedule cleanout, determine source and remedy cause
4. Condition of Manhole	Check for cracks, missing concrete, and damage to structure
5. Condition of inlet and outlet pipes	Check for cracks, gaps, and damage to pipes

Specific Comments:

Str No:

Comments

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## Operation & Maintenance Owner's Agreement

This plan has been prepared to comply with the requirements set forth in the City of Dayton's Stormwater Ordinance (Ordinance Chapter 54). I certify that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I agree that I will maintain the post-construction water quality measures outlined within the following manual, and submit a quarterly maintenance report to the City of Dayton, Department of Water. Any changes to the post-construction water quality measures must be submitted to the Department of Water for approval, and a revised operations and maintenance manual must be submitted.

According to the Ohio EPA Permit No: 1P100003 Dayton MS4 NPDES Permit:

- The Permittee shall ensure the long-term operation and maintenance of BMPs. The Permittee shall ensure that structural post-construction BMPs are properly installed and maintained in perpetuity.
  - a. The Permittee shall require the owner or operator of any new development or redevelopment site to implement and submit a maintenance agreement addressing requirements for any structural measuring installed.
  - b. The agreement or easement shall allow the Permittee access to conduct inspection of the storm water structural control measures and account for transfer of responsibility in leases and/or deeds.
  - c. The agreement shall allow the Permittee to perform any necessary maintenance or corrective actions neglected by the property owner/operator, and bill or recoup cost from the property owner/operator when the owner/operator has not performed the necessary maintenance within thirty (30) days of notification by the Permittee.
  
- The Permittee shall require that property owners or operators provide verification of maintenance for the approved storm water structural control measures. Verification shall include one or more of the following as applicable:
  - a. The owner or operator's signed statement accepting responsibility for maintenance with a provision for transferring maintenance responsibility if the property is legally transferred to another party; and/or
  - b. Written conditions in the sales or lease agreement that the recipient to assume responsibility for maintenance: and/or
  - c. Written conditions in project requirements, covenants and restrictions for residential properties assigning maintenance responsibility to a homeowner's association, or group for maintenance of structural and treatment control storm water management practices.

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Owner's Name (Printed)

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Title

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Signature

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Date

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Address

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Phone Number

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Email

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Maintenance Contact

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Address

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Phone Number

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Email

**APPENDIX B**  
**POST CONSTRUCTION STORM WATER REQUIREMENT DESIGN GUIDANCE**

**Appendix B - Post Construction Storm Water Requirements:**

Appendix B functions as a tool to help developers and designers implement the City of Dayton’s post construction storm water management program. This section includes 1) guidance on how to select non-structural post construction storm water best management practices (BMPs) and 2) guidance on how to select, design, and maintain structural post construction storm water BMPs. Temporary soil erosion and sedimentation control BMPs are also discussed in this section.

To incorporate storm water management effectively into a site design, it is essential to consider storm water during the early planning stages and during design to successfully implement storm water BMPs during construction and after construction.

Subsections within Appendix B include the following:

- B1 Storm Water Non-Structural Site Design Techniques
- B2 Select Temporary Soil Erosion and Sediment Control Techniques
- B3 Selecting the Appropriate Storm Water Best Management Practices for Dayton
- B4 Best Management Practices (BMPs) – Suitability, Design, and Maintenance Elements

B1, Storm Water Non-Structural Site Design Techniques, is comprised of BMPs that must be considered in the early planning stage. The non-structural BMPs presented in this section include the following:

- Conservation Development
- Site Reforestation
- Wetland Setback
- Stream Setback
- Soil Amendments/Tilling
- Disconnection of Impervious Cover
- Rooftop Disconnection
- Reduced Street Width
- Reduced Sidewalks
- Smaller and Vegetated Cul-de-sac
- Shorter Driveways
- Modified Parking Lots

B2, Select Temporary Soil Erosion and Sediment Control Techniques, is devoted to those storm water BMPs implemented temporarily during construction to minimize the movement of soil off-site. The BMPs in this section include the following:

- Pre-Construction Planning
- Tree and Natural Area Preservation
- Runoff Control
- Sediment Control
- Soil Stabilization
- Inspection and Maintenance

Structural post construction storm water BMPs are addressed in B3, Selecting the Appropriate Storm Water Best Management Practice for Dayton, and in B4, BMP – Suitability, Design, and Maintenance Elements. The specific BMPs in these sections include the following:

- Infiltration
- Vegetated Swales and Filter Strips
- Dry Extended Detention Basin
- Wet Extended Detention Basin
- Wetland Extended Detention Basin
- Bioretention (Rain Gardens)
- Pervious Pavement Systems
- Green Roofs
- Cisterns (Rain Barrels)
- Manufactured Devices

### **Flow Chart Description (Figure B-1)**

To understand Appendix B as a whole, a flow chart has been developed depicting the various subsections within Appendix B and how they relate to one another. Refer to Figure B-1 for the flow chart. B1, B2, and B3 are intended to be stepped through with the outcome of each section being one or more storm water BMPs suitable for the storm water goals of the site.

B3 is somewhat more complex than B1 and B2 in that there are two stages of BMP selection, 1) Treatment Elements followed by 2) Site Conditions. A designer should first consider the six treatment elements, selecting appropriate BMPs for each applicable treatment element and ensuring that the selected BMPs satisfy all treatment elements. To ensure all treatment elements are satisfied, it may be necessary to re-look at BMP selection. A combination of BMPs dispersed throughout the site or located in series may be the best option to address a given situation. Once all applicable treatment elements are satisfied, the designer should ensure that the selected BMPs are suitable for the site conditions. This may prompt additional iterations of BMP selection until all elements are satisfied and site conditions are not prohibitive. When satisfactory BMPs have been selected, the designer may proceed to B4 to begin designing the BMP(s). B4 may also be useful in providing alternative BMP designs that meet the site conditions.

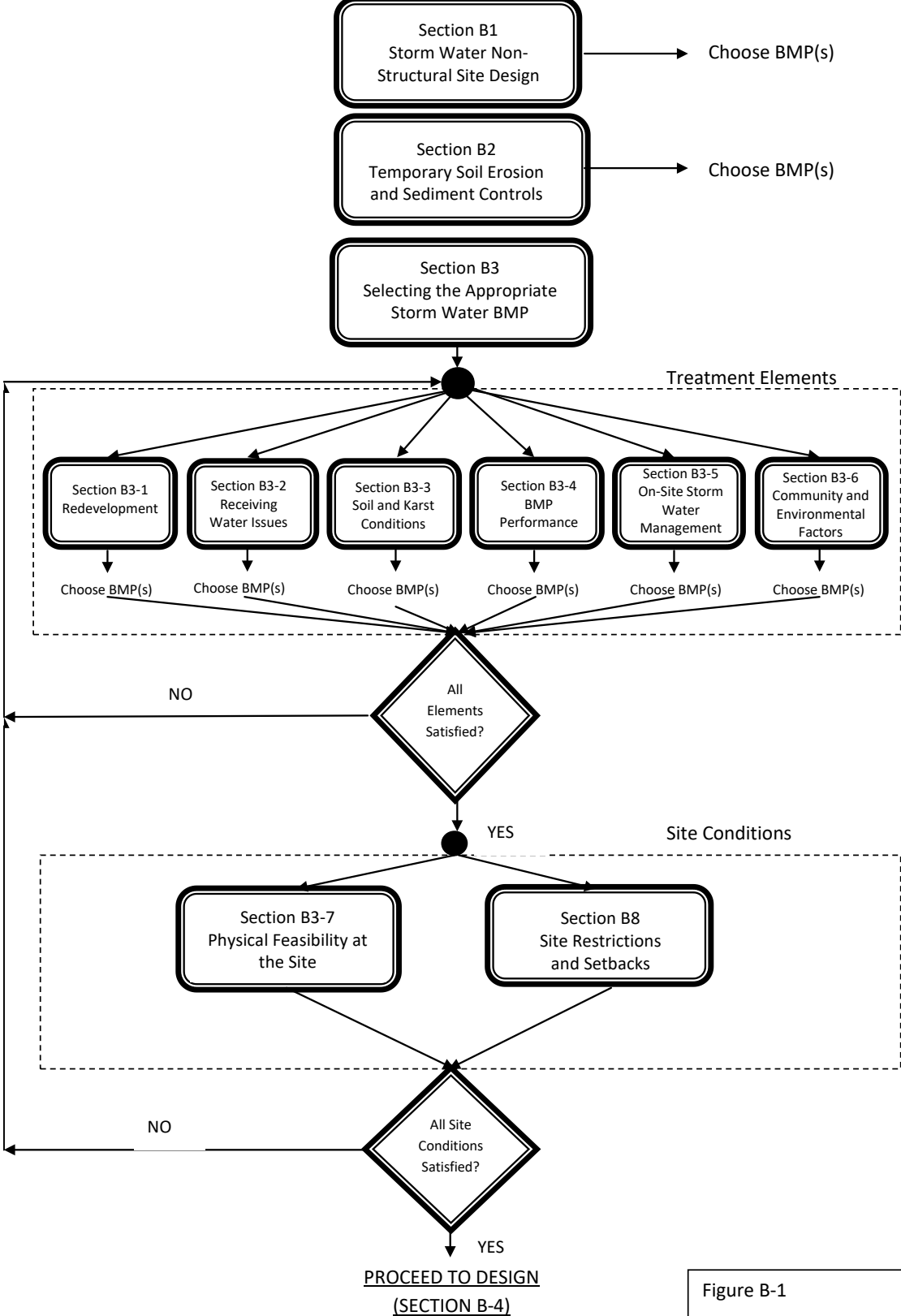


Figure B-1  
Site Development Storm Water  
Management Flow Chart

## **Section B1 - Storm Water Non-Structural Site Design Techniques**

A range of storm water non-structural site design techniques should be considered during the planning and design phases of every development and redevelopment project to minimize storm water runoff impacts to surface waters. These techniques, when implemented in coordination with one another, can approximate predevelopment hydrology, improve water quality, reduce the generation of storm water runoff, and reduce construction costs. Each site comes with different restrictions and attributes and techniques must be chosen on a case-by-case basis. These techniques are not only better for water quality, but if chosen with care, are likely to provide a more attractive residential, commercial, or industrial development.

An example of a storm water non-structural site design might be to 1) set aside 30% of the land for open space (as contiguous as possible), 2) cluster buildings in one area 3) provide a swale system rather than storm sewers, and 4) discharge roof drains to unchannelized green areas. Numerous possibilities exist for designing a site that reduces its impact on surface waters.

Section B1 includes storm water non-structural site design technique descriptions (section B1-1) and comparative information (section B1-2) to assist in planning and design of future developments.

### **B1-1 Technique Descriptions**

#### **1) Conservation Development (OH DNR 2006)**

Conservation Development (sometimes referred to as open space design) helps to maintain predevelopment hydrology by protecting natural areas which promote infiltration. Predevelopment hydrology refers to the natural flow of water on the site before being disturbed. During site plan development, natural areas including forests, water bodies, drainage ways, prairies, wetlands, floodplains, ridges, and steep slopes are delineated as preserved open space. Greater than 40% of the site should be allocated to permanent open space. Buildings and roads are then located in a logical manner throughout the rest of the site. Site plan layout should also be cognizant of open space planning in surrounding areas to try to interconnect natural areas and farmlands as much as possible.

#### **2) Site Reforestation (MN PCA 2006)**

Site reforestation encourages the planting of trees in cleared areas of the development site. This can either compensate for trees that were cleared from the site for construction, or it can provide additional trees on existing turf or barren ground. Increasing the net amount of foliage on the site provides many storm water benefits including a clear goal of establishing a mature forest canopy that can intercept rainfall, maximize infiltration, and decrease the risk of soil erosion.

#### **3) Wetland Setback (OH DNR 2006 and MN PCA 2006)**

A wetland is defined as an area that is saturated by enough water to be dominated by vegetation adapted for life in saturated soil. In Ohio, wetlands include swamps, marshes, fens, bogs, and other similar areas. Wetlands are best identified in a development/redevelopment site through delineations performed by wetland scientists/engineers.

A wetland setback, or buffer, is a vegetative setback between the development and a wetland, pond, lake, or water quality pond. The setback physically protects the wetland from further disturbance or encroachment while also providing a storm water filter. A setback can be designed

with a depression area on the outer boundary to capture the storm water, followed by a grass filter strip designed for sheet flow conditions to improve water quality. The filter strip can then discharge to a wider forest or shrub buffer that infiltrates the water or provides further treatment. In this way, surface flow is transferred to subsurface flow before it reaches the wetland. Vegetation should be chosen carefully by a landscape architect, botanist, or native plant dealer to ensure that the plants are suitable for the climate and conditions of the site.

The wetland setback width depends on the Ohio EPA classification of the wetland as defined in Ohio Administrative Code 3745-1-54, but ranges between 120 and 25 feet.

#### 4) Stream Setback (OH DNR 2006 and MN PCA 2006)

Similar to the wetland setback, a stream setback is a riparian buffer situated between a development site and a stream/river. The setback will minimize property damage and protect water quality by providing an area for bank flooding, meander mitigation, and stream processes to occur. Stream setbacks encourage stream stability, wildlife habitat, and water quantity and quality functions.

Per Ohio EPA the stream setback width is a total width that crosses the channel and is calculated empirically according to the drainage area. The setback area is a combination of two overlapping distances; 1) the streamway distance estimated to accommodate the meander belt and 2) the minimum distance from the channel bank. Refer to the Ohio DNR Rainwater and Land Development Manual for details on calculating stream setback. Similar to wetlands, a stream setback can be designed with a depression area on the outer boundary to capture the storm water followed by a grass filter strip designed for sheet flow conditions to improve water quality. The filter strip can then discharge to a wider forest or shrub buffer that infiltrates the water or provides further treatment. This ensures that water is not concentrated when entering the stream. Native vegetation, preferably forested should be used in the setbacks.

The stream setback area should be clearly defined on the site plans as well as demarcated on site during construction.

#### 5) Amended Soils and Tilling (MN PCA 2006)

To promote infiltration and thus predevelopment hydrology, soils can be amended and tilled (12 to 24 inches) to recover soil porosity and build density that was lost on site due to excavation and compaction. This is typically done on grassy lawns where construction has disturbed soil structure and caused highly compacted soils. Soil amendments or conditioners such as compost, topsoil, sand, lime, and gypsum can be used depending on the purpose of the amendment and what plants will be used on the lawn. Different organic material compositions are needed for the success of different plant covers. Amendments can be engineered to improve water holding capacity, and fibers can be used as amendments for structural support to prevent compaction. Using construction practices that prevent mechanical compaction of the soil and encourage tilling is essential to promoting infiltration.

#### 6) Disconnection of Surface Impervious Cover (MN PCA 2006)

The goal of disconnecting surface impervious cover is to spread runoff from impervious areas to adjacent pervious areas, where filtering and infiltration occur, and to reduce the rate and volume of runoff. Disconnections may be restricted based on the length, slope, and soil infiltration rate of

the adjacent pervious areas. Minor grading may be needed to promote sheet flow and vegetative filtering in the pervious areas.

7) Rooftop Disconnection (MN PCA 2006)

Instead of connecting roof drains to the sanitary or storm sewer system, they should be directed to discharge over lawns where the runoff can be filtered and infiltrated. Roof drains can also be directed to rain gardens, rain barrels, and dry wells; with the exception that dry wells are not allowed in Well Field Protection Areas per Section 150.363, Well Field Protection Districts, of the Revised Code of General Ordinances (R.C.G.O.) Zoning Regulations.

8) Reduce Impervious Surfaces (OH DNR 2006 and MN PCA 2006)

Impervious areas are surfaces, such as concrete or asphalt, which do not allow water to infiltrate into the soil base. In developed areas, impervious surfaces are the largest cause of increased storm water and subsequent water pollution. Several techniques are commonly used to effectively reduce the total area of rooftops, parking lots, streets, sidewalks, and other impervious covers. The overall goal of this technique is to reduce the impervious surface area and/or discharge impervious areas to pervious areas that will mimic predevelopment hydrology. Specific ideas for impervious surface reductions include the following:

*a. Streets*

Use the narrowest possible street width as allowed by City ordinance. Narrower residential streets would provide cost savings for construction and maintenance as well as improve pedestrian safety by reducing traffic speeds.

*b. Sidewalks*

Use minimal sidewalk widths as allowed by City ordinance. In addition, the following methods could be used for sidewalks to effectively decrease impervious areas and runoff:

- Require sidewalks on only one side of the road and set them back from the road to allow opportunities for infiltration.
- Disconnect sidewalks so that they drain to lawns or landscaping instead of directly to the storm sewer system.
- Use stepping stones instead of traditional sidewalks in areas of low traffic.
- Use pavers with permeable bases that allow infiltration and can be used instead of concrete.

*c. Cul-de-Sacs*

Use the minimum cul-de-sac diameter as allowed by City ordinance. Some additional alternatives include:

- Landscape an area in the middle of the cul-de-sac and turn it into a bioretention cell to treat storm water runoff.
- Use a ring road instead of a cul-de-sac.
- Use a T-shaped turnaround (or “hammerhead turnaround”).

*d. Driveways*

Use the minimum front yard setback as allowed by City ordinance. Other driveway alternatives to decrease the amount of impervious surfaces include:

- Reduce driveway width.
- Use permeable driveway surfaces such as porous pavement.
- Design shared driveways.

*e. Parking Lots*

Use the minimum parking space and aisle requirements as allowed by City ordinance. In addition, the following alternatives would benefit storm water quality:

- Provide compact car spaces.
- Use pervious pavement.
- Incorporate one-way parking lanes.
- Create storm water “islands” in traffic islands or landscaped areas.
- Utilize non-paved areas for additional overflow parking.
- Incorporate trees into the design to provide shade which reduces runoff temperatures.
- Use grass reinforced areas for maintenance and emergency access.

**B1-2 Comparative Information**

To assist planners and designers in incorporating storm water non-structural site design techniques into their projects, Table B-1 provides comparative information for various techniques. In addition, the techniques are organized into two categories; 1) techniques that help to approximate predevelopment hydrology and 2) techniques that reduce the storm water runoff volume from a developed site. Ideally, a combination of techniques from the two groups would be incorporated into a site design. The following describes each of the column headings and their contents:

1) What are the potential **cost savings** for developers?

Many storm water non-structural site design techniques can result in significant cost savings for developers during construction in the form of reduced infrastructure costs, more available land for development, higher and faster sales, and lower long-term maintenance costs. Table B-1 ranks the potential cost savings for each technique, as being high, medium, or low.

2) How **easy is it to implement** the technique in most communities?

Some storm water non-structural site design techniques are becoming or have become standard practices, while others are newer and more difficult to adopt. Table B-1 rates how easy it is to implement each technique given local codes and design guidelines. Techniques denoted as *experimental* are not included in current design guidelines and may involve a time-consuming and uncertain approval process. *Required* techniques are required under local ordinance and *promoted* techniques are actively encouraged. *Constrained* techniques are governed by local and in some cases state codes so designers should always refer to applicable codes and ordinances for design requirements.

3) What is the most **appropriate land use** for the techniques?

The nature of the proposed land use at a site often influences the kinds of storm water non-structural site design techniques that can be applied. Table B-1 presents a general indication of the most appropriate land use(s) for each technique. Land uses indicated in the table include Residential, Commercial/Office, and Industrial.

**Table B-1 Storm Water Non-Structural Site Design Techniques to Incorporate into Site Planning and Design**

Storm Water Non-Structural Site Design Techniques	Cost Savings	Ease of Implementation	Appropriate Land Use <sup>1</sup>
Conservation Development	High	Promoted	All
Site Reforestation	Medium	Promoted	All
Wetland Setback	High	Required	All
Stream Setback	High	Required	All
Soil Amendments/Tilling	Low/Med	Experimental	All
Disconnection of Surface Impervious Cover	High	Experimental	All
Rooftop Disconnection	High	Required	All
Reduced Street Width	High	Constrained	All
Reduced Sidewalks	High	Constrained	Residential, C/O
Smaller and Vegetated Cul-de-sac	High	Constrained	Residential
Shorter Driveways	High	Constrained	Residential
Modified Parking Lots	High	Constrained	C/O, I
<sup>1</sup> <u>Land Use Codes</u> I: Industrial development Residential: Residential development, any density C/O: Commercial/office including institutional uses			

**Section B2 - Select Temporary Soil Erosion and Sediment Control Techniques**

Construction sites can be a major source of sediment and non-point source pollutants if soils are exposed and therefore susceptible to erosion. Effective application of temporary soil erosion and sediment controls is an essential element of construction site planning and helps preserve the long-term capacity and function of the permanent storm water BMPs. Construction contractors should recognize that they may need to modify the original erosion and sediment control plan throughout the construction period as site conditions change.

Table B-2 lists temporary soil erosion and sediment control techniques that should be considered in a Storm Water Pollution Prevention Plan (SWP3) for a site. The table indicates how each technique is applied in the construction process, and provides some additional comments. More information on erosion control requirements is included in Section 6 of this document. For detailed design of temporary controls, refer to the Ohio DNR Rainwater and Land Development Manual.

**Table B-2 Temporary Soil Erosion and Sediment Control Techniques<sup>1</sup>**

Technique	Practice	How it Works	When to Apply	Comments
<b>Pre-Construction Planning</b>	Site planning and grading sequencing	Minimizes soil disturbance and unprotected exposure	Planning	Expose only as much area as needed for immediate construction.
<b>Tree and Natural Area Preservation</b>	Forest conservation and water resource buffers	Establishes protective zone around valued natural areas	Prior to earth disturbance	Buffer variable from a few feet to 100' depending upon resource being protected.
<b>Runoff Control</b>	Rock check dams	Reduce velocity of concentrated flows in small open channels	Prior to earth disturbance and as new swales are built prior to grass establishment	Not intended to trap sediment when used alone.
	Slope drain	Provides a temporary outlet to convey runoff down slope	Early in construction process and as embankments/diversions are built prior to stabilization	May include sediment traps at outlet/inlet.
	Temporary diversion	Directs sediment-laden water to a settling pond or routes clean water away from disturbed areas	Early in construction process	May increase erosion potential if not designed correctly.
<b>Sediment Control</b>	Sediment basin	Settles out sediment and controls release of runoff	Early in construction process	Refer to Ohio DNR Rainwater and Land Devel. Manual for design.
	Sediment trap	Settles out sediment for small drainage areas	Early in construction process	Refer to Ohio DNR Rainwater and Land Devel. Manual for design.
	Silt fence	Reduces sediment-laden runoff by ponding	Prior to earth disturbance	Not as effective as sediment basins/traps or diversions.
	Inlet protection	Minimizes movement of soil into drainage system	Prior to earth disturbance	Inlet devices must be inspected and maintained after every rain event.
	Filter berm	Reduces sediment-laden runoff by slowing and filtering	Early in construction process	Uses compost/mulch. Not intended for concentrated flow.
	Filter sock	Traps sediment by filtering water through a compost-filled permeable tube	Prior to earth disturbance	May handle more flow than silt fence and is more durable.

Technique	Practice	How it Works	When to Apply	Comments
<b>Soil Stabilization</b>	Construction entrances	Minimizes transport of sediment off-site	Prior to earth disturbance	Includes mechanism to dislodge soil from vehicles.
	Street sweeping	Minimizes transport of sediment off-site	On-going	Must use a vacuum-type sweeper to maintain site and do so frequently.
	Dust control	Reduces dust from exposed soils and reduces air-borne substances	On-going	May use temporary seeding, mulching, watering, wetting agents, graded soils, and wind breaks.
	Grade treatment	Minimizes rill and gully erosion	As slopes are disturbed and graded	All slopes steeper than 3:1 require treatment.
	Topsoiling, seeding, mulching	Establishes vegetation	As areas are disturbed and graded	Seed should be applied when work is not scheduled for more than 21 days.
	Sodding	Provides immediate stabilization	As areas are disturbed and graded	May be expensive.
	Erosion control products	Degradable and non-degradable manufactured materials used to stabilize bare areas	As areas are disturbed and graded	Follow manufacturer's specifications.
<b>Inspection and maintenance</b>	Inspection and follow-up maintenance	Assures that BMPs are properly installed and operating in anticipated manner	All construction phases	Inspect once per week and after every 0.5" or greater rainfall.
1 Based on information in the Ohio DNR Rainwater and Land Development Manual.				

**Section B3 Selecting the Appropriate Storm Water Best Management Practices for Dayton**

Designers need to carefully think through many factors to choose the most appropriate, effective and feasible practice(s) at a development site that will best meet local and state storm water objectives. This section presents a flexible approach to BMP selection, depicted in Figure B-1, that allows for the selection of BMPs most capable of addressing an identified problem. Selecting an inappropriate BMP for a site could lead to adverse resource impacts, friction with regulators if a BMP does not work as anticipated, misperceptions about storm water control success, and wasted time and money. Careful selection of BMPs will prevent negative impacts from installing the wrong BMP at the wrong location. In order to reduce the risk of choosing the wrong BMP, the following eight subsections should be considered in the BMP selection process. Each of these factors is addressed in this section as follows:

- ◆ **Redevelopment.** As Dayton is largely built-out, development within the city limits will likely be redevelopment with the most challenging areas being in the congested downtown business and residential areas. Although storm water treatment options may seem more limited in congested areas, suitable BMPs are available. Refer to section B3-1.
- ◆ **Receiving Water Issues.** Depending on the nature of the receiving water (ground water, impaired surface water, or wetland), certain BMPs may be promoted, restricted or prohibited, or special design or sizing criteria may apply. Refer to section B3-2.
- ◆ **Soil and Karst Conditions.** The soils in Dayton are predominately a mixture of urban fill and well drained loamy soil, which is generally well-suited to infiltration practices. There are, however, some areas on the west side of Dayton that are situated over shale and limestone; potential karst areas. Designers need to be aware of the soil on their site. Refer to section B3-3.
- ◆ **Best Management Practice Performance.** Different types of BMPs perform differently with regard to pollutant removal. At this time there is no water quality requirement for effluent pollutant concentrations but this may change in the future. Data regarding performance on BMP types continually grows and becomes more valid as more studies are conducted and reported. Rather than repeat data within this document, compilations of data are referenced for designer perusal. Refer to section B3-4 for more information.
- ◆ **On-site Storm Water Management Approach.** Although Dayton prefers storm water management to mimic predevelopment hydrology, it is recognized that this approach may not always be feasible and larger BMPs may be necessary. Designers can assess a BMPs ability to handle larger events. Refer to section B3-5.
- ◆ **Community and Environmental Factors.** Each group of BMPs provides different economic, community, and environmental benefits and drawbacks. Designers need to carefully weigh these factors when choosing BMPs for the site. Refer to section B3-6.
- ◆ **Physical Feasibility at the Site.** Each development site has many physical constraints that influence the feasibility (cost) of different kinds of BMPs; designers confirm feasibility by assessing physical factors at the site. Refer to section B3-7.
- ◆ **Site Restrictions and Setbacks.** Check to see if any environmental resources or infrastructure are present that will influence where a BMP can be located at the development site. Refer to section B3-8.

## **Treatment Elements**

The following subsections assist the designer in considering important issues that help determine appropriate BMPs for developing sites in Dayton including receiving waters issues, soils, and redevelopment. In some situations, specific pollutant effluent concentrations may be required or treatment volume may be a priority, in which case the designer may refer to subsections for BMP performance and storm water management. As shown in Figure B-1, the treatment elements below are not hierarchically arranged. BMP selection for each of the following elements is stand-alone and some may not be applicable to a particular project.

### **B3-1 Redevelopment**

Redevelopment refers to development conducted at a site that has already been disturbed and developed. As Dayton is largely built-out, apart from annex possibilities, much of the development within the city limits will be redevelopment. Table B-3 provides an assessment of how suitable each BMP is for storm water treatment/management within a given redevelopment type. The redevelopment types in the table target Dayton's more congested areas where available space and pervious area are limited. In areas where space is not constrained, selecting appropriate BMPs is usually not as restricted.

The redevelopment types in Table B-3 include Urban/Central Business, Mature Residential/Commercial, Urban Industrial, and Urban Road; the first three redevelopment types being deviated from Dayton's zoning map. Go to <http://www.cityofdayton.org/departments/pcd/planning/Pages/ZoningMap.aspx> for a copy of the map. The assessments are termed "Not recommended," "Favorable," and "Conditional."

#### 1) Urban/Central Business

In Dayton, Urban/Central Business redevelopment corresponds to the Urban Business District (UBD) and the Central Business District (CBD) from Dayton's zoning map. These districts make up the downtown district and are characterized by zero setbacks, pedestrian-oriented storefronts and sidewalks, and mix-use businesses. Residential development is encouraged. These districts are almost completely impervious and adding "green" is a challenge. Suitable post-construction BMPs may be underground manufactured devices, green roofs, pervious pavement, or bioretention.

#### 2) Mature Residential/Commercial

Mature residential and commercial redevelopment refers to areas very near the downtown district. Historical preservation is a priority and pedestrian-oriented commercial properties are vital to the area. This redevelopment type corresponds to the Dayton Zoning Districts including Mature Single-Family District, Mature Multi-Family District, and Mature Neighborhood Commercial District. Eclectic residential and commercial areas may also be applicable. Similar to the downtown district, this area is limited in available space but not quite as densely built. Opportunities may be available to substitute green storm water conveyance, such as vegetated swales, in lieu of conventional storm pipe. These areas also provide an opportunity for residential rain gardens and cisterns, which provides a means of watershed stewardship to the neighborhood and treatment of pollutants commonly found in lawns such as fertilizers and pet waste.

3) Urban Industrial

Urban industrial includes both Light Industrial and General (heavy) Industrial Districts. In Dayton, these areas tend to be located near the rivers and along the railroad corridor. Extra precautions should be taken when operating near a water body which should be considered during early planning as addressed in B1, **Section B1 - Storm Water Non-Structural Site Design Techniques**. In general, industrial areas have high impervious cover and may contain contaminants in the soil. Infiltration BMPs are considered conditional based on proximity to water bodies and soil contamination. There may also be more available space than the typical urban lots.

4) Urban Roads

Urban roads often have limited right-of-way and thus are limited in their options to treat runoff. BMPs conducive to treating the water quality volume from the roads are roadside swales, bioretention, manufactured devices, and infiltration trenches, provided the trench is designed to move water away from the road base. If a storm sewer system is already in place, BMPs could be installed to capture the water quality volume and then overflow into the existing drainage system. Cost savings happens when a road can be redesigned with less pavement and use of existing storm sewers.

**Table B-3 Redevelopment**

<b>BMP</b>	<b>Urban/Central Business</b>	<b>Mature Residential/Commercial</b>	<b>Urban Industrial</b>	<b>Urban Roads</b>
<b>Infiltration Trench</b>	Not Recommended	Conditional	Conditional	Conditional
<b>Infiltration Basin</b>	Not Recommended	Not Recommended	Conditional	Not Recommended
<b>Vegetative Swales and Filter Strips</b>	Not Recommended	Conditional	<b>Favorable</b>	<b>Favorable</b>
<b>Dry Extended Detention Basin</b>	Not Recommended	Not Recommended	<b>Favorable</b>	Not Recommended
<b>Wet Extended Detention Basin</b>	Not Recommended	Not Recommended	<b>Favorable</b>	Not Recommended
<b>Wetland Extended Detention Basin</b>	Not Recommended	Not Recommended	<b>Favorable</b>	Not Recommended
<b>Bioretention (Rain Gardens)</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>

<b>BMP</b>	<b>Urban/Central Business</b>	<b>Mature Residential/Commercial</b>	<b>Urban Industrial</b>	<b>Urban Roads</b>
<b>Pervious Pavement Systems</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>	Conditional
<b>Green Roofs</b>	<b>Favorable</b>	Conditional	<b>Favorable</b>	NA
<b>Cisterns (Rain Barrels)</b>	Conditional	<b>Favorable</b>	Conditional	NA
<b>Manufactured Devices</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>

**B3-2 Receiving Water Issues**

Designers should understand the nature and regulatory status of nearby waters, including ground water that will receive runoff from the development site. To aid in BMP selection, receiving waters fall into three categories: Well Field Protection Areas (WFPA), wetlands, and impaired waters. See Figure B-1 showing potential receiving water locations.

The type of the receiving water strongly influences the preferred BMP to be used, and in some cases, may trigger increased treatment requirements. For example, WFPAs may require BMPs with containment components such as impervious liners. BMP assessments for the three receiving water categories are presented in Table B-4 and described below. The assessments are termed “Not recommended,” “Favorable,” and “Conditional.”

1) Is the site within a Well Field Protection Area?

Sites located in the Miami or Mad River WFPAs require BMPs that do not have the potential to contaminate the aquifer but at the same time function to recharge the aquifer. For more description of WFPAs, refer to Section 150.363, Well Field Protection Districts, of the R.C.G.O. Zoning Regulations. Table B-4 indicates the kinds of BMPs that can meet these ground water protection challenges. Most of the BMPs are indicated as “Conditional” meaning that careful consideration must be given to the design of the BMPs, always looking at potential pollutants in the runoff and the distance of the bottom of the BMP to the water table. Many of the BMPs may be designed with a liner if potential pollutant loads are high, but it is always best to try to approximate the predevelopment hydrology and provide a treatment mechanism, such as filtering through a soil media, for the runoff followed by an opportunity to infiltrate to the ground water.

2) Does the site drain to a wetland?

Wetlands can be indirectly impacted by upland development sites, so designers should choose BMPs that can maintain wetland hydroperiods and limit phosphorus loads. As shown in Table B-4, several BMPs provide infiltration and extended detention storage that protect natural wetlands from increased storm water runoff and nutrient loads from upland development.

3) Does the site drain to an “impaired water”?

In Dayton, the Mad River, Great Miami River, and Stillwater River are all listed on the Ohio EPA 303(d) list for impaired waterbodies. BMP selection becomes very important when a development site drains to a receiving water that is not meeting water quality standards and may be subject to a total maximum daily load (TMDL). The designer may need to choose BMPs that achieve a more stringent level of removal for the listed pollutant(s) of concern. Table B-4 compares the capability of BMPs to remove a range of common pollutants that cause water quality impairments.

**Table B-4 Receiving Water Factors**

<b>BMP</b>	<b>Well Field Protection Area (WFPA)</b>	<b>Wetlands</b>	<b>Impaired Waters</b>
<b>General Location</b>	Greater than 3 feet above seasonally high water table	Outside setback from wetlands	Outside of shoreline or stream setback
<b>Infiltration (Trench and Basin)</b>	Conditional	<b>Favorable</b>	<b>Favorable</b>
<b>Vegetative Swales and Filter Strips</b>	Conditional	Conditional	Conditional
<b>Dry Extended Detention Basin</b>	Conditional	Conditional	Conditional
<b>Wet Extended Detention Basin</b>	Conditional	<b>Favorable</b>	Conditional
<b>Wetland Extended Detention Basin</b>	Conditional	<b>Favorable</b>	Conditional
<b>Bioretention (Rain Gardens)</b>	Conditional	<b>Favorable</b>	<b>Favorable</b>
<b>Pervious Pavement Systems</b>	Conditional	Conditional	Conditional
<b>Green Roofs</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>
<b>Cisterns (Rain Barrels)</b>	<b>Favorable</b>	<b>Favorable</b>	<b>Favorable</b>

<b>BMP</b>	<b>Well Field Protection Area (WFPA)</b>	<b>Wetlands</b>	<b>Impaired Waters</b>
<b>Manufactured Devices</b>	Conditional	Not Recommended	Conditional
<p>Note: The assessments made in this table are done so in consideration of the performance of individual BMPs. Many enhanced treatment possibilities exist with combinations of BMPs in series.</p>			

**B3-3 Identifying Soils and Karst Conditions**

The soils in Dayton are predominately a mixture of urban fill and well drained loamy soil, which is generally well-suited to infiltration practices. There are, however, some areas across Dayton that are situated over dolomite; potential karst areas. Refer to the Ohio DNR Karst Area Map at [www.dnr.state.oh.us/portals/10/pdf/karstmap.pdf](http://www.dnr.state.oh.us/portals/10/pdf/karstmap.pdf) and the Miami Conservancy District’s GIS application at <http://gis.miamiconservancy.org/GISApplication/> for more detailed information. See Figure B-1 showing karst feature areas within the city limits. The concern with shallow soils and karst areas is that they provide a direct outlet to an aquifer with no filtration opportunities. Although Dayton has some potential karst areas, for the most part, the soils covering them are not shallow (at least 20 feet of soil) but a developer should verify this when planning a site.

Understanding the specific soils on the site is important in choosing a storm water BMP. A helpful source of soil information can be found on the United States Department of Agriculture (USDA) web site at <http://websoilsurvey.nrcs.usda.gov/app/>. Table B-5 provides general recommendations on which BMPs may be favorable on the well drained loamy soils found in Dayton. The recommendations are termed “Not recommended,” “Favorable,” and “Conditional.”

**Table B-5 Soils**

<b>BMP</b>	<b>Areas with Well Drained Soils<sup>1</sup></b>	<b>Comments</b>
<b>Infiltration (Trench and Basin)</b>	<b>Favorable</b>	
<b>Vegetative Swales and Filter Strips</b>	<b>Favorable</b>	
<b>Dry Extended Detention Basin</b>	<b>Favorable</b>	
<b>Wet Extended Detention Basin</b>	Conditional	Would need an impervious layer.
<b>Wetland Extended Detention Basin</b>	Conditional	Would need an impervious layer.
<b>Bioretention (Rain Gardens)</b>	<b>Favorable</b>	
<b>Pervious Pavement Systems</b>	<b>Favorable</b>	
<b>Green Roofs</b>	<b>Favorable</b>	
<b>Cisterns (Rain Barrels)</b>	<b>Favorable</b>	
<b>Manufactured Devices</b>	<b>Favorable</b>	
<sup>1</sup> These recommendations assume that the seasonally high ground water table is at least 3 feet away from the bottom of the BMP and karst features are not a concern.		

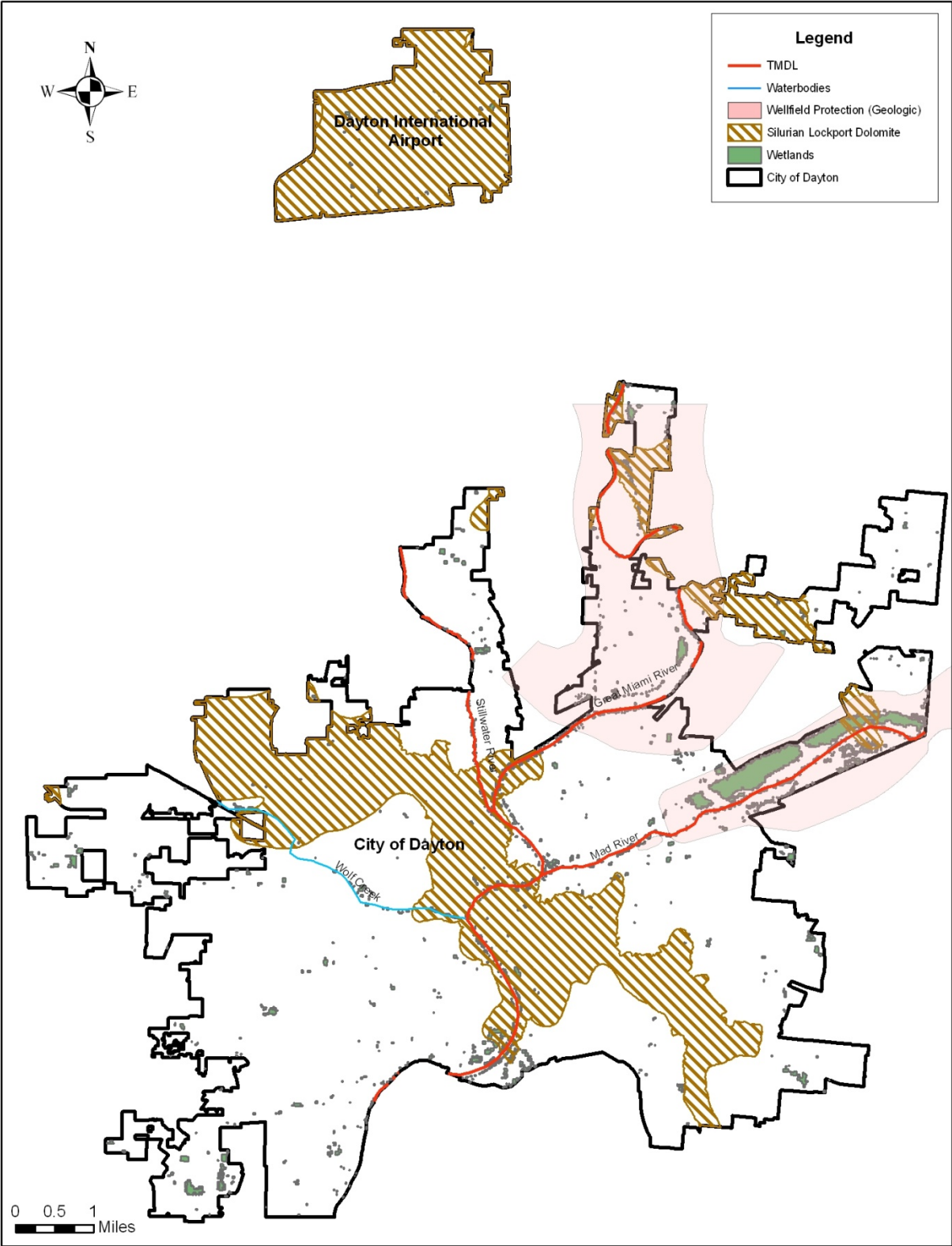


Figure B-1 Receiving Water and Karst Feature Areas

**B3-4 Evaluating Best Management Practice Performance**

Different types of BMPs perform differently with regard to pollutant removal. If discharge from a site must comply with a Total Maximum Daily Load (TMDL) initiated for one of Dayton’s impaired rivers, a BMP or a combination of BMPs may need to be selected based on their ability to remove the pollutant of concern. Refer to the Ohio EPA TMDL web site at <http://www.epa.state.oh.us/dsw/tmdl/> for the latest TMDL Reports approved by the U.S. EPA and to determine if any pollutant limits exist on that portion of the river in Dayton.

Data regarding performance of BMPs continually grows and becomes more valid as more studies are conducted and reported. Rather than repeat data within this document, the following compilations of BMP data listed in Table B-6 should be referenced. These compilations are recommended for their diligence in collecting quality data and the number of studies downloaded to the databases.

**Table B-6 References for BMP Pollutant Removal Performance**

Reference	Database	BMPs <sup>1</sup>	Analyzed Pollutants
Geosyntec Consultants and Wright Water Engineers. 2007. “Analysis of Treatment System Performance.”	International Stormwater Best Management Practices Database <i>Instated in 1999.</i> <a href="http://www.bmpdatabase.org">www.bmpdatabase.org</a>	Detention basin Biofilter Hydrodynamic device Media filter Retention pond Wetland basin Wetland Channel	Total Suspended and Dissolved Solids Total and Dissolved Phosphorus Total Nitrogen Total Kjeldahl Nitrogen Total Nitrate Nitrogen Total Nitrate + Nitrite Total and Dissolved Zinc Total and Dissolved Lead Total and Dissolved Copper
Center for Watershed Protection. 2007. “National Pollutant Removal Performance Database, Version 3.” <a href="http://www.cwp.org">www.cwp.org</a>	National Pollutant Removal Performance Database <i>Instated in 2000.</i>	Dry ponds Wet ponds Wetlands Filtering Bioretention Infiltration Open channels	Total Suspended Solids Total and Dissolved Phosphorus Total Nitrogen Nitrate Copper Zinc Bacteria
<sup>1</sup> Correlation in BMP names (database = <b>Dayton</b> ) Detention basin = Dry pond = <b>Dry extended detention basin</b> Biofilter = <b>Bioretention (Rain Gardens)</b> Hydrodynamic device = <b>Manufactured device</b> Media filter = <b>no comparison</b> Retention pond = Wet pond = <b>Wet extended detention basin</b> Wetland basin = Wetlands = <b>Wetland extended detention basin</b> Wetland channel = <b>no comparison</b> Infiltration = <b>Infiltration trench and pervious pavement</b> Open channel = <b>Vegetated swale</b>			

**B3-5 Determining the On-site Storm Water Management Approach**

Dayton prefers that storm water be managed to mimic predevelopment hydrology with dispersed smaller storm water BMPs rather than one large detention or retention basin. Nevertheless, in some cases this approach may not be feasible and BMPs must be chosen to handle larger storm events.

In this section, BMPs are assessed by their ability to handle flows/volumes from three levels of storm water management; 1) water quality volume (WQv) treatment (as defined by Ohio EPA), 2) channel protection (> 1-year event), and 3) peak discharge attenuation (>10-year or 100-year events). Designers first need to determine what requirements or priorities fall within the development site and then what type or combination of BMPs will likely meet the requirements or fulfill priorities. To meet all aspects of storm water management, a combination of BMPs arranged in a series, or inclusion of pre-treatment/post-treatment BMPs may be necessary. Refer to Table B-7 for an assessment of the BMPs independently.

1) Can the BMP treat the water quality volume?

All of the post-construction structural BMPs in this document can be designed to treat the WQv as defined in the Ohio DNR Rainwater and Land Development Manual with the exception of residential cisterns. Residential cisterns are typically used as a supplemental BMP to capture runoff for reuse and ultimately infiltration but currently they are rarely sized to capture a specific volume of roof runoff.

2) Can the BMP provide channel protection?

In order for BMPs to provide channel protection to protect streams, they must extend detention for long periods of time. This requirement limits the number of BMPs that can effectively provide channel protection, which is typically greater than the 1-year flow event. Alternately, if storm water is managed near the source through storm water non-structural site design techniques and structural BMPs, a channel protection BMP may not be necessary.

3) Can the BMP effectively control peak discharges from overbank floods?

Generally, only basins have the capacity to control peak discharge events that cause flooding at the site (e.g., 10-year and 100-year recurrence intervals). Typically natural floodplains are best suited to control overbank flooding, but in areas where the floodplain is developed, other measures may be required.

**Table B-7 Storm Water Management Suitability**

<b>BMP</b>		<b>Water Quality Volume</b>	<b>Channel Protection</b>	<b>Peak Discharge</b>
<b>Infiltration</b>	<b>Trench</b>	Yes	No	No
	<b>Basin</b>		Yes	Yes
<b>Vegetative Swale and Filter Strip</b>		Yes	No	No
<b>Dry Extended Detention Basin</b>		Yes	Yes	Yes
<b>Wet Extended Detention Basin</b>		Yes	Yes	Yes
<b>Wetland Extended Detention Basin</b>		Yes	Yes	No
<b>Bioretention (Rain Gardens)</b>		Yes	No	No

<b>BMP</b>	<b>Water Quality Volume</b>	<b>Channel Protection</b>	<b>Peak Discharge</b>
<b>Pervious Pavement</b>	Yes	No	No
<b>Green Roofs</b>	Yes	No	No
<b>Residential Cisterns (Rain Barrels)</b>	No	No	No
<b>Manufactured Devices</b>	Yes	No	No

### **B3-6 Consider Community and Environmental Factors**

Some BMPs can provide positive social, economic, and environmental benefits for the community, while others may have drawbacks or create nuisances. Table B-8 presents a comparative assessment of each BMP as it relates to land/area required, cost of construction, maintenance burden, possible site constraints, community acceptance, and pollutant removal. Assessments are made in terms of high, medium, and low.

#### 1) Land/Area Required

Often, the amount of land required to install a BMP determines its feasibility within a development plan. Additionally, the larger the land requirement generally means the greater the cost.

#### 2) Cost of Construction

Table B-8 presents a very general comparison of BMP construction costs, based on the average cost of the BMP per impervious acre treated.

#### 3) Maintenance Burden

All BMPs require routine inspection and maintenance throughout their life cycle; although some are easier to maintain than others. This consideration looks at each BMP from the standpoint of the frequency and cost of scheduled maintenance, chronic maintenance problems, reported failure rates, and inspection needs. It is best to anticipate maintenance needs and create a design which caters to those needs.

#### 4) Possible Site Constraints

Site constraints are typical in urban environments where available area is minimal and underground utilities are abundant. To overcome these constraints, it may take some creativity. Other constraints may include soils, ground water table, and available right-of-way.

#### 5) Community Acceptance

Community acceptance is very important and unfortunately nearly all BMPs can create nuisance conditions if poorly designed or maintained. BMP nuisances reduce community acceptance and generate complaints, but seldom affect the pollutant removal performance of the BMP. Common nuisances include mosquitoes, geese, overgrown vegetation, floatable debris and odors. If a BMP is prone to nuisance conditions, designers should focus attention on preventing or minimizing the problem.

6) Pollutant Removal

BMPs differ in their ability to reduce pollutant load and their ability to treat various types of pollutants. When constructed in series, BMPs are very effective at removing a host of pollutants.

**Table B-8 Community and Environmental Factors**

<i>BMP</i>		<i>Land/ Area Required</i>	<i>Cost of Construction</i>	<i>Maintenance Burden</i>	<i>Possible Site Constraints</i>	<i>Community Acceptance</i>	<i>Pollutant Removal</i>
<i>Infiltration</i>	<i>Trench</i>	<i>Med</i>	<i>Low-Med</i>	<i>Med-High</i>	<i>High</i>	<i>Med</i>	<i>Med-High</i>
	<i>Basin</i>	<i>High</i>	<i>Low-Med</i>	<i>Med-High</i>	<i>High</i>	<i>Low</i>	<i>Med-High</i>
<i>Vegetative Swales and Filter Strips</i>		<i>Med</i>	<i>Med</i>	<i>Low</i>	<i>Low</i>	<i>Med</i>	<i>Low-Med</i>
<i>Dry Extended Detention Basin</i>		<i>Med</i>	<i>Low</i>	<i>Med</i>	<i>Low-Med</i>	<i>Low</i>	<i>Med</i>
<i>Wet Extended Detention Basin</i>		<i>Med</i>	<i>Low</i>	<i>Med</i>	<i>Low-Med</i>	<i>High</i>	<i>High</i>
<i>Wetland Extended Detention Basin</i>		<i>High</i>	<i>Med</i>	<i>Med-High</i>	<i>Med-High</i>	<i>High</i>	<i>High</i>
<i>Bioretention (Rain Gardens)</i>		<i>Med</i>	<i>Med</i>	<i>Med-Low</i>	<i>Med</i>	<i>High</i>	<i>Med-High</i>
<i>Pervious Pavement</i>		<i>Low</i>	<i>Med-Low</i>	<i>Med</i>	<i>Med</i>	<i>Med-High</i>	<i>Med-High</i>
<i>Green Roofs</i>		<i>Low</i>	<i>Med-High</i>	<i>Low-Med</i>	<i>Med-High</i>	<i>High</i>	<i>Med-High</i>
<i>Cisterns (Rain Barrels)</i>		<i>Low</i>	<i>Low</i>	<i>Low</i>	<i>Low-Med</i>	<i>High</i>	<i>Med</i>
<i>Manufactured Devices</i>		<i>Low</i>	<i>High</i>	<i>High</i>	<i>Med-High</i>	<i>Med</i>	<i>Med</i>

**Site Conditions**

The site condition subsections below help the designer understand some of the specific design constraints of a BMP. Based on design constraints, it may become apparent that specific conditions of the site are prohibitive to a certain BMP. For instance, a site with high groundwater may prohibit the use of an infiltration practice. In some cases, a further look into design of the BMP may reveal alternative designs that can accommodate site conditions.

### **B3-7 Assess Physical Feasibility at the Site**

At this point in the selection process, the list of possible BMPs has been narrowed and now physical factors at the site are assessed to further limit the selection process. Table B-9 indicates eight physical factors at the site that can constrain or eliminate BMPs from further consideration.

1) Is there enough space available for the BMP at the site?

BMPs vary widely in the amount of surface area they consume, which can be an important factor at constricted and costly sites. In some instances, underground BMPs may be an attractive option in highly urban areas. Typical BMP surface area needs are presented in Table B-9 as governed by contributing impervious area or total contributing drainage area.

2) Is the drainage area at the site suitable for the proposed BMP?

Table B-9 shows the minimum or maximum recommended drainage areas for each group of BMPs. Designers should strive to distribute BMPs closer to the source of runoff to be most effective. The minimum drainage area thresholds for the wet extended detention basin and wetland extended detention basin must be met to maintain the minimum water pond depth; although smaller drainage areas may be sufficient if designers can confirm the presence of ground water flow able to sustain the design depth.

3) Will soils limit BMP options at the site?

Low infiltration rates limit or preclude the use of infiltration practices. By contrast, soils with low infiltration rates are preferred for wet/wetland basins since they help to maintain permanent pools without the need for a liner. Designers should consult Table B-9 to determine minimum soil infiltration rates, if any, or preferred Hydrologic Soil Groups for each kind of BMP. Further geotechnical testing may be needed to confirm soil permeability and ground water depth.

4) Will depth to the water table constrain the proposed BMP?

Bioretention, infiltration and some filtering practices need a minimum separation distance from the bottom of the practice to the seasonally high water table for ground water protection purposes and for functionality. The Ohio EPA requires a minimum distance of three feet between the bottom of an infiltrating BMP and the seasonally high water table. Other BMPs do not require as much separation distance, although the cost and complexity of construction of most BMPs increases sharply at development sites where the water table is close to the surface.

5) Is the slope at the proposed BMP site a design constraint?

Sites with extremely steep slopes can make it difficult to locate suitable areas for BMPs. Table B-9 indicates a maximum slope for BMP installation. Designers will need to refer to or modify site grading plans to provide suitable locations for desired BMPs.

**Table B-9 Physical Feasibility at the Site** (adapted from Minnesota Stormwater Manual)

BMP		Surface Area <sup>1</sup>	Drainage Area	Soil Infiltration Rate	Depth to Seasonally High Water Table	Max. Slope <sup>3</sup>
Infiltration	Trench	Varies based on depth	>5 ac	Native soils with 0.52<f<2.4 in/hr	3 ft	15%
	Basin		>10 ac			
Filtration	Filter Strip	Negligible, except for access	5 ac max	Engineered soil media – varies as desired <sup>4</sup>	2-4 ft	20%
	Vegetative Swale	Varies based on depth	10 ac max			
Dry Extended Detention Pond		1-3%	10 ac max	A or B soils may require liner	0 ft (shallow soil limits design)	25%
Wet Extended Detention Pond		1-3%	20 ac max	A or B soils may require liner	0 ft (shallow soil limits design)	25%
Wetland Extended Detention Pond		2-4%	20 ac min <sup>2</sup>	A or B soils may require liner	0 ft	25%
Bioretention (Rain Gardens)		5-10%	0.5-2 ac preferred	Engineered soil media <sup>4</sup> Use under-drain in C, D	3 ft	20%
Pervious Pavement		80-100%	N/A	Minimum of 0.1 inch/hr	3 ft	10%
Green Roofs		80-100%	N/A	Varies by plant and media	N/A	N/A
Cisterns (Rain Barrels)		N/A	N/A	N/A	N/A	N/A
Manufactured Devices		N/A	Varies by device	N/A	N/A if contained	
<p>1. Surface area as a function of contributing impervious area, except for ponds and wetlands, where it is a function of entire drainage area.</p> <p>2. 10 acres may be feasible if ground water is intercepted and/or if water balance calculations indicate a wet pool can be sustained.</p> <p>3. Slope is defined as the slope across the proposed location of the practice.</p> <p>4. Engineered soil mixture could be designed to provide.</p>						

**B3-8 Determine Any Site Restrictions and Setbacks**

The last step in BMP selection determines if any environmental resources or infrastructure are present that will influence where a BMP can be located on the site (i.e., setback or similar restriction). Table B-10 presents an overview of site-specific considerations and where to find applicable information.

**Table B-10 Location Restrictions and Setbacks**

Factor	Considerations
<p><b>Jurisdictional Wetland</b></p> <p>U.S Army Corps of Engineers Section 404 Permit</p> <p>Ohio Department of Natural Resources Division of Surface Waters Permit</p> <p>Ohio Environmental Protection Agency 401 Water Quality Certification and Isolated Wetland Permit</p>	<ul style="list-style-type: none"> <li>• Wetlands should be delineated prior to siting storm water BMPs.</li> <li>• Demonstrate that the impact to a wetland complies with all of the following principles in descending order of priority: avoid direct or indirect impacts, minimize impact by limiting the degree or magnitude of activity, mitigate unavoidable impacts through restoration or creation.</li> <li>• Natural wetlands should not be used for storm water treatment, unless they are severely impaired, and construction would enhance or restore wetland functions.</li> <li>• Direct pipe outfalls to wetlands are restricted. The discharge of untreated storm water to a wetland must be avoided.</li> <li>• BMPs are restricted within the wetland buffer.</li> <li>• Refer to the Ohio DNR Rainwater and Land Development Manual for requirements.</li> </ul>
<p><b>Stream Channel</b></p> <p>U.S Army Corps of Engineers Section 404 Permit</p> <p>Ohio Department of Natural Resources Division of Surface Waters Permit</p> <p>Ohio Environmental Protection Agency 401 Water Quality Certification and Isolated Wetland Permit</p>	<ul style="list-style-type: none"> <li>• All waterways (including streams, ponds, lakes, etc) should be delineated prior to design.</li> <li>• BMPs should not be placed within the stream under most conditions.</li> <li>• If in-stream BMPs are used, justification of no existing practical upland treatment alternatives must be made.</li> <li>• Implement measures that reduce downstream warming.</li> <li>• Activities such as excavation, bank protection, structures, dams, and water level controls are regulated by the state.</li> <li>• Ohio EPA water quality standards apply.</li> </ul>
<p><b>Stream Buffer</b></p>	<ul style="list-style-type: none"> <li>• Structural BMPs are strongly discouraged in the stream buffer.</li> <li>• Consider how an outfall channel will cross the buffer to the stream.</li> <li>• Refer to the Ohio DNR Rainwater and Land Development Manual for requirements.</li> </ul>
<p><b>Flood Plain</b></p>	<ul style="list-style-type: none"> <li>• Refer to Section 151.49, Flood Plain, of the City of Dayton Subdivision Regulations.</li> </ul>
<p><b>Well Field Protection Areas</b></p>	<ul style="list-style-type: none"> <li>• Refer to Section 150.363, Well Field Protection Districts, of the R.C.G.O. Zoning Regulations for building restrictions and setbacks.</li> </ul>

Factor	Considerations
<b>Septic Systems</b>	<ul style="list-style-type: none"> <li>• Recommended setback is 35 feet minimum from a drain field.</li> <li>• Consult the Ohio Department of Health and Montgomery County Health Department.</li> </ul>
<b>Utilities</b>	<ul style="list-style-type: none"> <li>• Call the Ohio Utilities Protection Service at 1-800-362-2764 to locate existing utilities prior to design.</li> <li>• Consider the location of proposed utilities to serve the development.</li> </ul>
<b>Roads</b>	<ul style="list-style-type: none"> <li>• Consult the City of Dayton, Ohio Zoning Code for building setbacks.</li> <li>• Consult the Ohio Department of Transportation guidelines for setback from State roads.</li> <li>• Approval will be needed to discharge storm water to the City of Dayton or Ohio DOT drainage system.</li> </ul>

**References**

Caraco, D. 2001. “Managing Phosphorus Inputs Into Lakes III: Evaluating the Impact of Watershed Treatment.” *Watershed Protection Techniques*. 3 (4): 791-796. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection. 2007. “National Pollutant Removal Performance Database, Version 3.”

Geosyntec Consultants and Wright Water Engineers. 2007. “Analysis of Treatment System Performance. International Stormwater Best Management Practices (BMP) Database [1999-2007].”

Maryland Department of the Environment (MDE). 2000. 2000 Maryland Stormwater Design Manual. MDE. Baltimore, MD. Walker Jr., W. W., 2000. P8 Urban Catchment Modal (Version 2.4), IEP, Inc. and Narragansett Bay Project USEPA/RIDEM. <http://www.walker.net/p8/>

Minnesota Pollution Control Agency. Minnesota Stormwater Manual, Version 1.1. September 2006

Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio’s Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

Winer, R. 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices. 2nd Edition. Center for Watershed Protection. Ellicott City, MD.

**Section B4 Best Management Practices (BMPs) – Suitability, Design, and Maintenance Elements**

This section is comprised of summaries of ten post-construction BMPs to aid developers and designers. Each section contains a description of the BMP, key considerations, major design elements, advantages, disadvantages, and maintenance issues. Many of the BMPs in this section are included in the Ohio Department of Natural Resources (DNR), Division of Soil and Water Conservation, Rainwater and Land Development Manual, which should be referenced for more comprehensive design details. Drawings for the following BMPs are included in Appendix C of this document.

**B4-1 Infiltration**

1) Infiltration Trench

**Description**

An infiltration trench is typically a long and narrow rock-filled trench that intercepts runoff and removes pollutants, provides temporary water storage and allows water to infiltrate into the ground. An infiltration trench requires a pretreatment practice such as a grass filter strip to remove the suspended solids in the runoff. After pretreatment, the runoff filters through a gravel layer and a geotextile sediment barrier before filtering through rock and a bottom sand layer. Typically, a perforated underdrain is used to capture and transport the filtered water.

Refer to the design drawings entitled Infiltration Trench Profile and Infiltration Trench Plan Configurations in Appendix C.

**Key Considerations**

Med	Land/Area Required
Low-Med	Cost of Construction
Med-High	Maintenance Burden
High	Possible Site Constraints
Med	Community Acceptance
Med-High	Pollutant Removal

**Major Design Elements<sup>1</sup>**

- Limited contributing drainage areas, generally less than 5 acres.
- A minimum setback of 20 feet from the road sub-grade to ensure that it does not cause frost heaving.
- A pretreatment mechanism must be designed to trap sediment before it enters the infiltration area to avoid clogging. The size of the pretreatment mechanism relies on the rate of infiltration of the soil used in the trench.
- The velocity of the runoff as it enters the infiltration area from the pretreatment must be non-erosive.
- The infiltration trench is designed to infiltrate the water quality volume (WQv) through the bottom within 24-48 hours per Ohio EPA standards.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio’s Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

- The length, width and depth of the trench are based on storage requirements and drainage time. Refer to the Ohio DNR Rainwater and Land Development Manual for details of the dimensions of the infiltration trench.
- To avoid freezing, the depth of the trench substrate must be greater than 2 feet. A required 3-foot space must be placed between the seasonal-high water table or bedrock and the bottom of the trench.
- The trench bottom must be layered with 8 inches of sand which must be placed on the day the trench is excavated. Clean, washed, poorly graded rock with a diameter of 1 to 3 inches is to be used to fill the trench above the sand. A Gravel layer 6 inches thick is to be placed on top of the rock, separated by a geotextile, to ground level.
- To ensure uniform infiltration through the bottom of the trench, the bottom must be absolutely flat.
- Geotextile must line the trench below the gravel layer and along the sides of the trench to control the sediment entering the trench. Refer to the Ohio DNR Rainwater and Land Development Manual for details of geotextile material specifications.
- A 4-inch diameter observation pipe must be installed to monitor the drainage and condition of the trench.
- Provide a by-pass around the trench for concentrated flows in excess of the WQv.

#### **Advantages**

- Single most efficient post-construction storm water practice.<sup>2</sup>
- Can be aesthetically pleasing when properly landscaped and maintained.
- Reflects pre-development hydrology.
- Can help protect channels.<sup>3</sup>

#### **Disadvantages**

- Very specific and demanding construction controls.
- Is a possible source of ground water contamination if not properly maintained.
- Effectiveness decreases with time due to clogging and inadequate maintenance.
- Cannot be constructed in areas with steep grades.
- Sometimes requires landscaping that can be affected by drought and flooding.
- Controlled by confining site slope requirements and soils with a narrow range of permeability.

#### **Maintenance**

- Maintenance to ensure proper function should be performed monthly. These actions include clearing debris, removing sediment and oil from pretreatment device, and repairing eroded inflow and outflow if needed.<sup>4</sup>
- For aesthetics, remove weeds as needed.
- Gravel and geotextile should be replaced as needed.

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<sup>2</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

<sup>3</sup>[http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6\\_Stormwater\\_Practices/Infiltration%20Practice/Infiltration%20Trench.htm](http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Trench.htm) (Last Accessed: January 18, 2008)

<sup>4</sup> Minnesota Pollution Control Agency. Minnesota Stormwater Steering Committee. The Minnesota Stormwater Manual. November 2005.

## 2) Infiltration Basin

### **Description**

An infiltration basin is a natural or constructed impoundment that captures and temporarily stores water as the water infiltrates through the bottom of the basin. The basin removes pollutants by allowing water to filter through a soil matrix to the ground water or to an underdrain. The basin provides flood control, ground water recharge and pollutant removal. Refer to the design drawing entitled Infiltration Basin in Appendix C.

### **Key Considerations**

High	Land/Area Required
Low-Med	Cost of Construction
Med-High	Maintenance Burden
High	Possible Site Constraints
Low	Community Acceptance
Med-High	Pollutant Removal

### **Major Design Elements**<sup>1,2</sup>

- Most effective when treating less than 10 acres of land.
- To ensure uniform infiltration though the bottom of the basin, the bottom must be absolutely flat.
- The infiltration rate of the soil should be between 0.52 to 2.4 inches/second and consist of less than 20% clay content and less than 40% clay/silt content.
- The infiltration basin is designed to infiltrate the WQv through the bottom within 24-48 hours per Ohio EPA standards.
- Basin should be greater than 150 feet from adjacent drinking water wells.
- A required 3-foot space must be placed between the seasonal-high water table or bedrock and the bottom of the basin.
- The velocity of the runoff as it enters the infiltration area from the pretreatment must be non-erosive.
- Upland drainage should include a layer of thick vegetation.
- The basin should include a forebay to remove total suspended solids (TSS) and avoid clogging of the basin.
- Basin and forebay should be easily accessible for proper maintenance.
- A basin drain should be installed as a means to correct structural and maintenance problems.
- An emergency overflow must be provided.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

<sup>2</sup>[http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6\\_Stormwater\\_Practices/Infiltration%20Practice/Infiltration%20Basin.htm](http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Basin.htm) (Last Accessed: January 18, 2008)

- A 4-inch diameter observation pipe must be installed to monitor the drainage and condition of the trench.

### **Advantages**

- Can be aesthetically pleasing when properly landscaped and maintained.
- Reflects pre-development hydrology.
- Used for flood control and can help channel protection.<sup>3</sup>

### **Disadvantages**

- Very specific and demanding construction controls.
- Is a possible source of ground water contamination if not maintained properly.
- Effectiveness decreases with time due to clogging and inadequate maintenance.
- Can not be constructed in areas with steep grades.
- Sometimes requires landscaping that can be affected by drought and flooding.
- Infiltration is controlled by strict site conditions and soils with a narrow range of permeability.

### **Maintenance**

- Repair undercut and eroded areas at inflow and outflow points; stabilize eroded banks and mow and remove debris as needed.
- Inspect for structural damage; check basin wetness to ensure proper drainage; and monitor any eroded areas semi-annually.
- Aerate and de-thatch basin bottom annually.
- Scrape basin bottom, remove sediment and restore original cross-section every five years.

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<sup>3</sup>[http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6\\_Stormwater\\_Practices/Infiltration%20Practice/Infiltration%20Trench.htm](http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Trench.htm) (Last Accessed: January 18, 2008)

## **B4-2 Vegetated Swales and Filter Strips**

### **Description**

Vegetated swales are shallow open channels with vegetation on the banks and in the channel. Vegetated swales provide conveyance for runoff as well as pollutant treatment. Filter strips are narrow areas of land planted with vegetation and typically located between a water body and a pollutant source. Vegetated swales and filter strips reduce the velocity of runoff, which promotes the deposition of sediment, and filter out pollutants through vegetation. Refer to the design drawings entitled Vegetated Swale and Filter Strip in Appendix C

### **Key Considerations**

Med	Land/Area Required
Med	Cost of Construction
Low	Maintenance Burden
Low	Possible Site Constraints
Med	Community Acceptance
Low-Med	Pollutant Removal

### **Major Design Elements**

#### ***Vegetated Swale<sup>1,2</sup>***

- Runoff computations must be based on the most severe soil and cover conditions that will exist in the area draining into the swale.
- Parabolic channels most closely approximate natural flow characteristics as well as controls high flows.
- Trapezoidal channels are used where flow is heavy, promoting settling and infiltration. Side slopes of 1V:3H are recommended.
- The vegetative lining is to be designed for a 10-year storm event and is based on Manning's equation.
- The longitudinal slope of the swale should be 1%-5%.
- The sub-layer must not experience compaction by mechanical devices.
- Vegetation should be established immediately after construction.
- Check dams can be installed to decrease flow velocity and increase slope stability.
- All swales should have a sufficiently large outlet to avoid pooling.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

<sup>2</sup> Minnesota Pollution Control Agency. Minnesota Stormwater Steering Committee. The Minnesota Stormwater Manual. November 2005.

### ***Filter Strips***<sup>1,3,4</sup>

Locate away from heavy pedestrian and vehicular traffic.

- The length of flow to the filter strip cannot exceed the length at which sheet flow concentrates.
- Separate from ground water by at least 2 to 4 feet.
- The sub-layer must not experience compaction by mechanical devices.
- To assure sheet flow across the filter strip, a level spreader should be installed at the top of the slope on a level contour. The level spreader must have a minimum depth and width of 1 foot.
- The land surrounding the filter strip should have 1%-20% grade.
- A flow splitter should be installed to divert peak flow volume around the filter strip.
- The filter strip must be constructed on a level contour to encourage sheet flow across the filter. The lateral slope of the filter strip should be no less than 1% and no greater than 5%.
- The width of the filter strip must be 25-120 feet depending on the lateral slope and the desired particulate removal efficiency.
- The ratio of filter strip area to drainage area should be no greater than 1:50. The ratio usually ranges from 1:3 to 1:8.
- The vegetation of the filter strips should be compatible with surrounding soils and weather conditions.

### **Advantages**

- Filter strips are ideal for agricultural areas where both point and non-point source pollution occurs.
- Vegetated swales and filter strips can add aesthetic value to the surrounding area.
- Vegetated swales have many variations of design and can be adjusted to fit exact requirements.
- Vegetated swales and filter strips can function properly with a large range of soil types.
- If lined, vegetated swales and filter strips are suitable for pollution hotspots because storm water treatment does not involve interaction with ground water.

### **Disadvantages**

- If not constructed and maintained properly, vegetative swales and filter strips will accrue high maintenance costs.
- Vegetated swales are potential sources of mosquito breeding areas and odor.
- Vegetated swales and filter strips provide minimal treatment of soluble nutrients.

### **Maintenance**

#### *Vegetated Swale*

- Inspect channel for clogging, remove trash and debris, and inspect and correct erosion problems along the slope and base of the channel monthly.

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<sup>3</sup> <http://ohioline.osu.edu/aex-fact/0467.html> (Last Accessed: January 18, 2008)

<sup>4</sup> [http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6\\_Stormwater\\_Practices/Filtering%20Practice/Grassed%20Filter%20Strip.htm](http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Filtering%20Practice/Grassed%20Filter%20Strip.htm) (Last Accessed: January 18, 2008)

- Mow grass of channel to no less than 3 to 4 inches as needed
- Remove sediment build-up within the bottom of the channel once it reaches the 25% design limit.

*Filter Strips*

- Ensure establishment of grass, seed or sod bare areas, and remove excess settlement semi-annually the first year and annually the following years.
- Mow grass no less than 3-4 inches as needed.
- Repair gullies and eroded areas.

**B4-3 Dry Extended Detention Basin**

**Description**

Dry extended detention basins are constructed to temporarily store and treat storm water before discharging the water to a storm drain system. The basin will only contain water during a rainfall event and during the drainage period. The basin efficiency can be aided by including a forebay at the inlet and/or a micropool at the outlet. Dry basins remove pollutants and sediment from storm water and control the discharge flow rate to natural water bodies. Refer to the design drawings entitled Dry Extended Detention Basin and Miscellaneous Basin Details in Appendix C.

**Key Considerations**

Med	Land/Area Required
Low	Cost of Construction
Med	Maintenance Burden
Low-Med	Possible Site Constraints
Low	Community Acceptance
Med	Pollutant Removal

**Major Design Elements<sup>1</sup>**

- Acceptable drainage area is greater than 10 acres.
- Sized to treat the water quality volume (WQv) as defined by Ohio EPA. An additional volume equal to 20% of the WQv shall be incorporated into the BMP for sediment storage.
- In addition to treatment of the WQv, the pond may be designed for flood control.
- The target depth is 3 feet.
- Design pond to avoid pooling water away from inlet and outlet and to maximize flow length.
- The shape and grade are affected by safety features and surrounding land constraints.
- The ratio of length to width should be no less than 3:1.
- Side slopes should be between 1V:12H and 1V:3H.
- A forebay should be designed to improve settling efficiency and maintenance accessibility.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio’s Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

- 8%-25% of the surface area of the dry basin should be assigned to the forebay.
- A submerged dike should connect the forebay and the main pond 6-12 inches below the normal water surface elevation.
- The forebay should have gentle slopes and unobstructed access to promote frequent sediment cleanout.
- A micropool should be constructed at the front of the outlet.
- A reverse flow pipe should be installed to avoid clogging at the outlet.
- The basin outlet must drain the basin in a 48-hour period. Less than 50% of collected storm water should be drained in the first 16 hours.
- The only permanent pools should be located in the forebay and the micropool.
- An emergency spillway must be constructed to safely convey flows exceeding the design storm flows.

### **Advantages**

- Drains a large surface area.
- Can be used as a sediment basin during construction.
- Easy to design and construct.

### **Disadvantages**

- Large land usage.
- When dry, basin is not aesthetically pleasing.
- Can increase water temperature and may cause thermal impact to surrounding water bodies.
- Potential source of insects, odor, and safety hazards if not operating properly.

### **Maintenance**

- For aesthetics, mow the embankment. For water quality purposes, mow no shorter than 3 to 4 inches.
- Clean debris and hydrocarbon residue from the outlet structure monthly.
- Inspect area for invasive species semi-annually.
- Embankment and outlet structure shall be inspected for damage and integrity annually.
- Inspect the forebay/micropool for sediment buildup annually and remove sediment every 3-7 years.
- Monitor sediment in basin annually. At a minimum, remove sediment when basin volume is reduced by 25%.

## **B4-4 Wet Extended Detention Basin**

### **Description**

A wet extended detention basin is a pond with a permanent water level greater than 3 feet constructed to store and treat runoff before discharging the water to a storm drain system. Wet basins remove pollutants by chemical interaction; settling; and organic uptake by plants, algae, and bacteria. Wet Basins also control the discharge flow rate to natural water bodies. Refer to the design drawings entitled Wet Extended Detention Basin and Miscellaneous Basin Details in Appendix C.

### **Key Considerations**

Med	Land/Area Required
Low	Cost of Construction
Med	Maintenance Burden
Low-Med	Possible Site Constraints
High	Community Acceptance
High	Pollutant Removal

### **Major Design Elements<sup>1</sup>**

- Acceptable drainage area is greater than 20 acres to support a permanent pool.
- Sized to treat 75% of the water quality volume (WQv) above the permanent pool as defined by Ohio EPA.
- The design capacity of the permanent pool shall be equal to 75% of the WQv plus an additional volume equal to 20% of the WQv for sediment accumulation.
- In addition to treatment of WQv, the pond may be designed for flood control
- The target depth of the pond is generally not deeper than 6-8 feet.
- If fish are present, 25% of the pond must be 6-8 feet deep.
- The shape and grade are affected by safety features and surrounding land constraints.
- The ratio of length to width should be no less than 3:1.
- Side slopes should be between 1V:12H and 1V:3H.
- A forebay should be designed to improve settling efficiency and maintenance accessibility.
- 8%-25% of the surface area of the wet basin should be assigned to the forebay.
- A submerged dike should connect the forebay and the main pond 6-12 inches below the normal water surface elevation.
- The forebay should have gentle slopes and unobstructed access to promote frequent sediment cleanout.
- A micropool should be constructed at the front of the outlet.
- A reverse flow pipe or drain should be installed to avoid clogging at the outlet.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

- The basin outlet must drain the recent storm water in a 24-hour period. Less than 50% of collected storm water should be drained in the first 8 hours.
- Wet basins can include wetland fringe which greatly increases the quality of water treatment.
- Trees can be planted around the pond to produce shading that will reduce the water temperature of the basin.
- An emergency spillway must be constructed to safely convey flows exceeding the design storm flows.

### **Advantages**

- Attracts wildlife and vegetation and enhances the aesthetic and recreational value of the area.
- Drains a large surface area.
- Easy to design and construct.
- Effective at removing pollutants including sediment, nutrients and heavy metals.

### **Disadvantages**

- Relatively large land requirement.
- Can increase water temperature and may cause thermal impact to surrounding water bodies.
- Potential source of insects, odor and safety hazards if not operating properly.
- Potential drowning hazard.

### **Maintenance**

- Ensure that 50% of the wetland vegetation has survived after the first year.
- For aesthetics, mow the embankment. For water quality purposes, mow no shorter than 3 to 4 inches.
- Clean debris and hydrocarbon residue from the outlet structure monthly.
- Inspect area for invasive species semi-annually.
- Embankment and outlet structure shall be inspected for damage and integrity annually.
- Inspect the forebay/micropool for sediment buildup annually and remove sediment every 3-7 years.
- Monitor sediment in basin annually. At a minimum, remove sediment when basin volume is reduced by 25%.

## **B4-5 Wetland Extended Detention Basin**

### **Description**

A wetland extended detention basin is a shallow marsh system that treats runoff through settling, nutrient uptake, microbial breakdown and filtration. Surface runoff is directed into the depressed wetlands where it may temporarily pond to allow suspended solids to settle before meandering through the wetland system. The runoff is stored and treated through soils and vegetation before discharging to a water body or storm drain system. Refer to the design drawings entitled Wetland Extended Detention Basin and Miscellaneous Basin Details in Appendix C.

### **Key Considerations**

High	Land Requirement
Med	Cost of Construction
Med-High	Maintenance Burden
Med-High	Possible Site Constraints
High	Community Acceptance
High	Pollutant Removal

### **Major Design Elements<sup>1</sup>**

- Acceptable drainage area is greater than 20 acres to support a permanent pool.
- Sized to treat the water quality volume (WQv) above the permanent pool as defined by the Ohio EPA.
- In addition to treatment of the WQv, the pond may be designed for flood control.
- The average depth of a wetland is between 6-12 inches and must support wetland vegetation.
- The shape and grade are affected by safety features and surrounding land constraints.
- The ratio of length to width should be no less than 3:1.
- Slopes should be between 1V:12H and 1V:3H.
- A forebay should be designed to improve settling efficiency and maintenance accessibility.
- 8%-25% of the surface area of the wetland should be assigned to the forebay.
- A submerged dike should connect the forebay and the main pond 6-12 inches below the normal water surface elevation.
- The forebay should have gentle slopes and unobstructed access to promote frequent sediment cleanout.
- A micropool should be constructed at the front of the outlet.
- A reverse flow pipe should be installed to avoid clogging at the outlet.
- The wetland outlet must drain the runoff volume increase in a 24-hour period. Less than 50% of the collected runoff should be drained in the first 8 hours.
- A water budget must be created to evaluate the proper volume and geometric shape of the constructed wetland.

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

- The design volume will be 20% greater than the water budget volume to accommodate for settlement accumulation over time.
- 6-8 different wetland vegetation species should be planted using one of the following methods: planting nursery stock, mulching with soils from an existing wetland, or allowing voluntary formation.
- The original planting should cover 30% of the constructed wetland area and clustered in 4-5 plants/sq. yard.
- The wetland foundation should be soft enough for easy planting of wetland vegetation. Refer to the Ohio DNR Rainwater and Land Development Manual for more details on wetland vegetation and planting requirements.

### **Advantages**

- Provides great wildlife habitat as well as an aesthetically attractive community.
- Creates an ideal environment for filtration, biological uptake, and microbial activity, and provides high pollutant removal.
- Able to provide a ground water to surface water interface.

### **Disadvantages**

- Ideal conditions for mosquito breeding.
- Requires extensive design and planning to guarantee sustainability of wetland hydrology.
- Water treatment quality can change with season.
- Requires a large amount of land.

### **Maintenance**

- Ensure that 50% of the wetland vegetation has survived after the first year.
- Mow embankment and clean debris from the outlet structure monthly. The build-up of hydrocarbons must also be inspected monthly.
- Inspect area for invasive species semi-annually.
- Embankment and outlet structure shall be inspected for damage and integrity annually.
- Inspect the forebay for sediment buildup annually and remove every 3-7 years.
- Monitor sediment in main pool and clean pool when pond becomes eutrophic or the volume reduces significantly, usually occurring every 15-20 years.

## **B4-6 Bioretention (Rain Gardens)**

### **Description**

Bioretention refers to a shallow landscaped depression that treats runoff using pollutant removal mechanisms that function in natural ecosystems; settling, filtration, adsorption, microbial breakdown, and nutrient assimilation. Surface runoff is directed into the bioretention area where it temporarily ponds before infiltrating through mulch and a soil media planted with vegetation. The infiltrated water percolates into native soils or, if necessary, enters a perforated underdrain that discharges to a water body or storm drain system. Refer to the design drawing entitled Bioretention in Appendix C.

### **Key Considerations**

Med	Land/Area Required
Med	Cost of Construction
Med-Low	Maintenance Burden
Med	Possible Site Constraints
High	Community Acceptance
Med-High	Pollutant Removal

### **Major Design Elements**<sup>1</sup>

- Limited contributing drainage areas, generally less than 2 acres.
- Surface area is generally between 5 and 10 percent of the contributing drainage area.
- Applicable to sites with soils of sufficient hydraulic conductivity or a suitable outlet for an underdrain system to fully drain the practice in a period of 40 to 72 hours.
- The primary treatment volume is limited to the water quality volume (WQv) per Ohio EPA.
- Not applicable where ground water flow will prevent the basin from draining between storm events.
- Not applicable where ground water pollution potential is high due to high pollution loads, high ground water table or extremely permeable soils.
- A minimum of 2 feet of separation recommended and a minimum of 1 foot of separation required between the water table and the bioretention practice.
- Sites with sufficient fall between inflow point and outlet for underdrain, (generally 5 feet). Shallower facilities are expected to reduce the effectiveness of treatment.
- Off-line versus in-line facilities are preferred to minimize erosion within the practice during high flows.
- The minimum recommended width shall be 10 feet, with the length generally exceeding 2:1 (length:width).

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<sup>1</sup> Ohio Department of Natural Resources, Division of Soil and Water Conservation. Rainwater and Land Development: Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection. December 2006.

- Minimum setbacks from property lines, wells, septic systems, basements and building foundations shall be maintained. Refer to the Ohio DNR Rainwater and Land Development Manual for recommendations.
- Infiltration of water shall be such that no more than one-half of the water quality volume is released in less than one-third of the drawdown period (40 hours).
- Depth of ponding should be less than 6 inches, but may be up to 12 inches provided ponding will not damage plant materials or nearby structures.
- A minimum of 3 inches of coarse shredded hardwood mulch is to be placed around plants and over soil.
- The soil mix must be certified by a qualified laboratory (1 test per 100 cubic yards of soil). Refer to the Ohio DNR Rainwater and Land Development Manual for details of the soil mixture.
- A geotextile layer or a combination of sand and pea gravel shall be used between the soil layer and the underdrain or subsoil. Refer to the Ohio DNR Rainwater and Land Development Manual for details of the bioretention filter layer.
- Refer to the Ohio DNR Rainwater and Land Development Manual for details of the underdrain pipe and gravel bed.
- An overflow system shall be in place.
- Native and non-invasive plant species shall be used. Trees and shrubs may also be used.
- Additional storm water detention needs do not make bioretention unfeasible.
- Consider pretreatment such as grass filter strips upstream of practice.

### **Advantages**

- Aesthetically pleasing when properly landscaped and maintained.
- Creates an ideal environment for filtration, biological uptake, and microbial activity, and provides moderate to high pollutant removal.
- Has been shown to reduce water quality runoff volume by 35% to 50% through evapotranspiration and infiltration of runoff.<sup>1,2</sup>
- Able to treat hotspot areas using underdrain and liner.

### **Disadvantages**

- Need adequate open area with ability to tie into storm drain system if soils are impermeable.
- Maintenance agreements may be necessary if installed on private property.
- Soil specialist should be consulted when choosing soil mixture.
- Limited drainage area required.

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<sup>1</sup> Hunt, W.A. Jarret, J. Smith and L. Sharkey. 2006. Evaluating bioretention hydrology and nutrient removal at three field sites in North Carolina. *Journal of Irrigation and Drainage Engineering*. 6: 600-612.

<sup>2</sup> Traver, R. 2006. Monitoring summary: Villanova University stormwater best management practice study. U.S.EPA. Philadelphia, PA.

**Maintenance**

- Water plants as necessary during the first growing season.
- Prune and weed plants and remove and replace unsuccessful or diseased plants as necessary.
- Inspect device for winter salting damage annually.
- Clean up debris monthly.
- Mulch annually.
- Test and regulate soil to maintain a 5.2-7.0 pH range annually if needed for plant species.
- Check filter layer for clogging and replace soil as necessary every 2-10 years.

## **B4-7 Pervious Pavement Systems**

### **Description**

Pervious pavement systems refer to a number of paving practices engineered to infiltrate runoff including porous pavements, permeable pavers, and plastic grids. Typical uses include parking lots and areas with light average daily traffic (ADT). Porous pavement systems consist of a layer with void spaces that act as a permeable surface like that of natural green space allowing infiltration, filtration, plant uptake, and microbial breakdown. Runoff is allowed to infiltrate through the open interconnected voids, and then percolate through the subbase into the natural soil subgrade or underdrain. Refer to the design drawings entitled Pervious Asphalt Detail, Pervious Concrete Detail, Pervious Paver Detail, Pervious Pavement System with Underdrain, and Pervious Pavement System with Backup Infiltration System in Appendix C.

### **Key Considerations**

Low	Land/Area Required
Med-Low	Cost of Construction
Med	Maintenance Burden
Med	Possible Site Constraints
Med-High	Community Acceptance
Med-High	Pollutant Removal

### **Major Design Elements**<sup>1,2</sup>

- Drainage area shall be limited to the pervious surface area and surrounding drainage area provided a buffer strip to settle out sediment is installed upstream.
- Not applicable where ground water flow will prevent storm water from infiltrating into the subgrade.
- The pervious system shall be designed to prevent saturation of open void spaces.
- Sites with soils of sufficient percolation rates or a suitable outlet for an underdrain system to fully drain the pavement system.
- Narrow grading sizes are preferred for aggregate materials.
- Not applicable where daily truck traffic is high, including freeways and major roads.
- Minimum and maximum local requirements for rainfall intensity shall be maintained.
- Sites shall have sufficient permeability to infiltrate into the subgrade or outlet flows from a 2-year, 24-hour storm event.
- Consider pretreatment such as grass filter strips upstream of practice.
- The recommended minimum permeable subbase for pervious pavement is 6-12 inches.
- Not applicable on sites with a significant change in grade.
- Applicable to sites with soils of sufficient hydraulic conductivity or a suitable outlet for an underdrain system to fully drain the practice in a period of 40 to 72 hours.
- The minimum infiltration rate should be 0.1 inch/hour.

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<sup>1</sup> National Ready Mixed Concrete Association, Portland Cement Association. Pervious Concrete Pavements. 2004.

<sup>2</sup> Hinman, C. Low Impact Development Technical Guidance Manual for Puget Sound. May 2005.

- Additional storm water detention needs do not make pervious pavement unfeasible.
- A nonwoven geotextile is recommended under the base material.
- Modulus of subgrade reaction (k) recommendation is not to exceed 200 lb/in<sup>3</sup>.

#### *Pervious Concrete*

- Recommended flow rates for water through pervious concrete are 3-8 gal/ft<sup>2</sup>/min.
- Concrete materials shall be limited to cementitious materials, aggregate, and water.
- Cementitious materials shall consist of portland cements (ASTM C 150, C 1157) and blended cements (ASTM C 595, C 1157).
- A maximum aggregate:cement ratio of 4.5 by mass is recommended to maintain the structural strength of the pervious concrete.
- Contractor is required to be certified (by the National Ready Mixed Concrete Association) as a Pervious Concrete Technician and have at least one Pervious Concrete Craftsman.

#### *Pervious Asphalt*

- Pervious asphalt is generally laid in one 2.5 inch layer directly over the aggregate base.
- Drain down of asphalt should be no greater than 0.3% according to ASTM D6930.
- The aggregate used is to be 0.5-2.5 inches and uniformly graded with a wash loss of no more than 0.5%.
- A 6% asphalt binder by weight is required.

#### **Advantages**

- Aesthetically pleasing surface when installed properly.
- Creates an ideal environment for filtration, biological uptake, and microbial activity, and provides moderate pollutant removal.
- Encourages ground water and aquifer recharge through infiltration, reducing peak water flow and flooding.
- Ideal facility to protect trees in a paved urban environment.
- Absorbs less heat due to the open pore structure fostering a reduction in the heat island effect.

#### **Disadvantages**

- Annual to semi-annual maintenance (vacuuming) is necessary to sustain void spaces for infiltration.
- Soils high in clay or silt require a more elaborate system to either remove/replace soils or provide an underdrain system.
- Heavy vehicular and truck daily traffic areas require a thicker pervious slab.

#### **Maintenance**<sup>3</sup>

- Confirm pavement is dewatering between rainfall events and free of debris and sediment buildup monthly.
- Annually inspect pavement for deterioration and spalling.

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<sup>3</sup>[http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6\\_Stormwater\\_Practices/Infiltration%20Practice/Porous%20Pavement.htm](http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Porous%20Pavement.htm) (Last Accessed: December 17, 2008)

- Vacuum surface to ensure surface is free of sediment as needed (typically three to four times a year).

## **B4-8 Green Roofs**

### **Description**

Green rooftops consist of a vegetation and soil layer facilitating plant growth that becomes a natural functioning green space. Surface runoff is captured and treated on the rooftop through absorption and biological uptake. The roofs also improve air quality, provide building insulation, and create wildlife habitat. Excess water not absorbed and utilized by the vegetation and soil layers is directed through the media to the existing rooftop drainage system. Refer to the design drawing entitled Green Roof in Appendix C.

### **Key Considerations**

Low	Land/Area Required
Med-High	Cost of Construction
Low-Med	Maintenance Burden
Med-High	Possible Site Constraints
High	Community Acceptance
Med-High	Pollutant Removal

### **Major Design Elements**<sup>4,5</sup>

- Plant selection for the green roof should be based on climatic considerations such as regional temperature, wind exposure, building shadows, orientation to the sun, and snow loading.
- Fundamental structural factors to be considered are building surface area, age, structural integrity, capacity, and accessibility.
- Suitable access must be available for workers and materials during construction and for maintenance and viewing post construction.
- Local zoning building codes sometimes control detentions and extent of green roofs.
- Two general design systems, extensive and intensive, are considered during the planning process.
- Extensive systems are 2-6 inches deep and can carry a load of 16-35 pounds/square feet.
- Intensive systems are 8-24 inches deep and can carry a load of 60-200 pounds/square feet.
- A drainage system for the excess runoff must be designed.
- All planted vegetation must be provided with moisture, drainage, nutrients and aeration to soil as appropriate for that plant.
- All green roofs must have the following layers: protection layer, drainage layer, filter layer, and a growing medium.

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<sup>4</sup> Center For Watershed Protection. Urban Subwatershed Restoration Manual No. 3. Urban Stormwater Retrofit Practices Version 1.0. August 2007

<sup>5</sup> [http://www.lid-stormwater.net/greenroofs\\_specs.htm](http://www.lid-stormwater.net/greenroofs_specs.htm) (Last Accessed: December 2007)

- Most effective in reducing storm water runoff volume in urban settings with a large percentage of rooftop coverage including commercial, industrial and multifamily housing units.<sup>6</sup>

### **Advantages**

- Aesthetically pleasing when properly landscaped and maintained.
- Reduces and cools storm water runoff. Insulates and lowers energy consumption and building operating costs.<sup>7</sup>
- Is conducive to wildlife.
- Lowers carbon dioxide levels and the urban heat island effect.

### **Disadvantages**

- Need a structural analysis to determine if the desired green roof system requires additional structural reinforcement.
- Maintenance needs may be higher than traditional systems and a leak detection system should be considered.
- A botanist or landscape architect should be consulted when choosing plant material.

### **Maintenance**<sup>8</sup>

- Watering, fertilization and weeding is required and should be done as needed and is greatest in the first two years as the plants become established.
- Inspection of proper drainage required 3 to 4 times per year.
- Irrigation is necessary as needed for the first year.
- After the first two years, semi-annual removal of invasive species and membrane inspection is necessary.

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<sup>6</sup> Traver, R. 2006. Monitoring summary: Villanova University stormwater best management practice study. U.S.EPA. Philadelphia, PA.

<sup>7</sup> [http://www.greenroofs.org/index.php?option=com\\_content&task=view&id=26&Itemid=40](http://www.greenroofs.org/index.php?option=com_content&task=view&id=26&Itemid=40) (Last Accessed: January 18, 2008)

<sup>8</sup> [http://www.lid-stormwater.net/greenroofs\\_maintain.htm](http://www.lid-stormwater.net/greenroofs_maintain.htm) (Last Accessed: January 16, 2008)

## **B4-9 Residential Cisterns (Rain Barrels)**

### **Description**

A residential cistern, (also referred to as a rain barrel) collects and stores rain water for future use. Runoff from impermeable surfaces such as residential rooftops is routed through a gutter system to the cistern where the water can then be accessed from a spigot outlet to use for garden and landscape irrigation. Refer to the design drawing entitled Residential Cistern (Rain Barrel) in Appendix C.

### **Key Considerations**

Low	Land/Area Required
Low	Cost of Construction
Low	Maintenance Burden
Low-Med	Possible Site Constraints
High	Community Acceptance
Med	Pollutant Removal

### **Major Design Elements**<sup>1,2,3</sup>

- Residential cistern location and intake are retrofitted on site.
- A barrel should have at least a 55-gallon capacity. Most rain barrels are manufactured with a 60-gallon capacity.
- System shall be watertight, have smooth interior walls and be located on level ground.
- System requires emptying within 5 days or less after a rain event to be effective..
- Can be installed inside of buildings or garages to avoid winter disconnection and freezing.
- Before the installation of the cistern, the gutters and connections must be cleaned of leaves and other organic materials and checked for leaks.
- Must ensure an adequate path of flow away from the house when the cistern overflows. The flow should not be erosive.
- A screen should be provided at the inlet of the cistern to keep out debris.
- A connector pipe can be added between two cisterns to increase the storage volume.

### **Advantages**

- Reduces runoff volume being discharged to downstream water bodies if emptied frequently.
- Inexpensive and easy to install.
- Lowers irrigation costs for homeowners.
- Promotes watershed and community awareness.
- Stores backup water in times of drought or water shortage.

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<sup>1</sup> Center For Watershed Protection. Urban Subwatershed Restoration Manual No. 3. Urban Stormwater Retrofit Practices Version 1.0. August 2007

<sup>2</sup> [http://www.lid-stormwater.net/raincist\\_specs.htm](http://www.lid-stormwater.net/raincist_specs.htm) (Last Accessed: February 19, 2008)

<sup>3</sup> <http://rainbarrelguide.com/> (Last Accessed: February 19, 2008)

**Disadvantages**

- System requires modifications when used in cold climates due to freeze/thaw events.
- Third party/proprietary systems can be cost prohibitive.
- If not properly maintained, can damage foundation of household.
- Can be a nuisance source for mosquito breeding.
- May need a maintenance agreement with the property owner.

**Maintenance**

- System requires emptying within 5 days or less after a rain event.
- All components of the system should be inspected at least semi-annually and repaired or replaced as necessary.
- Disconnect and drain system during the winter.

## **B4-10 Manufactured Devices**

### **Description**

Manufactured devices are designed to treat runoff by removing pollutants such as sediment, hydrocarbons, and debris before discharging the runoff to a drainage system. Specific pollutant-removal processes vary from product to product. Manufactured devices are commonly applied where space is limited and are typically installed within a manhole/catch basin or in conjunction with a piping system. As an ever-growing number of products are available, it is not practical to try to include them all within this section or provide reviews. Those choosing to use such devices within the City of Dayton are encouraged to make recommendations and discuss possibilities with the City. General guidelines are included in this section for devices falling under the categories of end-of-pipe treatment and inlet traps. Specific products and their design requirements can be obtained from the manufacturer.

### **Key Considerations**

Low	Land/Area Required
High	Cost of Construction
High	Maintenance Burden
Med-High	Possible Site Constraints
Med	Community Acceptance
Med	Pollutant Removal

### **Major Design Elements**<sup>4,5</sup>

#### *End-of-Pipe Treatment*

- Design to treat flows associated with the water quality volume (WQv) as defined by the Ohio EPA.
- When possible, design as an off-line system with larger flows bypassing the device.
- Consider multiple smaller devices rather than one large device if pollutant removal efficiency is enhanced.
- Capable of removing sediment, debris, hydrocarbons, and any targeted pollutant in the area.
- Locate within 15 feet of a paved road for vacuum truck access.
- Consider the ease of maintenance.
- Minimal head loss through device to the extent possible.
- Possible manufacturers include but are not limited to *AquaShield, BaySaver, CDS Technologies, Contech Stormwater Solutions, CrystalStream Technologies, Hydro International, KriStar Enterprises, Stormceptor, StormTreat, and SunTree Technologies.*

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<sup>4</sup> England, G. and S. Stein. Selection, Maintenance, and Monitoring of Stormwater BMPs. Forester Communications Inc. July 2007.

<sup>5</sup> United States Environmental Protection Agency. Storm Water Technology Fact Sheet. Hydrodynamic Separators. September 1999.

### *Inlet Traps*

- Consider as a pretreatment device to other downstream BMPs.
- Ability to trap trash without impeding upstream flows through the inlet.
- Bypass capability when trap is full of debris.
- Locate within 15 feet of a paved road for vacuum truck access.
- Consider the ease and expense of trap replacement and maintenance.
- For maintenance purposes, not ideal in high traffic areas.
- Capable of removing sediment, debris, hydrocarbons, and any targeted pollutant in the area.
- Minimal impact on the hydraulic capacity of the inlet.
- Possible manufacturers include but are not limited to *AbTech Industries, Contech Stormwater Solutions, Hancor, SunTree Technologies, Best Management Products, Inc., and Roscoe Moss Company.*

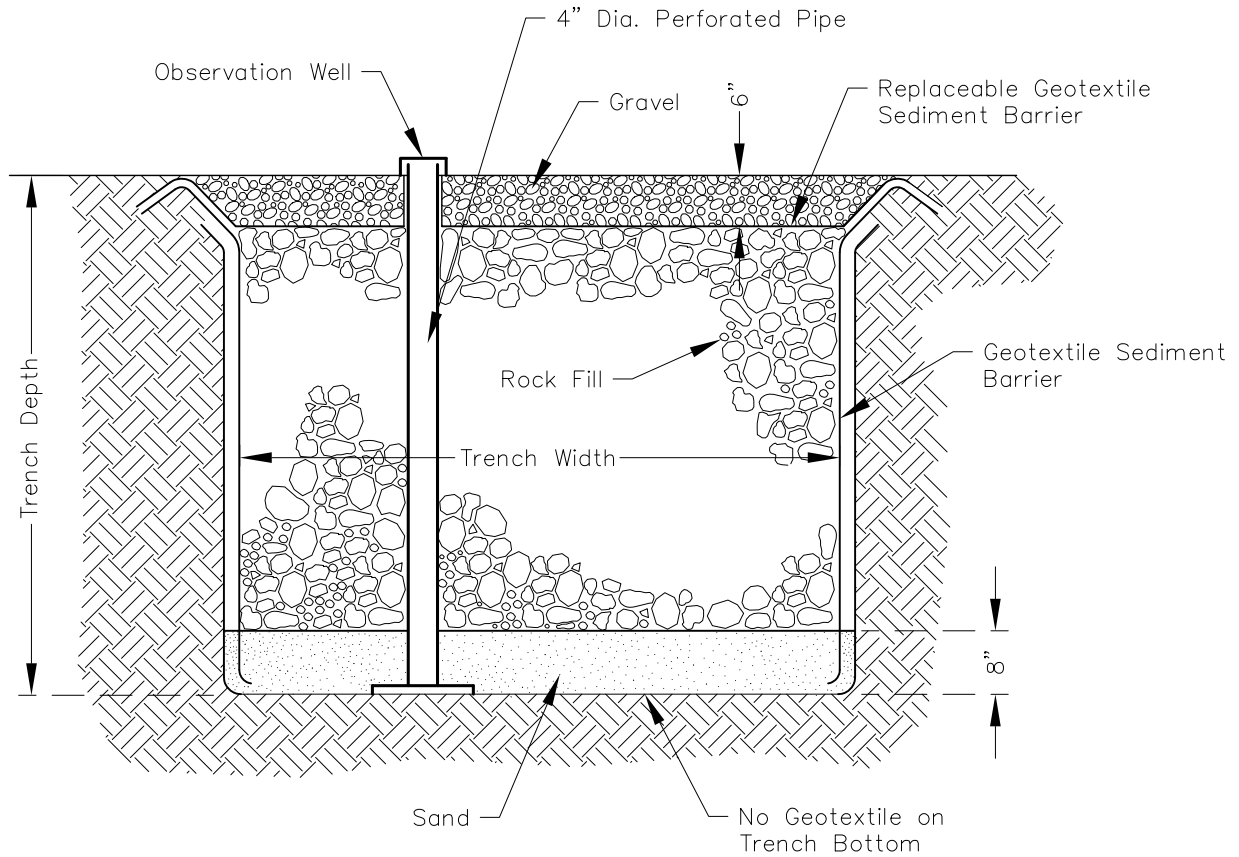
### **Advantages**

- Minimal land space needed.
- Many times can be installed in existing manholes.

### **Disadvantages**

- Amount of pollutant removal is very site specific and dependant of uncontrollable variables.
- Difficult to remove small pollutants such as nutrients, which adhere to small particles.
- Initial purchase and installation cost can be high.
- Can require extensive and costly excavation.
- Requires frequent maintenance.

**APPENDIX C**  
**STANDARD DETAILS/DRAWINGS**



NOTES:

PLEASE REFER TO THE OHIO DEPARTMENT OF NATURAL RESOURCES RAINWATER AND LAND DEVELOPMENT MANUAL FOR MORE INFORMATION. THIS PRACTICE HAS THE POTENTIAL TO BE A CLASS V INJECTION WELL PER U.S.E.P.A. MEMORANDUM ON "CLARIFICATION ON WHICH STORMWATER INFILTRATION PRACTICES/TECHNOLOGIES HAVE THE POTENTIAL TO BE REGULATED AS 'CLASS V' WELLS BY THE UNDERGROUND INJECTION CONTROL PROGRAM." THIS PRACTICE IS CLASSIFIED AS A CLASS V WELL IF IT IS DEEPER THAN ITS WIDEST SURFACE DIMENSION.

NO.	DATE	REVISIONS
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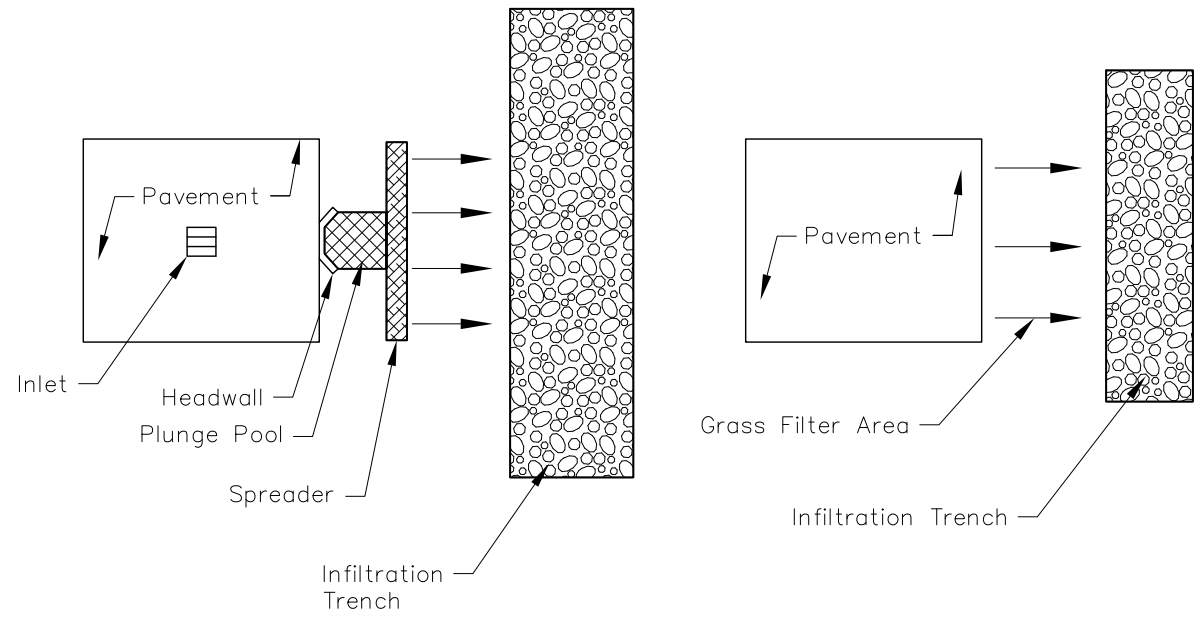
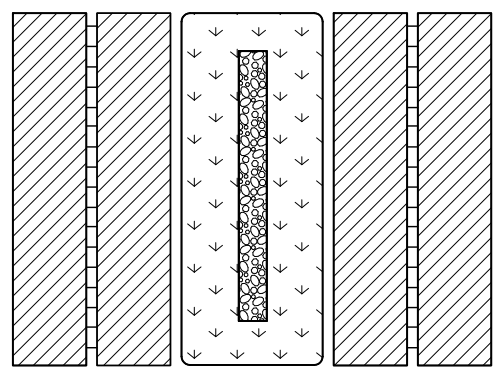
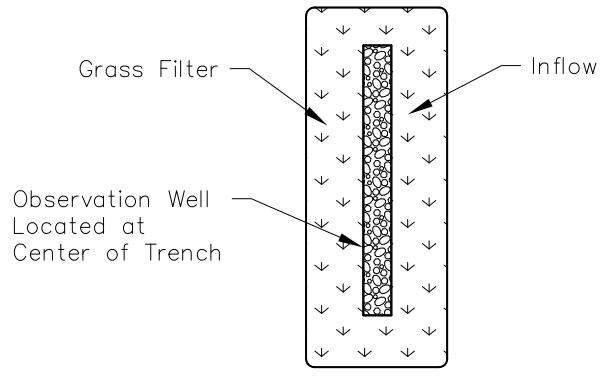
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NOTE:  
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INFILTRATION TRENCH  
PLAN CONFIGURATION

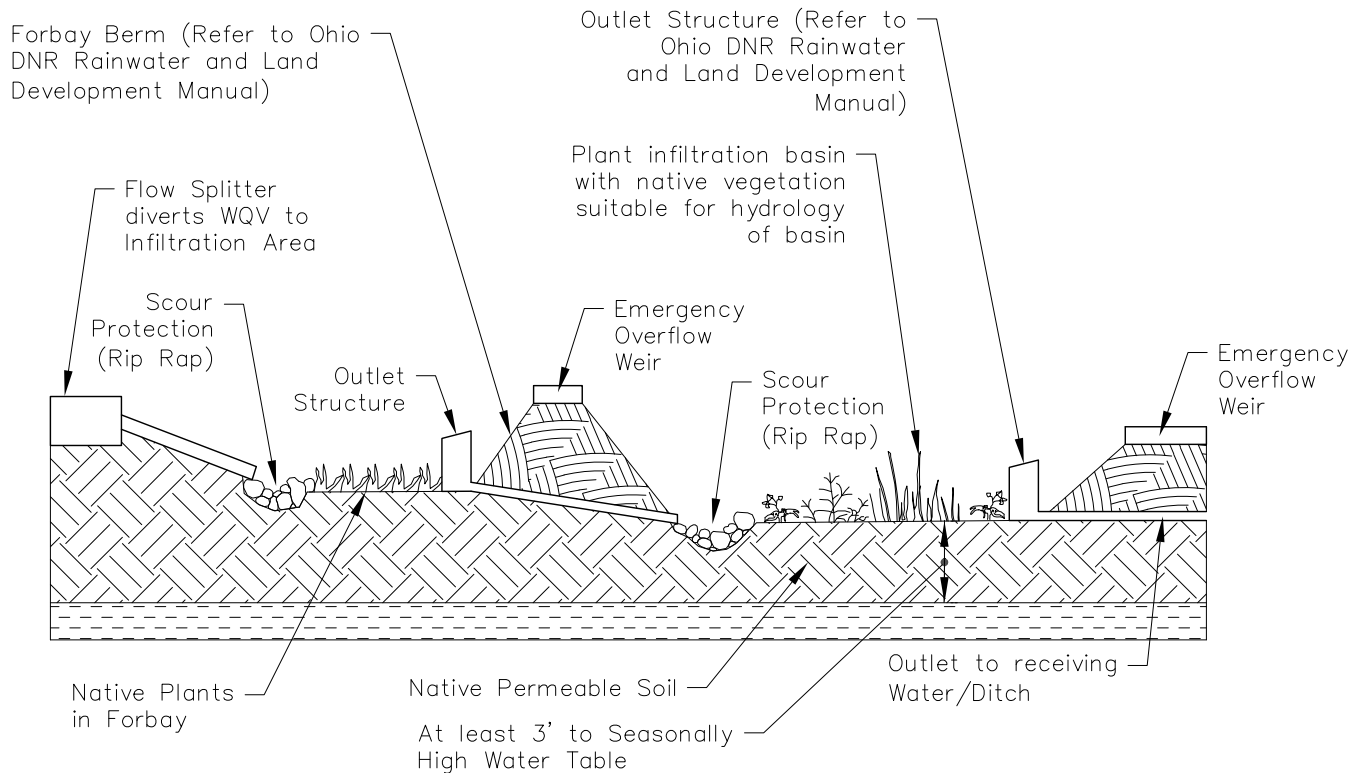
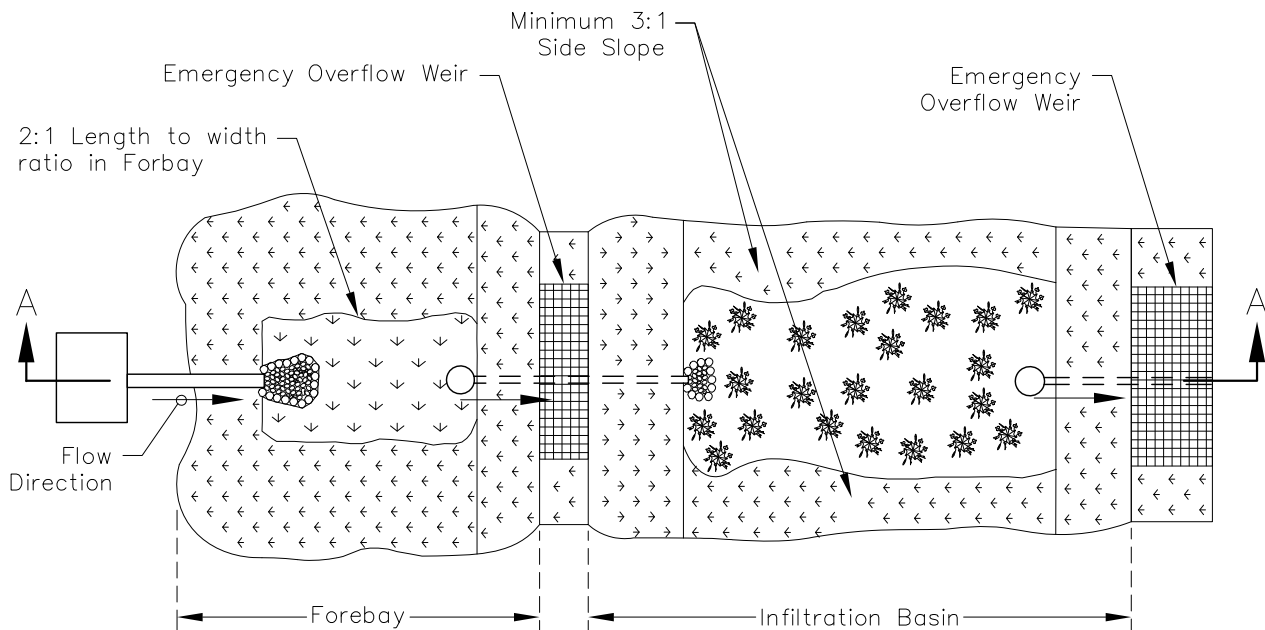
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SECTION A-A

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INFILTRATION BASIN

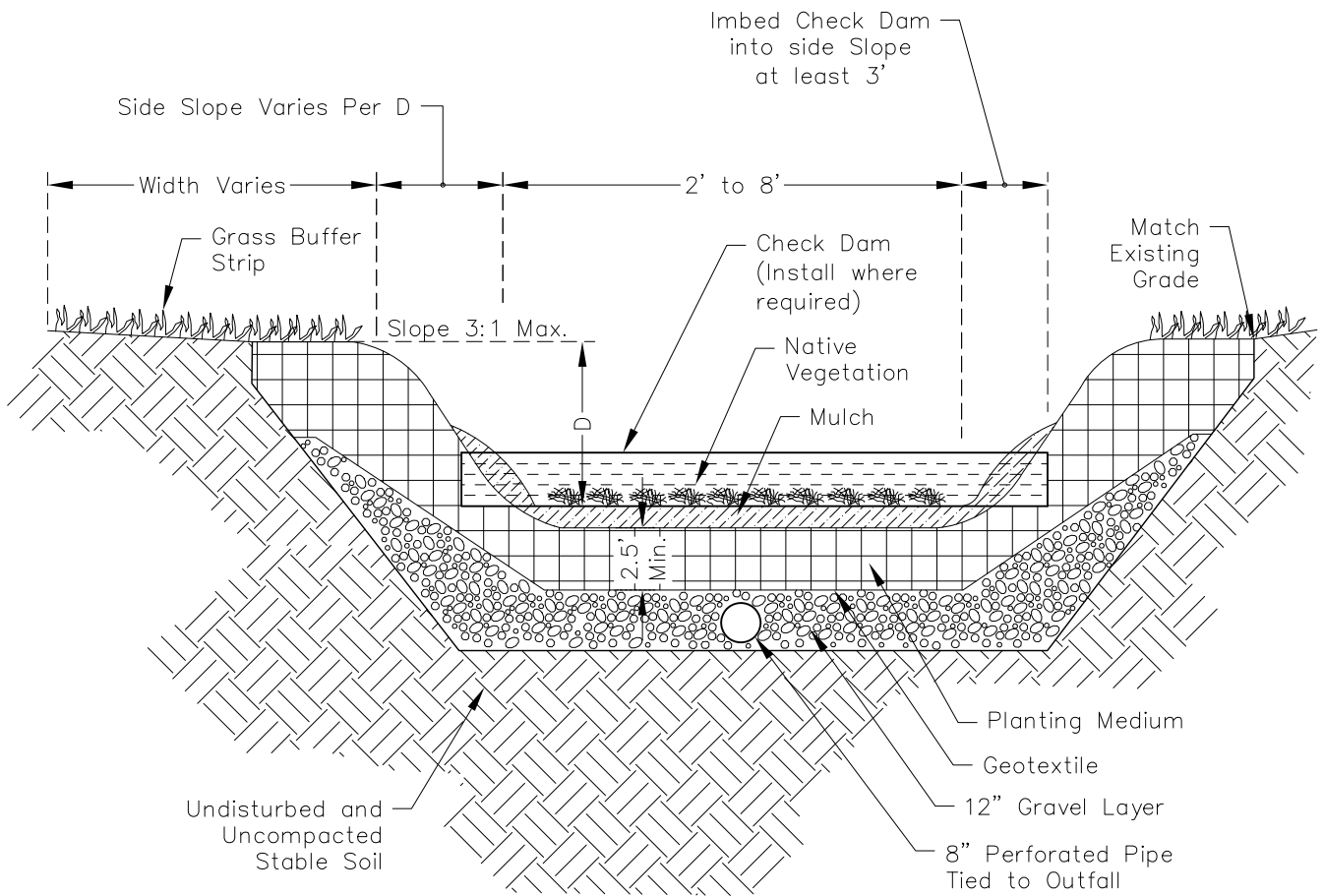
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VEGETATED SWALE

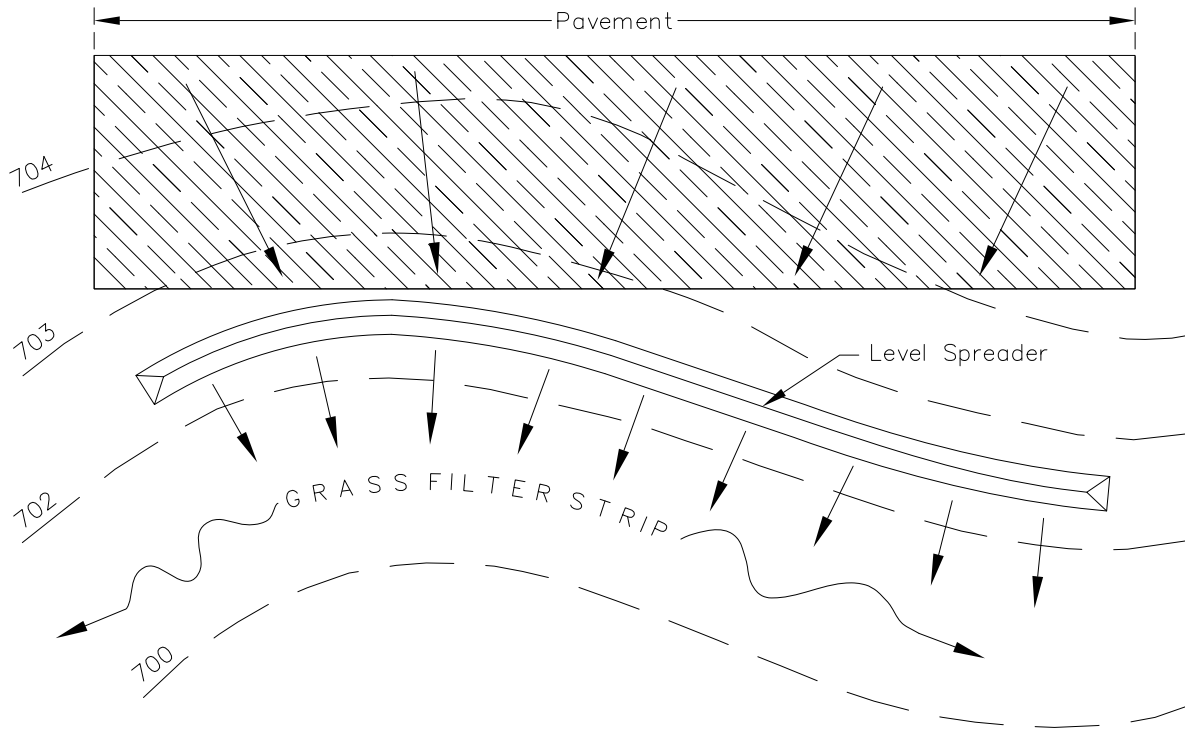
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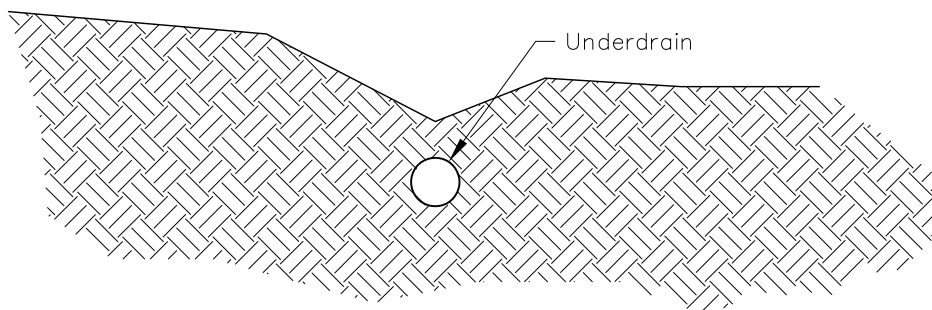
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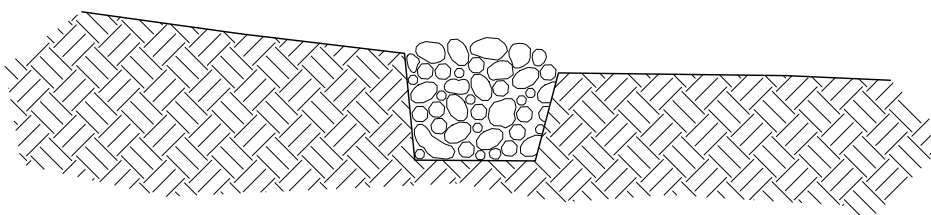
SHEET FLOW RUNOFF PLAN

OPTION: A



"GRASS" LEVEL SPREADER

OPTION: B



"ROCK TRENCH" LEVEL SPREADER

NOTE:

PLEASE REFER TO THE OHIO DEPARTMENT OF NATURAL RESOURCES RAINWATER AND LAND DEVELOPMENT MANUAL FOR MORE INFORMATION.

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FILTER STRIP

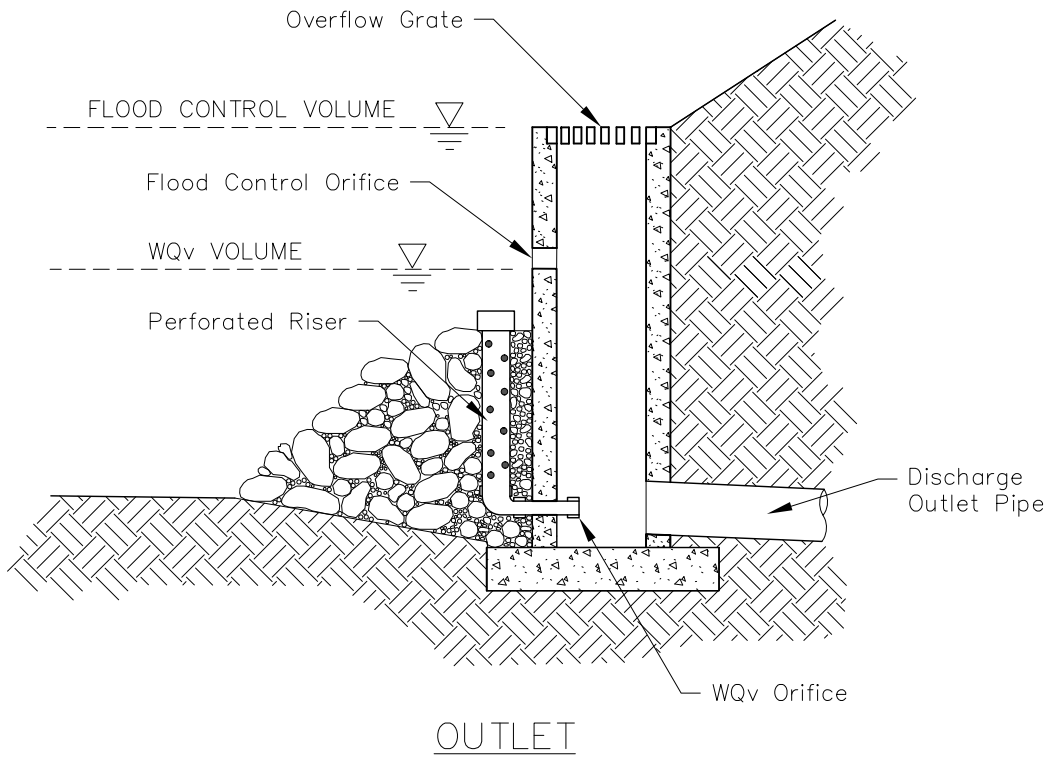
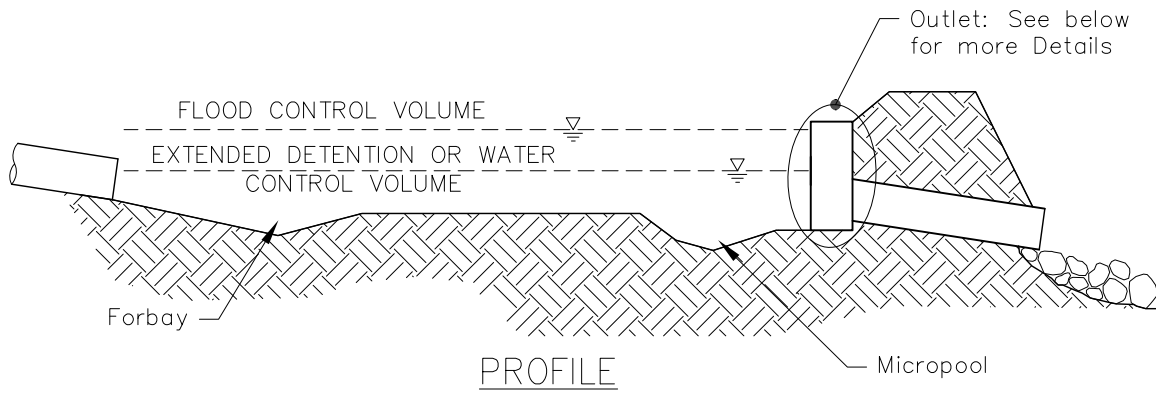
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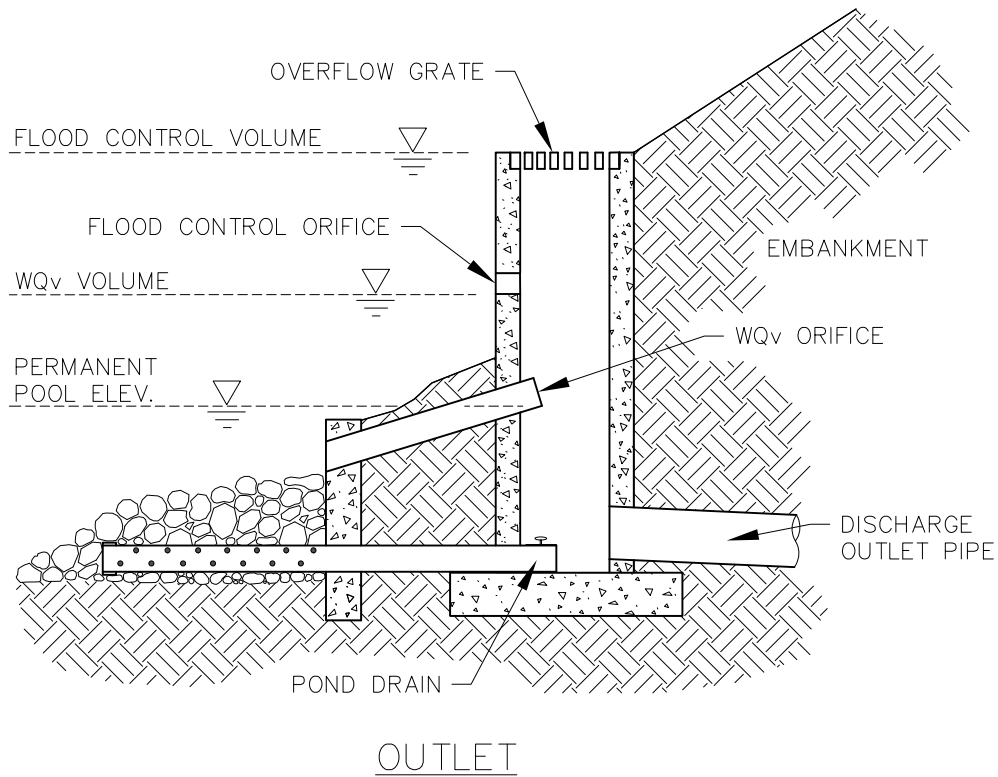
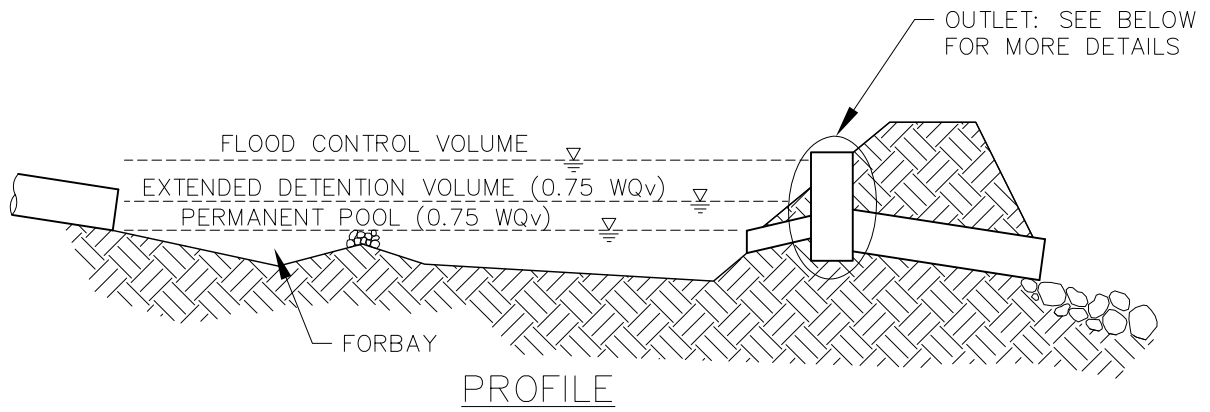
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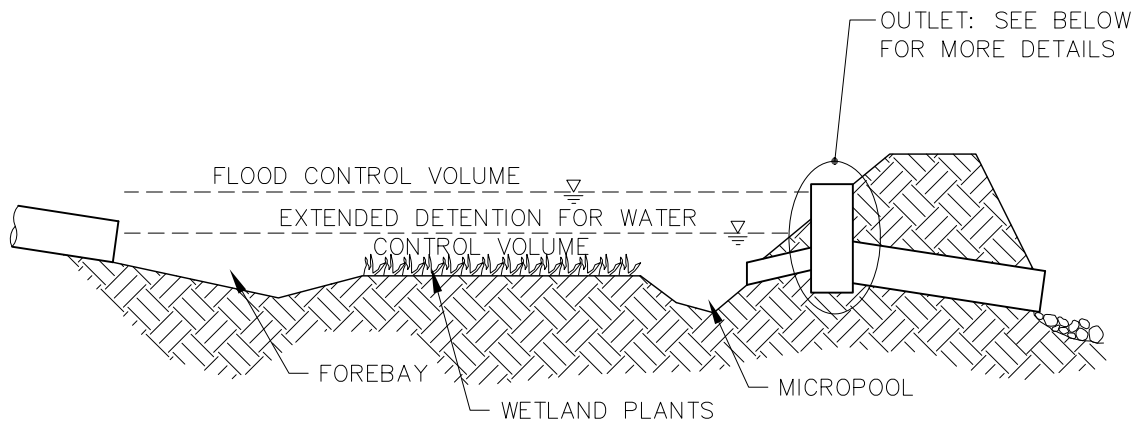
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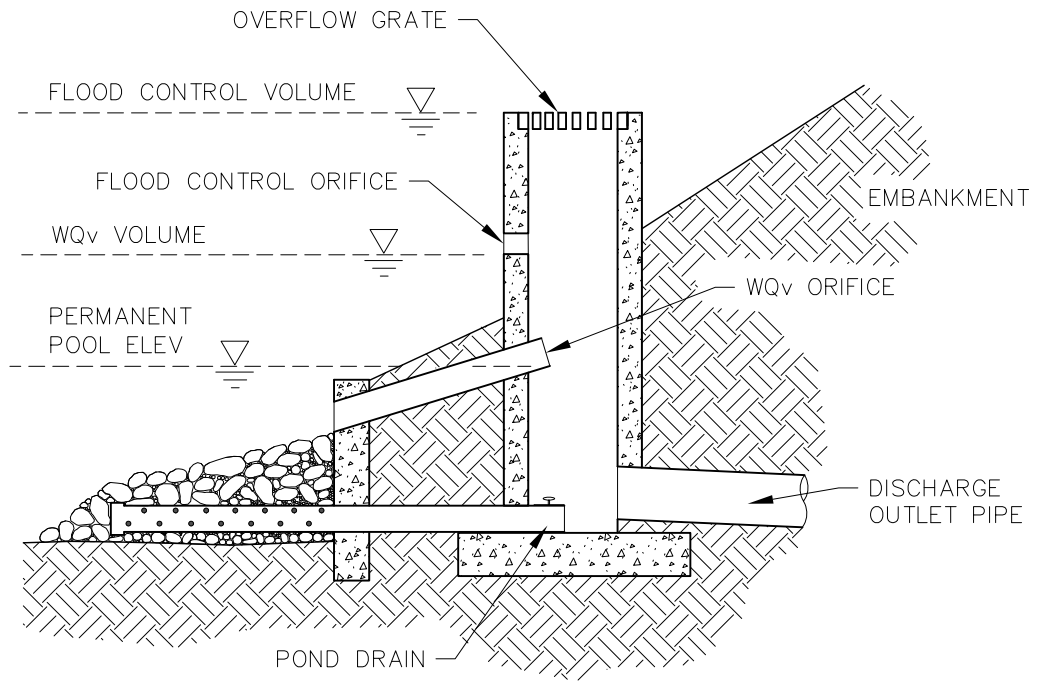
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PROFILE



OUTLET

NOTE:

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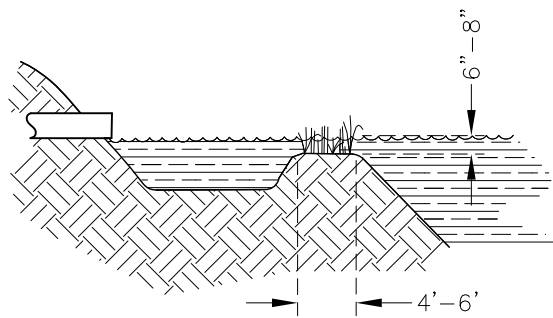
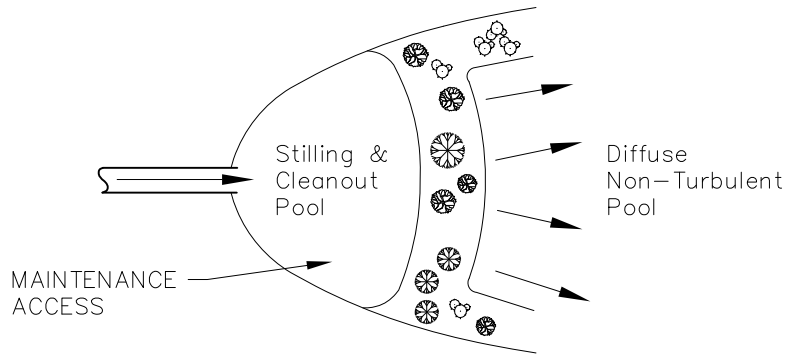
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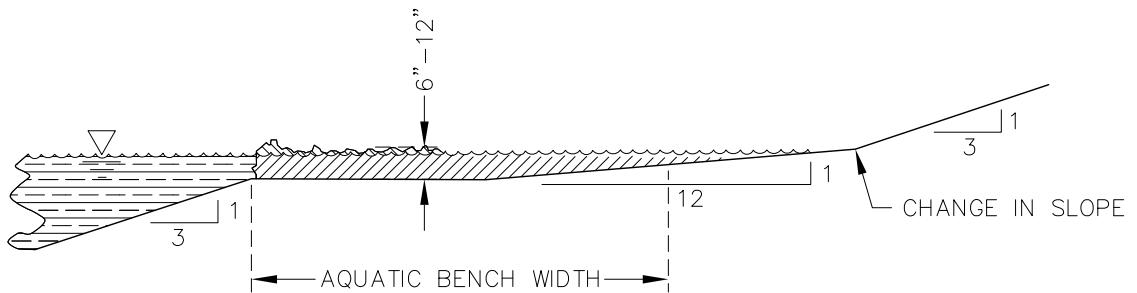
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FOREBAY



AQUATIC BENCH

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MISC. BASIN DETAILS

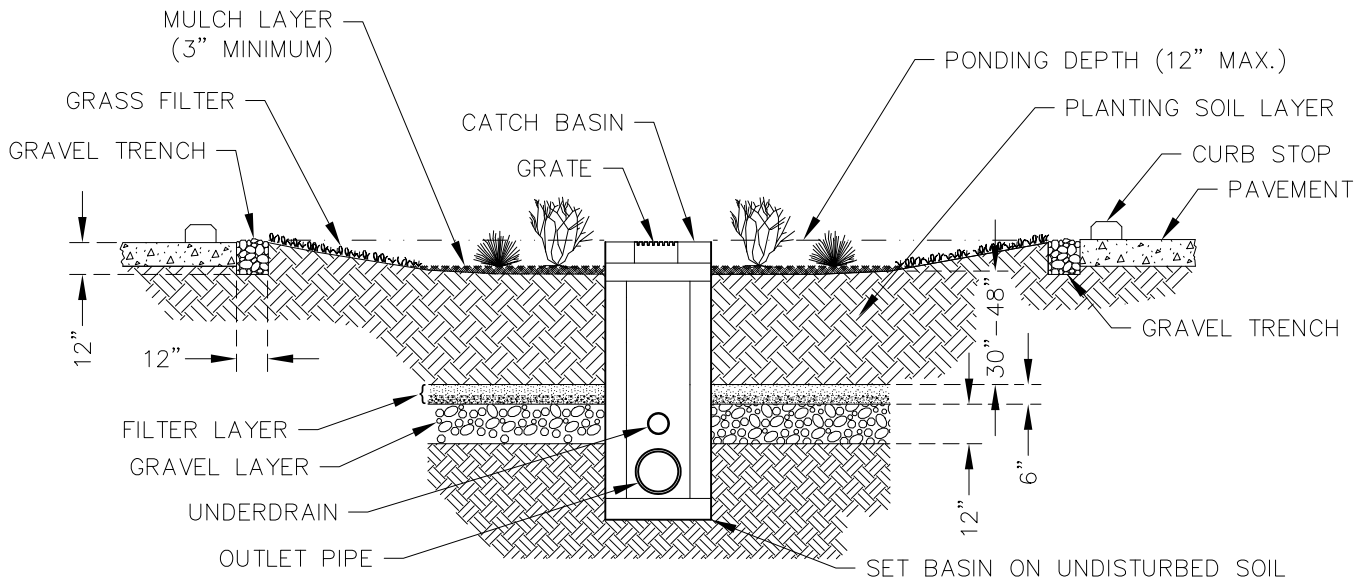
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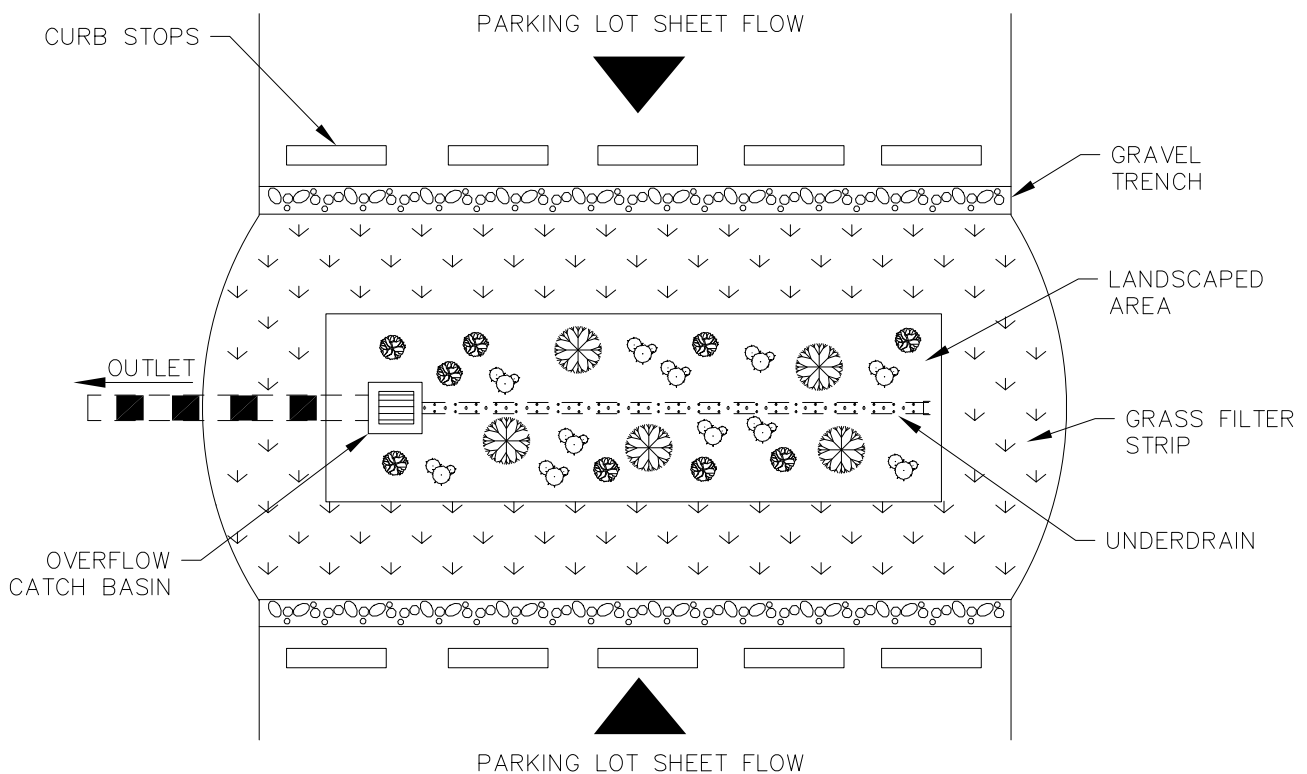
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CROSS SECTION



PLAN VIEW

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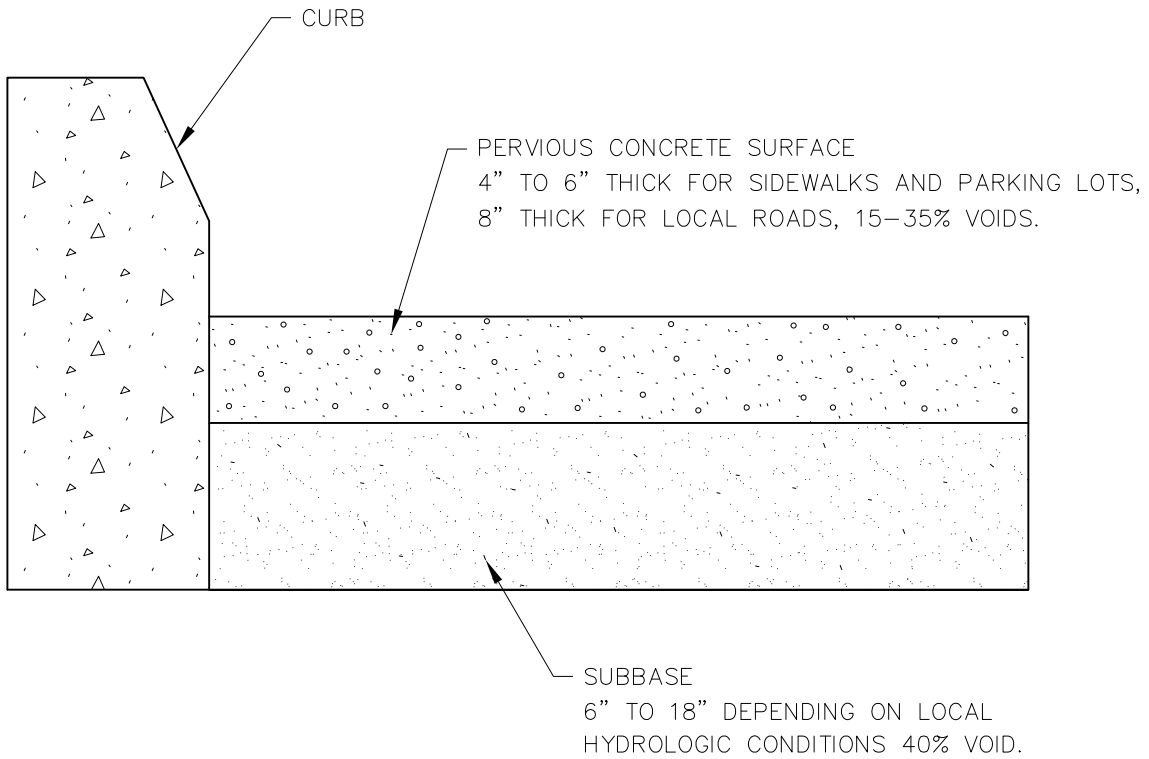
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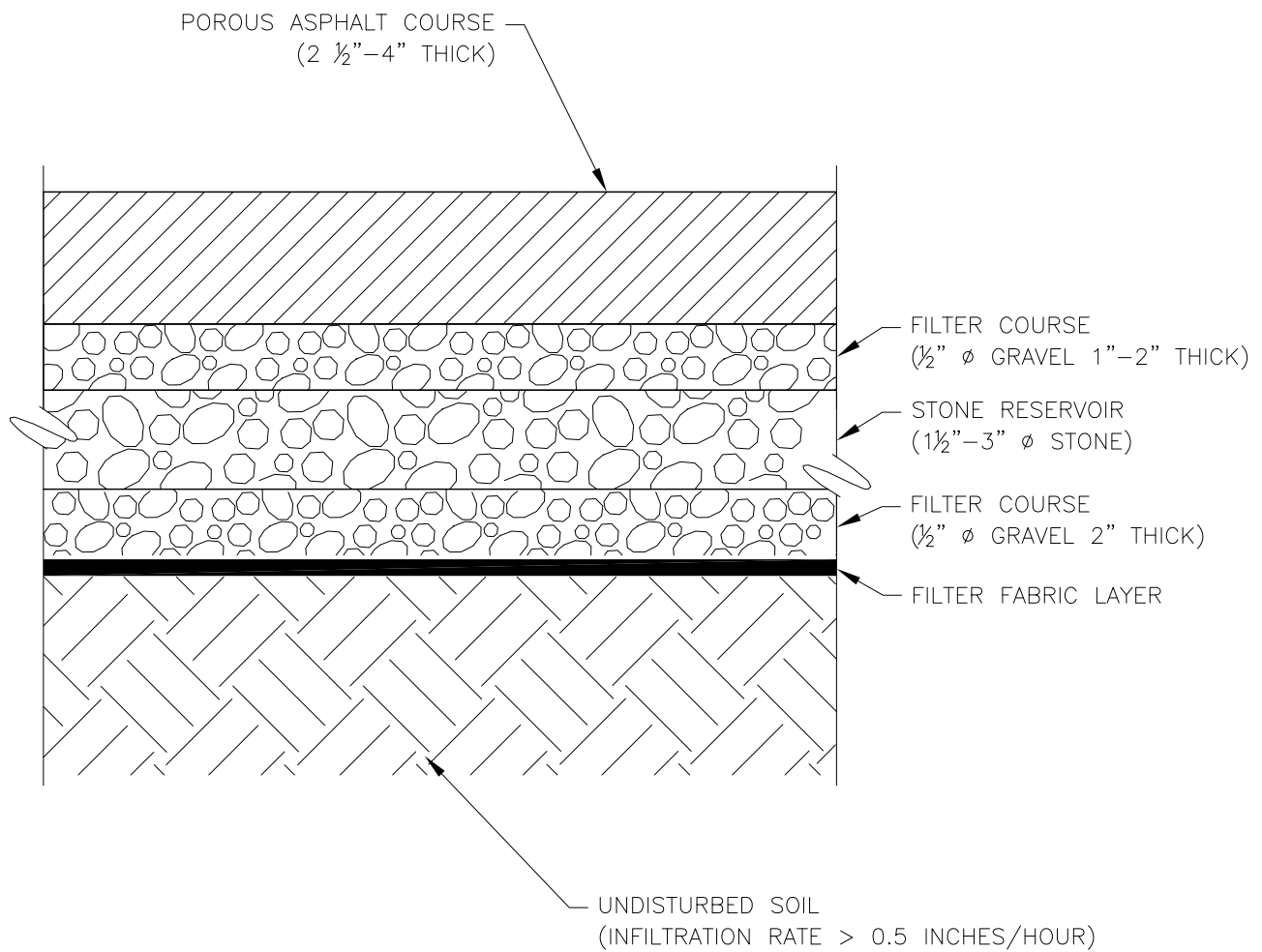
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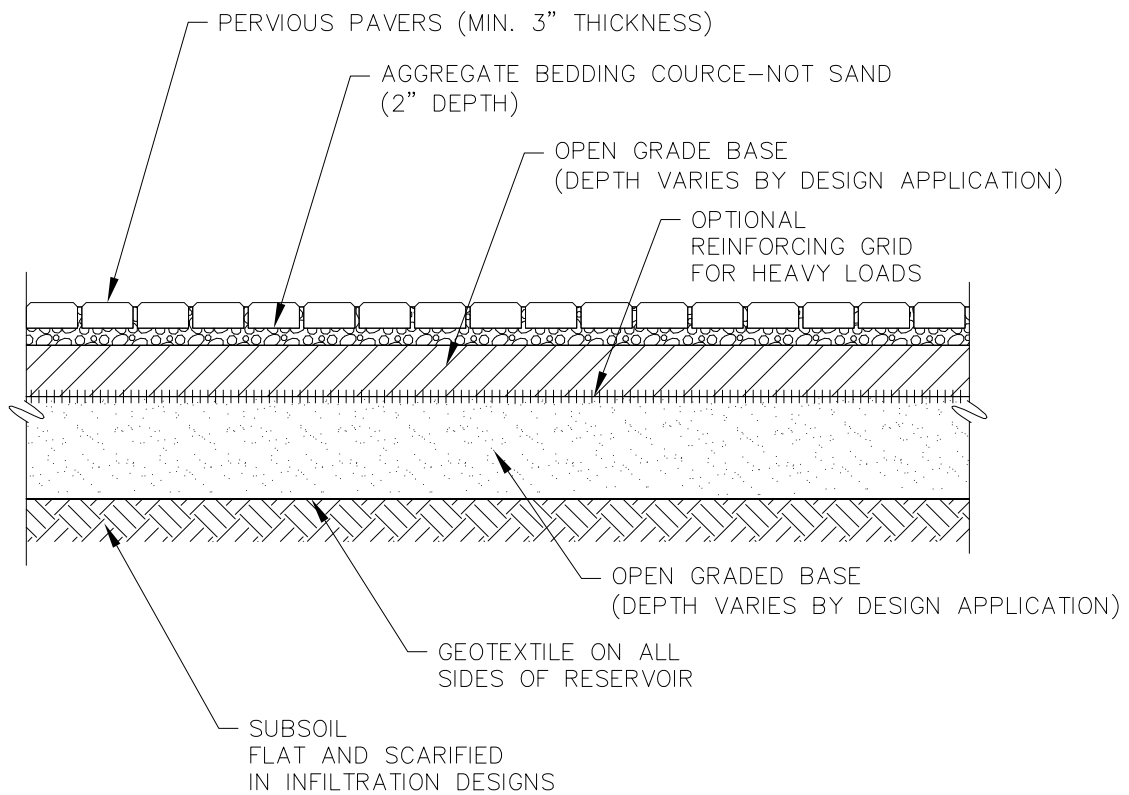
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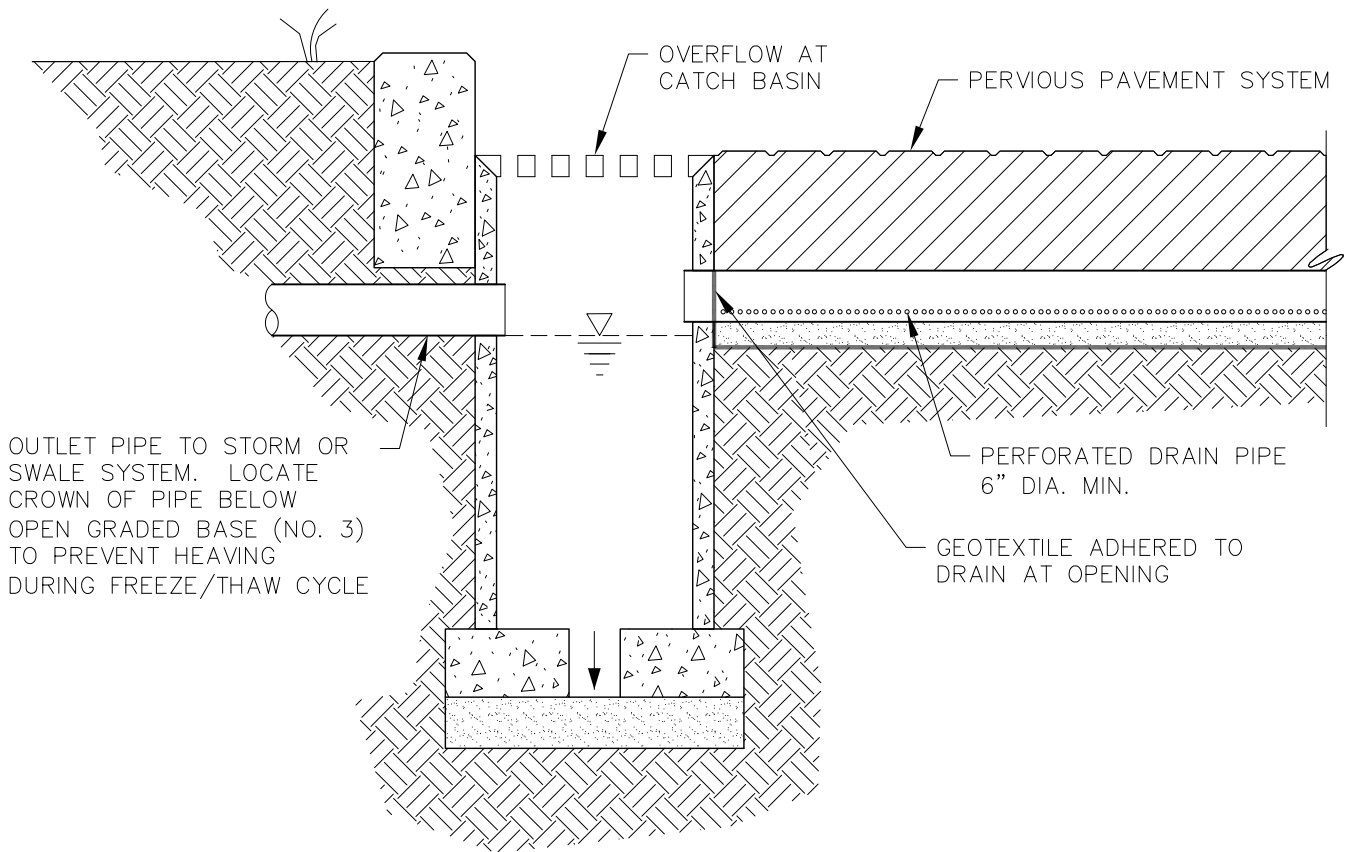
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PERVIOUS PAVEMENT SYSTEM  
WITH UNDERDRAIN

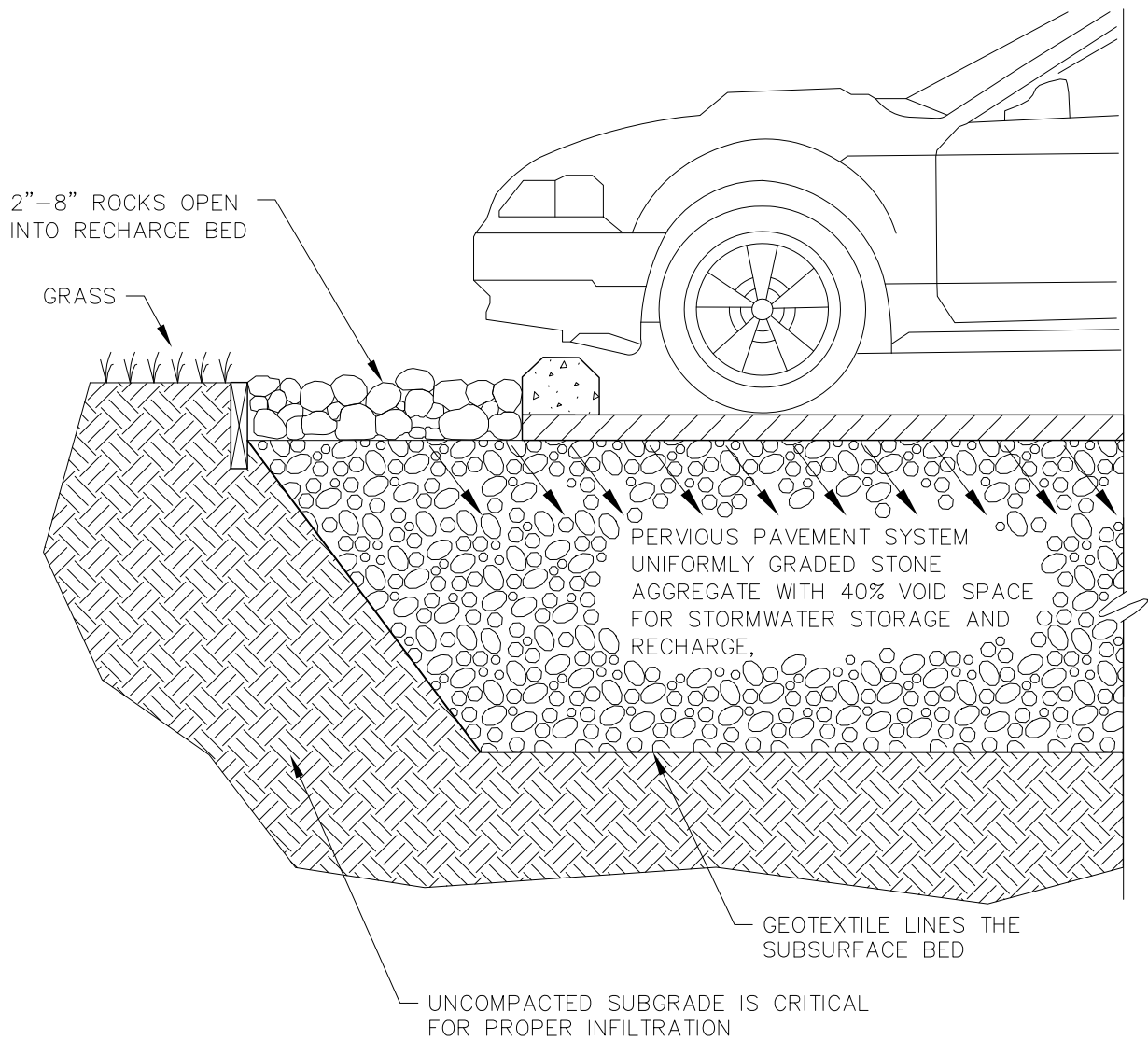
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PERVIOUS PAVEMENT SYSTEM  
WITH BACKUP INFILTRATION  
SYSTEM

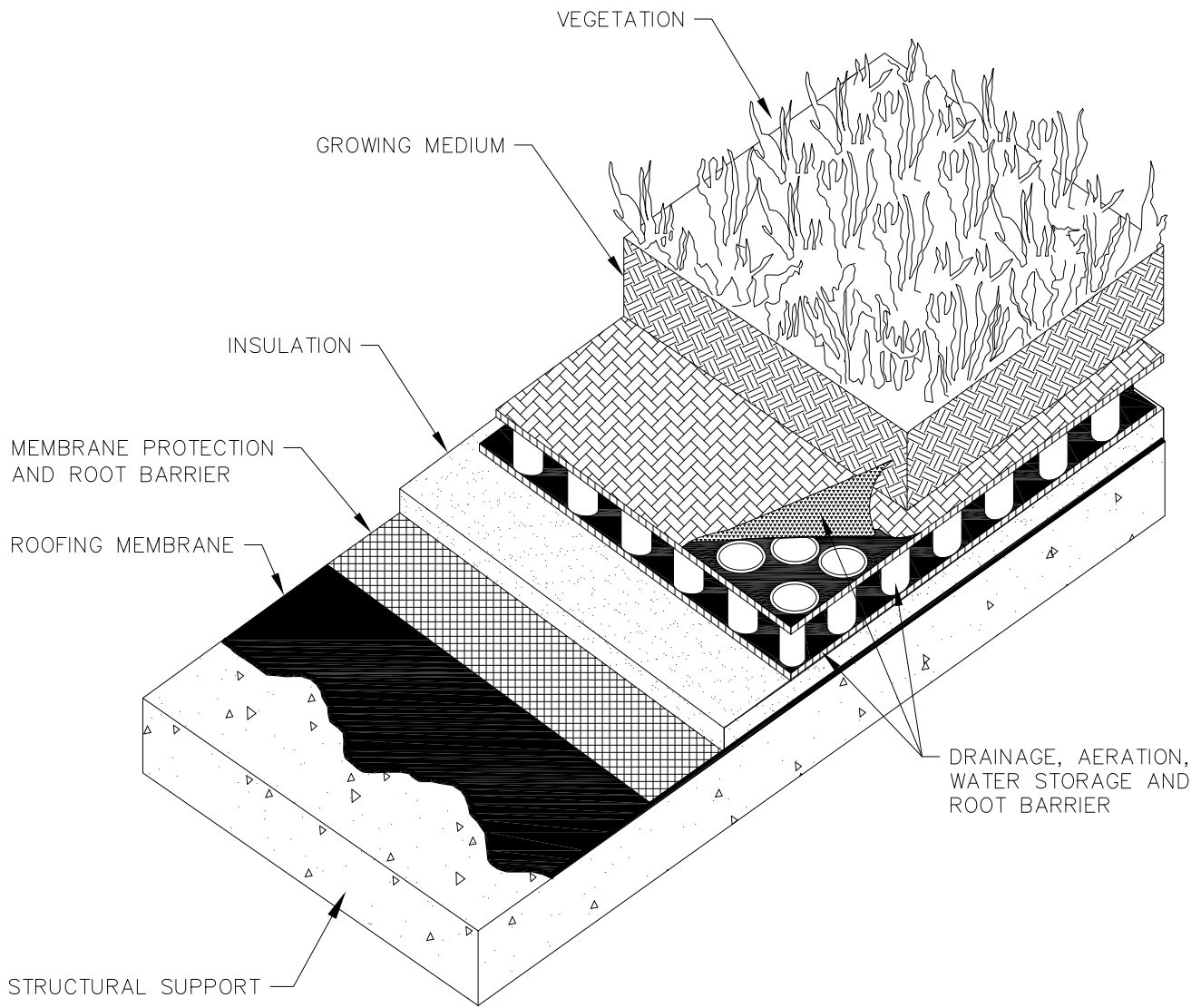
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NOTE:  
 DEPTHS/THICKNESS OF ALL LAYERS AND EXTENT OF STRUCTURAL SUPPORT VARIES PER MANUFACTURER'S  
 RECOMMENDATIONS.

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GREEN ROOF

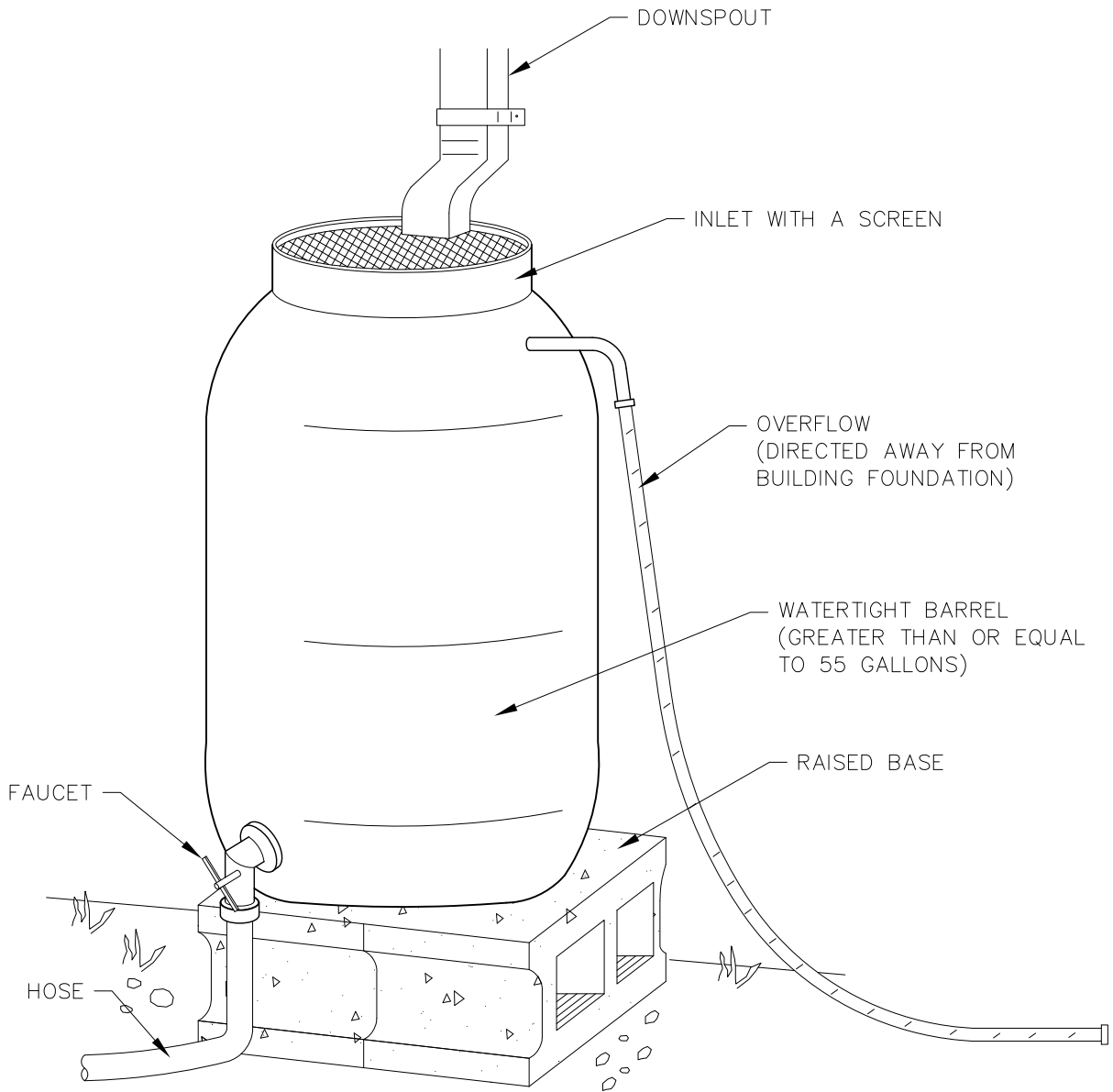
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RESIDENTIAL CISTERN  
(RAIN BARREL)

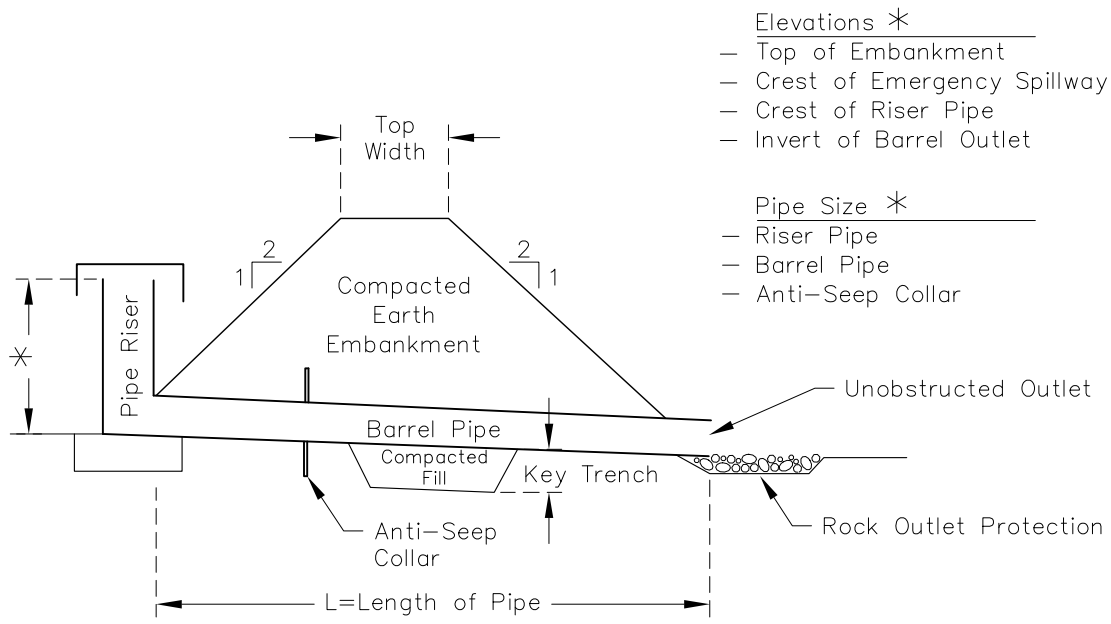
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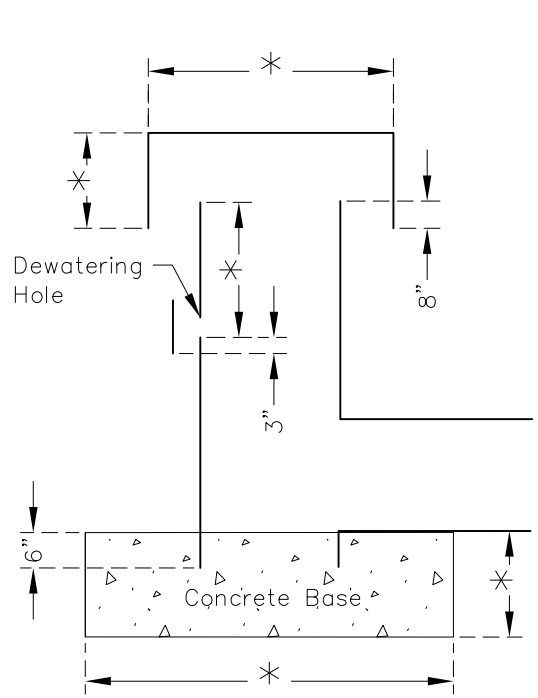
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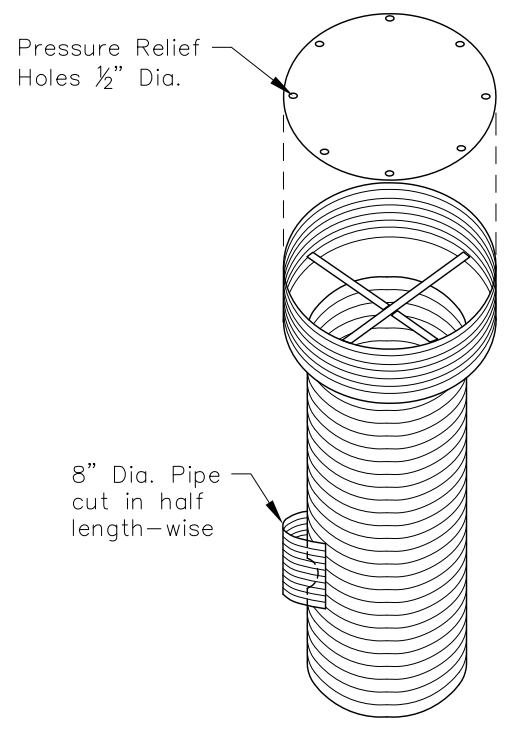


- Elevations \*
- Top of Embankment
  - Crest of Emergency Spillway
  - Crest of Riser Pipe
  - Invert of Barrel Outlet
- Pipe Size \*
- Riser Pipe
  - Barrel Pipe
  - Anti-Seep Collar

EMERGENCY SPILLWAY



SECTION  
Trash Racks & Base




ISOMETRIC

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

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SEDIMENT BASIN


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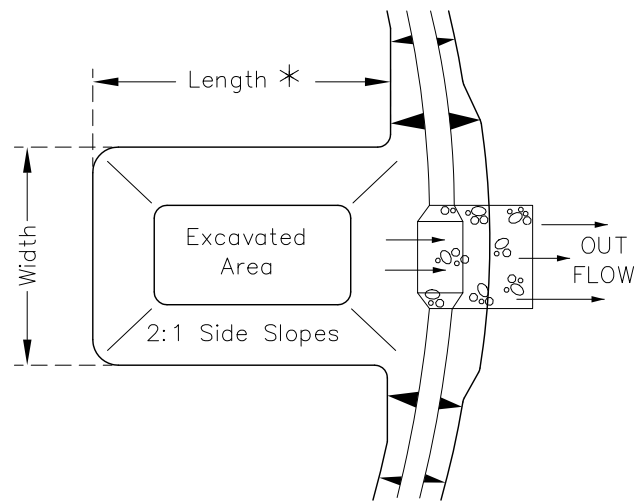


**City of Dayton**  
**WATER**

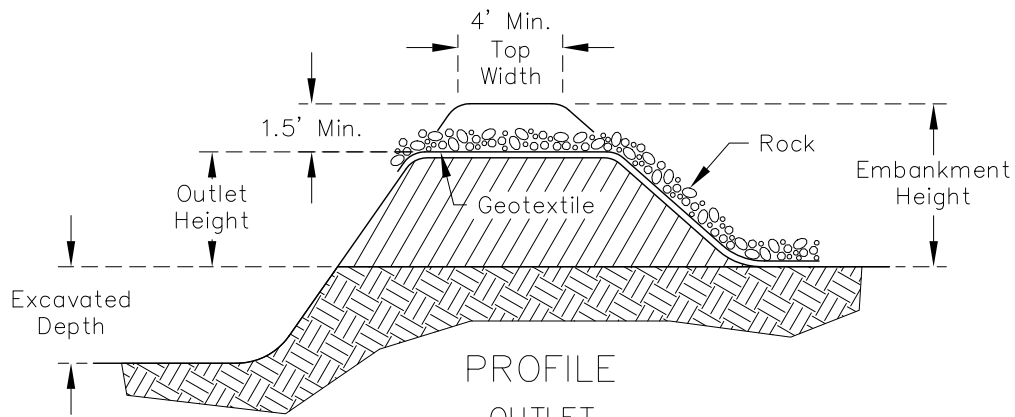
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DIVISION OF WATER ENGINEERING

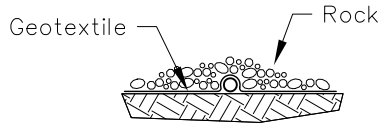




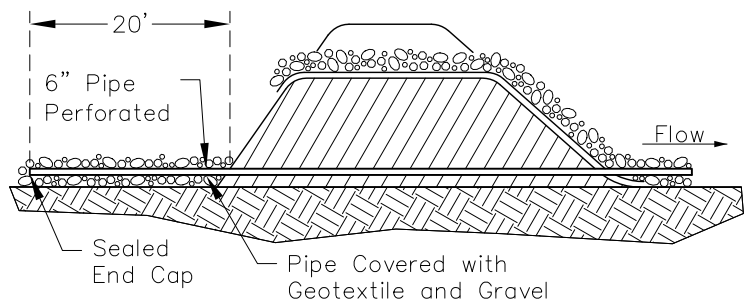
PLAN VIEW



PROFILE  
OUTLET



SECTION  
DEWATERING PIPE



PROFILE  
OUTLET

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

SEDIMENT TRAPS

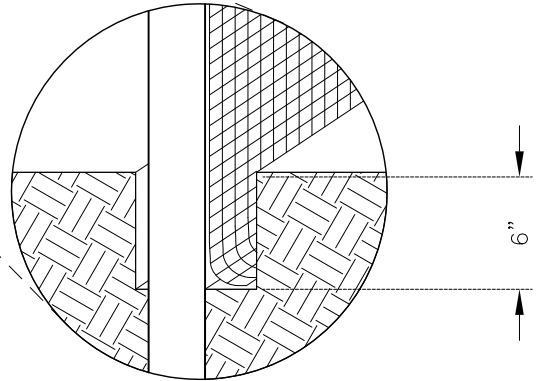
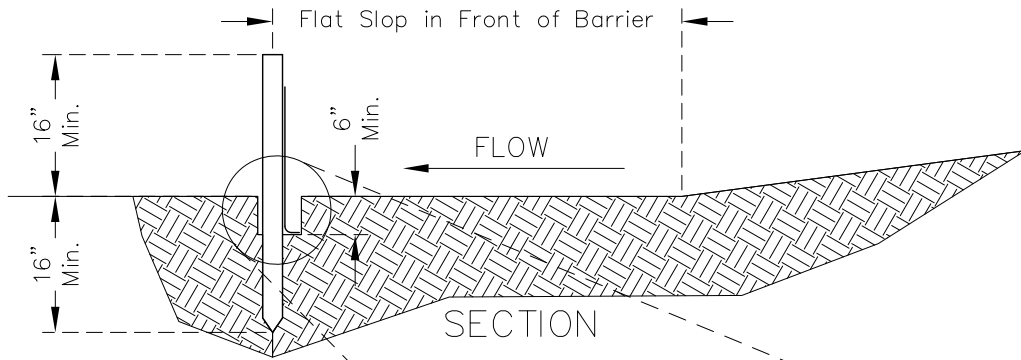
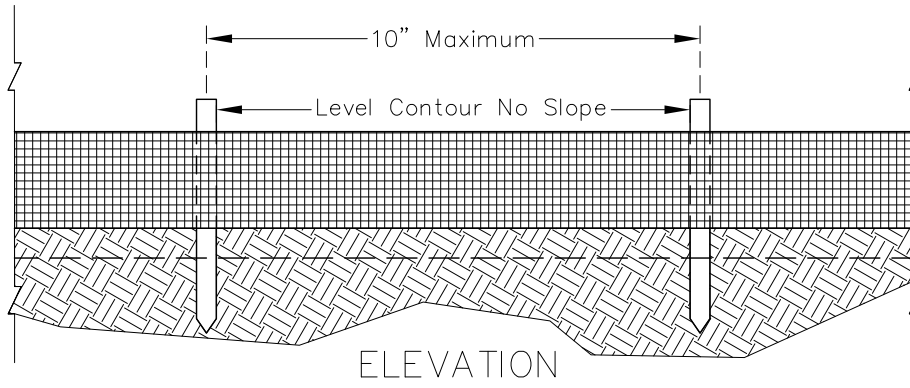
DRAWING NO. ER-2  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



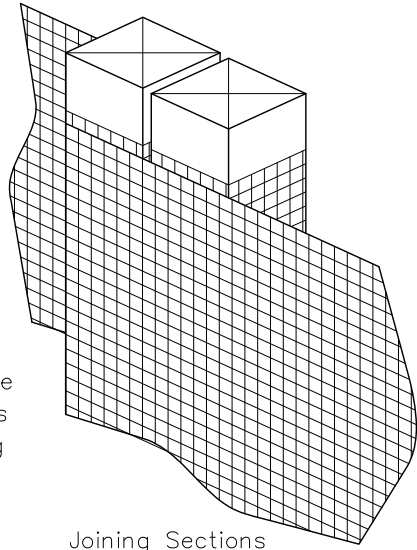
320 W. MONUMENT AVE.  
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Trench to be Backfilled and Compacted



Wrap Geotextile Around Stakes Before Driving

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Dimension Edit

SILT FENCE

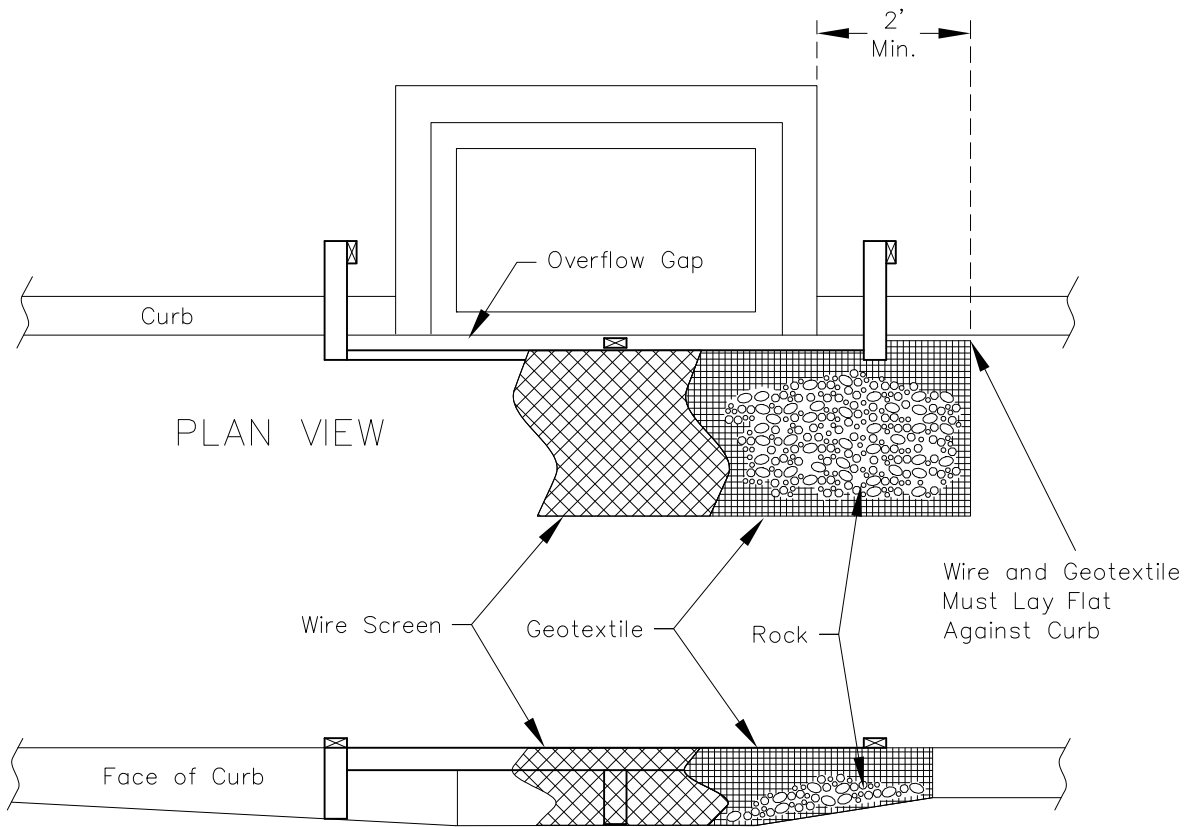
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SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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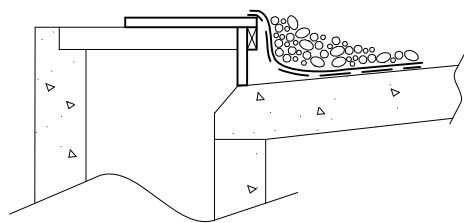
CITY OF DAYTON  
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DIVISION OF WATER ENGINEERING



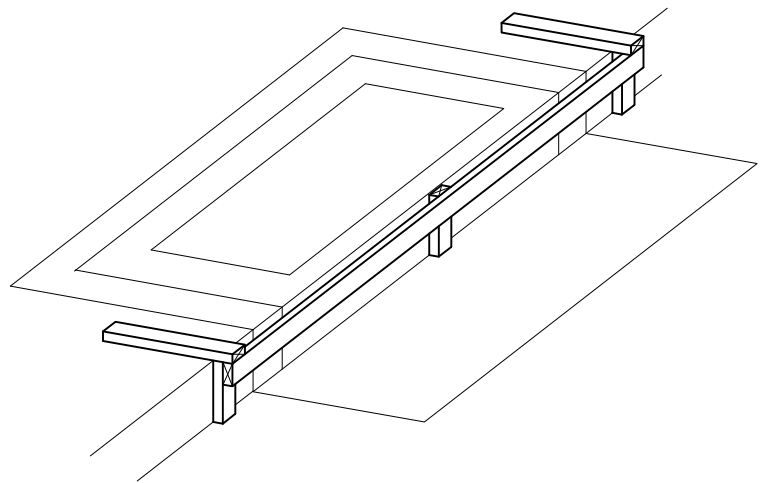


PLAN VIEW

ELEVATION



SECTION



\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

\* SEDIMENT BUILD-UP ON AND AROUND INLET PROTECTION SHALL BE REMOVED PERIODICALLY SO AS TO AVOID PONDING NEAR LANES OF TRAVEL.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Note added

INLET PROTECTION - CURB

DRAWING NO. ER-4  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS

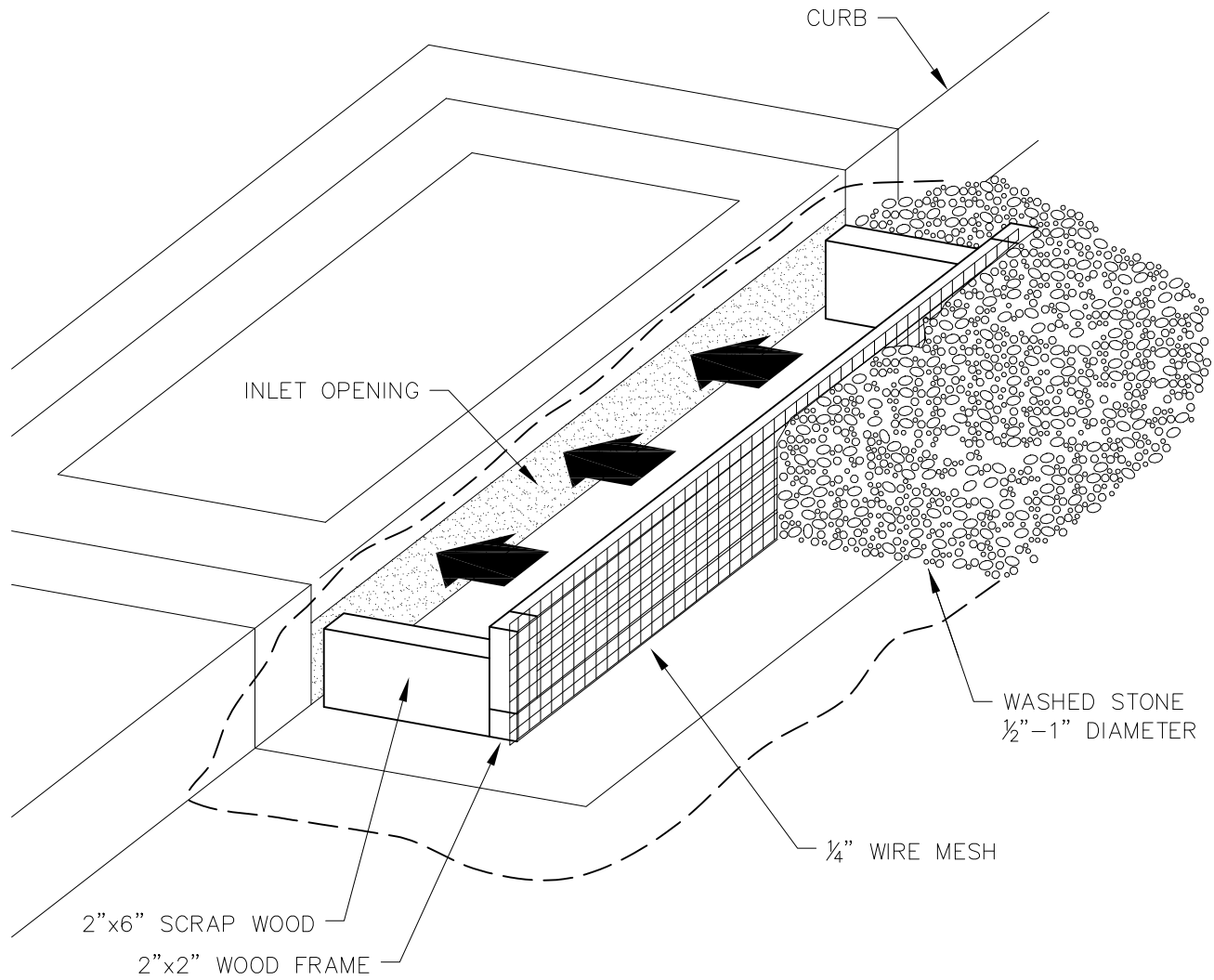


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# SLIDE BOX INTO INLET OPENING



\* SEDIMENT BUILD-UP ON AND AROUND INLET PROTECTION SHALL BE REMOVED PERIODICALLY SO AS TO AVOID PONDING NEAR LANES OF TRAVEL.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Note Added

INLET PROTECTION  
CURB/GUTTER

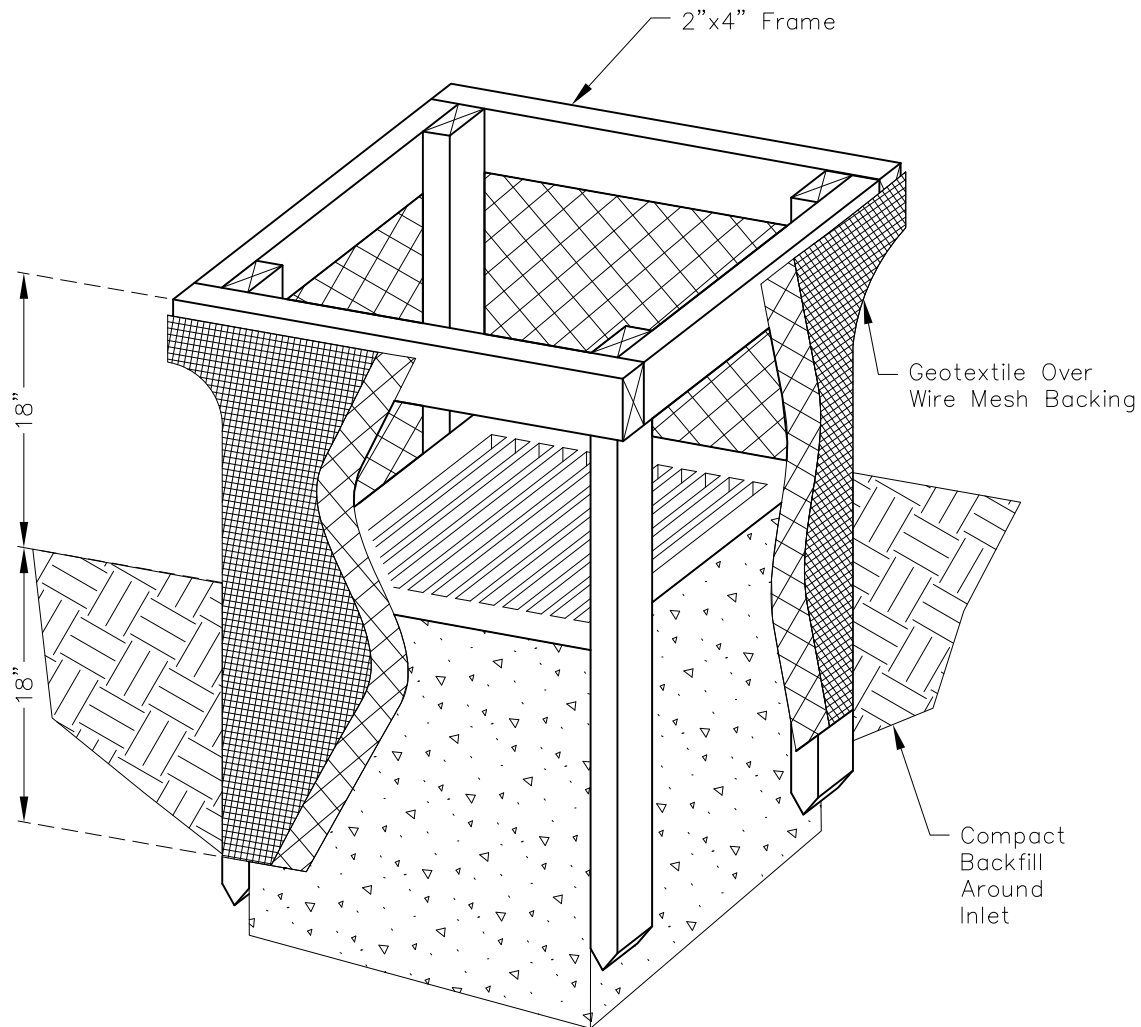
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SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

\* SEDIMENT BUILD-UP ON AND AROUND INLET PROTECTION SHALL BE REMOVED PERIODICALLY SO AS TO AVOID PONDING NEAR LANES OF TRAVEL.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Note Added

INLET PROTECTION - OTHER

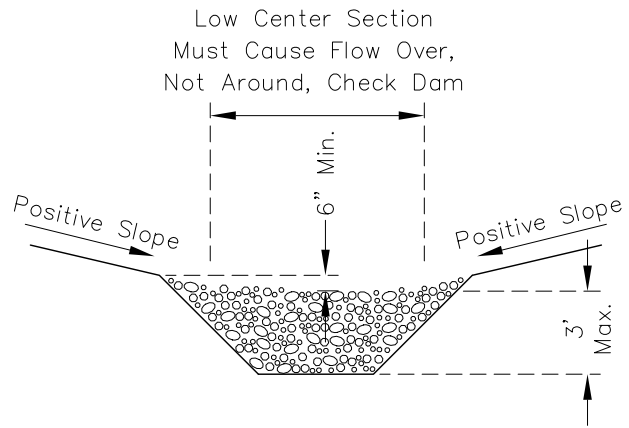
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 DRAWN: MAY 2002 BY: JBS



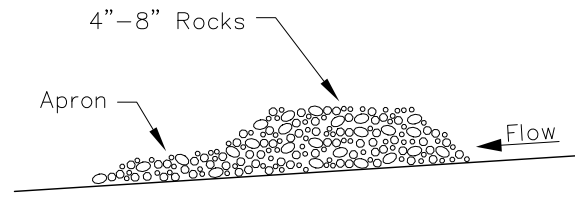
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 DIVISION OF WATER ENGINEERING





CROSS SECTION



PROFILE

1. The check dam shall be constructed of 4–8 inch diameter stone, placed so that it completely covers the width of the channel
1. The top of the check dam shall be constructed so that the center is approximately 6 inches lower than the outer edges, so water will flow across the center and not around the ends.
2. The maximum height of the check dam at the center of the weir shall not exceed 3 feet.
3. Spacing between dams shall be as shown in the plans or by the following table:

Check Dam Spacing				
Dam Height (feet)	Channel Slope			
	< 5%	5–10%	10–15%	15–20%
1	65 ft.	30 ft.	20 ft.	15 ft.
2	130 ft.	65 ft.	40 ft.	30 ft.
3	200 ft.	100 ft.	65 ft.	50 ft.

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CHECK DAM

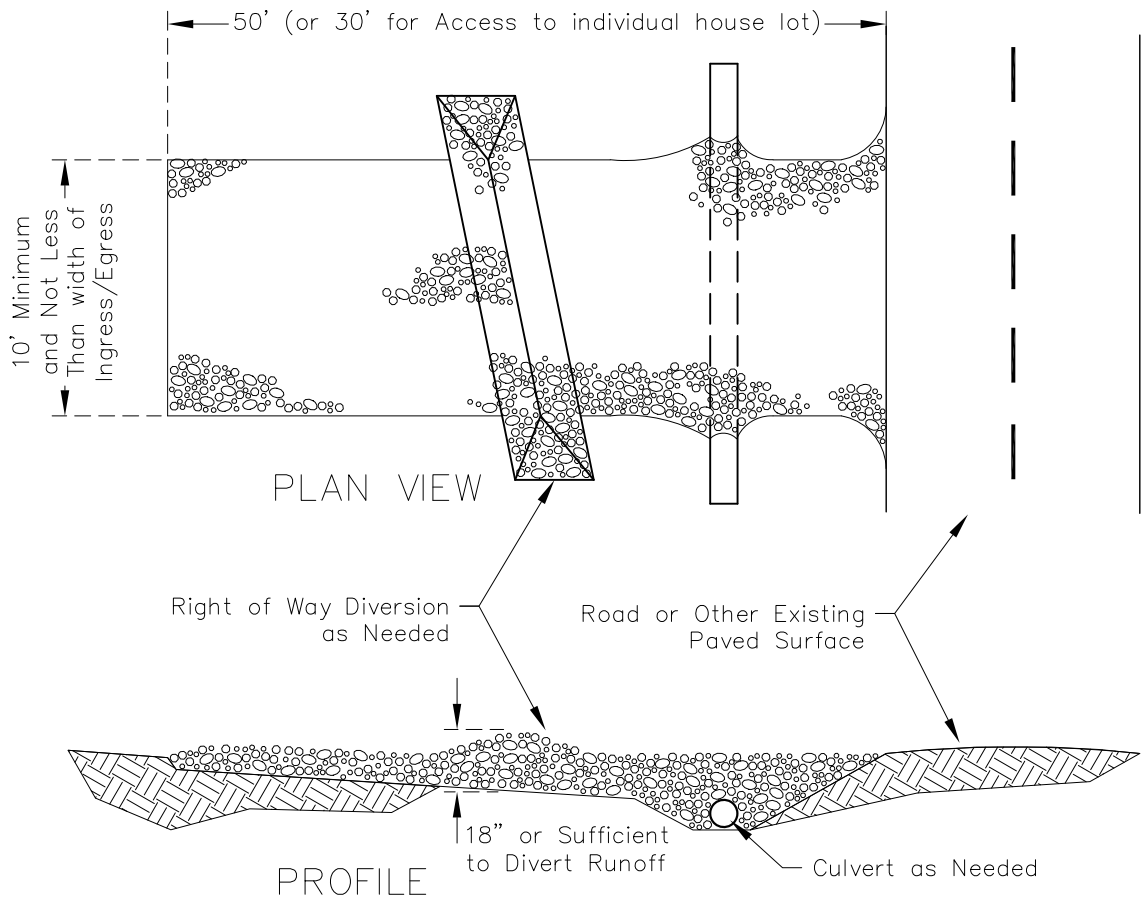
DRAWING NO. ER-7  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



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1. Stone Size – Two-inch stone shall be used, or recycled concrete equivalent.
2. Length – The construction entrance shall be as long as required to stabilize high traffic areas but not less than 50 ft. (except on single residence lot where a 30-ft. minimum length applies).
3. Thickness – The stone layer shall be at least 6 in. thick.
4. Width – The entrance shall be at least 10ft. wide, but not less than the full width at points where ingress or egress occurs.
5. Bedding – A geotextile shall be placed over the entire area prior to placing stone. It shall have a Grab Tensile Strength of at least 200 lb. and a Mullen Burst Strength of at least 190 lb.
6. Culvert – A pipe or culvert shall be constructed under the entrance if needed to prevent surface water flowing across the entrance from being directed out onto paved surfaces.
7. Water Bar – A water bar shall be constructed as part of the construction entrance if needed to prevent surface runoff from flowing the length of the construction entrance and out onto paved surfaces.
8. Maintenance – Top dressing of additional stone shall be applied as conditions demand. Mud spilled, dropped, washed or tracked onto public roads, or any surface where runoff is not checked by sediment controls, shall be removed immediately. Removal shall be accomplished by scraping or sweeping. Sweep road weekly with pick up broom 100 feet each direction.
9. Construction entrances shall not be relied upon to remove mud from vehicles and prevent off-site tracking. Vehicles that enter and leave the construction-site shall be restricted from muddy areas.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	9/18	Maintenance Note

CONSTRUCTION ENTRANCE

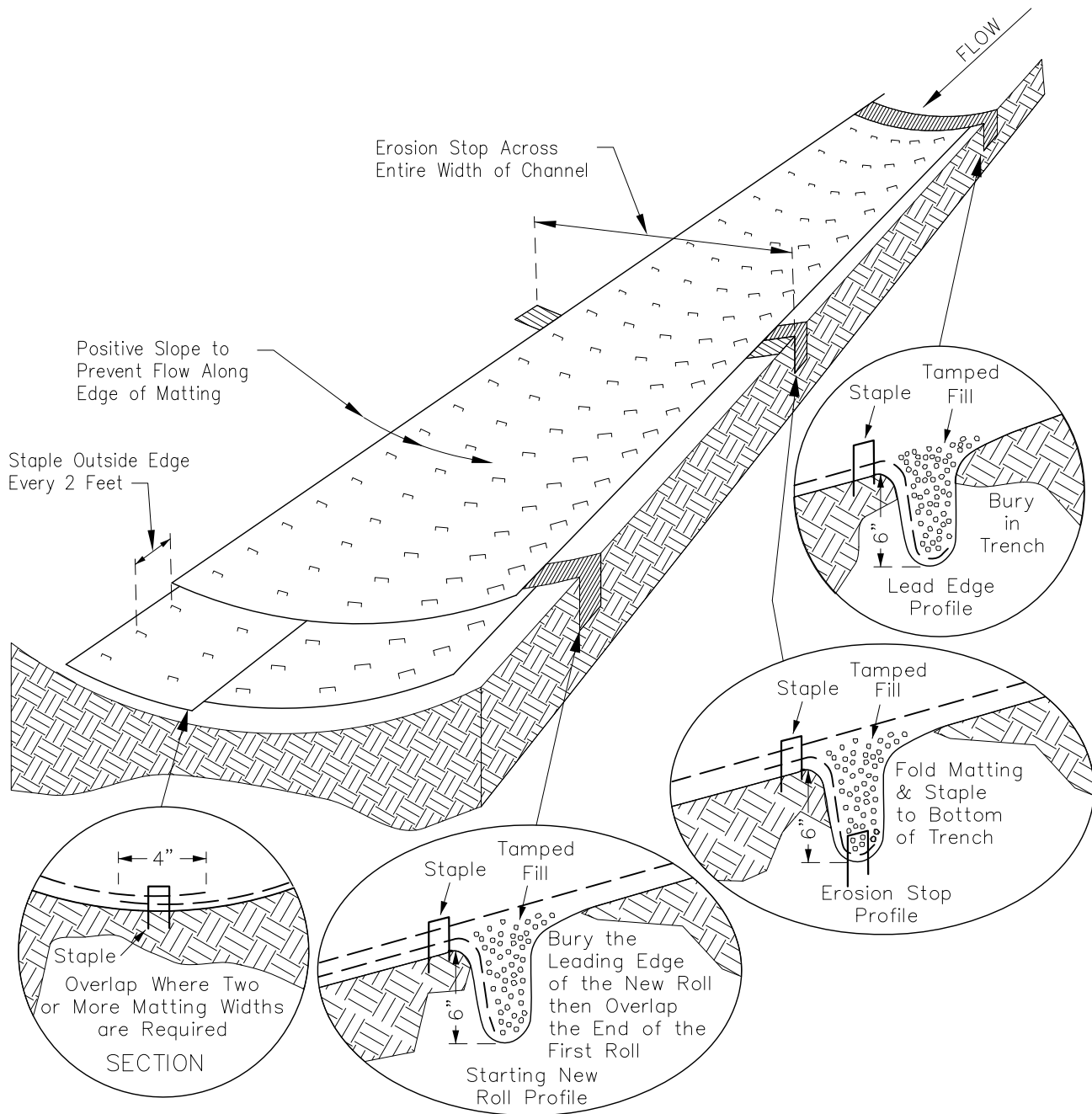
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 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



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\* ENGINEER TO SPECIFY MATTING MATERIAL, GRADE & MANUFACTURERS INSTALLATION INSTRUCTIONS / RECOMMENDATIONS FOR SPECIFIC USE.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

MATTING

DRAWING NO. ER-9  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



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## PERMANENT SEEDING

SEED MIX	SEEDING RATE		NOTES
	lb./ac.	lb./1000 ft <sup>2</sup>	
<b>GENERAL USE</b>			
Creeping Red Fescue	20-40	½ - 1	
Domestic Ryegrass	10-20	¼ - ½	
Kentucky Bluegrass	10-20	¼ - ½	
Tall Fescue	40	1	
Dwarf Fescue	40	1	
<b>STEEP BANKS or CUT SLOPES</b>			
Tall Fescue	20-40	1	
Crown Vetch Tall Fescue	10-20	¼ - ½	Do not seed later than August
Flat Pea Tall Fescue	20	½	Do not seed later than August
<b>ROADS, DITCHES and SWALES</b>			
Tall Fescue	40	1	
Dwarf Fescue	90	2 ½	
Kentucky Bluegrass	5		
<b>LAWNS</b>			
Kentucky Bluegrass	60	1 ½	
Perrenial Ryegrass	60	1 ½	
Kentucky Bluegrass	60	1 ½	For shaded areas
Creeping Red Fescue	60	1 ½	For shaded areas
Note: Other approved seed species may be substituted			

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

### PERMANENT SEEDING

DRAWING NO. ER-10  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



320 W. MONUMENT AVE.  
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## TEMPORARY SEEDING

SPECIES	SEEDING RATE		SEEDING DATES
	lb./ac.	lb./1000 ft <sup>2</sup>	
Oats	4 Bushel	3	March 1 to August 15
Tall Fescue	40	1	
Annual Ryegrass	40	1	
Perennial Ryegrass	40	1	
Tall Fescue	40	1	
Annual Ryegrass	40	1	
Rye	2 Bushel	3	August 16 to November 1
Tall Fescue	40	1	
Annual Ryegrass	40	1	
Wheat	2 Bushel	3	
Tall Fescue	40	1	
Annual Ryegrass	40	1	
Perennial Ryegrass	40	1	
Tall Fescue	40	1	
Annual Ryegrass	40	1	
Use mulch only, sodding practices or dormant seeding.			November 1 to Spring Seeding
Note: Other approved seed species may be substituted			

\* REFER TO "RAINWATER LAND DEVELOPMENT" OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT, AND URBAN STREAM PROTECTION FOR DESIGN INFORMATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

TEMPORARY SEEDING

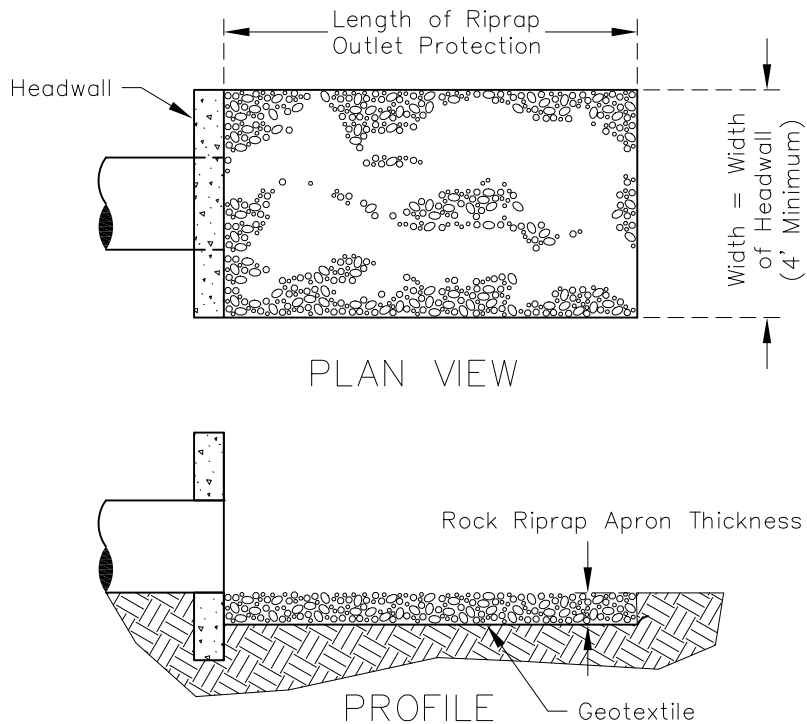
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SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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1. The subgrade for the filter and riprap shall be prepared to the required lines and grades as shown on the plan.
2. The riprap shall conform to the grading limits as shown on the plan.
3. Geotextile shall be woven or nonwoven monofilament yarn and shall meet the following:
  - Thickness 20-60 mils
  - Grab Strength 90-120 lb. .
  - ASTM D-1777 and ASTM D-1682
4. Riprap may be placed by equipment but shall be placed in a manner to prevent damage to the geotextile.
5. Length of Riprap outlet Protection shall be calculated based on ODOT L&D Manual, Rock Channel Protection at Culvert & Storm Sewer Outlets.

Type of Rock or Riprap	Size of Rock	
	50% by weight	85% by weight
Type D	>6"	3"-12"
Type C	>12"	6"-18"
Type B	>18"	12"-24"
Type A	>24"	18"-30"

NO.	DATE	REVISIONS
1	4/07	added note 5
2	5/13	Convert-AutoCAD

OUTLET PROTECTION

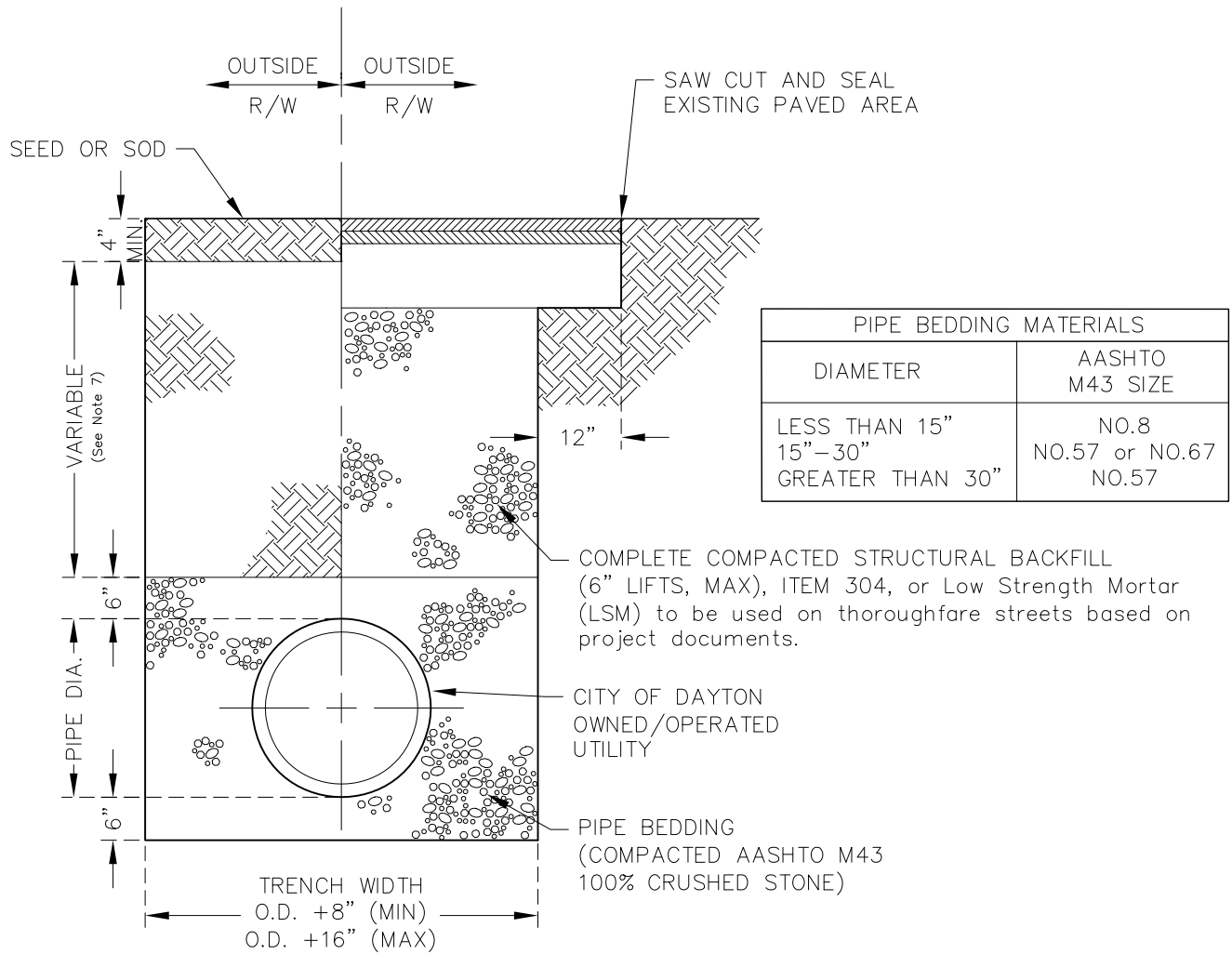
DRAWING NO. ER-12  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



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NOTE:

1. A STREET CUT PERMIT SHALL BE OBTAINED FROM THE CITY OF DAYTON.
2. TRAFFIC SHALL BE MAINTAINED AT ALL TIMES. ALL TRAFFIC CONTROL DEVICES AND THE MAINTENANCE OF TRAFFIC PLAN SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION DRAWINGS.
3. THE CITY OF DAYTON SHALL INSPECT THE OPEN TRENCH PRIOR TO BACKFILLING.
4. ALL BACKFILL MATERIAL SHALL BE COMPACTED IN UNIFORM LAYERS TO INSURE AGAINST SETTLEMENT.
5. DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK THE AREA SHALL BE CLEANED OF ALL DIRT, MUD AND DEBRIS.
6. ALL SURFACE RESTORATION SHALL BE MADE PER "RULES & REGULATIONS FOR MAKING OPENINGS IN A PUBLIC WAY" (LATEST EDITION).
7. NATIVE MATERIAL MAY BE USED OUTSIDE OF RIGHT-OF-WAY WITH the WATER ENGINEERING'S APPROVAL.

NO.	DATE	REVISIONS
1	4/07	added O.D. note added NO. 57 6" TO 12" 8" TO 6" LIFT
2	5/13	Convert-AutoCAD
3	1/20	Notes added

PIPE BEDDING & TRENCH

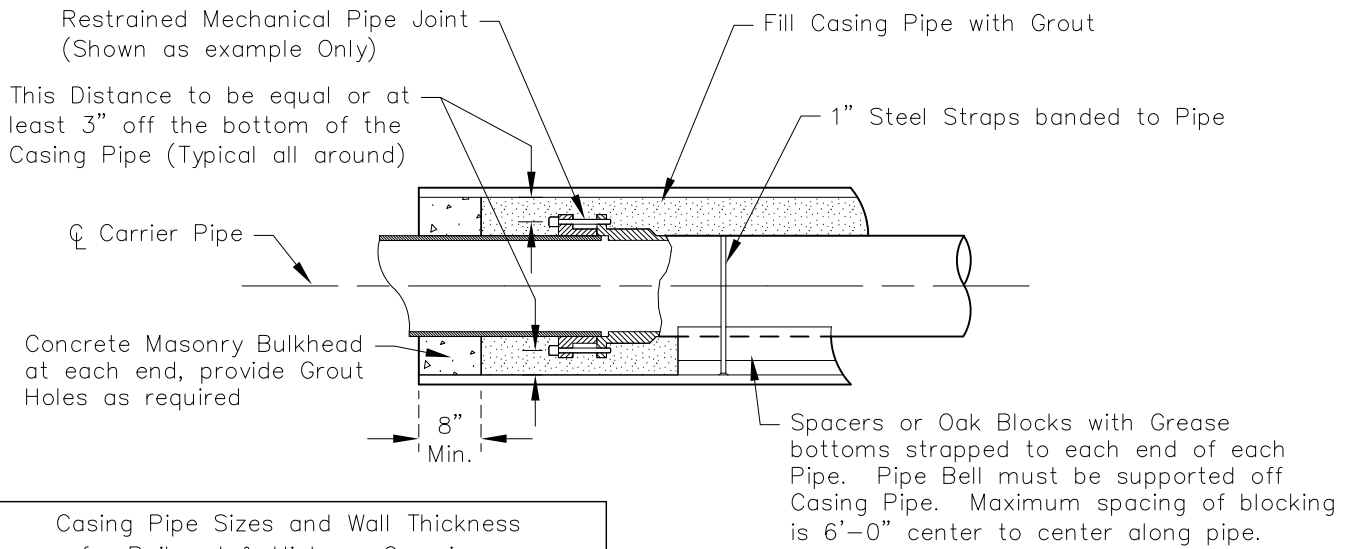
DRAWING NO. G-1  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001      BY: JBS



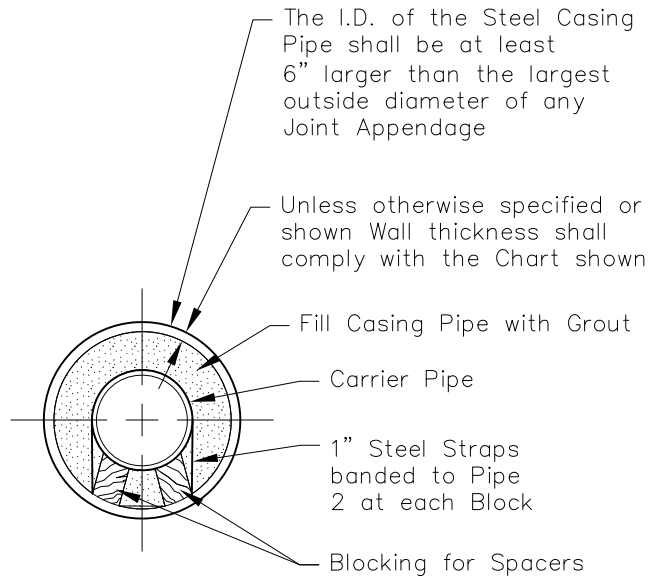
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CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING





Nominal Size	Actual O.D.	Railroad Crossing Bare	Highway Crossing Bare
8"	8 5/8"	.250"	.250"
10"	10 3/4"	.250"	.250"
12"	12 3/4"	.250"	.250"
14"	14"	.281"	.250"
16"	16"	.281"	.250"
18"	18"	.321"	.250"
20"	20"	.344"	.312"
24"	24"	.406"	.312"
30"	30"	.469"	.375"
36"	36"	.532"	.500"
42"	42"	.563"	.500"
48"	48"	.625"	.625"
54"	54"	.688"	.625"
60"	60"	.750"	.625"
66"	66"	.813"	.625"
72"	72"	.875"	.750"



NOTE:

1. BASED ON HS20 HIGHWAY LOADINGS WITH A MINIMUM COVER AT 4'-6".
2. STEEL CASING PIPE SHALL HAVE A STEEL YIELD STRENGTH OF 35,000 PSI, MEET ASTM A139 GRADE B REQUIREMENTS.
3. CHART BASED ON RECOMMENDATIONS FROM NATIONAL UTILITY CONTRACTORS ASSOCIATION.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	6/23	Block Spacing

CASING PIPE

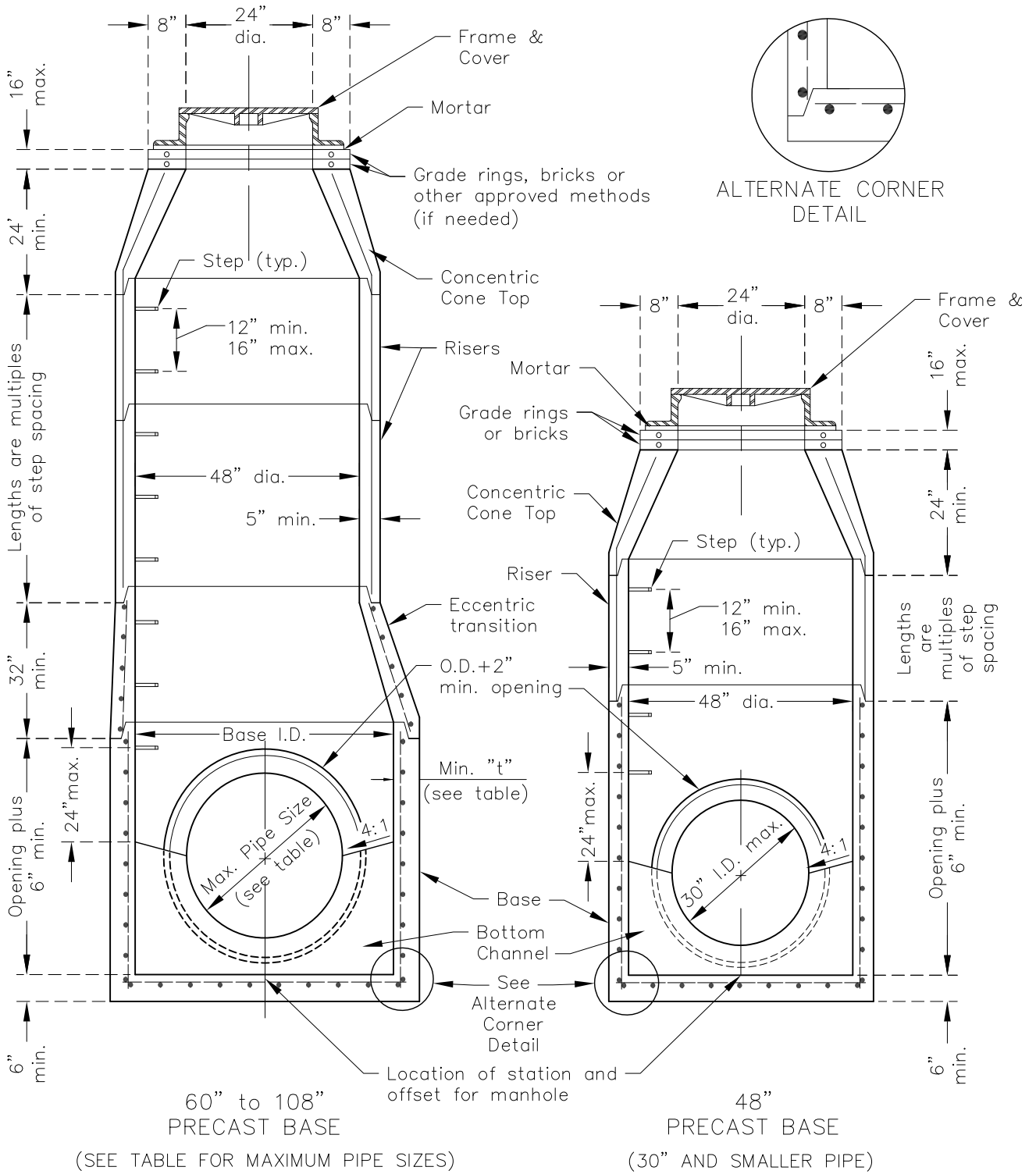
DRAWING NO. G-2  
 SCALE: NOT TO SCALE  
 DRAWN: JANUARY 2001 BY: JBS



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SECTION VIEWS OF REINFORCED PRECAST MANHOLES

\* Manhole shall meet ODOT Manhole No. 3 Minimum Requirements.

NO.	DATE	REVISIONS
1	7/05	CONCENTRIC
2	5/13	Convert-AutoCAD

MANHOLE "TYPE A"  
 Sheet 1 of 2

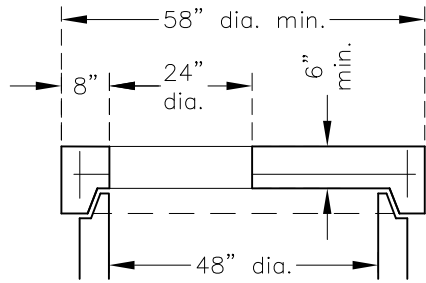
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 DRAWN: JANUARY 2001 BY: JBS



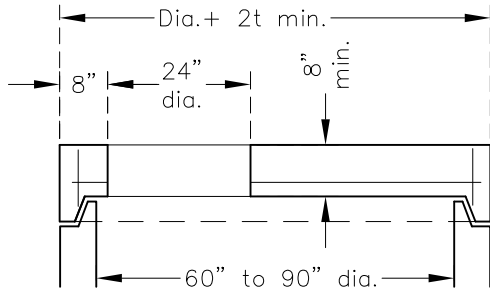
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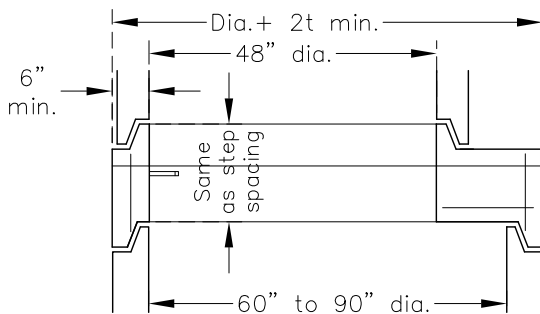




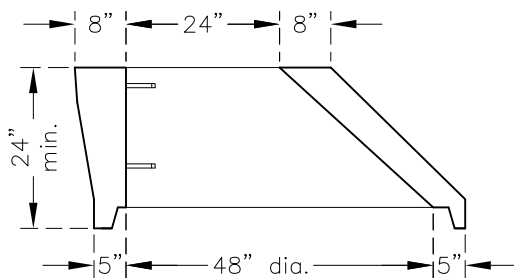
FLAT SLAB TOP



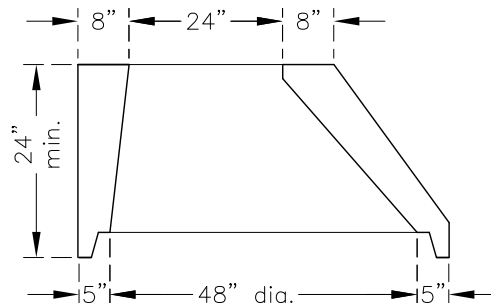
FLAT SLAB TOP



FLAT SLAB TRANSITION



ECCENTRIC CONE TOP



ALTERNATE ECCENTRIC CONE TOP  
REQUIRES APPROVAL BY THE CITY PRIOR TO  
INSTALLATION

NOTES:

GENERAL: With normal soil and site conditions this standard precast manhole may be used for any required manhole depth. Sections of the precast manhole shall be cast and assembled with either all tongue or all groove ends up. Lift holes may be provided in each section for handling. Handling device for the flat slab shall be left in place.

CONE TOP AND TRANSITION (OR REDUCER): Cone section shall be concentric unless a eccentric cone or flat slab is specified. Transition section shall be eccentric unless a flat slab is specified.

BASE: Manhole is shown with a monolithic floor and riser which may be cast in one or two operations. A permissible alternate is to cast and ship the floor and barrel separately. Openings for inlet and outlet pipes shall be provided, either when the unit is cast or later, to meet project requirements. Bottom channels may be formed of concrete, precast in the base or field constructed.

RISER SECTIONS: Openings for 18" and smaller inlet pipes may be either prefabricated, or cut in the field provided the sides of the pipe at the springline do not project into the manhole.

DROP PIPE: When specified on the plans, drop pipe shall be constructed as shown on Detail G-5.

STEPS, FRAMES AND COVERS: Shall comply with the requirements set forth on Detail G-6.

MAXIMUM PIPE SIZES		
BASE I.D.	MIN. "t"	MAX. PIPE SIZE
60"	5"	36"
72"	6"	48"
84"	7"	54"
90"	7½"	60"
96"	8"	66"
108"	9"	72"

NO.	DATE	REVISIONS
1	7/05	Added Eccentric
2	7/05	Cone Note
3	4/07	Cone modified
4	5/13	Convert-AutoCAD
5	9/18	Cone Note

MANHOLE "TYPE A"  
Sheet 2 of 2

DRAWING NO. G-3  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS



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DIVISION OF WATER ENGINEERING



NOTES:

With normal soil and site conditions this standard precast manhole may be used for any required manhole depth. Sections of the precast manhole shall be cast and Assembled with either all tongue or all groove ends up. Lift holes may be provided in each section for handling. Handling device for the flat slab shall be left in place.

CONE TOP AND TRANSITION (OR REDUCER):

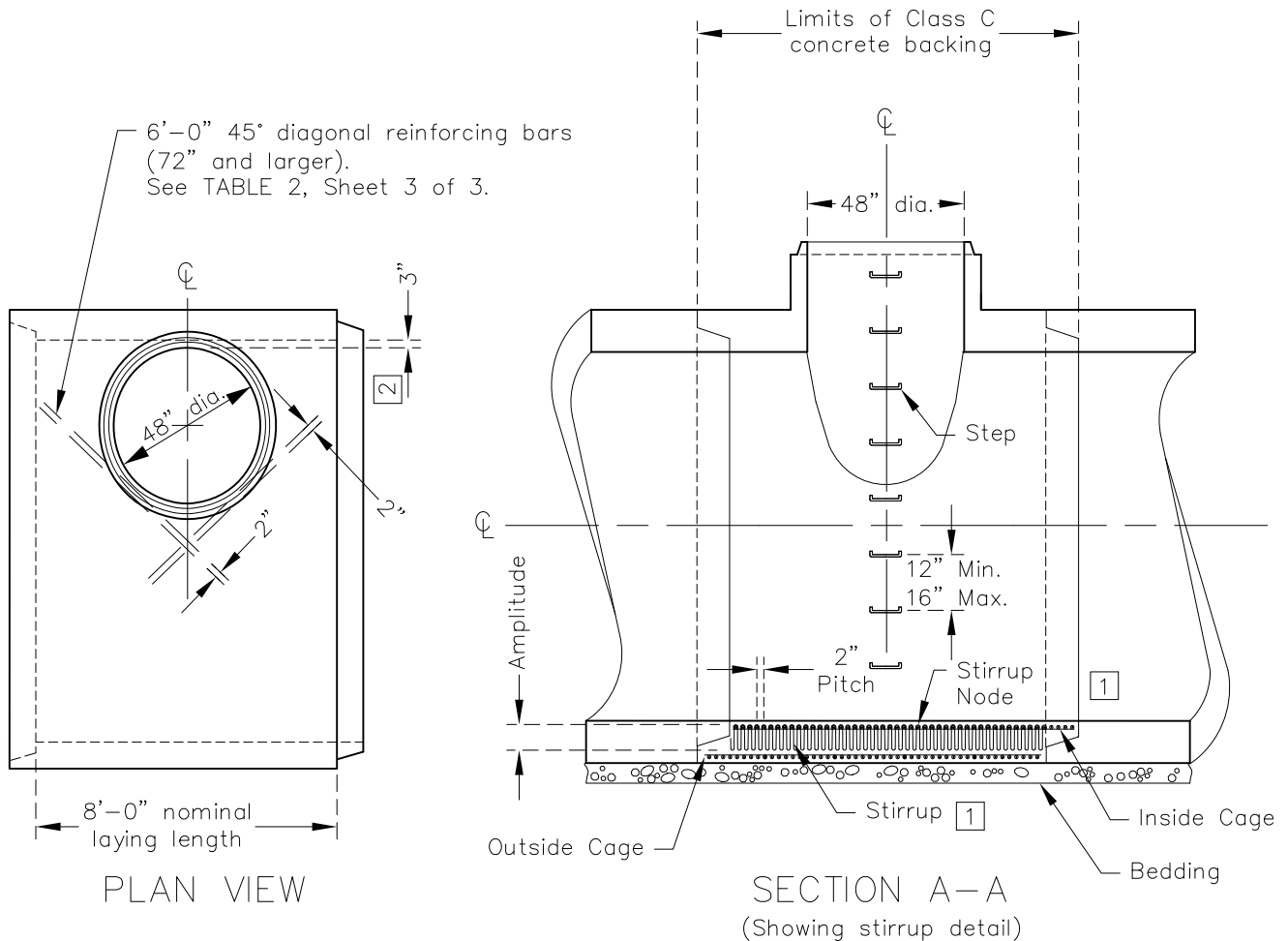
Cone section shall be eccentric unless a concentric cone or flat slab is specified.

BASE: Manhole is shown with a monolithic floor and riser which may be cast in one or two operations. A permissible alternate is to cast and ship the floor and barrel separately. Openings for inlet and outlet pipes shall be provided, either when the unit is cast or later, to meet project requirements. Bottom channels may be formed of concrete, precast in the base or field constructed.

RISER SECTIONS: Openings for 18" and smaller inlet pipes may be either prefabricated, or cut in the field provided the sides of the pipe at the springline do not project into the manhole.

DROP PIPE: When specified on the plans, drop pipe shall be constructed as shown on Detail G-5.

STEPS, FRAMES AND COVERS: Shall comply with the requirements set forth on Detail G-6.



\* Manhole shall meet ODOT Manhole No. 4 Minimum Requirements.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

MANHOLE "TYPE C"  
Sheet 1 of 3

DRAWING NO. G-4  
SCALE: NOT TO SCALE  
DRAWN: JUNE 2002 BY: JBS



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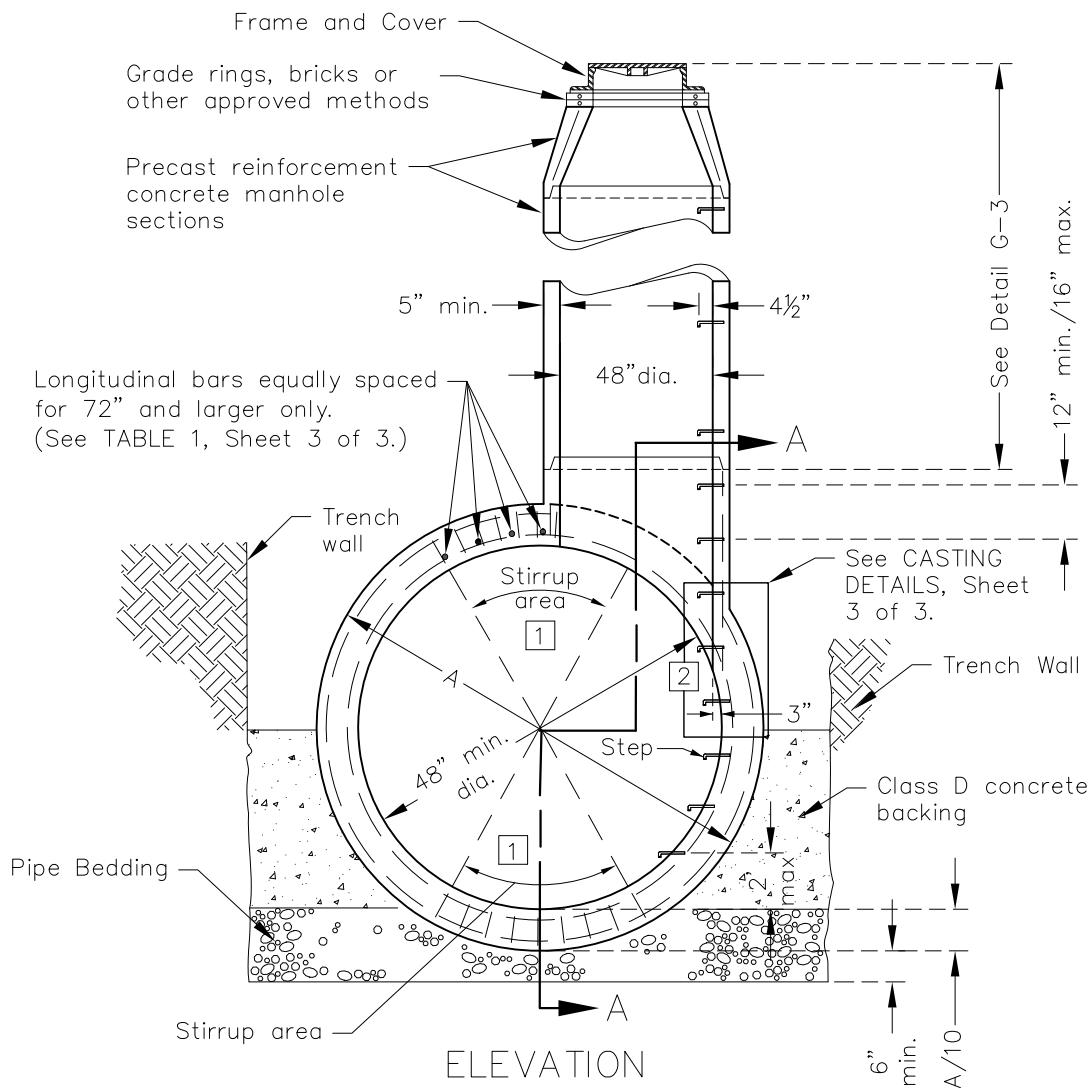
NOTES:

GENERAL: Base pipe, 48" dia. through 144" dia., shall consist of the design shown and as required for the stronger of the two adjoining sections of conduit. Other manhole components above the base shall be as detailed or specified on Detail G-3.

APPLICATION: The Manhole shown hereon may be used where no change in pipe size, direction or slope occurs, and no lateral sewers enter the manhole below the riser section.

BEDDING: Bedding shall be the same as used under the adjoining conduits and shall comply with the requirements of Detail G-1.

STEPS: The steps shall comply with the requirements set forth on Detail G-6.





NO.	DATE	REVISIONS
1	4/07	edit notes
2	5/13	Convert-AutoCAD

MANHOLE "TYPE C"  
Sheet 2 of 3

DRAWING NO. G-4  
SCALE: NOT TO SCALE  
DRAWN: JUNE 2002 BY: JBS

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DAYTON, OHIO 45402

CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING

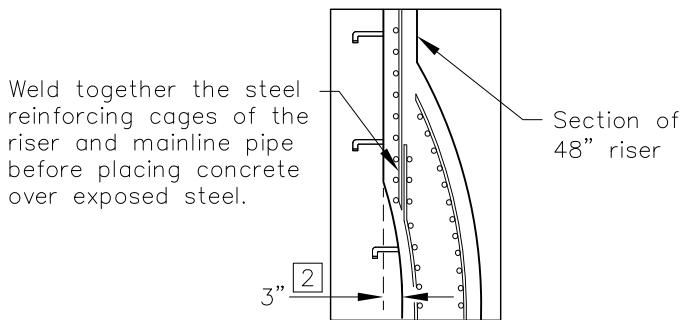
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Dia.	Longitudinal Bars			Longitudinal Bars			Longitudinal Bars			Longitudinal Bars		
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72"	#5	7'-5"	4	#5	7'-5"	4	#5	7'-5"	4	#5	7'-5"	4
78"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
84"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
90"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
96"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
102"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
108"	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4	#6	7'-5"	4
114"	#5	7'-5"	6	#5	7'-5"	6	#5	7'-5"	6	#5	7'-5"	6
120"	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4
126"	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4
132"	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4
144"	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4	#7	7'-5"	4

See PLAN VIEW Detail, Sheet 1 of 3.

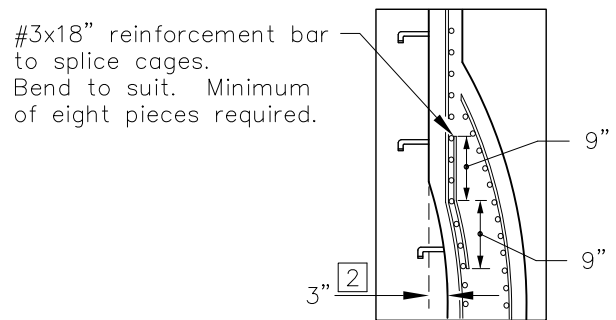
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	Size	No. Req'd <sup>[3]</sup>	Size	No. Req'd <sup>[3]</sup>	Size	No. Req'd <sup>[3]</sup>	Size	No. Req'd <sup>[3]</sup>
72"	#5	2	#5	2	#5	4	#5	4
78"	#5	2	#5	2	#5	4	#6	4
84"	#5	2	#4	4	#5	4	#6	4
90"	#5	2	#4	4	#5	4	#6	4
96"	#5	2	#4	4	#5	4	#7	4
102"	#4	4	#5	4	#6	4	#7	4
108"	#4	4	#5	4	#6	4	#7	4
114"	#4	4	#5	4	#6	4	#7	4
120"	#5	4	#5	4	#6	4	#6	6
126"	#5	4	#5	4	#6	4	#6	6
132"	#5	4	#5	4	#7	4	#7	6
144"	#5	4	#6	4	#7	4	#7	6

LEGEND

- [1] If required by conduit specification.
- [2] On all sizes except 48".
- [3] One-half of the required number to each side of hole.  
(See Sht. 3 of 3.)



PLANT FABRICATED



INTEGRALLY CAST

CASTING DETAILS

See ELEVATION Detail, Sheet 2 of 3.

NO.	DATE	REVISIONS
1	4/07	add details
2	5/13	Convert-AutoCAD

MANHOLE "TYPE C"  
Sheet 3 of 3

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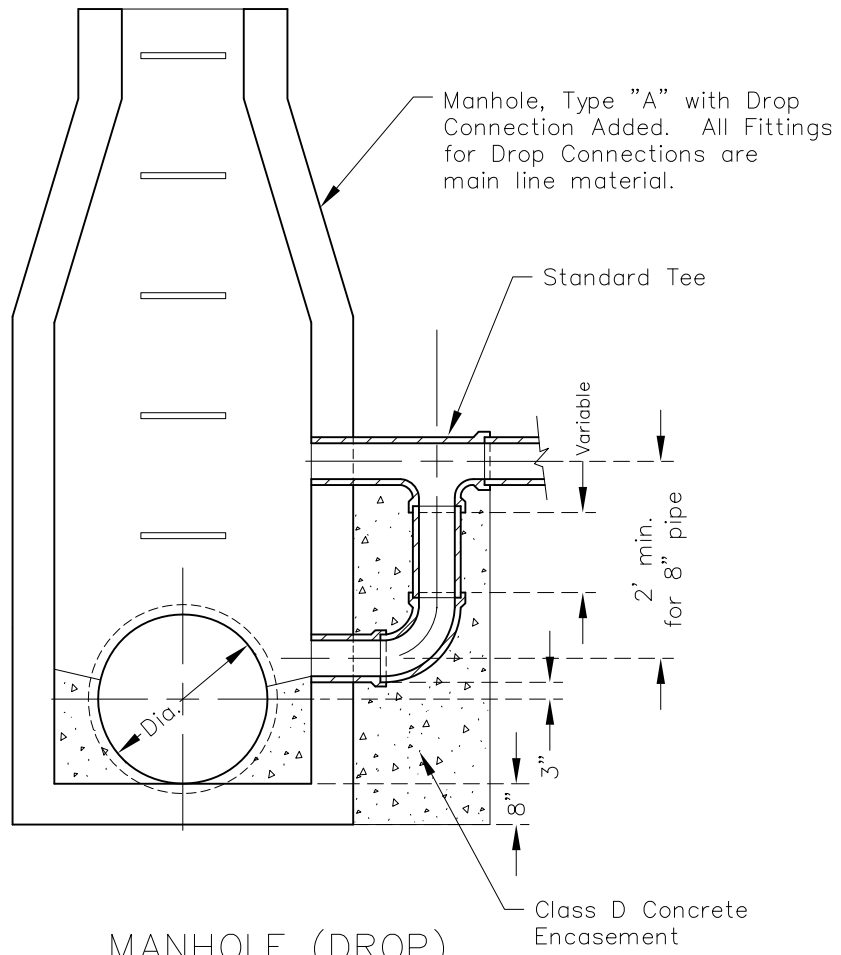
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DRAWN: JUNE 2002 BY: JBS



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**MANHOLE (DROP)**

NOT TO SCALE

NO.	DATE	REVISIONS
1	4/07	Encasement
2	5/13	Convert-AutoCAD

MANHOLE (DROP)

DRAWING NO. G-5  
 SCALE: NOT TO SCALE  
 DRAWN: NOV. 2002 BY: JBS



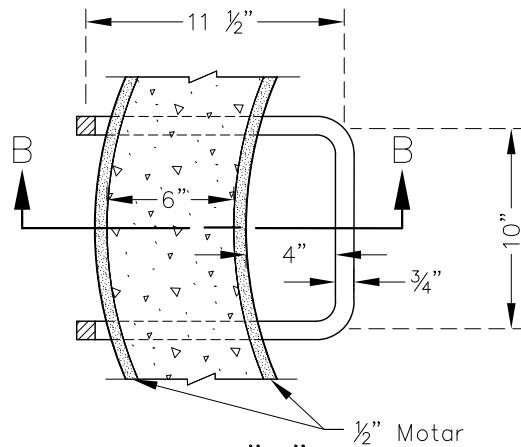
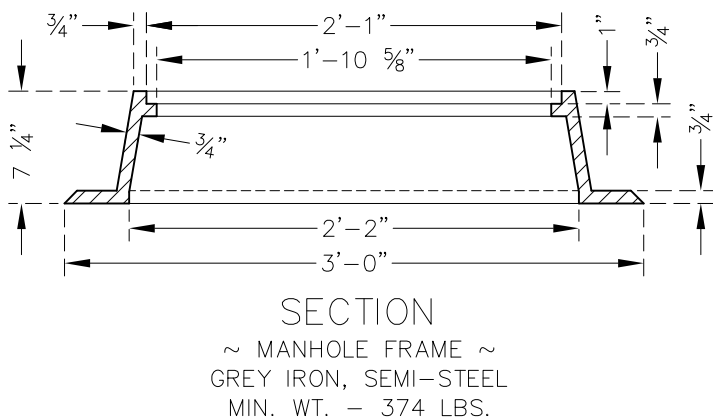
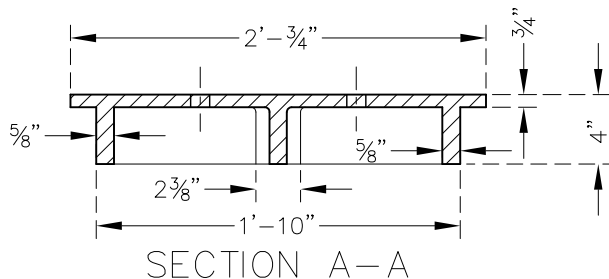
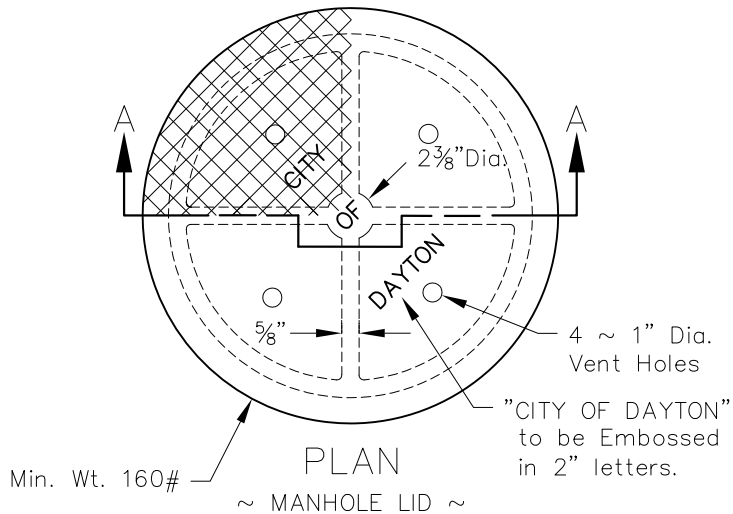
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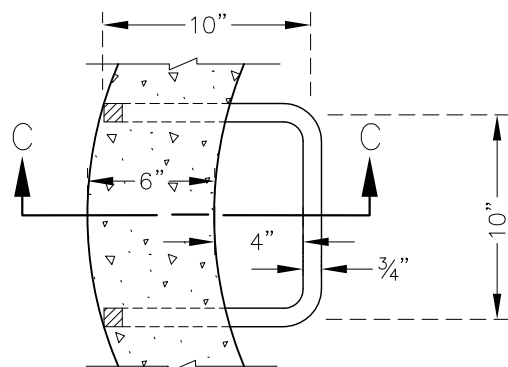
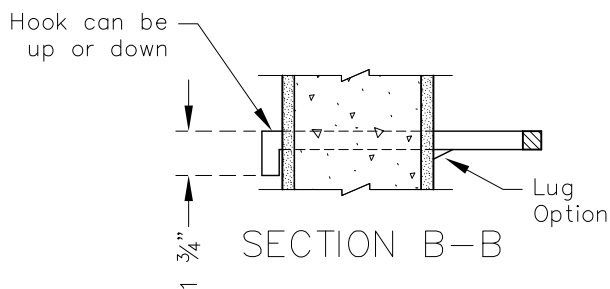


# MANHOLE STEP SPECIFICATIONS

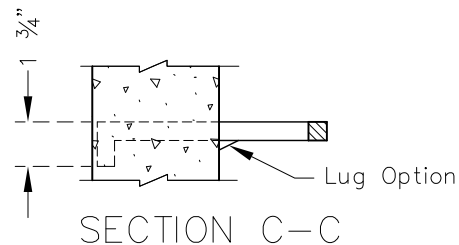
1. MANHOLE STEPS SHALL BE CAST OF HIGH STRENGTH ALUMINUM, MEETING THE REQUIREMENTS OF A.S.T.M. SPECIFICATIONS, ALLOY NO. 6061 T-6.
2. ALTERNATE ACCEPTABLE STEP IS REINFORCED PROPYLENE PLASTIC MANHOLE STEP, SPEC 711.31
3. SPECIFICATIONS SHALL BE THE LATEST REVISIONS THEREOF.



TYPE "A"  
SEGMENTAL BLOCK



TYPE "B"  
MONOLITHIC CONCRETE



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

MANHOLE LID, FRAME & STEPS

DRAWING NO. G-6  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

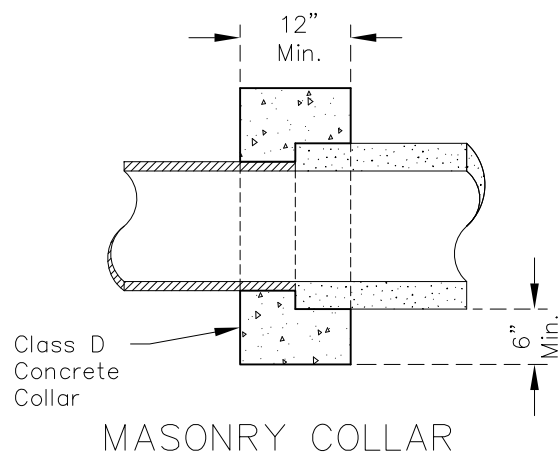


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NOTES:

MASONRY COLLARS: A masonry collar shall be provided where plans require that a pipe extension be joined to the end of an existing pipe with a butt joint. The cost shall be included in the unit price bid for the new conduit.

NO.	DATE	REVISIONS
1	4/07	edit notes
2	5/13	Convert-AutoCAD

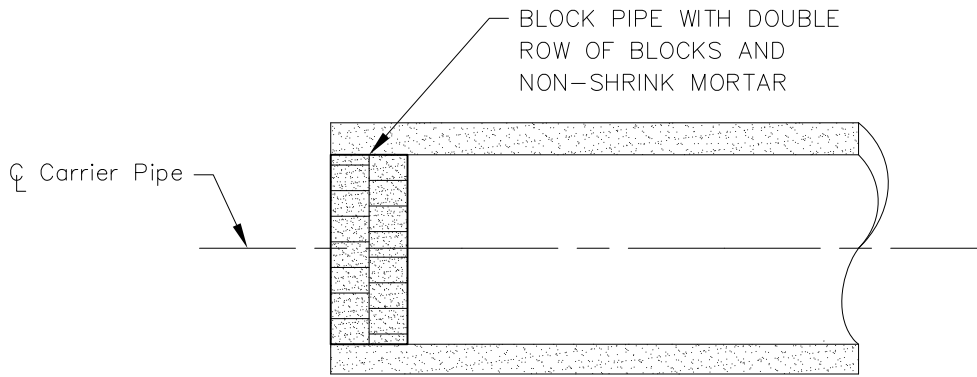
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DRAWING NO. G-8 SCALE: NOT TO SCALE DRAWN: JANUARY 2001 BY: JBS



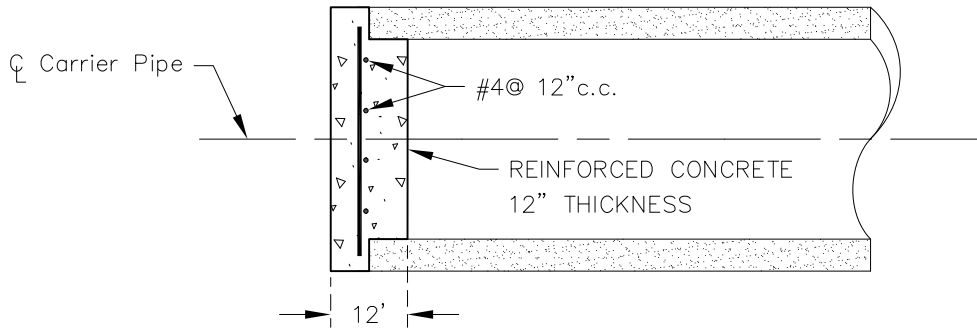
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PIPE PLUG (TYPE D)  
 (8" THRU 30" DIA. ONLY)  
 NOT TO SCALE



PIPE PLUG (TYPE D)  
 (30" DIA. or Greater)  
 NOT TO SCALE

\* Similar pipe plug details to be used in manholes.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Note Added

PIPE PLUG  
 (STORM & SANITARY)

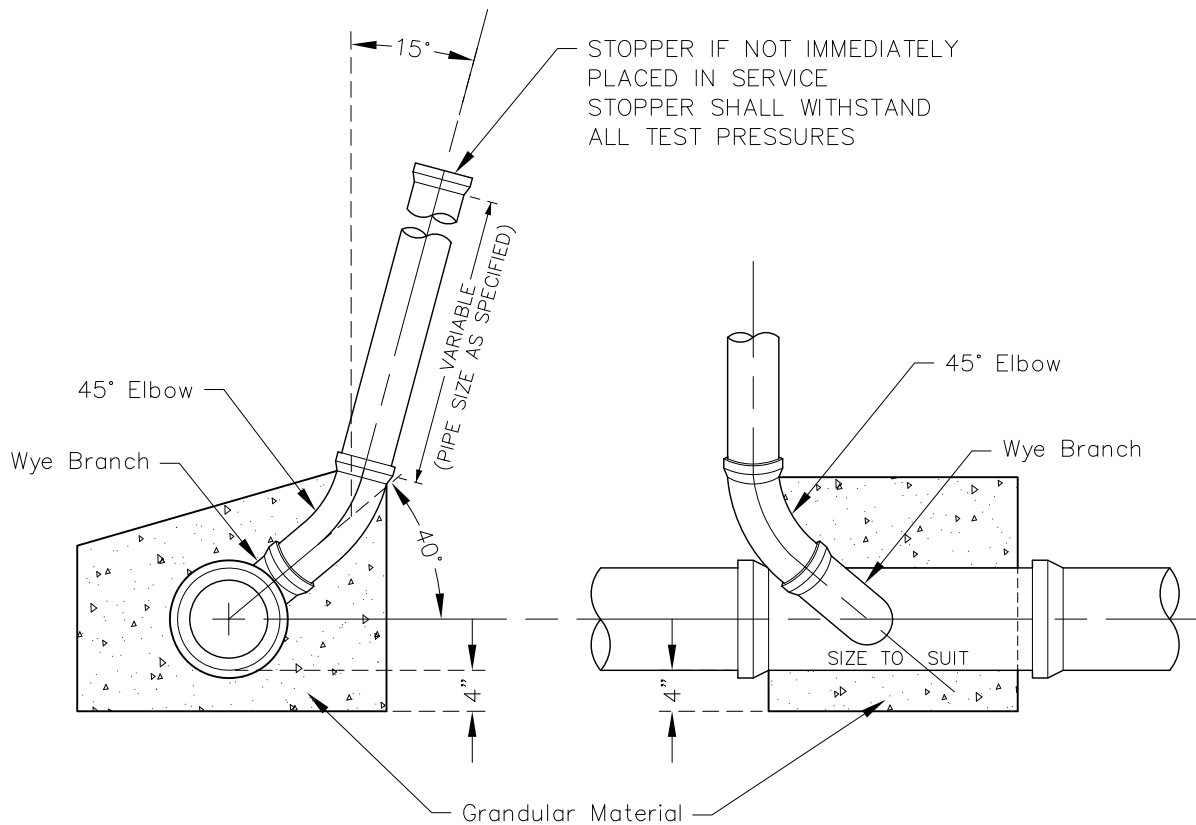
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 DRAWN: JANUARY 2001 BY: JBS



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NOTES:

1. RISER PIPE LAID ON STEEP GRADE TO BE BEDDED SOLIDLY AGAINST UNDISTURBED GROUND, OTHERWISE BED AS SPECIFIED IN CITY OF DAYTON STANDARD SPECIFICATIONS.
2. IF SANITARY SERVICES ARE SPECIFIED THEY SHALL BE A MINIMUM OF 7 FEET DEEP AT THE PROPERTY LINE UNLESS DIRECTED TO BE AT A GREATER DEPTH.
3. WITHIN NEW RESIDENTIAL SUBDIVISIONS, THE CONTRACTOR SHALL INSTALL ALL LATERALS TO THE RIGHT-OF-WAY OR EASEMENT LIMITS.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

SANITARY LATERAL RISER  
(TYPICAL)

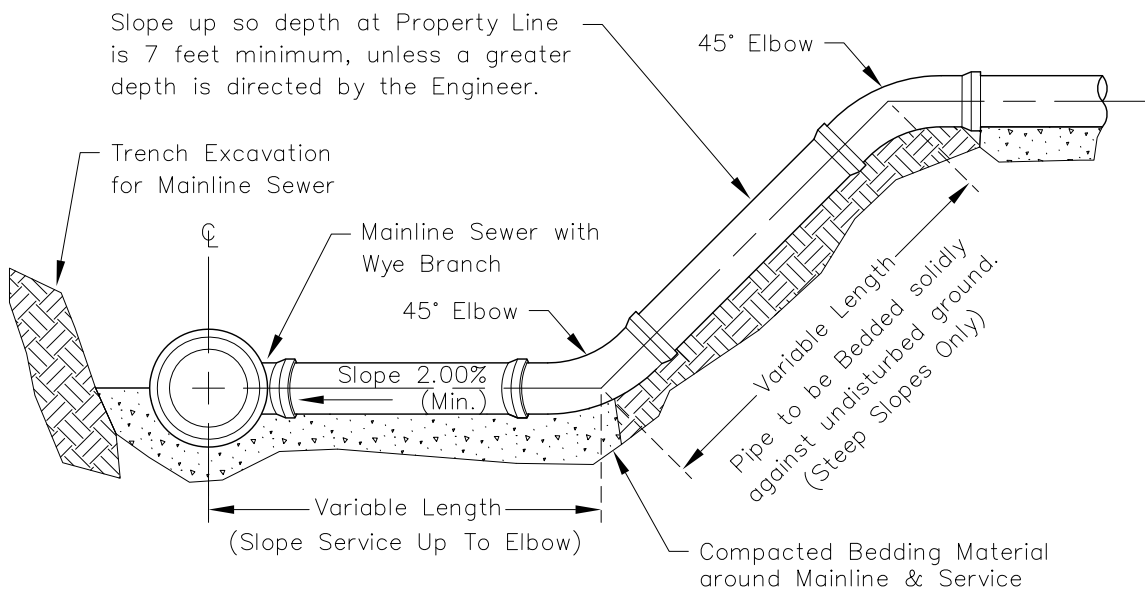
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DRAWN: JANUARY 2001 BY: JBS



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NOTE:

1. WITHIN NEW RESIDENTIAL SUBDIVISIONS, THE CONTRACTOR SHALL INSTALL ALL LATERALS FROM THE MAIN TO THE RIGHT-OF-WAY OR EASEMENT LIMITS.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	9/18	Note Edited

SANITARY LATERAL RISER  
(IN EXCESS OF 12')

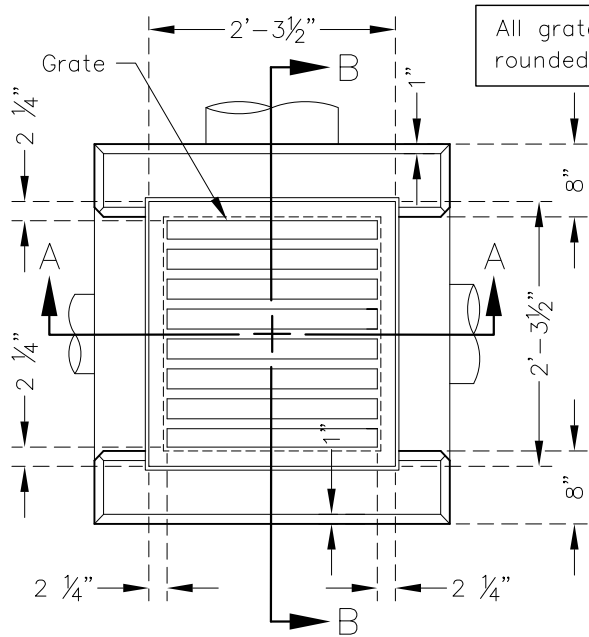
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DRAWN: JANUARY 2001 BY: JBS



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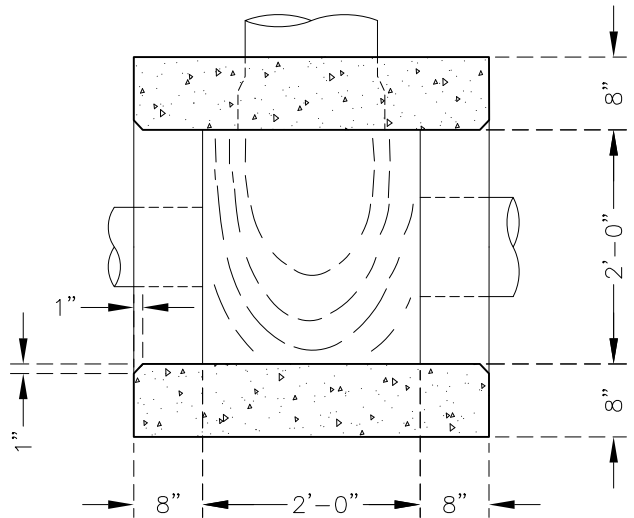
CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING



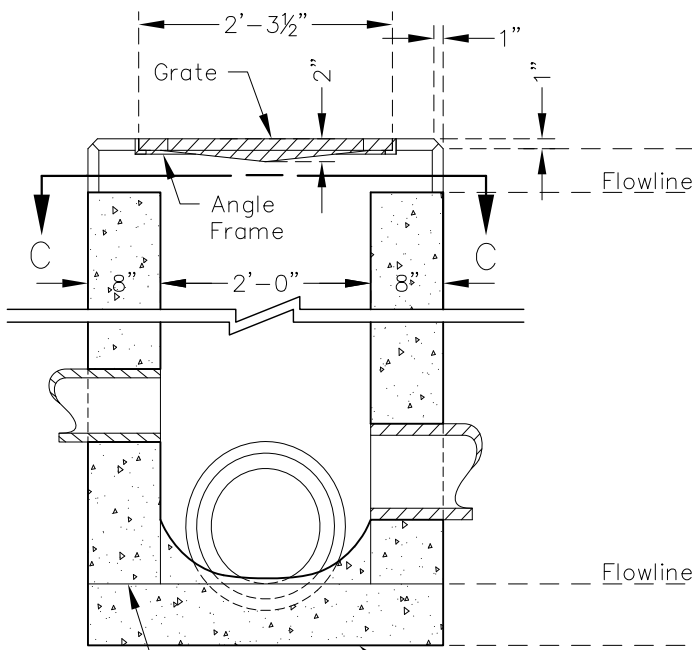


PLAN

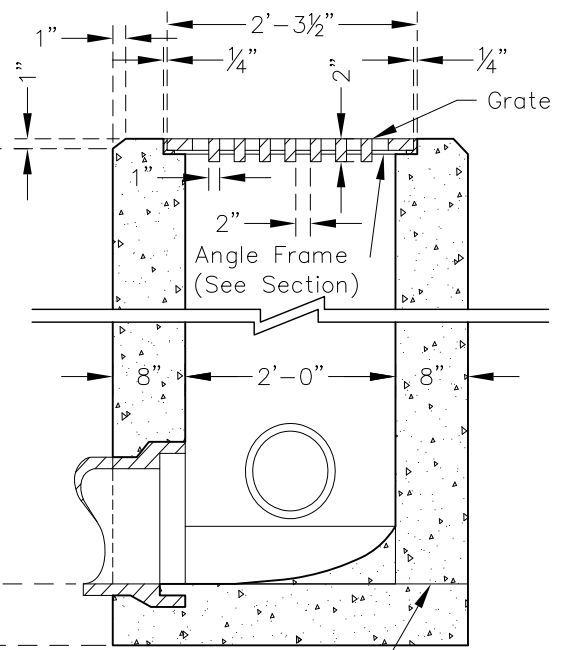
All grate edges to be rounded 1/4" radii



SECTION C-C



SECTION A-A



SECTION B-B

Bottom slab may be precast separately and the outlet pipe placed on top of it with the bottom shaped to drain.

CATCH BASIN No. 2-2A & B

CATCH BASIN	OUTLET PIPE SIZE
2-2A	12" to 21"
2-2B	12" to 21"



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASINS No. 2-2A & B  
(Sheet 1 of 2)

DRAWING NO. ST-1  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

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NOTES:

GENERAL: Catch Basins 2-2A and 2-2B are not intended for traffic bearing applications.

CATCH BASINS 2-2A & B This detail depicts Catch Basin 2-2A.

GRATE AND FRAME: The design shall be essentially the same and equally as strong as the one shown (see construction information table), or meets AASHTO M 306. If necessary, bicycle safe and traffic bearing grates shall be installed.

WALLS: Brick or cast-in-place walls have a nominal thickness of 8". Precast walls shall have a minimum thickness of 6" and be reinforced sufficiently to permit shipping and handling without damage. Brick shall not be used above the flow line of the side opening for Type 2-2A.

CONCRETE: Cast-in-place concrete is to be City of Dayton Class D. All precast concrete shall meet ODOT requirements.

PRECAST BASE: If a precast base is used, it shall be set deep enough so that the top can be placed on the base to provide the grate elevation specified in the plans. Layers of brick shall not be used to adjust the top elevation.

LOCATION AND ELEVATION: When given on the plans, location and elevation are at the top center of the grate. When side openings are provided, the elevation shall be at the flow line of the side inlet.

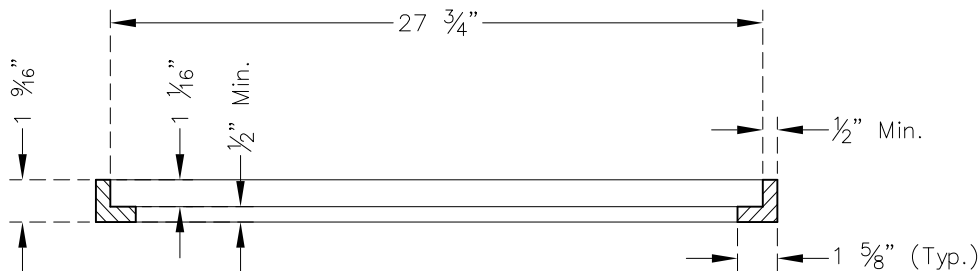
MINIMUM DEPTH: The minimum depth of CB No. 2-2A shall be the outside diameter (O.D.) of the outlet pipe plus 7".

OPENINGS: Pipe openings shall be the O.D. of the pipe being supplied plus 2" when fabricated or field cut. The interstitial space shall be filled with grout, no knockouts allowed.

2-2A SIDE INLETS: Inlets shall be provided on both sides of the No. 2-2A catch basin in sags and on upstream side only where the ditch has a continuous down grade past the catch basin. The flow line should be 4" to 6" below the normal elevation of the ditch flow line, returning to normal within 10' to 15' of the basin.

2-2B GRATE ELEVATION: Grate elevation is to be placed 4" to 6" below normal ditch returning to normal 10' to 15' each side of inlet.

CONSTRUCTION INFORMATION
Minimum weight of grate, 120 lbs.
Minimum weight of frame, 40 lbs.



SECTION THRU ANGLE FRAME  
FOR STANDARD No. 2-2A CATCH BASIN

NO.	DATE	REVISIONS
1	9/18	OPENINGS NOTE EDITED

CATCH BASINS No. 2-2A & B  
(Sheet 2 of 2)

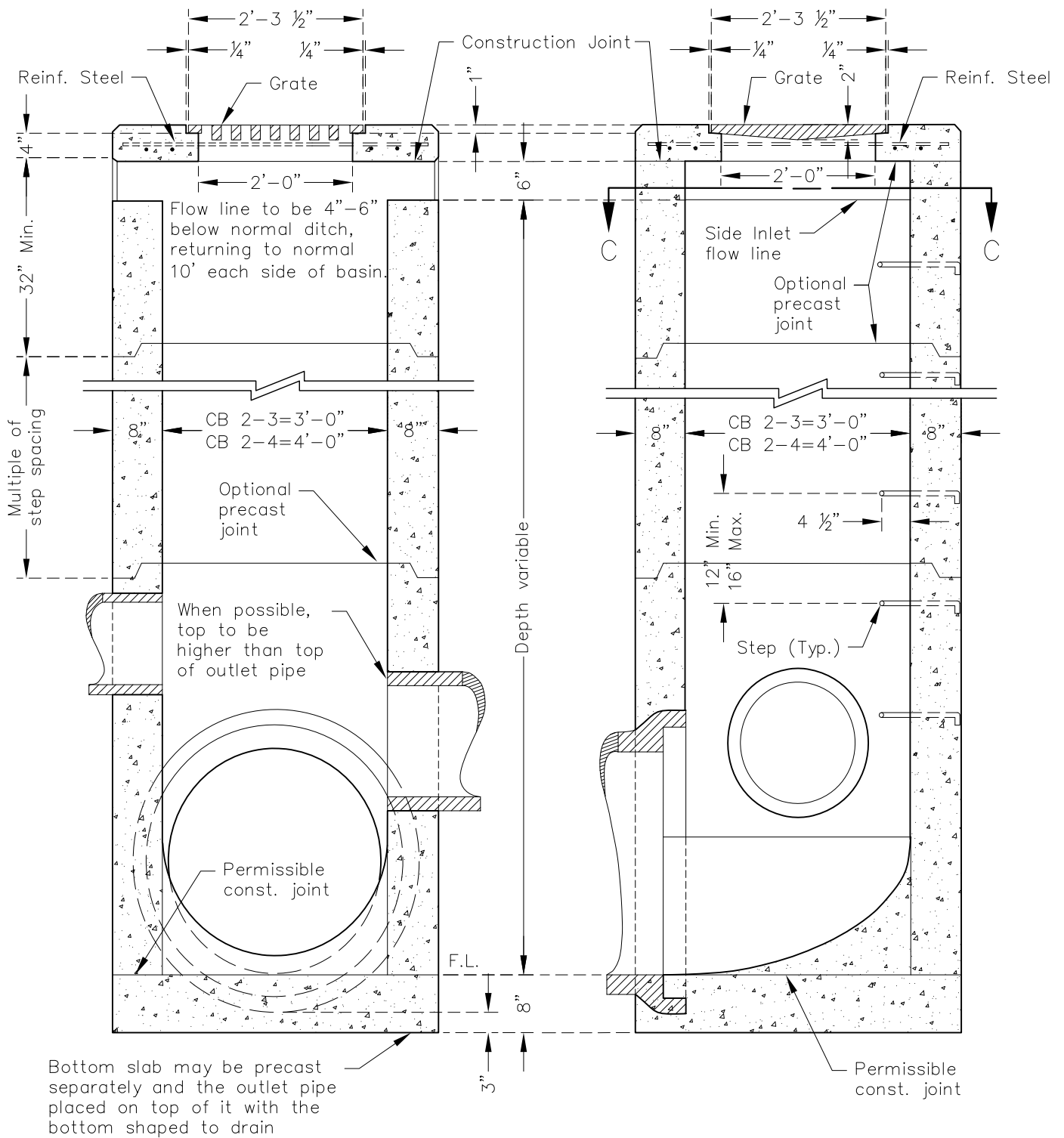
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DRAWN: JANUARY 2001 BY: JBS



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SECTION A-A

SECTION B-B

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD


CATCH BASINS No. 2-3 & 2-4  
(Sheet 1 of 2)

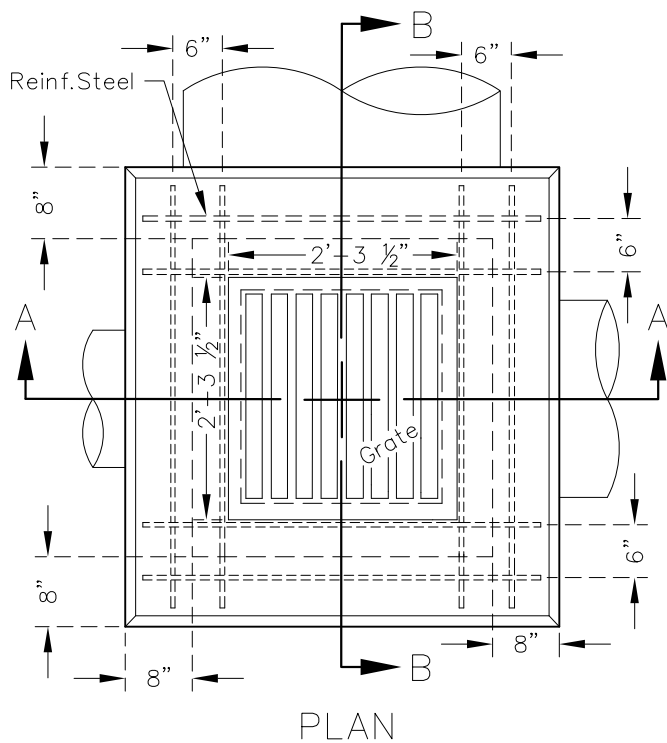
DRAWING NO. ST-2  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

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**City of Dayton WATER**

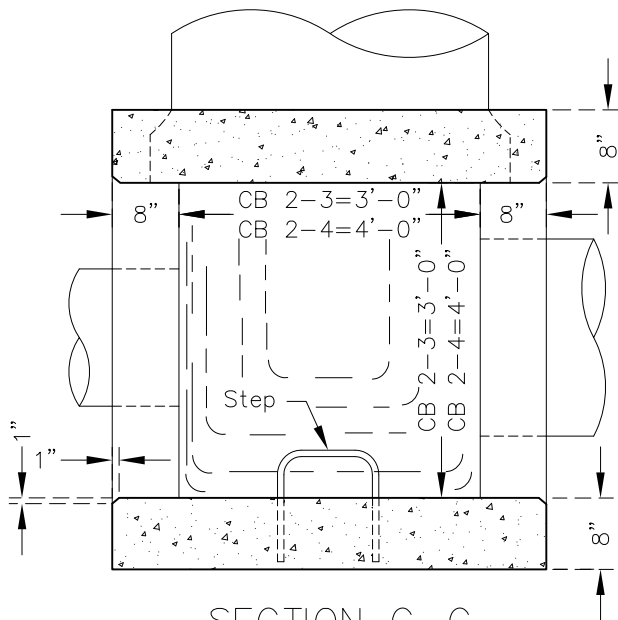
CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING





PLAN

All grate edges to be rounded 1/4" radii



SECTION C-C

CATCH BASIN	OUTLET PIPE SIZE
2-3	12" to 33"
2-4	36" to 42"

NOTES:

GRATE: See details on ST-1 weight of grate 120 lbs. , or meets AASHTO M 306.

If necessary, bicycle safe and traffic bearing grates shall be specified in the plans. Bicycle safe grates shall be Neenah No. R-4859-C or East Jordan No. 5110 Type M2 or approved equals.

WALLS: Brick or cast-in-place walls shall have a nominal thickness of 8" . Precast walls shall have a minimum thickness of 6" and be reinforced sufficiently to permit shipping and handling without damage.

STEPS: Steps shall be provided where the depth exceeds 6' and shall meet the requirements of G-6.

CONCRETE: Cast-in-place concrete is to be City of Dayton Class D. All concrete shall meet ODOT requirements.

REINFORCEMENTS: Reinforcing in the top is to be #4 bars spaced at 6" center to center. For Catch Basin No. 2-3 use eight bars and for Catch Basin No. 2-4 use twelve bars.

INLETS OVER 12 FEET IN DEPTH: Shall be precast or Cast-in-place concrete; reinforced with #4 bars on 12" centers both vertically and horizontally with 2" clearance from inside wall face.

PRECAST BASE: If a precast base is used, it shall be set deep enough so that the top can be placed on the base to provide the grate elevation specified in the plans. Layers of brick shall not be used to adjust the top elevation.

LOCATION AND ELEVATION: When given on the plans, the location and elevation are at the top center of the grate. When side openings are provided, the elevation shall be at the flow line of the side inlet.

MINIMUM DEPTH: The minimum depth of CB No. 2-3 and CB No. 2-4 shall be the outside diameter (O.D.) of the outlet pipe plus 7" .

OPENINGS: Pipe openings shall be the O.D. of the pipe being supplied plus 2" when prefabricated or field cut. The interstitial space shall be filled with grout.

SIDE INLETS: Shall be provided only when specified on the plans. Inlets shall be provided on both sides of the catch basin in sags and on upstream side only where the ditch has a continuous down grade past the catch basin. Catch basins with side inlets shall not be used within Clear Zone.



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASINS No. 2-3 & 2-4  
(Sheet 2 of 2)

DRAWING NO. ST-2  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

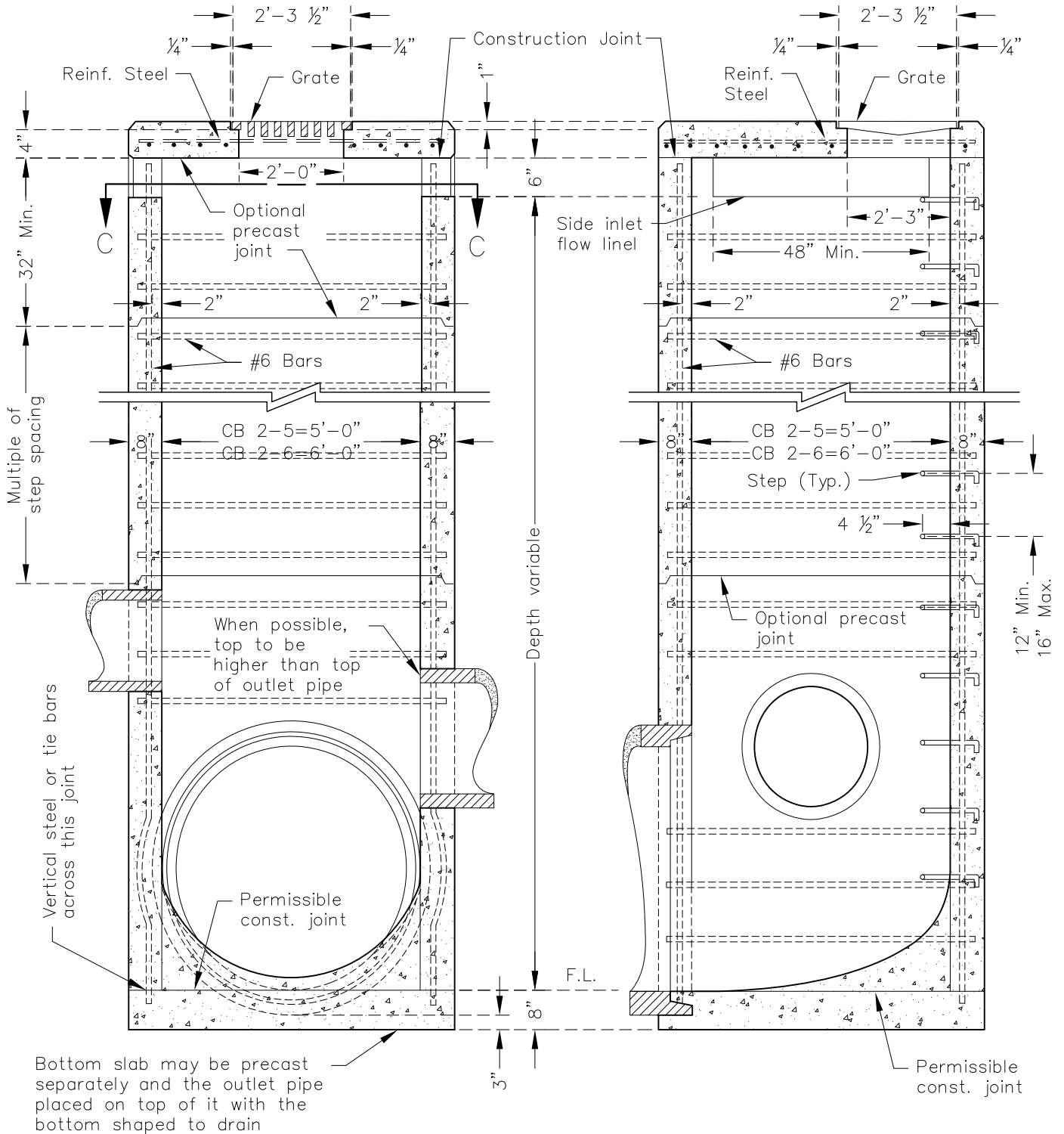
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NOTE:

Flow line to be 4" to 6" below normal ditch, returning to normal 10' to 15' each side of basin.



SECTION A-A

SECTION B-B

CATCH BASINS No. 2-5 & No. 2-6

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASINS No. 2-5 & 2-6  
(Sheet 1 of 2)

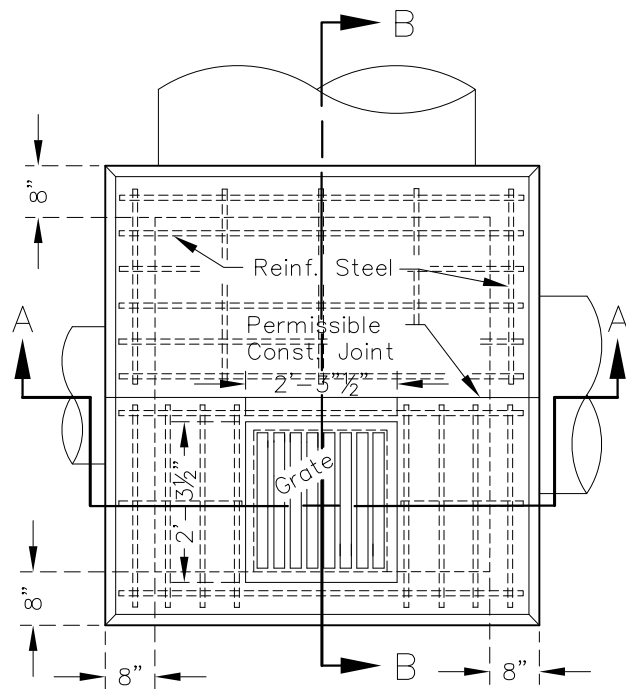
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DRAWN: JANUARY 2001 BY: JBS



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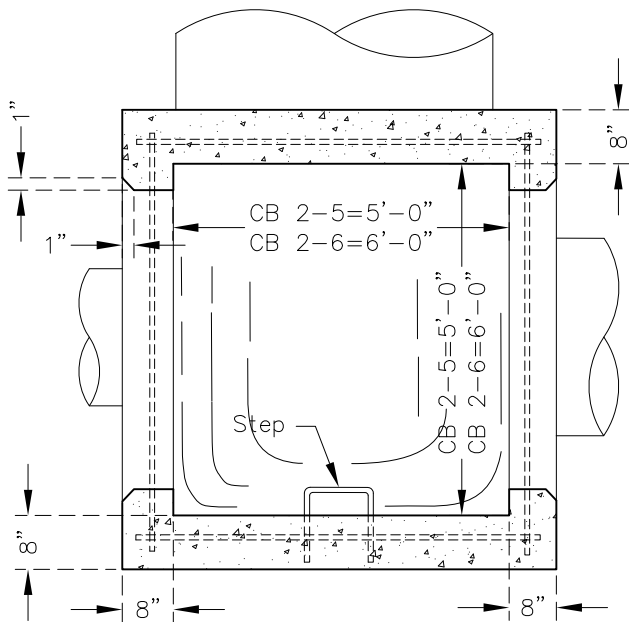
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PLAN

All grate edges to be rounded 1/4" radii



SECTION C-C

CATCH BASIN	OUTLET PIPE SIZE
2-5	48" to 54"
2-6	60" to 72"

NOTE:

GRATE: See details on ST-1 weight of grate: 120 lbs. ,or meets AASHTO M306.

If necessary, bicycle safe and traffic bearing grates shall be specified in the plans. Bicycle safe grates shall be Neenah No. R-4859-C or East Jordan No. 5110 Type M2 or approved equals.

WALLS: Shall be 8" thick when reinforced, as shown. Brick walls, when used in place of reinforced concrete, shall have a nominal thickness of 12". Precast walls shall have a minimum thickness of 6" and be reinforced sufficiently to permit shipping and handling without damage and shall be at least equivalent to reinforced cast-in-place construction.

STEPS: Steps shall be provided where the depth exceeds 6' and shall meet the requirements of G-b.

CONCRETE: Cast-in-place concrete is to be Class D. All precast concrete shall meet ODOT requirements.

REINFORCEMENT: Reinforcing in the top is to be #6 bars spaced 6" center to center and #6 tie bars spaced as shown. Main bars to clear bottom of slab by 1/4". Side wall to be reinforced with #6 bars horizontal in each side, 6' long for CB No. 2-5 and 7' long for CB 2-6, spaced at 1' center to center and #6 bars in each corner length equals depth plus 1'.

PRECAST BASE: If a precast base is used, it shall be set deep enough so that the top can be placed on the base to provide the grate elevation specified in the plans. Layers of brick shall not be used to adjust the top elevation.

LOCATION AND ELEVATION: When given on the plans, the location and the elevation are at the top center of the grate. When side openings are provided, the elevation shall be at the flow line of the side inlet.

MINIMUM DEPTH: The minimum depth of CB No. 2-5 and CB No. 2-6 shall be the outside diameter (O.D.) of the outlet pipe plus 7" .

OPENINGS: Pipe openings shall be the O.D. of the pipe being supplied plus 2" when fabricated or field cut. The interstitial space shall be filled with grout.

SIDE INLETS: Shall be provided only when specified on the plans. Inlets shall be provided on both sides of the catch basin in sags and on upstream side only where the ditch has a continuous down grade past the catch basin. Catch basins with side inlets shall not be used within Clear Zone.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASINS No. 2-5 & 2-6  
(Sheet 2 of 2)

DRAWING NO. ST-3  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

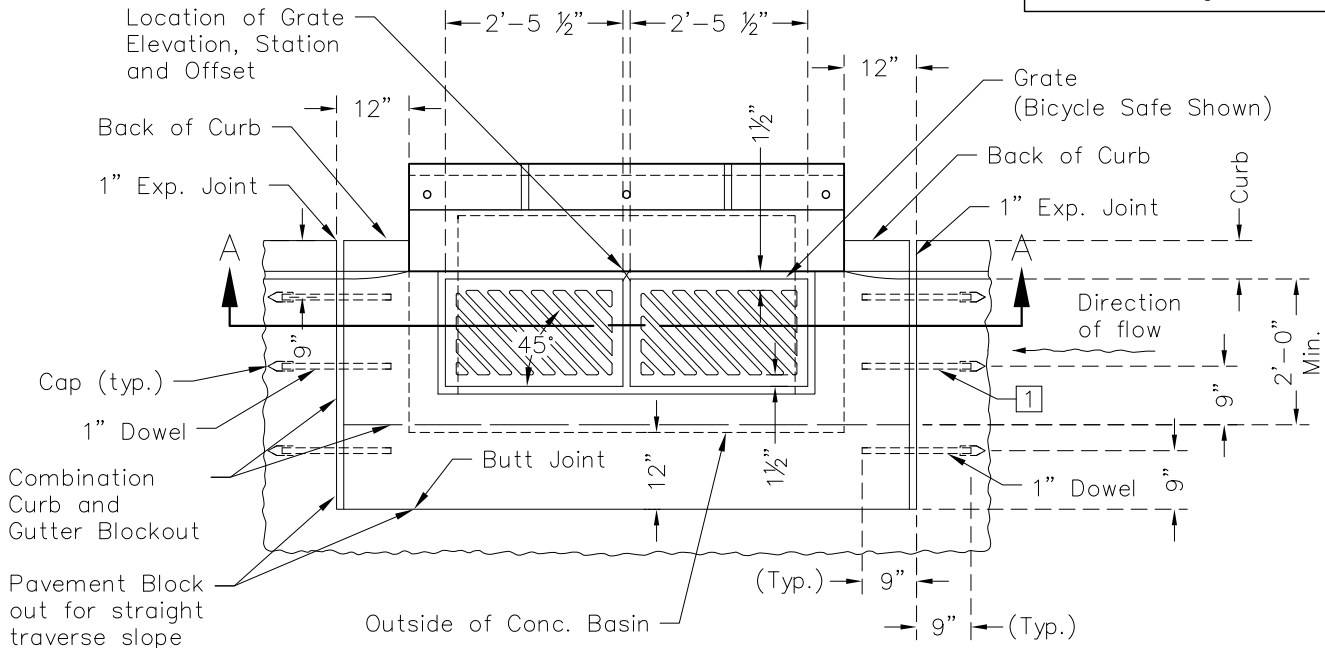


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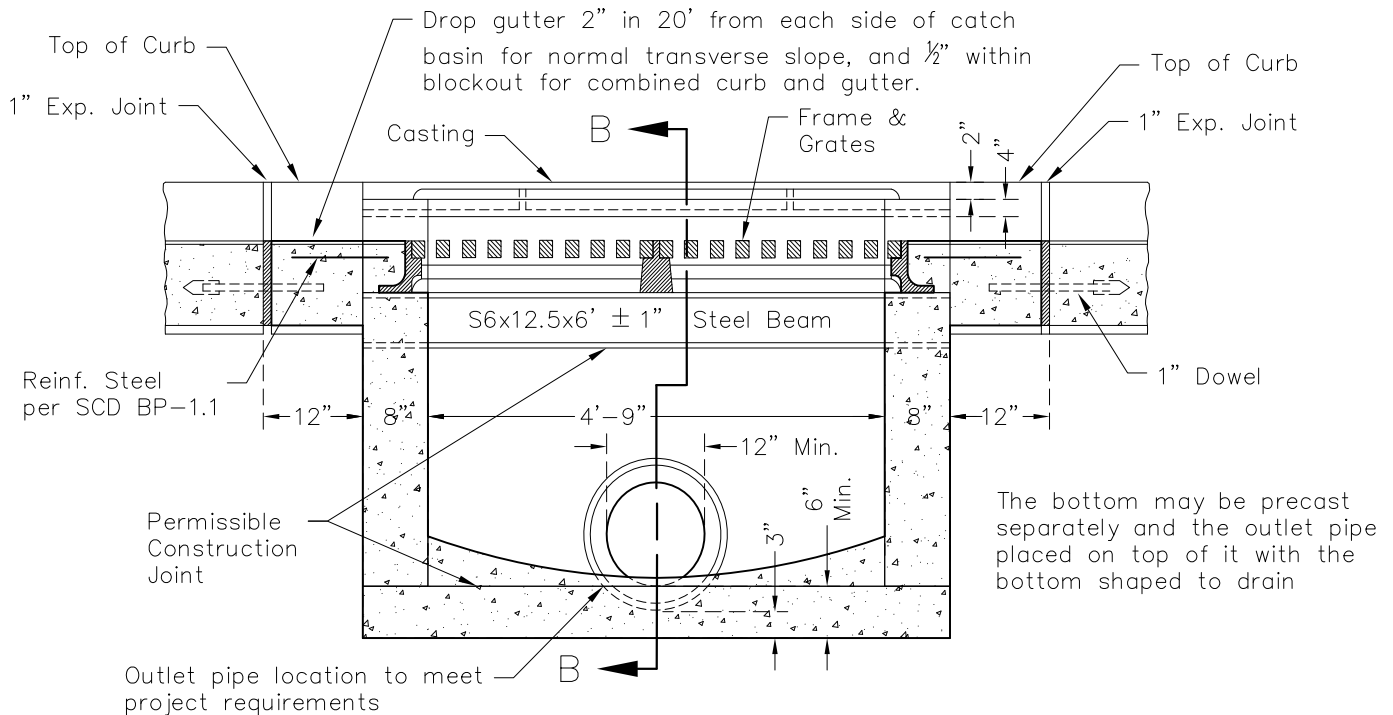


1 Dowel location for curb & gutter



CATCH BASIN AND PAVEMENT JOINTS

PLAN VIEW



SECTION A-A

NO.	DATE	REVISIONS
1	4/07	edit notes
2	5/13	Convert-AutoCAD

CATCH BASIN No. 3  
(Sheet 1 of 3)

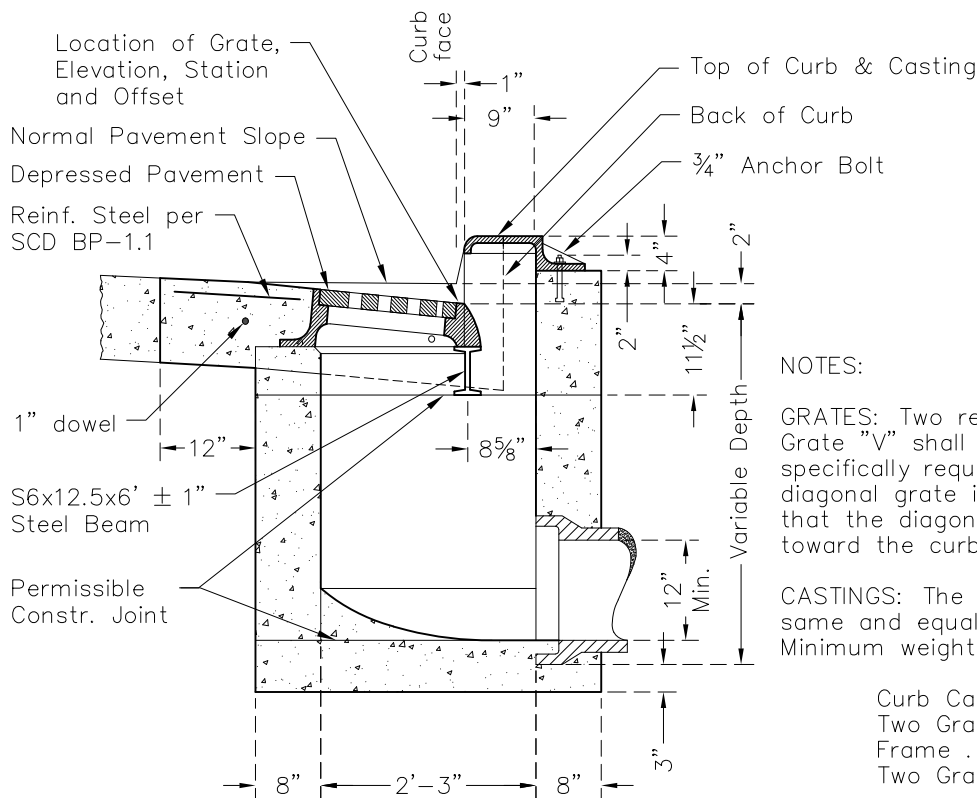
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DRAWN: NOVEMBER 2002 BY: JBS



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SECTION B-B  
2" DEPRESSION

NOTES:

GRATES: Two required.  
Grate "V" shall be provided unless the plans specifically require the diagonal grate. If the diagonal grate is specified, it shall be placed so that the diagonal bars direct drainage flow toward the curb.

CASTINGS: The design shall be essentially the same and equally as strong as shown.  
Minimum weight:

Curb Casting . . . . .	305 lbs.
Two Grates . . . . .	254 lbs.
Frame . . . . .	590 lbs.
Two Grate "V" . . . . .	210 lbs.

BEARING AREAS: The frame and grate shall be so fitted and finished as to provide a firm and even seat. No projections shall exist on bearing areas and the grate shall seat in its frame without rocking.

WALLS: When used in place of concrete, brick side walls shall be 8" nominal thickness.

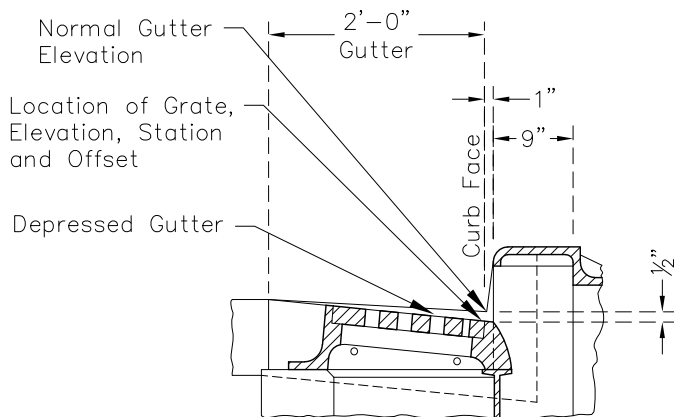
PRECAST CONSTRUCTION: Permitted, except for the apron. Precast walls shall have a minimum thickness of 6" and reinforcing shall be sufficient to permit shipping and placement without damage. The wall thickness reduction shall be from the outside.

MINIMUM DEPTH: The minimum depth is per the cover requirements for that pipe type.

OPENINGS: The maximum pipe opening shall be the O.D. of the pipe being supplied plus 2" when fabricated or field cut. The interstitial space shall be filled with grout.

DOWELS: Four 1"x18" dowels are required for concrete pavement or gutter blockout.

TEXT: The following text shall be cast into the top of the curb casting: "DUMP NO WASTE" and "DRAINS TO WATERWAY" (see curb casting plan on sheet 3 of 3).



SECTION B-B  
1/2" DEPRESSION

NO.	DATE	REVISIONS
1	4/07	edit notes
		add text note
2	5/13	Convert-AutoCAD
3	6/23	Correct Pipe Size

CATCH BASIN No. 3  
(Sheet 2 of 3)

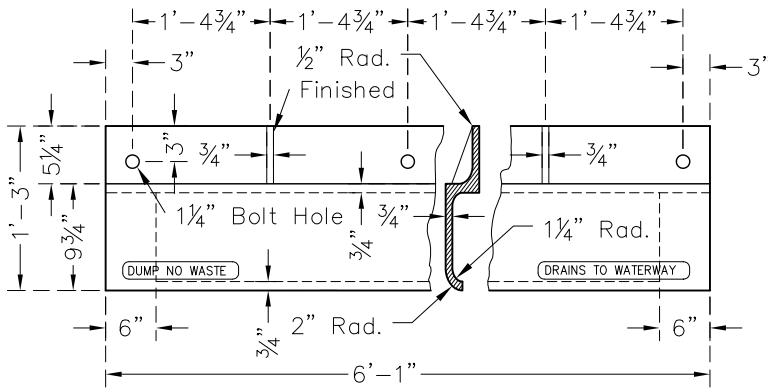
DRAWING NO. ST-4  
SCALE: NOT TO SCALE  
DRAWN: NOVEMBER 2002 BY: JBS



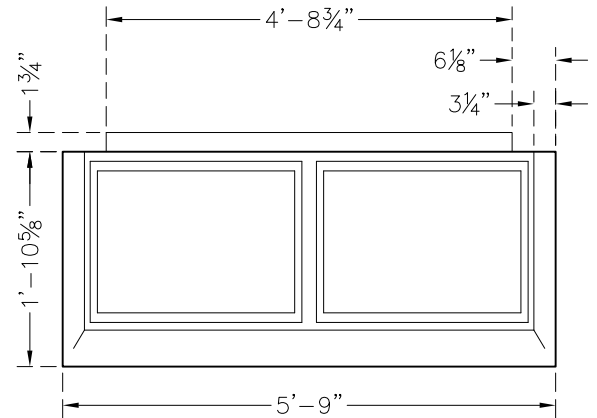
320 W. MONUMENT AVE.  
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DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING

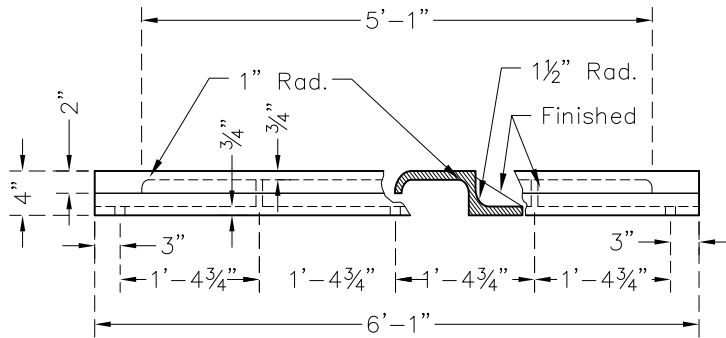




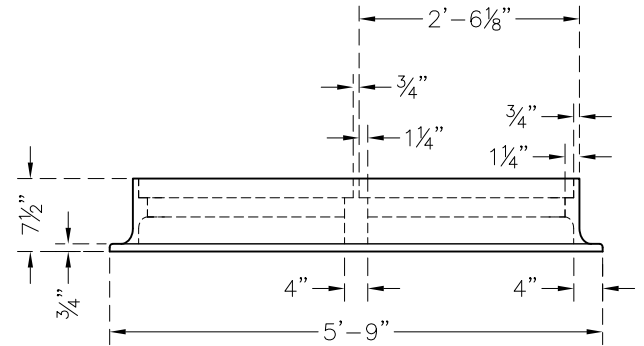
CURB CASTING  
PLAN & SECTION



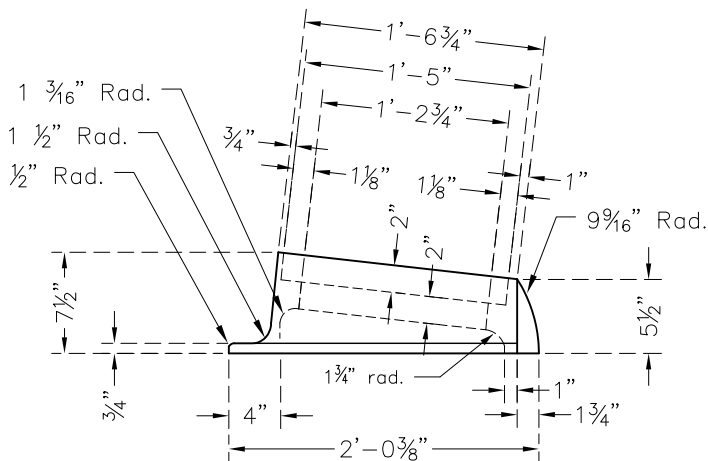
FRAME  
PLAN VIEW



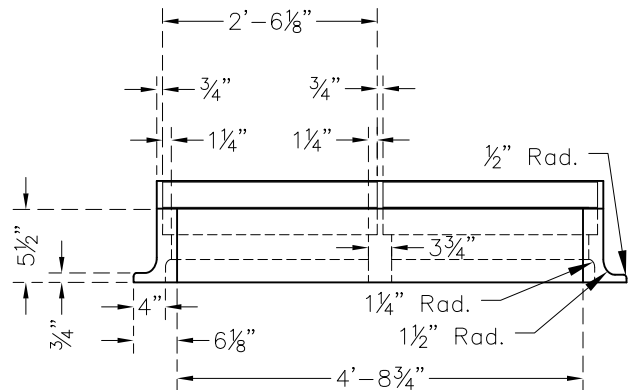
CURB CASTING  
FRONT VIEW & SECTION



FRAME  
FRONT VIEW



FRAME  
END VIEW



FRAME  
BACK VIEW

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASIN No. 3  
(Sheet 3 of 3)

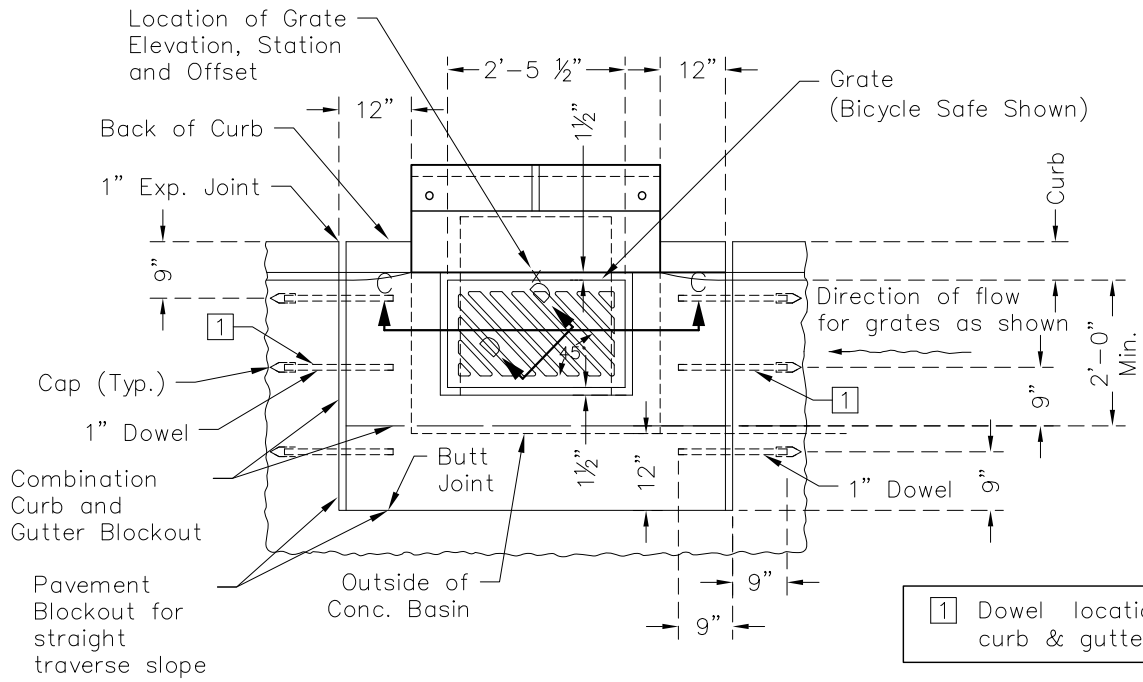
DRAWING NO. ST-4  
SCALE: NOT TO SCALE  
DRAWN: NOVEMBER 2002 BY: JBS



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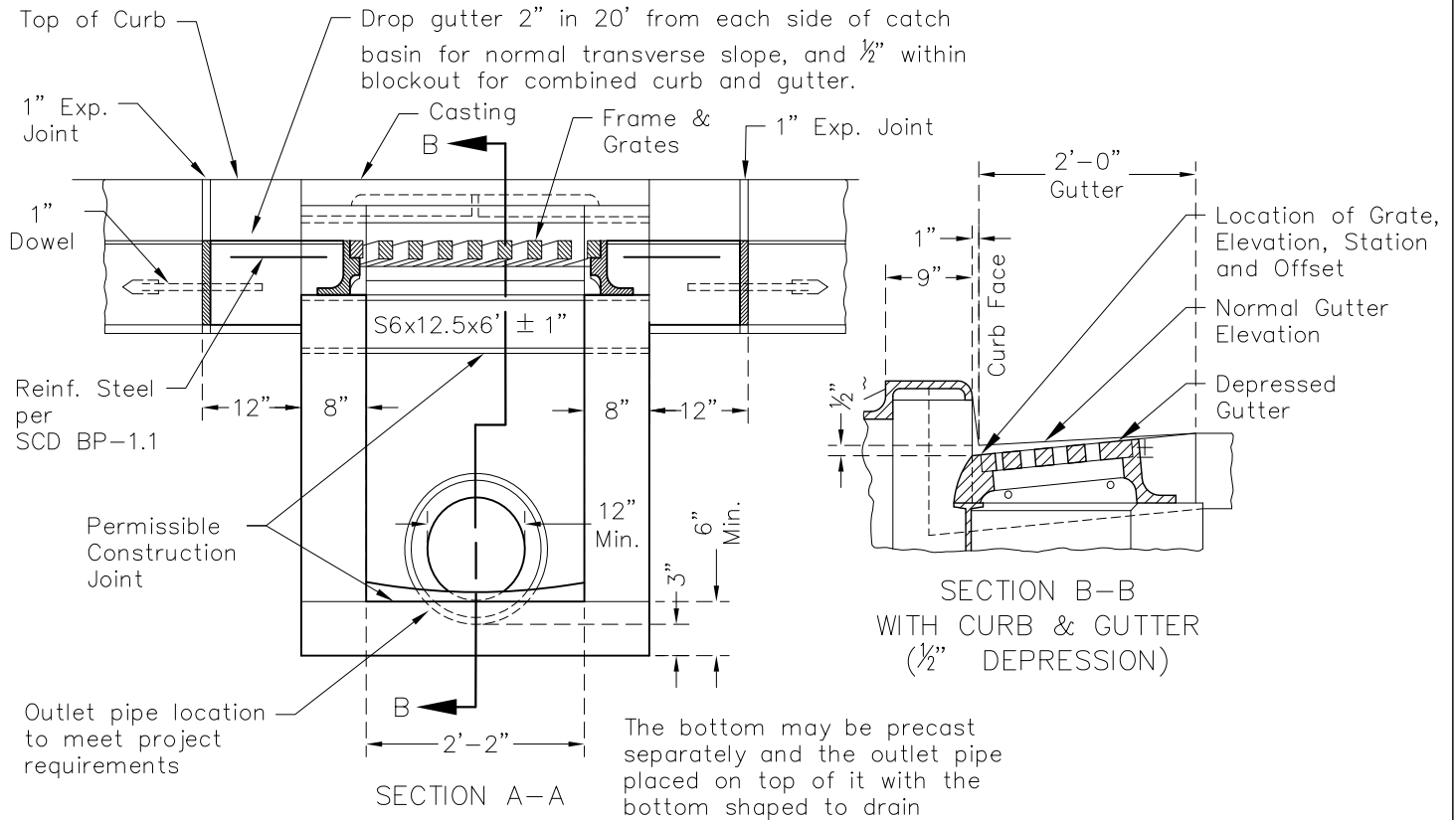
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DIVISION OF WATER ENGINEERING





### CATCH BASIN AND PAVEMENT JOINTS


PLAN VIEW



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASIN No. 3A  
(Sheet 1 of 3)


DRAWING NO. ST-5  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS

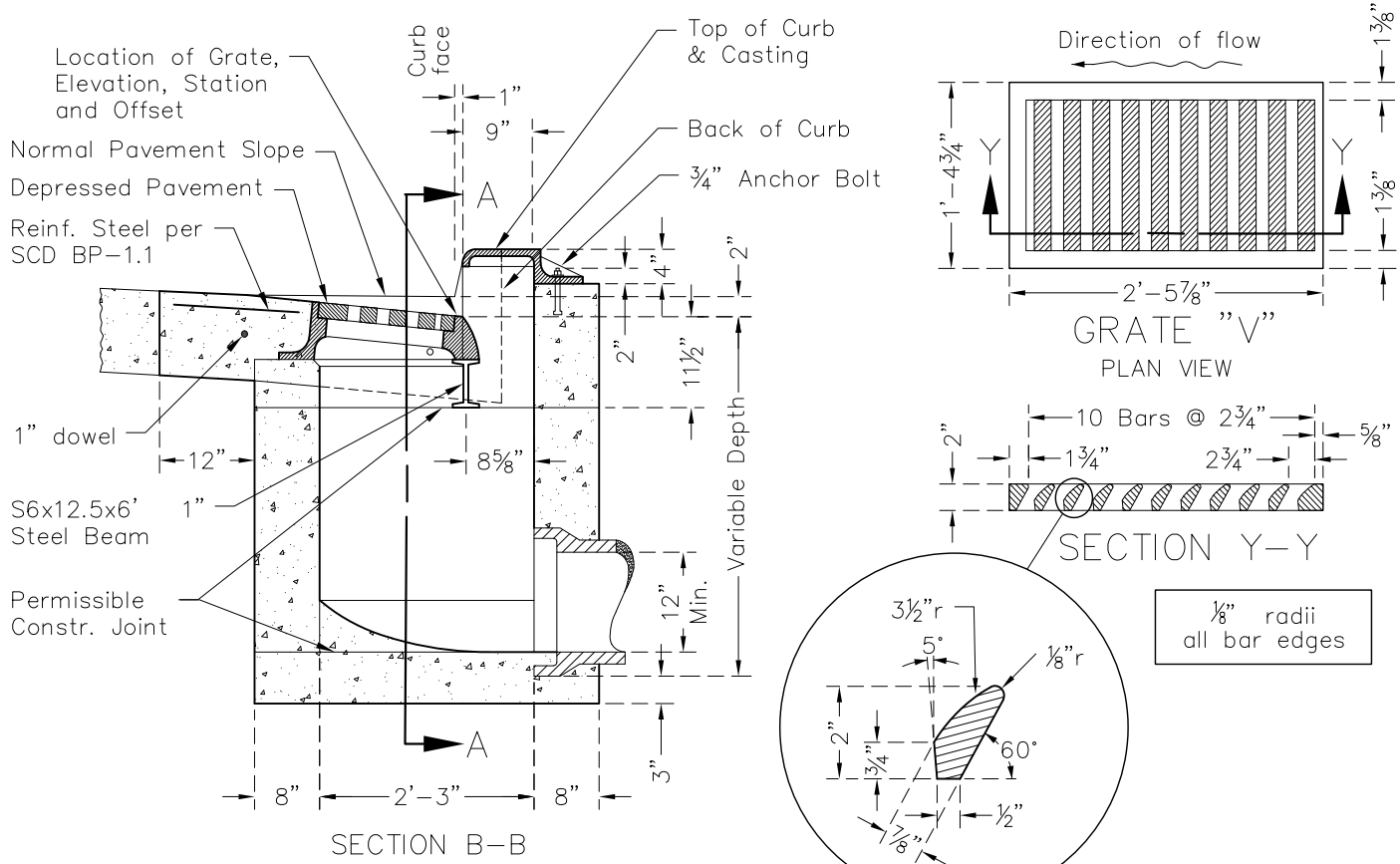


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**NOTES:**

**GRATE:** The Grate "V" shall be provided unless the plans specifically require the diagonal grate. If the diagonal grate is specified, it shall be placed so that the diagonal bars direct drainage flow toward the curb. If necessary, bicycle safe grates shall be specified in the plans. Bicycle safe grates shall be Neenah No. R-4859-C or East Jordan No. 5110 Type M2 or approved equals.

**CASTINGS:** The design shall be essentially the same and equally as strong as those shown.

- Curb Casting . . . . . 170 lbs.
- Standard Grate . . . . . 127 lbs.
- Frame . . . . . 320 lbs.
- Grate "V" . . . . . 105 lbs.

**BEARING AREAS:** The frame and grate shall be so fitted and finished as to provide a firm and even seat. No projections shall exist on bearing areas of either casting and the grate shall seat.

**WALLS:** When used in place of concrete, brick side walls shall be 8" nominal thickness.

**PRECAST CONSTRUCTION:** See ST-4 (Sheet 2 of 3).

**MINIMUM DEPTH:** The minimum depth is per the cover requirements for that pipe type.

**OPENINGS:** Pipe openings shall be the O.D. of the pipe being supplied plus 2" when fabricated or field cut. The interstitial space shall be filled with grout.


**DOWELS:** Four 1"x18" dowels are required for concrete pavement or gutter blockout.

**TEXT:** The Following text shall be cast into the top of the curb casting: "DUMP NO WASTE" and "DRAINS TO WATERWAY" (see curb casting - plan on sheet 3 of 3).

NO.	DATE	REVISIONS
1	4/07	add text note
2	5/13	Convert-AutoCAD
3	6/23	Correct Pipe Size

CATCH BASIN No. 3A  
(Sheet 2 of 3)


DRAWING NO. ST-5  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS

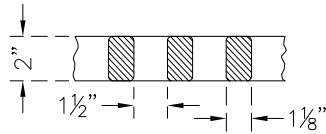


**City of Dayton**  
**WATER**

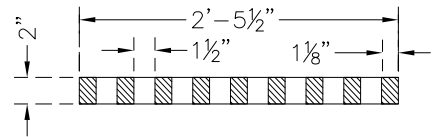
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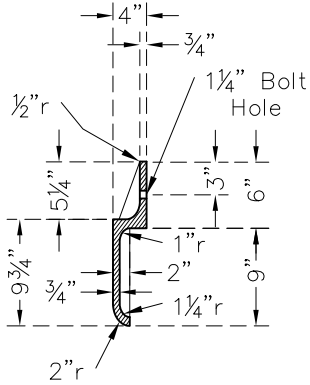


SECTION D-D

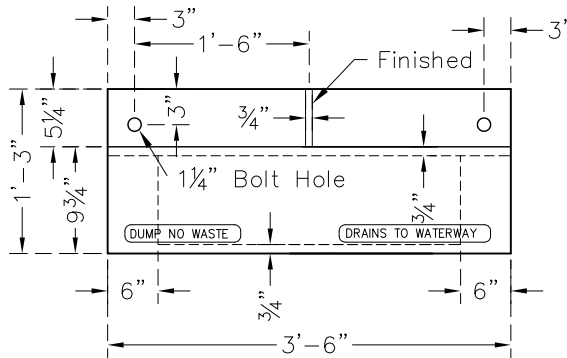


SECTION C-C

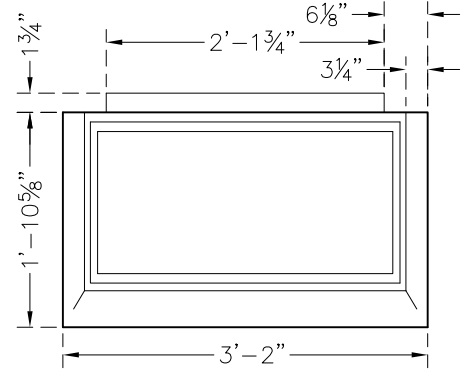
DIAGONAL GRATE  
(Grate Size 2'-5 1/2" x 1'-4 3/8" x 2")



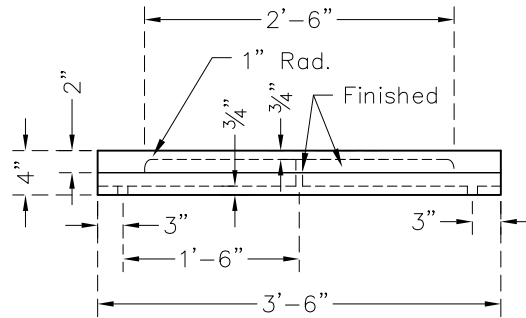
CURB CASTING  
END VIEW



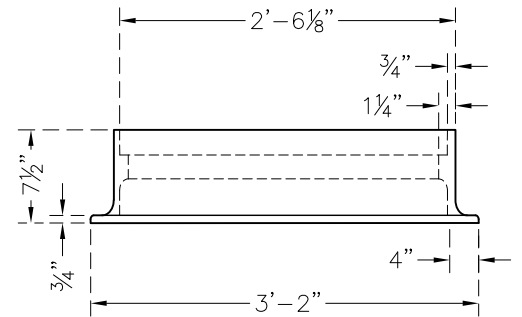
CURB CASTING  
PLAN & SECTION



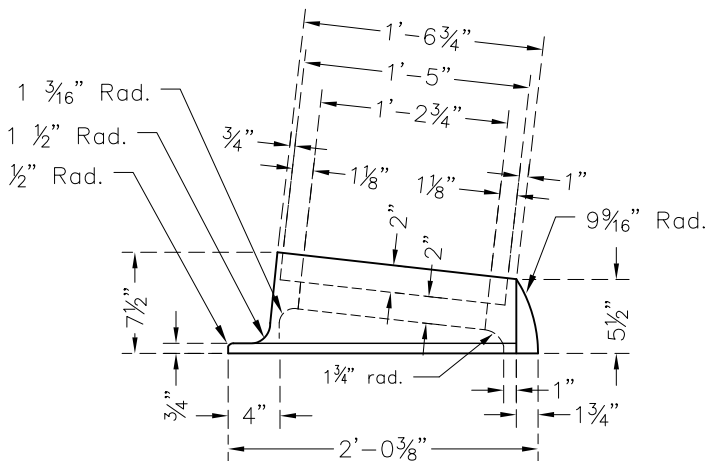
FRAME



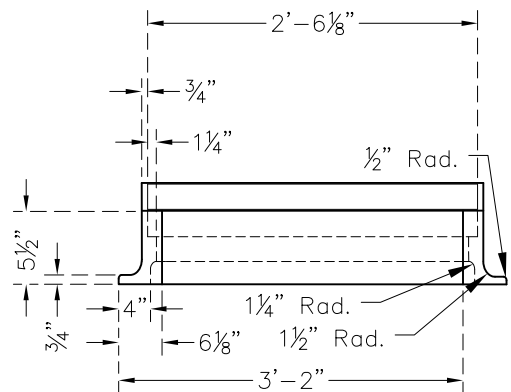
CURB CASTING  
FRONT VIEW



FRAME  
FRONT VIEW



FRAME  
END VIEW



FRAME  
BACK VIEW

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

CATCH BASIN No. 3A  
(Sheet 3 of 3)

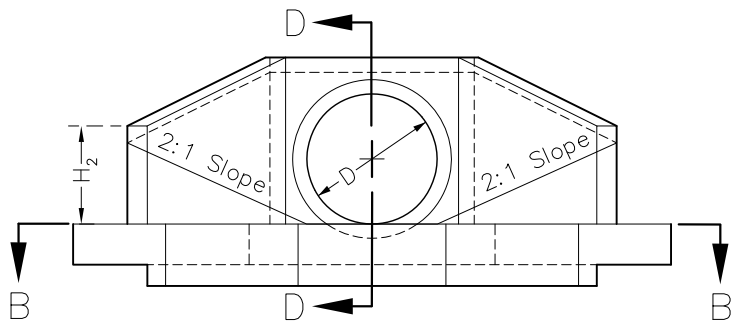
DRAWING NO. ST-5  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



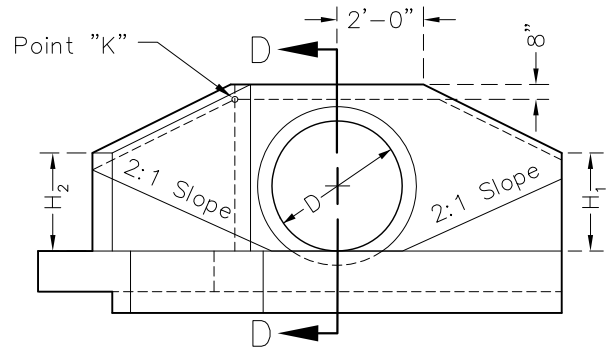
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DIVISION OF WATER ENGINEERING

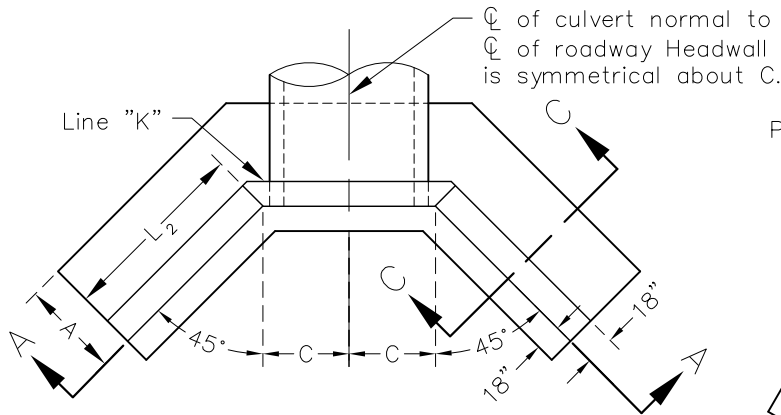




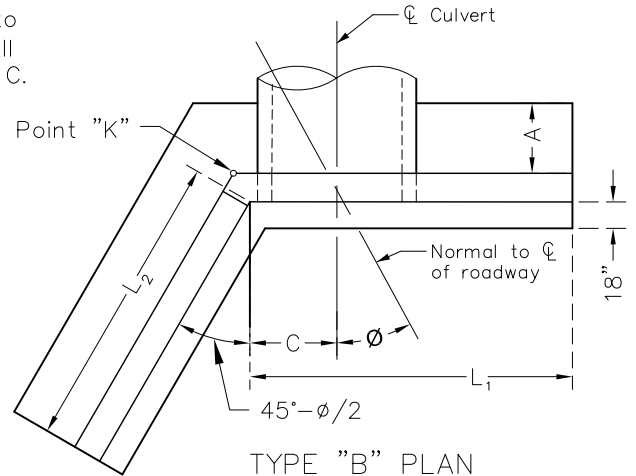
ELEVATION



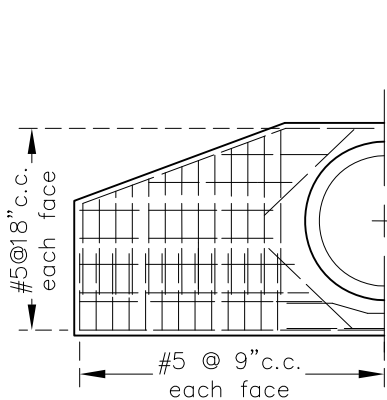
ELEVATION



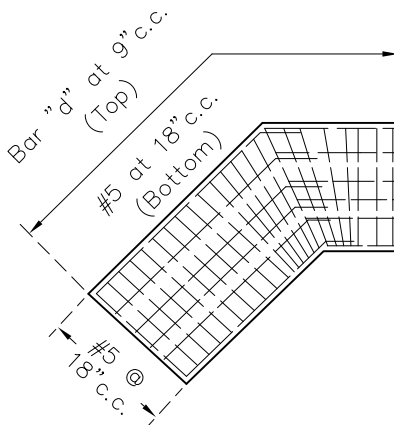
TYPE "A" PLAN



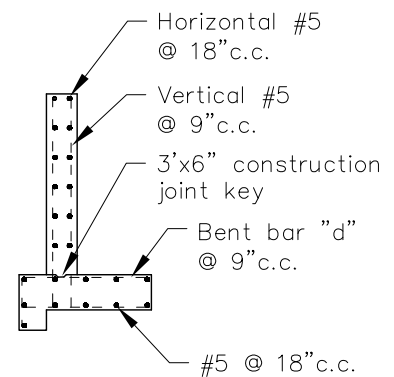
TYPE "B" PLAN



HALF-SECTION A-A

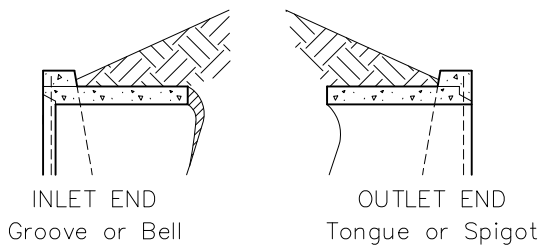


HALF-SECTION B-B

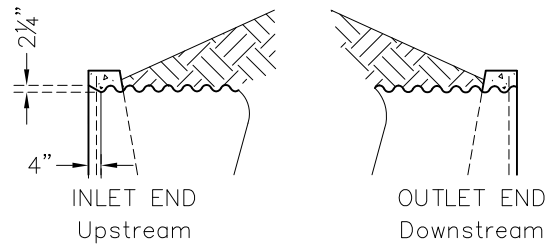


SECTION C-C

END TREATMENT AT HEADWALL



RIGID PIPE



CORRUGATED PIPE



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

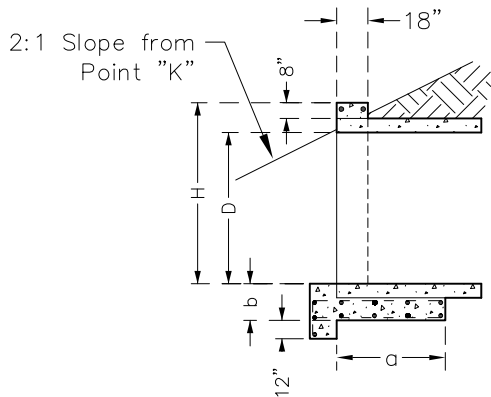
Full-Height Headwall  
(Sheet 1 of 2)

DRAWING NO. ST-6  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS

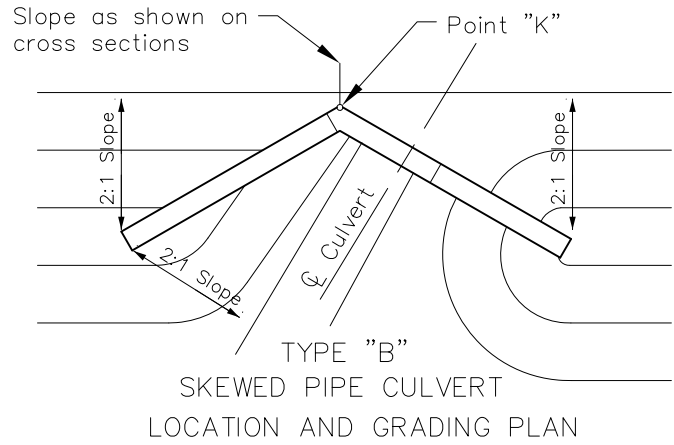
320 W. MONUMENT AVE.  
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SECTION D-D



NOTES:

APPLICATION: Full-Height Headwalls shall be provided for skewed and non-skewed culverts having a diameter or rise of 42" to 84" inclusive. Type "A" is used when the skew angle ( ) is ten degrees or less and Type "B" when the skew angle is over ten degrees.

CONCRETE: Concrete shall be City of Dayton Class C.

REINFORCING STEEL: Bars shall be #5 and epoxy coated.

DETAILS AND QUANTITIES: Are shown for circular sections only. When used with reinforced elliptical concrete pipe or corrugated metal pipe arches, it will be necessary to adjust dimensions and quantities to conform to those listed for the nearest size circular pipe. The dimensions established by vertical diameter shall apply to rise, and dimensions established by horizontal diameter shall apply to span. All calculated dimensions shall be rounded to the nearest 1". Chamfer all exposed corners 3/4".

FOUNDATION: Where the soil borings indicate a bearing capacity of less than 2,600 pounds per square foot, it will be necessary to increase the width of the footing.

HEADWALL LOCATION: To be determined by the intersection of the embankment slope at the back of the headwall at Point "K". The slopes adjacent to the headwall shall be 2:1.

D	H	a	b	c	Bar d
42"	4'-11"	3'-3"	1'-6"	2'-6"	#5
48"	5'-5"	3'-6"	1'-6"	2'-9"	#5
54"	5'-11"	3'-9"	1'-6"	3'-0"	#5
60"	6'-6"	4'-0"	1'-6"	3'-3"	#5
72"	7'-7"	4'-6"	1'-7"	3'-9"	#7
84"	8'-8"	5'-0"	1'-10"	4'-3"	#8

Ø=0°					
D	L <sub>2</sub>	H <sub>2</sub>	C.Y. Conc. CMP	C.Y. Conc. RCP	LBS
42"	3'-7"	3'-1"	7.0	6.7	598
48"	4'-4"	3'-4"	8.5	8.2	793
54"	5'-2"	3'-8"	10.3	10.0	1069
60"	5'-11"	3'-11"	12.3	11.8	1149
72"	7'-5"	4'-5"	17.0	16.2	1783
84"	9'-0"	5'-0"	23.7	22.8	2595

Ø=15°							
D	L	L <sub>2</sub>	H	H <sub>2</sub>	C.Y. Conc. CMP	C.Y. Conc. RCP	LBS
42"	7'-10"	7'-9"	3'-2"	3'-3"	8.7	8.5	718
48"	8'-9"	9'-2"	3'-5"	3'-7"	10.6	10.3	928
54"	9'-8"	10'-7"	3'-8"	3'-10"	12.6	12.2	1188
60"	10'-7"	12'-0"	3'-10"	4'-1"	14.8	14.3	1354
72"	12'-5"	4'-10"	4'-3'	4'-8"	20.2	19.6	2074
84"	14'-3"	17'-8"	4'-8'	5'-2"	27.9	27.0	2990

Ø=30°							
D	L	L <sub>2</sub>	H	H <sub>2</sub>	C.Y. Conc. CMP	C.Y. Conc. RCP	LBS
42"	7'-10"	7'-9"	3'-2"	3'-3"	8.7	8.5	633
48"	8'-9"	9'-2"	3'-5"	3'-7"	10.6	10.3	801
54"	9'-8"	10'-7"	3'-8"	3'-10"	12.6	12.2	1024
60"	10'-7"	12'-0"	3'-10"	4'-1"	14.8	14.3	1157
72"	12'-5"	4'-10"	4'-3'	4'-8"	17.3	19.6	1788
84"	14'-3"	17'-8"	4'-8'	5'-2"	24.1	23.3	2511

Ø=45°							
D	L	L <sub>2</sub>	H	H <sub>2</sub>	C.Y. Conc. CMP	C.Y. Conc. RCP	LBS
42"	7'-10"	7'-9"	3'-2"	3'-3"	8.7	8.5	718
48"	8'-9"	9'-2"	3'-5"	3'-7"	10.6	10.3	928
54"	9'-8"	10'-7"	3'-8"	3'-10"	12.6	12.2	1188
60"	10'-7"	12'-0"	3'-10"	4'-1"	14.8	14.3	1354
72"	12'-5"	4'-10"	4'-3'	4'-8"	20.2	19.6	2074
84"	14'-3"	17'-8"	4'-8'	5'-2"	27.9	27.0	2990



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

Full-Height Headwall  
(Sheet 2 of 2)

DRAWING NO. ST-6  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS

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NOTES:

GENERAL: If the pipe is depressed, a riprap reinforced concrete slab shall slope up to the channel bottom at a slope of 6 to 1 and terminate with a cutoff wall that has a depth of 6" below the depression depth.

CONCRETE: Headwall concrete shall be City of Dayton Class D. Concrete quantities are based on headwalls without the 6" extension under the channel protection.

ANCHOR BOLTS: Bolts (as detailed) for anchoring both ends of metal pipe shall meet ASTM A 307. The top 6" min. of bolt shall be galvanized according to ASTM A 153. Cost of anchors shall be included in the unit price bid per Foot [Meter] of Item 603.



Headwall dimensions are based on end treatment "A" for pipe sizes up to and including 120", 71"x47", and 66"x51", and on end treatment "B" for sizes over and including 132", 13'-3"x9'-4", and 7'-3"x5'-3".

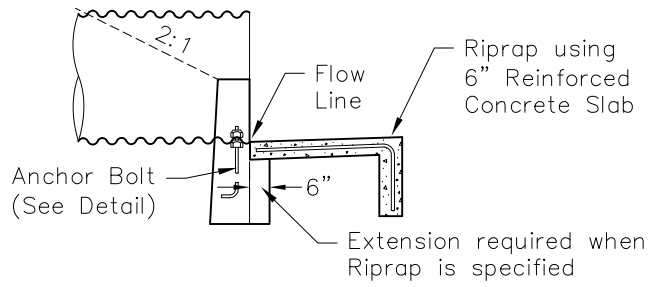
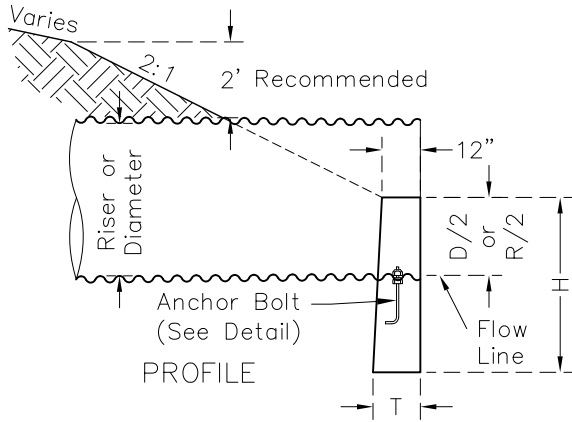
PLASTIC PIPE: Plastic pipe may not be available in all the sizes specified on this drawing.

### Headwall for Corrugated Metal Pipe & Plastic Pipe (English)

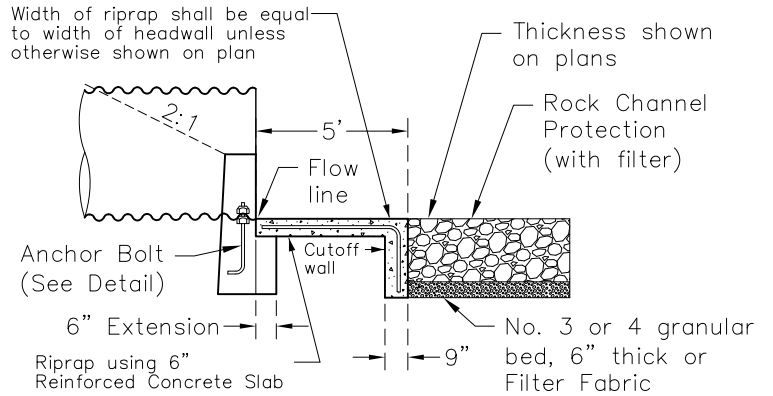
Circular					Pipe Arch						Pipe Arch					
D	W	H	T	Conc. C.Y.	Span	Rise	W	H	T	Conc. C.Y.	Span	Rise	W	H	T	Conc. C.Y.
12"	2'-0"	3'-0"	12"	0.21	2.67"x1/2" Corrugations						* 81"	59"	12'-3"	5'-5"	15"	2.14
15"	2'-6"	3'-2"	12"	0.27	17"	13"	3'-0"	3'-0"	12"	0.31	87"	63"	13'-0"	5'-7"	17"	2.50
18"	3'-0"	3'-3"	12"	0.33	21"	15"	3'-6"	3'-0"	12"	0.35	95"	67"	14'-0"	5'-9"	20"	3.14
21"	3'-6"	3'-4"	12"	0.39	24"	18"	4'-0"	3'-2"	12"	0.43	103"	71"	15'-0"	5'-11"	22"	3.54
24"	4'-0"	3'-6"	12"	0.46	28"	20"	4'-6"	3'-3"	12"	0.48	112"	75"	16'-0"	6'-1"	24"	3.96
27"	4'-6"	3'-8"	12"	0.53	35"	24"	5'-6"	3'-5"	12"	0.61	117"	79"	17'-9"	6'-3"	25"	4.89
30"	5'-0"	3'-9"	12"	0.60	42"	29"	6'-6"	3'-7"	12"	0.73	128"	83"	18'-0"	6'-5"	26"	5.01
33"	5'-6"	3'-10"	12"	0.68	49"	33"	7'-8"	3'-9"	12"	0.90	137"	87"	19'-0"	6'-7"	27"	5.45
36"	6'-0"	4'-0"	12"	0.76	57"	38"	9'-0"	4'-0"	12"	1.10	142"	91"	20'-9"	6'-9"	27"	6.31
39"	6'-6"	4'-2"	12"	0.84	64"	43"	10'-0"	4'-4"	12"	1.31	6"x2" Corrugations (18" Corner Radius)					
42"	7'-0"	4'-3"	12"	0.92	71"	47"	11'-0"	4'-8"	12"	1.54	* 6'-1"	4'-7"	11'-8"	5'-7"	12"	1.89
48"	8'-0"	4'-6"	12"	1.10	* 77"	52"	11'-8"	5'-3"	12"	1.84	* 6'-4"	4'-9"	12'-0"	5'-8"	14"	2.12
54"	9'-3"	4'-9"	12"	1.33	* 83"	57"	12'-4"	5'-5"	15"	2.46	* 6'-9"	4'-11"	12'-4"	5'-9"	15"	2.42
60"	10'-6"	5'-6"	12"	1.78	6"x2" Corrugations (31" Corner Radius)						* 7'-0"	5'-1"	12'-8"	5'-10"	16"	2.44
66"	11'-9"	5'-9"	12"	2.06	13'-3"	9'-4"	23'-11"	7'-11"	32"	9.63	7'-3"	5'-3"	12'-11"	5'-11"	17"	2.69
72"	13'-0"	6'-0"	12"	2.37	13'-6"	9'-6"	24'-9"	8'-0"	32"	10.12	7'-8"	5'-5"	13'-2"	6'-0"	18"	2.77
78"	14'-3"	6'-3"	14"	2.94	14'-0"	9'-8"	24'-10"	8'-1"	33"	10.33	7'-11"	5'-7"	14'-0"	6'-1"	20"	3.15
84"	15'-6"	6'-6"	14"	3.30	14'-2"	9'-10"	25'-9"	8'-2"	33"	10.87	8'-2"	5'-9"	14'-8"	6'-2"	21"	3.45
90"	16'-9"	6'-9"	16"	4.00	14'-5"	10'-0"	26'-7"	8'-3"	33"	11.39	8'-7"	5'-11"	15'-0"	6'-3"	22"	3.75
96"	18'-0"	7'-0"	16"	4.40	14'-11"	10'-2"	26'-9"	8'-4"	34"	11.68	8'-10"	6'-1"	15'-10"	6'-4"	23"	4.15
102"	19'-3"	7'-3"	18"	5.28	15'-4"	10'-4"	26'-11"	8'-5"	34"	11.96	9'-4"	6'-3"	16'-0"	6'-5"	24"	4.65
108"	20'-6"	7'-6"	20"	6.21	15'-7"	10'-6"	27'-9"	8'-6"	34"	12.51	9'-6"	6'-5"	16'-10"	6'-6"	26"	4.93
114"	21'-9"	7'-9"	22"	7.25	15'-10"	10'-8"	28'-7"	8'-7"	35"	13.06	9'-9"	6'-7"	17'-9"	6'-7"	27"	5.41
120"	23'-0"	8'-0"	24"	8.38	16'-3"	10'-10"	28'-8"	8'-8"	35"	13.34	10'-3"	6'-9"	17'-10"	6'-8"	27"	5.45
* 126"	23'-0"	8'-3"	26"	8.64	16'-6"	11'-0"	29'-7"	8'-9"	35"	13.94	10'-8"	6'-11"	17'-11"	6'-9"	27"	5.59
132"	23'-0"	8'-6"	28"	9.23	17'-0"	11'-2"	29'-8"	8'-10"	36"	14.24	10'-11"	7'-1"	18'-10"	6'-10"	28"	5.97
138"	24'-1"	8'-9"	30"	10.50	17'-2"	11'-4"	30'-7"	8'-11"	36"	14.84	11'-5"	7'-3"	18'-11"	6'-11"	28"	6.12
144"	25'-2"	9'-0"	32"	11.89	17'-5"	11'-6"	31'-5"	9'-0"	36"	15.42	11'-7"	7'-5"	19'-9"	7'-0"	28"	6.52
150"	26'-4"	9'-3"	34"	13.38	17'-11"	11'-8"	31'-7"	9'-1"	37"	15.83	11'-10"	7'-7"	20'-9"	7'-1"	29"	6.94
156"	27'-5"	9'-6"	36"	15.01	18'-1"	11'-10"	32'-5"	9'-2"	37"	16.43	12'-4"	7'-9"	20'-10"	7'-2"	29"	7.12
162"	28'-7"	9'-9"	38"	16.75	18'-7"	12'-0"	32'-6"	9'-3"	37"	16.78	12'-6"	7'-11"	21'-8"	7'-3"	29"	7.53
168"	29'-8"	10'-0"	40"	18.61	18'-9"	12'-2"	33'-4"	9'-4"	38"	17.43	12'-8"	8'-1"	22'-7"	7'-4"	30"	7.95
174"	30'-9"	10'-3"	42"	20.28	19'-3"	12'-4"	33'-5"	9'-5"	38"	17.78	12'-10"	8'-4"	23'-7"	7'-5"	30"	8.48
180"	31'-11"	10'-6"	43"	21.87	19'-6"	12'-6"	34'-5"	9'-6"	38"	18.49	13'-5"	8'-5"	23'-7"	7'-6"	30"	8.63
186"	33'-0"	10'-9"	44"	23.54	19'-8"	12'-8"	35'-3"	9'-7"	39"	19.19	13'-11"	8'-7"	23'-7"	7'-7"	31"	8.81
192"	34'-2"	11'-0"	45"	25.30	19'-11"	12'-10"	36'-3"	9'-8"	39"	19.95	14'-1"	8'-9"	25'-1"	7'-8"	31"	9.29
198"	35'-3"	11'-3"	46"	27.12	20'-5"	13'-0"	36'-3"	9'-9"	39"	20.30	14'-3"	8'-11"	25'-6"	7'-9"	31"	9.78
204"	36'-4"	11'-6"	47"	29.15	20'-7"	13'-2"	37'-2"	9'-10"	40"	21.05	14'-10"	9'-1"	25'-6"	7'-10"	32"	10.25
210"	37'-6"	11'-9"	48"	31.03	3"x1" Corrugations						15'-4"	9'-3"	25'-6"	7'-11"	32"	10.25
216"	38'-7"	12'-0"	49"	33.43	40"	31"	6'-6"	3'-7"	12"	0.70	15'-6"	9'-5"	26'-5"	8'-0"	32"	10.74
222"	40'-0"	12'-3"	50"	36.26	46"	36"	7'-8"	3'-9"	12"	0.85	15'-8"	9'-7"	27'-5"	8'-1"	33"	11.28
228"	40'-10"	12'-6"	51"	37.52	53"	41"	9'-0"	4'-0"	12"	1.06	15'-10"	9'-10"	28'-5"	8'-2"	33"	12.00
234"	42'-0"	12'-9"	52"	39.86	60"	46"	10'-0"	4'-4"	12"	1.27	16'-5"	9'-11"	28'-5"	8'-3"	33"	12.09
240"	43'-1"	13'-0"	53"	42.28	66"	51"	11'-0"	4'-8"	12"	1.54	16'-7"	10'-1"	29'-4"	8'-4"	34"	12.64
246"	44'-2"	13'-3"	54"	44.83	* 73"	55"	11'-8"	5'-3"	12"	1.81	-	-	-	-	-	-
252"	45'-4"	13'-6"	55"	47.44												

\* Channel configuration for pipe sizes between end treatment "A" and end treatment "B" is determined by 2:1 slopes passing through a point 6" below the top and at each side of the headwall. For end treatment "B", 2:1 slopes are tangent to pipe.

NO.	DATE	REVISIONS	Half Height Headwall for Corrugated Pipe (Sheet 1 of 2)		320 W. MONUMENT AVE. DAYTON, OHIO 45402  CITY OF DAYTON DEPARTMENT OF WATER DIVISION OF WATER ENGINEERING	
		Convert-AutoCAD	DRAWING NO. ST-7 SCALE: NOT TO SCALE DRAWN: DEC. 2002 BY: JBS			



INLET CHANNEL PROTECTION



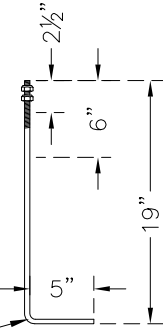
OUTLET CHANNEL PROTECTION

The depth of the riprap cutoff wall (2'-6" min.) shall match the thickness of the rock channel protection shown on the plan plus 6".

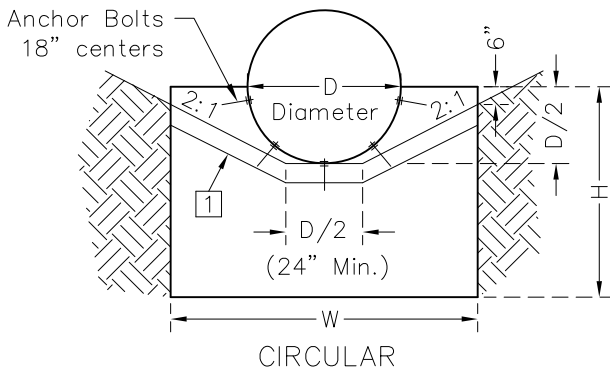
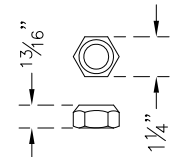
NOTE:  
BAR  
Galvanized,  
Dia. 3/4" Min.

Radius  
3/8" Min.  
3/4" Max.

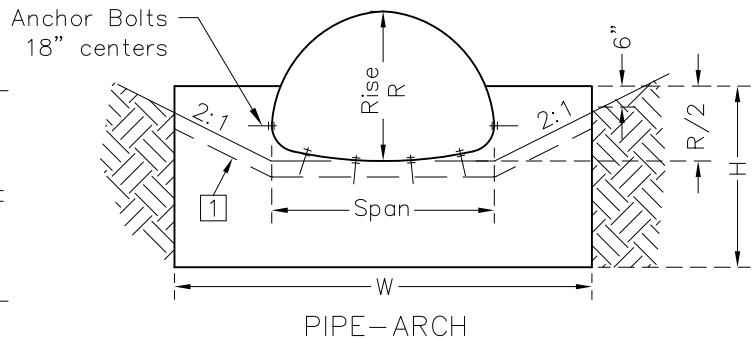
ANCHOR BOLT



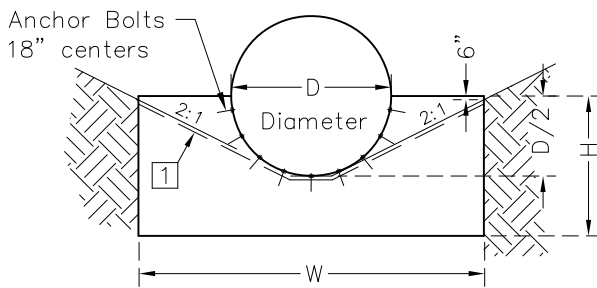
ANCHOR NUT  
(ASTM A 153  
&  
ASTM A 325)



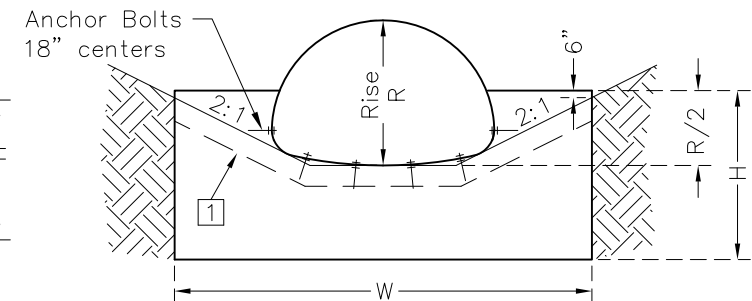
END TREATMENT "A"



1 Top surface of 6" inlet headwall extension



END TREATMENT "B"



NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

Half Height Headwall  
for Corrugated Pipe  
(Sheet 2 of 2)

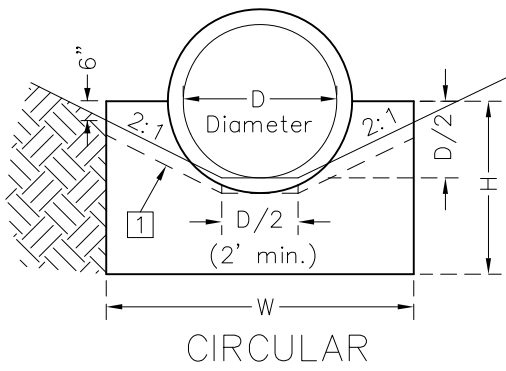
DRAWING NO. ST-7  
SCALE: NOT TO SCALE  
DRAWN: DEC. 2002 BY: JBS



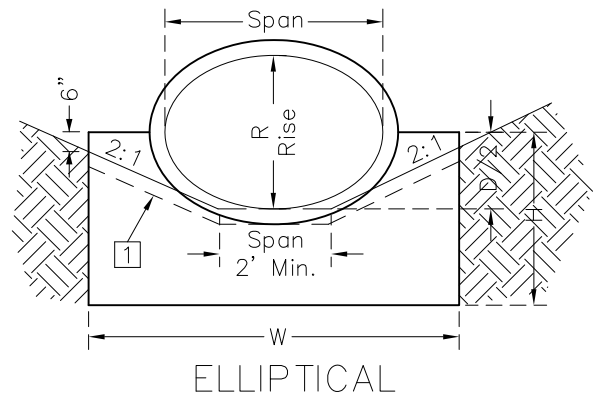
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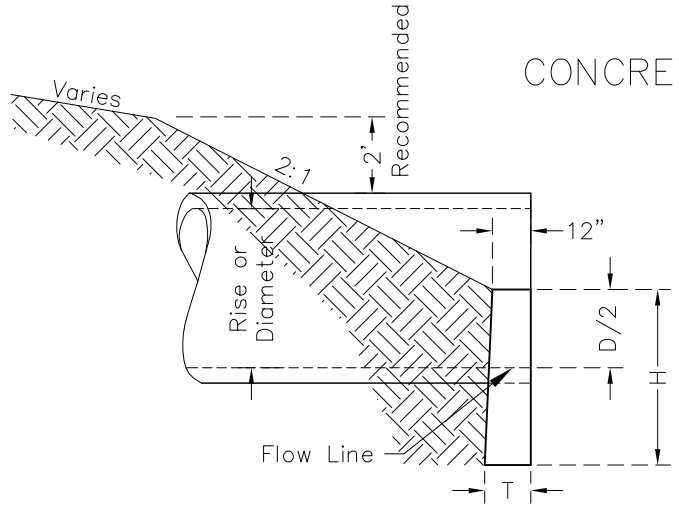
CIRCULAR



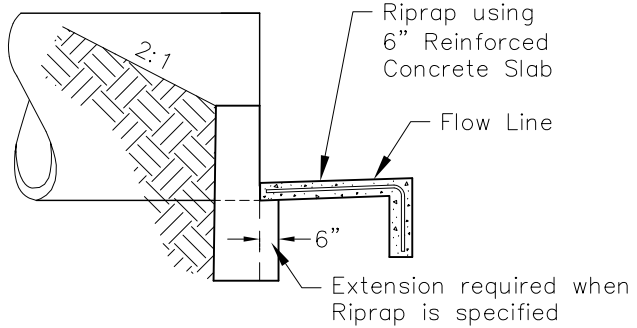
ELLIPTICAL

1 Top surface of 6" inlet headwall extension

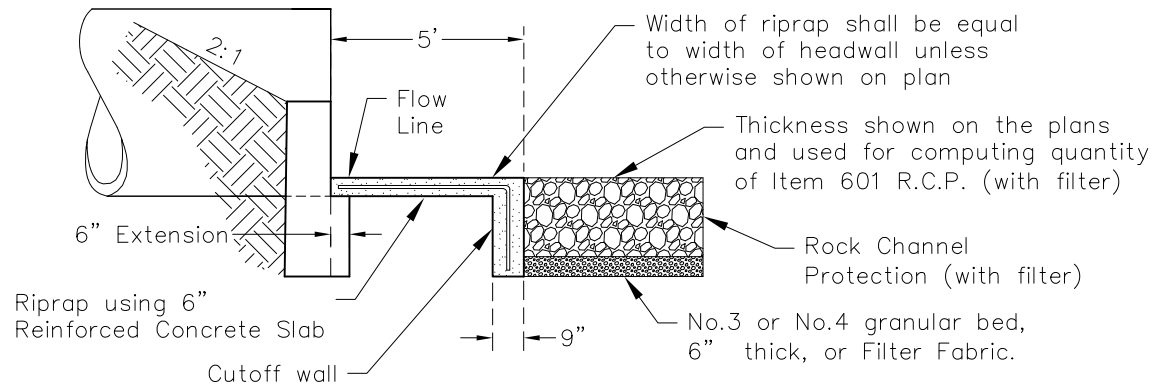
CONCRETE PIPE



PROFILE



INLET CHANNEL PROTECTION



OUTLET CHANNEL PROTECTION DETAIL

The depth of the riprap cutoff wall (2'-6" min.) shall match the thickness of the rock channel protection shown on the plan plus 6".

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

Half Height Headwall  
for Concrete Pipe  
(Sheet 1 of 2)

DRAWING NO. ST-8  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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DAYTON, OHIO 45402

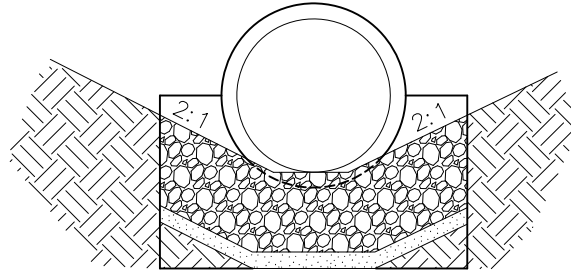
CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING



NOTES;

GENERAL: If the pipe is depressed, a riprap reinforced concrete slab shall slope up to the channel bottom at a slope of 6 to 1 and terminate with a cutoff wall that has a depth of 6" below the depression depth.

CONCRETE: Concrete for headwalls shall be City of Dayton, Class D. Concrete quantities are based on headwalls without the 6" extension under the channel protection.




Width of riprap and rock channel protection shall be equal to the width of headwall unless otherwise shown on the plans. (Minimum width 4'-0".)

Headwall for Corrugated Metal Pipe & Plastic Pipe (English)										
Circular					Pipe Arch					
D	W	H	T	Conc. C.Y.	Span	Rise	W	H	T	Conc. C.Y.
12"	2'-0"	3'-0"	12"	0.20	23"	14"	3'-0"	3'-2"	12"	0.29
15"	2'-6"	3'-2"	12"	0.25	30"	19"	3'-7"	3'-4"	12"	.035
18"	3'-0"	3'-3"	12"	0.31	34"	22"	3'-11"	3'-5"	12"	0.38
21"	3'-6"	3'-4"	12"	0.37	38"	24"	4'-6"	3'-6"	12"	0.44
24"	4'-0"	3'-6"	12"	0.43	42"	27"	4'-8"	3'-7"	12"	0.45
27"	4'-6"	3'-8"	12"	0.49	45"	29"	5'-2"	3'-8"	12"	0.49
30"	5'-0"	3'-9"	12"	0.56	49"	32"	5'-5"	3'-10"	12"	0.52
33"	5'-6"	3'-10"	12"	0.62	53"	34"	5'-11"	4'-0"	14"	0.66
36"	6'-0"	4'-0"	12"	0.69	60"	38"	6'-10"	4'-2"	14"	0.82
39"	6'-6"	4'-2"	12"	0.77	68"	43"	8'-0"	4'-4"	16"	10.1
42"	7'-0"	4'-3"	12"	0.84	76"	48"	9'-2"	5'-0"	16"	1.34
48"	8'-0"	4'-6"	14"	1.09	83"	53"	10'-4"	5'-2"	18"	1.65
54"	9'-3"	4'-9"	14"	1.32	91"	58"	11'-6"	5'-5"	18"	1.97
60"	10'-6"	5'-6"	16"	1.93	98"	63"	12'-7"	5'-7"	20"	2.38
66"	11'-9"	5'-9"	18"	2.42	106"	68"	13'-9"	5'-10"	20"	2.69
72"	13'-0"	6'-0"	18"	2.77	113"	72"	14'-9"	6'-0"	22"	3.14
78"	14'-3"	6'-3"	20"	3.37	121"	77"	15'-11"	6'-3"	22"	3.49
84"	15'-6"	6'-6"	22"	4.05	128"	82"	17'-0"	6'-5"	24"	4.04
90"	16'-9"	6'-9"	22"	4.51	136"	87"	18'-2"	6'-8"	24"	4.84
96"	18'-0"	7'-0"	24"	5.31	143"	92"	19'-4"	6'-10"	26'	5.12
102"	19'-3"	7'-3"	26"	6.20	151"	97"	20'-6"	7'-1"	26"	5.42
108"	20'-6"	7'-6"	26"	6.78	166"	106"	22'-7"	7'-5"	28"	6.60
114"	21'-9"	7'-9"	28"	7.81	180"	116"	24'-10"	7'-10"	30"	7.99
120"	23'-0"	8'-0"	30"	8.93	-	-	-	-	-	-
126"	24'-3"	8'-3"	30"	9.57	-	-	-	-	-	-
132"	25'-6"	8'-6"	32"	10.84	-	-	-	-	-	-
144"	28'-8"	9'-0"	34"	13.00	-	-	-	-	-	-

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

Half Height Headwall  
for Concrete Pipe  
(Sheet 2 of 2)


DRAWING NO. ST-8  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



**City of Dayton**  
**WATER**

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DAYTON, OHIO 45402

CITY OF DAYTON  
DEPARTMENT OF WATER  
DIVISION OF WATER ENGINEERING

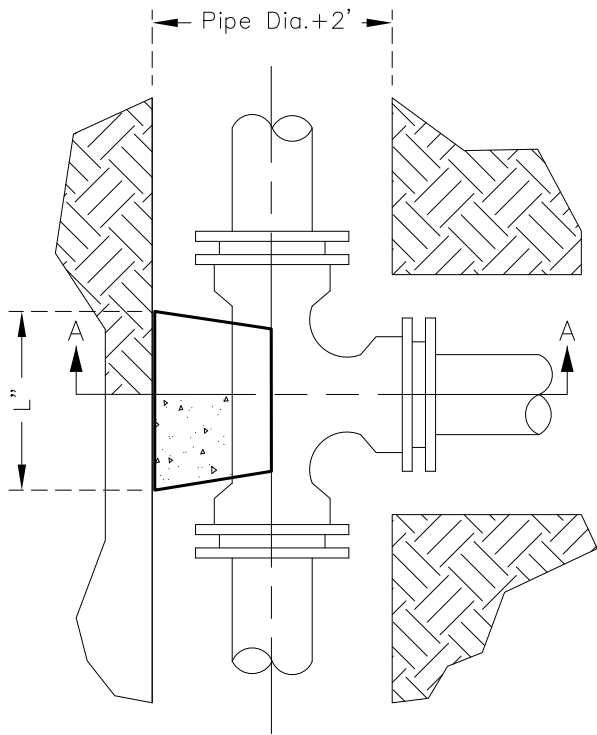


THE CITY OF DAYTON OHIO  
INCORPORATED 1803

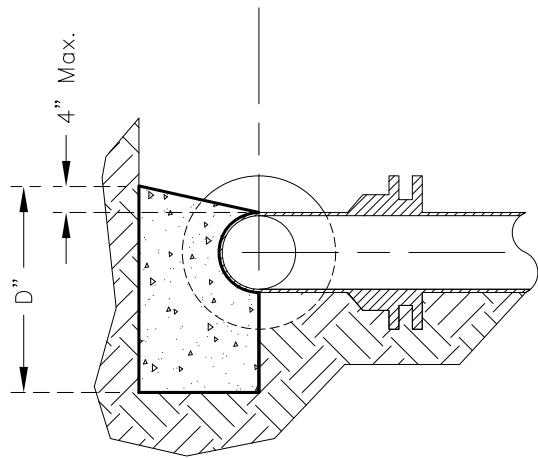
BRANCH

RUN	3"			4"			6"			8"			10"+12"			16"			20"			24"		
	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.
3"	12	5	0.5																					
4"	10	6	0.5	11	8	0.8																		
6"	9	7	0.5	11	8	0.8	18	12	1.9															
8"	8	8	0.5	10	9	0.7	18	12	1.9	23	16	3.5												
10"	6	12	0.6	8	12	0.8	18	12	1.9	23	16	3.5	38	22	8.7									
12"	6	12	0.6	8	12	0.8	18	12	1.9	23	16	3.5	38	22	8.7									
16"	6	16	0.8	6	16	0.8	14	16	2.0	20	18	3.3	36	23	8.7	49	30	13.6						
20"	6	20	1.0	6	20	1.0	11	20	1.9	18	20	3.3	35	24	8.7	46	32	13.6	60	38	26.5			
24"	6	24	1.2	6	24	1.2	9	24	1.9	15	24	3.3	30	28	8.7	42	36	14.0	54	42	26.3	68	48	45.4

STEEL WILL BE USED AS REQUIRED BY THE ENGINEER



PLAN VIEW



SECTION A - A

NOTE:

1. BACKER DESIGN FOR 3000 PSF SOIL BEARING.
2. CONCRETE TO BE PLACED AGAINST UNDISTURBED EARTH.
3. PROVIDE CLEARANCE FOR REMOVAL OF BOLTS.
4. A minimum of 6 mils thick polyethylene sheeting shall encase all bends tees and fittings where a thrust block is required and extend not less than 12" from the edge of the poured concrete.
5. Contractor must mix bagged concrete with water prior to placing around fittings. Mixing concrete in trench is prohibited.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	1/20	Added Notes 4&5

THRUST BLOCKING FOR WATER MAIN TEES

DRAWING NO. WA-1  
 SCALE: NOT TO SCALE  
 DRAWN: JANUARY 2001 BY: JBS



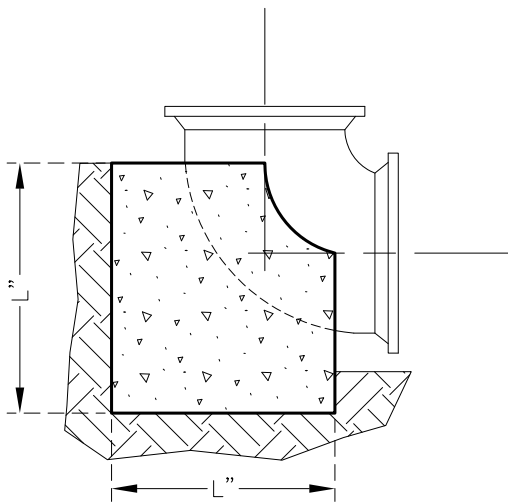
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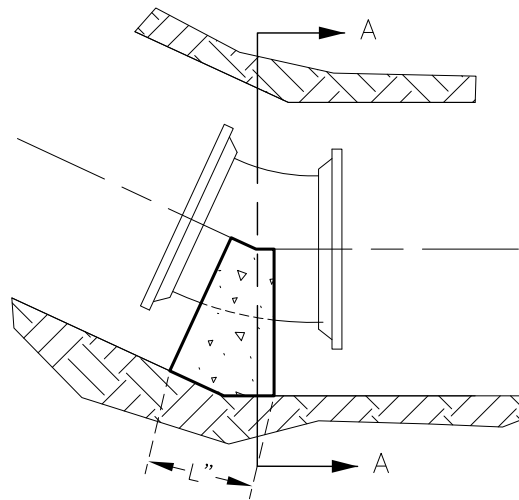


SIZE OF PIPE		DEGREE OF BEND											
		11°			22°			45°			90°		
		L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.
3"	4	3	0.1	6	4	0.2	10	4	0.3	10	4	0.3	
4"	5	4	0.2	9	5	0.4	14	5	0.6	14	5	0.6	
6"	8	6	0.5	12	7	0.7	20	8	1.4	18	9	1.7	
8"	9	8	0.7	16	9	1.4	24	12	2.7	25	11	4.0	
10"+12"	14	12	1.8	24	14	3.6	36	18	6.9	32	18	10.7	
16"	18	16	3.4	32	18	6.7	36	32	13.4	41	26	25.4	
20"	25	20	6.4	30	30	11.5	49	36	20.5	50	32	46.5	
24"	27	24	9.0	39	34	18.4	60	42	35.0	58	40	77.7	

STEEL WILL BE USED AS REQUIRED BY THE ENGINEER



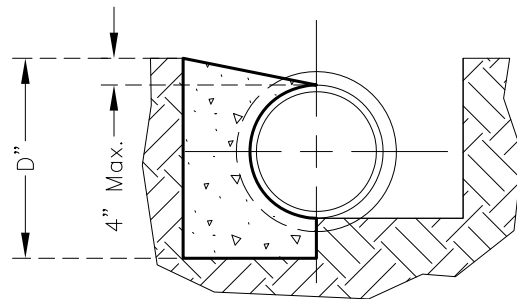
90° BENDS



BENDS LESS THAN 90°

NOTE:

1. BACKER DESIGN FOR 3000 PSF SOIL BEARING.
2. CONCRETE TO BE PLACED AGAINST UNDISTURBED EARTH.
3. A minimum of 6 mils thick polyethylene sheeting shall encase all bends tees and fittings where a thrust block is required and extend not less than 12" from the edge of the poured concrete.



SECTION A-A

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	9/18	ADDED NOTE NO. 3

THRUST BLOCKING FOR BENDS ON WATER MAINS

DRAWING NO. WA-2  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS

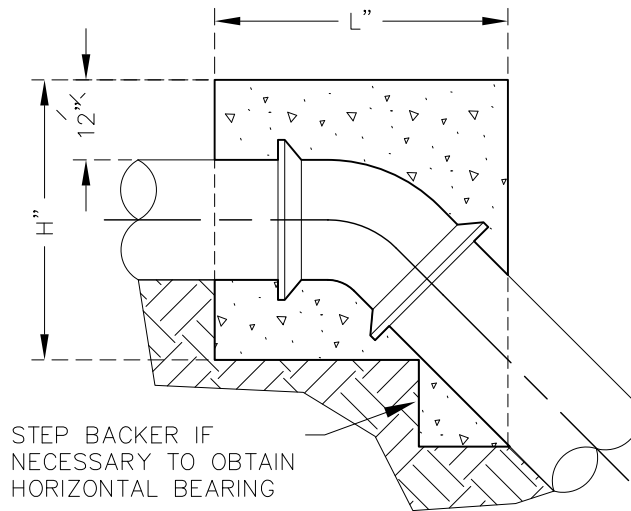


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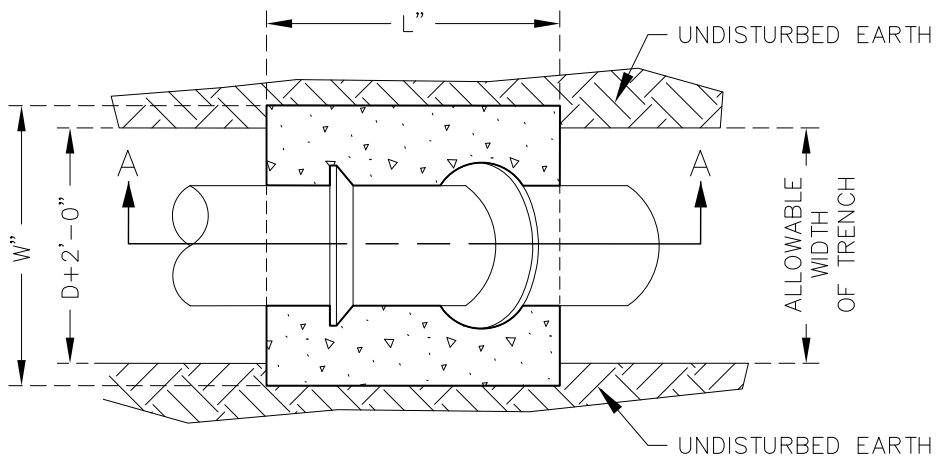
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DIVISION OF WATER ENGINEERING



		DEGREE OF BEND															
		11°				22°				45°				90°			
		L"	W"	H"	Vol.	L"	W"	H"	Vol.	L"	W"	H"	Vol.	L"	W"	H"	Vol.
SIZE OF PIPE	3"	12	18	12	1.5	13	25	16	3.0	18	30	19	5.9	25	30	24	10.4
	4"	12	24	16	2.6	16	30	18	5.0	22	36	24	11.0	27	48	25	18.7
	6"	12	48	18	6.0	15	43	36	13.4	30	55	24	22.9	37	54	36	41.6
	8"	12	63	24	10.5	18	57	34	20.2	36	57	33	39.2	47	60	46	75.0
	10"+12"	20	54	36	22.6	37	62	37	49.0	48	62	51	87.9	66	66	66	166.4
	16"	31	65	38	44.3	60	65	39	88.1	65	65	65	159.2	72	96	72	28.0
	20"	45	70	40	72.8	56	70	60	136.2	72	76	78	247.0	86	108	84	451.8
	24"	41	72	54	92.3	67	74	69	198.0	88	84	84	359.1	96	120	96	640.0



SECTION A - A



BENDS LESS THAN 90°

NOTE:

1. VOLUMES GIVEN IN CUBIC FEET.
2. BACKER TO BE CENTERED HORIZONTAL ON BEND.
3. STEEL ANCHOR RODS WILL BE USED AS REQUIRED BY ENGINEER.
4. BEND TO BE WRAPPED IN PLASTIC SHEETS PRIOR TO CONCRETE ENCASUREMENT.

NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD
2	9/18	ADDED NOTE NO.4

THRUST BLOCKING FOR  
OVER VERTICAL BENDS (ONLY)

DRAWING NO. WA-3  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS



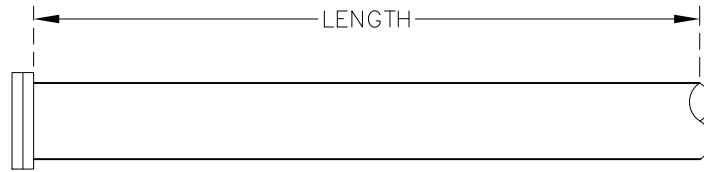
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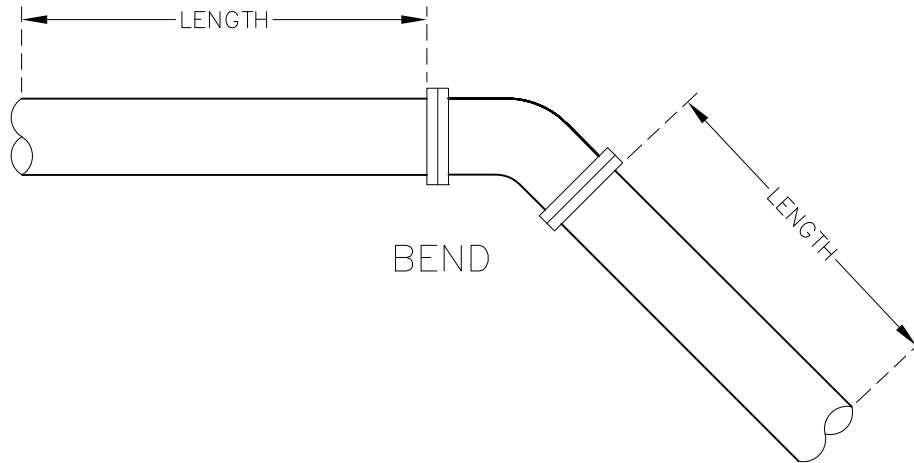


	4"	6"	8"	10"	12"	16"	LARGER THAN 16"
11 1/4"	2'	3'	4'	5'	6'	8'	CONSULT WATER ENGINEERING FOR RESTRAINED LENGTHS
22 1/2"	5'	7'	9'	11'	12'	16'	
45°	10'	14'	19'	22'	25'	33'	
90°	24'	33'	44'	53'	66'	98'	
TEE							
PLUG							

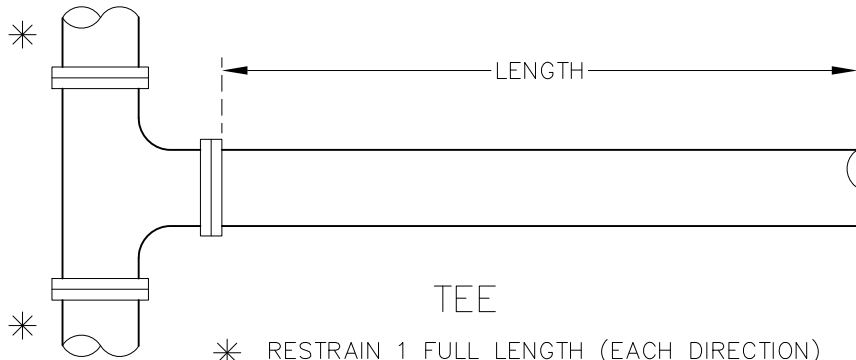
\* This table is valid for test pressure up to 150 PSI. For pressures more than 150 PSI, consult water engineering for restrained joint lengths.



PLUG



BEND



TEE

\* RESTRAIN 1 FULL LENGTH (EACH DIRECTION)

NO.	DATE	REVISIONS
1	3/09	EDIT LENGTH
2	5/13	Convert-AutoCAD
3	1/20	Note Added

RESTRAINED JOINT LENGTHS  
FOR WATER MAINS

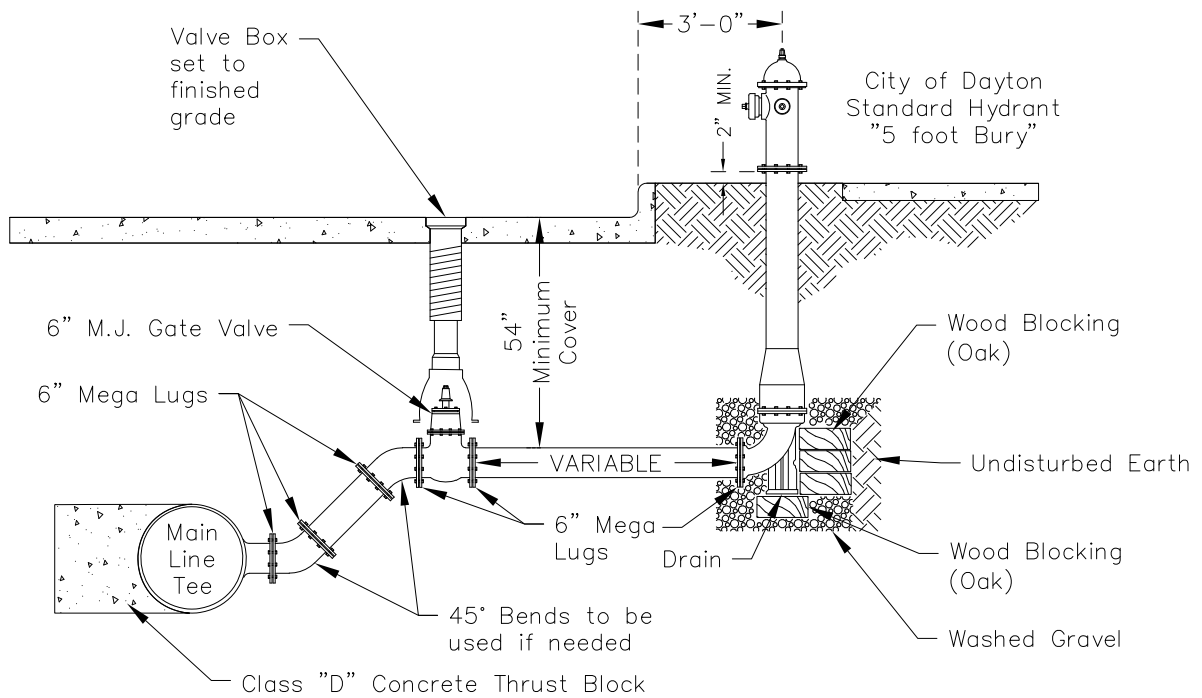
DRAWING NO. WA-4  
SCALE: NOT TO SCALE  
DRAWN: JANUARY 2001 BY: JBS



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TYPICAL FIRE HYDRANT DETAIL  
NO SCALE

NOTES:

1. 6" BRANCH LINE TO BE RESTRAINED FULL LENGTH.
2. CONCRETE THRUST BLOCK TO BE INSTALLED AT MAIN LINE TEE.
3. WOOD (OAK) THRUST BLOCK TO BE INSTALLED BEHIND INLET OF FIRE HYDRANT.
4. WASHED GRAVEL  $\frac{3}{4}$ " OR LARGER TO BE PUT AROUND DRAIN OF FIRE HYDRANT.
5. DEPTHS GREATER THAN 54" MINIMUM, COVER TO THE TOP OF FIRE HYDRANT BRANCH, 45° BENDS AND FITTINGS SHALL BE USED TO BRING THE PIPING TO THE 54" COVER SO THAT THE 5'-0" STANDARD HYDRANT MAY BE USED. EXTENSIONS SHALL NOT BE PERMITTED unless approved by Water Engineering.
6. RESTRAIN MAIN RUN ON THE TEE, ONE FULL LENGTH EACH DIRECTION.
7. PAINT HYDRANT ABOVE GRADE WITH #515 ENSIGN YELLOW AND BONNET WITH SAFETY BLUE.
8. CHAINS SHALL BE REMOVED BY THE CONTRACTOR.

NO.	DATE	REVISIONS
1	4/07	EDIT NOTES
		ADD EARTH
2	3/09	NOTE 5
3	5/09	45 BENDS
4	5/13	Convert-AutoCAD
5	1/20	Edit Note 7&8
6	6/23	Show Valve Bonnet

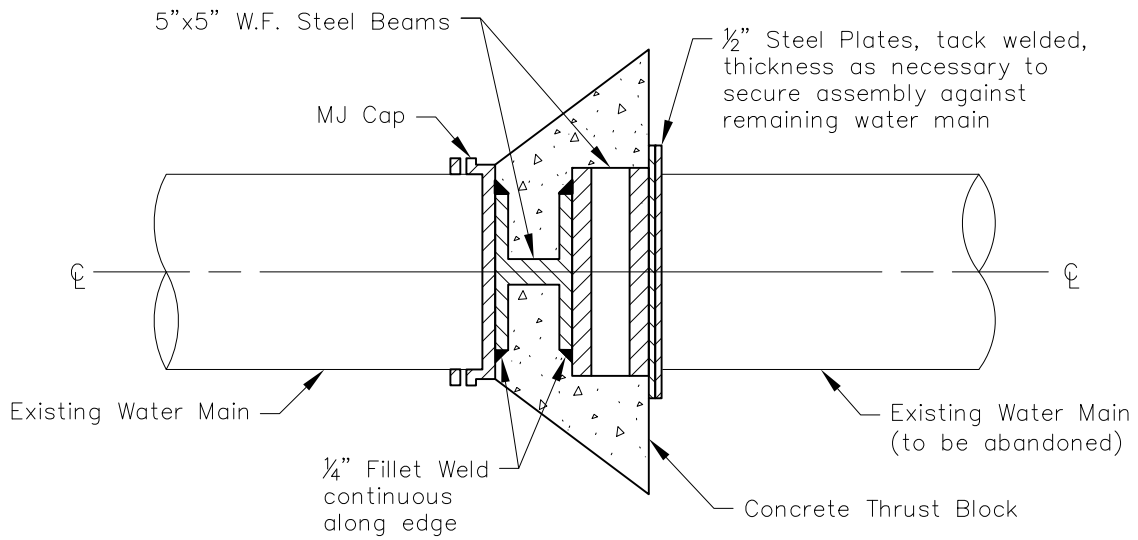
FIRE HYDRANT
DRAWING NO. WA-5 SCALE: NOT TO SCALE DRAWN: JANUARY 2001 BY: JBS



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NOTES:

- \* THE EXCAVATION PIT SHALL BE A MINIMUM OF 48" WIDE BY 72" LONG, CENTERED ON THE LOCATION OF THE PLUG.
- \* ALTERNATIVE METHODS WILL BE CONSIDERED FOR WATER MAIN 12" AND SMALLER AS APPROVED BY WATER ENGINEERING.

NO.	DATE	REVISIONS
1	4/07	edit notes
2	5/13	Convert-AutoCAD
3	1/20	NOTES ADDED

WATER MAIN CUT & PLUG

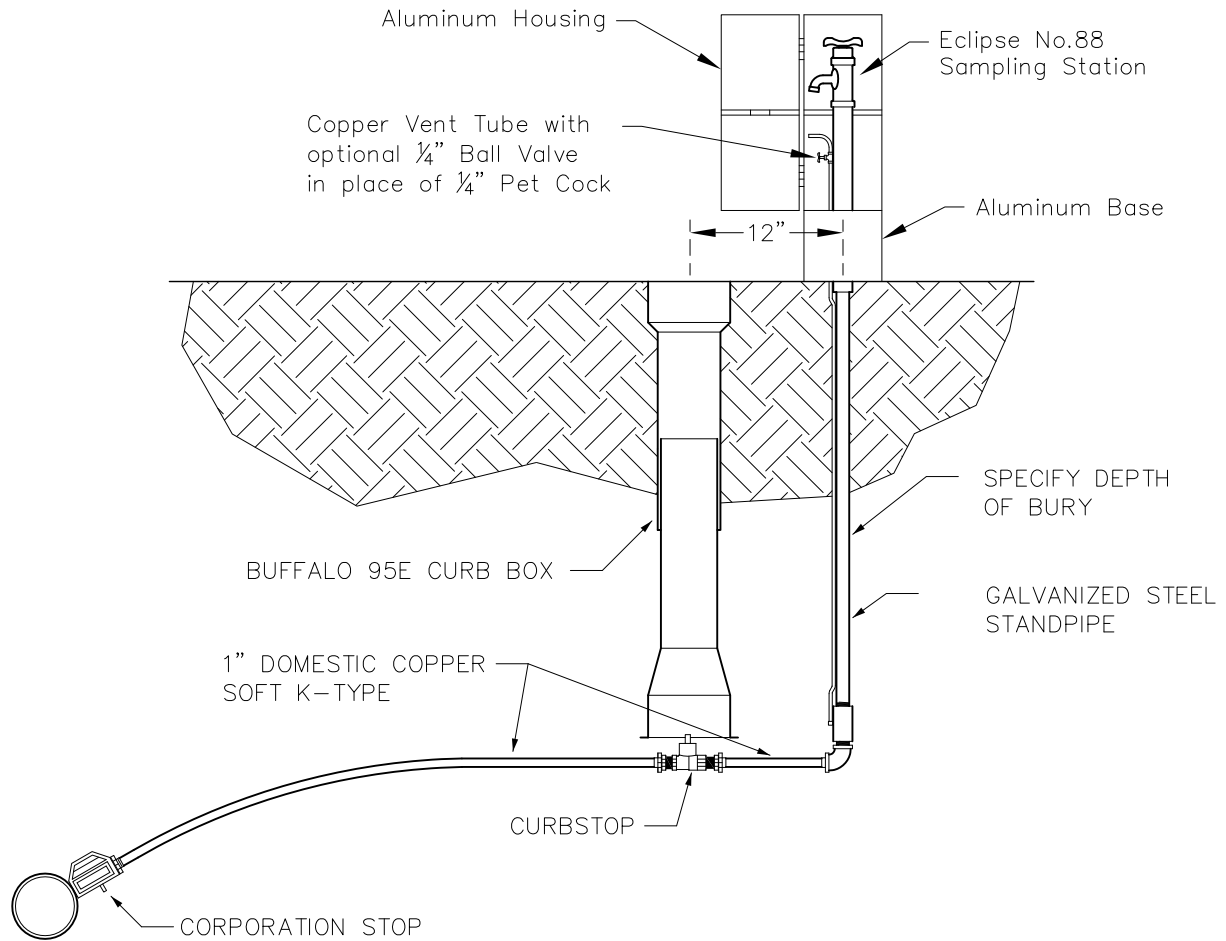
DRAWING NO. WA-6  
 SCALE: NOT TO SCALE  
 DRAWN: MAY 2002 BY: JBS



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STOP VALVE REQUIRED IMMEDIATELY  
AFTER SERVICE ENTERS BUILDING.

NOTES:

1. SAMPLING STATION SHALL HAVE 48" COVER, WITH A 1" FIP INLET, AND A 1" HOSE OR UNTHREADED NOZZLE.
2. ALL STATIONS SHALL BE ENCLOSED IN A LOCKABLE, NONREMOVABLE, ALUMINUM-CAST HOUSING.
3. ALL WORKING PARTS WILL ALSO BE OF BRASS AND BE REMOVABLE FROM ABOVE GROUND WITH NO DIGGING. EXTERIOR PIPING SHALL BE GALVANIZED STEEL (BRASS PIPE ALSO AVAILABLE).
4. A COPPER VENT TUBE WILL ENABLE EACH STATION TO BE PUMPED FREE OF STANDING WATER TO PREVENT FREEZING AND TO MINIMIZE BACTERIA GROWTH.
5. ECLIPSE NO.88 SAMPLING STATION SHALL BE MANUFACTURED BY KUPFERLE FOUNDRY, ST. LOUIS, MO 63102.

NO.	DATE	REVISIONS
1	4/07	EDIT NOTES
2	5/13	Convert-AutoCAD

SAMPLING STATION (ELEVATION)  
(Sheet 1 of 2)

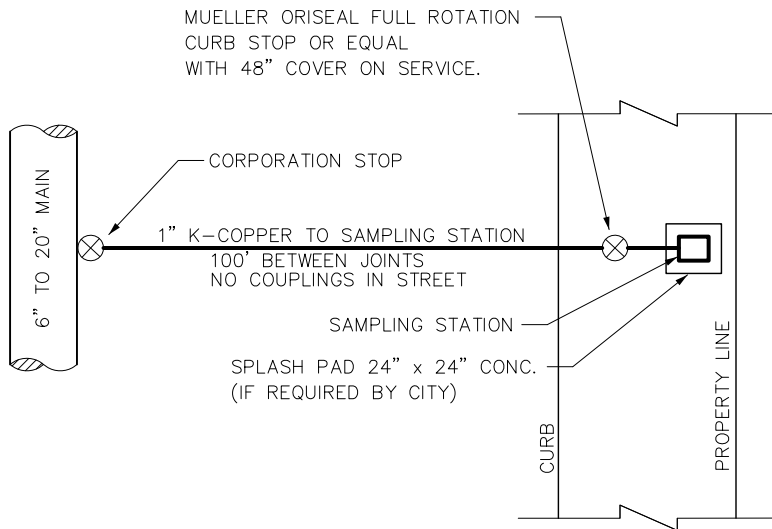
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SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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NO.	DATE	REVISIONS
1	5/13	Convert-AutoCAD

SAMPLING STATION (ELEVATION)  
(Sheet 2 of 2)

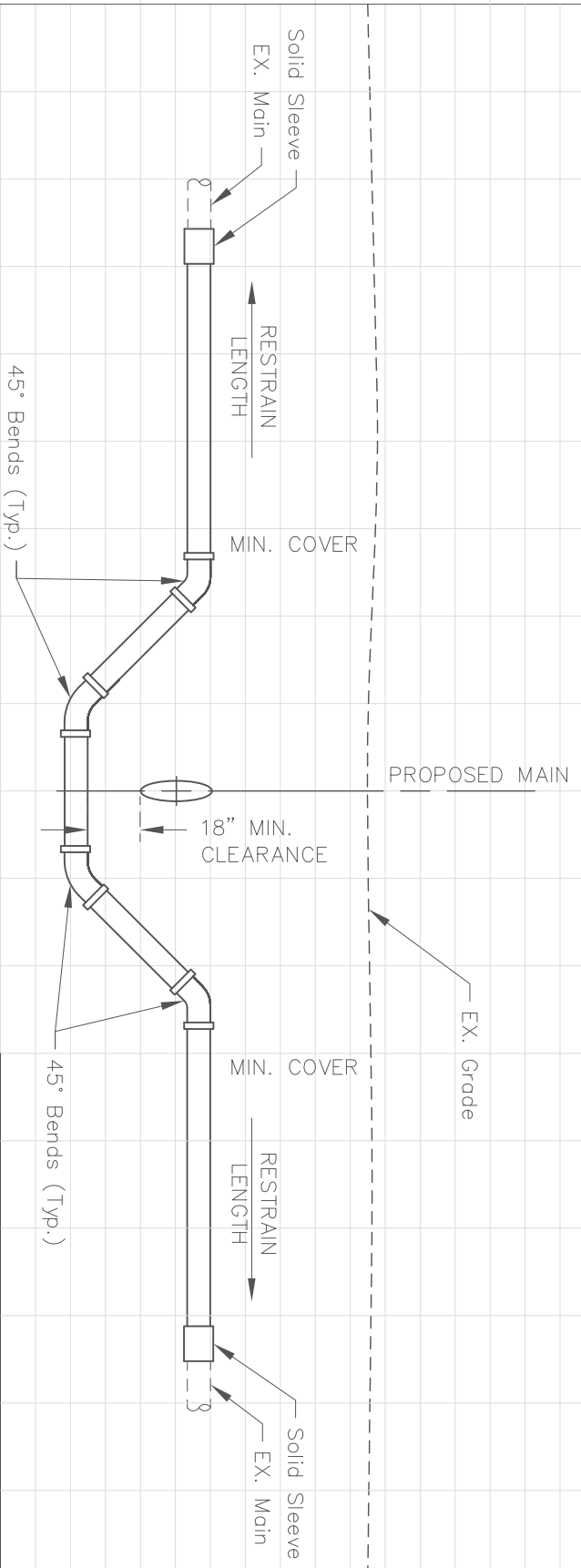
DRAWING NO. WA-7  
SCALE: NOT TO SCALE  
DRAWN: MAY 2002 BY: JBS



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NOTE: RESTRAIN ALL NEW JOINTS.

MAIN SIZE	RESTRAIN LENGTH (EACH SIDE OF 45° BENDS)
8"	19'
10"	22'
12"	25'
16"	33'

WATER MAIN LOWERING (TYPICAL)

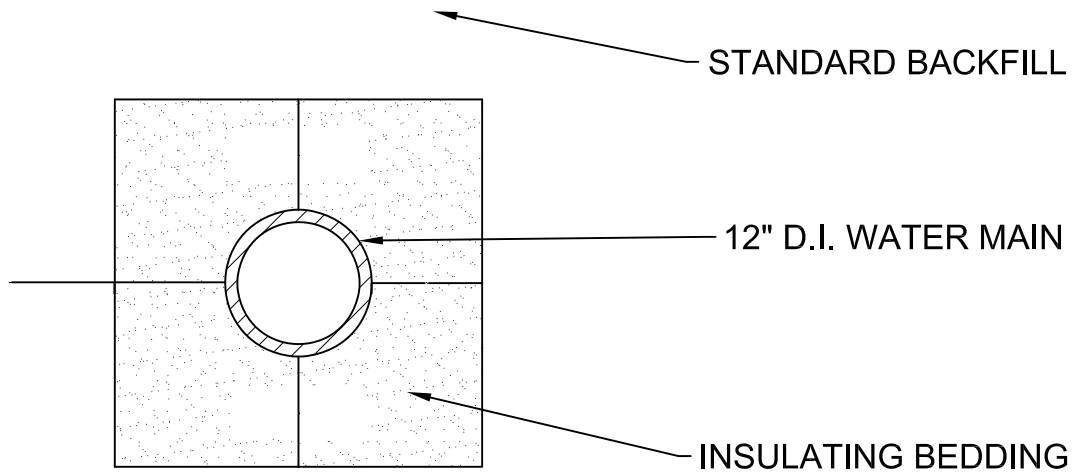
NO.	DATE	REVISIONS
1	5/13	Convert - AutoCAD

DRAWING NO. WA-8  
 SCALE: NOT TO SCALE  
 DRAWN: January 2001 BY: JBS

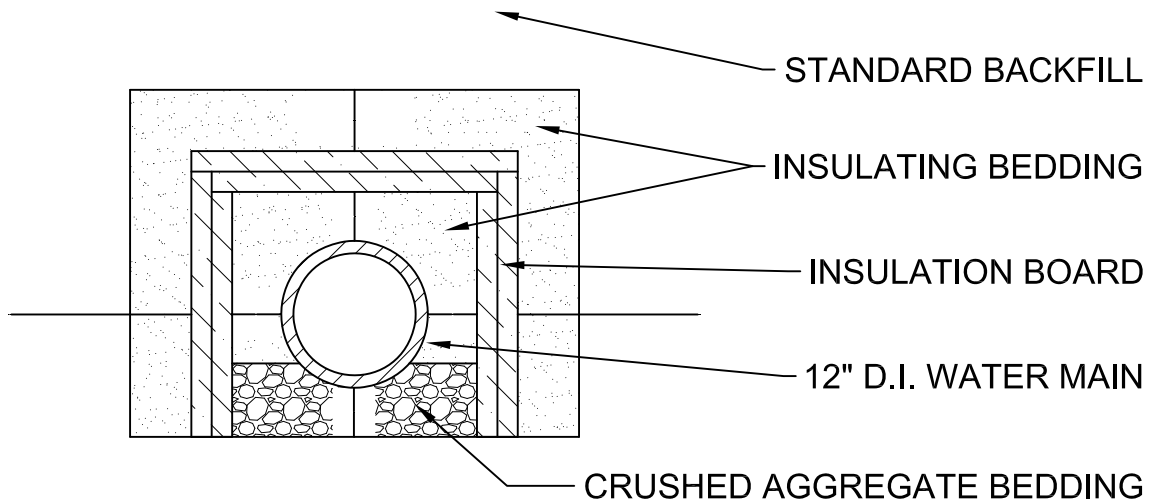


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TYPE 1: FOR COVER LESS THAN 54"



TYPE 2: FOR COVER LESS THAN 32"

**NOTES:**


1. INSULATING BEDDING MATERIAL SHALL BE "GILSULATE® 500-XR" BACKFILL OR APPROVED EQUAL.

2. INSULATION BOARD SHALL BE CLOSED CELL, EXTRUDED POLYSTYRENE FOAM MEETING ASTM 578, TYPE VI, 40 PSI COMPRESSING STRENGTH (ASTM D1621) 0.1% MAX. WATER ABSORPTION (ASTM C272). USE 2 - 2" THICK BOARDS. EXTEND SIDE BOARDS TO A DEPTH 6" BELOW BOTTOM OF THE PIPE. OVERLAP ALL INSULATION BOARD JOINTS. MASTIC AT ALL JOINTS.

NO.	DATE	REVISIONS
1	1/23	Convert-AutoCAD

FROST PROOFING DETAIL


DRAWING NO. WA-9  
 SCALE: NOT TO SCALE  
 DRAWN: JANUARY 2023 BY: ND



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