City of Auburn

Water Resource Management Design and Construction Manual

The City of Auburn, Alabama

Revised December 2014

Water Resource Management Design and Construction Manual

Prepared for

City of Auburn, Alabama

Revised December 2014

CH2MHILL

4121 Carmichael Road
Montgomery, Alabama 36106

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General Information

1.1 Introduction

The Auburn Water Resource Management (WRM) Department Design and Construction Manual (Manual) has been prepared to provide an understanding of the requirements of the WRM Department and to assist in providing the basis for consistent design standards and policies. It sets forth requirements and policies that should be followed to expedite the processing and approval of projects. This Manual also sets forth the minimum requirements for designing and constructing water, sewer, and erosion and sediment control facilities.

1.1.1 Purpose of the Manual

The purpose of the Manual is to provide the requirements for engineering design and construction of projects within the City of Auburn (City) and its planning jurisdiction, as applicable to water distribution services provided by the Water Works Board of the City of Auburn (AWWB), wastewater collection services provided by the City, and stormwater quality management. Also, the Manual addresses the objective of protecting the public health, safety and welfare by focusing on sound design and construction requirements.

The Manual consolidates the regulatory requirements of the City. Due to the authoritative and legal nature of some of these documents, it is important to note that this Manual will not, wholly, function as a substitute nor is it intended to replace some regulations. It is intended to complement existing ordinances and policies with the intent of helping the City in maintaining current technical standards pertinent to engineering design and construction.

1.1.2 Use of the Manual

This Manual establishes the standards and requirements governing the quality of design and construction that must be adhered to in preparing plans and constructing improvements for projects. Those doing business with the City are required to use this Manual to ensure compliance with all applicable design and construction standards.

In using the Manual, it should be recognized that compliance with the Manual's standards and requirements may not meet all conditions and requirements necessary for approval of a project. Other City departments, as well as state and federal agencies, may have requirements other than those contained in the Manual that must be addressed to obtain approval.

The Manual is not intended to hinder good engineering judgment or creative and innovative efforts; however, any deviations from the requirements of the Manual are subject to approval by the WRM Department Director.

1.1.3 Authority

The WRM Department is responsible for the protection and management of water resources within the City in three principal areas of service, as follows:

1. Potable water treatment and distribution services provided by the AWWB.

2. Wastewater treatment and collection services provided by the City.
3. Stormwater quality management, erosion and sedimentation control, and Best Management Practice (BMP) implementation within the City.

Therefore, the WRM Department has adopted this Manual as the primary guide for design and construction of projects as appropriate for work under these areas.

This Manual is established in pursuance of the authority conferred by Resolution No. 10-232 of the City Council of the City of Auburn, Alabama, which was adopted on November 2, 2010; and by the AWWB, which was adopted on November 18, 2010; and is effective as of January 1, 2011.

1.1.4 Fines and Penalties

Any person committing an offense within the corporate limits of the City, which is in violation of this Manual existing or hereafter enacted, shall, upon conviction, be punished by a fine of not more than five hundred dollars ($500). In addition thereto, any person so convicted may be imprisoned or sentenced to hard labor for the City for a period not exceeding six (6) months, at the discretion of the court trying the case. However, no penalty shall consist of a fine or sentence of imprisonment exceeding the maximum fine or sentence of imprisonment established under state law for the commission of substantially similar offenses. The penalty imposed on a corporation shall consist of the fine only, plus costs of court. Each day's violation shall constitute a separate offense unless otherwise provided.

1.2 Abbreviations, Acronyms, and Definitions

1.2.1 Purpose

It is the purpose of this section to define words, terms, and phrases contained within this Manual. In the event that a term is not listed in this section; or is not defined elsewhere in the Zoning Ordinance, the City Code, the Subdivision Regulations, or Sections 11-52-30 through 11-52-36 of the 1975 Code of Alabama, as amended; then the conventional meaning of such term shall apply.

1.2.2 Word Usage

The present tense includes the future tense and the future tense includes the present tense. The singular number includes the plural, and words in the plural number include the singular. The word "shall" or "must" is mandatory. The word "may" is permissive and indicates an action or choice that is usually beneficial. The word "lot" includes plot or parcel and the word "building" includes structure.

Where any word specifically defined in the Zoning Ordinance, Subdivision Regulations or other codes of the City is used in this Manual but not specifically defined herein, then the definition contained in the applicable ordinance or code shall apply.

Any confusion or questions regarding the definition of a term used in this Manual or a conflict with the definition as used in other City ordinances or codes shall be decided by the WRM Department Director, who shall have the right to interpret the definition of any word.

1.2.3 Abbreviations and Acronyms

The following abbreviations and acronyms are referenced within the Manual and are intended to have the following meanings:

AASHTO	American Association of State Highway and Transportation Officials
AC	Acre
ac-ft	acre-feet
A_f	surface area of the filter bed
ADEM	Alabama Department of Environmental Management
ADF	average daily flow
ALDOT	Alabama Department of Transportation
ALOA	Auburn, Lee County, Opelika, and Auburn University
ANSI	American National Standard Institute
ARV	air release valve
AWWA	American Water Works Association
AWWB	Water Works Board of the City of Auburn
BMP	best management practice

BOD_5	5-day biochemical oxygen demand
BWA	Beauregard Water Authority
C	critical
CBMPP	Construction Best Management Practices Plan
CD	compact disk
CEP	construction exit pad
cfs	cubic feet per second
CN	curve number
COD	Conservation Overlay District
CPv	channel protection volume
CWP	Center for Watershed Protection
CWA	Clean Water Act
DCBA	double check backflow assembly
DO	dissolved oxygen
DRT	Development Review Team
ECB	erosion control blanket
ED	extended detention
EPA	U.S. Environmental Protection Agency
EPDM	ethylene-propylene-diene M-class rubber
ESC	Erosion and Sediment Control Ordinance
FEMA	Federal Emergency Management Agency
fps	feet per second
ft	feet
ft/day	feet per day
ft/sec	feet per second
ft^2	square feet
ft^3	cubic feet
GA	general application
GFI	ground fault interrupter
GIS	geographic information system

gpd	gallons per day
gpm	gallons per minute
GPS	global positioning system
H:V	horizontal:vertical
HDPE	high-density polyethylene
hp	horsepower
Hz	Hertz
IEEE	Institute of Electrical and Electronics Engineers
in./hr	inches per hour
ISO	Insurance Services Office
IFC	International Fire Code
IPC	International Plumbing Code
ISR	impervious surface ratio
k	coefficient of permeability
kHz	kilohertz
LA	limited application
LEED	Leadership in Environmental and Energy Design
LID	low-impact development
LWA	Loachapoka Water Authority
mA	milliamp
Manual	*Water Resource Management Design and Construction Manual*
MG	million gallons
mg/L	milligrams per liter
mm	millimeter
MOV	metal oxide varistor
MS4	municipal separate storm sewer system
NAD	North American Datum
NAVD	North American Vertical Datum
NC	noncritical
NEC	National Electrical Code

NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
NTU	nephelometric turbidity unit
O&G	oil and grease
O&M	operation and maintenance
PAM	polyacrylamide
PE	Professional Engineer
PLS	Professional Land Surveyor
PMP	Probable Maximum Precipitation
ppm	parts per million
PRV	pressure-reducing valve
psf	pounds per square foot
psi	pounds per square inch
PVC	polyvinyl chloride
QCI	Qualified Credentialed Inspector
QCP	Qualified Credentialed Professional
Qf	100-year storm event
Qp25	overbank flood protection
Qwq	peak discharge
Qwr	water quality stream
ROW	right-of-way
rpm	revolutions per minute
RPBA	reduced pressure backflow assembly
RTK	real time kinematic
SCADA	supervisory control and data acquisition
SCS	Soil Conservation Service

sec	seconds
SF	square feet
tc	time of concentration
TDCBA	testable double check backflow assembly
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
TR	Technical Release
TSS	total suspended solids
UL	Underwriters Laboratories, Inc.
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
V	volt
VAC	volts alternating current
WQv	water quality volume
WRM	Water Resource Management

1.2.4 Definitions

When used, the following terms shall have the meanings herein ascribed to them:

ADEM: Alabama Department of Environmental Management. State regulatory agency charged with protecting water quality in the State of Alabama.

Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas (Alabama Handbook): Manual that provides standard design and construction guidelines for erosion and sediment control best management practices in Alabama.

ANSI: American National Standards Institute (ANSI), originally known as the American Standards Association published procedures in 1949. This activity of the American Association of Nurserymen, Inc. developed the first standardized system of sizing and describing plants to facilitate trade in nursery stock in the 1920's.

Alternative Grease Removal Technology or Device: Any approved device, other than a conventional grease trap, engineered to collect, contain, or remove food wastes and FOG from the wastewater prior to discharge into the public sanitary sewer collection system. Typically used in applications where grease traps are considered unfeasible. Such devises shall include an automatic grease recovery mechanism. Small volume, passive interceptors shall not be an acceptable alternative grease removal device.

Applicant: One (1) individual who is duly authorized to submit development plans for review, request waivers or changes in zoning classification, and apply for any form of development approval with respect to a development site. An applicant may be the property owner(s), or any person having written authority from the property owner(s). This written authority shall be provided in any form that the Planning Director and/or the City Engineer determine to be appropriate.

Application for Development: The application forms and all accompanying documents required by these regulations or other regulations for the approval of subdivision plans or site plans.

Apron: A platform below a storm drain outlet to protect against erosion. Also used to describe the area outside of the formed invert in the bottom of a sanitary sewer manhole, which is typically sloped from the walls of the manhole to the invert.

Backflow Protection Device: A device installed on all connections to a public water supply system used for domestic, irrigation, or fire protection services which prevents cross-contamination, backsiphonage, backpressure, or any other type backflow into the public water supply system. The type of device required for an individual connection is specified based on the degree of hazard that exists if a contamination occurs from the private source.

Backwater Valve: A device installed on sanitary sewer laterals to prevent sanitary sewer overflows from entering a structure.

Baffle Wall: A flat board or plate, deflector, guide, or similar device constructed or placed in flowing water or storm water storage systems to cause more uniform flow velocities, and to divert or guide liquids.

Best Management Practices: A physical, structural or managerial practice, which has gained general acceptance for its ability to prevent or reduce environmental impacts.

Calendar Day: Every day shown on the calendar, beginning and ending at midnight, Sundays and holidays included.

Capital Improvements Program (CIP): Potential capital projects based on goals established by the City Council and the AWWB and on established standards for the appropriate provision of services, regulatory compliance, and availability of funds. The CIP outlines a schedule for the expenditure of enterprise funds for public physical improvements. It consists of two components: a capital budget, which lists and describes the capital projects to be undertaken during the coming fiscal year, and a capital program, which lists and describes the capital projects proposed to be undertaken during each of the following six (6) years. The CIP is monitored continuously and updated every two years as part of the City's and the AWWB's biennial budgetary process and is subject to change.

Certified Survey: The orderly process of determining data relating to the physical characteristics of the earth, the primary purpose of which includes, but is not limited to, determining the perimeter of a parcel or tract of land by establishing or re-establishing corners, monuments, and boundary lines for the purpose of describing and locating fixed points, which has been signed and sealed by a professional surveyor licensed in the State of Alabama according to the standards of practice for surveying in the State of Alabama.

City: The City of Auburn, Alabama.

City Attorney: The licensed attorney designated by the City Council to furnish legal assistance in the administration and enforcement of these regulations.

City Council: The City Council of the City of Auburn, Alabama.

Collection System: A pressurized or non pressurized piping network capable of conveying waste water to a Water Pollution Control Facility or storm water to an appropriate discharge point.

Concept Plan: A generalized plan showing the entire development site of a conservation subdivision and meeting the requirements of the Auburn Subdivision Regulations.

Conservation Subdivision: A development design technique that concentrates buildings on a part of the site to allow the remaining land to be used for open space or preservation of environmentally sensitive areas. The open space may be owned by either a private or public entity.

Constructed Wetland: Wetlands constructed specifically for the purpose of treating stormwater before re-entering a stream or other body of water or being allowed to percolate into the groundwater.

Construction Best Management Practices Plan (CBMPP): A plan designed and sealed by a licensed professional engineer in the state of Alabama, or a QCP, that details erosion and sediment control best management practices to be installed on a construction site to minimize erosion and protect water quality.

Contaminant: Any substance that will impair the quality of the water to a degree that it creates a serious health hazard to the public leading to the poisoning or spread of disease.

Contiguous Area: Any property adjacent to a development site and that would be immediately affected by extension of water and/or sanitary sewer service through a property.

County: Lee County

Cover: The straight line distance between the top of a utility pipe to the ground surface in any location.

Crown: The vertex of an arch or arched surface (i.e., the top of a pipe).

Curve Number (CN): A number between 0 and 100 that indicates the runoff-producing potential of a soil/vegetation combination when the ground is not frozen.

Cul-de-sac: A local street with one outlet and having an appropriate terminal for the safe and convenient reversal of traffic movement.

Design Storm: The rainfall or precipitation amount and distribution adopted over a given drainage area.

Design Storm Flows: A storm whose magnitude, rate, and intensity do not exceed the design load for a storm drainage system or flood protection project.

Detention Basin (Pond): A relatively small storage lagoon for slowing stormwater runoff, generally filled with water for only a short period of time after a heavy rainfall.

Developer: The legal or beneficial owner(s) of a lot or parcel or any land proposed for inclusion in a development, including the holder of an option, contract to purchase, or a lease.

Development: The division of a parcel of land into two (2) or more parcels (See Subdivision); the construction, reconstruction, conversion, structural alteration, relocation, or enlargement of any buildings; any use or change in use of any buildings or land; any extension of any use of land or any clearing, grading, or other movement of land, for which an approved development plan is required pursuant to the Zoning Ordinance or other regulations, codes and ordinances of the City.

Development Agreement: A written contract between the City and a developer that articulates infrastructure commitments and off-site improvements necessary to maintain an appropriate level of service standard and mitigate impacts of a particular development. These commitments include, but are not limited to, improvements to ensure that adequate water, sewer, stormwater detention/retention, and traffic infrastructure capacities are maintained and protected. This agreement is binding on the developer and its successors and assigns.

Development Phase: A portion, part or geographical area within a development site that constitutes a stage of the development project with each stage being capable of existing independently of the other stages.

Development Review Team (DRT): A team of City officials responsible for the review and approval of all engineering/construction plans involved with development within the City of Auburn. The team consists of the Assistant City Manager, Public Safety Director, Planning Director, Public Works Director, Water Resource Management Director, and the Director of Environmental Services or designee.

Development Site: One (1) or more parcels of land included in a single development plan, and preferably under common ownership, which constitute the entire area of development shown on a site plan or subdivision plat. The development site must include all land needed for required open space, buffer yards, landscaping, parking (except as provided for in the Zoning Ordinance), internal access roads or driveways, and other physical design features needed to serve the proposed development.

Distribution System: A pressurized piping network capable of delivering potable water and fire protection services through underground water mains to individual customer connections.

Drainage: The removal of surface water or ground water from land by drains, grading, or other means. Drainage includes the control of runoff to minimize erosion and sedimentation during and after development and includes the means necessary for water-supply preservation or prevention or alleviation of flooding.

Drainageway: Minor watercourses, ravines, and ditches, natural or man-made, which are defined either by soil type or the presence of intermittent or perennial streams.

Drawings: All officially approved plans, which are on file with the City, or exact reproductions thereof, showing alignment, layout and design of structures, profiles, typical cross-sections, accessory features, and particular location, character, dimensions, and details of the work covered by the contract or included in a project.

Easement: The privilege or right of one property owner making limited use of another property owner's adjacent property.

Easement, Public: An easement intended to accommodate utilities and/or drainage facilities; or to provide public access to pedestrian ways, bikeways, greenways, public parks and other public facilities. Such easements shall be accepted for dedication by resolution of the City Council or the AWWB.

Energy Dissipation: Any loss of energy due to change in flow paths, generally by conversion into heat; quantitatively, the rate at which this loss occurs.

Energy Gradient: Total available energy in a system including potential and kinetic energy.

Engineer: The company or person designated by the Developer, Owner, or City acting within the scope of authority and/or the particular duties entrusted to him for engineering design and inspection services.

Engineering Plan: Plans prepared by a registered engineer in the State of Alabama showing details of the design and construction of required improvements in a proposed subdivision and/or site.

Erosion: The process by which rain, running water, waves, moving ice, and wind dislodge the upper layers of soil. As usually employed, the term includes weathering, solution, corrosion, and transportation.

Erosion Control: Measures and actions which are to be taken to control potential erosion and sedimentation problems.

ESC Ordinance: City Ordinance that regulates erosion and sediment control practices in the City of Auburn.

Fats, Oils, and Grease (FOG): Organic polar compounds derived from animal and/or plant sources that contain multiple carbon chain triglyceride molecules. These substances are detectable and measurable using analytical test procedures established in 40 CFR 136.

Fire Line: Any unmetered connection to the AWWB's distribution system that serves sprinklers, private hydrants, standpipes, and fire pumps, for the purpose of supplying water for fire protection.

Fixture Unit: Equal to one cubic foot of water (approximately 7.48 gallons) per minute.

Fixture Unit Value: A number assigned by the applicable plumbing code for each type of plumbing fixture based off of a standard fixture unit indicating the flow requirements for the specific fixture.

Floodplain: Any land area susceptible to flooding

Floodway: The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge a base flood without cumulatively increasing the water surface elevation more than a designated height.

Food Service Facility (FSF): Any restaurant, eatery, food caterer, cafeteria, or institution which cuts, processes, cooks, bakes, prepares, serves, or makes available for consumption any food products, or which disposes of food related wastes.

Freeboard: The vertical distance between a design maximum water level and the top of a structure such as a channel, dike, floodwall, dam, or other control surface. The freeboard is a safety factor intended to accommodate the possible effect of unpredictable obstructions, such as ice accumulations and debris blockage that could increase stages above the design water surface.

Geographic Information System (GIS): The City's organized collection of computer hardware, software, geographic data, and personnel designated to efficiently capture, store, update, manipulate, analyze and display forms of geographically referenced information.

Geotextile: A fabric made from petroleum products or fiberglass. It has four major uses; drainage, filtration, separation, and reinforcement.

Grade: The slope of land or stream bed or a built feature such as a conveyance pipe, specified in percentage terms.

Gravity Flow: The downhill flow of water or sanitary sewage through a system of pipes, generated by the force of gravity.

Grease Trap: An approved device designed to collect, contain, or remove food wastes and FOG from the wastewater prior to discharge to the public sanitary sewer collection system. These devices shall consist of large containment boxes, commonly located outside of a facility, equipped with the appropriate inspection manholes, sampling ports, and baffle design and shall be capable of providing an adequate retention time inside the device for the intended use in accordance with the current City design standards. Small volume, passive interceptors shall not be an acceptable means of protection for FOG entering the public sanitary sewer collection system.

Greenway: Interconnected corridors of natural land, preserved as open space, which follow natural, water, or man-made features. They connect people and places together, and when they include trails, they provide routes for alternative non-motorized transportation; a specific type of greenspace.

Habitable Structure: Any building or structure primarily designed for human occupancy.

Hundred (100) Year Flood: Flood created by a 100-year rainfall event; a storm having a one percent chance of being equaled or exceeded in any given year.

Hundred (100) Year Floodplain: The area of land inundated as a result of the 100-year rainfall event.

Hydraulic Grade Line: The measure of flow energy represented by the total head available to a fluid (energy gradient) minus the velocity head. If the hydraulic grade line is above the crown of the pipe, pressure flow conditions exist.

Hydraulic Radius: The cross-sectional area of a stream of water or pipe divided by the length of that part of its periphery in contact with its containing conduit; the ratio of area to wetted perimeter.

Hydrograph: A graph showing stage, flow, velocity, or other hydraulic properties of water with respect to time for a particular point on a stream.

Hydrologic Soil Group: The classification of soils by their reference to the intake rate of infiltration of water, which is influenced by texture, organic matter content, stability of the soil aggregates, and soil horizon development.

Impervious Surface: A surface that does not absorb water. Buildings, parking areas, driveways, roads, sidewalks, and any areas of concrete or asphalt are impervious surfaces.

Impervious surface ratio (ISR): A measure of the intensity of land use, which is determined by dividing the total area of all impervious surfaces on a development site by the total area of the site.

Imperviousness: The portion of a sub-basin, sub-watershed, or watershed, expressed as a percentage, which is covered by surfaces such as roof tops, parking lots, sidewalks, driveways, streets, and highways.

Infiltration: The process whereby the downward movement of precipitation is interrupted and redistributed.

Infiltration Capacity: The maximum rate at which the soil, when in a given condition, can absorb falling rain or melting snow.

Infrastructure: Facilities and services needed to sustain industrial, residential, and commercial activities. Infrastructure may include, but not be limited to, water and sewer lines, streets, communication lines, drainage facilities, and utilities.

Invert: The floor or bottom of a conduit, junction box, inlet, and manhole.

Lakes and Ponds: Natural or artificial bodies of water which retain water year round. A lake is a body of water of two (2) or more acres. A pond is a body of water of less than two (2) acres. Artificial ponds may be created by dams or may result from excavation. The shoreline of such bodies of water shall be measured from the maximum condition rather than from the permanent pool in the event of any difference.

Lot: A parcel of land occupied by, or designated to be developed for one (1) or more buildings or principal uses, and the accessory buildings or uses customarily incidental to such uses including such open spaces and yards as are designed and arranged or required by this Manual for such building, use or development (See also Development Site).

Lot Frontage: Lot width measured at the street lot line.

Lot Line: A line bounding a lot which divides one lot from another or forms a street or any other public or private space.

Main: See Sanitary Sewer Gravity Main, Sanitary Sewer Force Main, and Water Main

Manhole Height: Vertical distance between the exiting invert elevation and the rim elevation of a manhole.

Master Development Plan: A conceptual plan, meeting the requirements of the Zoning Ordinance and depicting a mixture of land uses, showing an entire development site and all component stages or phases which express the overall development concept for the site at buildout.

Monument: A permanent object serving to indicate a limit to or mark a boundary.

Nomograph: A chart that represents an equation containing three variables by means of three scales so that a straight line cuts the three scales in values of the three variables, thus satisfying the equation.

NRCS Curve Number (CN) Method: Relates soil type, soil cover, land use type, and antecedent moisture conditions to a curve number. Used to determine the depth of runoff for a given area.

Oil and Grit Separator: A receptacle designed for the collection of oils and greases commonly associated with car washes, equipment wash bays, automotive service stations, mechanical service stations and garages and the accumulation, separation, and removal of sand, grit, rocks and other similar debris.

Orifice: As used in water studies, an opening with a closed perimeter, usually sharp edged and of regular form in a plate wall or partition through which water may flow. An orifice is used for the measurement or control of water. This term is also used to describe the area used for intake and evacuation of air in an air release valve (ARV).

Owner: A person who, or entity which, alone, jointly or severally with others, or in a representative capacity (including, without limitation, an authorized agent, attorney, personal representative or trustee) have legal or equitable title to any property in question.

Parcel: See Lot, Development Site.

Peak Flow: The maximum anticipated flow rate.

Peak Demand: The maximum amount of treated water required to serve a development through a connection to the public water supply system, typically determined by fixture count values.

Planning Commission: The Auburn Planning Commission created by the City of Auburn under the authority of Chapter 52, Article 1, of the Code of Alabama, 1975, as amended.

Plans: See Drawings

Plat:

> **Preliminary Plat:** A map and related materials indicating the proposed layout of a development, including all proposed easements submitted for preliminary approval in accordance with all requirements.
>
> **Final Plat:** The map or plan or record of all or a portion of a subdivision, including all permanent easements, and any accompanying materials presented for final approval and recording as required.

Pollutant: Any foreign substance, that if permitted to get into the public water system, will degrade its quality so as to constitute a moderate hazard, or impair the usefulness or quality of the water to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably effect such water for domestic use.

Pond: See Lakes and Ponds.

Ponding: The natural formation of a pond in a stream by an interruption of the normal streamflow.

Project Manager/Inspector: An authorized representative of the City or Engineer, assigned to review any or all portions of materials furnished and work performed by the Contractor.

Qualified Credentialed Inspector (QCI): An operator, operator employee, or operator designated qualified person who has successfully completed initial training and annual refresher Qualified Credentialed Inspection Program (QCIP) training in the State of Alabama, and holds a valid certification from an ADEM approved cooperating training entity.

Qualified Credentialed Professional (QCP): A Professional Engineer, an Alabama Natural Resources Conservation Service professional designated by the State Conservationist, or a Certified Professional in Erosion and Sediment Control (CPESC). A QCP includes a registered landscape architect, a registered land surveyor, a Professional Geologist, a registered forester, a Registered Environmental Manager as determined by the National Registry of Environmental Professionals (NREP), and a Certified Professional Soil Scientist (CPSSc) as determined by ARCPACS, and other ADEM accepted professional designations, certifications, and/or accredited university programs that can document requirements regarding proven training, relevant experience, and continuing education, that enable recognized individuals to prepare CBMPPs, to make sound professional judgments regarding Alabama NPDES rules, the requirements of this Chapter, planning, design, implementation, maintenance, and inspection of construction sites, receiving waters, BMPs, remediation/cleanup of accumulated offsite pollutants from the regulated site, and reclamation or effective stormwater quality remediation of construction associated land disturbances, that meet or exceed recognized technical standards and guidelines, effective industry standard practices, and the requirements of this Chapter. The QCP shall be in good standing with the authority granting the registration or designation.

Registered Engineer: An engineer properly licensed and registered in the State of Alabama.

Registered Land Surveyor: A land surveyor properly licensed and registered in the State of Alabama.

Reserved Water Capacity: The ability of the AWWB to account for treated water availability to serve the domestic and fire protection needs of a development in both treatment capacity and conveyance. May be as a result of system upgrades required for the particular development.

Reserved Sewer Capacity: The ability of the City to account for the waste water treatment needs of a development in both treatment capacity and conveyance. May be as a result of system upgrades required for the particular development.

Residual Pressure: The system pressure in a water supply distribution system experienced during a significant flow event such as a fire-flow situation.

Retention Pond: A permanent pond used to slow storm water runoff and promote infiltration into the groundwater. See Wet Detention or Retention Pond.

Return Period: The mean number of such time units necessary to obtain a value equal to or greater than a certain value one time. For example, with a 1-year interval between observations, a return period of 100 years means that, on average, an event of this magnitude or greater is not expected to occur more often than once in 100 years.

Right-of-Way: A strip of land used or intended to be used for passage of the general public, and occupied or intended to be occupied by a street, road, bicycle path, pedestrian way, crosswalk, utilities, railroad or similar facility; and dedicated to public use through acceptance by the City Council.

Roadway: The portion of a right-of-way intended for use by vehicular and bicycle traffic.

Sanitary Sewer Gravity Main: Any section of a nonpressurized conveyance piping system, owned and maintained by the City of Auburn, used to collect public sanitary sewer and transport to a Water Pollution Control Facility.

Sanitary Sewer Force Main: Any section of a pressurized conveyance piping system, owned and maintained by the City of Auburn, extending from a sanitary sewer pump station and used to collect public sanitary sewer and transport to a Water Pollution Control Facility.

Sanitary Sewer Service Lateral: Any connection from a privately owned residence, residential complex, business, or commercial center to the City of Auburn's public sanitary sewer collection system. Sanitary Sewer Service Laterals are privately maintained to the ROW or easement, typically to a manhole or cleanout.

Scale: The relative proportion of the size of different elements of the built environment to one another; the measurement of the relationship of one object to another.

Sediment Forebay: Stormwater design feature that employs the use of a small settling basin to settle out incoming sediments before they are delivered to a stormwater BMP. Particularly useful in tandem with infiltration devices, wet ponds, or marshes.

Sedimentation: The act or process of depositing sediment from suspension in water. All the processes whereby particles of rock material are accumulated to form sedimentary deposits. Sedimentation, as commonly used, involves not only aqueous but also glacial, aeolian, and organic agents.

Service Lateral: See Sanitary Sewer Service Lateral and Water Service Lateral.

Setback: The required minimum distance between any features or structures.

Sewer Basin: An area served by gravity sanitary sewer, which typically corresponds to the stormwater drainage watershed, except where pump stations are installed or where the line depths are such that gravity service is capable of extending outside the normal drainage divide.

Sewer Ordinance: City Ordinance, as currently amended, that regulates all discharges into the sanitary sewer collection system in the City of Auburn.

Sheet Flow: An overland flow or downslope movement of water taking the form of a thin continuous film over relatively smooth soil, grass, or rock surfaces and not concentrated into channels.

Shop Drawings: Fabrication plans for any part of the work including, but not limited to, water and sanitary mains and appurtenances, precast concrete items, structural steel items, or other metal items, and connections thereof, which the contractor is required to submit to the Engineer.

Sidewalk: A paved path provided for pedestrian use.

Siltation: The deposition of finely divided soil and rock particles upon the bottom of stream and river beds and in reservoirs.

Site Plan: A plan, drawn to scale by a licensed engineer or other qualified professional, showing uses, structures, and all other physical features proposed for the development site, including bufferyards, parking, landscaping, and drainage facilities, in accordance with the requirements of the Zoning Ordinance.

Specifications: Written technical and other requirements for the Work, prepared by or on behalf of the City, which are on file with the City, containing directions, provisions, and technical and general requirements for the Work, together with such as may be added as Supplemental Specifications or Provisions.

Standard Details or Drawings: Drawings approved for repetitive use, showing details to be used where appropriate.

Standard Specifications: A book of specifications approved for general application and repetitive use.

State: The State of Alabama.

Static Pressure: The system pressure in a water supply distribution system experienced during normal operating conditions.

Steep Slopes: Land surface inclination as categorized in Section 4.3.1.1., unless otherwise specified. Surface inclination and slope is determined from on-site topographic surveys prepared with a two-foot contour interval.

Storm Water Phase II: The federal regulations requiring smaller communities to address storm water management and requiring coverage by a National Pollutant Discharge Elimination System (NPDES) permit.

Stream, Ephemeral: A stream channel or reach of stream channel that carries surface water runoff for short durations as a result of precipitation events. The channel bottom is always above the groundwater table.

Stream, Intermittent: A stream that flows at least six months out of a year but does not flow during part or all of the summer and may carry water during or after a rainstorm.

Stream, Perennial: A natural watercourse which contains flowing water, year around.

Subcontractor: Any properly qualified individual, firm, or corporation undertaking the performance of any part of the Work under the terms of the Contract, by virtue of any agreement between himself and the Contractor.

Subdivision: Any division, redivision, or consolidation of a tract, parcel, or lot of land by means of mapping, platting, conveyance, change or rearrangement of boundaries in accordance with the Subdivision Regulations. All subdivisions are also developments (See Development).

Subdivision Jurisdiction: All land located within the corporate limits of the City and within five (5) miles thereof, and not located within the corporate limits of any other city or within the subdivision jurisdiction of any other city having a planning commission, in accordance with Chapter 52, Article 2, Section 11-52-30 of the Code of Alabama, 1975, as amended.

Subdivision Regulations: The Subdivision Regulations of the City of Auburn, Alabama.

Subgrade: The soil or rock leveled off to support the foundation of a structure or roadway.

Sump: A low-lying place, such as a pit, that receives drainage.

Surety: The corporate body, licensed under the laws of the State, bound with and for the Contractor for the acceptable performance of the Contract, and also, for the payment of claims recoverable under the Contract Bonds.

Swale: An open drainage channel used for the conveyance of stormwater.

Tap: Any connection to a water or sanitary sewer main made without requiring any section of the public utility to be taken out of service to make the connection.

Time of Concentration: The time required for water to flow from the hydraulically farthest point on the watershed to the gauging station, culvert, or other point of interest.

Transmission Main: A water main designed specifically to convey water over an extended distance, typically greater than 1000 feet, to serve an area or development with no intermediate service connections.

Waiver: Modification of certain specific design standards, dependent upon a finding by the WRM Director that extraordinary hardships or practical difficulties peculiar to the land or that such standards are inappropriate in relation to a specific development will result from strict compliance with the WRM Design and Construction Manual and/or the purposes of the WRM Design and Construction Manual may be served to a greater extent by an alternative proposal, provided that such waiver shall not have the effect of nullifying the intent and purpose of the WRM Design and Construction Manual and result in detriment to the public interest. In granting waivers, the WRM Director may impose such additional conditions as will, in its judgment, secure substantially the objectives of the requirements that are waived.

Wastewater, Sanitary Sewer, or Sewage: Any liquid waste generated from bathrooms, toilets, kitchens, home laundries, and other similar facilities.

Water Feature: Any stream, creek, pond, lake, pool, fountain, etc., either man-made or naturally occurring, that holds, stores, or conveys water in a regular manner in dry weather conditions.

Water Main: Any segment of a pressurized conveyance piping network used to distribute potable water to the public.

Water Service Lateral: Any metered connection to the AWWB's distribution system. Water Service Laterals are privately maintained from the customer's side of the backflow prevention device.

Water Supply: The system made up of water sources, treatment, and conveyance systems to provide potable water and fire protection to the community.

Waters of the State: All waters of any river, stream, watercourse, pond, lake, coastal, ground or surface water, wholly or partially within the state, natural or artificial. This does not include waters which are entirely confined and retained completely upon the property of a single individual, partnership or corporation unless such waters are used in interstate commerce.

Waters of the US: All waters included in one of the following classifications:

1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
2. All interstate waters including interstate wetlands;
3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairiepotholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:
    a. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
    b. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
    c. Which are used or could be used for industrial purposes by industries in interstate commerce;
4. All impoundments of waters otherwise defined as waters of the United States under this definition;
5. Tributaries of waters identified in paragraphs (s)(1) through (4) of this section;
6. The territorial sea;
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1) through (6) of this section; waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition) are not waters of the United States.

Watershed: A watershed is an extent of land where stormwater drains downhill into a body of water, such as a creek, river, lake, reservoir, estuary, wetland, or ocean. The watershed includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels, and is separated from adjacent watersheds by a drainage divide. The watershed acts like a funnel, collecting all the water within the area covered by the watershed and channeling it into a waterway. Each watershed is separated topographically from adjacent watersheds by a geographical barrier such as a ridge, hill or mountain, which is known as a water divide.

Weir: A device for determining the quantity of water flowing over it from measurements of the depth of water over the crest or sill and known dimensions of the device.

Wet Detention or Retention Basin (Pond): Constructed basins that have a permanent pool of water throughout the year or wet season and generally are found in locations where groundwater is high and/or percolation is poor.

Wetland: An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that, under normal circumstances, does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. (Wetlands generally include swamps, marshes, bogs, and similar areas). Standards for defining wetland boundaries consider hydrology, vegetation and soil conditions.

Zoning Ordinance: A set of land use regulations enacted by the local governing body to create districts, which permit certain land uses and prohibit others. Land uses in each district are regulated according to type, density, height and the coverage of buildings.

1.3 Development Review Process

1.3.1 Overview

Any development within the City of Auburn is classified as a site plan project or subdivision project. Based on the classification of the development, the review and approval processes may vary. This section will identify the types of developments within the City and give guidance on the type of process to be followed to receive approval. The applicant for a development should consult with the Planning Department during the early stages to obtain specific information on the review and approval process.

1.3.2 Site Plan Project

Site plan projects include all proposed non-residential construction projects, as well as certain residential development types such as multiple unit developments (apartment complexes and condominiums) and manufactured home parks. These particular developments are described in greater detail in the Zoning Ordinance. This will also include clubhouses or other ancillary facilities within a residential subdivision. Site plan approvals could require rezoning, conditional use approval and a traffic impact study; however, all site plans are presented to the Development Review Team (DRT) for approval before any construction is allowed on the site.

1.3.2.1 Rezoning

When an application to develop land involves a need for rezoning, the DRT and/or site plan approval shall not be granted prior to approval of the requested rezoning. The rezoning request and conditional use approval (if required) can be addressed at the same meeting; however, a rezoning decision must be rendered before approval of the conditional use. A request to rezone land to zoning districts specified in the Zoning Ordinance may require certain engineering analysis and/or traffic studies.

1.3.2.2 Permitted Uses

The Zoning Ordinance identifies uses which are permitted by right. It shall be the responsibility of the property owner or the owner’s authorized representative to coordinate with the Planning Department to determine that the proposed project is a permitted use that meets all provisions of the Zoning Ordinance. If the project is not a permitted use, conditional use approval is required by the City Council.

1.3.2.3 Conditional Uses

The Zoning Ordinance identifies uses which are permitted only upon approval of a conditional use application. The Planning Commission, after holding a public hearing, shall recommend that the conditional use be approved, approved with conditions or denied to the City Council. The City Council then, after holding a public hearing, either approves or denies the proposed conditional use with any additional conditions that may be imposed subject to a site plan that meets all conditions of approval.

1.3.2.4 Traffic Study

Depending on the type, size, and intensity of a development, a traffic impact study may be required. The study may be required concurrent with a rezoning request, conditional use request, or during the site plan project approval process. The guidelines for submittal of a traffic impact study are discussed in detail in the Public Works Design and Construction Manual.

1.3.2.5 Development Committee

The Development Committee is chaired by the Planning Director and is comprised of various City Department Heads including Economic Development, Public Works, Water Resource Management, Finance, the Office of City Manager, and others as needed.

Because each proposed development project is unique in terms of its infrastructure needs and requirements, the Planning Director exercises discretion in placing a project on the Development Committee agenda for its review. As a result, the Committee is convened as needed.

The Development Committee is tasked with evaluating how a proposed project will impact existing public infrastructure or necessitate additional public investment in infrastructure to accommodate the project. More specifically, the committee evaluates the infrastructure impact, availability, and immediate or future needs associated with the development; and, based on that assessment, determines the public costs associated with the provisions of new or improved public infrastructure that are only necessitated because of the proposed development.

The Development Committee is typically involved in developments proposed on recently annexed property on the outer periphery of the City. However, Development Agreements have also been required in certain instances where the project was already zoned and considered to be an "infill" use but the need for infrastructure improvements was necessary.

The Development Committee process begins once a master plan is submitted for review. The Development Committee analyzes the proposal in terms of:

- Infrastructure (roads, water, sewer, traffic control devices)
- Greenways
- Bikeways
- Environmental concerns (wetlands, creeks, etc.)
- City services (garbage/trash/recycling service, fire protection, etc.)

In most cases, the developments referred to the Development Committee will cause a "Development Agreement" to be formulated which articulates two (2) items. The first analyzes what the various impacts and expenses will be and the second depicts how those items will be addressed for the purposes of ensuring that the infrastructure needs associated with the project, and surrounding area, if appropriate, are secured.

Once the analysis is complete, the City Manager or his designee will serve as the central point of negotiation with the developer. Negotiations will address the findings of the Development Committee and identify the financial responsibilities and commitments of each party. A development agreement is then drafted which is ultimately submitted to City Council for its consideration.

It is also important to note, when a proposed development requires improvements and/or reconstruction of City-maintained infrastructure; the developer will be required to provide a

Performance Bond prior to the issuance of any permits for construction. This Performance Bond will be required to cover the costs associated with the improvements and/or reconstruction.

1.3.2.6 Engineering Plans

As part of the site plan approval process, full engineering plans are required for submission. Regardless of the size of the development, engineering plans must be approved before any work can begin on the site. Some building expansions do not require submission of full engineering plans, but those are evaluated on a case by case basis. The engineering plans must be reviewed and approved through the DRT, as outlined in Section 1.3.4 of the Manual.

1.3.3 Subdivision

The subdivision of land must be in accordance with the requirements of the Subdivision Regulations and must be approved by the Planning Commission. It is, therefore, the responsibility of the property owner or the property owner's representative to make application to the Planning Commission for approval of a proposed subdivision.

1.3.3.1 Rezoning

When an application to develop land involves a need for rezoning, the DRT and/or subdivision project approval shall not be granted prior to approval of the requested rezoning. The rezoning request and conditional use approval can be addressed at the same meeting; however, a rezoning decision must be rendered before approval of the conditional use. A request to rezone land to zoning districts specified in the Zoning Ordinance may require certain engineering analysis and/or traffic studies.

When plat approval is requested for land that must be rezoned to permit the proposed development of the land to be subdivided, the plat approval shall not be granted prior to approval of the requested rezoning (see the Zoning Ordinance). The rezoning request and subdivision plat approval can be addressed at the same meeting; however, a rezoning decision must be rendered before considering the subdivision plat.

1.3.3.2 Lot Layout Plans

The Auburn Subdivision Regulations require the submission of a Lot Layout Plan to the Planning Department prior to the submission of the Preliminary Plat for subdivisions resulting in twenty-five (25) or more lots at complete build-out.

1.3.3.3 Preliminary Plat

The information required on a preliminary plat and details of the approval process are specified in the Auburn Subdivision Regulations. Preliminary Plat approval by the Planning Commission is required prior to submitting engineering plans to the DRT for all subdivisions except Administrative Subdivisions. If the subdivision (or lot consolidation) involves dedication of right-of-way, then a preliminary plat must be approved by the Planning Commission even if it involves four (4) or less lots of record.

1.3.3.4 Engineering Plan

As part of the subdivision project approval process, full engineering plans are required for submission. Regardless of the size of the development, engineering plans must be approved before any work can begin on the site. The engineering plans must be reviewed and approved through the DRT, as outlined in Section 1.3.4 of the Manual.

1.3.3.5 Final Plat

The Subdivision Regulations sets forth the requirements and procedure for approval of a Final Plat. To be considered for approval by the Planning Commission and the City Council, the Final Plat must be certified by the City Engineer as meeting all the requirements for street and utility improvements. Prior to receiving signatures for recording of the Final Plat, all improvements must be installed to the satisfaction of the City Engineer as evidenced by a signed statement or a Performance Bond based on an approved engineering estimate of required improvements and approved to form by the City Attorney. Furthermore, any plat that contains the dedication of right-of-way must be approved by the City Council.

The Final Plat shall be accompanied by an engineer's estimate of the costs of any required improvements yet to be constructed. The engineer's estimate must include all remaining items of infrastructure plus contingency costs for erosion control/grassing, street repair, utility adjustments, and other items as deemed necessary by the City Engineer.

1.3.3.6 Bonding

If the improvements outlined above are not completed and accepted at the time the Final Plat is requested, bonding can be initiated as in the Subdivision Regulations. The bonding shall be in the form of a performance bond with a commercial surety, an irrevocable letter of credit, or a bank certificate of deposit in an amount equal to one hundred twenty-five percent (125%) of the outstanding improvements.

In addition to bonding requirements for subdivisions, any infrastructure work within right-of-way or easements that will be affected, as shown on the approved engineering plans, by a site plan project must post a Signature Bond for the affected infrastructure prior to the issuance of the Erosion and Sediment Control Permit. This can include, but is not limited to, sidewalk, curb and gutter, roadways, striping, and utility connections. A copy of the bond can be found in Appendix X of the Public Works Design and Construction Manual. A separate Completion and Warranty Bond will be required for any development that includes a sanitary sewer pump station prior to the final plat being approved in accordance with Section 3.5.11.4 of this Manual.

Infrastructure improvements for site plan projects not covered by a Development Agreement must also comply with this requirement. See Section 1.3.3.8 of this Manual for information related to Development Agreements.

1.3.3.7 Traffic Study

Depending on the type, size, and intensity of a development, a traffic impact study may be required. The study may be required concurrent with a rezoning request, conditional use request, or during the subdivision project approval process. The guidelines for submittal of a traffic impact study are discussed in detail in the Public Works Design and Construction Manual.

1.3.3.8 Development Committee

The Development Committee is chaired by the Planning Director and is comprised of various City Department Heads including Economic Development, Public Works, Water Resource Management, Finance, the Office of City Manager, and others as needed.

Because each proposed development project is unique in terms of its infrastructure needs and requirements, the Planning Director exercises discretion in placing a project on the Development Committee agenda for its review. As a result, the Committee is convened as needed.

The Development Committee is tasked with evaluating how a proposed project will impact existing public infrastructure or necessitate additional public investment in infrastructure to accommodate the project. More specifically, the committee evaluates the infrastructure impact, availability, and immediate or future needs associated with the development; and, based on that assessment, determines the public costs associated with the provisions of new or improved public infrastructure that are only necessitated because of the proposed development.

The Development Committee is typically involved in developments proposed on recently annexed property on the outer periphery of the City. However, Development Agreements have also been required in certain instances where the project was already zoned and considered to be an "infill" use but the need for infrastructure improvements was necessary.

The Development Committee process begins once a master plan is submitted for review. The committee analyzes the proposal in terms of:

- Infrastructure (roads, water, sewer, traffic control devices)
- Greenways
- Bikeways
- Environmental concerns (wetlands, creeks, etc.)
- City services (garbage/trash/recycling service, fire protection, etc.)

In most cases, the developments referred to the Development Committee will cause a "Development Agreement" to be formulated which articulates two (2) items. The first analyzes what the various impacts and expenses will be and the second depicts how those items will be addressed for the purposes of ensuring that the infrastructure needs associated with the project, and surrounding area, if appropriate, are secured.

Once the analysis is complete, the City Manager or his designee will serve as the central point of negotiation with the developer. Negotiations will address the findings of the Development Committee and identify the financial responsibilities and commitments of each party. A development agreement is then drafted which is ultimately submitted to City Council for its consideration.

It is also important to note, when a proposed development requires improvements and/or reconstruction of City-maintained infrastructure; the developer will be required to provide a Signature Bond prior to the issuance of any permits for construction as identified above.

1.3.4 Development Review Team

1.3.4.1 DRT Process Overview

The DRT will conduct a weekly meeting except where conflicts with the City holiday schedule exists. For additional information regarding the DRT meeting schedule, submittal requirements, applications, forms, and processes please visit the City's website at www.auburnalabama.org. The DRT applications are also available through the Public Works Department.

In order for an applicant's plans to be reviewed at the weekly meeting, they must submit the required number of copies of all plans and all other required documents to the Public Works Department's Plans Review Engineer at least twenty-two (22) days before the regularly scheduled meeting at which time the plans are to undergo final review. The applicant will receive, within fifteen (15) days of the submittal deadline, from the City via e-mail, a detailed list of all comments concerning the submitted documents. This will give the applicant six (6) days to address the comments before appearing before the DRT, whereby the applicant will be asked to address each comment.

If, at the first meeting, all comments are addressed to the satisfaction of the DRT then the applicant will receive ***Approval***, and the DRT Approval Form will be signed by all department representatives. If the applicant has not addressed all comments to the satisfaction of the DRT, three (3) other actions are possible.

Conditional Approval.

A conditional approval may be granted in cases where the remaining issues are few and will not require substantial review time or significant coordination with other departments. If a conditional approval is granted, it is the applicant's responsibility to address each of the remaining issues to the satisfaction of the respective departments. It is also the applicant's responsibility to obtain each remaining department's signature on the DRT Approval Form.

Continuance.

A continuance may be granted (or requested by the applicant) when there are more than a few outstanding issues and/or the outstanding issues are significant in nature. A continuance may be to a date certain but not to exceed six (6) months from the date of the initial meeting.

Denial.

A denial may be issued in situations where outstanding issues are very significant and will require a substantial amount of review time by staff. A denial may also be issued if a continuance beyond six (6) months from the date of the submittal is effectuated. If a denial is issued, the applicant must resubmit plans to the DRT and begin the process again, including the payment of all applicable fees.

1.3.4.2 Pre-Construction Meeting

Upon receiving approval and having all departments sign-off on the DRT Approval Form, the project may be scheduled for a pre-construction meeting. To schedule a pre-construction meeting, the applicant should contact the Public Works Inspections Manager. The applicant is responsible for ensuring that representatives for the following parties are present at the pre-construction meeting:

1. The general contractor
2. The contractor(s) performing the site and utility work
3. The engineer of record

Representatives from other City departments will be in attendance at the pre-construction meeting as well as representatives from various private utility companies when appropriate. Typically, a pre-construction meeting can be scheduled to occur within one week of the request.

1.3.4.3 DRT Submittal Requirements

All applications to the DRT are required to contain the following items:

Site Plan Projects - Initial Submittal:

ALWAYS REQUIRED

- DRT Application for Site Plan developments
- Four (4) sets of civil engineering construction plans
- One (1) full-size copy of the site plan
- One (1) PDF of the overall site plan
- Two (2) copies of the completed and signed Engineering Checklist
- One (1) copy of the Site Plan Sufficiency Checklist
- One (1) copy of the deed(s)
- One (1) copy of the Authorization to Act as Applicant Form

REQUIRED WHEN APPLICABLE

- One (1) stamped hard-copy, and one (1) PDF of the Drainage Report (include Drainage Report Checklist)
- One (1) copy of relevant permits (ADEM, USACE, ALDOT, etc.)
- Three (3) hard-copies, and one (1) PDF of the traffic impact study
- One (1) copy of the Pump Station Design Worksheet
- Two (2) copies of Fire Flow Calculations
- Submit electronically: Development Water and Sewer Service Application
- Submit electronically: Backflow Protection Information Form
- Submit electronically: Grease Trap Sizing Calculation Data Sheet

Site Plan Projects – Final Submittal (after approval):

- Five (5) full sets of stamped civil engineering plans
- Three (3) separate, full-size copies of the site plan

- One (1) – 11x17 reduction copy of the site plan
- One (1) copy of signed offsite easements
- One (1) copy of the recorded Stormwater Storage Facility Operation and Maintenance Agreement (submitted prior to issuance of the Certificate of Occupancy)
- One (1) – CD or DVD containing PDF files of the following:
    - Engineering plans
        - Use a separate file for each sheet
        - Name each file according to the sheet name
        - Use a minimum resolution of 300 dpi
- Final Traffic Impact Study
- Final Drainage Report
- Any other items that were revised from the initial submittal

Subdivision Projects - Initial Submittal:

ALWAYS REQUIRED

- DRT Application for Subdivision Developments
- Four (4) sets of civil engineering construction plans
- One (1) PDF of the overall street layout plan
- Two (2) copies of the completed and signed Engineering Checklist
- One (1) copy of the deed(s)
- One (1) copy of the Authorization to Act as Applicant Form

REQUIRED WHEN APPLICABLE

- One (1) stamped hard-copy, and one (1) PDF of the Drainage Report (include Drainage Report Checklist)
- One (1) copy of relevant permits (ADEM, USACE, ALDOT, etc.)
- Three (3) hard-copies, and one (1) PDF of the traffic impact study
- One (1) copy of the Pump Station Design Worksheet
- Two (2) copies of Fire Flow Calculations
- Submit electronically: Development Water and Sewer Service Application
- Submit electronically: Backflow Protection Information Form
- Submit electronically: Grease Trap Sizing Calculation Data Sheet

Subdivision Projects – Final Submittal (after approval):

- Five (5) full sets of stamped engineering plans
- One (1) copy of signed offsite easements
- One (1) copy of the recorded Stormwater Storage Facility Operation and Maintenance Agreement (submitted prior to issuance of the first Certificate of Occupancy)
- One (1) – CD or DVD containing PDF files of the following:
  - Engineering plans
    - **Use a separate file for each sheet**
    - Name each file according to the sheet name
    - Use a minimum resolution of 300 dpi
- Final Traffic Impact Study
- Final Drainage Report
- Any other items that were revised from the initial submittal

1.3.4.4 DRT Forms and Checklists

The DRT submittal will not be considered complete unless the appropriate checklists are attached, completed-in-full, and signed. It is also important to note that the checklists are not intended to be all-inclusive. Therefore the completeness of each checklist does not alleviate the obligation of the designer to meet all City codes, regulations, ordinances, and specifications. The forms and checklists are provided to expedite the review process and provide staff with the basic project information. Not all forms are required for all projects as indicated in the individual form description.

The following checklists and/or worksheets have been made part of this Manual and are attached in Appendix B and can also be found on the City's website.

- *Site Development Plans Engineering Checklist* – This checklist must be submitted with every set of engineering construction plans for site developments (conditional & permitted use projects). The checklist must be filled out entirely and signed.
- *Subdivision Construction Plans Engineering Checklist* - This checklist must be submitted with every set of engineering construction plans for subdivision improvements. The checklist must be filled out entirely and signed.
- *Development Application for Water and Sewer Services* – This application form is required to be submitted electronically for any project proposing to utilize water from the AWWB or sewer service from the City.
- *Backflow Protection Information Form* – This form shall be submitted electronically for any development that proposes to connect to the AWWB water distribution system.

- *Pump Station Calculation Worksheet* - This worksheet shall be submitted for any development that proposes to utilize a sanitary sewer pump station.
- *Grease Trap Size Calculation Data Sheet* – This form is required to be submitted electronically for any development utilizing a grease trap.

The following forms and worksheets can be found within the Public Works Design and Construction Manual.

- *Site Plan Sufficiency Checklist* – This checklist is to assist in review by the Planning Department and must be submitted with the site plan.
- *Drainage Checklist* – This checklist must be submitted for all projects requiring stormwater detention.
- *Stormwater Drainage Forms*
    - Gutter Spread Table
    - Pipe Design Table
    - Pre-Development Conditions Worksheet
    - Post-Development Conditions Worksheet
    - Basin/Sub-Basin Peak Discharge Summary Table
    - Total Peak Discharge Summary Table

1.3.4.5 Final Approval

All approvals from other boards must be granted prior to receiving a full DRT approval. It is important to note that the approval will expire, unless construction has commenced, within eighteen (18) months following the date of approval. If the conditional use approval or plat expires, the DRT approval subsequently expires. The applicant must formally request an extension on the DRT application commensurate with the extension of the conditional use or plat approval. Furthermore, any substantial changes that effects the approved engineering plans before DRT expiration may require updated plans be submitted to the DRT and receive approval by the appropriate board.

1.3.4.6 DRT Process Flowchart

Figure 1-1 provides a development review process flowchart. This flowchart is meant to summarize the processes to be followed by the DRT and by the development submittal applicant.

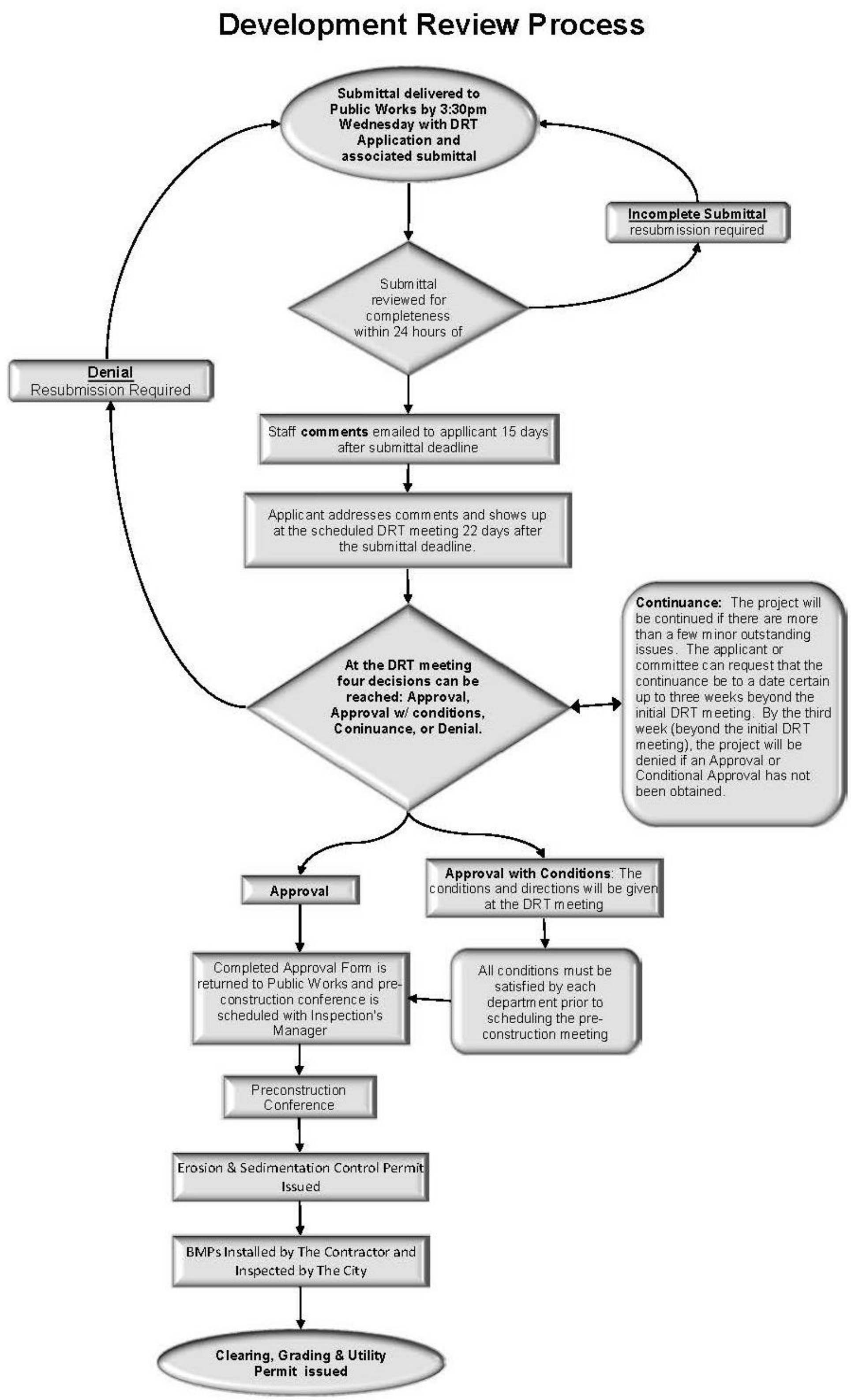


FIGURE 1-1
Development Review Process

1.3.5 Permits

Permits are required by the City to ensure that proper requirements, conditions, and standards are used in design and construction and to assist City staff in the monitoring of progress and assurance of quality in the constructed projects.

There are several departments within the City from which permits are required during specific points in the design and construction process. Pertinent permits that are issued by the City include the following:

- Demolition Permit
- Burn Permit
- Erosion and Sedimentation Control Permit
- Clearing, Grading, and Utility Permit
- AWWB Water Main Connection Permit
- Blasting Permit
- Zoning Certificate
- Building Permit
- Sign Permit

Each permit is discussed in some detail in the following subsections. The discussion of each permit is not meant to provide all information regarding that particular permit. The applicant should refer to the appropriate regulation, ordinance, or code that will describe the permit requirements in more detail.

It also is important to note that performing any work without the required and appropriate permit will result in a stop work order and a potential fine.

1.3.5.1 Demolition Permit

The City requires that a demolition permit be acquired to demolish existing structures. The Demolition Permit is issued by the City Public Safety Department – Codes Enforcement Division.

1.3.5.2 Burn Permit

Burn Permits are issued by the City's Public Safety Department - Fire Division. For information regarding Burn Permits, please contact the Auburn Fire Department.

1.3.5.3 Erosion and Sedimentation Control Permit

The Erosion and Sedimentation Control Permit is administered by the Public Works Department. It will be issued prior to the Clearing, Grading and Utility Permit. However, to obtain the Erosion and Sedimentation Control Permit, Erosion and Sediment Control Plans must be submitted to and approved by the DRT. All DRT submittal requirements still apply and the review is subject to the same dates and deadlines as any other required DRT submittal.

The Erosion and Sedimentation Control Permit allows the applicant to perform limited clearing of site vegetation required to install BMP measures around the proposed site.

Prior to issuance of the Erosion and Sedimentation Control Permit, a copy of an approved NPDES Permit from ADEM must be provided to the City, when required. If ADEM is only requiring submission of the NPDES Permit application and acknowledgement of receipt prior to commencement of land disturbing activities, the City will issue the Erosion and Sediment Control Permit after a copy of the acknowledgement of receipt is provided from ADEM. Once the NPDES Permit has been received, the City shall be provided with a copy. Additionally, a U.S. Army Corps of Engineers' (USACE) permit may be required for the site. In those cases, as well, the City must be provided with a copy of that permit before issuance of the Erosion and Sedimentation Control Permit.

On large or complex projects, a pre-construction meeting may be required to specifically address best management practice (BMP) installation. This type of pre-construction meeting does not take the place of the final pre-construction meeting after receiving a full engineering plan approval. Upon approval of the BMP plans and the pre-construction meeting being held, if required, an Erosion and Sedimentation Control Permit may be issued.

NOTE: No other permits will be issued until full construction plans have been granted approval. A complete submittal for the issuance of concurrent permits can be achieved through the DRT process.

1.3.5.4 Clearing, Grading, and Utility Permit

The Clearing, Grading and Utility Permit is administered by the Public Works Department. This permit allows the developer to clear site vegetation, begin grading operations, and install required site utilities. Clearing, Grading and Utility permits may be obtained only after the DRT has approved the engineering plans.

A Clearing, Grading and Utility Permit will not be issued until after the preconstruction meeting has been conducted.

Upon installation of all site BMPs, the developer must contact the Public Works Department and request a field inspection before proceeding with clearing, grading and utility installation. If the inspector determines that all site BMPs have been installed according to the approved Erosion and Sedimentation Control Plan, the developer may obtain a Clearing, Grading, and Utility Permit.

1.3.5.5 AWWB Water Main Connection Permit

The AWWB requires a permit for all connections made to existing water mains inside the AWWB's distribution system. These permits are administered by the WRM Department on behalf of the AWWB. Applicants must notify the WRM Department of the proposed connection prior to installation and shall submit a plan sheet detailing the connection if plans were not submitted through the DRT.

All connections made to the AWWB's distribution system shall be coordinated with and done in the presence of a representative of the AWWB or City inspector. The AWWB representative or City inspector shall be certified as an Alabama Grade I Water Operator to inspect the system connection. The Water Main Connection Permit will be provided to the appropriate AWWB representative or City inspector by the WRM Department upon approval for the authorization of the connection.

Because of the potential health hazard that exists as a result of contamination to the potable water system from improper system connections, only authorized connections will be allowed to the AWWB's distribution system. Persons making unauthorized connections to the AWWB's distribution system shall be subject to prosecution for theft of service in accordance with Alabama Criminal Code Section 13A-8-10 to 10.3 and for tampering with a public water system in accordance with Section 1432 of the Federal Safe Drinking Water Act.

1.3.5.6 Blasting Permit

The City requires a permit for blasting on any proposed project within the City. These permits are administered by the Codes Enforcement Division of the Public Safety Department. Applicants must notify the Codes Enforcement Division about the place and time the blasting will occur. Before issuing the permit, Codes Enforcement will perform a license check to determine that the blasting company is a licensed company within the State of Alabama. The applicant is advised to consult the City's standard specifications for information regarding blasting.

1.3.5.7 Zoning Certificate

The Zoning Ordinance sets forth the regulations and requirements for a Zoning Certificate, which must be granted before any development permitted by the Zoning Ordinance, including accessory and temporary uses, may be established or an existing building altered with respect to its use. The Codes Enforcement Division will not issue a Building Permit unless the DRT and the Planning Department have granted the developer approved site plans and a Zoning Certificate.

All applications for Zoning Certificates shall be filed with the Planning Director.

Following site plan and/or conditional use approval, an applicant shall have 18 months from the date of approval to obtain the necessary certificate and permits and to begin construction. In addition, an applicant shall have 90 days from the date of issuance of a Zoning Certificate to begin construction. The beginning of construction is defined as the date on which a Building Permit is issued by the City for the construction, renovation, modification, or other work required.

1.3.5.8 Building Permit

Building Permits issued by the City are administered by the Codes Enforcement Division of the Public Safety Department. The Codes Enforcement Division will not issue a building permit unless the DRT and the Planning Department have granted the developer approved site plans and a Zoning Certificate. The approved site plans are valid for an 18-month period and, within that period, the developer may obtain the Zoning Certificate and the Building Permit.

The applicant is allowed to submit plans and specifications to the Codes Enforcement Division and the DRT concurrently to begin the permitting process. Again, no Building Permit will be issued until the Zoning Certificate has been issued and the proposed site plan has been approved and is on file in the office of the Codes Enforcement Division.

Building Permits are discussed in more detail in the Zoning Ordinance. It also is important to note that there are three additional permits required by the City after the building permit has been issued:

- Electrical Permit
- Plumbing Permit
- Mechanical Permit

These permits will be issued only after the building permit has been approved.

1.3.5.9 Sign Permit

The City requires that all signs be permitted prior to installation. For a sign permit to be processed, a site plan showing the sign location and a scaled drawing are required. For additional information regarding Sign Permits, refer to the City's Zoning Ordinance.

1.3.5.10 Other Permits

Although it is not the responsibility of this Manual or of the City to inform each development applicant of all permits that may be required in other areas, it is important to note that other governmental agencies may require additional permits under their respective jurisdictions. The applicant may be required to obtain various permits from county, state and federal agencies for a particular project. It is the applicant's responsibility to determine any and all permits that may be required for a particular development.

1.4 Construction

1.4.1 Approved Plans and Revisions

Construction shall not begin without approved construction plans conforming to all applicable design standards in this Manual. Any changes in the design after the approval of the plans must be resubmitted to the Public Works Department's Plans Review Engineer. The Public Works Department Plans review Engineer will distribute the plans to the appropriate Department for review and approval. During construction, if changes are required, construction in the area of the changes shall halt until such time as the plans have been revised, submitted, and approved.

1.4.2 Materials

The materials required to be used for construction shall be as required by the City's Standard Specifications. The City may require detailed submittal information for any product being installed. Any product found not to be in compliance with the specifications shall be removed and replaced at the developer's expense.

1.4.3 Submittals

After approved plans have been issued and prior to construction beginning on public infrastructure, a material submittal package shall be provided to the City for review and approval. The material submittal package shall include all product specifications and material data sheets for public infrastructure that are to be installed during construction, and are to be owned and operated by the AWWB and/or the City. Submittal packages shall be provided to the Public Works Inspection Division Manager or the Project Manager. Submittals shall not be provided for infrastructure that is to be owned and operated by other private or public owners or entities.

All material submittals shall clearly detail all necessary product information as applicable including, but not limited to; product ID, dimensions, type, material, construction, strength or rating, graphical schematic, picture or sketch, standard technical specifications, or any other attribute critical to the design and function of the appurtenance. Material submittals for concrete structures such as manholes, vaults, or wet wells shall clearly detail all dimensions, reinforcement, layout of affected appurtenances, hatch or cover specifications, and associated fabrication manufacturer.

Each material submittal package shall include a minimum of five (5) full sets of all necessary appurtenance data sheets with a cover sheet detailing all included submittals.

The City will review and approve, conditionally approve (as noted), or reject the material submittals for the specific proposed application in accordance with the requirements detailed in this Manual, and the City's Standard Specifications. The City will keep three (3) copies of the material submittals, and will return the remaining two (2) copies to the developer and the contractor. Additional copies of the material submittals shall be included in the package if more than two (2) approved copies are needed.

It is the responsibility of the contractor to be familiar with the standard requirements of the AWWB and the City specifications prior to submittal. All rejected material submittals shall be resubmitted as required and approved prior to the commencement of construction.

1.4.4 Installation Requirements

Installation and construction shall follow the manufacturers' recommendations and the City's Standard Specifications. Where a discrepancy exists between the manufacturers' recommendations and the City's Standard Specifications, the more stringent of the requirements shall apply.

A Utility Installation Flow Chart for site plan development projects and residential subdivision development projects is included in Appendix C of this Manual.

1.4.5 Inspection and Testing

The City will assign an inspector for the project. This inspector will be responsible for the inspection of the construction. The inspector shall be present for all water and sewer connections and testing procedures.

- Testing of the street construction shall follow the City's Standard Specification, Section 10 for Streets.
- Testing of the sanitary sewer system shall follow the City's Standard Specification, Section 12 for Sanitary Sewer Systems.
- Testing and disinfection of the water mains and appurtenances shall follow the City's Standard Specifications, Section 14 for Water Mains and Appurtenances.

All testing and disinfection procedures shall be coordinated with the inspector. The City's Standard Specifications shall govern testing requirements for infrastructure not listed above.

1.4.6 Contacts

During construction activities, the first point of contact for the developer or contractor with the City for project related issues or questions shall be the assigned inspector. Where further technical assistance or clarification is required, the inspector will contact the appropriate Department. Any direction received from the City authorizing changes in design or construction methods from the approved plans or the City Standard Specifications and Details shall be at a minimum acquired in writing. Verbal approval shall not be an acceptable authorization to deviate from the approved plans or standards. Changes in the approved design will typically require revision to the plans to be submitted and approved.

All water and sewer locate requests shall be called into Alabama One Call at 1-800-292-8525.

The developer or contractor shall establish any preferred contact sequence for City staff to follow during construction activities at the development pre-construction meeting.

1.5 As-Built Drawings

As-built drawings are required to be submitted for any development where infrastructure such as water mains and services, sanitary sewer mains and services, and/or storm sewer structures are installed and where any ownership and maintenance of said infrastructure is to be administered by the City or the AWWB. The as-built drawings shall provide precise locations and elevations for all installed infrastructure for the entire approved development phase(s) including any offsite infrastructure or infrastructure in subsequent phases or developments that provide service for the particular development phase(s) seeking approval. In no case will hand drawn "red line" construction plans be accepted for as-built drawings. Any project specific requirements for as-built drawing feature collection will be discussed at the preconstruction meeting for the development. The as-built drawings shall be submitted and approved prior to a building permit being issued for the Subdivision Projects and prior to the Certificate of Occupancy for Site Plan Projects. In no case will the AWWB set a water meter or activate a water account for a Subdivision Project that has not submitted a complete set of as-built drawings. The City or the AWWB may waive the as-built requirement for small developments that are not installing more than 100 feet of publicly maintained water, sanitary sewer, or storm sewer mains.

1.5.1 Surveying

As-built drawings shall be surveyed and certified by a licensed professional land surveyor (PLS) in the State of Alabama. All coordinates shall conform to the Alabama East State Plane (0101) Coordinate system referenced to the North American Datum (NAD) 83 (2011) EPOCH 2010 for horizontal control, the North American Vertical Datum (NAVD) 88 for vertical control, and the National Geodetic Survey (NGS) GEOID12A model. All measurements must be recorded in US survey feet (Northing and Easting) to the nearest one hundredth of a foot.

As-built drawing features may be surveyed using traditional surveying methods or Real Time Kinematic (RTK) corrected Global Position System (GPS) methods. When utilizing GPS surveying methods, the survey shall reference the following Alabama Department of Transportation (ALDOT) Continuously Operating Reference Station (CORS):

CORS Name:	ALAU
IP Address:	205.172.52.26
Port Number(s):	14302

More information regarding the ALDOT CORS Network can be found at the following website: http://aldotcors.dot.state.al.us. Any GPS or traditional surveys that do not reference the ALDOT CORS shall reference a control point set by the City of Auburn. The surveyor shall contact the WRM Department to have the appropriate control points set for the development.

All points that are collected utilizing GPS surveying methods (including control points) shall be submitted with the degree of accuracy listed for each survey point. Coordinates and measurements that are provided using GPS technologies shall be classified as either Critical (C) or Noncritical (NC) in terms of the degree of accuracy required for those survey points. Critical coordinates and measurements shall generally be considered as any points used for establishing control (horizontal and vertical) or for purposes of attaining vertical positioning of sanitary or storm sewer rim and invert elevations (including pump stations), or where horizontal or vertical tolerance of the specific feature is minimal. All Critical coordinates and measurements shall be provided with a degree of accuracy of no greater than +/- 0.03 feet (sub-centimeter) with a minimum observation time of 30 epochs. All other GPS coordinates and measurements (horizontal and vertical) shall be considered Noncritical and shall in no case exceed a degree of accuracy of +/- 0.5 feet with a minimum observation time of 10 epochs. All GPS survey points shall be collected with a maximum Position Dilution of Precision (PDOP) value of 3.

In order for the as-built survey to be considered complete for a development, all of the following surveyed features, coordinates, and information shall be included, where applicable:

1. Water Distribution Features
    a. Water main location, top of pipe elevation, size, and material (one (1) coordinate provided every 100 feet minimum along straight sections of pipe, every 40 feet minimum where pipe is being deflected, and at all bends and fittings along the main). Note: Main locations should be marked by the contractor during installation with a 2 inch diameter vertical PVC pipe at all bends, fittings, elevation transitions, and at a minimum of every 100 feet in accordance with the standard specifications. (NC). In lieu of installing the vertical PVC pipe for features to be located, survey shots can be made on the exposed feature during installation.
    b. Water valve location (center of valve box cover), cover elevation, size, and type. (NC). For butterfly valves, a shot shall be taken on the valve box cover and the main adjacent to the valve box cover. Note: valve location shots are not to be counted as the main line shots referenced in 1.5.1.1.a.
    c. Fire hydrant location, finished grade elevation, manufacturer, and year (surveyed in front of the hydrant steamer nozzle at the finished grade elevation). (NC).
    d. Service line location, finished grade elevation, and size (typically at a meter box or meter vault at the edge of the easement or ROW). Approximate location of main line connection shall be field verified (where possible) and provided on the as-built drawings. (NC).
    e. Blow-off and air release valve location (center of cover), cover elevation, size, type, and manufacturer. (NC)
2. Waste Water Collection Features
    a. Sewer manhole location, size, material, rim elevation (center of cover), manhole type, cover type. (C).
    b. All main line invert elevations entering or exiting a manhole including proper connectivity to the appropriate manhole Object ID's (service line connection elevations are not required). "Memphis tee" drop connections in a manhole shall only be recorded for the highest vertical connection. (C).
    c. Sewer gravity main location, size, and material at all manholes. (C).

d. Service line location and size (typically at a clean out or stub out at the edge of the easement or ROW). Approximate location of main line or manhole connection shall be field verified (where possible) and provided on the as-built drawings. (NC).

e. Grease trap location (approximate center), finished grade elevation, and size. (NC).

f. Pump station site plan, which shall graphically display all pertinent features of an installed pump station site including but not limited to: property boundary, finished grade contours, fence boundary, gates, access road, water service, yard hydrant, concrete slabs, wet well and valve vault perimeter, wet well and valve vault hatch, standby diesel pump, electrical control panel, utility pole, telemetry pole, wet well vent, quick connection piping, force main piping, gravity main piping, manholes, drainage and storm sewer features, streams and applicable buffers, and any other appurtenance or notable feature within the pump station site. Also, the site plan and survey data shall include all of the following elevations: wet well rim, wet well floor, valve vault rim, valve vault floor, liquid level floats, onsite gravity inverts, and manhole rims. (C).

g. Sewer force main location, top of pipe elevation, size, and material (one (1) coordinate provided every 100 feet minimum). Note: Main locations should be marked by the contractor during installation with a 2 inch diameter vertical PVC pipe at all bends, fittings, elevation transitions, and at a minimum of every 100 feet in accordance with the standard specifications. (NC).

h. Sewer force main valve location (center of valve box cover), cover elevation, size, and type. (NC).

i. Sewer force main air release valve location (center of cover), cover elevation, size, type, and manufacturer. (NC).

3. Storm Water Features

   a. Storm sewer manhole/inlet location, rim elevation (center of cover), type, and condition, outlet structure. (C).

   b. Storm sewer headwall location at pipe terminus, type, presence of rip rap, and condition. (C).

   c. All invert elevations entering or exiting the manhole/inlet or headwall including proper connectivity to the appropriate manhole/inlet or headwall Object ID’s. (C).

   d. Storm sewer main size, shape, material, and condition. (C)

4. The PLS certification shall be provided on each as-built plan sheet and shall state:

   I HEREBY CERTIFY THAT ALL PARTS OF THIS AS-BUILT SURVEY AND DRAWING HAVE BEEN COMPLETED IN ACCORDANCE WITH THE CURRENT REQUIREMENTS OF THE STANDARDS OF PRACTICE FOR SURVEYING IN THE

STATE OF ALABAMA TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF BASED ON EVIDENCE VISIBLE ON THE SURFACE

Surveyor's Signature: _______________________________________

Alabama License Number __________________ Date____________

1.5.2 Engineering

As-built drawings shall be certified by the engineer of record responsible for the design of the project infrastructure and utilities or a licensed professional engineer (PE) in the State of Alabama with sufficient knowledge of the project. The engineer is responsible for reviewing the installed items for compliance with the approved construction plans and with the design standards detailed in this Manual.

The engineer of record certification shall be provided on each as-built plan sheet and shall state:

I HEREBY CERTIFY THAT THE INFORMATION PROVIDED BY ___________________, REGISTERED LAND SURVEYOR No. ______, AND SHOWN ON THIS AS-BUILT DRAWING HAS BEEN REVIEWED FOR COMPLIANCE WITH THE APPROVED PLANS FOR THE PROJECT AND DOES COMPLY WITH THE INTENT AND PURPOSE OF THE DESIGN IN ACCORDANCE WITH THE APPLICABLE ENGINEERING DESIGN STANDARDS OF THE CITY OF AUBURN AND/OR THE WATER WORKS BOARD OF THE CITY OF AUBURN TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

Engineer's Signature: _______________________________________

Alabama License Number __________________ Date____________

1.5.3 Submittal

As-built drawings shall be submitted directly to the WRM Department at 1501 West Samford Avenue. The WRM Department will distribute the drawings to the necessary departments of the City for review and approval. The review of the submittal and any subsequent comments should be completed within 10 business days. The drawings shall be reviewed and approved prior to a building permit being issued for Subdivision Projects and prior to Certificate of Occupancy for Site Plan Projects. In no case will the AWWB set a water meter or activate an account for a development that does not have an approved set of as-built drawings. The initial submittal package shall include four (4) hard copies printed on 24 x 36 inch plan sheets as well as one (1) digital copy provided on CD.

The completed as-built drawings shall include the following information:

1. Title block.
2. North arrow.
3. Graphic scale.
4. Overall plan view of the project.
5. Horizontal and vertical coordinates of all established survey control points.

6. Horizontal and vertical coordinates of all sanitary and storm sewer manholes and inverts.
7. All applicable bearings, distances, pipe sizes, slopes, materials, etc.
8. All applicable property line and easement information.
9. The hard copies shall be certified by the PLS and PE on each plan sheet with the applicable notation, signature, and seal.
10. All plan sheets shall be clearly marked in the title block with the notation “AS-BUILT”.

The digital copies of the as-built drawings shall be submitted in a format compatible to the City’s software. Each digital copy of the as-built drawings shall include a copy of all as-built plan sheets in both DWG and PDF formats. PDF files shall be a minimum resolution of 300 dpi. Each applicable feature provided in the DWG file shall be located in a separate and clearly labeled layer. In addition to the drawings, each digital copy shall also include the survey data in tabular form as an Excel (XLS) spreadsheet. The layout of the tabular data shall be in accordance with the standard template spreadsheet provided by the City for the appropriate feature being collected. All fields associated with that feature shall be populated as designated or required, and any applicable quality control query errors included in the spreadsheet template shall be addressed prior to submittal. The tabular data required is for features that will be imported into the City’s GIS database and is not intended to be all inclusive of the survey collection that may be required to adequately compile the as-built drawing information. Additional feature data may be required on the as-built drawings for graphical display of installed conditions that are not specifically requested as part of the tabular data to be submitted.

Upon approval of the initial submittal package, two (2) final hard copies and one (1) digital copy shall be provided.

1.6 Easements

1.6.1 Discussion

Easements shall be dedicated for all publicly owned and maintained infrastructure that are not located on public ROW or covered by an existing easement. Any easements that are needed for the development shall be dedicated in a manner acceptable to the City either by plat or by document. Specific language for the easement dedication shall be prepared by the City and shall be used for the dedication.

No fences, canopy trees, or any other obstructions shall be allowed in easements without prior approval of the City. Where it can be demonstrated that it is not possible to locate a necessary obstruction outside an easement, the City and/or the AWWB may approve the placement of the obstruction with the execution of a Hold Harmless Agreement as defined in Section 1.7.1 of this Manual. The location of the obstruction within an easement shall be such that the conflict with proposed or existing infrastructure is minimized to the maximum extent practical. Approval from the City shall be acquired prior to the placement of any necessary obstruction in an easement. Obstructions placed in easements without prior approval shall be removed, as directed, at no cost to the City or the AWWB.

All permanent easements where public infrastructure has been installed shall be graded and smoothed to allow sufficient access and use for mowing equipment and maintenance vehicles prior to acceptance by the AWWB or the City. The permanent easement shall be completely cleared of all trees, brush, boulders, and debris. All rocks shall be buried, crushed, or removed from the easement where, in the opinion of the AWWB or the City, they present a hazard for access and use of the easement. Typically, no rock shall remain on the ground surface that is larger than a No. 1 stone classification. All creek and ditch crossings shall also be made accessible for mowing and maintenance equipment as deemed appropriate by the AWWB and the City prior to acceptance of the public infrastructure.

No water or sewer services shall be activated prior to the actual legal dedication of all necessary easements. All testing and water main disinfection procedures may proceed prior to easements being dedicated in order to complete construction, but domestic services will not be provided until the necessary easements are granted.

All easements needed for the development shall be identified during the plan review process. The standard easement width for water, sewer, and storm drain is based on two times the depth of cover (measured from finished grade to the bottom of the pipe or structure), rounded up to the nearest multiple of 10 feet, with a minimum easement width of 20 feet. Easements for installation of water and sewer utilities may require additional width to ensure adequate separation between structures and the installed utility is achieved to allow reasonable excavation of the utility without compromising the structures foundation. Generally, a minimum separation of 15 feet would be acceptable to the City where depths of the utility are less than 10 feet; however, the City reserves the right to request additional easement width based on the site specific circumstances of the easement. The engineer of record shall be responsible for evaluating the foundation design and separation required on a case specific basis and may provide any applicable design information to the City for consideration in determining required easement widths. The actual easement width shall be calculated based on the actual installed depths. The infrastructure shall be centered in the easement, and shall be verified with the as-built drawings. If it is determined that the water, sewer, or storm drain line was not installed in the previously dedicated easement to allow for the proper maintenance, the easement shall be promptly rededicated in the installed location. The City will typically accept tolerance of up to four feet before a rededication of the easement will be required.

All water and sewer utility and storm drain easements shall be dedicated to the City as Drainage and Utility Easements unless otherwise approved and shall not be combined with any other utility easements (i.e. gas, electric, communications, etc.). City Drainage and Utility Easements are exclusive and are not to be used to install any other non-City owned and maintained utility. An exception to this would be a perpendicular crossing of another utility. Where other utilities must be installed inside a City Drainage and Utility Easement, and where approved by the City, an Easement Encroachment Agreement will be required with the encroaching utility as defined in Section 1.7.2 of this Manual.

1.6.2 Dedication by Document

Easements to be dedicated by document shall include a legal description of the easement area, a surveyed drawing titled 'Exhibit A' showing the easement limits and the installed location of the utility, as well as a vicinity map showing the general location of the property. The legal description and exhibit shall be prepared by a licensed professional land surveyor in the State of Alabama. The legal description, exhibit, and vicinity map for easements shall be submitted to the City for review and approval with the as-built drawings for the development.

After the legal description and exhibit have been submitted and approved, the City will assist the developer in preparing the easement document, and submitting to City Council for approval. Proof of ownership will be required prior to the recording of the easement document, and must be in a form acceptable to the City Attorney. The actual recording of the document will be coordinated with the City after the review and approval of the easement document by City Council.

1.6.3 Dedication by Plat

Easements to be dedicated by plat shall be identified during the review process and shall be identified on the preliminary plat included in the plans. All plats shall be prepared by a licensed professional land surveyor in the State of Alabama and shall be submitted to the Planning Department to be routed for review and shall be in accordance with all applicable City Zoning Ordinances and Subdivision Regulations. All easements shall be shown and clearly labeled on the plat. The easement widths shall be clearly identified and shall be in accordance with the standard easement width requirements based on installed depths.

All easements shown on the final plat shall be in the as-built location of the utility and shall be surveyed by a licensed professional land surveyor in the State of Alabama prior to submittal. If the final plat is recorded prior to infrastructure being installed, the recorded plat shall be checked against the surveyed as-built drawings by the City prior to acceptance of the utility. If any discrepancies are discovered between the recorded easement and as-built utility locations or installed depths that, according to the City, would hinder the maintenance or repair of the infrastructure, the developer/owner will be required to revise the plat and easements as necessary prior to preliminary acceptance of the affected water or sewer infrastructure in question.

1.6.4 Easement Language

The easement wording shall be reviewed by the City and the AWWB for approval. All plans and plats shall include the following standard notation:

- "No permanent structures may be constructed or placed on easements. Fences may be erected perpendicularly across the easement provided there is a minimum 12 foot wide access gate installed. If the gate is to be locked there must be a City approved lock installed in conjunction with the owners lock. No canopy trees shall be planted within 10 feet of utilities."
- "By placing obstructions within or encroaching onto the easement, the property owner(s) does for itself, its successors, and assigns agree to indemnify, hold harmless and defend the City of Auburn, its officials, representatives, agents, servants and employees from and against all liability and loss which may be sustained as a result of claims, demands, costs or judgments arising out of the location of the obstruction within the easement including its reasonable costs in defending against any such claims and further agrees to release and discharge the City of Auburn from any damages to the obstruction arising from utility maintenance work within the easement or any damages to the obstruction resulting from its placement in the easement."
- By placing any portion of an irrigation system within the easements or right of way, the property owner does for itself , its successors and assigns agrees to hold harmless and defend the City of Auburn, its officials, representatives, agents, servants, and employees from and against all liability and loss which may be sustained as a result of claims, demands, cost or judgments arising out of the location of the obstruction within the easements or right of way including its reasonable cost in defending against any such claims. The property owner further agrees to release and discharge the City of Auburn from any damages to the irrigation system arising from any work or maintenance work within the granted easement or right of way or any damages to the irrigations system resulting from its placement within the easement or right of way. Irrigation systems are limited to only laterals being placed within any easements or right of way.

1.7 Agreements

1.7.1 Hold Harmless and Indemnity

There may be certain unavoidable situations where an obstruction that would interfere with the maintenance or repair of infrastructure may be required to be placed on or adjacent to a dedicated easement or in the ROW. Where it can be demonstrated that it is not possible to locate the necessary obstruction outside the easement or ROW, the City and/or the AWWB may approve the placement of the obstruction with the execution of a Hold Harmless Agreement.

The City shall be notified prior to the construction or placement of any such obstruction and will make the determination if the encroachment will be allowed. A plan sheet shall be submitted to the City detailing the obstruction and its relative location to the easement for approval. The location of the obstruction within the easement or ROW shall be such that the conflict with existing or proposed infrastructure is minimized to the maximum extent practical. If the City decides the obstruction or encroachment will be allowed, the owner will be required to enter into a Hold Harmless Agreement with the AWWB and/or the City. The approved plan shall be attached to the Hold Harmless Agreement as 'Exhibit A' and shall be referenced in the agreement. The executed Hold Harmless Agreement shall be recorded in the Office of the Judge of Probate in Lee County, Alabama.

The exact format and language of this Hold Harmless Agreement will be determined by the City and the AWWB. A sample standard Hold Harmless Agreement is provided in Appendix B, but is subject to modification to fit the site specific request and conditions.

1.7.2 Easement Encroachment

There may be certain situations where other utilities that are not owned by the City or the AWWB may be required to be placed on an existing dedicated easement.

The City shall be notified prior to the construction or placement of any such utility and will make the determination if the encroachment will be allowed. A plan sheet shall be submitted to the City detailing the extents of the encroachment on the easement for approval. The location of the utility within the easement shall be such that the conflict with existing or proposed infrastructure is minimized to the maximum extent practical. If the City decides the utility encroachment will be allowed, the owner of the utility will be required to enter into an Easement Encroachment Agreement with the City and/or the AWWB. The approved plan shall be attached to the Easement Encroachment Agreement as 'Exhibit A' and shall be referenced in the agreement. The executed Easement Encroachment Agreement shall be recorded in the Office of the Judge of Probate in Lee County, Alabama.

The exact format and language of this Easement Encroachment Agreement will be determined by the City and the AWWB. A sample standard Easement Encroachment Agreement is provided in Appendix B, but is subject to modification to fit the site specific request and conditions.

1.8 Acceptance

1.8.1 Authorities

The AWWB may accept ownership and maintenance of all public water mains, services, and related appurtenances installed for a development up to any metered connection or approved backflow prevention assembly inside the ROW or at the edge of an easement that is directly connected to the AWWB distribution system and that was designed, installed and tested in accordance with the applicable standards detailed in this Manual. The AWWB maintains all meters and backflow prevention assemblies for domestic and irrigation connections services connected to the AWWB distribution system up to and including the associated meter. The AWWB does not maintain backflow prevention assemblies installed for isolated fire protection systems, but will regularly inspect these assemblies for proper maintenance and operation by the owner. It is the customer's responsibility to maintain the service beyond the AWWB's meter. The customer is also responsible for any maintenance associated with an unmetered fire protection system connected to the AWWB's system beginning at the AWWB's isolation valve. The customer's responsibility includes any backflow prevention assembly installed on a service connection, which shall be maintained, tested, and inspected in accordance with the AWWB's Backflow Prevention and Cross-Connection Control Policy.

The WRM Department, Sewer Division may accept ownership and maintenance of all public sanitary sewer gravity mains, pump stations, and force mains installed for a development inside the ROW or easement that connects to the City's sanitary sewer collection system and that was designed, installed, and tested in accordance with the applicable standards detailed in this Manual.

The Public Works Department may accept ownership and maintenance of all public storm drain infrastructure, streets, sidewalks, and bicycles facilities installed for a development inside the ROW or easement that was designed, installed, and tested in accordance with the applicable standards detailed in this Manual. The City does not maintain stormwater storage facilities, but will inspect these facilities annually to ensure proper maintenance and operation by the owner.

1.8.2 Preliminary Acceptance

A development will be eligible for preliminary acceptance of public water and sanitary sewer infrastructure by the AWWB and the City upon completion of the following items (in particular order):

1. Submittal and approval of construction plans in accordance with the applicable standards detailed in this Manual for both water and sanitary sewer design.
2. Construction inspection provided by the AWWB or the City or adequately documented in accordance with the City Standard Specifications and Details for water and sewer construction.
3. Successful testing procedures performed and results documented in accordance with the City Standard Specifications for water and sewer testing.
4. Proper disinfection achieved and documented for all water mains and appurtenances installed in accordance with the City Standard Specifications for water main disinfection.

5. As-built drawings submitted and approved in accordance with this Manual for all water and sewer infrastructure.

6. Final inspection by the AWWB and the City for all water and sewer infrastructure and all noted deficiencies corrected. The final inspection shall be scheduled with the project inspector, the Water Distribution Manager, and the Sewer Collection System Manager after all applicable testing and disinfection has been successfully completed for the water and sewer infrastructure and as-built drawings have been submitted to the WRM Department. Sewer pump stations shall be inspected in accordance with the requirements in Section 3.5.11.3 of this Manual.

7. All appropriate Drainage and Utility Easements dedicated in accordance with Section 1.6 of this Manual and the final development plat signed (if being platted).

8. All necessary Hold Harmless Agreements or Easement Encroachment Agreements executed in accordance with Section 1.7 of this Manual.

The WRM Department will issue a written preliminary acceptance letter upon completion of the items covered in this Section. Preliminary acceptance is not granted by the City for storm drain or transportation infrastructure.

1.8.3 Final Acceptance

Final acceptance of water and sewer mains and appurtenances will not be granted by the AWWB or the City until such time that all local construction activity for the entire development phase taking place on the ROW or easements in which the water and sewer are located is substantially completed, which is including but not limited to; other utilities, storm sewer construction, major grading, sidewalk installation, and roadway preparation, including curb, subbase, base, or binder placement. If more than 12 months has expired from the date of the preliminary acceptance letter, when final acceptance is requested by the developer, a second final inspection shall be scheduled with the Water Distribution Manager and Sewer Collection System Manager prior to final acceptance being issued. Upon substantial completion of construction and successful correction of all noted deficiencies at the time the final acceptance is requested, the WRM Department will issue a written final acceptance letter.

Final acceptance of storm drain and transportation infrastructure will occur after placement of the final wearing surface and subsequent final inspection by the Public Works Department. Any deficiencies noted for correction during the final inspection must be completed before final acceptance is granted. Subdivision completion bonds will be released after all City and AWWB infrastructure receives final acceptance.

1.9 Warranty Period

The developer is responsible for all damages caused to infrastructure within the development due to construction activity as well as any defects in materials and workmanship associated with the installed infrastructure for a period of not less than one year from the date of the City's final written acceptance of the infrastructure, or the signing of the final plat, whichever is later.

Due to the health risks associated with contamination of the potable water supply and regulations associated with maintaining a public water distribution system, only AWWB personnel are authorized to operate or work on water mains connected to the AWWB distribution system. As a result, the AWWB will provide all operation, maintenance, repair, and emergency response services after preliminary acceptance has been issued and the service has been activated for public use, including during the warranty period. The City will also provide repair, and emergency response services for sanitary sewer related issues within the development after preliminary acceptance and during the warranty period if not timely and satisfactorily addressed by the developer.

All costs associated with any necessary repairs or emergency response services provided by the AWWB or the City during the preliminary acceptance or warranty periods due to damages caused by construction activity, or defects in materials or workmanship shall be the full responsibility of the developer including all labor, equipment, and materials required to perform the work. The AWWB or the City will invoice the developer for all such costs.

1.10 Fees and Charges

1.10.1 Discussion

There are multiple fees associated with obtaining water and sewer services from the AWWB and the City. These fees include, but are not limited to, access fees, deposits, tap fees, and meter set fees. All applicable fees for any new development or redevelopment will be due for both water and sewer services, where provided by the AWWB or the City prior to the issuance of a building permit. All associated fees shall be paid at the Water Revenue Office at 1501 West Samford Avenue. A current rate schedule of all normally applicable water and sewer fees can be found on the City's website.

1.10.2 Water and Sewer Fee Estimates

During the plan review process, the WRM Department may provide an estimate for access fee credits and charges at locations with existing water and/or sewer accounts. The estimate provided will be based on information derived from the plans submitted and the published rates available on the date of the estimate. The rates are subject to change and are not guaranteed by the estimate. The estimate amount provided will not include any tap fees, meter set fees, or deposits that may also be applicable for the project. All required water and sewer fees shall be paid at the Water Revenue Office prior to the issuance of a building permit for the development, and will be based on the published rates at the time the fees are collected.

1.11 Updates and Waivers to the Manual

Updates to this Manual will be made periodically as deemed necessary. These updates will be posted to the City's web site, along with a brief overview of any of the changes made, the reason for the change, and a date the changes will go into effect.

1.11.1 Updates

The users of this Manual are encouraged to suggest changes and or/revisions to the Manual. These suggestions will be considered and, if deemed appropriate, a revision will be made to the Manual. It is expected that updates will be provided on an annual basis. Any individual who believes that a change is necessary to the Manual is encouraged to submit the suggestion in writing to the City for consideration.

Periodically, as revisions are made to the Manual, the changes will be posted to the City's website. It is the responsibility of the users of this Manual to make certain that they are using the current version.

1.11.2 Project-specific Waivers

1.11.2.1 Waiver Criteria

The City may make project-specific waivers to an existing City standard when any one of the conditions described below applies. It should be noted that the City is not required to make a waiver just because one of the conditions below applies, but these are the only circumstances under which a waiver will be considered:

1. The standard is not applicable to the particular situation.
2. Topography, ROW, or other geographical conditions impose undue hardship to the applicant or extraordinary environmental damage; and an equivalent alternative that can achieve the same design objective is available and does not compromise public safety.
3. A waiver is required to address a specific design or construction problem that will result in an undue hardship to the applicant with little or no material benefit to the public, if not granted.
4. A new technology is available that results in a benefit to the project, accomplishes the same design objective, reduces environmental intrusion, and does not compromise public safety.

1.11.2.2 Procedure

For items that meet the Waiver Criteria specified in Section 1.11.2.1 of this Manual, the following procedure applies:

- Waiver request
- City's review and request disposition
- Appeal

The elements of the procedure are discussed in more detail in the following subsections.

Waiver Request

Any person may request a waiver to a City standard contained in this document as pertaining to the purview of the WRM Department by submitting a written request to the WRM Department Director. The written request must state the desired waiver, the reason for the waiver, and a comparison of the waiver to the existing standard. The written request shall be on the City's Request for Design and Construction Standard Waiver form (Appendix B) and shall include, at a minimum, the following information:

1. A completed "Request for Design and Construction Standard Waiver" form.
2. A narrative description that includes the following information for each requested waiver:
    a. State what the waiver request is and compare it to the existing City standard.
    b. State the reason for the waiver and describe how it meets the Waiver Criteria specified in Section 1.11.2.1.
3. Reference any relevant industry standards or specifications that support the waiver request.

City's Review and Request Disposition

The City will review all properly completed forms and take one of the following actions:

- Approve as requested
- Approve with noted conditions
- Deny the request

The City's response will be in writing. A conditional approval or denial of the request will be accompanied with a brief explanation. Any approved waiver is project-specific and does not constitute a precedent for the modification of a standard.

Appeal

An applicant may appeal a denied waiver request to the AWWB for all waivers related to the AWWB's potable water distribution system and to the Planning Commission for all other standard waivers.

SECTION 2

Water Design and Construction

2.1 Introduction: Design Responsibility and Applicability of Requirements

The design and construction requirements for water distribution mains and related appurtenances included in this Manual are applicable for any development located within the City of Auburn (including the 5-mile planning jurisdiction) that intends to obtain water services from the Water Works Board of the City of Auburn (AWWB) upon successfully meeting all of the requirements of the AWWB for obtaining such services.

Developers are cautioned that the AWWB is not the only water supplier for the City of Auburn. There are certain areas of the City of Auburn that are served by other water suppliers. Please contact the WRM Department for information about the location of these areas that are being served by the Loachapoka Water Authority (LWA), the Beauregard Water Authority (BWA), or Opelika Utilities (OU). Specific information regarding the design requirements for developments in areas served by the LWA, the BWA, or OU can be obtained by contacting those water authorities.

The Water Resource Management (WRM) Department of the City of Auburn shall enforce the requirements included in this Manual on behalf of the AWWB. Distribution systems, within the City of Auburn, that are privately maintained or are not supplied by the AWWB shall not be required by the WRM Department to meet all of the design standards included in this Manual for water distribution systems. Any standards, included in this Manual, which are required by a federal or state regulatory authority, or any applicable local plumbing or fire codes shall be required and enforced by those specific authorities.

All developments inside the City of Auburn shall be required to meet the City's fire flow requirements in accordance with the currently adopted fire code. Fire flow requirements for each development will be specifically detailed and enforced by the Public Safety Department Fire Division. The WRM Department will assist the Public Safety Department Fire Division during the development review process in determining if adequate flow is available to meet those specified requirements. Consequently, all developments inside the City of Auburn shall submit fire flow calculations, where required by either department, in accordance with the standards provided in Section 2.3.3 of this Manual.

This Manual is intended to provide general guidance and minimum criteria for the design and construction of water facilities for development. However, the sole responsibility for the design is that of the engineer for the development.

Generally, this Manual is intended to be used for the typical subdivision and small-scale commercial development. The typical subdivision development would be a development that needs no more than a 12-inch water main. Developments that need water services in excess of this size are not considered typical developments. Although this Manual can be used for general guidance for other than typical developments, requirements for these developments will be handled on a case-by-case basis. A Utility Installation Flow Chart for site plan development projects and residential subdivision development projects is included in Appendix C of this Manual.

The engineer is encouraged to meet with and discuss each development with the WRM Department prior to the submittal of the plans for review.

Any costs attributable to the extension of the water distribution system to serve a single development shall be the responsibility of the developer.

2.2 General Considerations

2.2.1 Existing Water Facilities

All existing water facilities that are located within the project area or that will be affected by the development must be located, identified, and shown on the plans. It is the responsibility of the engineer to have any and all utilities located and shown accurately on the plans.

If, during construction, any utilities are discovered that were not shown on the plans, the WRM Department shall be notified immediately. The construction on any area of the project affected by the discovered utility may be halted and the plans may need to be revised and resubmitted for review at the discretion of the WRM Department.

Any existing water mains or services, currently maintained by the AWWB, shall be evaluated by the WRM Department to determine if they can be reused for development when a construction plan or site plan submittal is required for the development. Any existing water service that will be reused for a development must be brought to current standards of the AWWB.

Any water service to be abandoned on a development site or ROW adjacent to the development site shall have the connection terminated at the main, unless otherwise approved by the WRM Department. Services terminated at the main shall be severed at the connection point and the connection shall be closed at the corporation stop or sealed as necessary by the installation of a sleeved section, restrained plug, or other approved method. Services shall not be crimped, clamped, or improperly sealed for permanent abandonment. Failure to locate and show all water services on the construction plans does not negate the requirement to properly abandon water services at the main. The contractor shall also be required to locate and identify all services prior to construction.

2.2.2 Proposed Water Facilities

The plans submitted for review shall show all proposed water services, including all water mains, service lines, meters, backflow protection devices, vaults, isolation valves, hydrants, fire department connections, blow-off valves, air release valves, pressure reducing valves, fittings, thrust restraint, and any other appurtenances associated with the water system. All pipe diameters, material, locations, and pertinent features shall be identified clearly on the plans. The plans also will include the number of meters required and the types of meter (i.e., positive displacement, turbine, compound, or fire service assembly) as well as the types of backflow protection device (i.e., standard double check, testable double check, or reduced pressure). The final determination of the type of meter and backflow protection device required will be made by the WRM Department during plan review, however, guidance has been provided in this Manual for properly selecting those devices.

2.2.3 System Demand Analysis

The WRM Department will verify water availability and treated water capacity to serve a development in the AWWB distribution system with the assistance of the developer and engineer, where necessary. All developments are required to provide accurate fixture counts, for the estimation of water demand, in the Application for Water and Sewer Service (Appendix B) that shall be submitted at the time of plan submittal.

The WRM Department will perform a system demand analysis for developments that will be served by the AWWB distribution system to determine if the AWWB has the availability and capacity to serve the development.

Any upgrades to the existing water facilities necessary to provide adequate service to the development typically would be the responsibility of the developer. If the existing infrastructure, in the opinion of the WRM Department, is not sufficient to supply the quantity of water needed for the development, the developer may be required to participate in or to fully fund any necessary offsite infrastructure upgrades to obtain AWWB service. The amount of developer participation will depend on the amount of contiguous developable area that may be served by the expansion and the corresponding need of the AWWB-approved capital improvement plan. Developer participation in infrastructure improvements or expansions may be detailed in the Development Agreement, where required.

Once a development, that is to be served water by the AWWB, has been reviewed and approved by the DRT, the AWWB will reserve treated water capacity for the development, and the development will be allowed to connect to the AWWB distribution system as shown on the approved plans until said DRT approval expires, which is typically 18 months from the date of approval. Once DRT approval has expired, reserved capacity shall subsequently expire and the WRM Department will reevaluate the AWWB's capacity to serve the development when the plans are resubmitted for review and approval in accordance with the DRT requirements in this Manual. Reserved capacity will also be reviewed by the WRM Department prior to any requested extension of DRT approval, including preliminary plat or conditional use extension requests as they affect the DRT approval period. Reserved capacity for master development plans that will be brought to DRT in phases shall be detailed in the development agreement with a mutually agreeable time frame specified for future phases.

The developer will be responsible for coordinating with the applicable water service providers for developments not served by the AWWB to determine if adequate water supply is available.

2.3 Submittal Requirements

2.3.1 Overall Water Main Layout

The design engineer shall submit a complete set of design plans for review. The submitted plans shall be a complete set, comprehensive in all details of the design. The requirement to submit a set of design plans that are of a complete design shall not prevent an engineer from meeting with the WRM Department and submitting a "preliminary" design for recommendations and preliminary comments from the WRM Department. However, the WRM Department will only review and provide written comments on a completed set of design plans that are submitted for review, typically through the DRT process.

The submitted set of plans shall include the following:

- Overall water main layout of entire development
- Detailed plan sheets including all valves, main sizes, fittings, bends, hydrants, thrust restraints, and appurtenances with all features labeled
- All existing and proposed water facilities labeled and clearly differentiated
- Water main profiles (where required)
- Fire-flow calculations (where required)
- All standard details that are required
- Any unique details or notes relevant to the project
- All standard notes
- Grading plan indicating both the existing and the proposed contours
- Location of all other utilities adjacent to or crossing water mains

Additional requirements for the plans submitted for review are included in the City of Auburn Site Development Plans Submittal Checklist and the Subdivision Construction Plans Submittal Checklist (Appendix B). When the individual development is part of a larger Master Development Plan, the engineer may be required to submit an "overall water layout" for the entire development for review.

2.3.2 Water Main Profiles

Water main profiles are generally not required for the plans for a typical subdivision. However, the engineer must show the water main in the street or sewer profiles where the water main will cross any storm pipes, creeks, sewer lines, or any other obstruction. Profiles will be required for Alabama Department of Transportation (ALDOT) utility permits. Complete water main profiles are required for the installation of water mains 12 inches in diameter and larger.

All necessary water main profiles shall show and clearly label the existing and finished grades where the water main is to be located, NOT the centerline of the road, which typically varies from the shoulder elevation. All fittings, valves, hydrants, air release valves (ARVs), and other necessary appurtenances shall be shown at their proposed stations and elevations in both plan and profile views. Water main profiles shall take into account the maximum vertical deflections in determining where any vertical bends are required.

2.3.3 Fire-Flow Calculations

All developments currently within or that annex into the City are required to meet fire-flow demands as specified by the Public Safety Department Fire Division. The WRM Department will assist the Public Safety Department Fire Division in reviewing all fire-flow calculations to determine if adequate supply is available for the development. The engineer shall provide fire-flow calculations, upon request by either department, demonstrating the ability to meet the fire-flow requirements listed in the currently adopted International Fire Code (IFC), the Insurance Services Office's (ISO's) Fire Suppression Rating, and any applicable local code revisions at the time of the development submittal. In certain areas where availability of fire-flow demand for a particular development can be sufficiently demonstrated through existing infrastructure and is evident to both the Public Safety Department Fire Division and the WRM Department, a fire-flow calculation submittal may not be required.

2.3.3.1 Minimum Requirements

Under the IFC standards, the minimum fire-flow requirement for one- and two-family dwellings not exceeding 3,600 square feet (ft^2) shall be 1,000 gallons per minute (gpm) for 1 hour. The minimum fire-flow requirement for dwellings having a fire-flow area in excess of 3,600 square feet shall not be less than 1500 gpm for 2 hours or as specified in the IFC in Table B105.1. All developments are required to meet the fire-flow with a residual pressure of 20 psi for the specified duration. -The actual requirements for flow and duration that must be demonstrated are dependent on the size of the development as detailed in the IFC Appendix B and will be reviewed on a case-by-case basis by the Public Safety Department Fire Division.

In all cases, consideration must be given to the average domestic demand simultaneous to any fire-flow event.

2.3.3.2 Submittals

The fire-flow calculations shall be submitted to the WRM Department and the Public Safety Department Fire Division for review prior to DRT approval of the development. At a minimum, the calculations submitted shall include the following information, where applicable:

- A water distribution model of the internal development network, detailing all demand nodes. All hydrants and fire protection systems shall be properly identified and listed as demand nodes. Total domestic and irrigation demand shall also be estimated and input into the model.
- A list of assumptions, datum, or inputs used in determining the distribution model. This shall include any necessary information regarding the supply source and external distribution to the site when applicable.
- A schematic drawing of the distribution network with all demand nodes clearly labeled and identified.

- A table summarizing the output of the model for each fire-flow demand node that details, at a minimum, the following information:
    1. Static pressure (psi) at each fire-flow demand node in the system
    2. Flow (gpm) at each fire-flow demand node during a fire-flow event
    3. Residual pressure (psi) at each fire-flow demand node during a fire-flow event
    4. Modeled fire-flow duration at each fire-flow demand node
- If multiple adjacent hydrants are required to meet the fire-flow demand, a list of scenarios shall be included summarizing the infrastructures ability to meet the projected demands.
- Design information and flow model for all external distribution system improvements necessary to serve the development.

2.3.3.3 Fire Flow Information

Coordination with the water service provider will be required for any detailed fire-flow information, assumptions, fire hydrant flow data, or distribution system expansions that are necessary for a development. All flow tests for fire flow calculation submittals shall be accompanied by a representative of the WRM Department or the Public Safety Department Fire Division, and all fire hydrant flow data collected must be copied to the WRM Department for record-keeping purposes. Any existing flow data used for fire flow calculations may need to be verified if, in the opinion of the WRM Department, the data are erroneous.

2.4 Water Design and Layout

2.4.1 Water Main Location

The preferred location for the water main is on the north and east sides of the streets. If the specific design requirements do not allow for the water mains to be placed on the north and east sides of the street, the other utility companies must be notified by the engineer prior to DRT approval. The water main shall be laid generally at minimum cover.

The water main typically should be located in a public ROW, approximately 5 feet behind the curb, where possible, to provide for ease of access for maintenance and repairs. The water main shall be located in an area free from surface obstructions (signs, walls, utility poles, structures, ponds, water features, canopy trees, etc.) that, in the opinion of the WRM Department, would make maintenance or repairs to the water main more difficult. Water mains shall be a minimum of 15 feet from all habitable structures at minimum cover. Water mains with greater depths of cover may require additional separation from the habitable structures, as deemed appropriate by the WRM Department.

There are situations in which a water main cannot be placed entirely on the public ROW. In such situations, dedicated easements and property restrictions will be required to provide for future maintenance and repair of the water lines.

Generally, water lines shall not be allowed to be installed down lot lines or across the back of properties where access to the water lines would be restricted. However, there may be circumstances where it would be in the best interest of the WRM Department to allow such installations. Generally, this would be to provide for redundancy of the water system or to provide improved network circulation. Such installations will be handled on a case-by-case basis with the recommendation, or approval by the WRM Department. Where such installations are allowed, the water line will be required to be installed in a steel casing in a dedicated easement of proper width. The length of the casing shall extend at a minimum from building line to building line, plus the width of any utility easements. Valves will be required at both ends of the casing to provide for ease of maintenance.

2.4.2 General Design Considerations

The water distribution system shall be designed to provide for the delivery of potable water to the customers and, at the same time, to provide adequate water supply for fire protection considerations.

Typically, the domestic water component for a particular connection is small when compared to the fire-flow requirement for the area of the distribution system. The fire protection requirements will dictate the minimum size of the water main.

Particular requirements for fire protection can be found in the appropriate sections of this Manual, but the design intent is to provide adequate water pressure and supply for both fire protection and potable water consumption while not allowing the water pressure to fall below 20 psi at any point in the distribution system.

The maximum velocity in the public water distribution main during a fire-flow event shall be limited to 10 feet per second (fps) at the connection of the private fire line or fire hydrant service connection. If requested by the WRM Department, fire-flow calculations shall be provided for review in accordance with Section 2.3.3 of this Manual. When using the Hazen-Williams equation to calculate flow through a proposed water system, a roughness “C” coefficient of 140 shall be used for all new ductile iron pipe.

Generally, water mains shall be installed on a grid pattern with multiple connections (loops) to the water system. The intent of the grid pattern is to facilitate circulation and to provide redundancy in the water system. The minimum size water main to be used for grids in the distribution system is 6 inches. Additional connections may be required for a development if, in the opinion of the WRM Department, it is in the best interest of the public to promote circulation or to provide redundancy.

The design engineer shall take into account both the immediate needs of the current development and also the future needs of contiguous areas, and provide for ease of future expansion of the distribution system. This typically would be provided by the installation of additional valves at the end of the distribution system and/or additional connection points for additional developments. In such situations, the developer shall provide adequate easement to the property line for any future water main extensions.

All fittings, both horizontal and vertical, shall be shown on the plans, along with the type of thrust restraint required at each fitting location. Fittings shall be minimized in the design by utilizing pipe deflection for directional changes, where possible. A maximum 5 degree deflection angle is allowed at each joint for 12 inch and smaller diameter ductile iron pipe. The radius of curvature can be decreased by using shorter lengths of pipe, where necessary.

All water lines, 4 inches in diameter and larger, shall be Pressure Class 350, Ductile Iron pipe, conforming to the AWWB’s material specifications. All water lines 2 inches in diameter and smaller shall be Type K Copper, conforming to the AWWB’s material specifications.

2.4.3 Water Main Sizes

Water main sizes within the AWWB distribution system shall typically be 4, 6, 8, 10, or 12 inch diameters, as applicable. The sizing of a water main for a particular development will be based on several considerations, as follow:

- The AWWB’s overall water transmission and distribution needs.
- Fire-flow requirements for the development (i.e., residential or commercial)
- Size of individual development and need for redundancy and circulation mains
- Need to provide for development of contiguous areas

Every development will be evaluated individually to determine the required sizing of the water main. The developer shall be required to install appropriately sized water mains that will provide optimal service to all existing AWWB customers and proposed AWWB customers inside the development. The AWWB must approve all proposed water main sizes and has the right to require increased main sizes where a direct benefit will be provided to the development and the distribution system. Where increased main size is necessary only to serve future development of contiguous areas and provides no direct benefit to the immediate development, the developer may request the AWWB to participate in construction of the larger main. Such instances will typically require the AWWB to bid both size mains and receive contribution from the developer equal to the lowest competitive and competent bid price of the smaller main. This aspect will be discussed with the developer during the review phase.

The minimum water main size allowed for a typical subdivision development shall be 6 inches. The water main size shall be reduced to 4 inches in the case of a cul-de-sac past the last fire hydrant, because of water age and water quality issues, but shall in no case exceed 500 feet in length. The minimum water main size for a commercial, industrial, or high density residential development shall be 8 inches.

2.4.4 Water Main Connections

All connections to existing mains within the AWWB's distribution system must be approved and properly permitted by the AWWB before they can be made. Connection permits can be acquired from the WRM Department. The permit application is available on the City's website and shall be submitted electronically. At least 48 hours should be accounted for review and approval of all connection permits by the AWWB, regardless of size. Prior to submitting the permit application, a plan for all water main connections shall be submitted to the WRM Department for review and approval if not included in a previous DRT submittal. Developments that are required to submit plans to the DRT, in accordance with the standards included in this Manual, shall receive DRT approval prior to receiving approval for a water main connection. All connections to existing mains shall be done in the presence of a City inspector or a representative of the AWWB. The Water Main Connection Permit will be provided to the appropriate AWWB representative or City inspector by the WRM Department upon approval for the authorization of the connection.

Connections to existing water mains shall be designed for the greatest operational flexibility of the water system while maintaining the least disturbance to the existing customers as possible during installation. In most cases the WRM Department will require main connections, 4" and greater in diameter, to be a new ductile iron tee fitting cut into the existing main. In some special circumstances a ductile iron or stainless steel tapping sleeve and valve may be utilized with prior approval of the WRM Department. The WRM Department will require a tee to be cut into the system in the case of high-pressure areas (greater than 100 psi), or where the connection requires valves to be installed on the existing water main. Connections requiring an outage to existing commercial or industrial customers shall be done after normal hours of operation of the affected customers. Connections requiring an outage to existing residential customers only shall be done during off peak usage hours. All scheduled outages shall be coordinated with the AWWB at least 7 days in advance.

Any connection to the existing services shall be detailed completely on the plans and shall identify all fittings and line sizes. All applicable standard details shall be included with the plans. Although this Manual presents standard details applicable to most projects, the design engineer must provide any additional details, drawings, or other information that may be required to describe the work. Multiple water feed connections may be required by the WRM Department to enhance circulation and to provide for service redundancy, which would reduce the inconvenience to the public in the event of a water main break or water main shutdown.

The following connection fittings shall be used when tapping an existing water main in the AWWB distribution system, where approved:

- Stainless-steel tapping sleeve and gate valve – Required for all taps 4 inches and larger in diameter where a cut in tee is not installed.
- Ductile iron tapping sleeve (full body) and gate valve – Required for all "size-on-size" taps (i.e., 6 inch tap to a 6 inch main line) where a cut in tee is not installed.
- Double strap tapping saddle and gate valve – Required for all 2 inch diameter taps
- Direct tap and corporation stop valve – Required for all 1 inch diameter taps

One-inch-diameter taps shall not be placed at a spacing less than 12 inches, and taps larger than 1 inch shall not be placed at a spacing less than 36 inches.

Service line connections to the AWWB distribution system shall typically be 1, 2, or 4 inch diameters, as applicable. The AWWB does not allow 3 inch diameter connections, fractional diameter sizes (i.e., ¾ inch, 1 ½ inch, etc.), or connections smaller than 1 inch in diameter. In cases where the proposed meter size does not correspond to an approved service line diameter, the service line shall be increased in size to the next approved service line diameter. Each metered service shall have only one connection to the distribution main and in no case shall the connection and service line diameter be smaller than the diameter of the meter. Manifold connections of smaller diameter service lines are not allowed for an individual service. Where larger service lines are required, the diameters shall correspond with the typical water main sizes.

2.4.5 Cover Requirements

2.4.5.1 Minimum Cover

The minimum cover over the water main shall typically be measured from the top of the water main to the top of the finished grade elevation above the water main. Water main design in cut sections of a roadway shall take into account adequate depth to provide service across the roadway with the specified minimum cover for the service line under the pavement. Table 2-1 provides the minimum depth of cover based on water main and/or service size.

TABLE 2-1
Minimum Cover
WRM Department Design and Construction Manual, Auburn, Alabama

Size of Pipe	Minimum Cover
8 inches and smaller	30 inches
10 inches and larger	36 inches

It is the responsibility of the engineer to ensure that all existing water mains maintain the minimum cover on a site being developed. If the existing grade is to be lowered over an existing water main, the existing water main will have to be lowered or replaced so that the minimum cover requirements are met.

2.4.5.2 Maximum Cover

Typically, the water main will be installed with the minimum cover. There may be situations, however, where the water main needs to be installed deeper. Such situations may include obstructions, adjacent to roadways in cut sections, or when approaching a creek or road crossing.

The maximum depth of cover for a water main shall be limited to no more than 8 feet of cover. This maximum depth requirement is necessary to allow for maintenance on the water main with standard rubber tire excavation equipment. The 8-foot maximum cover shall not apply when the water main is installed in a casing. Consideration shall be given, however, for maintenance concerns and access to the ends of the water main at the casing.

Special depth consideration also must be taken into account where vaults are to be installed. The maximum depth of cover where a water main enters a vault typically will be limited to no more than 4 feet of cover to minimize the depth of the vault.

It is the engineer’s responsibility to ensure that all of the existing water mains do not exceed the maximum cover on a site being developed. If the existing grade is raised over an existing water main, the water main shall be raised as necessary to maintain the appropriate maximum depth of cover.

2.4.6 Utility Crossings

All utility facilities and lines shall be shown on the plans. Any locations where the water mains cross beneath storm sewer or sanitary sewer pipelines or other obstructions shall be shown on the plans. All utility crossings shall be laid out so that they are centered on a section of pipe, providing the maximum spacing between the joints and the crossing.

Water lines generally will be installed so that they would cross over the top of the storm sewer and sanitary sewer pipes. There may be certain circumstances where this is not feasible. These situations will be handled on a case-by-case basis. To provide for future maintenance of the water lines, the installation of a steel casing may be required when the water mains are not accessible and pass beneath another pipeline.

2.4.6.1 Separation from Sanitary Sewer

Water mains shall be designed so that they are separated from sanitary sewer lines by 10 feet horizontally and 18 inches vertically. The distance shall be measured from the outside-of-pipe to the outside-of-pipe. Where proper horizontal or vertical separation cannot be attained, refer to Section 3.4.7 of this Manual.

2.4.6.2 Separation from Storm Sewer

Water mains and storm sewer utilities shall be designed to maintain a minimum separation of 24 inches horizontally and 6 inches vertically to allow for maintenance. The minimum separations are intended to be a guideline for determining the proposed location of water mains in relation to storm sewer utilities only where unavoidable constraints exist. Greater-than-minimum separation shall be accounted for and provided in most cases where necessary easement or ROW space is available. Typically, water mains shall be located greater than 36 inches horizontally from all storm sewer utilities. Crushed stone backfill shall be used where the vertical separation between the utilities is less than 2 feet. In no case will a water main be allowed inside a storm sewer structure.

2.4.7 Road Bores and Casings

Road borings for water mains will typically be required in lieu of open-cut trenching methods when crossing existing paved streets in the City of Auburn or when crossing a county, state, or federal highway or railroad. This determination will be made on a case specific basis by the City's Public Works Department and/or the appropriate ROW authority, where applicable.

Where road borings are required, they shall typically be a traditional jack-and-bore construction method using a steel casing. Where possible, the steel casing shall extend at least 5 feet beyond the edge of the roadway or planned roadway widening, but shall in no case continue within 5 feet of a water main connection, fitting, or valve. Directional drilling methods may also be allowed by the WRM Department in certain situations for the installation of new water mains and services.

All bores for water service connections shall be aligned and delivered precisely to the location shown on the construction plans to minimize additional fittings required at the main connection. The existing water main shall be excavated as part of the receiving pit prior to setting up the bore to determine the necessary depth for a front-side connection to the main. Back-side connections will not be allowed, unless approved by the WRM Department. All other utilities shall be located and potholed, where necessary, prior to performing the bore. Where open-cut trenching methods are allowed across an existing paved street for new water mains and services, the repair shall be made in accordance with the standards of the appropriate ROW authority.

Steel casings also may be required if, in the opinion of the WRM Department, the water mains are located in an area that would make maintenance on the water main difficult or impractical. Installing water mains in such areas will be at the discretion of the WRM Department, and will only be allowed where it is in the best interest of the distribution system. Steel casings shall be sized according to the carrier pipe size with appropriately sized spacers to center the pipe in the encasement. The pipe joints shall be restrained using external restraint mechanisms or locking gasket restraints for retrieval of the pipe from the encasement. The ends of the encasement shall be sealed with brick and mortar or with a rubber boot and double stainless steel bands to prevent water from entering the casing. Encasements shall be installed per the AWWB Standard Detail No. 212 (Appendix A).

2.4.8 Thrust Restraint Devices

Thrust restraint will be required for all water lines 4 inches or larger where unbalanced forces exist. This shall include all ends of main locations where plugs or caps are installed, all changes in size or direction where fittings such as reducers, tees, horizontal bends, vertical bends, etc., are installed, and where the water main is installed in close proximity to a filled slope.

The engineer is ultimately responsible for the design of the restraint devices for the water main. This Manual provides guidance and recommended minimums for the length of restraint required, but it is the responsibility of the design engineer to verify that this information is valid and applicable for the specific installation.

All thrust restraint devices shall be indicated on the plans. Any additional information or unusual circumstances or conditions concerning the restraint design shall be discussed with the WRM Department.

2.4.8.1 Restrained Joint Devices

The preferred method of thrust restraint is through the use of externally restrained joint devices such as Mega-Lug or approved equal in lieu of concrete blocking.

Tables 2-2 through 2-5 provide the minimum linear footages of restraint required past the fittings using Mega-Lug restraint devices, according to the Restraint Length Calculator Version 5.5 provided by EBAA Iron, Inc., with the following assumptions: Type 3 trench conditions as defined in American Water Works Association (AWWA) C150, minimum cover over the pipe, worst-case soil conditions (ML or CH, granular fill), safety factor of 1.5, and a maximum working pressure of 100 pounds per square inch (psi) (hydrostatically tested to 200 psi). These tables are intended as a guide and are subject to evaluation for each site-specific condition. Additional restraint design will be required where the working pressures exceed 100 psi, where trench conditions vary, or where alternate thrust restraint mechanisms are approved. If the site conditions on all or part of a development are different from the assumptions used in these tables, the lengths of restraint can be modified, as beneficial to the development, with the submittal of a restraint design by the engineer to the WRM Department for approval. All alternate thrust restraint designs shall include detailed drawings and list all assumptions used, along with providing any necessary supporting documentation for those assumptions (i.e., geotechnical report, main profile, etc.).

All thrust restraint shall be adequately calculated by the engineer and clearly detailed on the plans. The exact linear footage of restraint shall be shown at each location and shall be measured from the flange of the fitting that is being restrained.

Where restraint listed in Tables 2-2 through 2-5 is less than a full joint of pipe, unless otherwise directed by the WRM Department, a minimum of one full joint of pipe shall be restrained on both sides of the fitting.

TABLE 2-2
External Thrust Restraint for Bends and Dead Ends (Linear Feet of Restraint Required on each Side of the Fitting along the Main Line)
WRM Department Design and Construction Manual, Auburn, Alabama

	Fitting				
Main Size, Inches	**Dead End, or (Valve)**	**90°**	**45°**	**22.5°**	**11.25°**
4	42	28	12	6	3
6	58	39	16	8	4
8	76	50	21	10	5
10	77	51	21	10	5
12	91	59	25	12	6

TABLE 2-3
External Thrust Restraint for Cut-In Tees on Existing Mains (Linear Feet of Restraint Required along the Branch Line Only)
WRM Department Design and Construction Manual, Auburn, Alabama

	Existing Main Size				
Branch Size, Inches	**4**	**6**	**8**	**10**	**12**
4	42	39	37	34	31
6	61	58	55	52	49
8	82	79	76	73	69
10	-	98	94	91	87
12	-	118	114	111	106

TABLE 2-4
External Thrust Restraint for Tees on Proposed Mains (Linear Feet of Restraint Required along the Branch Line in Addition to 20-feet of Restraint on Both Sides of the Tee along the Main Line)
WRM Department Design and Construction Manual, Auburn, Alabama

	Main Size				
Branch Size, Inches	**4**	**6**	**8**	**10**	**12**
4	14	1	1	1	1
6	41	30	20	9	1
8	67	57	48	38	29
10	-	79	71	62	53
12	-	102	94	86	77

TABLE 2-5
External Thrust Restraint for Reducers (Linear Feet of Restraint Required on the Large Side of the Reducer)
WRM Department Design and Construction Manual, Auburn, Alabama

	Small Side				
Large Side, Inches	**4**	**6**	**8**	**10**	**12**
6	30	-	-	-	-
8	55	32	-	-	-
10	74	56	31	-	-
12	92	77	57	31	-

2.4.8.2 Concrete Blocking

For water main sizes less than 12 inches, concrete thrust blocking may be approved on a case-by-case basis by the WRM Department where it can be demonstrated that external restrained joints are not feasible for the particular application. Concrete blocking shall only be allowed in areas where there is no interference with other utilities or where obstructions are not present that would limit the effectiveness of the thrust restraint.

Where approved, concrete for thrust restraint shall be a minimum of Class B, 2000-psi design mix. The thrust bearing sides of all concrete blocking shall be poured against firm undisturbed soil and the non-thrust bearing sides shall be formed at a 45 degree angle to the undisturbed soil. Concrete blocking shall be designed for the appropriate directional restraint and bearing area in accordance with the AWWB Standard Detail No. 202 and 204 (Appendix A).

All mechanical joint fittings shall be wrapped in plastic prior to pouring thrust restraint blocking and concrete shall not be poured over any joints, to maintain accessibility to the joints for repairs. Calcium chloride shall not be used to accelerate the curing process of the concrete due to its corrosive properties. All concrete blocking shall be given a curing time of not less than 5 days prior to filling the main and performing a hydrostatic pressure test.

2.4.9 Water Valves

Isolation valves will be required by the WRM Department on all public water mains as necessary for the appropriate operation and maintenance of the distribution system. Isolation valves shall be located in a manner that minimizes disturbance to customers during maintenance or repair operations.

The spacing requirements presented in this Manual are to be considered maximums; the WRM Department may require additional valves due to unusual circumstances or the need to minimize the disruption to the distribution system.

Any new connection to the water system shall include valves to isolate the new connection. Typically, isolation valves shall be installed on all pipe segments extending from tees and crosses (i.e. three valve make-up at all tees and four valve make-up at all crosses), unless otherwise approved by the WRM Department. Valve make-ups at intersections shall typically be located outside the paved roadway unless additional fittings or bends will be required due to the water main alignment. All valve make-ups at tees or crosses shall be installed in close proximity to the tee or cross, and shall not be spread across the intersection.

Valves shall be installed on each side of all creek crossings, major street crossings, or other obstructions so that the water main can be taken out of service for maintenance with the least disruption to the public. In a typical subdivision where the water mains are extended to serve each successive development, a valve will be required at the end of each successive development phase so that the water main can be extended without requiring a shutdown.

Generally, isolation valves shall be installed at the maximum intervals shown in Table 2-6 for typical subdivision developments.

TABLE 2-6
Maximum Valve Spacing
WRM Department Design and Construction Manual, Auburn, Alabama

Water Main Size	Maximum Valve Spacing
4 inches	400 feet
6 inches	600 feet
8 inches	800 feet
10 inches	1,000 feet
12 inches	1,200 feet

However, this spacing may be increased for transmission mains, with no service connections, where an isolation valve is to be installed after every other fire hydrant. The maximum valve spacing allowed for transmission mains is twice that required for fire hydrant spacing, which is detailed in Section 2.4.12.2 of this Manual.

All proposed isolation valves shall be resilient wedge gate valves unless otherwise approved. Each underground gate valve shall be provided with a cast iron valve box to house and protect the valve stem. All valve boxes installed in unpaved areas shall have a concrete collar installed. If a precast collar is used, the annular space between the valve box and the concrete collar shall be grouted. Ductile iron or cast iron pipe shall not be used as valve box extension unless approved. Polyvinyl chloride (PVC) should never be used as a valve box extension.

All plans shall include the statement that only the AWWB or personnel authorized by the AWWB may operate valves inside the AWWB distribution system, where service has been activated.

2.4.10 Air Release Valves

Air release valves (ARVs) will be required on all distribution system expansions where water mains are extended to serve outlying developments, or where necessary for operating the distribution system. Each ARV installed shall be sized according to the site-specific conditions, and the engineer shall provide design calculations to the WRM Department for review.

2.4.10.1 Automatic Air Release Valves

There are three general types of automatic ARVs that are used in water distribution systems:

- Standard ARVs (small orifice valves): Designed for the slow release of air during normal pipeline operations.
- Air/Vacuum Valves (large orifice valves): Designed to release large amounts of air during filling operations, and to admit large amounts of air during draining (in case of a main break).
- Combination Air Vacuum/ARVs (small and large orifices): Designed to perform both functions of small and large orifice ARVs.

The primary types of automatic ARVs used in the AWWB's distribution system are standard small orifice ARVs for the slow release of air during normal pipeline operations. Generally, automatic ARVs will not be required in a typical subdivision installation because of the number of connections that accomplish this goal. Automatic ARVs typically are required when a water main is extended a long distance to serve a new development, typically over 1000 feet. ARVs may also be required where considerable grade change exists where few customer connections are present.

If automatic ARVs are required, they shall be installed at all high points and at a distance between ARVs not to exceed 1,500 feet. The high points shall be field verified during construction to ensure appropriate placement, and the ARVs shall be installed on a level section of pipe equidistant between the joints. The pipe should continually slope between ARVs.

Automatic ARVs shall be sized and located in accordance with the design criteria provided in the AWWA Manual M51, *Air-Release, Air/Vacuum, & Combination Air Valves,* and shall be installed in accordance with the AWWB Standard Detail No. 234 (Appendix A).

Air/vacuum and combination valves typically are not allowed in the AWWB distribution system unless specified by the WRM Department.

2.4.10.2 Manual Air Release Valves

Manual ARVs, which also are referred to as blow-off valves, are designed to manually release air during the process of filling a main. These ARVs typically are required at the ends of mains where a fire hydrant is not available to flush the main, at high points in the main, or as necessary for filling and pressure testing a main. Manual ARVs shall be extended to a curb where possible, or to a standard meter box if the end of the main is not adjacent to a curb location.

Manual ARVs shall be installed in accordance with the appropriate AWWB Standard Details (Appendix A), as applicable.

2.4.11 Pressure-Reducing Valves

The engineer is responsible for determining the static water pressure at the connection point to the water system.

The City maintains different pressure zones across the distribution system. Information regarding these pressure zones is available from the WRM Department.

The engineer is responsible for evaluating the normal operating pressure of the system and determining if a pressure-reducing valve (PRV) is needed. For a normal single-family residential customer, a PRV is recommended when the static pressure at the connection point is more than 70 psi. If a PRV is installed, it must be installed behind the meter in a separate box, located on the customer's property. This PRV is owned and maintained by the customer. Any PRV installed must be installed in accordance with the local plumbing codes.

Developments in areas where static pressures exceed 100 psi may be required to install a large diameter PRV on the public main entering the development at the discretion of the WRM Department. The PRV shall be manufactured by Ames, Watts, Cla-Val, or an approved equal and shall be installed in an approved concrete vault. The pressure set point shall be determined by the WRM Department.

2.4.12 Fire Hydrants

2.4.12.1 Location

Fire hydrants are required on all public mains for public safety and for maintenance of the distribution system. Fire hydrants shall be located in unobstructed and accessible locations that minimize the potential for damage to vehicles or injury to pedestrians while facilitating adequate fire protection and distribution maintenance use. Fire hydrants shall be located based on the currently adopted International Fire Code (IFC) Appendix C, any applicable local code revisions at the time of the development submittal, and any recommendations of the Public Safety Department Fire Division and/or the WRM Department.

Fire hydrants shall not be physically or visually obstructed from the travel way. Landscaping, fences, signs, structures, and any other movable or immovable impediments will not be allowed where they may be considered a hindrance in the opinion of the AWWB or the Public Safety Department Fire Division. No vertical landscaping taller than 6 inches will be allowed within 5 feet of a fire hydrant.

2.4.12.2 Spacing

Under the IFC standards, the maximum spacing for fire hydrants in developed areas where structures needing fire protection will exist shall be 500 feet, with a maximum distance of 250 feet from any point on the road frontage to a fire hydrant. The actual maximum spacing requirements for fire hydrants within a development depend on the fire-flow requirements, as detailed in IFC Appendix C, and will be reviewed on a case-by-case basis by the Public Safety Department Fire Division.

Fire hydrants also will be required within 125 feet of any Fire Department Connection for private sprinkler systems.

On transmission mains, where hydrants are not needed for the protection of structures, the maximum spacing for fire hydrants can be extended to 800 feet. All fire hydrant locations must be approved by the Public Safety Department Fire Division and the WRM Department.

2.4.12.3 Installation

Fire hydrants shall be three-way assemblies with two, 2 ½-inch hose connection nozzles and one, 4 ½-inch steamer connection nozzle. Each fire hydrant set shall be connected using a 6-inch mechanical joint anchoring tee assembly and shall have its own isolation valve. Generally, in-line valves on the main line supplying the fire hydrant shall be positioned so that no more than two fire hydrants are taken out of service when a water main is shut down and in accordance with the valve spacing standards in Section 2.4.9. Fire hydrants shall be installed plumb, and to the appropriate “bury” line on the riser providing 18 inches from the ground to the steamer nozzle. The steamer nozzle should face the curb, edge of pavement, or travel way. The outsides of all fire hydrants shall be painted with yellow high-gloss machinery enamel when installed.

Fire hydrants shall be specifically designed and installed in accordance with AWWA Specification C502, the AWWB Standard Specifications, and AWWB Standard Detail No. 214

(Appendix A). Any fire hydrants installed in state highway ROWs shall also be in accordance with any applicable ALDOT standards.

2.4.13 Fire Protection and Fire Lines

A fire line is defined as a connection to the public water system that serves sprinklers, private fire hydrants, standpipes, and fire pumps, primarily to provide water for fire protection. Any fire line connection to the public water system will be protected against backflow into the public water system with the appropriate backflow protection device in accordance with Section 2.4.15 of this Manual.

The design engineer is completely responsible for the design of the private fire line. The City's Public Safety Department will review private fire protection systems for compliance with all applicable fire protection codes.

The potable water connection may be taken off the same connection as the fire line in the event that the main is on the opposite side of the street and would require a long side tap, provided that the appropriate backflow protection and a separate isolation valve are installed.

AWWB's responsibility for maintenance of a fire line will stop at the isolation valve for the fire line, typically where the connection is made to the distribution system. The maintenance of fire line vaults and associated backflow prevention assemblies will be the responsibility of the property owner.

Backflow protection will be required prior to all Fire Department connections, including master metered private systems where the fire-flow is metered, to prevent contamination of the potable water distribution system.

2.4.14 Water Meters

All service connections to the AWWB shall be equipped with an appropriate type and size meter for the proposed development prior to the required backflow protection device. Isolated fire line connections, which are not required to install line size meters, shall be required to install a detector check backflow assembly, which includes a low-flow meter to ensure that water is not being used through the connection except for fire protection use. All existing and proposed water meters shall be clearly shown and detailed on the plans. All meters shall be installed per the manufacturer's instructions.

2.4.14.1 Type

The WRM Department will determine what type of meter is needed for an individual customer. This determination will be made based on information collected and submitted during the plan review process. For customers other than single-family residential, the type of meter shall be indicated on the plans. Meters shall be manufactured by Neptune Technology Group and shall be equipped with Neptune R-900 Pro Read Registers. As a guide, the four main types of meters are presented in Table 2-7, along with an example of a typical installation.

TABLE 2-7
Meter Selection
WRM Department Design and Construction Manual, Auburn, Alabama

Meter Type	Neptune Model	Application	Examples
Positive Displacement	T-10	Low to medium flows	Individual Residences, Small Commercial, Irrigation
Compound	Tru/Flo	Varying low to high flows	Apartment Complexes, Large Commercial
Fire Service Assembly	Protectus III	Varying low to high flows	Combined fire and domestic water systems

2.4.14.2 Location

Meters shall be located at the edge of the easement or ROW in an accessible location. Site grades, main location, service line location, and site layout shall be considered when determining the meter location for a site. Meters shall not be located in traffic areas, sidewalks, or within 10 feet of any structure, and shall not be covered, hidden, or obstructed by landscaping or any other movable or immovable objects.

All meters shall be installed in a meter box or vault per the applicable AWWB standard detail. Meter boxes shall be installed flush with the surrounding grade.

2.4.14.3 Meter and Service Line Sizing

The engineer is responsible for properly sizing the water meter and service line for the customer. Design criteria provided in the AWWA Manual M22, *Sizing Water Service Lines and Meters*, the currently adopted International Plumbing Code (IPC), and any applicable local code revisions at the time of the development submittal shall be considered when properly sizing service lines and meters.

Water meters shall be sized, at a minimum, for the peak instantaneous demand based on the fixture unit values assigned by the IPC for the specific type of development. Service line sizing shall take into account all demand needs and all pressure and friction losses due to elevation change and service length. Service lines shall be designed to provide sufficient capacity to serve each lot fronted by the service line, including each meter and fire system connection. Service lines shall not be smaller in diameter than the proposed meter size. Table 2-8 provides the maximum number of ¾-inch and 1-inch meters that are allowed on a given service line size.

When installing multiple meters on a single property, the AWWB will allow up to two standard ¾-inch meters in a standard meter box using a branch connector, per the AWWB Standard Detail No. 244 (Appendix A). Only one standard 1-inch meter will be allowed in a standard meter box.

TABLE 2-8
Maximum Number of ¾-inch and 1-inch Meters Allowed by Service Line Size
WRM Department Design and Construction Manual, Auburn, Alabama

Service Line Size, Inches	¾ Inch Meters	1 Inch Meters
1	2	1
2	8	4

The WRM Department requires all fixture unit data to be submitted with the plans for initial review on the Water Demand Table located on the Application for Water and Sewer Service (Appendix B), and will review the meter and service line sizing criteria according to the information provided. The WRM Department will use the project information submitted to determine a minimum meter size required and meter type to ensure the optimal reading accuracy of the meter for the intended use. It is the engineer's responsibility to provide accurate information and to determine the suitability of a particular meter size for the development. The AWWB and the WRM Department do not assume any responsibility or liability for the sizing of meters for a particular customer.

2.4.15 Backflow Protection Devices

Backflow protection devices will be required for all private connections to the AWWB distribution system. The backflow protection devices will be installed at the edge of the ROW or easement for all connections and shall be immediately behind all meters. The exact type of backflow protection device will be determined based on information submitted during the plan review.

All required backflow protection devices shall be noted on the plans and installed according to the applicable AWWB Standard Detail (Appendix A).

2.4.15.1 Authority

The AWWB, as a water purveyor under state regulations, is required to meet the Cross Connection Control Requirements under the Water Supply Program administered by ADEM. Specifically, Chapter 335-7-9 of the ADEM Administrative Code establishes the minimum requirements for public water systems.

The AWWB adopted an updated Backflow Prevention and Cross-Connection Control Policy effective January 1, 2011 in compliance with ADEM regulations. The Backflow Prevention and Cross-Connection Control Policy establishes the minimum water service requirements for necessary protection of the AWWB's water distribution system.

2.4.15.2 Purpose

As required by ADEM, a public water system shall be designed, installed, maintained, and operated in such a manner as to prevent contamination from being introduced through any water service connection in the system.

2.4.15.3 Backflow Protection

Every new connection to the water system will have some type of backflow protection installed at the time service is established.

Each service connection shall be protected against a backflow incident. The exact type of backflow protection will be determined based on the degree of hazard of a backflow incident from the customer's premises, not the likelihood of a backflow incident occurring.

The device also will be determined based on the potential consequences of a backflow incident. A backflow incident may be considered to be a "pollutant" issue, wherein the introduction of the material is mainly an aesthetic issue. For the purposes of the backflow protection, a pollutant is defined as, "A foreign substance, that if permitted to get into the public water system, will degrade its quality so as to constitute a moderate hazard, or impair the usefulness or quality of the water to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably effect such water for domestic use."[1]

The consequences of a backflow incident also could be considered to be a "health" issue. Backflow incidents that are considered a "health" issue would involve the introduction of a contaminant that would be considered dangerous to the public. For the purposes of the backflow protection, a contaminant is defined as, "A substance that will impair the quality of the water to a degree that it creates a serious health hazard to the public leading to the poisoning or spread of disease." These types of backflow incidents are considered to be the most serious types of backflow incidents. As such, they require the highest degree of backflow protection.

The recommended protection for specific categories of customers was developed from the AWWA Manual M14, *Backflow Prevention and Cross-Connection Control.*

2.4.15.4 Types of Backflow Protection

Each new application for new water service shall include the AWWB Backflow Protection Information Form (Appendix B). This form will be reviewed to determine the specific type of backflow protection device required.

Each type of backflow protection device identified shall meet all applicable local plumbing codes.

The general types of backflow protection devices are presented below:

- Dual Check Valve (DCV): Minimum type of protection required; this type is automatically installed for each new residential connection or service connection that is 1 inch in diameter and smaller which does not present a specific health or pollutant hazard to the system as identified by the AWWB. This device consists of two internally loaded check valves. DCVs are not testable backflow prevention assemblies.
- Double Check Backflow Assembly (DCBA): Level of backflow protection typically required for "pollutant" type hazards and as a minimum protection for any connection larger than 1 inch.

[1]Definitions from EPA Cross-Connection Control Manual, EPA Office of Drinking Water, 1989

- Reduced Pressure Backflow Assembly (RPBA): Highest degree of backflow protection. Required for "health" or "contaminant" types of hazards.

Isolated fire line connections, which are not required to install line size meters, shall be required to install a detector check backflow assembly, which includes a low-flow meter to ensure that water is not being used through the connection except for fire protection use.

2.4.15.5 Double Check Backflow Assemblies

Description

DCBAs consists of two internally loaded check valves installed between two resilient-seated gate valves with properly located resilient-seated test cocks as shown in Figure 2-1.

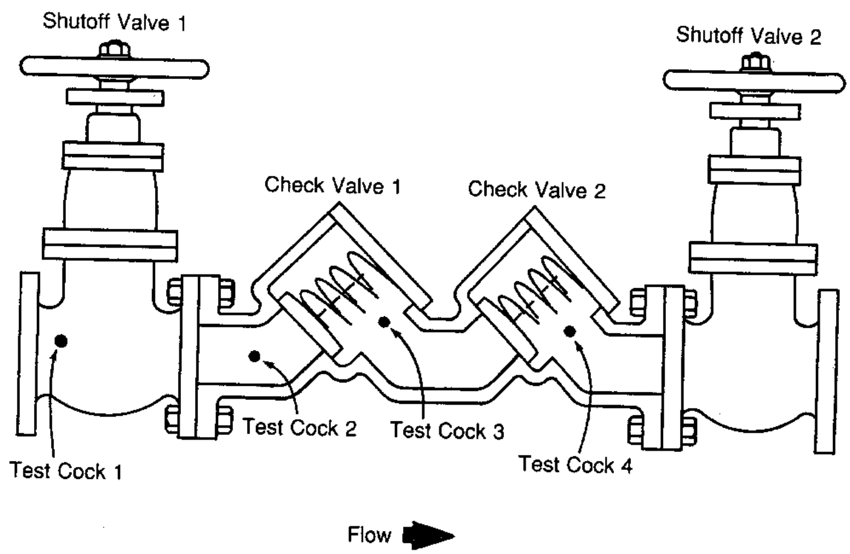


FIGURE 2-1
Double Check Backflow Assembly (DCBA)
AWWA Manual M14, *Backflow Prevention and Cross-Connection Control*

Facilities Requiring DCBAs.

DCBAs that meet all of the applicable plumbing codes will be required to be installed when the potential backflow consequences would constitute a "pollutant" hazard.

The DCBA device shall meet AWWA C510-97 (latest revision) and be approved by the Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California, as well as all local plumbing codes.

The WRM Department will evaluate each facility on its own unique set of circumstances for the type of backflow protection required. The following list has been developed as a general guide for the type of facilities requiring DCBAs:

- Connections to other approved public potable water systems (e.g., LWA, BWA, and OU)
- Connections larger than 1 inch
- Multistoried building without booster pumps
- Fire lines and fire hydrants with no chemical addition capability

Installation.
DCBAs shall be installed in a vault in accordance with this Manual and with the applicable AWWB Standard Detail (Appendix A). DCBAs shall be manufactured by Ames, Watts, or an approved equal.

DCBAs shall not be equipped with a bypass connection unless a completely redundant DCBA system is installed.

2.4.15.6 Reduced Pressure Backflow Assemblies

Description
RPBAs consists of two independently acting check valves together with a hydraulically operating, mechanically independent pressure-differential relief valve installed between two resilient-seated gate valves with properly located resilient-seated test cocks as shown in Figure 2-2.

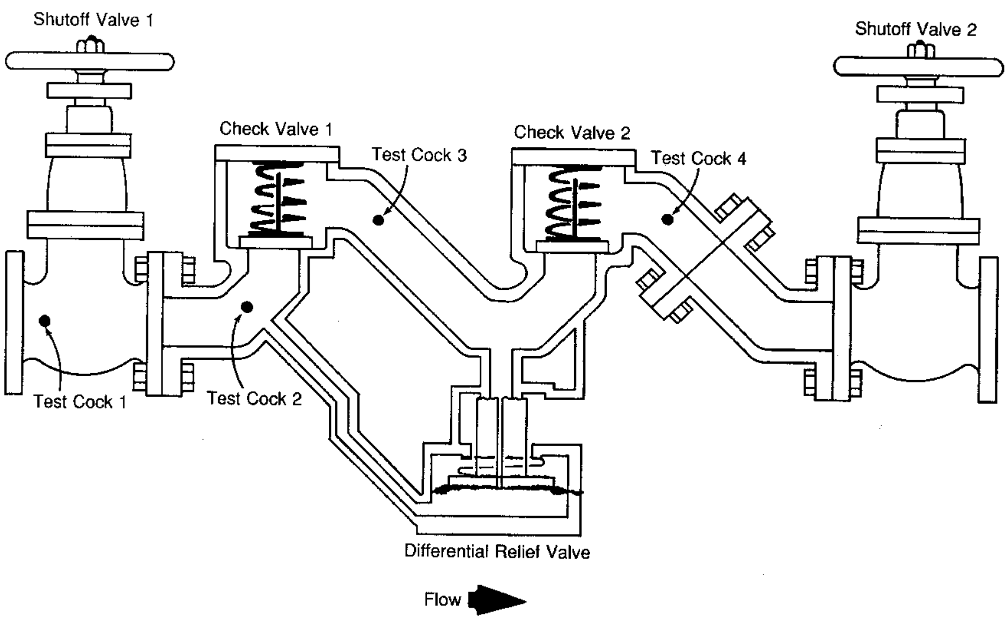


FIGURE 2-2
Reduced Pressure Backflow Assembly (RPBA)
AWWA Manual M14, *Backflow Prevention and Cross-Connection Control*

Facilities Requiring RPBAs.
RPBAs that meet all applicable plumbing codes will be required to be installed when the potential backflow consequences would constitute a "health" hazard due to the introduction of a "contaminant" into the water system.

The RPBA device shall meet AWWA C511-97 (latest revision) and be approved by the Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California, as well as all local plumbing codes.

The WRM Department will evaluate each facility on its own unique set of circumstances for the type of backflow protection required. The following list has been developed as a general guide for the type facilities requiring RPBAs:

- Car washing facilities
- Multistoried buildings with booster pumps
- Commercial laundries
- Sewer treatment plants and sewer pump stations (private or public)
- Hospitals or medical centers
- Veterinary facilities
- Mortuaries
- Laboratories
- Premises with restricted access
- Facilities with cooling systems connected to the water system
- Food and beverage processing facilities
- Chemical plants using water
- Metal plating plants
- Petroleum processing or storage facilities
- Radioactive material processing plants/nuclear reactors
- Premises with fire lines and/or private fire hydrants with potential chemical addition (i.e., foamite systems, antifreeze addition, close proximity to auxiliary water supply)
- Premises with an auxiliary water supply for domestic or irrigation services
- Premises using “reclaimed” water
- Facilities with complex piping
- Any premises that, in the opinion of the WRM Department, constitutes a “health hazard” should a backflow incident occur

Installation.

RPBAs shall be installed in an insulated aboveground enclosure in accordance with the AWWB Standard Detail No. 218 (Appendix A). RPBAs shall not be installed in a vault below grade due to the contamination hazard that exists if the relief valve becomes submerged. RPBAs shall be manufactured by Ames, Watts, or an approved equal.

RPBAs shall not be equipped with a bypass connection unless a completely redundant RPBA system is installed.

2.4.15.7 Initial Testing and Certification

If a backflow protection device is required ***other*** than a standard DCV, the backflow protection device must be tested by a certified tester upon installation in accordance with the AWWB's Backflow Prevention and Cross-Connection Control Policy. The test report indicating that the device is functioning correctly shall be submitted on the AWWB Backflow Testing and Certification Form (Appendix B) prior to a certificate of occupancy being issued and service being activated.

2.4.15.8 Inspection Program

Once installed, the backflow protection devices shall be inspected following the AWWB's Backflow Prevention and Cross-Connection Control Policy requirements. Any deficiencies found must be corrected or the water service will be discontinued, per Chapter 335-7-9 of the ADEM Administrative Code.

2.4.16 Concrete Vaults

Concrete vaults are to be used for any service connection larger than 1 inch that houses meter assemblies, PRVs, testable double check backflow assemblies (TDCBAs), and/or any other water related appurtenances that are not recommended by the manufacturer for direct-bury applications. Concrete vaults also are required for multiple meter pits, where more than six standard ¾-inch meters or more than three standard 1-inch meters are to be installed for a commercial or multi-family development.

2.4.16.1 Installation

Vaults shall be sized and arranged according to the appropriate AWWB Standard Detail (Appendix A) for the purpose for which they are intended. All vaults must be inspected and approved by the AWWB prior to being placed in the ground.

Vaults shall be installed level to ensure proper drainage and the surrounding grade shall be modified where necessary to accommodate drainage. The top of the vault shall be between 2 to 6 inches above finish grade. Vaults shall be placed at an adequate distance from any other utility lines or structures to allow safe excavation for any needed repairs. Vaults shall not be located in traffic areas or sidewalks.

Vaults shall be no more than 6 feet deep and shall have no additional pre-cast riser sections added without prior approval by the AWWB.

2.4.16.2 Concrete

Concrete vaults may be pre-cast or cast-in-place. The concrete shall be Class "A" steel reinforced in accordance with the Standard Specifications. Service connections larger than 2-inch diameter will require the use of two separate pre-cast vaults to house the meter and backflow assembly due to the size of the appurtenances.

2.4.16.3 Hatch

The hatches on all vaults shall be aluminum construction rated for a minimum of 300-pounds per square foot (psf) loading. All hardware installed shall be ASTM Type 316 stainless steel. The frame and cover shall be cast into the concrete and shall be flush with the top of the concrete. The hatch shall span the entire length and width of the vault to provide maximum opening access to the interior of the vault. The hatch shall be equipped with compression springs, an automatic hold-open arm, a water-tight slamlock device, and a removable key wrench.

2.4.16.4 Piping

All piping and assemblies should be centered in the vault. The vault shall be of adequate size to allow a minimum of 1-foot spacing around all appurtenances and between paralleling appurtenances, where possible, for maintenance and repair. All appurtenances installed inside a vault shall be approved by the AWWB prior to the vault being placed in the ground.

2.4.16.5 Drainage

All vaults are required to have positive drainage through a floor drain to grade or to a storm sewer collection system. The drain shall be a minimum 3 inches in diameter and cast into the floor. The floor of the vault shall be sloped to drain to the opening. The drain shall be adequately screened to prevent debris from clogging the drain. No sidewall drains are permitted. The vault shall be placed on no. 57 stone or larger at a minimum depth of 6 inches.

If it is demonstrated that positive drainage cannot be acquired, approval may be given by the WRM Department on a case-by-case basis to construct a “false bottom” of no. 57 stone or larger. The volume of the stone under the vault shall then be greater than or equal to the volume of the vault, and shall be at a minimum 12 inches deep and extend a minimum of 24 inches from all sides of the vault.

If adequate volume is unavailable below the vault to construct a “false bottom” drainage system, or conditions are such that the vault will not be able to adequately drain the appurtenances shall be placed in an aboveground enclosure according to Section 2.4.17 of this Manual. In no case shall a sump pump be installed for the purpose of providing drainage to a vault.

2.4.17 Aboveground Enclosures

Aboveground enclosures are to be used for the installation of reduced-pressure backflow assemblies (RPBAs) or where drainage conditions prevent the installation of a vault below grade.

2.4.17.1 Installation

Aboveground enclosures shall be constructed of concrete, reinforced aluminum, or fiberglass. Access shall be provided through doors and/or a hinged lid for testing and maintenance purposes. The enclosures shall be lockable to protect against vandalism and tampering. The enclosure shall have drain openings sized to accommodate the maximum discharge under the most severe conditions. Discharge points shall be protected against intrusion of wind, debris, and animals. The enclosures shall be insulated to prevent freezing of the appurtenances. The enclosures shall be installed on concrete slab with a minimum thickness of 4 inches, and shall be in accordance with the recommendations of the enclosure manufacturer.

Enclosures shall be manufactured by Hydrocowl, Hot Box, Lok Box, or an approved equal and shall be installed in accordance with the AWWB Standard Detail No. 218 (Appendix A).

2.4.18 Right-of-Way Permits for Utility Crossings

When the development requires the installation of new AWWB water services across a ROW not owned by the City, such as an ALDOT ROW, railroad ROW, or other utility ROW, the engineer will be required to prepare appropriate utility permit applications for submittal to the utility for review and approval. The engineer shall submit a draft of the appropriate utility permit application and plans directly to the WRM Department for review. Upon approval by the WRM Department, the engineer shall submit six (6) copies of the permit application and plans to the WRM Department for submittal to the appropriate permitting authority.

The developer shall be responsible for any applicable permitting fees. The necessary fees shall be submitted with the permit application to the WRM Department. The WRM Department will provide the necessary bond for the utility.

No work can begin on any ROW until the appropriate utility permit has been submitted and approved by the permitting utility. Typically, all required utility permits for a project shall be identified and the permit application shall be submitted well in advance of the DRT plan submittal to provide sufficient review time for the permitting utility. The WRM Department will not grant DRT approval until the approved application has been submitted to the permitting utility. A Grading and Utility Permit cannot be acquired from the City of Auburn until all required utility permits are received and approved by the permitting utility.

2.4.19 Water Easements

Generally, the water main shall be installed within the public ROW. There may be situations, however, where the water main must be installed on private property. These will be considered on a case-by-case basis.

Where required, water main easements shall be wide enough to allow for maintenance of the water line to remain completely within the easement. A minimum easement width of 20 feet typically will be required. Additional easement width may be required due to depth and/or where water mains are proposed adjacent to habitable structures.

Any easements must be properly dedicated to the AWWB or the City prior to any customers being connected to the water line. Easements may be dedicated by plat or by a separate document. Easements for water mains and appurtenances shall typically be dedicated to the City of Auburn as "Drainage and Utility Easements" unless otherwise approved. Additional information for easement requirements is presented in the General Section of this Manual.

SECTION 3

Sewer Design and Construction

3.1 Introduction: Design Responsibility and Applicability of Requirements

The design and construction requirements for sewer collection systems included in this Manual are applicable for any development located within the City of Auburn (including the 5-mile planning jurisdiction) that intends to obtain sewer services from the City upon successfully meeting all of the City's requirements for obtaining such services.

The Water Resource Management (WRM) Department of the City of Auburn shall enforce the requirements included in this Manual on behalf of the City of Auburn. Privately maintained sewer collection systems are not required to meet all of the design standards included in this Manual for sewer collection systems. Any standards, included in this Manual, which are required by a federal or state regulatory authority, or any applicable local plumbing codes shall be required and enforced by those specific authorities.

This Manual is intended to provide general guidance and minimum criteria for the design and construction of sewer facilities for development. However, the sole responsibility for the design is that of the engineer for the development.

Generally, this Manual is intended to be used for the typical subdivision and small-scale commercial development. The typical subdivision development would be a development that needs no more than a 12-inch gravity sewer main. Developments that need sewer services greater than this size are not considered typical developments. Although this Manual can be used for general guidance for other than typical developments, requirements for these developments will be handled on a case-by-case basis. A Utility Installation Flow Chart for site plan development projects and residential subdivision development projects is included in Appendix C of this Manual.

The engineer is encouraged to meet with and discuss each development with the WRM Department prior to the submittal of the plans for review.

Any costs attributable to the extension of the sewer collection system to serve a single development shall be the responsibility of the developer.

3.2 General Considerations

3.2.1 Existing Sewer Facilities

All existing sewer facilities that are located within the project area or that will be affected by the development must be located, identified, and shown on the plans. It is the responsibility of the engineer to have any and all utilities located and shown accurately on the plans.

If, during construction, any utilities are discovered that were not shown on the plans, the WRM Department shall be notified immediately. The construction on any area of the project affected by the discovered utility may be halted and the plans may need to be revised and resubmitted for review at the discretion of the WRM Department.

Any existing sewer mains or services, currently maintained by the City of Auburn, shall be evaluated by the WRM Department to determine if they can be reused for development when a construction plan submittal is required for the development. Any existing sewer service that will be reused for a development must be brought to current standards of the City of Auburn.

Any existing sanitary sewer services that are not to be used should be abandoned, per City requirements. Typically, this requires terminating the sewer lateral at the ROW or edge of easement and sealing the end of the lateral to prevent infiltration into the sewer system. Laterals shall be sealed by installing an approved and secured plug or cap and shall be encased in concrete. Laterals that are temporarily abandoned for future use shall be marked in accordance with the requirements of Section 3.4.9.1 of this Manual for future location identification. All lateral abandonments shall be inspected by the City prior to backfilling.

The WRM Department requires any new Food Service Facility (FSF) connected to the City's sanitary sewer system to comply with the current requirements for Fats, Oils, and Grease (FOG) protection. This shall include all retrofits into existing buildings regardless of previous use.

Where existing onsite sewer treatment (or septic) systems are to be abandoned to make a new connection to the sanitary sewer collection system, the septic system shall be properly abandoned in accordance with the Alabama Department of Public Health regulations. A new service lateral will be required to connect to the public sewer main. In no case will a connection be allowed directly from a septic system to the City's sewer collection system.

3.2.2 Proposed Sewer Facilities

The plans submitted for review shall show all proposed sewer services, including all proposed sewer mains, manholes, laterals, cleanouts, grease traps, oil and grit separators, pool drains, and any other features associated with the sewer system. All diameters, material, locations, elevations, and pertinent features shall be identified clearly on the plans. Any proposed sanitary sewer pump stations shall also be clearly identified and described in detail on the plans, including a completed design of all associated components in accordance with the requirements in Section 3.5 of this Manual.

3.2.3 System Capacity Analysis

The WRM Department will verify sewer availability as well as collection and treatment capacity to serve a development in the City of Auburn with the assistance of the developer and engineer, where necessary. All developments are required to estimate the sewer capacity required in the

Application for Water and Sewer Service (Appendix B) that shall be submitted at the time of plan submittal.

The WRM Department may require that a system capacity analysis be performed during the plan review process. The exact requirements of the system capacity analysis will be handled on a case-by-case basis. Any and all such costs for the study or required infrastructure surveying will be the responsibility of the developer.

Any upgrades to the existing sewer facilities necessary to provide adequate service to the development typically would be the responsibility of the developer. If the existing infrastructure, in the opinion of the WRM Department, is not sufficient to serve the development, the developer may be required to participate in or to fully fund any necessary offsite infrastructure upgrades to obtain sewer service. The amount of developer participation will depend on the amount of contiguous developable area that may be served by the expansion and the corresponding need of the City-approved capital improvement plan. Developer participation in infrastructure improvements or expansions may be detailed in the Development Agreement, where required.

Once a development, that is to be served sewer by the City of Auburn, has been reviewed and approved by the DRT, the City will reserve sewer capacity for the development, and the development will be allowed to connect to the sewer collection system as shown on the approved plans until said DRT approval expires, which is typically 18 months from the date of approval. Once DRT approval has expired, reserved capacity shall subsequently expire and the WRM Department will reevaluate the City's capacity to serve the development when the plans are resubmitted for review and approval in accordance with the DRT requirements in this Manual. Reserved capacity will also be reviewed by the WRM Department prior to any requested extension of DRT approval, including preliminary plat or conditional use extension requests as they affect the DRT approval period.

3.3 Submittal Requirements

The design engineer shall submit a complete set of design plans for review. The submitted plans shall be a complete set, comprehensive in all details of the design. The requirement to submit a set of design plans that are of a complete design shall not prevent an engineer from meeting with the WRM Department and submitting a "preliminary" design for recommendations and preliminary comments from the WRM Department. However, the WRM Department will only review and provide written comments on a completed set of design plans that are submitted for review.

The submitted set of plans shall include the following:

- Overall sewer main layout of entire development with existing and proposed contours shown and all manhole elevations labeled
- Detailed sewer main plan/profile sheets
- All existing and proposed sewer facilities labeled and clearly differentiated
- Manholes, including all rim and invert elevations, sequentially numbered
- Identification of all pipe sizes and materials
- Sewer laterals
- Minimum finished floor elevations
- Grease traps and future grease trap locations
- All standard details that are required
- Any unique details /notes relevant to the project
- All standard notes
- Sanitary sewer pump station information (where required)
- Any engineering calculations (where required)
- Location of all other utilities adjacent to or crossing sewer mains

Additional requirements for the plans submitted for review are included in the City of Auburn Site Development Plans Submittal Checklist and the Subdivision Construction Plans Submittal Checklist (Appendix B). When the individual development is part of a larger Master Development Plan, the engineer may be required to submit an "overall sewer layout" for the entire larger development for review.

3.4 Gravity Sewer Design and Layout

3.4.1 Sewer Main Location

The preferred location for sanitary sewers will be beneath pavement, located in the middle of the street or in low-lying areas where the maximum surrounding area can be served. The sanitary sewer gravity system shall be designed to be straight between any manholes (i.e., no curved sections of gravity sewer between manholes shall be permitted). Sewer main alignment and grade shall be verified by the use of a laser leveling device.

The sanitary sewer system shall be located with consideration given to the following:

- Development of contiguous areas
- Ability to serve basements by gravity service, where possible
- Any environmentally sensitive areas, such as wetlands or creeks
- Any other existing (or proposed) utilities
- Location of any permanent structures
- Location of any streams, water bodies, or other water features
- Any steep slopes (natural or filled)
- Any areas that would hinder future access and maintenance
- Proposed street extensions
- Any proposed future site grading
- Any areas that would require excessive depth (greater than 20 feet)
- Any future development that may affect the sewer system

Sewer mains shall be located in an area free from surface obstructions (signs, walls, utility poles, structures, ponds, water features, canopy trees, etc.) that, in the opinion of the WRM Department, would make maintenance or repairs to the sewer main more difficult. Sewer mains shall be a minimum of 15 feet from all habitable structures, stream banks, water bodies, or dam structures. Sewer mains with depths greater than 10 feet may require additional separation from these obstructions, as deemed appropriate by the WRM Department.

The Contractor shall place utility line markers on all wastewater conveyance lines in unpaved areas and where development has not yet been established. Markers shall be placed at all manholes for gravity systems, and a minimum of every 250 feet for force mains. Utility markers shall be 66 inch green Rhino 3-rail fiberglass marking post or approved equal.

3.4.2 General Design Considerations

The sanitary sewer facilities shall be designed with the future maintenance of the sewer facilities being considered. The sewer lines shall be sized appropriately for the development, taking into account any future developments that could be served by the sewer system. Where future maintenance of the sewer lines would be difficult due to depth or surface congestion, there may be additional requirements from what is identified in the Manual. Any special considerations or requirements will be identified during the review process.

The design engineer shall use “Recommended Standards for Wastewater Facilities” published by Health Education Services, a division of Health Research, Inc. (commonly referred to as the 10-State Standards), latest edition, for minimum design criteria for pump station and sanitary sewer facilities that are not specifically addressed in this Manual. In the case of conflicting guidelines between this Manual and the 10-State Standards, the requirements included in this Manual shall take precedence.

3.4.2.1 Contiguous Areas

The design engineer shall consider any additional land that is located within the drainage basin that can drain through the new sewer line and shall design and provide for future connections to the sewer system. Stub-outs or other means of future connections to the sewer system must be provided, which may involve easements and other means to allow for the least disruptive means for future connections.

3.4.2.2 Pipeline Velocities

The minimum flow velocity (or scour velocity) in the sewer shall be 2 fps and the maximum flow velocity (or critical velocity) shall be 15 fps. The minimum slopes for sewer lines specified in Section 3.4.4 of this Manual account for the required scour velocity for gravity flow. When calculating the critical flow velocity for a sewer line, a minimum Manning “n” value for gravity flow shall be 0.013 for cement lined ductile iron pipe, and 0.009 for PVC or HDPE pipe.

3.4.2.3 Hydraulic Analysis

When designing sewer collection systems, the hydraulic grade line should be plotted for peak flow conditions to model the sewer network. The hydraulic grade line shall not be allowed to rise above the crown of any pipe. The engineer may be required to submit the plotted hydraulic grade line and associated calculations during review at the discretion of the WRM Department.

Manholes shall be designed so that the flow transitions smoothly across the invert and turbulence is minimized. The outgoing pipe invert elevation shall be lowered as necessary to maintain a smooth energy gradient across the manhole. Where multiple lines combine in a single manhole, each line shall be analyzed separately to determine the appropriate exit elevation. All manholes shall have an elevation drop across the invert. At a minimum there shall be a 0.10 foot drop where the manhole does not include a break in direction greater than 22 degrees and a 0.25 foot drop if the manhole includes a break in the direction greater than 22 degrees for a standard 48 inch diameter manhole.

3.4.2.4 Capacity Estimation Criteria

Sanitary sewers shall be designed using commonly accepted design standards, using per-capita flow rates. Sewers shall be designed to flow half full at peak flow. If requested, the engineer must provide the calculations and assumptions used in sizing sanitary sewer lines.

In general, the sewer collection system shall be designed based on 250 gallons per day per unit (gpd/unit) and shall use a minimum peaking factor of 2.5. This requirement would be applicable for a sanitary sewer system serving primarily residential developments. For systems that would serve significant commercial or industrial developments, the design engineer will be required to provide flow data for review during design.

In the case of commercial developments or large subdivisions, the engineer may be required to perform a capacity analysis of both the proposed and existing sewer systems and to provide these to the WRM Department for review.

If the WRM Department determines that the existing sanitary sewer line does not have the capacity to accept wastewater from the proposed development, the engineer may be required to prepare an engineering analysis to propose alternatives.

3.4.2.5 Lowest Floor Elevations

Gravity sanitary sewer mains shall be designed so that the lowest floor elevation of any structure that is served by public sewer is at least 12 inches above the rim elevation of the connection manhole or the nearest upstream manhole. If the lowest floor elevation is not 12 inches above the manhole rim elevation, the customer shall install a private pump station for the sewer service or an approved backwater valve on the private gravity service line capable of preventing sewer backflows into the structure. Backwater valves installed on the customer's service line shall be normally-open to avoid flow restriction during normal use and shall be installed in a location that is accessible for maintenance and repairs. Approved normally-open backwater valves for interior basement installation or where the external depth of cover is less than 24 inches shall be "Fullport" backwater valves manufactured by Mainline Backflow Products, Inc. as shown in Figure 3-1, or an approved equal. Approved normally-open backwater valves for installation in external applications where the depth of cover will be greater than 24 inches shall be an "Adapt-a-Valve" backwater valve manufactured by Mainline Backflow Products, Inc. or an approved equal.

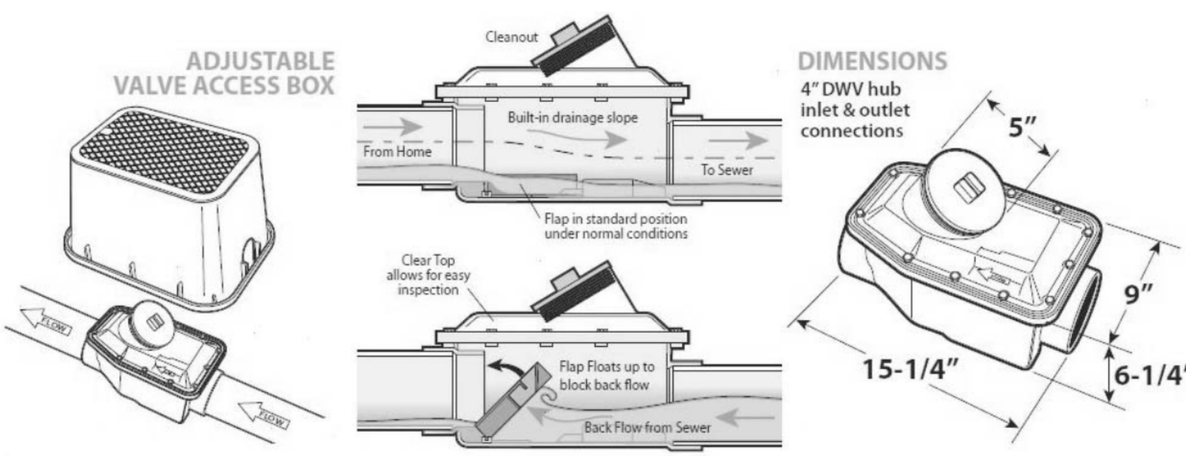


FIGURE 3-1
Fullport Backwater Valve
Mainline Backflow Products, Inc.

Each lot of record within the development shall be noted on the plans and the plat as having a potential backflow issue, where the finished grades are such that the lowest floor elevation of a structure served by public sewer could potentially be less than 12 inches above the manhole rim elevation. The property owners, successors, and assigns shall indemnify, hold harmless, and defend the City for any backflows that occur due to improper maintenance, repairs, use, or omittance of this device. If the property will not be platted as a result of the development, a hold-harmless agreement will be required prior to DRT approval.

The WRM Department will evaluate each development for potential backflow issues during plan review, however, it is the engineer's responsibility to determine the lots or units that are affected by this requirement and shall indicate them on the construction plans prior to submittal.

3.4.3 Sewer Size and Materials

The minimum sewer size for a public gravity sewer main shall be 8 inches. Solid-wall PVC pipe SDR 35 or SDR 26 may be used for sewer mains, provided that the depth of cover is between 3 feet and 12 feet, and there are no unusual loadings or concerns. The cover requirements for PVC pipe will not be changed with increased pipe thickness classification. High-density polyethylene (HDPE) pipe DR 9 is also allowed on a case-by-case basis for installations between depths of 3 feet and 12 feet. Gravity sewer mains with less than 3 feet of cover shall be ductile iron Pressure Class 350 or Thickness Class 51. Gravity sewer mains installed with more than 12 feet of cover shall be ductile iron, of the appropriate Thickness Class for the installation.

Changes in pipe sizes and/or materials shall not be allowed between manholes.

3.4.4 Minimum Slopes

Table 3-1 lists the minimum slopes for sewers. Gravity sewer lines shall be laid to grade with uniform slope between manholes. The diameter of the sewer line may not be increased above that which is necessary from a capacity standpoint to obtain a shallower design grade.

TABLE 3-1
Minimum Sewer Slopes
WRM Department Design and Construction Manual, Auburn, Alabama

Diameters	Minimum Slope	Comments
4 inches	2 percent	4-inch size only used for laterals
6 inches	1 percent	6-inch size only used for laterals
8 inches	0.6 percent	
10 inches	0.35 percent	
12 inches	0.30 percent	
14 inches	0.20 percent	

3.4.5 Cover Requirements

The cover over gravity sewer mains shall be measured from the top of the pipe to the finished grade elevation above the pipe. Typically, gravity sewer mains shall be installed below finished grade with a depth of cover between 3 feet and 12 feet. Gravity sewer mains installed under pavement shall be designed with a minimum cover of 3 feet or as governed by the required manhole depth detailed in Section 3.4.6.3 of this Manual. All gravity sewer mains shall be designed with sufficient depth to provide below grade sewer service across adjacent creeks, ditches, roads, utilities, etc. The maximum depth of cover allowed for gravity sewer mains is 20 feet.

In locations where gravity sewer mains cross creeks or streams, the crossing shall be made perpendicular to the direction of flow and shall not be located at major bends or stream intersections. Where possible, a minimum cover of 24 inches shall be provided at all creek crossing locations. If adequate cover cannot be provided, the sewer shall be encased in concrete or placed on concrete piers according to the Standard Detail No.s 320 and 322 (Appendix A).

The developer is responsible for bringing existing sewer mains into compliance in terms of pipe material and thickness as specified in Section 3.4.4 of this Manual where existing grades are raised or lowered to accommodate a development. Where the depth of cover over an existing gravity sewer main is increased, additional easement width may also be required in accordance with the easement requirements in the General Section of this Manual. Existing manholes shall also be raised or lowered to accommodate any necessary grade changes.

3.4.6 Sewer Manholes

Manholes are required on all gravity sewer mains for access and maintenance purposes. Manholes shall be provided at all junctions, grade breaks, and other discontinuities in the sewer line, as well as at the beginning of all gravity sewer mains. Sewer manholes shall be constructed of precast structural concrete. Standard sewer manholes shall be installed in accordance with Standard Detail No. 302 (Appendix A).

3.4.6.1 Location

Manholes typically shall be located in the center of the street for residential subdivision construction, and shall be installed flush with the final wearing surface. In certain cases where a street location is not a feasible route to provide gravity sewer, the manholes shall be located in the low-lying areas, adjacent to streams, or in a location such that the majority of the sewer basin can be served. Manhole locations shall take into consideration the ability to service future developments of contiguous areas and adjacent properties that are not currently served by sewer.

All manholes in undeveloped areas shall be a minimum of one foot above finished grade. Manhole lids located within 1 vertical foot of the 100-year floodplain elevation shall be water-tight gasketed with lock-down lid, and anchor ring. The watertight manhole cover and ring shall be in accordance with Standard Detail No. 310 (Appendix A). Where the finished grade elevation at the manhole is 3 feet or less below the 100-year floodplain elevation, risers shall be utilized to extend the rim elevation to 1 foot above the 100-year floodplain elevation. The maximum extension of a manhole shall be 4 feet above the ground surface. Manholes shall be located a minimum of 15 feet from any stream bank or water body.

All manholes located within the 100-year flood plain shall have a concrete waterproofing admixture of the cementitious crystalline type, such as Xypex admix C-500R or approved equal, added according to the product manufacturer’s specifications.

3.4.6.2 Spacing

Sewer manholes shall be spaced as necessary to provide turns and grade breaks in the sewer main. Sewer manholes shall be spaced a maximum of 400 feet apart to allow for maintenance of the sewer main. A minimum spacing of 100 feet shall be provided, where possible.

3.4.6.3 Shape and Dimensions

Sewer manholes shall be cylindrical in shape with a concentric cone section on top. Manholes that are box shaped or that have flat top sections shall not be allowed.

Sewer manholes shall be sized according to the main size, connections, and degree of directional change in the main line. The minimum diameter of sewer manholes shall be 48 inches for typical sewer installation. Larger manholes may be required on lines larger than 12 inches, or where the angle between the invert in and invert out is less than 120 degrees.

The height of a manhole shall be measured from the outgoing invert elevation to the rim elevation. The minimum height of a sewer manhole shall be 50 inches, providing adequate space for a standard precast concentric base cone section, ring, and cover. Specialty precast concentric manhole sections requiring less height may be submitted by the engineer for review as part of the construction plans, where available. In all cases, clear line of sight shall be maintained from the rim to all pipe inverts. Flat top manhole sections and risers shall not be allowed. Special consideration shall be provided by the engineer for manholes designed in paved areas, or where the rim elevation cannot be extended above the finished grade elevation, to ensure that the minimum manhole height is provided in the cover over the sewer line.

The maximum depth of a sewer manhole will be controlled by the maximum cover of 20 feet allowed for gravity sewer mains, with additional height allowed above finished grade, where applicable.

3.4.6.4 Connections

Connections in manholes shall be done in a manner to provide as little turbulence and disruption to the flow as possible. All connections shall be directed into the flow smoothly by shaping the invert or apron to accommodate all incoming sewer lines. The invert shall be formed and poured to provide a smooth transition across the manhole. Directional change in the main line through a manhole shall be no less than 90 degrees between the invert in and invert out.

Manhole connections shall be sealed appropriately to minimize groundwater infiltration into the sewer system. Typical sealing methods include the use of a rubber boot around the connecting pipe as well as grouting the annular space between the pipe and the connection core. Other methods of sealing the connection points may be used as approved by the WRM Department.

Where adjacent connections are required to be cored into manholes for 4 and 6 inch service lines, the minimum separation between the connections shall not be less than 6 inches. The minimum separation between adjacent connections larger than 6 inches in diameter shall not be less than the largest diameter of the connecting lines. Connection separation shall be measured from the nearest edges of the connection cores.

There shall be a minimum of 0.10 foot drop across manholes where there is not a turn greater than 22 degrees and a minimum of 0.25 foot drop across manholes where there is a turn 22 degrees or greater. The turning angle shall be measured as the difference between the bearing direction of the incoming pipe and the bearing direction of the outgoing pipe.

Memphis Tees shall be used to construct a drop manhole whenever the elevation drop is 2 feet or greater. The Memphis Tee shall be installed outside the manhole if the pipe diameter is greater than 6 inches. Drop manholes shall be installed in accordance with Standard Detail No.s 300 and 306 (Appendix A).

Saddle manhole connections shall be used where a new sewer main is proposed to tie into an existing sewer main mid-span between existing manholes. Saddle manholes shall be installed in accordance with Standard Detail No.s 304 (Appendix A).

3.4.7 Separation of Sewer and Water Lines

In general, sewer and water lines shall be separated by a minimum of 10 feet horizontally and 18 inches vertically. This distance shall be measured from the outside edge of the pipelines.

Where proper horizontal separation cannot be attained, the sewer line shall be ductile iron and shall be hydrostatically pressure tested to 150 psi. In no case will a sewer line be allowed within 5 feet horizontally of a water main.

Where proper vertical separation cannot be attained, the sewer line shall be ductile iron and shall either be installed in a steel casing that extends a minimum of 10 feet past the centerline of the crossing, or hydrostatically pressure tested to 150 psi. All sewer main casings shall be installed in accordance with Section 3.4.8 of this Manual and Standard Detail No. 324 (Appendix A). All crossings shall be laid out so that they are perpendicular and centered on a section of pipe, providing the maximum spacing between the joints and the crossing.

3.4.8 Road Bores and Casings

Road borings for sewer mains will typically be required in lieu of open-cut trenching methods when crossing existing paved streets in the City of Auburn or when crossing a county, state, or federal highway or railroad. This determination will be made on a case specific basis by the City's Public Works Department and/or the appropriate ROW authority, where applicable.

Where road borings are required, they shall be a traditional jack-and-bore construction method using a steel casing. Where possible, the steel casing shall extend at least 5 feet beyond the edge of the roadway or planned roadway widening, but shall in no case continue within 5 feet of a service connection or cleanout. When casings are installed for gravity sewer and manholes are needed at the ends of the casings, the manholes shall be set back far enough to allow for excavation and maintenance of the sewer line without requiring the removal of the manhole. A typical set-back distance would be 25 feet. Directional drilling methods shall not be allowed for the installation of sewer mains and services.

All bores for sewer mains and services shall be placed on proper grade and delivered precisely to the location shown on the construction plans with uniform slope and direction. It is recommended that the engineer design the jack-and-bore crossings at a grade slightly steeper than the minimum to allow for variations in the as-constructed slopes for the installed sewer. The minimum slopes as provided for sewer lines are applicable and will be enforced for sewer lines installed in jack-and-bore casings.

Where sewer service connections are being made, the existing sewer main shall be excavated as part of the receiving pit, prior to setting up the bore, to verify the necessary depth and grade shown on the construction plans. All other utilities shall be located and potholed, where necessary, prior to performing the bore. Where open-cut trenching methods are allowed across an existing paved street for new sewer mains and services, the repair shall be made in accordance with the standards of the appropriate ROW authority.

Steel casings also may be required if, in the opinion of the WRM Department, the sewer mains are located in an area that would make maintenance on the sewer main difficult or impractical. Installing sewer mains in such areas will be at the discretion of the WRM Department, and will only be allowed where there are no alternatives for providing gravity sewer service to a development. Steel casings shall be sized according to the carrier pipe size with appropriately sized spacers to center the pipe in the encasement. The carrier pipe shall be ductile iron, and the pipe joints shall be restrained using external restraint mechanisms or locking gasket restraints for retrieval of the pipe from the encasement. The ends of the encasement shall be sealed with brick and mortar or with a rubber boot and double stainless steel straps to prevent water from entering the casing. Encasements shall be installed per the City’s Standard Detail No. 324 (Appendix A).

3.4.9 Sewer Laterals

3.4.9.1 Location

Sewer laterals shall typically be installed directly from a sewer manhole or main perpendicular to the ROW, easement, or property line. Sewer laterals shall be located in areas free from obstructions in maintaining continuous grade and alignment. All sanitary sewer lateral and stub out locations shall be identified by an "S" marked in the concrete gutter and on the face of the curb where streets are being built. The contractor shall bury a marker ball locator (Tempo Omni Marker Model 162, 121.6 kHz, or approved equal) at the ROW or edge of easement where the lateral terminates. The contractor shall also mark the termination point of the lateral above grade using a green post or marker.

3.4.9.2 Size

Where possible, a sewer lateral shall only serve a single-platted lot or a single piece of property. Individual service laterals, with a minimum diameter of 4 inches, shall be provided for each dwelling unit when serving single-family subdivisions, duplexes, townhomes, or similar segmented residential development. Multi-family or combined residential development such as apartment complexes or condominium complexes shall be served by a single sewer lateral sized sufficiently to handle the expected sewer capacity.

Sewer laterals shall be greater than 4 inches in diameter where serving more than a single-dwelling or commercial unit, or where the water meter size is greater than 1 inch. Where two single-dwelling units must be connected to the same service lateral, the cleanout shall be placed at the property line between the units.

Sewer lateral material shall be in accordance with Section 3.4.3 of this Manual from the main to the property line, easement line, ROW, or where the City’s maintenance ends. Sewer laterals shall be installed at the minimum slopes noted in Table 3-1.

3.4.9.3 Connections

Sewer laterals shall be connected to a manhole, where possible, with a maximum of four connections. An exception to the number of connections will be made in the case of beginning manholes, where five connections are permitted. A maximum of two Memphis tee connections will be allowed to an individual manhole.

Internal Memphis Tees are required for 4-inch to 6-inch laterals if the connections are 2 feet above the flow line. The internal Memphis Tees should be directed into the flow line. Where sewer lateral connections are less than 2 feet above the flow line, the lateral or the apron shall be adjusted so that the connection is no more that 4 inches above the apron. Where a lateral is to be connected to an existing manhole where the existing main is larger than 12 inches in diameter, the invert of the connection should be made above the crown of the existing main. Where a lateral is to be connected to an existing manhole where the existing main is 12 inches in diameter or smaller, the connection can be lowered to a crown-to-crown elevation. Laterals entering beginning manholes shall be directed into the flow line with no drop allowed.

Where sewer laterals must be connected directly to a sewer main, the connections shall be separated by a minimum of 3 feet. For new sewer main installation, the contractor shall install an inline “tee” or “wye” in all locations where a lateral is proposed to connect directly to the main. Where it becomes necessary to tap an existing main, such connection shall be made with an approved type saddle fitting, either a “tee” or “wye” connection. The saddle shall be placed over a carefully cut opening in the upper quadrant of the sewer main and attached to the main using stainless steel straps. Under no circumstances shall any lateral connection be allowed to protrude into the sewer main.

3.4.9.4 Cleanouts

All sewer laterals shall be installed with cleanouts. At least one cleanout shall be installed at the ROW or easement line, and another at the building, in accordance with the local plumbing code. Typically, publicly maintained sewer laterals shall be designed to not be long enough to require multiple cleanouts. Where long public sewer service laterals are required, and approved by the WRM Department, a sewer cleanout shall be installed at a spacing not to exceed 100 feet. Cleanout spacing for privately maintained laterals shall be in accordance with the currently adopted local plumbing code.

If a cleanout is located in pavement or concrete, the cleanout shall be installed in a traffic-rated enclosure, per the Standard Detail No. 330 (Appendix A).

3.4.10 Grease Traps

Grease traps are required to prevent fats, oils, and grease (FOG), typically discharged by food production or processing operations, from entering and becoming a hazard to the sanitary sewer system.

Grease traps are required for all Food Service Facilities (FSFs) which shall include, but is not limited to, any restaurant, eatery, food caterer, cafeteria, grocery store, manufacturing facility, or institution which cuts, cooks, bakes, prepares, serves, or makes available for consumption any food products by any prescribed method, or which disposes of food related wastes.

Grease traps shall be required on all FSFs including all new construction, redevelopments, or retrofit applications that connect to the City of Auburn sewer collection system regardless of previous use. Grease traps shall be shown and detailed on the plans for current or future intended use. The grease trap shall meet all applicable local plumbing codes, any applicable county and state health department requirements, and shall be of a sufficient size to handle the grease loading and provide adequate detention time from the facility as defined in Section 3.4.10.2 of this Manual. All fixtures associated with food production and preparation which may potentially contain grease laden waste shall be connected to the grease trap. All domestic sanitary sewer (i.e. restroom sewer) shall be plumbed separately from grease laden waste lines and shall only be combined into a single discharge line beyond the outlet of the grease trap and required sampling port.

The grease trap shall be cleaned and inspected regularly and shall meet all discharge requirements as specified in the City's Sewer Ordinance. Any FSF found to not be in compliance with the specified discharge requirements shall be required to immediately install additional FOG protection prior to the public sewer connection at the expense of the FSF owner.

3.4.10.1 Location

Grease traps shall be located in an area that can be easily accessed for maintenance, cleaning, and inspection. They shall not be located in an entrance, exit, drive-through, or under a menu board, sign, or structure. If the trap is located in a drive or parking area, it must contain traffic-rated rings and covers and meet H-20 loadings. Manhole rings and covers shall not be covered or obscured by landscaping, pavement, or other obstructions.

Grease trap locations shall also be considered by the design engineer for all commercial sites that potentially will require a grease trap for future intended uses. Strip retail centers or commercial developments comprising of multiple units should consider including separately plumbed sewer connections for each unit that can be used to retrofit a grease trap connection if the proposed use changes to a FSF. Multiple adjacent FSFs on the same property may also be plumbed to a common on-site grease trap, if desired, provided that the grease trap is sized appropriately for all the proposed plumbing fixtures that will drain to it. If a common grease trap is not designed for proposed multiple adjacent retail units, the engineer shall provide locations for future grease traps to be installed that shall be identified on the construction plans and approved by the WRM Department.

3.4.10.2 Design

The design engineer shall submit sizing calculations on the Standard Grease Trap Size Calculation Data Sheet (Appendix B) to the WRM Department for each grease trap that is installed. The sizing calculation is derived from the 2009 Uniform Plumbing Code detention time calculation, which is based on the determined fixture unit values.

FSFs shall be classified according to the FOG loading based on the operational characteristics of the facility as Light or Heavy FOG Producers. Light FOG producers shall only be applicable to FSFs where the products used in food preparation and service contain little or no dairy, shortening, oil, butter, vegetable fat, animal fat, or other fatty compounds which are insoluble in water at room temperature, as deemed appropriate by the WRM Department.

Grease traps for FSFs meeting the criteria of a Light FOG Producer shall be a minimum of 500 gallons to provide a minimum detention time of 30 minutes. Grease traps for Heavy FOG Producers shall be a minimum of 1000 gallons to provide a minimum detention time of 1 hour. Consideration also should be given by the designing engineer in regard to the type and nature of the facility requiring the grease trap to determine if the volume of the trap should be increased beyond the detention time requirement to properly handle the expected grease loading and to minimize the required regular cleaning and maintenance for the owner.

Grease traps shall be required to have a minimum of two access manholes for cleaning and inspection. A sampling port or manhole is also required downstream of the grease trap. No other connections to the sewer line are allowed between the grease trap and the sampling location.

The inlet and outlet pipes of the grease trap shall be Schedule 40 PVC. The open-ended tee used to extend the inlet and outlet below the fluid level shall not be covered or capped. The inlet pipe must be a minimum of 4 inch diameter, and the vertical pipe on the outlet side must be a minimum of 6 inch diameter. The WRM Department recommends installing 2 inch diameter vents connected to the building vent system from each chamber of the grease trap in order to prevent odors and gas collection.

Grease traps shall be designed and installed in accordance with Standard Detail No. 316 (Appendix A).

3.4.10.3 Alternative Grease Removal Device

In certain cases, where existing and unavoidable site constraints are present that would prohibit a FSF from installing an external grease trap in accordance with the standards outlined in this Manual, the WRM Department may be willing to review alternative grease removal devices, such as internal automatic grease recovery systems, or devices with enhanced engineered baffling systems as proposed by the developer for attaining grease protection for the sewer system. The proposed alternative grease removal device shall be required to meet the discharge requirements as specified in the City's Sewer Ordinance.

Alternative grease removal devices shall be installed in a readily and easily accessible location for cleaning, maintenance, and inspection. The device shall be designed, sized and installed in accordance with the manufacturer's specifications and shall be connected downstream of all fixtures that, in the opinion of the WRM Department, will produce FOG laden wastewater. Multiple devices may be required to facilitate the appropriate fixtures and/or anticipated flow. Such installations shall comply with all applicable building and plumbing codes.

Approved automatic grease recovery systems shall include a solids separator, heating element, and an automatic grease recovery mechanism. The FOG shall be removed from the wastewater and stored in a separate container that can easily be removed and transported for proper disposal.

All alternative grease removal devices shall be approved by the WRM Department prior to installation. Small volume, passive interceptors (i.e., "under-the-sink" type devices) shall not be considered as an acceptable alternative grease removal device to provide adequate protection for FOG entering the sewer system.

3.4.11 Oil and Grit Separators

Oil and grit separators will be required at all commercial car washes, equipment wash bays, automotive service or repair stations, mechanical equipment service or repairs stations, and similar garages and facilities that would discharge polluted wastewater as deemed necessary by the WRM Department. The oil and grit separators shall meet all applicable local plumbing codes and be of a sufficient size to handle the specified loading for the intended use. The oil and grit separators shall be cleaned and inspected regularly and shall meet all discharge requirements as specified in the City's Sewer Ordinance.

3.4.11.1 Location

Oil and grit separators shall be located in an area that can be easily accessed for maintenance, cleaning, and inspection. They shall not be located in an entrance, exit, drive-through, or under a menu board, sign, or structure. If the separator is located in a drive or parking area, it must contain traffic-rated rings and covers and meet H-20 loadings. Manhole rings and covers shall not be covered or obscured by landscaping, pavement, or other obstructions.

3.4.11.2 Design

Oil and grit separators shall be a minimum of 1,000 gallons unless otherwise approved by the WRM Department. The design engineer shall submit sizing calculations, assumptions, and typical performance data for each installation to the WRM Department. Additional information and treatment parameters for oil and grit separators are provided in Section 4.4.11 of this Manual for storm water quality treatment that can also be used in the design of systems connecting to the sanitary sewer collection system.

Oil and grit separators shall be required to have a minimum of two access manholes for cleaning and inspection. A sampling manhole also is required downstream of the separator. No other connections to the sewer line are allowed between the separator and the sampling manhole.

The inlet and outlet pipes of the oil and grit separator shall be Schedule 40 PVC. The open-ended tee used to extend the inlet and outlet below the fluid level shall not be covered or capped. The inlet pipe must be a minimum of 4-inch diameter and the vertical pipe on the outlet side must be a minimum of 6-inch diameter.

Oil and grit separators shall be designed and installed in accordance with Standard Detail No. 318 (Appendix A).

3.4.12 Open Surface Drains

An open surface drain is considered any connection that would collect stormwater such as grade inlets, roof drains, vault drains, etc. Open surface drains generally are not allowed to be connected to the sanitary sewer system. However, certain cases may require these drains to connect to sanitary sewer because of the nature and pollution hazard of the potential discharge and will be evaluated on a case-by-case basis by the WRM Department. Developments that include drains for items such as large trash compactors or commercial car washes will be required to connect to the sanitary sewer. All open surface drains connecting to the sanitary sewer will be assessed a surcharge based on the drainage area and amount of stormwater being treated. The drainage area shall be provided on the Water and Sewer Application for Service Form (Appendix B), and shall be clearly identified on a schematic drawing with the proposed site contours that shall be submitted to the WRM Department.

Garbage dumpster pad drains shall be tied to the storm system, or graded to drain away from the area, if necessary for the development, and shall not be allowed to tie into the sanitary sewer collection system.

3.4.13 Pool Drains

Swimming pools that are constructed for public use, private community or organization use, or with a volume greater than 30,000 gallons will be required to connect the drain line to the sanitary sewer system to avoid chemical release into local streams or water bodies. Swimming pool drain connections made to sanitary sewer shall be no larger than 2 inches in diameter and shall in no case exceed 50 GPM of flow, either by gravity or pumped discharge, to avoid surcharging the collection system. Swimming pools connected to the sanitary system shall not be filled through the use of an irrigation meter.

Typical single-family residential swimming pools with volumes smaller than 30,000 gallons will not be required to connect the drain line to the sanitary sewer system.

3.5 Sanitary Sewer Pump Station and Force Main Design

3.5.1 Discussion

Where technically feasible, the means for providing sanitary sewer service to a development shall be by gravity sewer, without the use of any pump stations.

The WRM Department realizes that there are certain developments that, because of unique circumstances, cannot be served by gravity sanitary sewer systems.

The WRM Department will look at each separate development on its unique circumstances and work with the developer to determine the best way to provide the needed services that are in the best long-term interest of the City and its citizens. All sanitary sewer pump stations that are approved shall be constructed to the City's standards.

It is the City's intent to minimize the number of sanitary sewer pump stations that are located in the service area.

Pump stations shall be designed with regional intent in mind. A cost sharing and regional planning concept should be used to provide for the most cost-effective means to provide public sewer for developments.

The WRM Department reserves the right to require the developer to participate in a cost-shared regional type pump station to be designed by the WRM Department, when, in the opinion of the WRM Department, such an arrangement is in the best interest of the City.

The maximum size of a pump station that will be allowed to be designed by the developer will be 250-gpm firm design capacity. The City shall reserve the right to contract the design and inspection of any pump station proposed for a single development with a firm design capacity larger than 250 gpm at the full cost of the developer. No pump station will be considered for an individual development that would serve fewer than 50 equivalent residential dwelling units.

Private pump stations and force mains used to connect to the City's sewer collection system shall only be allowed for a single customer connection, lot of record, or residential dwelling unit (i.e., individually owned grinder pump station). No privately maintained pump stations or force mains will be approved for servicing multiple connections.

3.5.2 Submittal Requirements

No development will be approved that includes a sanitary sewer pump station without a detailed engineering report having been submitted to the WRM Department for review. This report must include an evaluation of any alternatives to a sanitary sewer pump station and include cost estimates for the alternatives evaluated. At the City's request, the report also will include a conceptual analysis of the regional sewer service area. If a development is considering the installation of a sanitary sewer pump station, the developer must contact the WRM Department to discuss the development during conceptual planning and prior to the initial submittal of the plans to the DRT.

The design engineer shall submit a complete design package to the WRM Department for review prior to DRT submittal for the development. All pump station design data, reports, drawings, studies, specifications, calculations, pump curves, supervisory control and data acquisition (SCADA) information, and any other design information submitted for review shall be stamped and sealed by a registered engineer in the State of Alabama in the appropriate and specific discipline of service (i.e., civil, electrical, etc.). The review time required by the WRM Department for developments, including sanitary sewer pump stations, will vary depending on the specific details of the pump station and the development. The design engineer shall coordinate any necessary review meetings with the WRM Department to facilitate the review process.

The design engineer shall submit a complete set of pump station design drawings for each pump station. A general pump station site and section layout is provided on Standard Detail No.s 336 and 338 (Appendix A). These drawings are provided as a general guide for the design engineer in preparation of the design drawing package for the pump station.

The design engineer shall submit all design calculations and assumptions for review. The design calculations shall include all sizing criteria, assumptions, references, etc., to provide the WRM Department with a complete design package for review.

The pump station drawing package shall include the following:

- Overall site plan
- Grading plan (existing and proposed)
- Pump station section views
- Plan and profile of gravity sewer onsite
- Plan and profile of force main, including all air release valves
- Electrical drawings (including power feed and control panel wiring schematics)
- SCADA details
- Access roads and site fencing
- Stormwater drainage plan

3.5.3 General Design Considerations

The information presented in this Manual is to be used by the design engineer in the design of a sanitary sewer pump station. The design engineer shall also use *Recommended Standards for Wastewater Facilities*, published by Health Education Services, a division of Health Research, Inc. (commonly referred to as the 10-State Standards) as a general design guide for any criteria that are not covered as part of this Manual.

3.5.4 Mechanical

3.5.4.1 Submersible Pumps

The pump station layout shall include, at a minimum, a submersible, duplex pump arrangement with the firm design capacity being met with the largest pump out of service. The firm design capacity shall be equal to the estimated peak design flow. For residential development, incoming average daily flow (ADF) can be estimated as 250 gallons per day per dwelling unit. A peaking factor based on the development size shall be applied to determine the design capacity of the pump station, as defined in the Pump Station Calculation Worksheet (Appendix B).

Criteria for estimating flow for any non-residential development being served by a pump station shall be submitted to the WRM Department with the pump station design calculations. Additional information may also be required by the WRM Department during review in regards to the type of waste and operational characteristics of any non-residential developments where needed for proper pump selection.

The pumps shall be set up in a lead-lag arrangement, alternating the lead pump with each cycle. A maximum of five starts per hour is allowed for each pump, and a minimum of two starts per hour is required at maximum build out.

Submersible pumps shall be at a minimum vertical, double mechanical sealed, non-clog, solids handling pumps capable of passing a 3-inch-diameter sphere. Submersible grinder pumps are not acceptable. Pump suction and discharge openings shall be a minimum of 4 inches in diameter, and each pump shall have an individual intake.

The pump casing and volute shall be constructed of heavy-duty cast iron or stainless steel. The impeller shall be constructed of stainless steel or abrasion-resistant cast iron. The shaft shall be constructed of stainless steel and shall be supported by heavy-duty, sealed, anti-friction bearings. The bearings shall be sized to handle all expected loads and shall have a minimum rating of 50,000 hours. The casing and impeller shall be fitted with removable and replaceable wear rings. The elastomer seals shall be constructed of nitrile rubber.

The submersible pumps shall be equipped with a double mechanical seal to prevent leakage into the pump shaft. The primary (outer) seal shall be constructed of tungsten carbide and/or silicon carbide faces with stainless-steel fittings and shall be equipped with a moisture detection switch to activate a warning alarm in case of seal failure. The secondary (inner) seal shall be constructed of carbon steel. Ceramic faces shall not be acceptable.

The pump motor shall meet the requirements of Section 3.5.5.3 of this Manual.

Submersible pumps shall be specified based on the site-specific conditions of the pump station. The design shall take into account head conditions, type of waste, flow rate, impeller type, motor size, need for future upgrades, etc. The top and bottom elevation of the pumps shall be shown on the pump station drawings.

Pumps shall be manufactured by ABS, Flygt, KSB, Hydromatic, or an approved equal.

3.5.4.2 Guide Rails and Hoist

All pump stations shall be equipped with guide rails for extracting the pumps from the wet well. The sliding guide bracket shall be an integral part of the pump unit. The pump lifting chain shall be sized to accommodate the installed pump weight, but shall in no case be sized smaller than 3/16 of an inch diameter links. All guide rails, lifting chains, clevises, shackles, hook assemblies, guide rail brackets, anchors, bolts, nuts, and other exposed metal shall be ASTM A276 Type 316 stainless steel.

All pump stations shall include a portable hoist with an adjustable reach from 24 inches to 36 inches. The winch shall have a minimum load rating of 1,000 pounds. The hoist shall be installed with a socket embedded in a concrete base adjacent to the top of the wet-well. The hoist shall be Halliday Products-Series D2B Portable Hoist with Series D Portable Hoist Socket, or an approved equal. The hoist shall be provided with a weather-resistant cover.

3.5.4.3 Standby Diesel Pump

All pump stations shall be equipped with an onsite standby diesel pump. The standby pump shall be self-priming and capable of solids handling. The standby pump shall be sized to handle the firm design capacity of the pump station. A separate intake line for the standby pump shall be extended to the low water level inside the wet well. The standby pump shall operate on a separate float system from the submersible pumps and shall have separate motor controls. Contacts for run status of the standby pump shall be provided for indication in the SCADA system. The fuel capacity of the standby pump shall be sufficient to allow for a 24-hour run time. The standby pump shall be a Godwin Dri-Prime Pump or an approved equal.

The standby pump shall be equipped with an electric start kit. A battery tender, trickle charging system shall be installed of the appropriate manufacturer size and specification for the motor size, battery voltage, and power requirements of the specific pump.

The standby pump shall be installed in a sound attenuated enclosure to reduce the operating noise produced by the diesel-driven pump. The standby pump shall be equipped with a silenced muffler and priming exhaust. The enclosure shall be a Godwin Pumps, Critically Silenced Enclosure, or an approved equal. A drain line shall be provided from the standby pump enclosure to the wet well.

The standby pump shall be skid mounted and shall be anchored to a concrete pad with stainless-steel anchor bolts. The concrete shall at a minimum consist of Class A concrete in accordance with the City of Auburn Standard Specification with a minimum thickness of 6 inches. The concrete pad shall also be installed in accordance with the pump manufacturer's recommendations.

3.5.4.4 Isolation Valves

All isolation valves installed at sanitary sewer pump stations and on sanitary sewer force mains shall be either resilient-seated gate valves or eccentric plug valves with a minimum port opening equal to 100 percent of the adjacent pipe area, thereby providing maximum passage of solids. The valves shall be rated for a minimum 150-psi working pressure.

Each pump discharge shall have an isolation valve installed after the check valve in the valve vault. The valves shall be the same nominal dimension as the discharge piping.

Valves installed in a vault shall include a hand wheel-operated actuator. Each underground valve shall be provided with a cast iron valve box to house and protect the valve stem. All valve boxes installed in unpaved areas shall have a concrete collar installed according to Standard Detail No. 332 (Appendix A). If a precast collar is used the annular space between the valve box and the concrete collar shall be grouted in. Ductile iron or cast iron pipe shall not be used as valve box extension unless approved. PVC should never be used as a valve box extension.

Isolation valves on force mains shall be installed at a maximum spacing of 500 feet between valves and on both sides of all creek crossings.

3.5.4.5 Check Valves

A check valve shall be installed on each pump discharge including the submersible pumps, the standby diesel pump, and the quick connection to the force main for bypass pumping. The check valves shall be swing type with an external arm and counter weight, and shall have flanged ends, a cast iron body, solid bronze hinges, and a stainless-steel hinge shaft. Check valves shall be rated to a minimum 150-psi working pressure and shall be manufactured in compliance with AWWA C508.

3.5.4.6 Air Release Valves

Three general types of automatic ARVs are used on sewer force mains:

- Standard ARVs (small orifice valves): Designed for the slow release of air during pumping operations
- Air/Vacuum Valves (large orifice valves): Designed to release large amounts of air during filling operations, and to admit large amounts of air during draining
- Combination Air Vacuum/ARVs (small and large orifice): Designed to perform both functions of small and large orifice ARVs

Typically, ARVs used in force main applications shall be Combination Air Vacuum/ARVs capable of releasing small amounts of air during normal pumping operations and admitting large amounts of air to break the vacuum when the pumps are turned off. Small orifice ARVs may be used in certain cases where not much grade change occurs in the force main and air vacuum relief is not necessary. Small orifice ARVs also may be required on steep sections of a force main to release trapped air intermittently between combination ARVs that are located at the high points.

ARVs, at a minimum, shall be installed at all high points and at a distance between ARVs not to exceed 1,500 feet. The high points shall be field verified during construction to ensure appropriate placement, and the ARVs shall be installed on a level section of pipe equidistant between the joints. The pipe should continually slope between ARVs except on the joint of pipe where the ARV is installed.

ARVs installed on force mains shall be specifically manufactured for use in wastewater applications. The valve body and hardware shall be constructed of Type 316 stainless steel. The sealing mechanism shall be ethylene-propylene-diene M-class rubber (EPDM) and shall be activated by an HDPE control float. The large intake and discharge orifice area shall be equal to the nominal size of the valve. The small discharge orifice shall be sized based on the flow of air required to evacuate from the force main during filling operations. ARVs shall be manufactured by Vent-O-Mat, ARI, or an approved equal.

ARVs shall be sized appropriately to vent and admit air when all pumps are in operation and shall be sized and located in accordance with the design criteria provided in the AWWA Manual M51, *Air-Release, Air/Vacuum, & Combination Air Valves.* ARVs shall be installed in accordance with the Standard Detail No. 334 (Appendix A).

3.5.5 Electrical

The electrical design shall be prepared by an electrical engineer registered in the State of Alabama for all sewer pump stations. The design shall comply with National Fire Protection Association (NFPA) Article 820, the Institute of Electrical and Electronics Engineers (IEEE), and the National Electrical Code (NEC), as well as all local electrical codes. The standards included in this section shall be considered minimum requirements for the electrical design of a sanitary sewer pump station.

3.5.5.1 Classification

The wet well of a sewer pump station is classified as a Class I, Division 1 or 2, Group D hazardous location, per NFPA Article 820. The electrical design shall be suitable for this environment, which shall include, but is not limited to, intrinsically safe, hermetically sealed float switches; explosion-proof motors and junction boxes; rigid galvanized conduit (no PVC); and appropriately sealed wet well penetrations.

3.5.5.2 Power Supply

Pump stations shall be served by utility supplied three-phase power for pumps greater than 7 HP. An Underwriters Laboratories, Inc. (UL), recognized three-phase power monitor shall interrupt the control power in the event of phase loss, phase reversal, low voltage, and phase unbalance. The power monitor shall have primary fuse protection. The contacts shall be rated for 15A resistive at 120 volts alternating current (VAC).

The use of single-phase power and a phase converter will only be considered three-phase power is not available or the cost to acquire three-phase power is excessive. The use of phase-converters must be approved prior to design. If a phase converter is to be used, the plans shall detail the converter installation. All phase converter installations shall meet the following requirements:

- Rotary-type converters are unacceptable.
- All wiring ahead of the three-phase panel shall be protected with single-phase fusing sized to meet the total single-phase amperage; conductors shall be sized based on single-phase amperage and fusing.
- Converters shall be sized to operate the total installed pump station amperage with all pumps running.
- A static phase shift method converter shall be a Ronk "Add-a-phase," manufactured by Ronk Electrical Industries, Inc. (or approved equal). The converter shall be housed in a locking National Electrical Manufacturers Association (NEMA)-3R, rain-tight, stainless-steel enclosure.
- Variable Frequency Drives (VFD) may be used for phase conversion. The horsepower rating must be increased to meet the three-phase load requirement of the motor.
- A 5-year warranty bond shall be provided on all electrical equipment and pumps if phase conversion is used.

The design engineer shall contact the electrical utility and determine the utility requirements for motor starting and any soft-start requirements. Correspondence with the electrical utility shall be copied to the City, along with design submittals. For most installations, the standard electrical supply shall be 480 volt (V), and 60 Hertz (Hz). All control panels, circuit breakers, and other electrical equipment shall be located inside the fenced site.

The surge protector shall be parallel metal oxide varistor (MOV) design and shall provide protection for Category C Transient Surges, as defined in American National Standard Institute (ANSI)/IEEE C62.41 without degradation of components. Protection shall be provided between each phase line and the ground line. The surge protection shall be Stedi-Volt, V-Blox, or approved equal.

The electrical system shall also be protected by a lightening arrestor capable of handling up to 600 VAC.

A 110V, ground fault interrupter (GFI), two-plug outlet inside a weather enclosure shall be provided and have a dedicated 15A circuit breaker. The outlet shall be located at the electrical control panel.

3.5.5.3 Motors

All pump stations shall include explosion-proof motors, with a maximum speed of 1,800 revolutions per minute (rpm). Motors shall be high efficiency, using copper winding, Class F or H insulation, and heavy varnish. The motor shall be non-overloading for the entire pump curve. The motor electrical design shall comply with NEMA Design B. The motors shall be equipped with thermal overload protectors embedded in each phase of the windings to sense high temperatures.

The pump motor shall be housed in an air-filled or oil-filled water tight chamber designed to operate continuously in a non-submerged application. The chamber shall be constructed of heavy-duty cast iron. The cable entry shall be sealed to prevent capillary leakage into the motor chamber. The motor and motor housing shall be bolted to the pump body to allow for removal and repair.

Motors shall be supplied with a high-quality, factory-applied epoxy coating system.

3.5.5.4 Control Panel

The pump control panel system shall be fabricated by a current UL 698A-listed industrial control panel manufacturer. The panel manufacturer shall show its UL follow-up service procedure file number on submittals. All devices within the panel shall be UL listed and/or recognized where applicable and shall be mounted and wired in accordance with the most current edition of UL 698 A and NFPA. Wiring shall include standard numbering and color coding for clear identification. The panel shall be factory assembled, wired, and fully tested before shipment. Testing shall include both power and control devices, as well as all control functions. A final inspection shall be performed before shipment and a copy of this form shall be provided with the panel. The panel manufacturer shall supply two sets of as-wired drawings to the City upon completion of construction.

An HOA Switch shall be included for each pump and shall provide the following functionality:

- HAND–In this position, the applicable pump shall run without regard for the level sensing commands and will rely on operator discipline to run and stop.

- AUTO–In this position, the pumps shall be controlled by the local pump controller in the control panel. The controller will sense the level in the wet well and initiate start and stop commands to the pumps based on configured on/off set points.
- OFF–In this position, the applicable pump will not run under any circumstance.

All electrical enclosures shall be NEMA-4X stainless-steel standard lockable control panel on a stainless-steel frame with an external operating handle to padlock the breaker in the “ON” or “OFF” positions. The enclosure shall be sized sufficiently to contain the required components and shall be designed specifically for municipal wastewater applications. All pump controls shall be located inside the lockable control panel. An equipment data tag shall be permanently affixed on the inside of the exterior door of the control panel with the station designation, power source, pump horsepower (hp), and pump full load amps. In addition to the label requirements of UL 698A, an engraved legend plate shall be permanently affixed on the inside of the exterior door of the control panel with the name, address, and telephone number of the service representative for the pumps and control panel.

All exposed conduits shall be aluminum (no PVC) and electrical equipment shall be explosion proof for installation inside the wet-well. Electrical penetrations into the wet well shall be appropriately sealed using explosion-proof seal fittings and approved sealing compound. Fittings shall be Crouse-Hinds or approved equal, and sealing compound shall be Chico SpeedSeal or approved equal. An explosion-proof junction box shall be provided below the control panel for each motor control cable. See Standard Detail No. 338 (Appendix A) for conduit termination details, including junction boxes.

3.5.5.5 Alarm

A weatherproof, red-flashing, incandescent alarm light shall be provided and be mounted in a location visible from the access road. There shall also be an audible horn alarm rated at 90 decibels at 10 feet. The alarm light and horn shall indicate a high wet well level alarm condition or power failure. Alarm power shall be derived from the 120V control power and battery backup. A silencing switch for the audible alarm shall be located inside the control panel.

3.5.5.6 Liquid Level Controls

The pumps shall be controlled by a Symcom PumpSaver ISS-105 Pump Controller, or approved equal. The design pump control elevations shall be shown on the pump station drawings and shall control as follows:

1. All Pumps Off; low water level
2. Lead Pump On; shall alternate on each call
3. Lag Pump On/Warning Alarm; both pumps running
4. High Level Alarm; activate alarm light and siren

The controller uses floats as the primary level indication. A 4-20 mA level transmitter may be wired directly to the SCADA RTU panel for continuous level monitoring as determined by the Owner (either a submersible level transducer or an ultrasonic level transducer).

The loop-powered submersible level transducer shall be a KPSI Series 750, Siemens A1000i or approved equal with a 4-20 mA output, barometric compensation, cable termination, and units of measurement in “feet of water.” The loop-powered ultrasonic level transducer shall be a Siemens SITRANS Probe LU, or approved equal and shall be wall-mounted and accessible from the top of the wet well for maintenance. The level transducer shall be wired per the Manufacturer’s Certification Drawings for Intrinsically Safe Circuits to meet Class I, Division 1, Group D area classification. The manufacturer’s literature and device nameplate must call out hazardous area (Class I, Division 1, Group D) approval.The float leads, submersible level transducer cables, and pump cords shall not be located near the incoming flow or the turbulence of the incoming sewer line. The High Level Alarm float elevation shall be a minimum of 12 inches below the elevation of the incoming gravity sewer line invert. The All Pumps Off float elevation shall be a minimum of 12 inches above the floor of the wet well, or as specified by the pump manufacturer if greater depth is required. The float leads and pump cords shall be suspended with stainless-steel kellum grips from the bracket supplied by the pump manufacturer. The bracket shall be attached to the wet-well hatch frame or firmly bolted to the concrete immediately below the hatch frame. The bracket shall be positioned so the float leads and pump cords are easily accessible without entering the wet-well.

The float wires shall be neatly routed away from the pump access hatch opening, then through the chamber access conduit, without excessive wire strain or pull. Wire length on all float wires shall be such that each float may be adjusted to the bottom of the station wet-well. The floats shall be hermetically sealed and intrinsically safe, and shall be Roto-Float Type S or approved equal.

3.5.5.7 SCADA Requirements

The engineer shall contact the WRM Department for information regarding the current SCADA provider to determine the requirements for the pump station. The pump station shall be provided with all necessary SCADA equipment as required by WRM Department. All costs associated with the SCADA requirements shall be the responsibility of the developer. The developer shall have a representative of the SCADA provider present at the preconstruction meeting.

All SCADA equipment, along with the alarm components, shall be supplied with a minimum 12-hour battery backup.

The SCADA equipment shall provide for the following information to be monitored:

- Monitor submersible pump STATUS for each pump
- Monitor submersible pump ISSUED for each pump
- Monitor standby pump STATUS
- Run time
- Number of starts
- Pump failure
- Monitor main power supply on/off

- Monitor phase loss
- Monitor high wet well
- Monitor low wet well
- Monitor wet well level from transducer, if included
- Monitor Hand/Off/Auto Switch Status for each pump
- Pump seal fail alarms
- Pump temperature alarms
- Estimated flow totals (based on pump curves)
- Motor amps
- Station voltage
- Run time mismatch alarm

3.5.6 Structural

3.5.6.1 Wet Well

The wet well shall be pre-cast concrete with a protective PVC or HDPE liner cast into the concrete. The minimum thickness of the liner shall be 0.065 inch, and the material shall have locking extensions spaced at a maximum of 2.5 inches apart by .375 inches high that are cast into the concrete. The PVC or HDPE liner shall be spark tested upon finishing of the installation in the field and any defects identified shall be repaired to the City's satisfaction. Alternate spray-on protective coatings (SpectraShield or approved equal) may also be approved for wet well applications. No fiberglass wet wells will be allowed.

The floor of the wet well shall be sloped toward the pump intakes to facilitate solids removal and shall be designed according to the pump selection. The minimum slope allowed for the floor of the wet well shall be 1 horizontal foot to 1 vertical foot.

The wet well shall provide sufficient volume, based on the peak design flow, to allow a maximum filling time of 30 minutes from the All Pumps Off float elevation (low water level) to the High Level Alarm float elevation. The wet well depth shall in no case be less than 5 feet from the floor elevation to the lowest wet well invert elevation. The wet well diameter shall be a minimum of 5 feet. Pump manufacturer recommendations also will be considered when sizing the wet well.

All penetrations into the wet well shall have gas-tight and water-tight seals. The wet well shall be vented through an isolated 4-inch-diameter Schedule 40 stainless-steel vent pipe in the top of the wet well. The vent pipe shall be turned down 180 degrees and shall be equipped with a screen to prevent animal or pest intrusion.

3.5.6.2 Valve Vault

The valve vault shall be pre-cast concrete and located adjacent to the wet well. The valve vault shall include, at a minimum, a check valve, an isolation valve, an ARV, and a pressure gauge for each submersible pump discharge. The individual pump discharges shall manifold into a single force main inside the valve vault.

All appurtenances and fittings inside the valve vault shall be flanged and properly supported and restrained. All piping and assemblies should be centered in the valve vault. The valve vault shall be of adequate size to allow a minimum of 1-foot spacing around all appurtenances, and between paralleling appurtenances where possible for maintenance and repair. The depth of the valve vault shall be no greater than necessary to accommodate the necessary piping and assemblies and shall be no more than 6 feet deep from the lid to the floor elevation.

A 4-inch ductile iron drain pipe shall be installed from the valve vault to the wet well. The drain shall include a flapper-style back-water check valve or similar device to prevent water and gasses from entering the valve pit. The floor of the valve vault shall be sloped as necessary to the drain piping to prevent standing water.

All penetrations into the valve vault shall have gas-tight and water-tight seals.

3.5.6.3 Hatch

An aluminum, lockable hatch shall be provided on the wet well and valve vault and shall be rated for a minimum loading of 300 psf with a noncorrosive locking bar with a padlock hole of at least 3/8 inch (10 millimeters [mm]) (Halliday Products, Thompson Fabrication, or approved equal). All hardware shall be ASTM A276 Type 316 Stainless Steel. The frame and cover shall be cast into the concrete and shall be flush with the top of the concrete. The hatch shall be equipped with compression springs, an automatic hold-open arm, a water-tight slamlock device, and a removable key wrench.

The hatch shall be sized sufficiently to allow the maximum opening over the wet well and valve vault for access and maintenance.

3.5.7 Piping

3.5.7.1 Gravity

All gravity sewer mains entering a pump station site shall be designed and installed in accordance with Section 3.4 of this Manual. Gravity piping shall enter the pump station site from the most practical direction to connect to the wet well. In no case will gravity sewer mains be allowed to cross under the valve vault, diesel pump, or control panels for the pump station.

The incoming gravity line shall be turned down into the wet well with an open-ended tee and extend to the low water level to minimize turbulence. The open end of the tee shall be directed toward the top of the wet well to allow for maintenance and cleaning of the incoming gravity line. All ductile iron gravity piping inside the wet well shall be manufactured with a suitable corrosion-resistant liner, Protecto 401 or approved equal, and shall be coated on the exterior with a 100-percent epoxy coating, suitable for use in corrosive wastewater applications.

3.5.7.2 Force Main

The engineer shall be responsible for designing the force main to accommodate the head conditions, correlating pump selection, and any necessary surge protection and/or restraint necessary. The force main shall be a minimum of 4 inches in diameter and shall have a minimum flow velocity of 2 fps at design flow. Any vertical sections of the pump discharge piping inside the wet well shall have a minimum velocity of 2.5 fps to minimize the potential for settlement of solids, and shall in no case be less than the pump manufacturer's recommended minimum velocity.

All ductile iron piping for sanitary sewer force mains shall be manufactured with a suitable corrosion-resistant liner, Protecto 401 or approved equal. Flanged ductile iron piping intended for installation in the wet well shall be coated on the exterior with a 100-percent epoxy coating, suitable for use in corrosive wastewater applications. All force main piping (including piping offsite) shall be ductile iron using either mechanical or push-on joints.

Force mains shall be installed normally at a depth of cover of 36 inches. The maximum depth of force main shall be 8 feet. Thrust restraint for force mains shall be done in accordance with the requirements in Section 2.4.8 of this Manual as detailed for water mains unless otherwise approved. Thrust restraint devices shall be designed according to the site-specific characteristics of the pump station, force main, and soil conditions.

A tracer wire shall be installed 12 inches above the ductile iron force main. The tracer wire shall be brought to grade every 500 feet in a standard cast iron valve box, and at all air release valve manholes per the Standard Detail No.s 332 & 334 (Appendix A). The tracer wire shall be No. 14 A.W.G. copper clad steel with polyethylene insulation.

The discharge point of the force main shall terminate in a manhole. The manhole shall be lined with a protective coating (SpectraShield or approved equal). The discharge shall be directed into the invert of the manhole to minimize turbulence.

All pump stations shall include 4-inch-diameter intake and discharge quick-connections for bypass pumping purposes according to Standard Detail No. 338 (Appendix A). The quick-connections shall be in accessible locations on the pump station site close to the wet well. The quick-connect intake piping shall be extended to the low water level inside the wet well. The quick-connect discharge piping shall connect directly to the force main and shall be equipped with a check valve and an isolation valve.

3.5.8 Site Design

3.5.8.1 Location

All pump station sites shall be located in a single lot of record which shall be owned by the City and shall conform to the City's Subdivision Regulations for outlots, as required. The minimum site size shall be 50 feet by 50 feet and shall include adequate space for maintenance vehicles to turn around inside the fenced area.

Pump stations shall be located in accessible areas to vehicles and maintenance personnel. The pump station shall be slightly elevated above the surrounding site area at a minimum of 6 inches and shall be a minimum of 2 feet above the 100-year flood plain elevation. The pump station site shall comply with the City's stream buffer requirements in Section 5.4.7 of this Manual.

3.5.8.2 Access

All pump stations shall include a minimum 12-foot-wide access road constructed of 825B, asphalt, or concrete. Access roads constructed of 825B shall have a compacted thickness of at least 12 inches. Access roads constructed of asphalt shall consist of a standard Class II street build-up in accordance with the City of Auburn Standard Specifications. Access roads constructed of concrete shall consist of Class A concrete in accordance with the City of Auburn Standard Specifications and shall have a minimum thickness of 6 inches. The access road and site shall be sloped to properly drain stormwater. The maximum allowable grade on a pump station access road or site shall be 4 horizontal feet to 1 vertical foot. The entire pump station site, inside the fenced area, shall be covered with 825B at a minimum compacted thickness of 12 inches at 85-percent standard proctor. Additional design considerations for access may be required depending on soil type and hydrologic conditions.

3.5.8.3 Security

All pump station sites shall be enclosed with suitable security perimeter fencing. The fencing shall be 6 feet high and typically will be constructed of galvanized chain-link. The fencing shall be located so that a minimum 5-foot spacing is provided between all pump station equipment and the fence perimeter.

Chain-link fencing shall be constructed in accordance with Standard Detail No. 336 (Appendix A). The chain-link fabric shall be a 2-inch mesh woven from No. 9 gauge aluminum-coated steel or aluminum-zinc alloy conforming to ASTM A491 or A783. Aluminum-coated steel fabric shall be given a clear organic coating after fabrication. Aluminum-zinc alloy coating on steel fabric shall be not less than 0.47 ounce per square foot of uncoated wire surface. The framework of the fencing shall be galvanized steel conforming to ASTM F1083 or ASTM A123, with not less than 1.8 ounces of zinc per square foot of surface, or steel conforming to ASTM A569 externally triple-coated with hot-dip galvanizing at 1 ounce per square foot. All fence fittings shall be galvanized according to ASTM A153, with zinc weights per ASTM Table 1. The chain-link fencing shall include three strands of barbed wire conforming to ASTM A585-81, Type 1, located at the top held out at a 45-degree angle on galvanized supports. The bottom tension wire shall be No. 7 gauge aluminum-coated steel conforming to ASTM A824, Type 1. The post tops shall be designed as weather-tight closure caps for tubular posts. Continuous fence shall be grounded at each corner post and at intervals not to exceed 500 feet.

As an alternative, a 6-foot-high wooden shadow box privacy fence may be installed, as approved. Wooden fences may be used for aesthetic purposes in conjunction with a security chain-link fence, or may be constructed appropriately to provide adequate site security. All wooden fences shall be constructed of pressure treated structural lumber. Wooden posts shall be a minimum 6-inch by 6-inch dimension solid wood and the base shall be set in concrete to a minimum depth of 2 feet below the ground surface. Data and drawings of the proposed wooden privacy fencing used for site security shall be submitted to the City for review and approval.

At least one lockable gate shall be provided into the pump station site centered on the access road. The gate shall be a minimum of 12 feet wide and shall provide an unobstructed path for maintenance vehicles to the wet well, valve vault, and diesel pump. The access gate shall not be placed over a manhole. The gate shall either be hinged and free to rotate to both the interior and the exterior of the fenced site as needed, or be installed on a roller wheel assembly sized to adequately support the weight of the gate and allowing the gate to slide open in a parallel direction to the fence. Gates shall be constructed of the same material as the perimeter fencing.

All pump station sites shall also be equipped with suitable security lighting. The lighting shall be controlled with a photocell, with an additional on/off switch located in the lockable control panel.

3.5.9 Potable Water Requirements

A 1-inch water service with standard single ¾-inch meter and meter box with a customer side shutoff valve and yard hydrant (Simmons 800 series or approved equal) shall be provided from the potable water service. The yard hydrant shall be located near the fence in an area that does not hinder or obstruct maintenance of the pump station or gate access.

A testable reduced-pressure backflow assembly in accordance with the AWWB Standard Detail No. 218 (Appendix A) is required on all potable water service lines serving a sanitary sewer pump station.

3.5.10 Construction Submittals

Submittals are required for all major pump station equipment and materials including, but not limited to, all pumps, electrical equipment, SCADA, structural, standby pumps, piping, linings, coatings, pre-cast wet-wells, vaults, valves, etc. Before construction, the developer's contractor shall submit at least five signed copies of the submittals to the WRM Department. Three copies will be retained for use by the WRM Department and City inspections. The remaining two copies will be returned to the contractor. The information shown in the submittals shall be complete with respect to dimensions, design criteria, materials, applicable warranty information, etc., to enable an appropriate review of the information required.

The construction submittal package shall include, but shall not be limited to, the following items and shall be consistent with the design of the pump station:

- Pumps–Including manufacturer, type, model, rotation speed, size of suction elbow inlet, size of discharge elbow outlet, net weight, complete performance curves showing capacity versus head, brake horse power, efficiency, and data on shop painting
- Motors–Including manufacturer, type, model, type of bearings and method of lubrication, rated size (hp), temperature rating, full load rotation speed, net weight, efficiency at full load and at rated pump condition, full load current, locked rotor current, and voltage rating
- Control Panel and Components–Including manufacturer, type, model, dimensions, net weight, overcurrent characteristics, details of motor control, cable lengths, enclosure specifications, wiring diagrams, and pump controls
- SCADA – Including manufacturer, component specifications, program logic, wiring diagram, and enclosure specifications
- Lightning and Surge Protection Equipment – Including manufacturer, type, model, and specifications
- Isolation Valves and Check Valves–Including manufacturer, type, model, and pressure rating
- ARVs–Including manufacturer, type, model, and orifice sizes
- Liquid Level Control Floats and Transducer–Including manufacturer, model, area classification, and cable lengths

- Standby Diesel Pump–Including manufacturer, type, model, enclosure specifications, fuel capacity, and battery charger specifications
- Hoist–Including manufacturer and model
- Precast Wet Well and Valve Vault Details–Including precast manufacturer, dimensions, schematic location of all openings in the concrete, internal piping schematic, liner material specifications, hatch specifications and manufacturer, and pertinent material specifications
- Pipe and Fittings–Including manufacturer, pressure class rating, material, coatings, thrust restraint, joint type, etc.
- Miscellaneous material specifications (not covered under other major categories)–Including vent pipe, bolts and hardware, poles, lights, alarm, fencing, gates, mounting brackets, junction boxes, conduit, fittings, sealing compound, etc.
- Water Service–Including yard hydrant manufacturer, type and model, onsite piping material and fitting specifications, meter manufacturer, type, and model, backflow prevention assembly manufacturer, type, and model. All potable water service submittals shall also be submitted and approved by the appropriate water service provider.

Construction submittals shall be provided to the WRM Department as a single complete package for all aspects of a sewer pump station. Submittal packages that do not include major components of the sewer pump station, or that include incomplete information regarding any of these items, will be considered an incomplete submittal package and will be rejected in their entirety and not reviewed until all submittals are provided. Upon the receipt of a complete submittal package, the WRM Department will review the package and approve, conditionally approve (as noted), or reject the submittals. Copies of the reviewed submittal package will then be returned to the contractor. Rejected submittals shall be resubmitted for review. Materials installed without approval are installed at the contractor’s risk and are subject to rejection during the inspection and acceptance process.

3.5.11 Inspection and Acceptance

All sewer pump stations installed in the City shall be inspected for quality control during construction and shall be inspected thoroughly upon completion of construction for compliance with the design standards detailed in this Manual, as well as the approved project-specific plans and specifications. Because of the specialized expertise necessary for sewer pump station construction and inspection, the City may retain professional quality control and inspection services at the expense of the developer where required or deemed necessary by the WRM Department due to the size of the proposed pump station or other detailed site-specific parameters that increase the complexity of constructing the proposed pump station.

3.5.11.1 Construction Inspection

Sewer pump station construction shall be inspected daily for quality control by or on behalf of the City. The inspection of the pump station construction shall be coordinated with the WRM Department during the conceptual and design phases and may be addressed in the development agreement where a sewer pump station is required. The City shall reserve the right to contract the design and inspection services of any pump station proposed for a single development where the firm design capacity exceeds 250 gpm at the full cost of the developer. In such developments, it is the ultimate responsibility of the developer to construct the pump station as designed in accordance with the approved plans and specifications under the direction of the design engineer.

Single developments requiring a pump station with a firm design capacity smaller than 250 gpm typically will be inspected by City personnel, where practical. In such developments, it is the ultimate responsibility of the developer to design and construct the pump station according to the standards detailed in this Manual. The design engineer shall provide regular quality control inspections for the developer, at the full cost of the developer, in addition to the City personnel inspections. Each engineer involved with the design of a pump station (i.e., civil, electrical, etc.) shall only inspect the work under his/her specific expertise and is expected to be involved during the construction phase on behalf of the developer.

Where conflicts exist between this Manual and the approved plans, typically the more stringent requirement shall apply. However, it is the contractor's responsibility to contact the WRM Department and the engineer for clarification about the requirements before commencing construction in any areas of conflict.

3.5.11.2 Final Inspection

Before final acceptance of any pump station by the City, there shall be a final inspection performed by a representative of the City. The final inspection shall be arranged through the WRM Department, Sewer Division. The final inspection shall show that the pump station is fully operable and all necessary appurtenances have been installed and constructed in accordance with the design standards in this Manual, as well as in the project-specific plans and specifications.

Representatives from the contractor, the installing electrical contractor, any applicable subcontractors, the design engineer(s) (civil, electrical, etc.), and the pumping equipment manufacturer shall be present at the pump station site for the final inspection, in addition to the City representatives.

The contractor shall subject all of the pumping equipment including all submersible pumps and the standby diesel pump to operating tests for all possible pump combinations to demonstrate satisfactory performance of the equipment, including proper controls and float switch operation. All equipment associated with the pump station shall be tested for proper operation. The Pump Station Inspection Checklist (Appendix B) will be used as a minimum guideline for conducting the final inspection. If tests do not demonstrate satisfactory performance of the equipment, deficiencies shall be corrected and equipment shall be retested.

The contractor shall arrange to obtain a sufficient volume of water, at the contractor's expense, from the public water supply for the test. The minimum quantity of water to be pumped for the test shall be equivalent to 1.5 minutes of continuous pumping at the rated pump capacity for each pump operating alone and for every possible combination of pumps operating simultaneously. Each pump combination shall be tested a minimum of two times.

All pump station equipment shall be tested by the contractor prior to requesting a final inspection. At a minimum, each pump shall be started with the voltage, current, and other significant parameters being recorded. The manufacturer shall provide a formal test procedure and forms for recording data. The recorded data shall be submitted to the WRM Department, Sewer Division, in conjunction with the as-built electrical schematics before the final inspection is requested from the City. The following documentation and items shall be provided to the WRM Department, Sewer Division, as a minimum prior to scheduling a final pump station inspection:

- Three sets of as-built wiring and piping schematics of the pump station site and any station access areas. The as-built survey of the pump station and equipment shall be in accordance with the requirements detailed in Section 1 of this Manual.
- Three sets of operation and maintenance (O&M) manuals, record drawings, O&M Manuals, copies of certified tests, and inspection data
- Warranty documents
- One spare impeller for each pump
- Two seal assemblies for each pump: top and bottom at impeller and at winding of motor
- One complete set of bearings for each pump
- One additional level float switch (normally open type) with sufficient cable for the lowest level float
- O-ring and gasket kit for each pump motor and impeller housing
- One complete set of spare fuses for all electrical devices
- Ten spare bulbs for each lamp type
- Two sets of keys to the standby diesel pump enclosure
- Standby pump fuel tank shall be filled to capacity

3.5.11.3 Acceptance

The following items shall be completed prior to acceptance of a pump station by the City of Auburn for ownership and maintenance:

- All documentation and items listed in Section 3.5.11.2 of this Manual provided to the WRM Department.
- Successful completion of final inspection and all noted deficiencies with the pump station, force main, and related appurtenances corrected.
- Preliminary acceptance issued by the City for all public sewer mains being served by the pump station.
- Successful completion of required testing procedures for all private sewer mains being served by the pump station.
- All ground surrounding the pump station must be graded, seeded, and mulched per the City's Standard Specifications and satisfactory erosion control measures must be installed and functioning properly.

- Warranty bond provided for pump station equipment and components in accordance with Section 3.5.11.4 of this Manual.
- Activation of the pump station for sanitary sewer service, which is typically once the first certificate of occupancy is issued for the development. No pump station will be accepted prior to the first certificate of occupancy being issued for the development or serviceable area.

The City will issue a written letter of acceptance upon satisfactory completion of all items listed in this section, at which time the City will accept responsibility for operating and maintaining the pump station.

The WRM Department prefers that all mechanical and electrical components of a pump station not be installed until the development is prepared to activate the station in order to avoid unnecessary equipment damage and malfunctions or preliminary expiration of the original manufacturer's warranty. Pump station equipment or components that are installed and left inactive (i.e., no certificates of occupancy are issued for the development) for a period of more than six months from the final inspection, shall be retested and inspected for proper operation prior to acceptance by the City. At that time, all noted deficiencies shall be corrected. Typically, the final inspection shall not be scheduled until the development is ready to activate sanitary sewer service through the pump station.

3.5.11.4 Warranty and Completion Bond

In addition to the equipment manufacturer's general warranties, the developer shall bond the pump station and related appurtenances to be fully operational and free from defects in materials and workmanship for a period of not less than 1 year from the date of the City's written acceptance. The Pump Station Warranty Bond shall be accompanied with a surety note or letter of credit from a financial institution approved by the City of Auburn Finance Director for the total replacement value of all mechanical and electrical components of the pump station. During the specified warranty period, any mechanical or electrical component failures or malfunctions shall be repaired by the City of Auburn or its agents at the full cost of the developer, except where due to gross negligence of the City of Auburn in maintenance or operations. The City will reserve the right to call and liquidate the bond if the developer fails to comply with the terms of the agreement.

A Pump Station Completion Bond will be required for all developments wishing to receive final plat approval of a subdivision including a pump station prior to acceptance of the pump station by the City. The Pump Station Completion Bond shall be required at the same time as the Subdivision Completion Bond outlined in Section 1 of this Manual and in accordance with the Subdivision Regulations and shall be executed prior to the signing of the final plat. The Pump Station Completion Bond shall be renewed every 12 months at the current replacement value of the mechanical and electrical components of the pump station until the pump station has been accepted by the City. Once a pump station has been accepted by the City, the standard Pump Station Warranty Bond will be required for a period of not less than 1 year from the date of the City's written acceptance.

There may be certain situations that will require the Pump Station Warranty Bond to be extended beyond the first year of operation such as 3-phase power conversion as specified in Section 3.5.5.2 of this Manual, or other special circumstances involved with a specific pump station as deemed necessary by the WRM Department. Details of any extended warranty requirements shall be addressed during the plan review process.

The exact format and language of the Pump Station Warranty Bond and the Pump Station Completion Bond will be determined by the City. A sample standard bond agreement is provided in Appendix B, but it is subject to modification to fit the case-specific condition.

SECTION 4

Stormwater Quality, Erosion, and Sediment Control

4.1 Introduction

The City has been identified by ADEM as an NPDES Stormwater Phase II community. One requirement of the Phase II program is to develop and implement a stormwater management program for construction and post-construction conditions. This section of the Manual is designed to provide resources to local agencies, engineers, developers, or others involved in erosion control and stormwater management in the City for helping to meet the NPDES Phase II requirements.

4.1.1 Erosion and Sediment Control

Construction activities typically require the stripping of vegetation and/or removal of other existing stabilization from the ground surface, which exposes soil to rainfall energy and runoff velocities. As a result, significant soil erosion from construction sites can occur. The yield of soil erosion products from a construction site will depend on soil characteristics, climatic conditions, ground topography, and other site-specific factors. For this reason, varying amounts of sediment and turbidity will be generated and have a potential to discharge to Waters of the State, potentially violating State of Alabama Water Quality Standards. Sediment also can cause adverse impacts to offsite drainage conveyances and roads.

Construction activities that have the potential to affect the environment include, but are not limited to, land disturbance or discharges of pollutants associated with building, excavation, land clearing, grubbing, placement of fill, grading, blasting, reclamation, areas in which construction materials are stored in association with a land disturbance or handled aboveground; and other associated areas including, but not limited to, construction site vehicle parking, equipment or supply storage areas, material stockpiles, temporary office areas, and access roads. Construction activities of concern also include significant preconstruction land disturbance activities performed in support of NPDES construction activity including, but not limited to, land clearing, dewatering, and geotechnical investigations.

To protect water quality and to comply with the ADEM NPDES regulations (ADEM Admin. Code R. 335-6-12) and the City’s Erosion and Sediment Control Ordinance (ESC Ordinance), effective and applicable BMPs must be fully implemented to the maximum extent practicable. The operator must remediate any adverse impact that is caused by ineffective BMPs to maintain compliance with the requirements.

4.1.2 Post-development Stormwater Quality Management

Once completed, land development projects have a long-lasting impact on water quality caused by the discharge of pollutants to nearby watercourses. These pollutants vary in type and concentration from place to place; but certain pollutants such as total suspended solids (TSS), petroleum-based contaminants, phosphorus, nitrogen, heavy metals, and fecal coliform bacteria are of particular concern. Water quality issues related to these non-point source pollutants generally are addressed through the implementation of post-development water quality BMPs. Various types of BMPs, as well as the benefits and drawbacks of each type and the methods to select them to address particular site concerns, are included in this section of the Manual.

The Manual will serve as a guide for city staff, consultants, and citizens to achieve consistency in the design and compliance of stormwater projects so that both growth and environmental guidelines can be followed effectively. Incorporating the guidelines contained in this Manual into applications and permits will aid in obtaining construction permits from the City.

4.1.3 Importance of Compliance

Full compliance with both ADEM Phase II Stormwater regulations and the City's ESC Ordinance are required to protect the quality of water and the quality of life in the Auburn area. Any noncompliance with the requirements constitutes a violation and is grounds for potential enforcement actions by ADEM, U.S. Environmental Protection Agency (EPA), and/or the City. An enforcement action could include, but not be limited to, a warning letter, notice of violation, consent or administrative order with monetary penalty, civil or criminal litigation, monetary fines imposed by the City, or an order to stop work on the site.

The ADEM Phase II Stormwater Regulations require that the stormwater runoff from construction activities be protective of water quality to the maximum extent practicable. To accomplish this goal, the regulations require that all site operators of NPDES Construction Sites develop and fully implement and maintain effective and applicable BMPs.

"NPDES Construction Sites" are construction activities that are required to obtain NPDES permit coverage under the ADEM regulations and are defined as the following:

- Construction activities with land disturbance that will disturb 1 acre or greater
- Construction activities that will disturb less than 1 acre but are part of a larger common plan of development or sale whose land-disturbing activities total 1 acre or greater.
- Construction or maintenance activities, irrespective of size, whose stormwater discharges have a reasonable potential to be a significant contributor of pollutants to a Water of the State, or whose stormwater discharges have a reasonable potential to cause or contribute to a violation of an applicable Alabama water quality standard as determined by a Qualified Credentialed Professional (QCP) or ADEM.

Construction activities that will disturb less than 1 acre may not be required to obtain NPDES permit coverage, but are still required to implement the appropriate BMPs to protect water quality.

The continual assessment of the compliance status of an NPDES Construction Site is the responsibility of the construction site NPDES permit holder. This is accomplished through the full implementation of the Construction Best Management Practices Plan (CBMPP) and the inspection and maintenance activities required by the ADEM regulations and the City's ESC Ordinance. These activities are discussed specifically in Section 4.3 of this Manual.

Because ADEM has primary regulatory authority of NPDES permitting of regulated construction activities in Alabama, permitting, compliance, and enforcement are all under the ADEM NPDES jurisdiction. Permitting and enforcement are under the ADEM Water Division. The field compliance unit is under the ADEM Field Operations Division. ADEM is responsible for the protection and preservation of water quality in Alabama by regulating activities that could lead to adverse impacts on the environment.

ADEM performs the following tasks as related to NPDES Construction Sites in Alabama:

- Review and approve or reject construction site NPDES construction stormwater permit coverage requests (Permitting Branch).
- Conduct routine compliance assurance site inspections in accordance with their guidelines (Field Operations).
- Conduct site inspections in response to citizen concerns (Field Operations).
- Review the compliance status of a construction site based on submitted documentation and field reports (Enforcement Branch).
- Issue enforcement actions when noncompliant issues are evident on the site that may result in any adverse impacts (Enforcement Branch).

Acting in the best interest of the community, the City developed local construction site erosion and sediment control regulations (ESC Ordinance) for construction activities within the jurisdiction of Auburn. The ESC Ordinance reinforces the Auburn goal to protect and preserve the local water resources and quality of life. The City developed the ESC Ordinance as a regulatory means to manage construction sites. The original Ordinance was developed by the Auburn, Lee County, Opelika, and Auburn University (ALOA) Citizen Advisory Committee in 2002 and was adopted by the Auburn City Council in July 2002. This ordinance provides guidelines for submitting CBMPPs, as well as for documenting City inspection and enforcement procedures. The City's policies and procedures regarding erosion and sediment control inspection and enforcement are outlined in Section 4.3.3 of this Manual.

The City supports the ADEM permitting, compliance, and enforcement processes through the adoption of the ESC Ordinance and the City's enforcement and site inspection efforts. The City's response to post-storm events ensures that failing or deficient BMPs are corrected promptly. The City has adopted statewide standards for the design, construction, and maintenance of BMPs to provide a degree of uniformity in the requirements across the City. The City also routinely consults with ADEM to determine if there are any changes that need to be made to better support the ADEM efforts to protect the Waters of the State.

The City has not been delegated any authority to directly develop water quality standards. These are promulgated at the state and federal levels and managed through ADEM and EPA. The City works closely with these governing agencies when there appear to be deficiencies that may have resulted in adverse water quality or environmental impacts, as well as to learn ways to improve the City's program to support the Auburn area.

4.1.3.1 Protecting Water Quality during Construction

It is the responsibility of the developer or operator to retain or employ a qualified professional to design all aspects of the proposed project or development and a QCP to plan, design, and certify the CBMPP for the project. The QCP shall be responsible for preparing a CBMPP using good engineering practices that will result in specific strategies to protect water quality. The CBMPP must use the basic design principles available in the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas* (Alabama Handbook), the City's standard erosion and sediment control details (Appendix A), and other recognized BMP documents. The Alabama Handbook can be downloaded from the ADEM website. As part of its review, the City is responsible for determining if the QCP has considered the necessary measures in selecting and designing the site-specific BMPs. If there are any CBMPP deficiencies noted by the City, comments will be provided. This review will be similar to staff reviews of other aspects of the design, including streets and water and wastewater infrastructure, and is discussed in more detail in Section 4.2 of this Manual.

4.1.3.2 Avoiding Enforcement Actions by ADEM, EPA, and the City of Auburn

To avoid enforcement actions and to protect water quality, the operator must take all actions necessary to achieve and maintain regulatory compliance at the site at all times. Regulatory enforcement by ADEM, EPA, and the City may include monetary fines and associated costs that can be significant and detrimental to the financial well-being of a development. NPDES permit holders can avoid enforcement actions by performing the following:

- Retain the services of a QCP who will prepare a CBMPP that will protect water quality.
- Fully implement the CBMPP for the project.
- Perform the regular inspections and corrective actions at the intervals and within the time frame required by the ADEM regulations and the City's ESC Ordinance.
- If the CBMPP is deficient, communicate and work with the QCP so that the CBMPP can be revised and the additional BMPs installed in a timely manner.

Because enforcement actions by ADEM, EPA, and/or the City could be in the form of fines and/or stop-work orders, the cost of noncompliance is high.

4.1.4 Common Needs on Construction Sites

The common characteristics of all construction and development projects include the need to remove trees and/or other forms of vegetation. This action causes the underlying soils to be exposed to precipitation, resulting in a greater chance for erosion to occur. If allowed to occur without any controls, the products of erosion and sedimentation can enter Waters of the State and offsite conveyances and cause water quality and/or hydraulic impacts to occur. It is critical that the appropriate BMPs be designed and implemented using good engineering practices for each specific construction site to protect water quality and to comply with the ADEM regulations and the City's ordinances. Common needs of all construction sites are discussed in this section.

4.1.4.1 Good Planning

To ensure compliance with applicable regulatory requirements, the CBMPP must address effective measures that are to be implemented and maintained to prevent and/or minimize the discharge of all sources of pollution (i.e., sediment, trash, garbage, debris, oil and grease, chemicals, materials, etc.) to Waters of the State in stormwater runoff. Good planning is a crucial element in any CBMPP. Preconstruction planning should consider site soil types, steepness and stability of cut-and-fill slopes, precipitation patterns that are typical for the area, preservation of existing vegetative cover, and site-specific and effective erosion prevention, along with site-specific and effective sediment control.

The operator shall incorporate basic planning principles related to erosion prevention and sediment control for all construction sites in the City regardless of the size of the project or its registration status. These principles should be discussed in the CBMPP and should be implemented to address the following minimum site planning goals:

- Preconstruction gathering and analysis of information to plan and conduct the construction activity in such a manner to prevent or avoid potential discharges or problems; know where all the stormwater receptors and streams are located and locate regulated activities accordingly.
- Identify and divert upslope water around the disturbance areas.
- Limit the exposure of disturbed areas to precipitation to the shortest amount of time possible.
- Use a phased development plan when possible to minimize the amount of surface area that is disturbed at any one time.
- Identify the clearing limits and provide barriers and/or other methods to confine disturbance activities to that area.
- Show all stream and wetland buffers on the CBMPP and preserve them throughout the construction period.

- Immediately correct any deficiencies in BMP implementation and maintenance.
- Incrementally implement stabilization practices as soon as possible following final grading.
- Give special attention to critical areas such as slopes because they are difficult to stabilize.
- Perform site inspections to ensure BMP effectiveness.

4.1.4.2 Site-specific Construction Best Management Practices Plan

Each NPDES Construction Site must have a site-specific CBMPP that has been prepared and certified by a QCP. The CBMPP shall identify the applicable and effective BMPs that must be implemented and maintained to meet the requirements of the ADEM regulations and the City's ESC Ordinance. The CBMPP and the individual BMPs shall meet or exceed the following technical standards and guidelines:

- The Alabama Handbook
- ADEM's regulations and the City's ESC Ordinance and standard details

The permit holder of an NPDES Construction Site is responsible for fully implementing the CBMPP, which shall be maintained at the project site and shall describe in detail the structural and/or nonstructural practices and management strategies that will be implemented and continually maintained to prevent or minimize the discharge of all sources of pollutants. The CBMPP shall be updated as necessary to address any potential or observed deficiencies.

4.1.4.3 CBMPP Inspection and Maintenance

Permit holders shall ensure that their construction activities are evaluated continually to ensure compliance with the provisions of the ADEM regulations and the City's ordinance. All NPDES Construction Site operators shall ensure that their construction activities are regularly inspected by a Qualified Credentialed Inspector (QCI), QCP, or a qualified person under the direct supervision of a QCP, as applicable, to ensure compliance with the provisions of the ADEM requirements. Each NPDES Construction Site permit holder shall fully implement and maintain a comprehensive CBMPP in accordance with the requirements of the ADEM regulations and the City's ordinance until the regulated activities have ceased and the registration has been properly terminated.

All required site inspections shall be noted in the CBMPP and shall be performed and documented as required by the ADEM regulations. A copy of all required site inspection reports should be submitted to the City's Watershed Division, WRM Department, 1501 West Samford Avenue, Auburn, Alabama, 36832. Corrective actions on deficient BMPs shall be completed within the timeframe required by the ADEM regulations and/or the City's regulations.

4.1.4.4 Erosion Prevention Emphasis

It is strongly encouraged that permit holders on construction projects in the Auburn area place emphasis on the use of ***erosion prevention*** on their sites. Erosion prevention strategies could include, but not be limited to, maintaining stabilization, limiting the amount of area that is cleared at one time, and limiting the duration of soil exposure and other erosion prevention strategies. By placing an emphasis on erosion prevention, a smaller amount of erosion products will be generated, resulting in a greater chance for success in protecting water quality.

4.1.5 City of Auburn Requirements and Special Conditions under the Municipal Separate Storm Sewer System Designation by ADEM

The Phase II regulations are an extension of the Phase I Stormwater Regulations and became effective in March 2003. The City came under the Phase II Stormwater regulations because of the overall population of Auburn, Opelika, and surrounding Lee County. Under its General Permit, the City is required to perform representative monitoring of water quality within its MS4 that discharge to impaired waters and/or to a water for which a TMDL has been approved by the EPA. When the City began its Phase II Stormwater Program, coordination and implementation of the individual stormwater management program was the responsibility of the City's Public Works Department. In October 2005, management of the City's stormwater program was transitioned from the Public Works Department to the City's Water and Sewer Department under a newly created Watershed Division. Coinciding with the formation of the Watershed Division was the renaming of the City's Water and Sewer Department to the WRM Department. The intent of the move was to manage water supply operations, wastewater operations, and stormwater operations based on a watershed perspective for all components that affect water quality within areas of jurisdiction for Auburn, including construction stormwater.

4.1.5.1 Phase II General MS4 Permit–Construction Activities

Under the federal Phase II Stormwater regulation, provisions are provided that allow a permitting authority to be responsible for implementing one or more of the minimum control measures for the Municipal Separate Storm Sewer System (MS4). If the permitting authority provides this recognition, then the MS4 is not required to include that minimum control measure in its Program. ADEM Administrative Code Chapter 335-6-12 implements a statewide construction stormwater regulatory program that meets NPDES requirements for construction activities. Additionally, under General Permit ALG040000, it is specifically stated that this General Permit does not require an MS4 to implement a local construction stormwater control program. Therefore, the City is not required to include this measure in its program. The City, however, saw a need to develop a construction site erosion and sediment control program to aid in the protection of local water resources. City regulations do not supersede the ADEM regulations and are intended to support the ADEM efforts.

4.1.5.2 Erosion and Sedimentation Control Policy and Ordinance

To fulfill its goal to provide additional protection to the Waters of the State in the Auburn area, the City has implemented an ESC Ordinance and Policies and Procedures dealing with its overall Stormwater Management Program; construction stormwater is included under this program.

4.1.5.3 Tier 1 Waters–Construction Activities

ADEM considers Tier 1 Waters related to Construction Activities as those waters that are affected by construction activities and that: 1) do not meet use classification water quality standards; 2) have use classifications less than Fish and Wildlife; or 3) have implemented total maximum daily loads (TMDLs). These waters are listed in the ADEM Construction Stormwater TMDL and 303(d) Listed Tier 1 Water bodies, which is periodically updated by ADEM and provided at www.adem.state.al.us under the Water Division. Moore's Mill Creek (AL03150110-0301-400) has the following use classifications: 1) Swimming; and 2) Fish and Wildlife. However, it is listed on the ADEM Construction Stormwater TMDL and 303(d) Listed Tier 1 Waterbodies for siltation from its source to Chewacla Creek. The sources that have caused this sediment listing are land development and urban and storm sewers.

For priority construction sites, which include any site that discharges to (1) a waterbody which is listed on the most recently EPA approved 303(d) list of impaired waters for turbidity, siltation, or sedimentation, (2) any waterbody for which a TMDL has been finalized or approved by EPA for turbidity, siltation, or sedimentation, (3) any waterbody assigned the Outstanding Alabama Water use classification in accordance with ADEM Admin. Code r. 335-6-10-.09, and (4) any waterbody assigned a special designation in accordance with ADEM Admin. Code r. 335-6-10-.10, the CBMPP must be submitted to ADEM for review along with the NOI.

4.2 City of Auburn Erosion and Sedimentation Control Permitting

4.2.1 Erosion and Sedimentation Control Ordinance

The City's ESC Ordinance and related Policy and Procedures identify the permitting steps involved for construction activities as related to erosion and sediment control. The City's review process for permitting includes the following reviews:

- CBMPP review
- Stream buffer review
- Steep slope review

For the protection of water quality and other area resources, these reviews are conducted by the City for all land disturbance projects. Review comments will be provided to the permit holder and must be corrected before any construction activities are begun.

4.2.2 City of Auburn Erosion and Sedimentation Control Guidelines and Requirements

The City's desire to protect water quality and the quality of life for residents of the Auburn area has led it to develop regulations and documents for use by local developers and contractors during construction activities. The ordinances and documents that describe the guidelines and requirements are as follows:

- Erosion and Sedimentation Control Ordinance
- Illicit Discharge Ordinance
- City of Auburn Stormwater Management Program, Policies and Procedures
- Summary of Auburn's Stormwater Program–Erosion and Sediment Control

These and other related documents are available through the City and provide the City's requirements for development at construction sites.

4.2.3 City of Auburn Design and Construction Standards

The following is a list of the City's major design and construction standards and policies related to erosion prevention and sediment control on all construction sites:

- A CBMPP shall be developed for any construction activity where soil is disturbed to the point at which Waters of the State or adjoining property could possibly be affected by sediment transport. The CBMPP shall comply with applicable ADEM regulations and shall contain sufficient information to describe the structural, nonstructural, and planning procedures that are to be used to prevent erosion.

- Minimize sediment transport from the site and address potential hydrologic impacts resulting from the activity.

- Erosion prevention and sediment control measures shall be incorporated prior to or concurrent with all clearing and grubbing construction activity and prior to grading and utility construction activity, and shall be maintained to maximize performance and efficiency during construction. The CBMPP may be revised and control measures altered during construction as necessary to comply with the City's ESC regulations.
- The City shall perform monthly inspections (at a minimum) of active construction sites and shall at times perform water quality monitoring to assess the impacts of an active construction site on the City's stormwater conveyance system and/or waterways. Any deficiencies shall be documented and reported to the contractor and/or developer/operator for immediate attention and remediation. If the water quality monitoring indicates that the current BMPs are insufficient because of a rise in the water turbidity by 50 nephelometric turbidity units (NTUs) or greater, the contractor and/or developer/operator shall be notified to revisit the CBMPP to improve the performance of BMP measures or add to measures that currently are installed.
- All CBMPP BMPs shall be inspected monthly at a minimum or within 48 hours following an 0.75-inch or greater rainfall within any 24-hour period. Copies of the ADEM inspection report for applicable sites shall be submitted to the City's WRM Department. Maintenance, repair, and improvements to the CBMPP control measures shall be completed within the timeframe outlined in the inspection report.
- A construction exit pad (CEP) shall be installed at all points of ingress or egress to the site, as approved by the City, and shall be maintained at all times to minimize the transport of sediment from construction sites to City public streets. No more than one CEP is allowed per construction site unless otherwise approved by the City.
- Erosion control blankets and netting and/or a flocculant such as polyacrylamide (PAM) shall be used on steep slopes (greater than 3 horizontal: 1 vertical [3H:1V]) and in channels to stabilize soils while establishing vegetative cover. The City may require the use of flocculants on developments that discharge directly to the water bodies and in other areas as deemed necessary by the City.
- All bare areas shall be mulched immediately following the completion of initial grading practices. All bare areas shall receive temporary seeding and mulching when the area has been graded for 5 calendar days and will not be worked for more than 13 calendar days.
- All erosion and sediment control measures shall be designed and maintained in accordance with the Alabama Handbook (latest version) and the City's standards.
- Erosion and sediment control BMPs shall be designed and installed according to their intended application. In the event BMPs are misapplied, they shall be replaced immediately upon notification by the QCI and QCP or City.

- Buffer zones (from streams and wetlands) shall be clearly marked such that no excavation shall occur within this zone other than what is prescribed for the construction of approved utilities and access routes (roads, streets, greenways, etc.); any and all such work shall be performed in a workmanlike manner as to minimize impacts within the reasonable construction limits.
- Any work outside the boundaries of the construction limits or buffer zones is not allowed. The developer/operator shall modify the CBMPP prior to disturbance and receive approval from ADEM and the City prior to any work beginning outside the boundaries of the construction limits or buffer zones.
- Permits shall be obtained from ADEM and the USACE, as applicable, for any land disturbance activity. Any work performed or impacts made outside the boundaries of approved wetland and stream impact zones shall be reported to ADEM and/or the USACE.
- Each day on which there is activity at the construction site, the operator, a QCI, a QCP, a qualified person under the direct supervision of a QCP, other qualified consultant, or other qualified persons shall visually observe that portion of the construction project where active disturbance, work, or construction occurred and report any apparent BMP deficiencies observed to the operator, QCP, or QCI for maintenance.

4.3 CBMPP Approval, Implementation, Inspection, and Maintenance Requirements

4.3.1 Submittals

For NPDES construction sites, the following submittals to the City are required as part of the City's permitting and review process:

- Completed ADEM Notice of Intent
- CBMPP
- ADEM Notice of Receipt of Registration
- For sites within the Moore's Mill watershed, a copy of the permit or approval letter from ADEM is required.

As described in Section 4.3.1.1 of this Manual, the City has a formal review and approval process for all CBMPPs.

4.3.1.1 Review and Approval of Construction Best Management Practices Plans

Watershed Division personnel will review the CBMPP submitted for each individual development and will provide written comments to the engineer and/or QCP regarding the CBMPP in accordance with the City's DRT, which is covered in a previous section of this Manual. Generally, the developer's QCP as a professional engineer licensed in Alabama is responsible for designing, planning, and certifying the CBMPP BMPs that will ensure protection of Waters of the State and ensure compliance with the City's rules, as well as compliance with the ADEM regulations. The City has adopted the statewide standards to encourage uniformity in CBMPP design, implementation, and maintenance.

As described previously, the CBMPPs shall be submitted to the City by the engineer of record, along with other applicable engineering drawings and specifications for the project. The CBMPP will be reviewed as part of the City's plan review process by Watershed Division staff to ensure that minimum criteria are met. City staff will issue comments to address deficiencies or areas of concern with the submitted plan. Comments generally will be emailed to the City's Public Works Department and subsequently mailed, along with additional plan review comments, to the engineer of record.

Once all comments have been addressed, a preconstruction meeting will be scheduled by the City's Public Works Inspection Division Manager. The developer, contractor, engineer of record, QCP, and any other applicable parties should attend the preconstruction meeting.

Following the preconstruction meeting, a Clearing and Grubbing Permit will be issued to the permit holder by the Inspection Division Manager provided that the permit holder has secured the ADEM NPDES permit for the site and has submitted a copy of that permit to the City. Any applicable USACE permits also should be provided to the City prior to issuance of the Clearing and Grubbing Permit. This Clearing and Grubbing Permit allows the contractor to begin implementation of the site CBMPP, and then to begin conducting clearing and grubbing operations. A Grading and Utility Permit will not be issued until the CBMPP has been fully implemented by the permit holder, and has been inspected and approved by the City.

In addition to the normal items that are reviewed in the CBMPPs, the Watershed Division personnel specifically review two special areas: 1) stream buffers; and 2) steep slopes. The City's CBMPP stream buffer review is intended to ensure that the CBMPP has included requirements of the City's stream buffer regulations, Article IV, Section 413, of the City Code. The City will use its Geographic Information System (GIS) Watershed Delineation Tool in situations where the buffer shown is in question to ensure that the applicable buffers have been applied. The purpose of this review is for staff to ensure that proper identification of stream buffers and buffer requirements are documented on the CBMPP, subdivision plats, and other site plans and that the proper delineation and documentation are provided on engineering plans.

The second specific area of concern during the City's CBMPP review involves steep slopes, which should be designated as critical areas and should be noted on the CBMPP. To encourage the uniform establishment of stabilization, steep slopes require special attention and treatment. These must be specifically identified in the CBMPP. Steep slope restabilization shall begin immediately following final grading. Typical BMPs may include, but not be limited to, slope tracking, installation of geofabrics and other BMPs that are specifically applicable to steep slope critical areas. The Watershed Division personnel will review the CBMPP and analyze GIS topography of steep slope areas on developments to ensure that the designer has included an evaluation and requirements of the City's steep slope regulations, as shown below, and included appropriate delineation and documentation on the plat and plan, and appropriate BMPs in the CBMPP to promote the management of any land disturbance in an area where steep slopes exist. The City's steep slope regulations include the following requirements:

- Areas subject to steep slope restriction shall be indicated on a map maintained by the Information Technology Department and available to the public.
- Steep slope areas within 600 feet of the top of any perennial or intermittent stream shall be preserved in their natural state whenever possible. Where construction of roads, building, driveways, or infrastructure cannot be avoided, disturbance shall be kept to a minimum, and in no case, shall it exceed the following limits:

  A. *Fifteen- to 30-percent slopes:* Site disturbance shall be minimized to the maximum extent practicable. The site erosion and sediment control plan should provide BMPs to minimize erosion of these slope areas during development.

  B. *More than 30-percent slopes:* No more than 25 percent of such areas containing 1 acre or more of continuous slopes shall be developed and/or regraded or stripped of vegetation and the slope area to be developed, regarded, or stripped of vegetation shall be shown on the plat or plan. If the application of these steep slope regulations results in the loss of buildable area on a lot, mitigation measures in accordance with Section 413.10 of the Zoning Ordinance may be proposed by the engineer of record and considered by the City's WRM Department to allow for disturbance within these slope areas.

C. *Steep Slopes in a Stream Buffer:* No slopes greater than 30 percent that lie within a stream buffer shall be developed and/or regraded or stripped of vegetation unless approved in accordance with Sections 413.09 through 413.12 of the City's Zoning Ordinance.

4.3.1.2 Design Calculations

The QCP will develop design calculations to provide supporting documentation for the CBMPP. Design calculations shall be in accordance with the Alabama Handbook (latest revision) and shall be submitted to the City for review and comment.

4.3.2 Checklists

The permit holder shall be aware of the standard checklists that the City will use to assess completeness of a development design and items that will be reviewed by the City while performing site inspections. The major checklists are described below.

4.3.2.1 City of Auburn Site Development Plans Submittal Checklist

The plan submittal checklist deals directly with the CBMPP and must be submitted with every set of engineering construction plans for site developments. All items on the checklist shall be addressed. This checklist is not intended to be all-inclusive, and fulfillment of this checklist does not alleviate the obligation of the permit holder to protect Waters of the State and to meet all related City codes, regulations, ordinances, and specifications. The purpose of this checklist is to facilitate a more efficient plan review process for the designer and the review team. The CBMPP requirements are outlined in the checklist found in Appendix B of this Manual and may be in addition to the CBMPP requirements in the ADEM regulations:

- Used a phased plan when applicable.
- Show clearing limits.
- Show stream and wetland buffers. Drainage basin of stream should be delineated from the commencement point of the stream, to the point that it leaves the property. Basin area determines buffer widths (see Zoning Ordinance).
- Provide an ESC legend.
- Identify project site identification sign location and provide project rain gauge onsite.
- Provide a CEP (minimum 20 feet x 50 feet). Use #1 stone with geotextile fabric underneath. Use one CEP per site at any given time.
- All silt fencing shall be Type "A" (wire-reinforced, metal-staked, trenched) or C-POP.
- Hay bales may not be used as stand-alone inlet protection. They can be used in conjunction with silt fence or other sediment barriers.

- Use rock check dams, wattles, or silt fence check dams (rather than hay bales) where applicable.
- Design and show outlet protection at all discharges.
- Show curb inlet protection devices (no stand–alone hay bales).
- Slopes greater than 3:1 require erosion control blankets. Specify types of blankets being used.
- Show all sediment basin location, filter volumes, and sediment volumes.
- Submit copies of all sediment storage design calculations.
- Attach City standard erosion and sedimentation control details (Appendix A).
- Include the following notes on the ESC or CBMP Plans:
  a. Any area that has been disturbed and will remain so for more than 13 days shall be seeded and mulched within 5 days of being disturbed.
  b. Additional BMPs may be required by the QCP and/or City over the course of the project to minimize sediment release from the site
  c. All BMPs shall be designed and installed in accordance with the Alabama Handbook and the City's standard erosion and sediment control details.
  d. The use of floc-blocks, PAM, or other settling enhancement materials may be required by the QCP or the City during the course of construction to minimize turbidity and sediment release from the site.

4.3.2.2 City of Auburn ESC Inspection Checklist

This checklist is used by the City inspectors to guide and document site inspection activities. Its specific use is discussed in the Inspection section.

4.3.3 City of Auburn Inspection and Enforcement Program

The City staff has developed an inspection and enforcement strategy that promotes compliance with the City's erosion and sediment control regulations by monitoring sites in a proactive manner and responding to deficiencies with the appropriate action to ensure that the City's standards are being met to the maximum extent practical. The City's program does not supplement, but supports, the ADEM construction site inspection program in that a majority of issues and deficiencies are resolved before any significant water quality impacts have occurred. Because the level of enforcement by the City is more extensive than that required by the City's NPDES permit, the program promotes natural resource protection.

The City requires developers and/or contractors to develop and fully implement a CBMPP on all NPDES Construction Sites to minimize erosion and sedimentation impacts on the surrounding environment and natural resources. Although CBMPPs are only required for NPDES Construction Sites, carefully planned Erosion and Sediment Control Plans are required for all sites where land is disturbed. Actual selection and installation of BMPs will depend on the specific needs of each individual site characteristics and will be displayed and marked on the CBMPP, which is approved by City personnel prior to site clearing and development. Inspection comments and recommendations will be based on the measures outlined in the CBMPP.

Upon issuance of the City's Clearing and Grubbing Permit, the contractor is authorized to begin conducting clearing and grubbing operations at the site. Prior to beginning any clearing and grubbing activities, appropriate BMPs must be implemented. Once all BMPs have been fully implemented, the contractor or operator should schedule an initial CBMPP walk-through inspection with the Watershed Division Manager and or Public Works Inspection Division Manager. The Division Manager will then conduct a walk-through inspection of the BMPs onsite in accordance with the approved CBMPP. If all measures are satisfactorily installed, the Division Manager will issue a Grading and Utility Permit to the contractor authorizing the contractor to begin grading operations and utility installation onsite. If the BMPs onsite have not been satisfactorily installed in accordance with the CBMPP or other deficiencies are noted, the Division Manager will notify the contractor of the issues onsite and will schedule a follow-up inspection prior to issuing the grading and utility permit.

4.3.3.1 City of Auburn Construction Site Inspections

In addition to the ADEM inspection requirements, the City staff will be performing certain other inspections and compliance determinations for each site, using the inspection checklist provided in Appendix B. Even with these additional inspections, it is still the operator's sole responsibility to continually assess the compliance status of each site. The City's and the ADEM site inspections are Compliance Assurance Inspections. The timing and general processes of construction stormwater inspections within the City's jurisdictions are summarized below:

- Routine inspections will be made on a monthly basis, within the first full week of the month to determine site compliance with City Ordinances and the CBMPP.
- Rainfall inspections will be made within 48 hours after each rainfall event that equals or exceeds 0.75 inch in any 24-hour period to determine site compliance with City ordinances and the CBMPP.
- The Watershed Division Manager will determine the schedule of inspections.
- Documentation of inspection, including inspection report, photographs (if applicable), and letter to permit holder will be mailed and filed within 48 hours of inspection.
- When major deficiencies are observed upon inspection, the Watershed Division Manager shall coordinate with the Stormwater Coordinator to determine if a Notice of Violation (NOV) is warranted.
- Inspection reports shall be entered into the City's Construction Site Database within 1 month of the inspection.

The following general guidelines are used by the City when performing CBMPP inspections for construction sites.

The City's inspector shall use commonly accepted procedures and practices for conducting each inspection. Site inspections will include a review of existing BMPs to determine effectiveness and to develop recommendations to modify, add, or improve existing measures.

Each inspection sheet will note the following:

- Date, time, and inspector
- Development or construction site name, name of developer, contractor or operator, and location of site

Condition assessments will be noted on the inspection sheet as "Good," "Fair," or "Poor" for each applicable BMP. Additionally, the inspector will note whether a BMP requires maintenance, as well as including any relevant comments or considerations. All deficiencies should be documented on the inspection form and by digital photograph.

City staff will inspect the installation and maintenance of the BMPs. However, it is the sole responsibility of the operator to fully inspect the construction site, to make continual assessments of the compliance status, and to identify corrective actions for the BMPs that are needed to protect Waters of the State and offsite conveyances. The City does not direct work, but points out deficiencies and takes necessary enforcement actions when deficiencies are not addressed in a timely manner.

Site inspections will determine and document whether uncontrolled releases of sediment or turbid water have occurred, as well as what corrective actions are necessary for proper control. If it is determined that significant releases of sediment have occurred and/or there is evidence of water quality impairment as a result of the deficiencies, then the NPDES permit holder shall provide a 24-hour verbal and 5-day written Noncompliance Notification Report (ADEM Form No. 501) to ADEM and the City. The Watershed Division Manager also may immediately notify ADEM of these deficiencies.

The Inspector shall communicate any major deficiencies noted during the inspection so that issues may be addressed while a report is prepared. The compliance inspection and monitoring processes are self-monitoring in that the operator must have on his staff or hire a QCP to design, prepare, and certify the CBMPP. A QCP, qualified person under the direct supervision of a QCP, or a QCI must inspect the BMPs for proper installation and maintenance. ADEM inspection reports (Stormwater Inspection Report and BMP Certification [ADEM Form No. 500]) must be prepared and signed by the inspector and placed in the file ready for ADEM or the City's review within 15 days of the date of the inspection. If noncompliant issues are found during the routine inspections, the QCP is required to provide ADEM with a verbal notification within 24 hours of becoming aware of the noncompliant BMP and/or discharge and then provide ADEM, within 5 days, a written Stormwater Noncompliance Notification Report that fully describes the noncompliant issue(s), the period of the noncompliance, and the measures taken and/or being taken to correct the noncompliant condition and to keep it from recurring.

In addition to the BMPs and other strategies provided in the Alabama Handbook, the City has identified certain control measures for inspection emphasis. Also, the City has prepared standard details for certain BMPs that are accepted by the City and used frequently on projects within the City's jurisdiction. These standard details are provided in the two Erosion Control drawings provided in Appendix A. The City's inspection emphasis is provided herein for certain construction BMPs and strategies.

4.3.3.2 Sediment Control Structures

Appropriate BMPs must be selected by the QCP and will vary by site. Typically, sediment control devices will serve as the second line of defense to protect water quality and are intended to minimize sediment from entering waters of the state or Waters of the United States or adjacent parcels of property. Sediment control structures are effective in providing a location to collect sediment-laden stormwater and to remove sediment by filtering or settling. In general, inspectors should observe the site overall, paying special attention to areas of existing or potential erosion and accumulation of sediment.

Sediment control structures should include the following, at a minimum:

1. **Sediment traps–**Typically, these are small, temporary structures that are removed when construction activities have been completed. Overall condition should be assessed during inspections (stabilization of trap slopes, buildup of sediment, inlet structures, etc.). Required volume calculations for sediment traps are based solely on 3,600 cubic feet per acre of drainage area.
2. **Filter structures–**Should be clean and functioning properly. Filter media and outlet pipe shall be large enough to reduce filter blinding during use.
3. **Detention/retention pond–**See sediment trap comments. Detention and retention ponds are retrofitted for sediment storage to serve as sediment basins until the site is completely stabilized, provided that proper outlet and filter structures are in place.
4. **Outlet structure**–Overall condition and proper installation.
5. **Flocculants (logs blocks PAM)–**Assess the need for flocculants. Is the water flowing through the filter and outlet structure still significantly turbid? Check slopes and other critical areas to determine the need for additional stabilization.
6. **Discharge headwalls–**Overall condition (proper installation, stabilization, and outlet protection): Are stilling basins or energy dissipaters required to maximize efficiency of the structures?
7. **Sediment Forebays and Baffles–**Evaluate the need for sediment forebays and/or baffles in the basin. Baffle design requirements can be found in a publication produced by the North Carolina State Cooperative Extension Service (*Using Baffles to Improve Sediment Basins, Publication No. AG-439-59)* and calculations must be submitted to the City's WRM Department for review. Baffles are required if the basin cannot be designed in accordance with the City's 3:1 length:width ratio requirement. Forebays and/or baffles can be used in conjunction with flocculants to

minimize turbidity leaving the basin. If forebays and/or baffles are in place, check the need for maintenance of the structures.

4.3.3.3 Sheet Flow Barriers

The City's Ordinances require that measures be taken to control erosion and runoff of disturbed soil areas and open areas that are affected by development and construction activities. Furthermore, City Ordinances require that disturbed soil that is not to be worked for at least 13 days be stabilized with seed and mulch within 5 days of initial disturbance.

Inspections of sheet flow barriers should include, at a minimum, the following:

1. Silt fences erected to control sheet water flow–Assess for proper installation, correct type of silt fence, breached or damaged silt fence, etc.
2. Seeding, mulching, chemical stabilization (PAM, hydro seeding, etc., and other methods of stabilization for exposed areas to encourage vegetative growth).
3. Daily mulching may be required when utilities are constructed adjacent to or within stream buffers.
4. Sediment and erosion control blankets (ECBs) should be installed on all slopes greater than 3H:1V. The engineer of record or QCP shall be responsible for designing and specifying the correct type of ECB for the slope and soil in question in accordance with the Alabama Handbook. The contractor or operator shall be responsible for installing the ECBs in accordance with the Alabama Handbook guidelines and manufacturers' recommendations.

4.3.3.4 Channel Check Structures

Drainage channels, both natural and manmade, shall be inspected to ensure that appropriate BMPs have been implemented to control erosion and sedimentation impacts from stormwater runoff. In no case shall BMP measures be placed within Waters of the State and or Waters of the United States unless otherwise permitted through a site-specific USACE Section 404 permit.

Inspections of channel check structures should include the following:

1. Rock check structures–Proper installation, cleaning, and/or maintenance, etc.
2. Silt fence checks–Proper installation, cleaning, and/or maintenance, etc.

4.3.3.5 Stream Bank Stabilization

Special considerations exist for streams that flow through areas being developed. Stabilization of stream banks is critical for preventing further erosion, as well as preventing unnecessary damage to the environment due to discharges into the stream from construction activities. It is important for inspections to note the effect of all the CBMPP measures on streambeds, especially when considering issues of stream bank stabilization.

Specifically, inspections will cover the following stream bank stabilization issues:

1. Chemical stabilization (use of PAM, hydro seeding, etc.) of banks. Is coverage adequate and complete?
2. Rip-rap–Is sizing and installation appropriate? Is filter fabric underlining required and has it been installed?
3. Stream crossing and protection–Assess the installation of or the need for installing additional CBMPP measures such as silt fences, erosion and sediment control blankets, etc.

4.3.3.6 Inlet Protection

All storm drain inlets shall be protected against the entry of sediment and silt at all times. Because conditions may change throughout the development process, modifications to these barriers are to be expected to be implemented. Inlet protection BMPs should be appropriate for the type of inlet and surrounding areas.

Inspections for inlet protection BMPs should include the following, at a minimum:

1. Silt fences or other prefabricated inlet barriers such as molded polyethylene cage with filter fabric or wattles at storm drain inlets. The use of hay bales for inlet protection is strictly prohibited unless used in conjunction with silt fencing around the inlet.
2. Curb inlet protection to include gravel filter bags or other approved devices such as wattles.

4.3.3.7 General Site Measures

Inspections of general site BMPs and other management strategies typically entail observation of good grounds keeping and also consider how the overall site is affecting the surrounding areas. General site measures inspections will include inspections of the following:

1. General maintenance of construction entrances and buffer areas–Sediment and debris tracked by vehicles onto roadway will wash into stormwater systems and may cause hazardous road conditions for the general public. Does the construction entrance consist of ALDOT No. 1 course aggregate with geofabric? Is the construction entrance the proper length and width? Should the contractor consider lengthening or widening the construction entrance?
2. Posting of all applicable federal, state, and local permits in a visible location near the construction entrance and clear marking of construction limits and buffer areas.
3. Rain gauges should be posted onsite in a visible location near the construction entrance.

4.3.3.8 Inspection Report and Follow-up Documentation

Inspection report checklists will be completed for each inspection as it is performed, as follows:

1. Digital photographs will be taken of all site deficiencies and any other area of interest. Photographs shall be time and date stamped.
2. Inspection report results shall be entered into the City's Construction Site database within 1 month of the inspection.
3. A formal letter detailing the inspection results, as well as any other relevant comments, shall be mailed to the permit holder and other applicable parties within 48 hours of inspection. Photographs, a copy of the inspection report, and any supporting documentation shall be included.
4. All documentation shall be maintained on a Laserfiche file within the City's WRM Department.

4.3.3.9 City of Auburn Construction Site Enforcement Procedures

Under the authority of the City's Ordinances dealing with erosion prevention and sediment control, the City may initiate enforcement actions, if needed, to ensure that construction sites are in compliance with its ordinances and are protecting water quality. The City's action is independent and in addition to any enforcement actions that may be initiated by ADEM. The City's enforcement approach is summarized below:

1. If no deficiencies are found onsite, a copy of the inspection report and letter should be mailed to the permit holder stating that no deficiencies were found onsite at the time of inspection.
2. If minor deficiencies are noted onsite at the time of inspection, a copy of the inspection report, along with a letter outlining the deficiencies and proposed corrective actions, will be mailed to the permit holder stating that these issues should be corrected prior to the next rain event. The inspector should also follow up with the permit holder via phone and/or email to ensure that the permit holder understands the nature of the deficiencies and proposed corrective actions. The inspector will follow up onsite as necessary prior to a subsequent rain event to ensure that these items are being addressed.
3. If major deficiencies (sediment is leaving the site, failure to correct minor deficiencies since the last inspection, failure to adequately install or maintain BMPs, etc.) are noted onsite, the following enforcement process shall be initiated:
    a. An NOV is issued in writing to the permit holder and/or responsible party documenting the deficiencies noted during the site inspection. This NOV will provide a specific time to comply with action items listed in the NOV, normally 72 hours from the date of communication of the NOV.
    b. When the time specified in the NOV has expired, a follow-up inspection is conducted by the Watershed Division Manager, the inspector, and/or the WRM

Director. If the permit holder has failed to satisfactorily address the deficiencies onsite at the end of this time period, a citation will be issued by the City to the permit holder for violations of the City's ESC Ordinance. City personnel also have the ability to issue a stop-work order onsite if conditions warrant.

c. Penalties for violating the City's ESC Ordinance are $500 per day per offense and/or possible jail time, as determined by the City of Auburn Municipal Judge.

4. In cases where there are repeat violators or repeat violations by the same contractor for the same or similar items, the City may issue a citation in lieu of an NOV. This is to allow more timely action by the City against the contractors that continue to violate the ordinance.

4.4 Post-development Stormwater for Water Quality Management

4.4.1 Introduction

4.4.1.1 Structural Stormwater Controls–Categories and Applicability

A non-disturbed watershed generally has stormwater storage widely distributed in small-volume components throughout the watershed (shallow depressions, porous soils, etc.). This natural storage usually is reduced when urbanization occurs. If the reduction is significant, onsite stormwater storage measures are required to offset the increase in stormwater peak discharge and the reduction in water quality. These measures are known as stormwater BMPs, a variety of which have been developed to address specific stormwater quality or quantity concerns. Because the City has been designated by ADEM as a Phase II Small MS4 community under the NPDES, the City is required to show that stormwater runoff into local streams does not degrade the water quality of the stream. This section identifies various types of stormwater BMPs that are deemed to be appropriate for use in the Auburn area and to achieve compliance with the NPDES requirements. In addition to the types of stormwater hydrologic controls, this section discusses which BMP is most suitable to achieve specific treatment objectives and the general design considerations for each BMP.

Structural stormwater BMPs are engineered facilities intended to treat stormwater runoff and/or mitigate the effects of increased stormwater runoff peak rate, volume, and velocity caused by urbanization. This section provides an overview of structural stormwater controls that can be used to address the minimum stormwater management standards outlined below.

The stormwater management goals established by the City are defined as follows:

- Provide stormwater treatment for the Water Quality Volume (WQv), the runoff generated by the first 1.2 inches of rainfall. The WQv can be calculated using the City's stormwater quality site development review tool, available from the City's web site at: http://www.auburnalabama.org/wrm/sitedevelopment.asp.
- The post-development peak discharge from a detention facility must be less than or equal to pre-development peak discharges for the following design storms: 2-, 5-, 10-, and 25-year, 24-hour.
- The post-development peak discharge from a detention facility must be limited based on the discharge capacity to the first City-maintained stormwater management facility downstream from the project.

These water quality requirements are applicable to the City's Lake Ogletree source water watershed, as well as any other watershed deemed impaired by state, federal and/or local regulations.

In addition, it is recommended that the designer provide for extreme flood events by either: 1) control of the peak discharge increase from the 100-year storm event discharge through detention; or 2) safely pass the 100-year storm event discharge through the structural control and allow it to discharge into receiving water whose protected floodplain is sufficiently sized to account for extreme flow increases without causing damage.

The design and sizing calculations for stormwater facilities are reviewed by the City's Public Works Department and/or WRM Department. Therefore, this Manual focuses on the water quality objectives to be achieved through new development or redevelopment projects.

The City's requirements for water quality treatment are an 80-percent reduction in TSS and a 40-percent reduction in total phosphorus (TP), on an average annual basis. TSS is the recognized indicator pollutant for water quality, and a significant reduction in TSS concentration typically is accompanied by an equally significant reduction in other stormwater pollutants (including nutrients, pathogens, and metals). Phosphorus is a nutrient contaminant that primarily comes from fertilizer. Excessive phosphorus loading to streams contributes to stream eutrophication, which typically results in severe water quality degradation. The descriptions provided for BMPs listed in this Manual include information about the expected water quality performance for each BMP, assuming that it is properly designed and constructed. The water quality standards and guidance outlined in this Manual are adopted by EPA and by the criteria for other organizations, such as the U.S. Green Building Council for Leadership in Environmental and Energy Design (LEED).

The calculation of offsite discharges must be determined to the first downstream City-maintained stormwater management facility so that during design storm flows, the structures and system currently in place are not flooded. If the added volume will compromise the current structures and system, necessary steps must be taken to resolve flooding problems.

4.4.1.2 Structural Control Categories

The structural stormwater control practices recommended in this Manual have been placed into one of three categories, based on their applicability and ability to meet stormwater management goals, as discussed in the following text.

General Application Structural Controls.
General application structural controls are recommended for use with a wide variety of land uses and development types. These structural controls have a demonstrated ability to effectively treat the WQv and are presumed to be able to remove 80 percent of the annual average TSS load in typical post-development urban runoff when designed, constructed, and maintained in accordance with recommended specifications. Several of the general application structural controls can also be designed to provide water quantity control (downstream channel protection volume [CPv], overbank flood protection [Qp25], and/or extreme flood protection [Qf]). General application controls are the recommended stormwater management facilities for a site wherever feasible and practical.

Limited Application Structural Controls.
Limited application structural controls are those that are recommended only for limited use or for special site or design conditions. Generally, these practices: 1) cannot alone achieve the 80-percent TSS removal target; 2) are intended to address hot spot or specific land use constraints or conditions; and/or 3) may have high or special maintenance requirements that may preclude their use. Limited application controls typically are used for water quality treatment only. Some of these controls can be used as a pretreatment measure or in series with other structural controls to meet pollutant removal goals. Limited application structural controls should be considered primarily for commercial, industrial, or institutional developments.

Detention Structural Controls.
Detention structural controls are used only for providing water quantity control (CPv, Qp25, and/or Qf), and typically are used downstream of a general application or limited application structural control.

4.4.1.3 General Application Structural Controls

General application structural controls are stormwater BMPs that are recommended for use in a wide variety of land uses and development types. These water quality BMPs are designed to provide a high level of water quality treatment when designed, constructed, and maintained according to the recommended specifications. General application controls are ideally suited to reduce non-point source pollution from impervious and disturbed areas. These controls are the preferred alternatives for post-development stormwater treatment, wherever feasible. A detailed description of each BMP recommended for the City is provided below.

4.4.2 Stormwater Wetland

4.4.2.1 Description and Benefits

Stormwater wetlands are constructed systems that mimic the functions of natural wetlands and are designed to mitigate the impacts of urbanization on stormwater quality and quantity.

Stormwater wetlands provide an efficient method for removing a wide variety of pollutants, such as the following:

- Suspended solids
- Nutrients (nitrogen and phosphorus)
- Heavy metals
- Toxic organic pollutants
- Petroleum compounds
- Fecal coliform contamination, if property designed for this function

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 80 percent
- Nutrients (TP[a]/ TN[b]) ~ 40/ 30 percent
- Metals ~ 50 percent
- Pathogens ~ 70 percent

[a]TP = Total Phosphorus

[b]TN = Total Nitrogen

These wetlands temporarily store stormwater runoff in shallow pools that support emergent and riparian vegetation. The storage, complex microtopography, and vegetative community in stormwater wetlands combined form an ideal matrix for the removal of many pollutants. Treatment wetlands also can effectively reduce peak runoff rates and stabilize flow to adjacent natural wetlands and streams. An example constructed wetland is shown in Figure 4-1.

FIGURE 4-1
Constructed Wetland, National Museum of the American Indian in Washington, D.C.
(Courtesy D. Medina)

Long-term data from wetland treatment systems indicate that treatment performance for parameters such as 5-day biochemical oxygen demand (BOD_5), TSS, and total nitrogen (TN) typically does not deteriorate over the life of a treatment wetland. The dissolved oxygen (DO) concentration in wetland outflows, however, may be below 1 milligram per liter (mg/L). Higher DO concentrations can be achieved by incorporating aeration techniques such as turbulent or cascading discharge zones, or mechanical mixing.

There are several design variations of the stormwater wetland, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland. These include the shallow wetland, the extended detention shallow wetland, pond and wetland system, and pocket wetland. Below are descriptions of each design variant.

Shallow Wetland–In the shallow wetland design, most of the water quality treatment volume is in the relatively shallow high marsh or low marsh depths. The only deep portions of the shallow wetland design are the forebay at the inlet to the wetland, and the micropool at the outlet. One disadvantage of this design is that, because the pool is shallow, a relatively large amount of land is typically needed to store the WQv.

Extended Detention Shallow Wetland–The extended detention (ED) shallow wetland design is the same as the shallow wetland; however, part of the water quality treatment volume is provided as ED above the surface of the marsh and released over a period of 24 hours. This design can treat a greater volume of stormwater in a smaller space than can the shallow wetland design. In the ED wetland option, plants that can tolerate both wet and dry periods need to be specified in the ED zone.

Pond/Wetland Systems–The pond/wetland system has two separate cells–a wet pond and a shallow marsh. The wet pond traps sediments and reduces runoff velocities prior to entry into the wetland, where stormwater flows receive additional treatment. Less land is required for a pond/wetland system than for the shallow wetland or the ED shallow wetland systems.

Pocket Wetland–A pocket wetland is intended for smaller drainage areas of 5 to 10 acres and typically requires excavation down to the water table for a reliable water source to support the wetland system.

4.4.2.2 Application and Site Feasibility Criteria

Stormwater wetlands generally are applicable to most types of new development and redevelopment, and can be used in both residential and nonresidential areas. Because of the large land requirements, however, wetlands may not be practical in higher-density areas. The following criteria should be evaluated to ensure the suitability of a stormwater wetland for meeting stormwater management objectives on a site or development.

4.4.2.3 General Design Considerations

The criteria discussed below should be considered when designing stormwater wetlands.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES.
- Suitable for High Density/Ultra Urban Areas–Land requirements may preclude use.
- Regional Stormwater Control–YES.

Physical Feasibility–Physical Constraints at Project Site.

- **Drainage Area–**A minimum of 25 acres and a positive water balance is needed to maintain wetland conditions; 5 acres are needed for pocket wetlands.
- **Space Required–**Approximately 3 to 5 percent of the contributing drainage area.
- **Site Slope–**There should be no more than an 8-percent slope across the wetland site.
- **Minimum Head–**Elevation difference needed at a site from the inflow to the outflow: 3 to 5 feet; 2 to 3 feet for pocket wetland.
- **Minimum Depth to Water Table–**If used on a site with an underlying water supply aquifer or when treating a hot spot, a separation distance of 2 feet is recommended between the bottom of the wetland and the elevation of the seasonally high water table; a pocket wetland is typically below the water table.

- **Soils–**Permeable soils are not well suited for a constructed stormwater wetland without a high water table. Underlying soils of hydrologic group "C" or "D" should be adequate to maintain wetland conditions. Most group "A" soils and some group "B" soils will require a liner. Evaluation of soils should be based on an actual subsurface analysis and permeability tests.

Other Constraints/Considerations.

- A continuous base flow or high water table is required to support wetland vegetation. A water balance must be performed to demonstrate that a stormwater wetland can withstand a 30-day drought at summer evaporation rates without completely drawing down.
- Wetland siting also should take into account the location and use of other site features such as natural depressions, buffers, and undisturbed natural areas, and should attempt to aesthetically "fit" the facility into the landscape. Bedrock close to the surface may prevent excavation.
- Stormwater wetlands cannot be located within navigable waters of the United States, including wetlands, without obtaining a Section 404 permit under the Clean Water Act (CWA), and any other applicable state permit. In some isolated cases, a wetlands permit may be granted to convert an existing degraded wetland in the context of local watershed restoration efforts.
- If a wetland facility is not used for overbank flood protection, it should be designed as an offline system to bypass higher flows rather than passing them through the wetland system.
- Minimum setback requirements for stormwater wetland facilities are as follows:
  - From a property line 10 feet
  - From a private well–100 feet; if well is downgradient from a hot spot land use, then the minimum setback is 250 feet
  - From a septic system tank or leach field–50 feet
- All utilities should be located outside the wetland site.

4.4.2.4 Advantages

- Creates a shallow matrix of sediment, plants, water, and detritus that collectively removes multiple pollutants through a series of complementary physical, chemical, and biological processes.
- Provides good conditions for particle settling, sediment trapping, and reducing suspended solids transport.
- Features relatively high efficiency in removing phosphorus, trace metals, and hydrocarbons that are adsorbed to the surfaces of suspended particles.
- Can provide attenuation of peak flood flows.
- Aesthetically pleasing when properly landscaped and maintained.

- Can provide an excellent habitat for wildlife and waterfowl.
- Relatively low maintenance when properly constructed and operated.

4.4.2.5 Disadvantages

- Occupies more land than other stormwater BMPs.
- When sited in watersheds that are too small to provide adequate hydration, wetlands tend to dry out frequently and to function ineffectively. This problem generally can be avoided by properly sizing the wetland to match the available drainage area.
- Can be colonized by invasive species that out-compete native wetlands plants. Removal of invasive plants is difficult and labor intensive and may need to be done repeatedly. The chance of occurrence of this problem may be reduced by proper selection of the wetlands vegetation to be planted initially.
- If there are industrial or commercial land uses in the drainage area, accumulated pollutants may eventually increase environmental risks to wildlife. Typical pollutant loads found in urban settings are unlikely to cause this problem.
- If improperly designed, they may adversely affect existing wetland and forest areas in the region of the stormwater wetland by intercepting water that might otherwise reach the natural system.
- Can lead to overpopulation by waterfowl and thus increase the potential for bacterial contamination.

4.4.2.6 Design Procedures

Step 1. Compute runoff control volumes

Calculate the WQv using the City's stormwater quality site development review tool.

Step 2. Determine if the development site and conditions are appropriate for the use of a stormwater wetland

Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 3. Determine pretreatment volume

A sediment forebay should be is provided at each inlet, unless the inlet provides less than 10 percent of the total design storm inflow to the pond. The forebay should be sized to contain 0.1 inch per impervious acre of contributing drainage and should be 4 to 6 feet deep. The forebay storage volume counts toward the total WQv requirement and may be subtracted from the WQv for subsequent calculations.

Step 4. Allocate the WQv volume among marsh, micropool, and ED volumes

Allocate the volumes according to the recommended criteria listed in Table 4-1.

TABLE 4-1
Recommended Design Criteria for Stormwater Wetlands
WRM Department Design and Construction Manual, Auburn, Alabama

Design Criteria	Shallow Wetland	ED Shallow Wetland	Pond/Wetland	Pocket Wetland
Length to Width Ratio (minimum)	2:1	2:1	2:1	2:1
Extended Detention (ED)	No	Yes	Optional	Optional
Allocation of WQv Volume (pool/marsh/ED) in %	25/75/0	25/25/50	70/30/0 (includes pond volume)	25/75/0
Allocation of Surface Area (deepwater/low marsh/high marsh/semi-wet) in %	20/35/40/5	10/35/45/10	45/25/25/5 (includes pond surface area)	10/45/40/5
Forebay	Required	Required	Required	Optional
Micropool	Required	Required	Required	Required
Outlet Configuration	Reverse slope pipe or hooded broadcrested weir	Reverse slope pipe or hooded broadcrested weir	Reverse slope pipe or hooded broadcrested weir	Hooded broadcrested weir

Depth:
Deepwater: 1.5 to 6 feet below normal pool elevation
Low marsh: 6 to 18 inches below normal pool elevation
High marsh: 6 inches or less below normal pool elevation
Semi-wet zone: Above normal pool elevation

Step 5. Determine wetland location and preliminary geometry, including distribution of wetland depth zones

- This step involves initially laying out the wetland design and determining the distribution of wetland surface area among the various depth zones (high marsh, low marsh, and deepwater). Set the WQv permanent pool elevation (and WQv-ED elevation for ED shallow wetland) based on volumes calculated earlier.

Step 6. Compute extended detention orifice release rate(s) and size(s), and establish weir elevation

Shallow Wetland and Pocket Wetland

- The 25-year control weir elevation is determined from the stage-storage relationship and the orifice is then sized to release the channel protection storage volume over a 24-hour period. The orifice should have a minimum diameter of 3 inches and should be adequately protected from clogging by an acceptable external trash rack. A reverse slope pipe attached to the riser, with its inlet submerged 1 foot below the elevation of the permanent pool, is a recommended design. The orifice diameter may be reduced to 1 inch if internal orifice protection is used (an over-perforated vertical stand pipe with ½-inch orifices or slots that are protected by wirecloth and a stone filtering jacket). Adjustable gate valves also can be used to achieve this equivalent diameter.

ED Shallow Wetland

- On the basis of the elevations established in Step 6 for the ED portion of the WQv, the water quality orifice is sized to release this extended detention volume in 24 hours. The water quality orifice should have a minimum diameter of 3 inches and should be adequately protected from clogging by an acceptable external trash rack. A reverse slope pipe attached to the riser, with its inlet submerged one foot below the elevation of the permanent pool, is a recommended design. Adjustable gate valves also can be used to achieve this equivalent diameter. The 25-year weir elevation is then determined from the stage-storage relationship. The invert of the channel protection orifice is located at the water quality ED elevation, and the orifice is sized to release the channel protection storage volume over a 24-hour period.

Step 7. Calculate Qp25 (25-year storm) release rate and water surface elevation

- Set up a stage-storage-discharge relationship for the control structure for the extended detention orifice(s) and the 25-year storm.

Step 8. Design embankment(s) and spillway(s)

- Size emergency spillway, calculate 100-year water surface elevation, set top of embankment elevation, and analyze safe passage of the extreme flood volume. At final design, provide safe passage for the 100-year event. Attenuation may not be required.

Step 9. Design inlets, sediment forebay(s), outlet structures, maintenance access, and safety features

Sediment Forebay and Inlets

- Sediment regulation is critical to sustain stormwater wetlands. A wetland facility should have a sediment forebay or equivalent upstream pretreatment. A sediment forebay is designed to remove incoming sediment from the stormwater flow prior to dispersal into the wetland. The forebay should consist of a separate cell, formed by an acceptable barrier. A forebay is to be provided at each inlet, unless the inlet provides less than 10 percent of the total design storm inflow to the wetland facility.

- The forebay is sized to contain 0.1 inch per impervious acre of contributing drainage and should be 4 to 6 feet deep. The pretreatment storage volume is part of the total WQv requirement and may be subtracted from WQv for wetland storage sizing.

- A fixed vertical sediment depth marker shall be installed in the forebay to measure sediment deposition over time. The bottom of the forebay may be hardened (using concrete, paver blocks, etc.) to make sediment removal easier.

- Inflow channels are to be stabilized with flared rip-rap aprons, or the equivalent. Inlet pipes to the pond can be partially submerged. Exit velocities from the forebay must be non-erosive.

Outlet Structures

- Flow control from a stormwater wetland typically is accomplished with the use of a concrete or corrugated metal riser and barrel. The riser is a vertical pipe or inlet structure that is attached to the base of the micropool with a watertight connection. The outlet barrel is a horizontal pipe attached to the riser that conveys flow under the embankment. The riser should be located within the embankment for reasons of maintenance access, safety, and aesthetics.
- A number of outlets at varying depths in the riser provide internal flow control for routing of the water quality, channel protection, and overbank flood protection runoff volumes. The number of orifices can vary and is usually a function of the pond design.
- For shallow and pocket wetlands, the riser configuration is typically comprised of a channel protection outlet (usually an orifice) and overbank flood protection outlet (often a slot or weir).
- The channel protection orifice is sized to release the channel protection storage volume over a 24-hour period (12-hour ED may be warranted in some cold water streams). Because the WQv is fully contained in the permanent pool, no orifice sizing is necessary for this volume. As runoff from a water quality event enters the wet pond, it simply displaces that same volume through the channel protection orifice. Thus, an offline shallow or pocket wetland providing only water quality treatment can use a simple overflow weir as the outlet structure.
- In the case of an ED shallow wetland, there is generally a need for an additional outlet (usually an orifice) that is sized to pass the extended detention WQv that is surcharged on top of the permanent pool. Flow will first pass through this orifice, which is sized to release the water quality ED volume in 24 hours. The preferred design is a reverse slope pipe attached to the riser, with its inlet submerged 1 foot below the elevation of the permanent pool to prevent floatables from clogging the pipe and to avoid discharging warmer water at the surface of the pond. The next outlet is sized for the release of the channel protection storage volume. The outlet (often an orifice) invert is located at the maximum elevation associated with the extended detention WQv and is sized to release the channel protection storage volume over a 24-hour period (12-hour ED may be warranted in some cold water streams).
- Alternative hydraulic control methods to an orifice can be used and include a broad-crested rectangular, V-notch, proportional weir, or an outlet pipe protected by a hood that extends at least 12 inches below the normal pool.

Maintenance Access (Recommended)

- A maintenance ROW or easement is recommended to access the wetland facility from a public or private road. The maintenance access should be at least 12 feet wide, have a maximum slope of no more than 15 percent, and be appropriately stabilized to withstand maintenance equipment and vehicles.
- The maintenance access should extend to the forebay, safety bench, riser, and outlet and, to the extent feasible, be designed to allow vehicles to turn around.
- Access to the riser is to be provided by lockable manhole covers and manhole steps within easy reach of valves and other controls.

Safety Features

- Fencing of wetlands generally is not desirable, but may be required by the City. A preferred method is to manage the contours of deep pool areas through the inclusion of a safety bench (see above) to eliminate dropoffs and reduce the potential for accidental drowning.
- The principal spillway opening should not permit access by small children, and end walls above pipe outfalls greater than 48 inches in diameter should be fenced to prevent a hazard.

Step 10. Prepare Vegetation and Landscaping Plan

- A landscaping plan should be provided that indicates the methods used to establish and maintain wetland coverage. Minimum elements of a plan include delineation of landscaping zones, selection of corresponding plant species, planting plan, sequence for preparing wetland bed (including soil amendments, if needed), and sources of plant material.
- Landscaping zones include low marsh, high marsh, and semi-wet zones. The low marsh zone ranges from 6 to 18 inches below the normal pool. This zone is suitable for the growth of several emergent plant species. The high marsh zone ranges from 6 inches below the pool up to the normal pool. This zone will support greater density and diversity of emergent wetland plant species. The high marsh zone should have a higher surface-area-to-volume ratio than does the low marsh zone. The semi-wet zone refers to those areas above the permanent pool that are inundated on an irregular basis and can be expected to support wetland plants.
- The landscaping plan should provide elements that promote greater wildlife and waterfowl use within the wetland and buffers.
- Woody vegetation may not be planted on the embankment or allowed to grow within 15 feet of the toe of the embankment or 25 feet from the principal spillway structure.
- A wetland buffer shall extend 25 feet outward from the maximum water surface elevation, with an additional 15-foot setback to structures. The wetland buffer should be contiguous with other buffer areas that are required by existing regulations (stream buffers) or that are part of the overall stormwater management

concept plan. No structures should be located within the buffer, and an additional setback to permanent structures may be provided.

- Existing trees should be preserved in the buffer area during construction. It is desirable to locate forest conservation areas adjacent to ponds. To discourage resident geese populations, the buffer can be planted with trees, shrubs, and native ground covers.
- The soils of a wetland buffer are often severely compacted during the construction process to ensure stability. The density of these compacted soils is so great that it effectively prevents root penetration, and therefore, may lead to premature mortality or loss of vigor. Consequently, it is advisable to excavate large and deep holes around the proposed planting sites and to backfill these with uncompacted topsoil.

4.4.2.7 Design Example

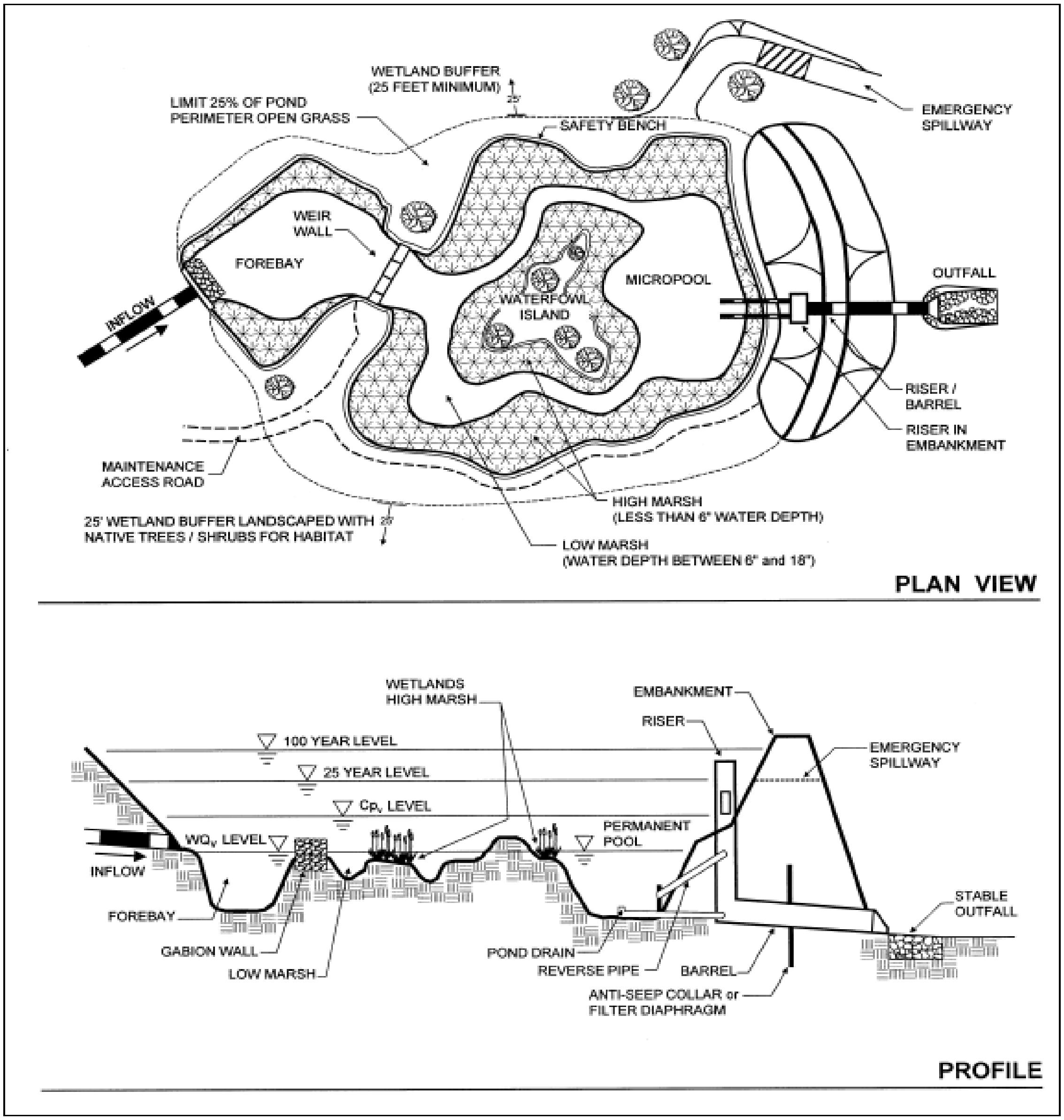
A shallow wetland design example is provided in the *Maryland Stormwater Design Manual* (2000), which can be obtained at the following internet link: http://www.mde.state.md.us/assets/document/appendixc1.pdf. It is important that the engineer performs all design calculations using local rainfall data and site-specific data (curve number [CN], soils, etc). The Maryland example is only a reference guide and numbers will vary depending on the site conditions. Technical Release 55 (TR-55) is recommended to calculate runoff volume. Figure 4-2 shows a plan view and profile of a typical shallow wetland. The sizing and shaping will vary based on the site topography and the runoff volume.

4.4.2.8 Monitoring and Maintenance

Although wetlands generally are designed to require limited maintenance, they should be monitored to ensure the highest performance. The following monitoring activities are recommended:

- Assess plant cover periodically.
- Inspect wetlands annually after a rain event and after all large (mean annual or greater) events to ensure that the basin is operating as designed.
- Perform general inspections to identify localized problems such as changes in water level, erosion, sediment accumulation, or damage to flow control structures.

Maintenance is required, primarily to repair problems identified during the monitoring. Unlike maintenance requirements for wet or dry stormwater ponds, sediment should only selectively be removed from constructed treatment wetlands. Sediment removal disturbs stable vegetation cover and disrupts flow paths through the wetland. The wetland should be designed to accommodate moderate sediment levels, so that only sediments near the inlet and outlet should be removed.



Note: Channel Protection Volume (CPv) shown in Figure 4-2 is not used in Auburn. The weir invert elevation at the CPv elevation should be set to meet the City's discharge criteria, as detailed in the City of Auburn *Stormwater Management Manual.*

FIGURE 4-2
Schematic of Shallow Wetland
Source: *Georgia Stormwater Management Manual* (GSMM, 2001)

Pocket wetlands, or any wetland that has no sediment pretreatment, tend to accumulate sediment rapidly, and therefore, should be cleaned out when they accumulate 6 inches of deposition–in most cases, every 5 to 10 years.

Debris should be removed from pocket wetlands, or any treatment wetland, whenever it accumulates or at least twice annually.

4.4.3 Bioretention Area (also known as Rain Garden or Biofiltration Device)

4.4.3.1 Description and Benefits

A bioretention area is a shallow, vegetated depression incorporated into the landscape of a development (Figure 4-3). The purpose of bioretention is to restore, as much as possible, the predevelopment hydrology of an area and provide both water quantity and water quality benefits.

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 80 percent
- Nutrients (TP/TN) ~ 60/50 percent
- Metals ~ moderate, but varies

Stormwater is conveyed as sheet flow to the bioretention area that temporarily stores runoff. As stormwater percolates through the bioretention area, soils and plants remove pollutants via adsorption, filtration, sedimentation, volatilization, ion exchange, and biological decomposition. Filtered stormwater is then directed to the conveyance system, or if underlying soils are appropriate, stormwater is allowed to infiltrate to the aquifer below and provide recharge. Bioretention also can be effective in reducing peak runoff rates and runoff volumes.

FIGURE 4-3
Bioretention in Parking Lot Island

Many development projects present a challenge to the designer of conventional stormwater BMPs because of physical site constraints. Bioretention areas are intended to address the spatial constraints that can be found in densely developed urban areas where the drainage areas are highly impervious. They can be used on small urban sites that would not normally support the hydrology of a wet detention pond and where the soils would not allow for an infiltration device. This makes the bioretention area a suitable stormwater practice for commercial, transportation, industrial, and residential developments. Applications include parking lot islands, roadway medians, roadside swales, and residential gardens positioned to collect roof and parking lot runoff.

Bioretention areas are particularly effective on sites of 1 acre or less. A bioretention area is not suitable for regional-scale stormwater management.

Bioretention facilities are ideally deployed in an offline configuration (having the ability to bypass flow once the inflow begins to exceed the device capacity) to which the initial stormwater flows are diverted. An overflow control allows excess flows to bypass the facility. The offline setup can reduce potential erosion that may arise in an inline configuration. Bioretention facilities need an underdrain system when the native soil has a low infiltration rate. The underdrain system connects to another BMP or to the conveyance system. A grassed buffer strip aids in distributing the inflow and pretreats runoff by removing some of the suspended solids, which is recommended. Alternatively, a small forebay or a grass swale can serve as pretreatment.

4.4.3.2 General Design Considerations

Figure 4-4 illustrates various bioretention area applications. The criteria described in the following text should be considered when designing bioretention areas.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- **Drainage Area–**5 acres maximum; 0.5 to 2 acres are preferred
- **Space Required–**Approximately 5 percent of the contributing impervious area is required; minimum 200-ft^2 area for small sites (10 feet x 20 feet)
- **Site Slope–**No more than 6-percent slope
- **Minimum Head–**Elevation difference needed at a site from the inflow to the outflow: 5 feet
- **Minimum Depth to Water Table–**A separation distance of 2 feet is recommended between the bottom of the bioretention facility and the elevation of the seasonally high water table
- **Soils–**No restrictions; engineered media required

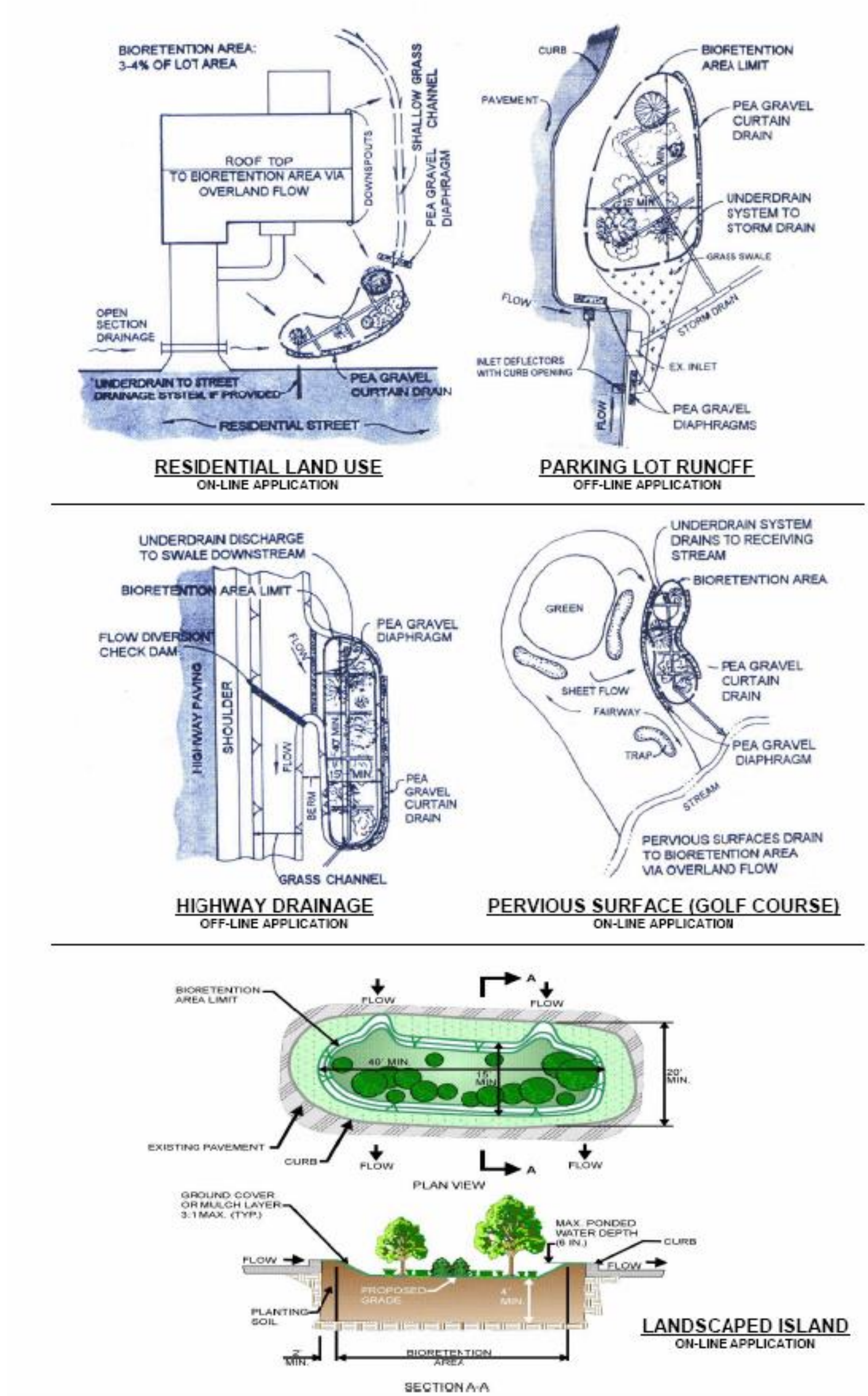


FIGURE 4-4
Bioretention Applications
Source: GSMM (2001)

Other Constraints/Considerations.

- Native vegetation is preferred in bioretention areas. Plants should be tolerant of both extreme wet and dry conditions. Publications, such as the *Residential Rain Garden Handbook* (Alabama Cooperative Extension System), provide a list of adapted species used in the region. The Alabama Cooperative Extension System specialists who are trained in bioretention technology also can provide plant selection guidance.
- Aquifer Protection–Do not allow exfiltration of filtered hot spot runoff into groundwater.
- Bioretention systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.
- Bioretention area locations should be integrated into the site planning process, and aesthetic considerations should be taken into account in their siting and design. Elevations must be carefully worked out to ensure that the desired runoff flow enters the facility with no more than the maximum design depth.

4.4.3.3 Advantages

- Efficient removal method for suspended solids, heavy metals, and adsorbed pollutants. Moderate to high removal of phosphorus, provided that the soil medium has a low phosphorus content. Certain configurations allow for moderate-high removal of nitrogen.
- Effective means of reducing peak runoff rates for relatively frequent storms, reducing runoff volumes, and recharging groundwater by infiltrating runoff.
- Flexible adaptation to urban retrofits.
- Successful use in small areas and, as distributed control measures, in large drainage areas or as part of low-impact development (LID).
- Natural integration into landscaping for habitat enhancement.

4.4.3.4 Disadvantages

- In residential applications, homeowners need training to maintain the plant material and mulch layer, and to provide general cleaning.
- Depending on the design, they may not be effective at removing nitrate.
- Surface soil layer may clog over time (although it can be restored easily).
- Frequent trash removal may be required, especially in high-traffic areas.
- Vigilance in protecting the bioretention area during construction is essential.

4.4.3.5 Design Procedures

Step 1. Compute runoff control volumes

- Calculate the WQv for the drainage area using the City's Site Development Review Tool.
- Calculate the 100-year discharge to the bioretention area.

Step 2. Determine if the development site and conditions are appropriate for the use of a bioretention area

- Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 3. Size flow diversion structure, if needed

- A flow regulator (or flow splitter diversion structure) should be supplied to divert the WQv to the bioretention area.

Step 4. Determine size of bioretention ponding/filter area

- The required planting soil filter bed area is computed using the following equation (based on Darcy's Law):

$$A_f = (WQv)\ (d_f)\ /\ [\ (k)\ (h_f + d_f)\ (t_f)]$$

where: A_f = surface area of ponding area (ft^2)
WQv = water quality volume (or total volume to be captured)
d_f = filter bed depth (4-foot minimum)
k = coefficient of permeability of filter media (ft/day) (use 0.5 foot/day for silt-loam)
h_f = average height of water above filter bed (feet) (typically 3 inches, which is half of the 6-inch ponding depth)
t_f = design filter bed drain time (days) (2 days or 48 hours is recommended maximum)

Step 5. Set design elevations and dimensions of facility

- Recommended minimum dimensions of a bioretention area are 10 feet wide by 20 feet long. All designs except small residential applications should maintain a length-to-width ratio of at least 2:1.
- The planting soil filter bed is sized using a Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 feet per day (ft/day).
- The maximum recommended ponding depth of the bioretention areas is 6 inches.
- The planting soil bed must be at least 4 feet deep. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent. The soil must have an infiltration rate of at least 0.5 inch per hour and a pH between 5.5 and 6.5. In addition, the planting soil should have a 1.5- to 3-percent organic content and a maximum 500 parts per million (ppm) concentration of soluble salts.
- For online configurations, a grass filter strip with a pea gravel diaphragm typically is used as the pretreatment measure. The required length of the filter strip depends

on the drainage area, imperviousness, and the filter strip slope. Design guidance regarding the filter strips for pretreatment is included in Section 4.4.10 of this Manual.

- For offline applications, a grass channel with a pea gravel diaphragm flow spreader is used for pretreatment. The length of the grass channel depends on the drainage area, land use, and channel slope. The minimum grassed channel length should be 20 feet. Design guidance regarding the grass channels for pretreatment is provided in Section 4.4.5 of this Manual.
- The mulch layer should consist of 2 to 4 inches of commercially available, fine-shredded hardwood mulch or shredded hardwood chips.
- The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15-percent silt or clay content.
- Pea gravel for the diaphragm and curtain, where used, should be ASTM D 448 size No. 6 (1/8-inch to 1/4-inch).

Step 6. Design pretreatment

- Pretreat with a grass filter strip (online configuration) or grass channel (offline), and stone diaphragm.

Step 7. Size underdrain system

- The underdrain collection system is equipped with a 6-inch perforated PVC pipe (American Association of State Highway and Transportation Officials [AASHTO] M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5 percent must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.

Step 8. Design emergency overflow

- An overflow must be provided to bypass and/or convey larger flows to the downstream drainage system or stabilized watercourse. Non-erosive velocities need to be ensured at the outlet point.

Step 9. Prepare Vegetation and Landscaping Plan

- A landscaping plan for the bioretention area should be prepared to indicate how it will be established with vegetation.

4.4.3.6 Design Example

The following example focuses on the design of a bioretention facility to meet the water quality treatment requirements of the site. Channel protection and overbank flood control are not addressed in this example other than through the quantification of preliminary storage volume and peak discharge requirements. In general, the primary function of bioretention is to provide water quality treatment, rather than large storm attenuation. As such, flows in excess of the WQv typically are routed to bypass the facility or tp pass through the facility. Where quantity control is required, the bypassed flows can be routed to conventional detention basins (or some other facility such as underground storage vaults). Under some conditions, channel protection storage can be provided by bioretention facilities. The layout of the Recreation Center is shown in Figure 4-5.

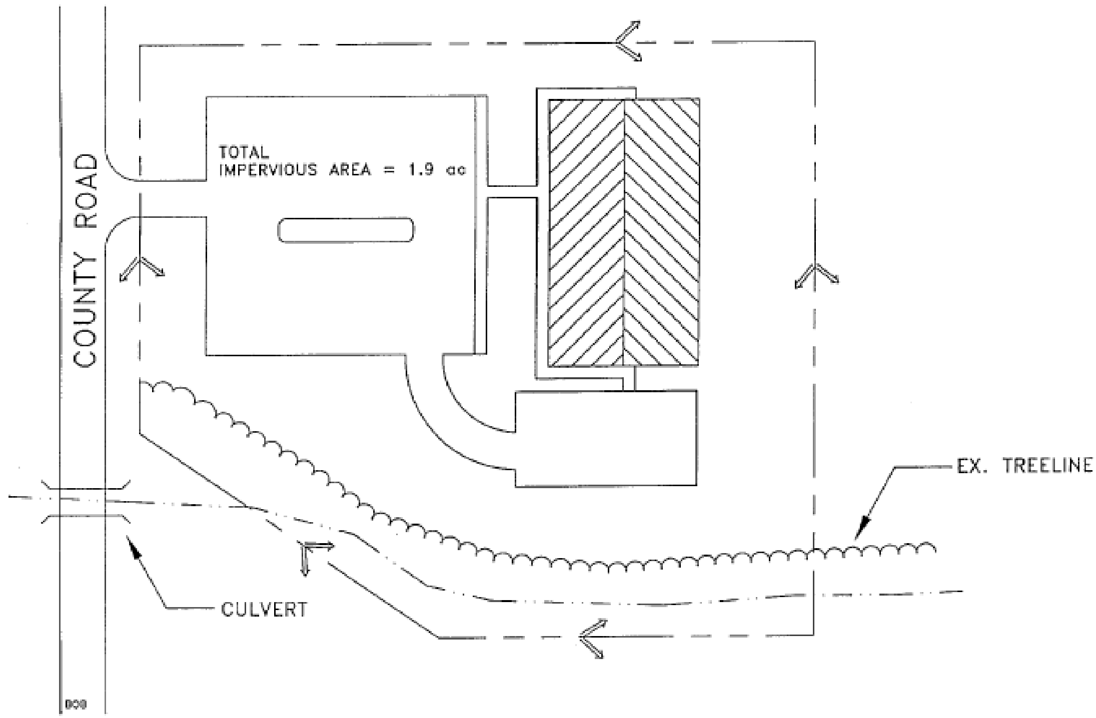


FIGURE 4-5
Bioretention Example Site Plan
Source: GSMM (2001)

Base Data

Site Area = Total Drainage Area (A) = 3.0 ac
Impervious Area = 1.9 ac; or **I** =1.9/3.0 = 63.3% Soils Type "C"

Hydrologic Data

Pre Project CN = 70; Post Project CN = 88
Pre Project t_c = 0.39; Post Project t_c = 0.2

Step 1. Compute runoff control volumes

On the basis of the site data listed above, the calculated WQv for the bioretention area is 0.186 acre-feet (ac-ft). The 100-year flow to the bioretention area should be calculated using TR-55 (U.S. Department of Agriculture [USDA], 1986).

Step 2. Determine if the development site and conditions are appropriate for the use of a bioretention area

Site-specific Data:

The existing ground elevation at the facility location is 922 feet, mean sea level. Soil boring observations reveal that the seasonally high water table is at 913 feet and the underlying soil is silt loam (ML). The adjacent creek invert is at 912 feet.

Step 3. Size flow diversion structure, if needed

Bioretention areas can be either on or offline. Online facilities generally are sized to receive, but not necessarily treat, the 25-year event. Offline facilities are designed to receive a more or less exact flow rate through a weir, channel, manhole, "flow splitter," etc. This facility is situated to receive direct runoff from grass areas and parking lot curb openings and piping for the 25-year event (19 cubic feet per minute [cfs]), and *no special flow diversion structure is incorporated.*

Step 4. Determine size of bioretention ponding / filter area

$$\mathbf{A_f = (WQv)\ (df)\ /\ [\ (k)\ (hf + df)\ (tf)]}$$

$$A_f = (8{,}102\ ft^3)(5')\ /\ [(0.5'/day)\ (0.25' + 5')\ (2\ days)]$$

(With $k = 0.5'/day$, $h_f = 0.25'$, $t_f = 2$ days)

$$= 7{,}716\ ft^2$$

Step 5. Set design elevations and dimensions of facility

Assume a roughly 2-to-1 rectangular shape. Given a filter area requirement of 7,716 ft^2, say the facility is roughly 65 feet by 120 feet (Figure 4-6). Set the top of facility at 921 feet, with the berm at 922 feet. The facility is 5 feet deep, which will allow 3 feet of freeboard over the seasonally high water table. Figure 4-7 shows a typical section of the facility.

Step 6. Design pretreatment

Pretreat with a grass channel, based on the guidance provided in Section 4.4.10 of this Manual. For a 3-acre drainage area, 63-percent imperviousness, and a slope less than 2 percent, provide a 90-foot grass channel at a 1.5-percent slope. The value from Table 4-2 is 30 feet for a 1-acre drainage area.

Step 7. Size underdrain system

Base the underdrain design on 10 percent of the surface area of the filter bed (A_f) or 772 ft^2. Using 6-inch perforated plastic pipes surrounded by a 3-foot-wide gravel bed, 10 feet on center (Figures 5-6 and 5-7). Thus, (772 ft^2)/3 feet per foot of underdrain = 257 feet, for 260 feet of perforated underdrain.

To ensure against the planting media getting clogged, design a small ornamental stone window of 20-inch to 5-inch stone connected directly to the sand filter layer. This area is based on 5 percent of the A_f, or 386 ft^2, say 14 feet by 28 feet (Figures 5-6 and 5-7).

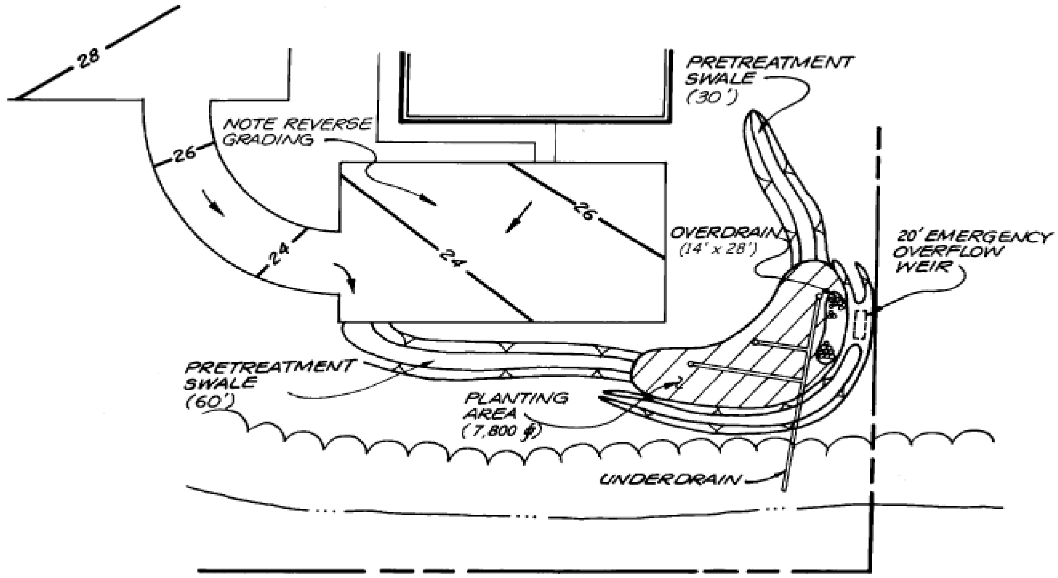


FIGURE 4-6
Bioretention Facility Layout
Source: GSMM (2001)

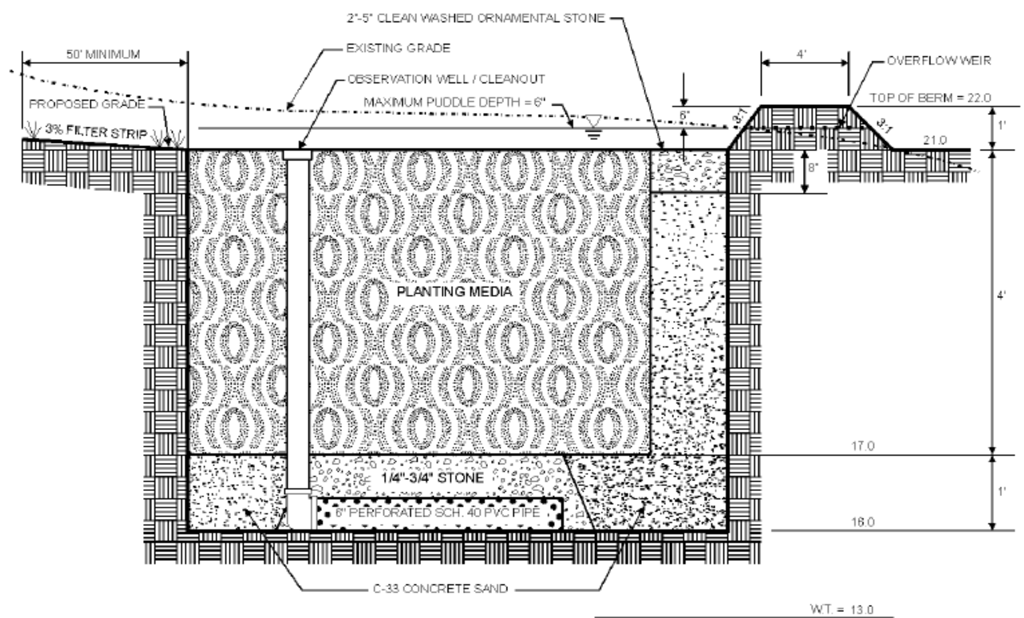


FIGURE 4-7
Bioretention Facility Typical Section
Source: GSMM (2001)

TABLE 4-2
Filter Strip Sizing
WRM Department Design and Construction Manual, Auburn, Alabama

Parameter	Impervious Areas				Pervious Areas (Lawns, etc)			
Maximum inflow approach length (feet)	35		75		75		100	
Filter strip slope (max=6%)	<2%	>2%	<2%	>2%	<2%	>2%	<2%	>2%
Filter strip minimum length (feet)	10	15	20	25	10	12	15	18

Step 8. Design emergency overflow

The parking area, curb, and gutter are sized to convey the 25-year event to the facility. Should filtering rates become reduced because of facility age or poor maintenance, an overflow weir is provided to pass the 25-year event. Size this weir with 6 inches of head, using the following weir equation:

$$Q = CLH^{3/2}$$

where: Q = 19.0 cfs
C = 2.65 (smooth crested grass weir)
H = 6"

Solve for L:

$L = Q / [(C)(H^{3/2})] = (19.0 \text{ cfs}) / [(2.65)(.5)^{1.5}] = 20.3'$ (say 20')

Outlet protection in the form of rip-rap or a plunge pool and stilling basin should be provided to ensure non-erosive velocities (Figures 5-6 and 5-7).

Step 9. Prepare Vegetation and Landscaping Plan

Choose plants based on factors such as whether they are native, resistance to drought and inundation, cost, aesthetics, maintenance, etc. Select species locations (on center planting distances) so that species will not “shade out” one another. Do not plant trees and shrubs that have extensive root systems near pipe work.

4.4.3.7 Monitoring and Maintenance

Monthly inspections are recommended until the plants are established. Annual or semiannual inspections should then be adequate and can be a part of routine monthly maintenance, such as trash removal.

An example maintenance schedule is presented in Table 4-3. Bioretention areas may be considered relatively maintenance-intensive but, when incorporated into a site design, are generally no more maintenance-intensive than the landscape areas they replace.

TABLE 4-3
Example Maintenance Schedule for Bioretention Areas
WRM Department Design and Construction Manual, Auburn, Alabama

Description	Method	Frequency	Time of Year
	Soil		
Inspect and repair erosion; clean up trash; flush underdrain pipes	Visual	Monthly	Monthly
	Organic Layer		
Remulch any void areas	By hand	Whenever needed	Whenever needed
Remove previous mulch layer before applying new layer (optional)	By hand	Once every 2 times mulch is added	Spring
Add any additional mulch if necessary	By hand	Twice a year	Spring/Fall
	Plants		
Remove and replace all dead and diseased vegetation considered beyond treatment	Mechanical or by hand	Twice a year	March 15 to April 30 and October 1 to November 30
Treat all diseased trees and shrubs	Mechanical or by hand	Not applicable	Varies, but will depend on insect or disease infestation
Water plant material at the end of each day for 14 consecutive days and after planting has been completed	By hand	Once a year	Remove stakes only in the spring
Replace support stakes	By hand	Once a year	Whenever needed
Replace any deficient stakes or wires	By hand	Whenever needed	Whenever needed
Remove mulch from outlets and cleanouts	By hand	Monthly or as needed	Monthly

4.4.3.8 Soil Media

When the filtering capacity diminishes substantially (when water ponds on the surface for more than 24 hours), the top few inches of material must be removed and replaced with fresh material. The removed sediments should be disposed in an acceptable manner (landfill).

4.4.4 Wet Detention Basin (also known as Stormwater Retention or Detention Ponds)

4.4.4.1 Description and Benefits

A wet detention basin is a stormwater management facility that includes a permanent pool of water for removing pollutants and additional capacity above the permanent pool for detaining stormwater runoff (for peak flow attenuation). Wet detention basins can often be made part of a multi-use recreation facility that provides additional benefits for the community above and beyond stormwater management.

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 80 percent
- Nutrients (TP/TN) ~ 50/30 percent
- Metals ~ 50 percent (cadmium, copper, lead, and zinc)
- Pathogens ~ 70 percent

In wet detention basins, a permanent pool of standing water is maintained by the riser–the elevated outlet of the wet detention basin (Figure 4-8). Water in the permanent pool mixes with and dilutes the initial runoff from storm events. Wet detention basins fill with stormwater and release most of the mixed flow over a period of a few days, slowly returning the basin to its normal depth. Wet detention basins do the following:

- Improve water quality by two mechanisms; ***first,*** by settling of suspended particulates (sediments and attached pollutants) to remove the following pollutants:
  - Sediment
  - Organic matter
  - Metals

  Second, by dilution during the storm and biological uptake (consumption of pollutants by plants) after the storm to remove dissolved pollutants, including the following:

  - Nutrients
  - Dissolved metals

FIGURE 4-8
Permanent Pool of Water in Wet Detention Basin

Extending the detention time of stormwater runoff can be an effective means of: 1) controlling stream bank erosion by reducing the magnitude and frequency of erosive runoff events downstream; and 2) improving water quality by allowing particulate pollutants to settle.

Runoff generated during the early phases of a storm usually has the highest concentrations of sediment and dissolved pollutants. Because a wet detention basin dilutes and settles pollutants in the initial runoff, the concentration of pollutants in runoff released to downstream drainages is reduced. The total mass of pollutants released to downstream areas also can be substantially reduced by using wet detention basins. If the basin is not adequately maintained (such as by periodic dredging), storm flows may resuspend sediments and deliver them to the stream.

Generally, there are two types of basins, excavated or embankment. Excavated basins are normally the simplest to construct and maintain. Embankment basins deal with more complex issues such as earthen dams and possible destruction of property if these structures fail.

Therefore, all embankment ponds must be designed and certified by a PE before construction.

Except as otherwise provided by the subdivision regulations or the City Code, the detention pond provisions of this Manual do not apply to development properties smaller than 1 acre.

4.4.4.2 General Design Considerations

The following criteria should be considered when designing wet detention basins.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra-Urban Areas–Land requirements may preclude use
- Regional Stormwater Control–YES

Physical Feasibility – Physical Constraints at Project Site.

- **Drainage Area–**A minimum of 25 acres is needed for a wet pond and a wet ED pond to maintain a permanent pool; 10 acres minimum is needed for a micropool ED pond. A smaller drainage area may be acceptable with an adequate water balance and anti-clogging device.
- **Space Required–**Approximately 2 to 3 percent of the contributing drainage area.
- **Site Slope–**There should be more than 15-percent slope across the pond site. However, the pond should not be constructed on eroding or unstable slopes.
- **Minimum Head–**Elevation difference needed at a site from the inflow to the outflow: 6 to 8 inches

- **Minimum Depth to Water Table–**If used on a site with an underlying water supply aquifer or when treating a hot spot, a separation distance of 2 feet is required between the bottom of the pond and the elevation of the seasonally high water table.
- **Soils–**Underlying soils of hydrologic Group "C" or "D" should be adequate to maintain a permanent pool. Most Group "A" soils and some group "B" soils will require a pond liner. The evaluation of soils should be based on an actual subsurface analysis and permeability tests.

Other Constraints/Considerations.

- A stormwater pond should be sited such that the topography allows for maximum runoff storage at minimum excavation or construction costs. Pond siting also should take into account the location and use of other site features such as buffers and undisturbed natural areas and should attempt to aesthetically "fit" the facility into the landscape. Bedrock close to the surface may prevent excavation.
- Stormwater ponds cannot be located within a stream or any other navigable waters of the United States, including wetlands, without obtaining a USACE Section 404 permit under the CWA, and any other applicable state permit.
- Minimum setback requirements for stormwater pond facilities are as follows:
  - From a property line–10 feet
  - From a private well–100 feet; if well is downgradient from a hot spot land use, then the minimum setback is 250 feet
  - From a septic system tank or leach field–50 feet
- All utilities should be located outside the pond or basin site.
- According to the City's Stormwater Management Manual requirements, permanently wet basins must contain side slopes that are no steeper than 3H:1V out to a depth of 2 feet below the normal water level. If steeper side slopes are required because of space constraints, the basin can be fenced or otherwise restricted from public access.

4.4.4.3 Advantages

- Can be aesthetically pleasing and can be sited in both low- and high-visibility areas.
- Often perceived by residents as enhancing property values, as well as the aesthetic appeal of the area.
- Can provide wildlife habitat and a focal point for recreation.
- Best technique available for reducing the frequency of flooding events that cause bank erosion.

- Appropriate in areas where infiltration is impractical because of low infiltration rates of the underlying soils.
- Can reduce the peak runoff rate from a developed site and control downstream erosion.

4.4.4.4 Disadvantages

- Sometimes create problems such as nuisance odors, algae blooms, and rotting debris when not properly maintained; dying plants may need to be harvested or removed periodically to prevent plant nutrients from being released back into the water.
- If not properly maintained, wet detention basins can become eyesores.
- May pose drowning hazards and other public safety issues.
- Unless inlets are maintained often, trash accumulation can occur.
- Although some waterfowl are desirable, larger concentrations of these animals could be a nuisance and contribute large concentrations of bacteria (fecal coliform) to the downstream waterbody.
- May contribute to thermal pollution and cause downstream warming, so may not be appropriate in areas where sensitive aquatic species live; outlets that "pull" water below the normal pool elevation can be helpful in controlling thermal pollution.

4.4.4.5 Design Procedures

Step 1. Compute runoff control volumes

- Calculate the WQv for the drainage area using the City's Site Development Review Tool.
- Consult the City's Stormwater Management Manual for criteria relating to controlling the 2-, 5-, 10-, and 25-year, 24-hour storm events.
- Consult Section 4.2 of the City's Stormwater Management Manual for general design procedures.

Step 2. Determine if the development site and conditions are appropriate for the use of a stormwater pond

- Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 3. Determine pretreatment volume

- A sediment forebay is provided at each inlet, unless the inlet provides less than 10 percent of the total design storm inflow to the pond. The forebay should be sized to contain 0.1 inch per impervious acre of contributing drainage and should be 4 to 6 feet deep. The forebay storage volume counts toward the total WQv requirement and may be subtracted from the WQv for subsequent calculations.

Step 4. Determine permanent pool volume (and water quality ED volume)

- Size the permanent pool volume to 1 x WQv.

Step 5. Determine pond location and preliminary geometry

- Refer to Section 4 of the City's Stormwater Management Manual for pond design guidelines.

Step 6. Compute extended detention orifice release rate(s) and size(s)

- Include an orifice in the control structure sized to release the channel protection storage volume over a 24-hour period. The orifice should have a minimum diameter of 3 inches and should be protected adequately from clogging by an acceptable external trash rack. A reverse slope pipe attached to the riser, with its inlet submerged 1 foot below the elevation of the permanent pool, is a recommended design. The orifice diameter may be reduced to 1 inch if internal orifice protection is used (an over-perforated vertical stand pipe with ½-inch orifices or slots that are protected by wirecloth and a stone filtering jacket). Adjustable gate valves also can be used to achieve this equivalent diameter.

Step 7. Design inlets, sediment forebay(s), outlet structures, maintenance access, and safety features

- Design outlet structures according to Section 4.2.5 of the City's Stormwater Management Manual. Include the extended detention orifice, as detailed in Step 7.
- Design sediment according to Section 4.2.6 of the City's Stormwater Management Manual.
- Design inlets according to Section 4.2.7 of the City's Stormwater Management Manual.
- A maintenance ROW or easement must be provided to a pond from a public or private road. Maintenance access should be at least 12 feet wide, have a maximum slope of no more than 15 percent, and be stabilized appropriately to withstand maintenance equipment and vehicles.
- The maintenance access must extend to the forebay, safety bench, riser, and outlet and, to the extent feasible, be designed to allow vehicles to turn around.
- Access to the riser is to be provided by lockable manhole covers, and manhole steps within easy reach of valves and other controls.

Step 8. Prepare Vegetation and Landscaping Plan

- A landscaping plan for a stormwater pond and its buffer should be prepared to indicate how aquatic and terrestrial areas will be stabilized and established with vegetation.

4.4.4.6 Design Example

A design example for a wet detention basin is provided in Section 4.3 of the City's Stormwater Management Manual. Note that this example does not include any provision for WQv and would require some modifications to be used as a water quality BMP. The designer would need to calculate the required WQv using the City's Site Development Review Tool (there is not enough information in the example to include a value here). The WQv is contained between the invert of an orifice set at the permanent pool elevation and a weir designed to meet the maximum peak discharge criteria established by the City's Stormwater Management Manual. The orifice would be sized to release the WQv over a 24-hour period based on the average head on the orifice (the average of the elevation at the center of the orifice and the elevation of the crest of the overflow weir). The elevations listed in the example and the dimensions of the pond probably would have to be modified to accommodate the additional WQv. The sizing of the overflow weir is detailed in the City's Stormwater Management Manual.

4.4.4.7 Monitoring and Maintenance

Detailed inspections by a qualified inspector to ascertain the operational condition and safety of the facility, particularly the condition of embankments, outlet structures, and other safety-related features, should occur at least annually to verify that the facility is operating as designed and to identify any maintenance requirements. If possible, inspections should occur during wet weather to verify that the facility is maintaining desirable retention times. In addition to regularly scheduled inspections, deficiencies should be noted during any visits by City or other maintenance personnel. At a minimum, inspections should address the following:

- Examination of plantings
- Settling, woody growth, animal burrowing, and signs of piping in the embankment
- Signs of seepage on the downstream face of the embankment
- Condition of wet detention basin floor, perimeter of the wet detention basin, and grass cover on the embankment
- Excessive erosion or sedimentation in or around the basin
- Rip-rap displacement or failure
- If principal and emergency spillways meet the design plans for operation
- Outlet controls, inlet controls, debris racks, and mechanical and electrical equipment
- Inlet and outlet channel conditions
- Stability of slopes
- Safety features of the facility
- Access for maintenance equipment

- Signs of trespass or unauthorized traffic
- Sediment buildup

Additionally, a program of regular monitoring of the aquatic environment for a permanent wet detention basin should be established to allow for the timely correction of any imbalance in the ecosystem; such monitoring can prevent more serious problems from occurring.

The maintenance requirements for wet detention basins are intensive compared to most BMPs. Normal maintenance costs can range from 3 to 5 percent of the construction costs annually (Schueler, 1992). Areas of concern include excessive weed growth, maintaining adequate vegetative cover, sedimentation, bank erosion, insect control, outlet stoppages, algal growth, embankment failures, and seepage.

4.4.5 Grassed Swale (also known as Enhanced Swale or Biofiltration Swale)

4.4.5.1 Description and Benefits

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 80 percent
- Nutrients (TP/TN) ~ 50/ 50 percent
- Metals ~ 40 percent

A grassed swale is a shallow open-channel drainageway stabilized with grass or other herbaceous vegetation and designed to convey runoff and to filter pollutants.

Grassed swales typically are used in residential and commercial developments, as well as along highway medians, as alternatives or enhancements to conventional storm sewers (Figure 4-9). Swales remove pollutants from stormwater by filtration through grasses and other vegetation, settling, and infiltration through soil. Swales work best in conjunction with other BMPs. Grassed swales are designed with limited longitudinal slopes to force the flow to be slow and shallow, thus allowing for particulates to settle and limiting the effects of erosion. Grassed swales occasionally are enhanced with check dams to retain water and promote infiltration. Swales rely on vegetation to perform biofiltration functions (Gwinnett County, 1999).

FIGURE 4-9
Recently Constructed Grassed Swale in Residential Area, Pembroke Woods Subdivision in Emmittsburg, MD
(Courtesy of Mike Clar, Ecosite, Inc., Columbia, MD)

Care should be taken to design grassed swales with the length, slope, and vegetation type needed to provide effective stormwater attenuation and filtration. For grassed swales, pollutant removal depends on the design, but properly designed grassed swales can be efficient in managing the following:

- Peak flows
- Channel protection
- Pretreatment before bioretention or other BMPs
- Suspended solids
- Nitrate
- Oxygen-demanding substances
- Metals (including copper, lead, and zinc)
- TP

Swales are not to be confused with filter strip or grass channels, which are limited application structural controls and not considered acceptable for meeting the TSS removal performance goal by themselves. Ordinary grass channels are not engineered to provide the same treatment capability as a well-designed biofiltration swale. Filter strips are designed to accommodate overland flow rather than channelized flow and can be used as stormwater credits to help reduce the total water quality treatment volume for a site. Both of these practices may be used for pretreatment or be included in a “treatment train” approach where redundant treatment is provided.

4.4.5.2 General Design Considerations

The following criteria should be considered when designing grassed swales.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–NO
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- **Drainage Area–**5 acres maximum.
- **Space Required–**Approximately 10 to 20 percent of the contributing impervious area.
- **Site Slope–**Typically no more than 4-percent channel slope.
- **Minimum Head–**Elevation difference needed at a site from the inflow to the outflow: 3 to 5 feet.
- **Minimum Depth to Water Table–**2 feet required between the bottom of the swale and the elevation of the seasonally high water table, if an aquifer or hot spot is present.
- **Depth of Ponding–**store WQv with less than 18 inches of ponding at the downstream end.
- **Bottom Width–**Bottom width should range from 2 to 8 feet

- **Side slopes–**No greater than 2:1 (4:1 recommended)
- **Soils–**No restrictions

Other Constraints/Considerations.

- **Aquifer Protection–**Exfiltration should not be allowed for hot spots.
- The swale should be sited such that the topography allows for the design of a channel with sufficiently mild slope (unless small drop structures are used) and cross-sectional area to maintain non-erosive velocities.

4.4.5.3 Advantages

- Can reduce runoff peak rates and increase opportunities for filtration, partially infiltrating runoff from small storm events if the underlying soil is not compacted or saturated. Underdrains can be installed to compensate for low hydraulic conductivities in the native soil.
- Can reduce the use of costly development infrastructure (curb and gutter).
- Can be aesthetically pleasing.
- Low-slope swales can create wetland areas.
- Unmowed systems not adjacent to roadways can provide valuable "wet meadow" habitat.

4.4.5.4 Disadvantages

- Could be subject to standing water and mosquito infestations.
- May be subject to channelization due to concentrated flows.
- Steep roadside swales may pose traffic hazards in residential subdivisions. Shallow swales should not present an excessive traffic hazard. Accepted state and federal references should be required when establishing the safety protocol.

4.4.5.5 Design Procedures

Step 1. Compute runoff control volumes

- Calculate the WQv for the drainage area using the City's Site Development Review Tool.

Step 2. Determine if the development site and conditions are appropriate for the use of an enhanced swale system

- Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 3. Determine swale dimensions

- Consider the application and site feasibility criteria listed in Section 4.4.5.2 of this Manual.

Step 4. Compute number of check dams (or similar structures) required to detain WQv

- Use 18-inch maximum ponding depth requirement to calculate the required number of check dams.

Step 5. Calculate draw-down time.

- Planting soil should pass a maximum rate of 1.5 feet in 24 hours and must completely filter WQv within 48 hours.

Step 6. Check 2-year and 25-year velocity erosion potential and freeboard

- Check for erosive velocities and modify design as appropriate. Provide 6 inches of freeboard.

Step 7. Design low flow orifice at downstream headwalls and checkdams

- Design orifice to pass WQv in 6 hours. Use Orifice equation.

Step 8. Design inlets, sediment forebay(s), and underdrain system

Inlets

- Inlets to enhanced swales must be provided with energy dissipators such as rip-rap.

Pre-treatment

- Pretreatment of runoff in a swale system typically is provided by a sediment forebay located at the inlet. The pretreatment volume should be equal to 0.1 inch per impervious acre. This storage is usually obtained by providing check dams at pipe inlets and/or driveway crossings.
- Enhanced swale systems that receive direct concentrated runoff may have a 6-inch drop to a pea gravel diaphragm flow spreader at the upstream end of the control.
- A pea gravel diaphragm and gentle side slopes should be provided along the top of channels to provide pretreatment for lateral sheet flows.

Underdrain

- The bed of the swale consists of a permeable soil layer of at least 30 inches deep, above a 4-inch-diameter perforated PVC pipe (AASHTO M 252) longitudinal underdrain in a 6-inch gravel layer. The soil media should have an infiltration rate of at least 1 foot per day (1.5 feet per day maximum) and contain a high level of organic material to facilitate pollutant removal. A permeable filter fabric is placed between the gravel layer and the overlying soil.

Step 9. Prepare Vegetation and Landscaping Plan

- A landscaping plan for a swale should be prepared to indicate how the enhanced swale system will be stabilized and established with vegetation.

4.4.5.6 Design Example

Basic Data:

Small commercial lot 300 feet deep x 145 feet wide located in Auburn
Drainage area (A) = 1 acre
Impervious percentage (I) = 70%

Step 1. Compute runoff control volumes

The calculated WQv for the drainage area using the City's Site Development Review Tool is 0.068 ac-ft.

Calculate the flow to the swale for the water quality storm event (P=1.2 inches) using TR-55. For this example, the flow is peak discharge (Qwq) = 1.22 cfs.

Step 2. Determine if the development site and conditions are appropriate for the use of an enhanced swale system

For this example, it is assumed that use of an enhanced swale system is appropriate.

Step 3. Determine swale dimensions

The maximum flow depth for water quality treatment should be approximately the same height of the grass. A maximum flow depth of 4 inches is allowed for water quality design. A maximum flow velocity of 1 fps for water quality treatment is required. For Manning's n, use 0.15 for medium grass, 0.25 for dense grass, and 0.35 for dense Bermuda-type grass. The site slope is 2 percent.

Input variables: n= 0.15
S = 0.02 ft/ft
D = 4/12 = 0.33 ft

Using the equation:

$$\mathbf{Q_{wq} = Q = VA = (1.49/n) * (D^{2/3}\ S^{1/2}\ DW)}$$

where: Q = peak flow (cfs)
V = velocity (ft/sec)
A = flow area (ft2) = WD
W = channel bottom width (ft)
D = flow depth (ft)
S = slope (ft/ft)

(Note: D approximates hydraulic radius for shallow flows.)

$$W = (nQ)/(1.49 * D^{5/3} * S^{1/2})$$
$$= (0.15*1.22)/(1.49*0.33^{5/3} * 0.02^{1/2})$$
$$= 5.5 \text{ feet minimum}$$

$$V = Q/(WD) = 1.22/(\cancel{4.0}\ 5.5 * 4/12) = \cancel{0.92}\ 0.67 \text{ fps (okay)}$$

(Note: WD approximates the flow area for shallow flows.)

Minimum length for 5-minute residence time:

$$L = V * (5*60) = 201 \text{ feet}$$

Depending on the site geometry, the width or slope or density of grass (Manning's n value) might be adjusted to slow the velocity and shorten the channel in the next design iteration. For example, using a 9.3-foot bottom width* of flow and a Manning's n of 0.25, solve for a new depth and length.

4.4.5.7 Monitoring and Maintenance

The vegetation in the grassed swale should be inspected at least once per year. Maintenance of grassed swales involves grooming the vegetation and occasionally removing trash and repairing damage as needed.

Typical annual maintenance activities are as follows:

- Maintain grass or vegetative cover as appropriate for the selected vegetation.
- Remove trash.
- Repair erosion and regrade the swale to ensure that runoff flows evenly in a thin sheet through the swale.
- Revegetate the swale as needed to maintain a dense growth.

4.4.6 Infiltration Devices (Trench, Basin, or Dry Well)

4.4.6.1 Description and Benefits

Infiltration devices are dry wells, trenches, or basins that fill with stormwater runoff and allow the water to exfiltrate (exit the device by infiltrating into the soil).

"Infiltration," in the context of BMPs, refers to the process of stormwater soaking into the soil. A number of infiltration devices with differing designs have been used in various locations throughout the country. Three types of infiltration devises are described in this Manual: 1) infiltration trenches (Figure 4-10); 2) infiltration basins (Figure 4-11); and 3) dry wells.

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 80 percent
- Nutrients (TP/TN) ~ 60/60 percent
- Metals ~ 90 percent
- Pathogens ~ 90 percent

Infiltration devices enhance percolation to groundwater by the following methods:

- Directing surface runoff to locations where it can come into contact with pervious underlying soils
- Capturing runoff until it can soak into the underlying soil:
  1. Infiltration trenches are filled with large crushed stone or other media to create storage for the stormwater in the voids between the media. Other versions use precast concrete vaults with open bottoms to provide a large storage volume to hold stormwater for infiltration into the soil. Infiltration trenches typically are used to manage the runoff from parking lots and buildings.

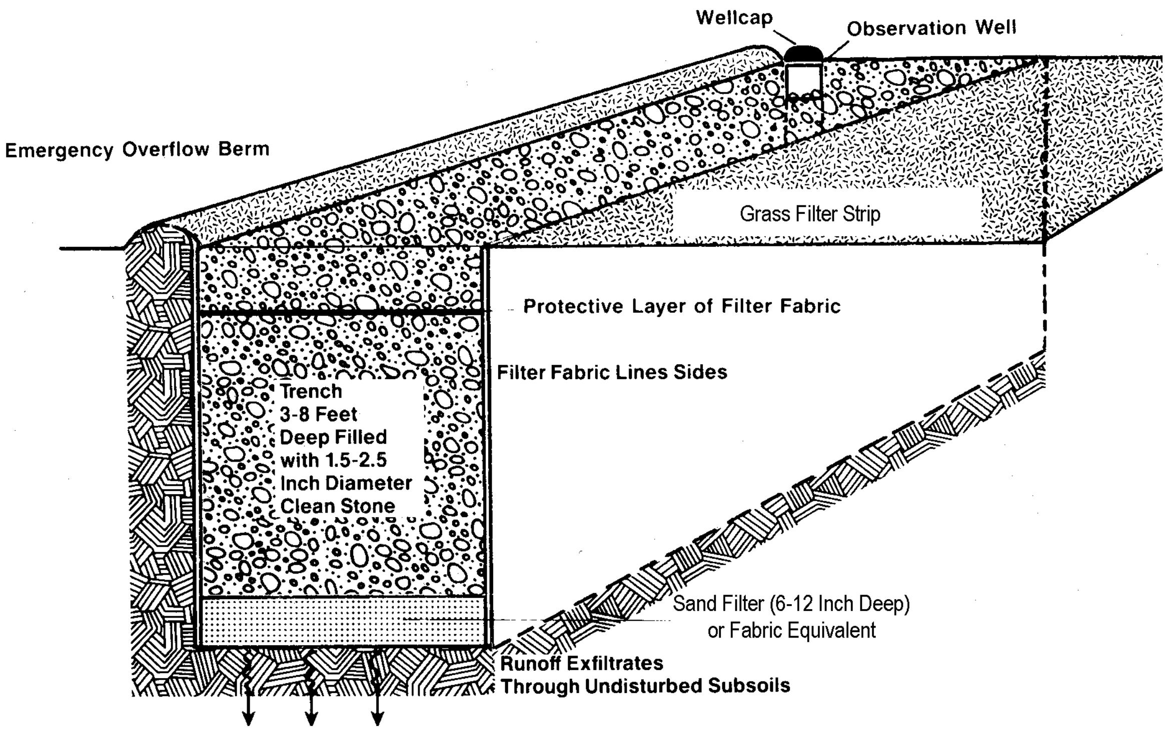


FIGURE 4-10
Typical Infiltration Trench
Adapted from (1992); Source: GSMM (2001)

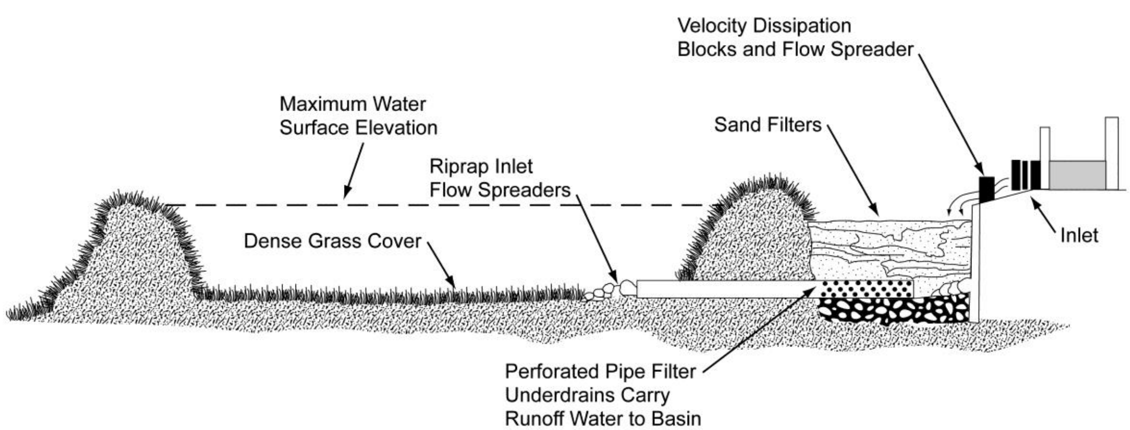


FIGURE 4-11
Typical Infiltration Basin with Sand Filter
Source: GSMM (2001)

2. Infiltration basins are normally dry basins, much like ED detention basins, with the exception that the stormwater does not flow out into a receiving stream. Rather, the stormwater is allowed to infiltrate.

3. Dry wells are similar to infiltration trenches, but are sufficiently smaller to be considered as a separate BMP. Dry wells are most useful for receiving the runoff from roofs of buildings and allowing it to infiltrate into the soil.

Infiltration trenches generally are suited for medium- to high-density residential, commercial, and institutional developments where the subsoil is sufficiently permeable to provide a reasonable infiltration rate and the water table is low enough to prevent groundwater contamination. They are applicable primarily for impervious areas where there are not high levels of fine particulates (clay/silt soils) in the runoff and should only be considered for sites where the sediment load is relatively low.

All types of infiltration devices have the following benefits:

- Reduce runoff volume
- Recharge groundwater
- Provide high removal efficiencies for sediment
- Provide high removal efficiencies for pollutants adsorbed onto sediment particles

To protect groundwater from potential contamination, runoff from designated hot spot land uses or activities must not be infiltrated. Infiltration trenches should not be used for manufacturing and industrial sites, where there is a potential for high concentrations of soluble pollutants and heavy metals. In addition, infiltration should not be considered for areas that have high pesticide concentrations. Infiltration trenches also are not suitable in areas that have karst geology without adequate geotechnical testing by qualified individuals and in accordance with local requirements.

4.4.6.2 General Design Considerations

The following criteria should be considered when designing infiltration areas.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- **Drainage Area–**5 acres maximum.
- **Space Required–**Will vary depending on the depth of the facility.
- **Site Slope–**No more than 6-percent slope (for preconstruction facility footprint).
- **Minimum Head–**Elevation difference needed at a site from the inflow to the outflow: 1 foot.

- **Minimum Depth to Water Table–**4 feet recommended between the bottom of the infiltration trench and the elevation of the seasonally high water table.
- **Soils–**Infiltration rate greater than 0.5-inch-per-hour required (typically hydrologic Group "A"; some Group "B" soils).

Other Constraints/Considerations.

- **Aquifer Protection–**No hot spot runoff allowed; must meet setback requirements in the design criteria.

4.4.6.3 Advantages

- Reduce frequency of flooding by increasing the amount of water entering the soil.
- Help maintain shallow groundwater, which supports dry-weather flows in streams.
- Have particulate pollutant removal efficiencies generally as good as other BMPs.
- Are economical for small drainage areas (fewer than 10,000 ft^2 of storage volume).

4.4.6.4 Disadvantages

- Often fail relatively quickly compared to other types of BMPs. In many instances, this premature failure is due to excess sediment from sites that have not been properly stabilized.
- Tend to clog easily, so pretreatment BMPs must be used to remove coarse particulate pollutants.
- Restricted to areas that have permeable soils, deep water tables, deep bedrock, and stable areas where stormwater contains little sediment or can be pretreated to reduce the sediment load.
- Require significant maintenance to enhance longevity and maintain performance.
- May cause undesirable groundwater seepage into basements and foundations if not properly sited.
- Infiltration of stormwater may contaminate groundwater (Schueler et al., 1992). This is an important concern, although Caltrans (2000) indicates that little pollution travels beyond 20 inches below the facility bottom.

4.4.6.5 Design Procedures

Step 1. Compute runoff control volumes

- Calculate the WQv for the drainage area using the City's Site Development Review Tool.

Step 2. Determine if the development site and conditions are appropriate for the use of an infiltration trench

- Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 4. Size flow diversion structure, if needed

- A flow regulator (or flow splitter diversion structure) should be supplied to divert the WQv to the infiltration trench.
- Size low-flow orifice, weir, or other device to fully dewater the WQv in 24 to 48 hours after the rainfall event.

Step 6. Size infiltration trench

- The area of the trench can be determined from the following equation:

$$A = \frac{WQ_v}{(nd + kT/12)}$$

where: A = Surface Area
WQ_v = Water Quality Volume (or total volume to be infiltrated)
n = porosity
d = trench depth (feet)
k = percolation (inches/hour)
T= Fill Time (time for the practice to fill with water), in hours

- A porosity value n = 0.32 should be used.
- A fill time T=2 hours can be used for most designs.
- Trench depths should be between 3 and 8 feet, to provide for easier maintenance. The width of a trench must be less than 25 feet.
- Broader, shallow trenches reduce the risk of clogging by spreading the flow over a larger area for infiltration.
- The bottom slope of a trench should be flat across its length and width to evenly distribute flows, encourage uniform infiltration through the bottom, and reduce the risk of clogging.
- The stone aggregate used in the trench should be washed, bank-run gravel, 1.5 to 2.5 inches in diameter, with a void space of about 40 percent (ALDOT No. 3 Stone). Aggregate contaminated with soil shall not be used. A porosity value (void space/total volume) of 0.32 should be used in the calculations, unless aggregate-specific data exist.
- A 6-inch layer of clean, washed sand should be placed on the bottom of the trench to encourage drainage and prevent compaction of the native soil while the stone aggregate is added.
- The infiltration trench is lined on the sides and top by an appropriate geotextile filter fabric that prevents soil piping, but that has greater permeability than the parent soil. The top layer of filter fabric is located 2 to 6 inches from the top of the trench and serves to prevent sediment from passing into the stone aggregate. Because this top layer serves as a sediment barrier, it will need to be replaced more frequently and must be readily separated from the side sections.

- The top surface of the infiltration trench above the filter fabric typically is covered with pea gravel. The pea gravel layer improves sediment filtering and maximizes the pollutant removal in the top of the trench. In addition, it can easily be removed and replaced should the device begin to clog. Alternatively, the trench can be covered with permeable topsoil and planted with grass in a landscaped area.
- An observation well must be installed in every infiltration trench and should consist of a perforated PVC pipe, 4 to 6 inches in diameter, extending to the bottom of the trench (Figure 4-7 provides a schematic of an observation well used in a bioretention facility). The observation well will show the rate of dewatering after a storm, as well as provide a means of determining sediment levels at the bottom and when the filter fabric at the top is clogged and maintenance is needed. It should be installed along the centerline of the structure, flush with the ground elevation of the trench.
- A visible floating marker should be provided to indicate the water level. The top of the well should be capped and locked to discourage vandalism and tampering.
- The trench excavation should be limited to the width and depth specified in the design.
- Excavated material should be placed away from the open trench so as not to jeopardize the stability of the trench sidewalls. The bottom of the excavated trench shall not be loaded in a way that causes soil compaction, and should be scarified prior to placement of sand. The sides of the trench shall be trimmed of all large roots. The sidewalls shall be uniform, with no voids, and shall be scarified prior to backfilling. All infiltration trench facilities should be protected during site construction and should be constructed after upstream areas have been stabilized.

<u>Step 7. Determine pretreatment volume and design pretreatment measures</u>

- Size the pretreatment facility to treat 25 percent of the WQv for offline configurations.
- Pretreatment facilities must always be used in conjunction with an infiltration trench to prevent clogging and failure.
- For a trench receiving sheet flow from an adjacent drainage area, the pretreatment system should consist of a vegetated filter strip with a minimum 25-foot length. A vegetated buffer strip around the entire trench is required if the facility is receiving runoff from both directions. If the infiltration rate for the underlying soils is greater than 2 inches per hour, 50 percent of the WQv should be pretreated by another method prior to reaching the infiltration trench.
- For an offline configuration, pretreatment should consist of a sediment forebay, vault, plunge pool, or similar sedimentation chamber (with energy dissipaters) sized to 25 percent of the WQv. Exit velocities from the pretreatment chamber must be non-erosive for the 2-year design storm.

Step 8. Design spillway(s)

- Adequate stormwater outfalls should be provided for the overflow that exceeds the capacity of the trench, thus ensuring non-erosive velocities on the downslope.

4.4.6.6 Design Example

The following example focuses on the design of an infiltration trench to meet the water quality treatment requirements of the site. Channel protection and overbank flood control are not addressed in this example other than quantification of preliminary storage volume and peak discharge requirements. In general, the primary function of infiltration trenches is to provide water quality treatment and groundwater recharge, but not large storm attenuation. As such, flows in excess of the WQv typically are routed to bypass the facility or pass through the facility. Where quantity control is required, the bypassed flows can be routed to conventional detention basins (or some other facility such as underground storage vaults). The layout of the Community Center is shown in Figure 4-12.

Base Data

Site Area = Total Drainage Area (A) = 3.0 ac
Impervious Area = 1.9 ac; or I =1.9/3.0 = 63.3% Soils Type “C”

Hydrologic Data

Pre Project CN = 70; Post Project CN = 88
Pre Project t_c = 0.39; Post Project t_c = 0.2

Step 1. Compute runoff control volumes

The WQv for the infiltration trench would be calculated using the City’s Site Development Tool. The WQv was determined to be 0.186 ac-ft or 8,102 cubic feet (ft^3). The 100-year flow and the 25-year, 24-hour event to size the infiltration trench were calculated using TR-55.

Step 2. Determine if the development site and conditions are appropriate for the use of a infiltration trench

Site-specific Data:

Existing ground elevation at the facility location is 922 feet, mean sea level. Soil boring observations reveal that the seasonally high water table is at 913 feet and the underlying soil is silt loam (ML). The adjacent creek invert is at 912 feet.

Assuming the above-mentioned conditions, it was assumed the infiltration trench is a suitable BMP for this application.

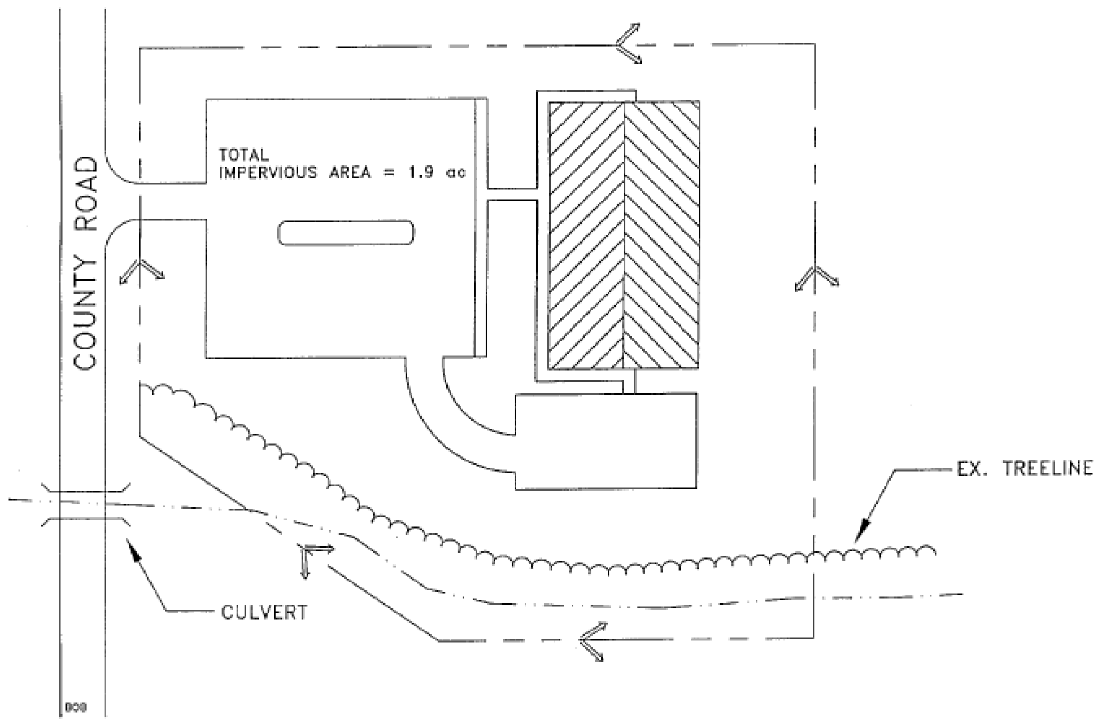


FIGURE 4-12
Infiltration Trench Example Site Plan
Source: GSMM (2001)

Step 3. Determine WQv peak discharge (Qwq)

Infiltration trenches should be developed offline only. Offline facilities are designed to receive a more or less exact flow rate through a weir, channel, manhole, "flow splitter," etc. This facility is situated to receive direct runoff from grass areas and parking lot curb openings and piping for the 25-year event (19 cfs), and *no special flow diversion structure is incorporated.*

Compute the WQv: The WQv previously was determined to be 8,102 ft^3.

The peak rate of discharge for the water quality design storm is needed for the sizing of offline diversion structures, such as sand filters and grass channels. Conventional Soil Conservation Service (SCS) methods have been found to underestimate the volume and rate of runoff for rainfall events less than 2 inches. This discrepancy in estimating runoff and discharge rates can lead to situations where a significant amount of runoff bypasses the filtering treatment practice because of an inadequately sized diversion structure, or can lead to the design of undersized trenches.

The following procedure can be used to estimate peak discharges for small storm events. It relies on the volume of runoff computed using the Small Storm Hydrology

Method (Pitt, 1994) and uses the Natural Resource Conservation Service (NRCS), TR-55 Graphical Peak Discharge Method (USDA, 1986). A brief description of the calculation procedure is presented below:

$$CN = 1000 / [10 + 5P + 10Q - 10(Q^2 + 1.25\,QP)^{1/2}]$$

where: P = rainfall, in inches (use 1.2" for the Water Quality Storm)
Q = runoff volume, in inches (equal to WQV ÷ area)

Once a CN is computed, the time of concentration (t_c) is computed (based on the methods identified in TR-55).

Using the computed CN, t_c, and drainage area (A), in acres, the Qwq for the water quality storm is computed (based on the procedures identified in TR-55). Use the appropriate rainfall distribution type.

Step 4. Determine size of infiltration trench

$$A_f = (WQv) / (nd + kT/12)$$

Af = (8,102 ft^3) / (0.32 x 5' + 1"/ hour x 2 hours / 12)
(With n = 0.32, d = 5, k = 1"/hour, T = 2 hours)
= 4,586 ft^2

Because the width can be no greater than 25 feet (see above, feasibility), determine the length:

L = 4,586 ft^2 / 25 ft
L = 183 feet

Assume that one third of the runoff from the site drains to Point A and two thirds drains to Point B. Use an L-shaped trench in the corner of the site (Figure 4-13 provides a site plan view). The surface area of the trench is proportional to the amount of runoff it drains (the portion draining from Point A is half as large as the portion draining from Point B).

Step 5. Size the flow diversion structures

Because two entrances are used, two flow diversions are needed, as follows:

For the entire site:

Q25-year = 17 cfs
Peak flow for WQv = 2.2 cfs. (Step 3).

For the first diversion (Point A):

Assume peak flow equals 1/3 of the value for the entire site.
Thus, Q25-year = 17/3 = 5.7 cfs
Peak flow for WQv = 2.2/3 = 0.73 cfs

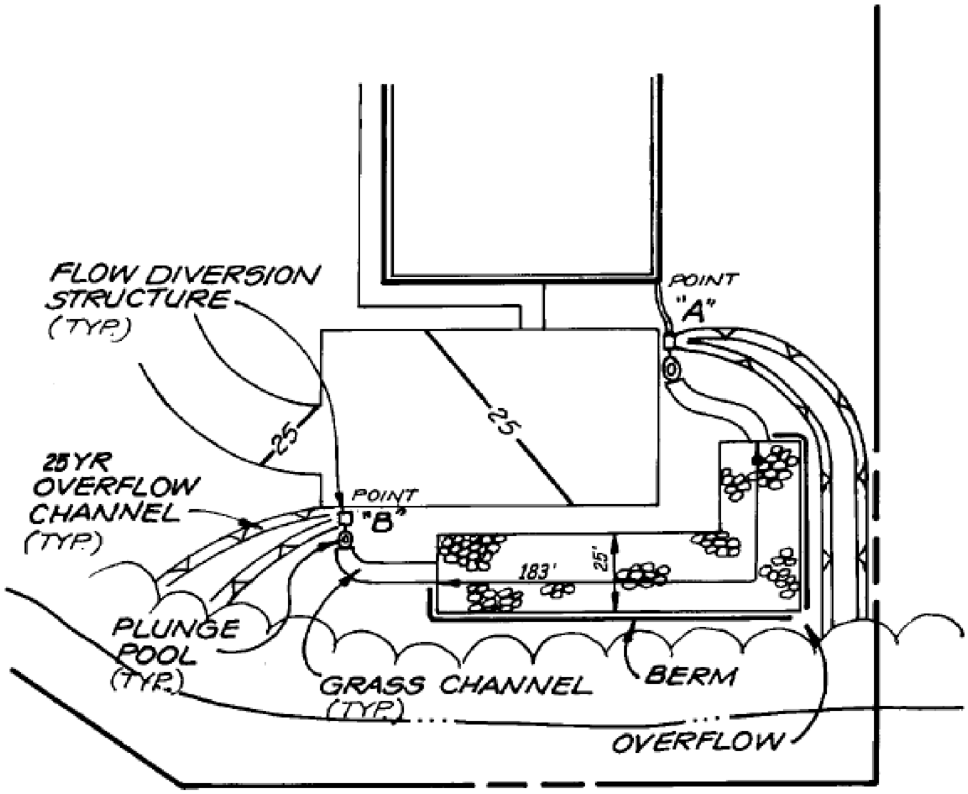


FIGURE 4-13
Infiltration Trench Site Plan
Source: GSMM (2001)

Size the low flow orifice to pass 0.73 cfs with 1.5 feet of head using the Orifice equation:

Q=CA(2gh) ½ ; 0.73 cfs = 0.6A(2 × 32.2 ft/s2 × 1.5') ½
A=0.12 sq. ft. = πd2/4; d = 0.4'; use 6" pipe with 6" gate valve

Size the 25-year overflow weir crest at 22.5 feet. Use a concrete weir to pass the 25-year flow (5.7 – 0.73 = 5 cfs). Assume 1 foot of head to pass this event. Size using the weir equation:

Q = CLH1.5; L= Q/(CH1.5)
L = 5 cfs/ (3.1)(1)1.5 = 1.6'; use 1.6' (Figure 4-14)

Size the second diversion (Point B) using the same techniques. Peak flow equal to two thirds of the value for the entire site. Thus:

Q25-year = 17*0.67 = 11.4 cfs
Peak flow for WQv = 2.2*0.67 = 1.47 cfs

Size the low-flow orifice to pass 1.47 cfs with 1.5 feet of head using the Orifice equation:

Q=CA(2gh) ½ ; 1.47 cfs = 0.6A(2 × 32.2 ft/s2 × 1.5') ½
A=0.25 sq. ft. = πd2/4; d = 0.56'; use 8" pipe with 8" gate valve

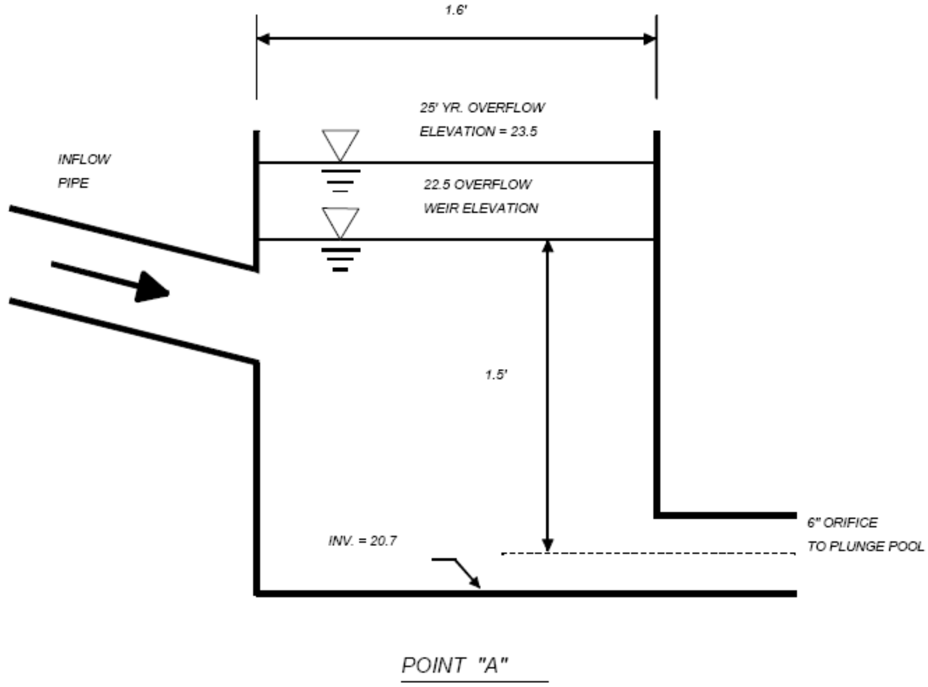


FIGURE 4-14
First Flow Diversion Structure (Point A)
Source: GSMM (2001

Size the 25-year overflow weir crest at 22 feet. Use a concrete weir to pass the 25-year flow (11.4 –1.47 = 9.9 cfs). Assume 1 foot of head to pass this event. Size using the weir equation:

$Q = CLH1.5$; $L = Q/(CH1.5)$
L = 9.9 cfs/ (3.1)(1)1.5 = 3.2'; use 3.2' (see Figure 4-15)

Step 6. Design pretreatment

As rule of thumb, size pretreatment to treat 25 percent of the WQv. Therefore, treat 8,102 × 0.25 = 2,026 ft^3.

For pretreatment, use a pea gravel filter layer with filter fabric, a plunge pool, and a grass channel.

Pea Gravel Filter

The pea gravel filter layer covers the entire trench with 2 inches. Assuming a porosity of 0.32, the water quality treatment in the pea gravel filter layer is:

WQfilter= (0.32)(2")(1 ft/12 inches)(3,883 ft2) = 207 ft^3

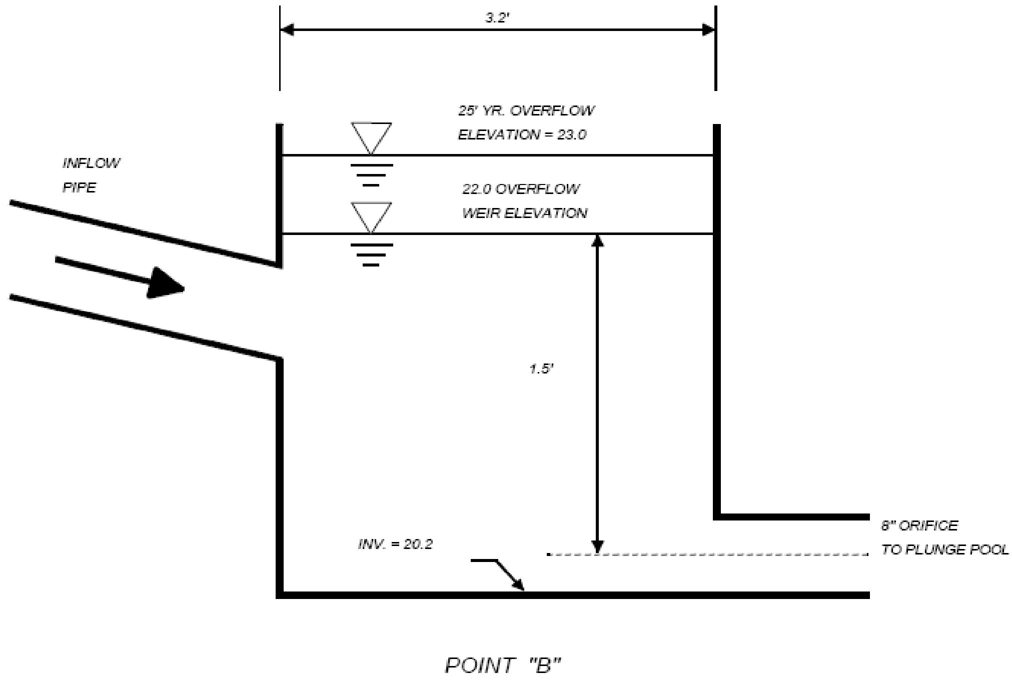


FIGURE 4-15
Second Flow Diversion Structure (Point B)
Source: GSMM (2001

*Plunge Pool*s

Use a 5-foot x 10-foot plunge pool at Point A and a 10-foot x 10-foot plunge pool at Point B with average depths of 2 feet:

Total WQpool= (10 ft)(10+5 ft)(2 ft) = 300 ft^3

Grass Channel

Thus, the grass channel needs to treat at least (2,026 - 207 - 300) ft^3 = 1,519 ft^3

Use a Manning's equation nomograph or software to size the swale.

The channel at Point A should treat one third of 1,519 ft^3 or 501 ft^3.

- Assume a trapezoidal channel with 4-foot channel bottom, 3H:1V side slopes, and a Manning's n value of 0.15. Use a nomograph to size the swale; assume a 1-percent slope.
- Use a peak discharge of 0.73 cfs (Peak flow for one third of WQv, or 2,674 ft^3)
- Compute velocity: V=0.5 fps
- To retain the 1/3 of the WQv (2,674 ft^3) for 10 minutes, the length would be 300 feet.

- Because the swale only needs to treat 25 percent of the WQv minus the treatment provided by the plunge pool and the gravel layer, or 501 ft^3, the length should be pro-rated to reflect this reduction.

  Therefore, adjust length as follows:

  L= (300 ft)(501 ft3/2,674 ft^3) =56 feet. Use 60 feet.

The channel at Point B should treat two thirds of 1,519 ft^3, or 1,018 ft^3

- Assume a trapezoidal channel with 5-foot channel bottom, 3H:1V side slopes, and a Manning's n value of 0.12. Use a nomograph to size the swale; assume a 0.5-percent slope.
- Use a peak discharge of 1.47 cfs (Peak flow for two thirds of WQv, or 5,428 ft^3)
- Compute velocity: V=0.5 fps
- To retain the 2/3 of the WQv (5,428 ft^3) for 10 minutes, the length would be 300 feet.
- Because the swale only needs to treat 25 percent of the WQv minus the treatment provided by the plunge pool and the gravel layer, or 1,018 ft^3, the length should be prorated to reflect this reduction.

  Therefore, adjust length as follows:

  L= (300 ft)(1,018 ft^3/5,428 ft^3) = 56 feet. Use 60 feet.

Step 7. Design spillway

Adequate stormwater outfalls should be provided for the overflow associated with the 25-year and larger design storm events to ensure non-erosive velocities on the downslope.

Step 8. Design emergency overflow

The parking area, curb, and gutter are sized to convey the 25-year event to the facility. Should filtering rates become reduced because of facility age or poor maintenance, an overflow weir is provided to pass the 25-year event. Size this weir with 6 inches of head, using the weir equation:

$$Q = CLH^{3/2}$$

where: Q = 19.0 cfs
C = 2.65 (smooth crested grass weir)
H = 6"

Solve for L: L = Q / [(C) ($H^{3/2}$)] or (19.0 cfs) / [(2.65) $(.5)^{1.5}$] = 20.3' (say 20')

Step 9. Prepare Vegetation and Landscaping Plan

Choose plants based on factors such as whether they are native, resistance to drought and inundation, cost, aesthetics, maintenance, etc. Select species locations (on center planting distances) so that species will not "shade out" one another. Do not plant trees and shrubs that have extensive root systems near pipe work.

4.4.6.7 Monitoring and Maintenance

Sediment accumulation eventually will render an infiltration device ineffective, so regular inspections are necessary. Because the trenches and dry wells are belowground and out of sight, there can be a tendency is to ignore inspection and maintenance, which leads to failure. Regular inspections of all types of infiltration devices will help ensure that problems are identified in advance.

A monitoring well should be installed in all infiltration devices to facilitate proper monitoring. For the first year of operation, installations should be inspected quarterly and after each major storm. After the first year, annual inspections, preferably conducted after a storm, are recommended.

Property owners should be educated in the function and maintenance requirements of infiltration devices. Especially important is the maintenance of vegetated areas that drain to the infiltration system. Areas that are allowed to become bare and unvegetated will contribute excess sediment to the infiltration system and hasten its failure. Maintenance requirements are summarized as follows:

- Grass areas, grassed swales, and filter strips leading to infiltration devices should have a dense vegetation cover and be mowed at least twice a year.
- Sediment deposits should be removed from pretreatment devices at least annually.
- In trenches, the top several inches of aggregate and the filter cloth along the top of the trench or dry wells should be replaced annually or at least when the facility shows evidence that infiltration rates have declined. Proper disposal of the removed materials is necessary.
- The surfaces of infiltration trenches must be kept in good condition. Colonization by grass or other plants should be discouraged because it can lead to reduced surface infiltration rates. In many instances, it is convenient to cover infiltration trenches with concrete grid pavers or similar permeable paving systems that can be removed easily and replaced as necessary to service the trench.
- The infiltration facility must be dismantled and reconstructed when the infiltration rate drops to unacceptable levels.

4.4.7 Buffers (also known as Riparian Forested Buffers)

4.4.7.1 Description and Benefits

Buffers are natural or constructed low-maintenance ecosystems adjacent to surface water bodies where trees, grasses, shrubs, and/or herbaceous plants function as a filter to remove pollutants from overland stormwater flow and shallow groundwater flow before discharge to receiving waters.

Effective buffers filter pollutants through natural mechanisms such as deposition, infiltration, adsorption, absorption, filtration, biodegradation, and

Estimated Pollutant Removal Efficiency Rates*

- TSS ~ 85 percent
- Nutrients (TP/TN) ~ 40/ 30 percent
- Metals ~ 50 percent
- Pathogens ~ 70 percent

*The pollutant removal effectiveness of vegetated buffers varies with the width of the buffer.

plant uptake. Riparian buffers also improve habitat by providing food and cover for wildlife and aquatic organisms (Figure 4-16). Riparian buffers alone cannot provide all of the surface runoff treatment required (both water quality and quantity), but can help in the following ways:

- Attenuating the rate of runoff into streams
- Increasing infiltration and recharge to groundwater and surface water bodies
- Reducing erosion of streams and riverbanks
- Improving aquatic habitat
- Reducing sedimentation and pollutants
- Reducing sediment-binding pollutants, including some metals and organics

FIGURE 4-16
Forested Buffer with Well-developed Streambank Vegetation

4.4.7.2 General Design Considerations

The following criteria should be considered when selecting buffers.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- Section 413 of the City's Zoning Ordinance (May 2, 2006) requires buffers varying in width from 35 feet to 100 feet perpendicular from each side of the stream bank, creek, or waterway under "bank-full conditions." The buffer requirements apply to all perennial and intermittent streams as defined in Section 413.02 of the ordinance.

Other Constraints/Considerations.

- Generally, the wider the stream buffer, the more effectively pollutants are removed from surface runoff. Consider a wider stream buffer (if possible) in areas where pollutant loading from the upstream watershed is expected to be high.
- If planting is needed in the buffer, the use or reinforcement of existing vegetation is preferred. However, where improvements are required, sodding, plugging, and the use of stockpiled vegetation or seeding are acceptable.
- No clearing or grading of land in the buffer zone may occur without the City's written permission.

4.4.7.3 Advantages

- Offers numerous aesthetic and passive recreational benefits.
- Provides water quality treatment, erosion control, and water temperature benefits.
- Maintaining trails that are constructed, marked, and signed well can build support for greenways of riparian forest in urban and suburban watersheds.
- Owners of commercial and institutional properties that front on urban water bodies can be encouraged to landscape the areas and add to riparian buffers.
- Inexpensive to "construct."

4.4.7.4 Disadvantages

- Sometimes seen as dangerous or unkempt public areas.
- Shrubby bank-side vegetation can be perceived as interfering with views of streams.
- Can be abused as places for illegal dumping.
- By the time the riparian corridor is reached, surface flow frequently has become concentrated into swales or the buffer has been bypassed by underground storm drains discharging to the stream. Therefore, benefits may be limited to the area that is contributing sheet flow to the buffer itself.

4.4.7.5 Stream Buffers

Purpose.

The purpose of this subsection is to establish minimal acceptable requirements for the design of buffers to ensure that the stream and adjacent land will fulfill their natural functions; to reduce land development impacts on stream water quality and flows; and to provide for the environmentally sound use of the City's land resources.

Definitions.

For the purpose of this section, these words and phrases shall be defined as specified below:

A. *Perennial stream:* A natural watercourse which contains flowing water, year around.

B. *Intermittent stream*: One which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.

C. *Ephemeral stream:* A stream channel or reach of stream channel that carries surface water runoff for short durations as a result of precipitation events. The channel bottom is always above the groundwater table.

D. *BMPs:* Conservation practices or management measures that control soil loss and reduce water quality degradation caused by nutrients, animal wastes, toxics, sediment, and runoff.

Streams Determination.

All perennial, intermittent and ephemeral streams should be identified and delineated by a qualified professional. The WRM Department may request an onsite inspection to verify the accuracy and completeness of the determination per the definitions provided herein. All streams should be shown on site development plans, along with corresponding stream buffers where applicable.

Buffer Description, Width, and Permitted Uses.

Stream buffers shall be required on each side of all perennial and intermittent streams as defined in this subsection. Stream buffers width shall vary based on the size of the upstream drainage basin. Table 4-4 specifies the buffer required based on the drainage area for a particular stream above the most downstream point on the development being considered. The USGS 7.5-minute 1″:2000′ quadrangle maps, in conjunction with the Soil Survey Maps of Lee County and the City's GIS, will serve as tools to delineate the size of drainage basins and to specify the corresponding buffer width.

The stream buffer is comprised of three zones–Streamside Zone, Managed Use Zone, and Upland Zone. Buffer zones' functions, vegetation, and permitted uses vary by zone, as described in Table 4-5.

TABLE 4-4
Stream Buffer Width based on Drainage Area
WRM Department Design and Construction Manual, Auburn, Alabama

Drainage Area (Watershed) Designation	Streamside Zone	Managed Use Zone	Upland Zone	Total Buffer Width on Each Side of Stream
< 100 acres	25 feet	None	10 feet	35 feet
≥ 100 acres	25 feet	None	20 feet	45 feet
≥ 300 acres	25 feet	20 feet	10 feet	55 feet
≥ 640 acres	25 feet	50 feet	25 feet	100 feet

TABLE 4-5
Stream Buffer Width based on Drainage Area
WRM Department Design and Construction Manual, Auburn, Alabama

Characteristics	Streamside	Managed Use Zone	Upland Zone
Function	Protects the physical and ecological integrity of the stream ecosystem	Protects key components of the stream and provides distance between upland development and the streamside zone	Prevents encroachment and filter runoff from residential and commercial development
Vegetative Target	Undisturbed natural vegetation	Mature vegetation and native trees; exotic vegetation and underbrush may be removed and maintained	Lawns, gardens, shrubs, and pervious landscaping features
Uses	***Very restricted***–Permitted uses limited to: flood control structures, utility easements*****, natural footpaths, crossings and approaches for paved roadways, and pedestrian paths and bikeways.	***Restricted***–Permitted uses limited to: all uses allowed in the Streamside Zone as well as storm water best management practices (BMPs), biking and hiking paths (with natural or pervious surfaces), greenway trails, and limited tree clearing approved by the WRM Department	***Restricted***–Permitted uses limited to: all uses allowed in the Streamside and Managed Use Zones, as well as, grading for lawns, gardens, and gazebos and accessory structures. No septic systems, principal structures or impervious surfaces are allowed.

Note:
***** As deemed necessary and approved by the City Engineer

If an ephemeral stream remains after construction has been completed, and all or a portion of that stream falls within the stream buffer of an intermittent or perennial stream, then that ephemeral stream shall be revegetated on both sides of the stream in accordance with the targeted vegetation of the corresponding buffer zone. Appropriate stream bank stabilization measures shall be designed if warranted by excessive velocities in the ephemeral stream. If the ephemeral stream remains after construction and falls outside of an intermittent/perennial stream buffer, then that ephemeral stream shall be grassed and/or revegetated in accordance with the surrounding vegetation at a width of 25 feet on each side of the ephemeral stream. Ephemeral stream channels and banks shall be stabilized as appropriate for the predicted stream velocities. These measures are performed to preserve and protect water quality.

Applicability.
The buffer requirements shall apply to all perennial and intermittent streams as defined in this subsection. Buffer widths for streams are measured horizontally on a line perpendicular to the surface water, landward from the top of the bank on each side of the stream. The top of bank is the landward edge of the stream channel during high water or bank full conditions at the point where the water leaves the stream channel and begins to overflow onto the floodplain.

All properties shall be subject to the buffer width requirements except those properties that are an existing lot of record and/or included on an approved preliminary subdivision plat and the lot or lots cannot meet the requirements described in this subsection *(Effective date 5/02/06 pursuant to Ordinance Number 2389).*

Minimize Intrusion.
Any uses allowed in Table 4-5 shall be designed and constructed to minimize the amount of intrusion into the stream buffer and to minimize clearing, grading, erosion, and water quality degradation.

Land in the Stream Buffer.
Land in stream buffers shall not be used for principal structures. All new platted lots shall be designed to provide sufficient land outside of the stream buffer to accommodate primary structures. Stream buffers should be delineated before streets and lots are laid out to minimize buffer intrusion and to ensure there is adequate buildable area on each platted lot.

Land within the stream buffer can serve to meet the minimum lot size requirements.

Setback Requirements.
For all lots within a development requiring a stream buffer, setbacks can be 100 percent within the stream buffer.

Buffer Impact.
When the application of the buffer zones would result in the loss of buildable area on a lot that was recorded prior to the effective date of these regulations, then modifying the width of the buffer zones may be allowed, through an administrative process, as determined by the WRM Department.

Modification and mitigation of the stream buffer width also are available to landowners or developers of newly platted lots or subdivisions where there are exceptional situations or physical conditions on the parcel that pose practical difficulty to its development and restrict the application of these regulations. There must be proof of such circumstances by the landowner.

The landowner or his designated representative proposing any of the impacts shall prepare and submit for approval a written request and a site plan showing the extent of the proposed impact and must specify a proposed mitigation technique. Mitigation techniques are described in this subsection.

The WRM Department and other appropriate city staff members shall review and render a decision on any buffer encroachment and mitigation technique with regard to the stream buffer requirements. Amendment to the stream buffer width may be allowed in accordance with the following criteria:

A. The proposed encroachment and mitigation is in accordance with the purpose and intent of this section of the ordinance.

B. The proposed lot and structure conforms to all other zoning and development regulations.

C. Encroachments into the buffer areas shall be the minimum necessary to achieve a reasonable buildable area for a principal structure and necessary utility.

D. The landowner or his designated representative submitted an acceptable written statement justifying the need for the buffer impact.

E. The landowner or his designated representative submitted an acceptable mitigation plan in accordance with cited mitigation techniques.

F. Attention has been given to maintaining natural vegetation and eliminating runoff.

In no case shall the reduced portion of the buffer area be less than the width of the Streamside Zone (25 feet).

Stream Buffer Mitigation Techniques.
The following techniques are available to landowners for the mitigation of buffer impact:

A. *Installation of Structural BMPs.* The installation of an onsite structural BMP (i.e., bioretention, extended detention and retention, rain gardens, stormwater wetlands, etc.) will allow for stream buffer impacts on the specific site. The structural BMP shall be designed to achieve pollutant (nutrients, herbicides, pesticides, sediment, and other illicit discharges) removal to the maximum extent practicable. The BMP shall remain outside the Streamside Zone. A detailed BMP design plan must be submitted to the City Engineer for approval, along with a long-term maintenance plan.

B. *Controlled Impervious Surface.* The landowner may commit to and provide a specific site development plan that limits the overall site impervious surface ratio equal to or less than 25 percent.

C. *Open Space Development.* The landowner may submit a specific site development plan which preserves an undisturbed, vegetative area onsite or near the development site as open space equal to 200 percent of the buffer encroachment area. The open space preserved must promote water quality protection.

D. *Stream Restoration:* The landowner may restore and preserve the buffer area on any stream of equivalent or greater drainage area the condition of which is determined to be qualified for restoration by the City Engineer on a 1:1 basis in linear feet of stream. This restoration shall include stream bank improvements and Streamside and Managed Use Zone re-vegetation.

E. *Stream Preservation:* The landowner may purchase, fee simple, other stream segments within the City limits at equivalent or greater drainage area on a 1:1 linear foot basis and convey fee simple and absolute title of the land to the City.

F. *Wetland Restoration:* On a 2:1 acreage basis for disturbed stream and buffer area (2 acres of wetland for each acre of disturbed area), the landowner may provide a combination of the preservation and/or restoration of wetlands with protective easements, and the implementation of structural or non-structural BMPs to achieve pollutant removal to the maximum extent practicable.

G. *Greenways:* The landowner may allocate and donate open space within the City limits through fee simple to the City for preservation and use as common open space.

H. *Wider Buffer Widths:* A developer may add additional widths to buffer areas where encroachment occurs in other areas on a development site and may obtain an acre-for-acre credit based on the stream buffer zone affected. A 2:1 credit could be obtained by determination of the WRM Department in the event additional streamside buffer is set aside for encroachment of the managed use and upland stream buffer zones.

I. *Other Mitigation Techniques:* Other creative mitigation techniques and plans may be considered by the WRM Department.

Vegetation Preservation.

The buffer shall provide for the preservation and enhancement of natural vegetation or planting. No live vegetation may be removed from the Streamside and Managed Use Zones for preparation of land for uses permitted in Table 4-5 unless approved by the WRM Department.

The WRM Department may grant approval of the removal of exotic vegetation (i.e., privet, kudzu, etc.) provided that a vegetation restoration plan is submitted and approved prior to the disturbance of the vegetation. The purpose of such plan is to ensure that native vegetation is restored to the Streamside Zone.

Where a developer or lot owner removes live vegetation from the buffer strip, in violation of this subsection, the WRM Department shall require native vegetation of reasonable diameter in size to be planted so as to create a buffer area that is in compliance with this subsection. A vegetation restoration plan must be submitted and approved by the WRM Department prior to restoration.

Vegetation Restoration Plan.
A vegetation restoration plan shall include the following information:

A. Scaled map of lot showing buffer delineation (copy of the survey is acceptable).

B. Square footage of the actual area disturbed or the proposed disturbed area.

C. Proposed vegetation to be removed from the buffer.

D. Proposed location, number, and species of plants to be planted in the disturbed area. A list of suitable plant species is available from the Watershed Division of the WRM Department.

E. Type of ground cover to be placed in the disturbed area (i.e., mulch, pine straw, etc.).

F. Proposed planting schedule and deadline for the completion of the restoration activities.

Approved Permits.
Where a landowner or his/her representative obtain permits from ADEM or the USACE for proposed impacts to the stream or stream buffers, then these approved mitigation impacts and plans would supersede the applicable requirements of these sections of the ordinance. The regulations that these permits do not affect shall be applicable to the proposed development site.

4.4.7.6 Monitoring and Maintenance

The vegetative structure throughout the buffer must be maintained. The buffer should be monitored to evaluate its success and plant material should be replaced as necessary. Conditions to be investigated and corrected include damaged livestock fences, streambank erosion and washout, disease and insect infestation, dead plants, invasive species, gullies caused by concentrated flow, and damage by wildlife.

Maintenance must be carried out with minimal impact in the zone closest to the stream. Watering may be necessary in the initial year or during periods of drought, especially if bare root vegetation is installed. Ongoing maintenance activities include selective cutting, replanting to maintain forest structure, and weed control. Fertilization and liming are recommended during plant establishment. Long-term fertilization, however, should not be necessary if the proper vegetation has been selected. Weeds can be suppressed by planting vigorous species that can compete successfully, and by ensuring that the nutritional needs of the plants are met.

Eradicating invasive plant species such as Japanese honeysuckle (*Lonicera japonica*), kudzu (*Pueraria lobata*), and privet (*Ligustrum* spp.) may be necessary to ensure that forest structure and diversity are maintained. Measures also may need to be taken to prevent wildlife from damaging seedlings by browsing. If the streambank structure is not maintained by riparian vegetation, then additional measures should be used such as live staking, intercepting runoff before it enters the riparian forested buffer, or using stabilization techniques.

Riparian buffers require maintenance to do the following:

- Repair fences
- Fill gullies
- Remove weeds and invasive vegetation
- Repair stream bank erosion
- Protect against wildlife damage and insect and disease problems
- Replant to maintain the proper stand density
- Provide periodic vegetative thinning and harvesting of mature trees to maintain health and growth

4.4.8 Permeable Pavement (also known as Pervious Pavement)

4.4.8.1 Description and Benefits

Permeable pavement is an alternative to conventional concrete and asphalt paving materials that allows for rapid infiltration of stormwater. Stormwater infiltrates though the permeable pavement to a gravel substrate that provides temporary storage until the water infiltrates into underlying permeable soils or through an underground drain system.

Estimated Pollutant Removal Efficiency Rates

- TSS ~ not applicable
- Nutrients (TP/TN) ~ 80/80 percent
- Metals ~ 90 percent

Traditional paved surfaces, such as asphalt and concrete, do not allow water to infiltrate and convert almost all rainfall into runoff. If designed and implemented correctly, permeable pavement systems allow at least a portion of the stormwater to infiltrate. Modular permeable pavers typically are placed on a gravel (stone aggregate) base course. Runoff infiltrates through the permeable paver surface into the gravel base course, which acts as a storage reservoir as it exfiltrates to the underlying soil. The infiltration rate of the soils in the subgrade must be adequate to support drawdown of the entire runoff capture volume within 24 to 48 hours. Special care must be taken during construction to avoid undue compaction of the underlying soils, which could affect the infiltration capability of the soil. Permeable pavement systems are designed to do the following:

- Reduce peak runoff volumes
- More effectively manage stormwater flows

Permeable paving materials include, but are not necessarily limited to, porous concrete, permeable interlocking concrete pavers, concrete grid pavers, and porous asphalt.

Modular permeable paver systems typically are used in low-traffic areas such as the following types of applications:

- Parking pads in parking lots
- Overflow parking areas
- Residential driveways
- Residential street parking lanes
- Recreational trails
- Golf cart and pedestrian paths
- Emergency vehicle and fire access lanes

Figure 4-17 shows a typical installation of permeable pavement in a parking lot.

FIGURE 4-17
Parking Lot with Interlocking Concrete Grid Installation
(Courtesy of the Interlocking Concrete Pavement Institute)

4.4.8.2 General Design Considerations

The following criteria should be considered when designing permeable pavement.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- Permeable paver systems typically should be used in applications where the pavement receives contributing runoff only from impervious areas. The ratio of the contributing impervious area to the permeable paver surface area should be no greater than 3:1.
- If runoff is coming from adjacent pervious areas, it is important that those areas be fully stabilized to reduce sediment loads and to prevent clogging of the permeable paver surface.
- Permeable paver systems are not recommended on sites with a slope greater than 2 percent.
- A minimum of 2 feet of clearance is required between the bottom of the gravel base course and underlying bedrock or the seasonally high groundwater table.
- Permeable paver systems should be sited at least 10 feet downgradient from buildings and 100 feet away from drinking water wells.
- Soils–permeable paver systems can be used where the underlying in situ subsoils have an infiltration rate of between 0.5 and 3 inches per hour. Therefore, permeable paver systems are not suitable on sites with hydrologic Group D or most Group C soils, or soils with a high (greater than 30 percent) clay content. During construction

and preparation of the subgrade, special care must be taken to avoid compaction of the soils.

Other Constraints/Considerations.

- Permeable paver system designs must use some method to convey larger storm event flows to the conveyance system. One option is to use storm drain inlets set slightly above the elevation of the pavement. This approach would allow for some ponding above the surface, but would accept bypass flows that are too large to be infiltrated by the permeable paver system, or if the surface clogs.
- For the purpose of sizing downstream conveyance and structural control systems, permeable paver surface areas can be assumed to be 40-percent impervious.

4.4.8.3 Advantages

- Reduces stormwater runoff rate and volume.
- Reduces the loads of some pollutants in surface runoff by reducing the volume of stormwater leaving a site.
- Can be a potential component of LID site designs.

4.4.8.4 Disadvantages

- Potential for sediment to clog porous media, which would lead to reduced effectiveness.
- High maintenance requirements.
- Higher cost than conventional pavements.
- Special attention to design and construction required.
- Not applicable for high-traffic areas or for use by heavy vehicles.
- Completed permeable pavement installation must have a slope less than 2 percent.

4.4.8.5 Design Procedures

- An appropriate modular porous paver should be selected for the intended application. A minimum of 40 percent of the surface area should consist of open void space. If it is a load-bearing surface, then the pavers should be able to support the maximum load.
- The porous paver infill is selected based upon the intended application and required infiltration rate. Masonry sand (such as ASTM C-33 concrete sand or ALDOT Fine Aggregate Size No. 10) has a high infiltration rate (8 inches per hour [in./hr]) and should be used in applications where no vegetation is desired. A sandy loam soil has a substantially lower infiltration rate (1 in./hr), but will provide for growth of a grass ground cover.
- A 1-inch top course (filter layer) of sand (ASTM C-33 concrete sand or ALDOT Fine Aggregate Size No. 10) underlain by filter fabric is placed under the porous pavers and above the gravel base course.

- The gravel base course should be designed to store, at a minimum, the WQv. The stone aggregate used should be washed, bank-run gravel, 1.5 to 2.5 inches in diameter, with a void space of about 40 percent (ALDOT No. 3 Stone). Aggregate contaminated with soil shall not be used. A porosity value (void space/total volume) of 0.32 should be used in calculations.
- The gravel base course must have a minimum depth of 9 inches. The following equation can be used to determine whether the depth of the storage layer (gravel base course) needs to be greater than the minimum depth:

$$d = V / A * n$$

where: d = Gravel Layer Depth (ft)
V = Water Quality Volume –or– Total Volume to be Infiltrated
A = Surface Area (ft^2)
n = Porosity (use n=0.32)

- The surface of the subgrade should be lined with filter fabric or an 8-inch layer of sand (ASTM C-33 concrete sand or ALDOT Fine Aggregate Size No. 10) and be completely flat to promote infiltration across the entire surface.
- For impermeable clays and soils with infiltration rates less than 0.5 in./hr, a perforated underdrain system (with clean-outs) connected to storm drain piping should be used with permeable pavement. The underdrain system should be made of 6-inch perforated or slotted Schedule 40 PVC pipe. The underdrain should be wrapped in filter fabric or embedded in a 1-foot-thick layer of clean sand.

4.4.8.6 Design Example

The sizing and the design of permeable pavement are site dependent and usually are performed by the selected manufacturer. Figure 4-18 shows a cross-section and some examples of permeable pavement.

4.4.8.7 Monitoring and Maintenance

Permeable pavement installations should be monitored regularly to ensure that sediment clogs are not inhibiting infiltration. Maintenance requirements are critical for the success of permeable pavement. The installation and maintenance requirements listed in Table 4-6 are designed to ensure that the permeable pavement system will work effectively.

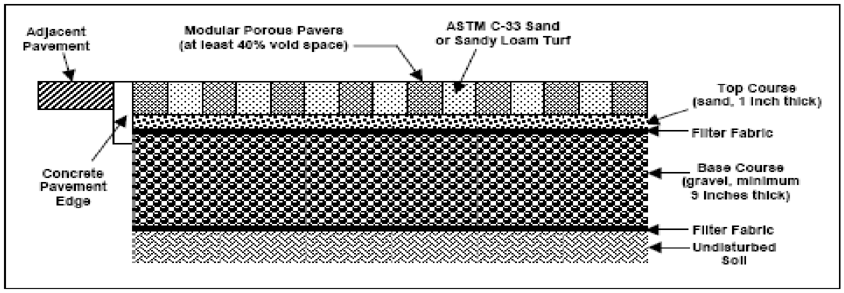


Figure 3.3.8-2 Modular Porous Paver System Section

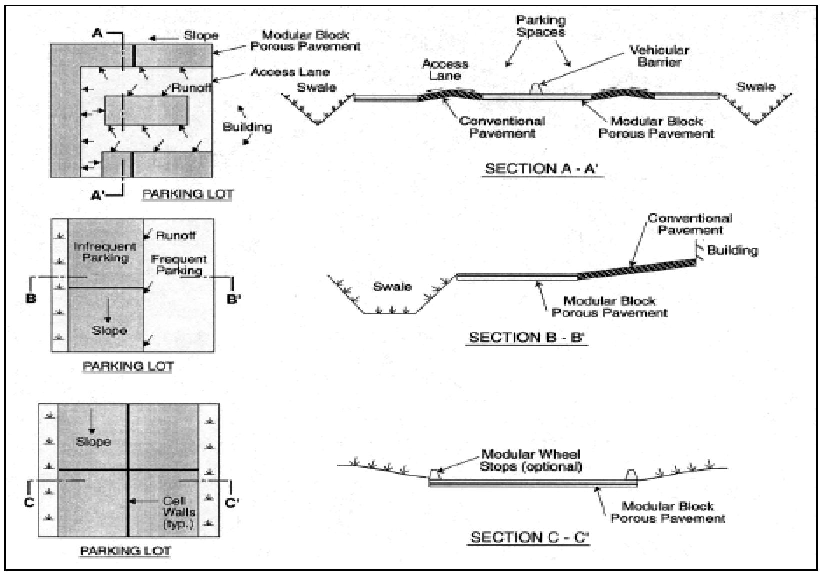


FIGURE 4-18
Typical Permeable Paver Design

TABLE 4-6
Required Maintenance Activities for Permeable Pavement Installations
WRM Department Design and Construction Manual, Auburn, Alabama

Activity	Schedule
Initial inspection	Monthly for 3 months after installation
Ensure that permeable pavement surface is free of sediment	Monthly
Ensure that the contributing and adjacent area is stabilized and mowed, with clippings removed	As needed, based on inspection
Vacuum sweep permeable pavement surface	Annually
Inspect the surface for deterioration	Annually
Verify that the permeable pavement system dewaters between storms	Annually
Verify that underdrain outlet is free from obstructions (if applicable)	Annually

Note:
Adopted from Atlanta Regional Commission and Georgia Department of Natural Resources, 2001.

4.4.9 Sand Filter

4.4.9.1 Description and Benefits

Estimated Pollutant Removal Efficiency Rates

The efficiency rates for both open and closed sand filters are similar, as follows:

- TSS ~ 80 percent
- Nutrients (TP/TN) ~ 50/25 percent
- Metals ~ 50 percent
- Pathogens ~ 40 percent

A sand filter is a device that allows stormwater to percolate down through sand layers and possibly a topsoil layer. Common usage areas for this type of BMP are parking lots, driveways, loading docks, service stations, garages, airports, and storage yards.

The two types of sand filters presented in this Manual are: 1) surface or open sand filter; and 2) perimeter or closed sand filter. The surface sand filters can treat larger drainage areas than can the perimeter sand filters. A surface sand filter facility consists of a two-chamber open-air structure, which is located at ground-level. The first chamber is the sediment forebay (that is, the sedimentation chamber), while the second chamber is the sand filter bed. Flow enters the sedimentation chamber, where settling of larger sediment particles occurs. Runoff is then discharged from the sedimentation chamber through a perforated standpipe into the filtration chamber. After passing though the filter bed, runoff is collected by a perforated pipe and gravel underdrain system. Figure 4-19 provides plan view and profile schematics of a surface sand filter. A variation of the open sand filter, the open organic filter, is used when maximum nutrient or trace metal removals are desired.

A perimeter or closed sand filter facility is a vault structure located just below grade level. Runoff enters the device through inlet grates along the top of the structure into the sedimentation chamber. Runoff is discharged from the sedimentation chamber through a weir into the filtration chamber. After passing though the filter bed, runoff is collected by a perforated pipe and gravel underdrain system. In a closed sand filter, runoff is collected in underground pipes and discharged to a drain, but water is not infiltrated into the groundwater. This method obtains the benefits of sand filtration without the potential groundwater contamination.

Studies show that properly designed, constructed, and maintained sand filters are considered one of the more effective BMPs at managing the following:

- Fecal coliform
- Oxygen-demanding substances
- Sediment
- TSS

A sand filter also can aid in reducing the following pollutants:

- Nutrients (TN, total Kjeldahl nitrogen [TKN], and TP)
- Trace metals including lead, zinc, and copper
- Hydrocarbons

Additionally, sand filters need the following maintenance:

- In areas where heavy hydrocarbon loadings may be expected, the top 2 to 3 inches of sand or overlying layers of geotextile and top soil must be replaced every 3 to 5 years. The removed material must be tested for proper disposal.
- Remove sediment from the sedimentation chamber when it accumulates to a depth of more than 6 inches.
- Vegetation in the sedimentation chamber of open sand or organic filters should be mowed. Vegetation in the sedimentation chamber of a closed sand filter should be removed.

Figure 4-19 shows a plan view and a cross-section of an open sand filter.

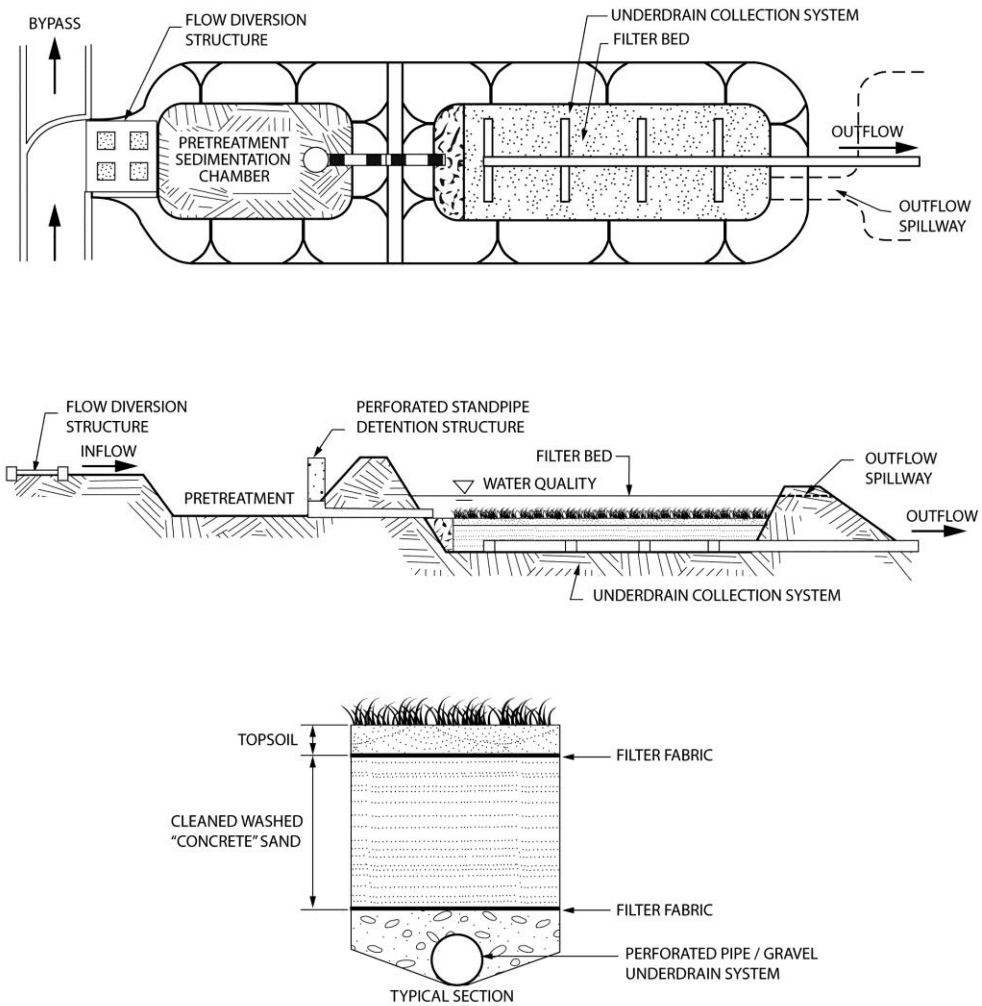


FIGURE 4-19
Typical (Open) Sand Filter
Source: Stormwater Manager's Resource Center (2004)

4.4.9.2 General Design Considerations

The following criteria should be considered when designing sand filters.

General Feasibility.

- Suitable for Residential Subdivision Usage–NO
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- **Drainage Area–**10 acres maximum for surface sand filter; 2 acres maximum for perimeter sand filter.
- **Space Required–**Function of available head at a site.
- **Site Slope–**No more than a 6-percent slope across filter location.
- **Minimum Head–**5 feet of elevation difference needed at a site from the inflow to the outflow.
- **Minimum Depth to Water Table–**For a surface sand filter with exfiltration (earthen structure), 2 feet are required between the bottom of the sand filter and the elevation of the seasonally high water table.
- **Soils–**No restrictions; Group "A" soils generally required to allow exfiltration (for surface sand filter earthen structure).

Other Constraints/Considerations.

- **Aquifer Protection–**Do not allow exfiltration of filtered hot spot runoff into groundwater.

4.4.9.3 Advantages

- Highly effective at filtering TSS.
- Can filter flows from moderate to large areas.
- Larger units can attenuate runoff peaks, particularly if the design storm is not large (less than 10-year return period).
- Underground closed filters are useful where space is limited.
- Perimeter closed filters are useful for small sites that have flat terrain or a high water table.

4.4.9.4 Disadvantages

- Need to integrate trash screens or grated inlets in all designs so materials that can cause premature failures are kept out of filter chambers. Frequent cleaning of these screens may be required. Clogging of the sand filter materials can limit the life span of the BMP.
- If anoxic conditions develop in the sand filter, phosphorus levels can increase as water passes through the sand filter.
- May not be effective in controlling peak discharges.

- Large sand filters without grass cover may not be attractive in residential areas.
- When used in some settings, trash accumulation on the surface of sand filters can be unattractive.

4.4.9.5 Design Procedure

Step 1. Compute runoff control volumes

- Calculate the WQv for the drainage area using the City's Site Development Review Tool.

Step 2. Determine if the development site and conditions are appropriate for the use of a sand filter

- Refer to the site selection criteria listed in Section 4.6 of this Manual.

Step 3. Size flow diversion structure, if needed

- A flow regulator (or flow splitter diversion structure) should be supplied to divert the WQ_v to the sand filter facility.
- Size the low-flow orifice, weir, or other device to pass the Q_{wq}.

Step 4. Size filtration basin chamber

- The filter area is sized using the following equation (based on Darcy's Law):

$$A_f = (WQ_v)\,(d_f) \,/\, [(k)\,(h_f + d_f)\,(t_f)]$$

where: **A_f =** surface area of filter bed (ft^2)
d_f = filter bed depth (typically 18 inches, no more than 24 inches)
k = coefficient of permeability of filter media (ft/day) (use 3.5 ft/day for sand)
h_f = average height of water above filter bed (ft) (1/2 h_{max}, which varies based on site but h_{max} is typically ≤ 6 feet)
t_f = design filter bed drain time (days) (1.67 days or 40 hours is recommended maximum)

- Set the preliminary dimensions of the filtration basin chamber.

Step 5. Determine the physical specifications and geometry

Surface or Open Sand Filter

- The entire treatment system (including the sedimentation chamber) must temporarily hold at least 75 percent of the WQv prior to filtration. Figure 4-20 illustrates the distribution of the treatment volume (0.75 WQv) among the various components of the surface sand filter, including the following:
  - Vs–volume within the sedimentation basin
  - Vf–volume within the voids in the filter bed
  - Vf-temp–temporary volume stored above the filter bed
  - As–the surface area of the sedimentation basin
  - Af–surface area of the filter media
  - hs–height of water in the sedimentation basin

  - hf–average height of water above the filter media
  - df–depth of filter media

- The sedimentation chamber must be sized to at least 25 percent of the computed WQv and have a length-to-width ratio of at least 2:1. Inlet and outlet structures should be located at opposite ends of the chamber.
- The filter area is sized based on the principles of Darcy's Law. A coefficient of permeability (k) of 3.5 ft/day for sand should be used. The filter bed typically is designed to completely drain in 40 hours or less.

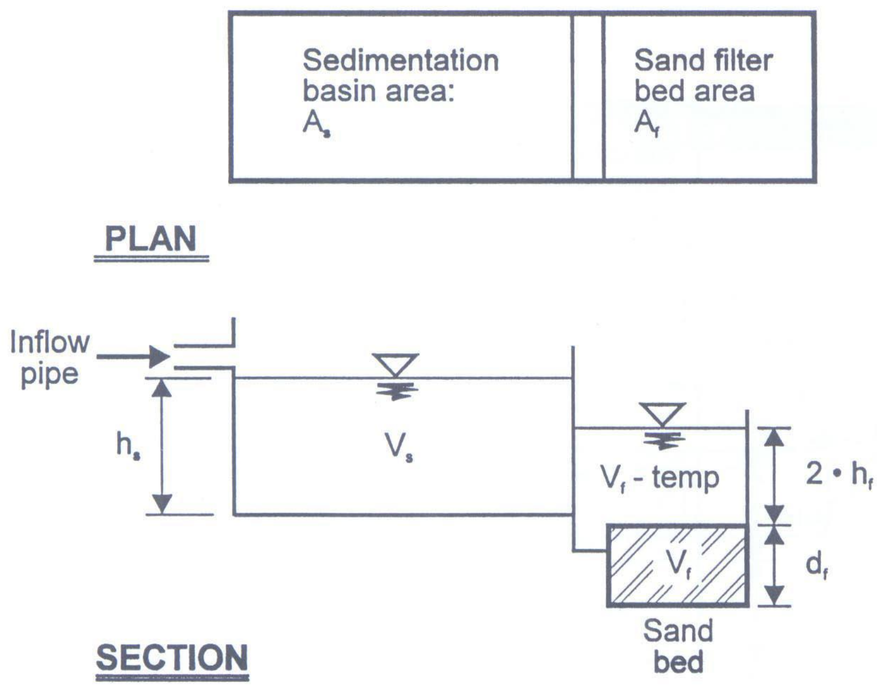


FIGURE 4-20
Surface or Open Sand Filter Volumes
Source: Claytor and Schueler (1996)

- The filter media consists of an 18-inch layer of clean washed medium sand (meeting ASTM C-33 concrete sand or ALDOT Fine Aggregate Size No. 10) on top of the underdrain system. Three inches of topsoil are placed over the sand bed. Permeable filter fabric is placed both above and below the sand bed to prevent clogging of the sand filter and the underdrain system.
- The filter bed is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) underdrain in a gravel layer. The underdrain must have a minimum grade of 1/8-inch per foot (1-percent slope). Holes should be 3/8-inch diameter and spaced approximately 6 inches on center. Gravel should be clean washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches, with a void

space of about 40 percent (ALDOT No. 3 Stone). Aggregate contaminated with soil shall not be used.

- The surface sand filter may be constructed of impermeable media such as concrete, or through the use of excavations and earthen embankments. When constructed with earthen walls and embankments, filter fabric should be used to line the bottom and side slopes of the structures before the installation of the underdrain system and filter media.

Perimeter or Closed Sand Filter

- The entire treatment system (including the sedimentation chamber) must temporarily hold at least 75 percent of the WQv prior to filtration. Figure 4-21 illustrates the distribution of the treatment volume (0.75 WQv) among the various components of the perimeter sand filter, including the following:
  - Vw–wet pool volume within the sedimentation basin
  - Vf–volume within the voids in the filter bed
  - Vtemp–temporary volume stored above the filter bed
  - As–the surface area of the sedimentation basin
  - Af–surface area of the filter media
  - hf–average height of water above the filter media (1/2 htemp)
  - df–depth of filter media

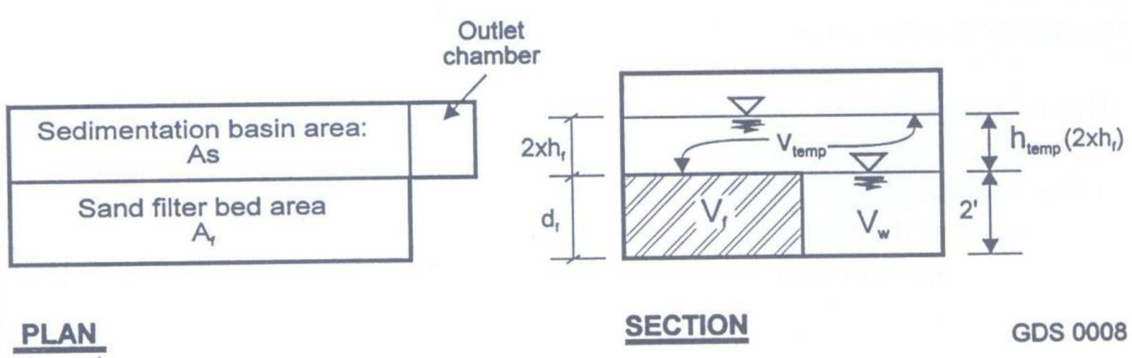


FIGURE 4-21
Perimeter or Closed Sand Filter Volumes
Source: Claytor and Schueler (1996)

- The sedimentation chamber must be sized to at least 50 percent of the computed WQv.
- The filter area is sized based on the principles of Darcy's Law. A coefficient of permeability (k) of 3.5 ft/day for sand should be used. The filter bed typically is designed to completely drain in 40 hours or less.
- The filter media should consist of a 12- to 18-inch layer of clean washed medium sand (meeting ASTM C-33 concrete sand or ALDOT Fine Aggregate Size No. 10) on top of the underdrain system. Figure 4-22 illustrates a typical media cross section.

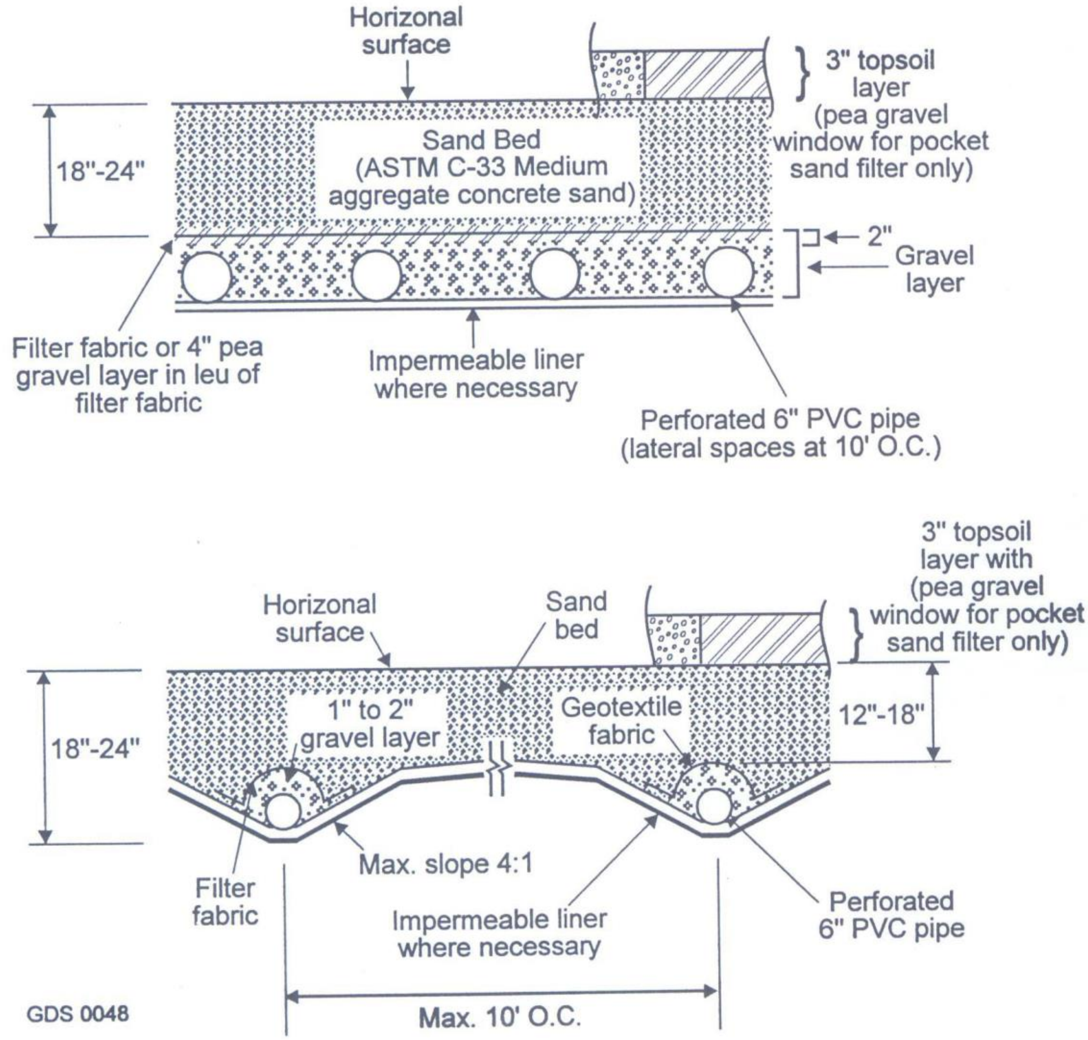


FIGURE 4-22
Typical Sand Filter Media Cross Sections
Source: Claytor and Schueler (1996)

- The perimeter sand filter is equipped with a 4-inch perforated PVC pipe (AASHTO M 252) underdrain in a gravel layer. The underdrain must have a minimum grade of 1/8 inch per foot (1-percent slope). Holes should be 3/8-inch diameter and spaced approximately 6 inches on center. A permeable filter fabric should be placed between the gravel layer and the filter media. Gravel should be clean washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches, with a void space of about 40 percent (ALDOT No.3 Stone). Aggregate contaminated with soil shall not be used.

Step 6. Size sedimentation chamber

Surface or Open Sand Filter

- The sedimentation chamber should be sized to at least 25 percent of the computed WQv and have a length-to-width ratio of 2:1. The Camp-Hazen equation is used to compute the required surface area:

$$A_s = -(Q_o/w) * Ln(1-E)$$

where: A_s = sedimentation basin surface area (ft^2)
Q_o = rate of outflow = the WQv over a 24-hour period
w = particle settling velocity (fps)
E = trap efficiency

Assuming:

- 90-percent sediment trap efficiency (0.9)
- Particle settling velocity (feet per second [ft/sec]) = 0.0033 ft/sec for imperviousness < 75%
- Particle settling velocity (ft/sec) = 0.0004 ft/sec for imperviousness ≥ 75%
- Average of 24-hour holding period

Then:

A_s = (0.066) (WQv) ft^2 for I < 75%
A_s = (0.0081) (WQv) ft^2 for I ≥ 75%

- Set the preliminary dimensions of the sedimentation chamber.

Perimeter or Closed Sand Filter

- The sedimentation chamber should be sized to at least 50 percent of the computed WQv. Use same approach as for the surface sand filter.

Step 7. Compute minimum volume (V_{min})

$$V_{min} = 0.75 * WQv$$

Step 8. Compute storage volumes within entire facility and sedimentation chamber orifice size

$$V_{min} = 0.75\ WQv = V_s + V_f + V_{f\text{-}temp}$$

- Compute V_f = water volume within filter bed/gravel/pipe = $A_f * d_f * n$
  Where: n = porosity = 0.4 for most applications

- Compute $V_{f\text{-}temp}$ = temporary storage volume above the filter bed = $2 * h_f * A_f$

- Compute V_s = volume within sediment chamber = $V_{min} - V_f - V_{f\text{-}temp}$

- Compute h_s = height in sedimentation chamber = V_s/A_s

- Ensure that h_s and h_f fit available head and other dimensions still fit–change as necessary in the design iterations until all site dimensions fit.

- Size the orifice from the sediment chamber to the filter chamber to release V_s within 24 hours at an average release rate with 0.5 h_s as the average head.
- Design the outlet structure with perforations allowing for a safety factor of 10 (see example).
- Size the distribution chamber to spread flow over the filtration media–level spreader weir or orifices.

Step 9. Design inlets, pretreatment facilities, underdrain system, and outlet structures

Inlets and Pretreatment

- Pretreatment of runoff in a sand filter system is provided by the sedimentation chamber.
- Inlets to surface sand filters are to be provided with energy dissipators. Exit velocities from the sedimentation chamber must be non-erosive.
- Figure 4-23 shows a typical inlet pipe from the sedimentation basin to the filter media basin for the surface sand filter.

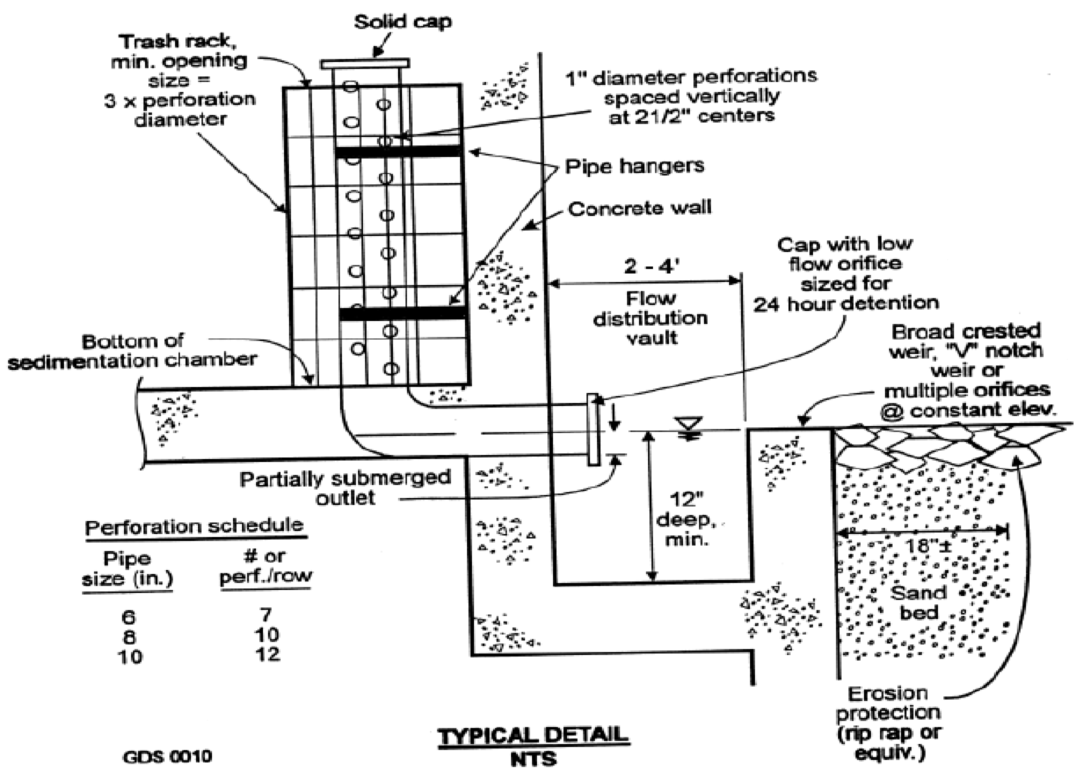


FIGURE 4-23
Detail for a Surface Sand Filter Perforated Standpipe
Source: GSMM (2001)

Underdrain System

- The filter bed is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) underdrain in a gravel layer. The underdrain must have a minimum grade of 1/8-inch per foot (1-percent slope). Holes should be 3/8-inch diameter and spaced approximately 6 inches on center. Gravel should be clean washed aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches, with a void space of about 40 percent. Aggregate contaminated with soil shall not be used.

Outlet Structures

- Outlet pipe is to be provided from the underdrain system to the facility discharge. Because of the slow rate of filtration, outlet protection generally is unnecessary (except for emergency overflows and spillways).

Step 10. Compute overflow weir sizes

- Size overflow weir at elevation h_s in sedimentation chamber (above perforated stand pipe) to handle the surcharge of flow through the filter system from a 25-year storm.
- Plan inlet protection for overflow from the sedimentation chamber and size the overflow weir at elevation h_f in the filtration chamber (above the perforated stand pipe) to handle the surcharge of flow through the filter system from a 25-year storm.

4.4.9.6 Design Example

The following example focuses on the design of a sand filter to meet the water quality treatment requirements of the site. Channel protection and overbank flood control are not addressed in this example other than the quantification of preliminary storage volume and peak discharge requirements. In general, the primary function of sand filters is to provide water quality treatment, but not large storm attenuation. As such, flows in excess of the WQv typically are routed to bypass the facility. Where quantity control is required, the bypassed flows can be routed to conventional detention basins (or some other facility such as underground storage vaults). The layout of the Community Center is shown in Figure 4-24.

Base Data

Site Area = Total Drainage Area (A) = 3.0 ac
Impervious Area = 1.9 ac; or I =1.9/3.0 = 63.3% Soils Type “C”

Hydrologic Data

Pre Project CN = 57; Post Project CN = 88
Pre Project t_c = 0.39; Post Project t_c = 0.2

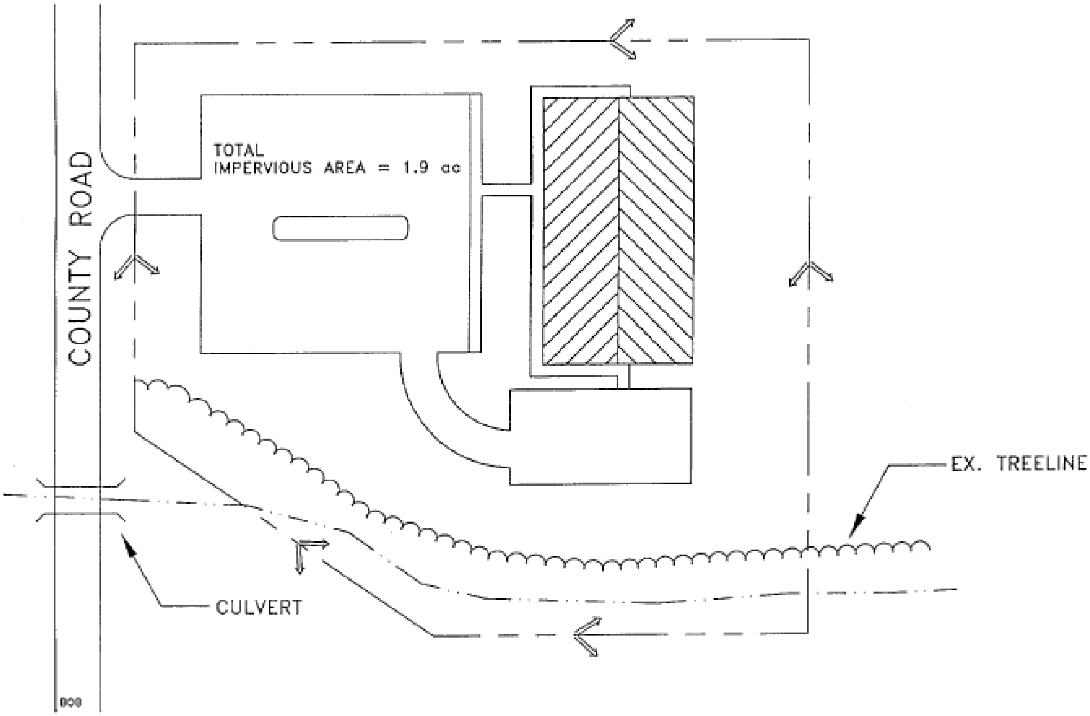


FIGURE 4-24
Sand Filter Example Site Plan
Source: GSMM (2001)

Step 1. Compute runoff control volumes

Water Quality Volume
On the basis of the site data listed above, the calculated WQv for the sand filter is 0.186 ac-ft.

Stream Channel Protection Volume (Cpv)
For stream channel protection, provide 24 hours of ED for the 1-year event:

Condition	CN	$Q_{1\text{-year}}$ *Inches*	$Q_{1\text{-year}}$ *cfs*	$Q_{25\text{-year}}$ *cfs*	$Q_{100\text{-year}}$ *cfs*
Pre-developed	57	0.5	0.6	6.0	9.0
Post-Developed	83	1.9	5.5	17.0	22.0

- Use a modified TR-55 approach to compute the Cpv Initial abstraction (Ia) for a CN of 83 is 0.41: (TR-55) [Ia = (200/CN - 2)]:

  Ia/P = (0.41)/ 3.6 inches = 0.11
  t_c = 0.15 hours
  From TR-55 (NRCS, 1986): qu = 590 csm/in

Knowing qu and T (ED time), find qo/qi for a Type II rainfall distribution:

Peak outflow discharge/peak inflow discharge (qo/qi) = 0.03

Vs/Vr = 0.683 - 1.43(qo/qi) +1.64(qo/qi) 2 - 0.804(qo/qi) 3

Where Vs equals the Cpv and Vr equals the volume of runoff in inches:

Vs/Vr = 0.64

Therefore, Vs = Cpv = 0.64(1.9")(1/12)(3 ac) = 0.30 ac-ft = 13,068 ft3

- Define the average ED Release Rate:

  The above volume, 0.30 ac-ft, is to be released over 24 hours.

  (0.30 ac-ft × 43,560 ft2/ac) / (24 hrs × 3,600 sec/hr) = 0.15 cfs

Overbank Flood Protection Volume (Qp25):

For a Qin of 17 cfs and an allowable Qout of 6 cfs, the Vs necessary for 25-year control is 0.52 ac-ft or 22,677 ft^3, under a developed CN of 83. Note that 7.9 inches of rain fall during this event, with 5.9 inches of runoff.

Safe Passage of 100-year Design Storm:

At final design, prove that the discharge conveyance channel is adequate to convey the 100-year event and discharge to receiving waters, or handle it with a peak flow control structure, typically the same one used for the overbank flood protection control. The stream Cpv should be calculated using TR-55 (USDA, 1986).

Symbol	Control Volume	Volume Required (cubic feet)	Notes
WQv	Water Quality	8,102	
Cpv	Channel Protection	13,068	
Qp25	Overbank Flood Protection	22,677	
Qf	Extreme Flood Protection	NA	Provide safe passage for the 100-year event in the final design.

<u>Step 2. Determine if the development site and conditions are appropriate for the use of a sand filter</u>

Site-specific Data:

The existing ground elevation at the facility location is 22 feet, mean sea level. Soil boring observations reveal that the seasonally high water table is at 13 feet and the underlying soil is silt loam (ML). The adjacent creek invert is at 12 feet.

Step 3. Compute WQv peak discharge (Qwq) and Head

Water Quality Volume:

The WQv previously was determined to be 8,102 ft^3.

Determine available head (Figure 4-25)

The low point at the parking lot is 23.5 feet. Subtract 2 feet to pass the Q25 discharge (21.5) and a half foot for the channel to the facility (21.0). The low point at the stream invert is 12. Set the outfall underdrain pipe 2 feet above the stream invert and add 0.5 feet to this value for the drain (14.5). Add to this value 8 inches for the gravel blanket over the underdrains and 18 inches for the sand bed (16.67). The total available head is 21.0 - 16.67, or 4.33 feet. Therefore, the average depth, hf, is (hf) = 4.33 feet/2, and hf = 2.17 feet.

The peak rate of discharge for the water quality design storm is needed for the sizing of offline diversion structures, such as sand filters and grass channels. Conventional SCS methods have been found to underestimate the volume and rate of runoff for rainfall events of less than 2 inches. This discrepancy in estimating runoff and discharge rates can lead to situations where a significant amount of runoff bypasses the filtering treatment practice because of an inadequately sized diversion structure and leads to the design of undersized bypass channels.

The following procedure can be used to estimate peak discharges for small storm events. It relies on the volume of runoff computed using the Small Storm Hydrology Method (Pitt, 1994) and uses the NRCS, TR-55 Graphical Peak Discharge Method (USDA, 1986). A brief description of the calculation procedure is presented below.

- Using the WQv, a corresponding CN is computed using the following equation:

$$CN = 1000/[10 + 5P + 10Q - 10(Q^2 + 1.25\ QP)^{1/2}]$$

  where P = rainfall, in inches (use 1.2 inches for the water quality storm)
  and Q = runoff volume, in inches (equal to WQV ÷ area)

- Once a CN is computed, the t_c is computed
- Using the computed CN, t_c and drainage area (A), in acres; the peak discharge (Qwq) for the water quality storm is computed.
  - Read initial abstraction (Ia) and compute Ia/P
  - Read the unit peak discharge (qu) for appropriate t_c

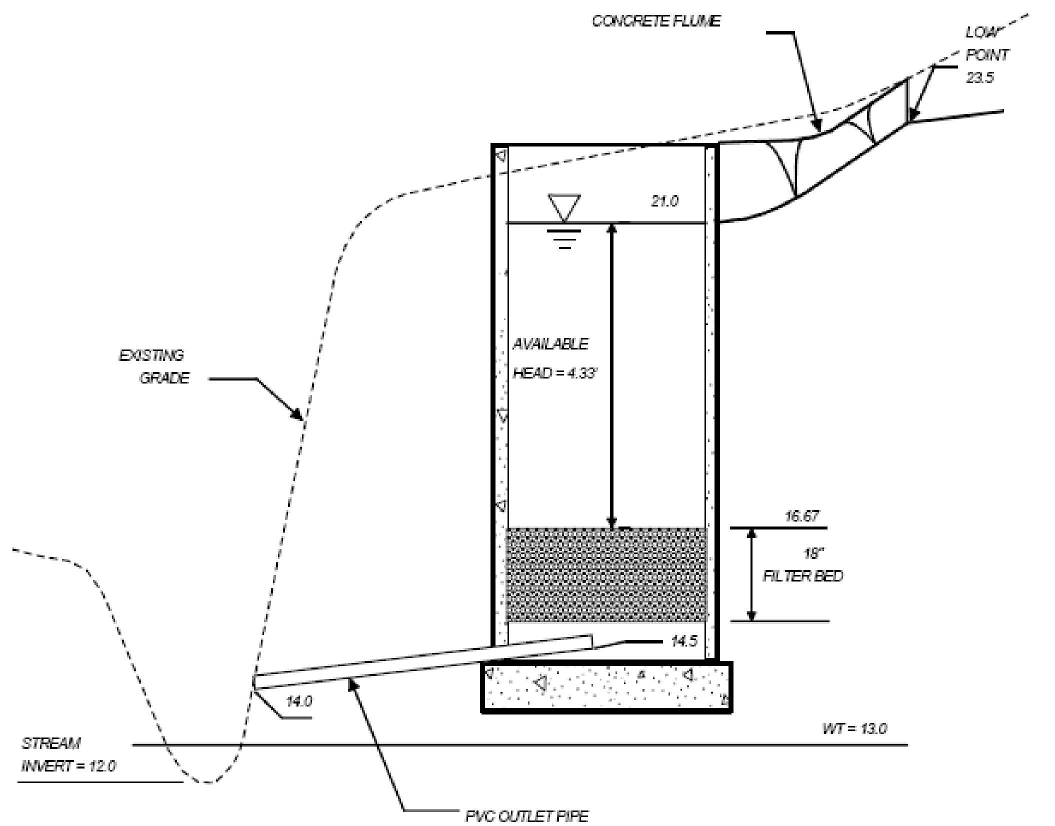


FIGURE 4-25
Head Diagram
Source: GSMM (2001)

- Using the WQv, compute the water quality Qwq:

Qwq = qu*A*WQV

where Qwq = the peak discharge, in cfs
qu = the unit peak discharge, in cfs/mi²/inch
A = drainage area, in square miles
WQv = Water Quality Volume, in watershed inches

For this example, the steps are as follows:

Compute a modified CN for 1.2 inches of rainfall

P = 1.2"
Q = WQv ÷ area = (8,102 ft3 ÷ 3 ac ÷ 43,560 ft2/ac × 12 in/ft) = 0.74"
CN = 1000/[10+5P+10Q-10(Q2+1.25*Q*P)½]
= 1000/[10+5*1.2+10*0.74-10(0.742+1.25*0.74*1.2)½]
= 95.01

Use CN = 95

For CN = 95 and the t_c = 0.15 hours, compute the Qp for a 1.2-inch storm. With the CN = 95, a 1.2-inch storm will produce 0.74 inches of runoff. Ia = 0.105; therefore, Ia/P = 0.105/1.2 = 0.088. From Section 2.1, qu = 625 csm/in, and therefore, Qwq = (625 csm/in) (3.0 ac/640ac/sq mi.) (0.74") = 2.2 cfs.

Step 4. Size flow diversion structure (see Figure 4-26):

Size a low-flow orifice to pass 2.2 cfs with 1.5 feet of head using the Orifice equation:

$Q = CA(2gh)^{1/2}$; 2.2 cfs = (0.6) (A) [(2) (32.2 ft/s^2) (1.5')]$^{1/2}$

A = 0.37 sq ft = $\pi d^2/4$: d = 0.7' or 8.5"; use 9 inches

Size the 25-year overflow as follows: the 25-year water surface elevation is set at 923. Use a concrete weir to pass the 25-year flow (17 cfs) into a grassed overflow channel using the Weir equation. Assume 2 feet of head to pass this event. Overflow channel should be designed to provide sufficient energy dissipation (e.g., rip-rap, plunge pool, etc.) so that there will be non-erosive velocities:

$Q = CLH^{3/2}$
17 = 3.1 (L) (2')$^{1.5}$
L = 1.94'; use L = 2'-0" which sets flow diversion chamber dimension.

Weir wall elev. = 21.0. Set the low flow invert at:
21.0 - [1.5' + (0.5*9"*1ft/12")] = 19.13.

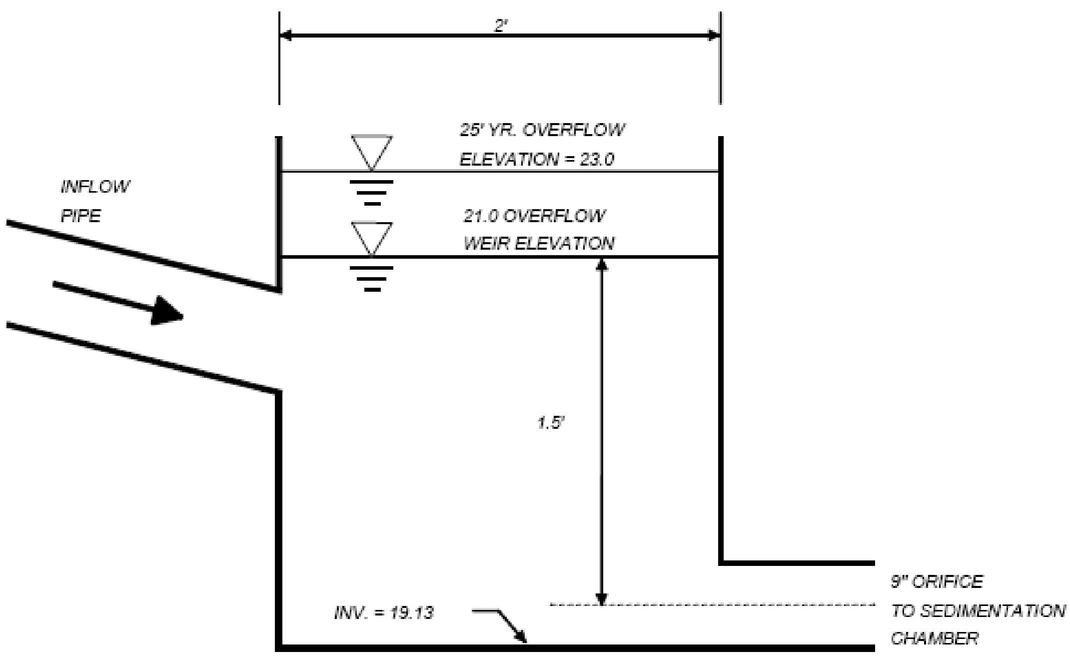


FIGURE 4-26
Flow Diversion Structure
Source: GSMM (2001)

Step 5. Size filtration bed chamber

From Darcy's Law:

Af = WQv (df) / [k (hf + df) (tf)]

where: df = 18"
k = 3.5 ft/day
hf = 2.17'
tf = 40 hours

Af = (8,102 cubic feet) (1.5') / [3.5 (2.17' + 1.5') (40hr/24hr/day)]
Af = 567.7 sq ft; using a 2:1 ratio, say filter is 17' by 34' (= 578 sq ft)

Step 6. Size sedimentation chamber

From the Camp-Hazen equation, for I < 75%: As = 0.066 (WQv)

As = 0.066 (8,102 cubic ft) or 535 sq ft

given a width of 17 feet, the length will be 535 feet/17 feet or 31.5 feet (use 17' x 32')

Step 7. Compute Vmin

Vmin = ¾(WQv) or 0.75 (8,102 cubic feet) = 6,077 cubic feet

Step 8. Compute storage volumes within entire facility and sedimentation chamber orifice size (see Figure 4-27)

Volume within filter bed (Vf):

Vf = Af (df) (n); n = 0.4 for sand
Vf = (578 sq ft) (1.5') (0.4) = 347 cubic feet

Temporary storage above filter bed (Vf-temp):

Vf-temp = 2hfAf
Vf-temp = 2 (2.17') (578 sq ft) = 2,509 cubic feet

Compute the remaining volume for the sedimentation chamber (Vs):

Vs = Vmin - [Vf + Vf-temp] or 6,077 - [347 + 2,509] = 3,221 cubic feet

Compute height in the sedimentation chamber (hs):

hs = Vs/As
(3,221 cubic ft)/(17' x 32') = 5.9'

The height is larger than the head available (4.33 feet); modify the size of the settling chamber, using 4.33 feet as the design height:

(3,221 cubic ft)/4.33' = 744 sq ft; 744'/17' yields a length of 43.8 feet (say 44')

The new sedimentation chamber dimensions are 17 feet by 44 feet.

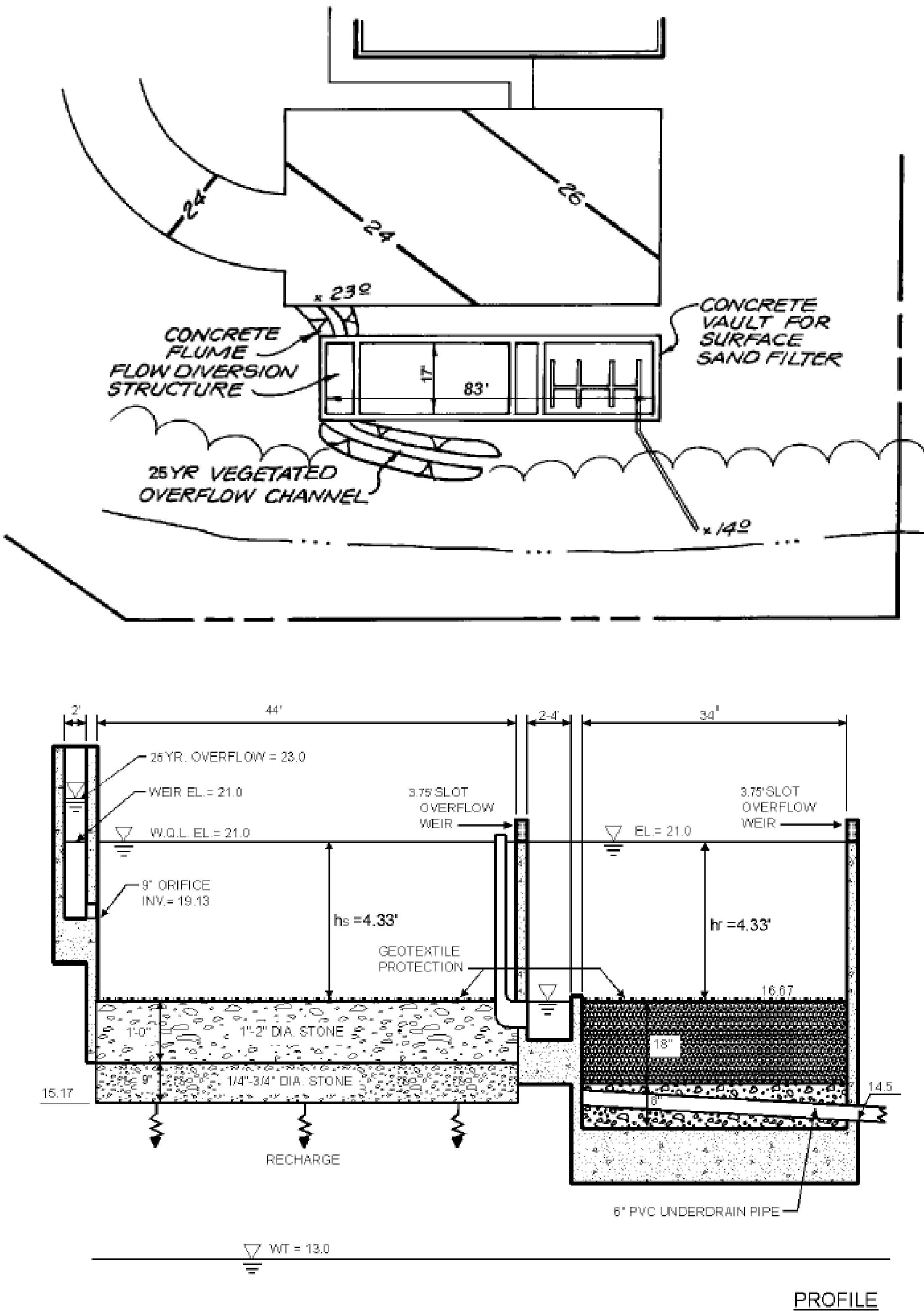


FIGURE 4-27
Sand Filter Site Plan View and Profile
Source: GSMM (2001)

With adequate preparation of the bottom of the settling chamber (rototil earth, place gravel, then surge stone), the bottom can infiltrate water into the substrate. The runoff will enter the groundwater directly without treatment. The stone will eventually clog without protection from settling solids, so use a removable geotextile to facilitate maintenance. Note that there are 2.17 feet of freeboard between the bottom of the recharge filter and the water table.

Provide a perforated standpipe with an orifice sized to release volume (within sedimentation basin) over a 24-hour period (see Figure 4-23). The average release rate equals 3,221 ft^3/24 hr = 0.04 cfs.

The equivalent orifice size can be calculated using the orifice equation:

$Q = CA(2gh)^{1/2}$, where h is average head, or 4.33'/2 = 2.17'
0.04 cfs = 0.6*A*(2*32.2 ft/s2*2.17 ft)$^{1/2}$
A = 0.005 $ft^2 = \pi D^2/4$: therefore, equivalent orifice diameter equals 1"

The recommended design is to cap the stand pipe with a low-flow orifice sized for a 24-hour detention. Overperforate the pipe by a safety factor of 10 to account for clogging. Note that the size and number of perforations will depend on the release rate needed to achieve 24-hour detention. A multiple orifice stage-discharge relation needs to be developed for the proposed perforation configuration. The stand pipe should discharge into a flow distribution chamber prior to the filter bed. The distribution chamber should be between 2 and 4 feet in length and the same width as the filter bed. Flow distribution to the filter bed can be achieved either with a weir or with multiple orifices at a constant elevation. See Figure 4-23 for the stand pipe details.

Step 9. Design inlets, pretreatment facilities, underdrain system, and outlet structures

Step 10. Compute overflow weir sizes

Assume the overflow that needs to be handled is equivalent to the 9-inch orifice discharge under a head of 3.5 feet (i.e., the head in the diversion chamber associated with the 25-year peak discharge).

$Q = CA(2gh)^{½}$
Q = 0.6(0.44 ft2)[(2)(32.2 ft/s2)(3.5 ft)]$^{1/2}$
Q = 3.96 cfs, say 4.0 cfs

For the overflow from the sediment chamber to the filter bed, size to pass 4 cfs.

Weir equation:

$Q = CLh^{3/2}$, assume a maximum allowable head of 0.5'

4.0 = 3.1 * L * (0.5 ft) $^{3/2}$
L = 3.65 ft, Use L = 3.75 ft.

Similarly, for the overflow from the filtration chamber to the outlet of the facility, size to pass 4 cfs.

Weir equation:

$Q = CLh^{3/2}$, assume a maximum allowable head of 0.5’

$4.0 = 3.1 * L * (0.5\ ft)^{3/2}$
$L = 3.65$ ft, Use $L = 3.75$ ft.

Adequate outlet protection and energy dissipation (e.g., rip-rap, plunge pool, etc.) should be provided for the downstream overflow channel.

4.4.9.7 Monitoring and Maintenance

- Sand filters should be inspected at least once per year after a storm event to ascertain whether the infiltration capacity of the filter is decreasing due to clogging of the top layer. This layer may be removed in such cases to restore the infiltration rate.

Sand filters must be maintained as needed to ensure the design capacity. Typical maintenance activities include the following:

- Remove visible surface sediment accumulation.
- Remove trash, debris, and leaf litter.
- Remove a layer of sand if decreased infiltration capacity is observed.

4.4.10 Filter Strip (also known as Grass Filter Strip and Buffer Strip)

4.4.10.1 Description and Benefits

A filter strip is a linear section of land, either forested or vegetated with turf grasses or other plants, that forms a boundary (with uniform mild slopes) along the perimeter of a waterbody, another BMP, or areas that need to be protected from upgradient development.

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 50 percent
- Nutrients (TP/TN) ~ 20/20 percent
- Metals ~ 40 percent

Any natural vegetated form, from grassy meadow to small forest, may be adapted for use as a filter strip (Figure 4-28). The vegetation, however, must have dense foliage and thick root mat to be effective. Filter strips are designed to accept runoff from overland sheet flow from upgradient development. The strips trap sediment and sediment-bound pollutants. Because they “disconnect” impervious surfaces from storm sewers and lined channels, filter strips reduce the effective imperviousness and help reduce peak discharge rates by increasing travel time and by increasing abstractions from the total flow. Filter strips often are designed with level spreaders, which are excavated depressions constructed at zero grade to allow for the discharge of concentrated runoff during heavier stormwater flows.

Filter strips typically include some method of spreading the runoff as sheet flow. If planted with grass, filter strips are sometimes called “grass filter strips.”

Filter strips can be effective in helping to manage the following:

- Sediment
- Organic material
- Metals

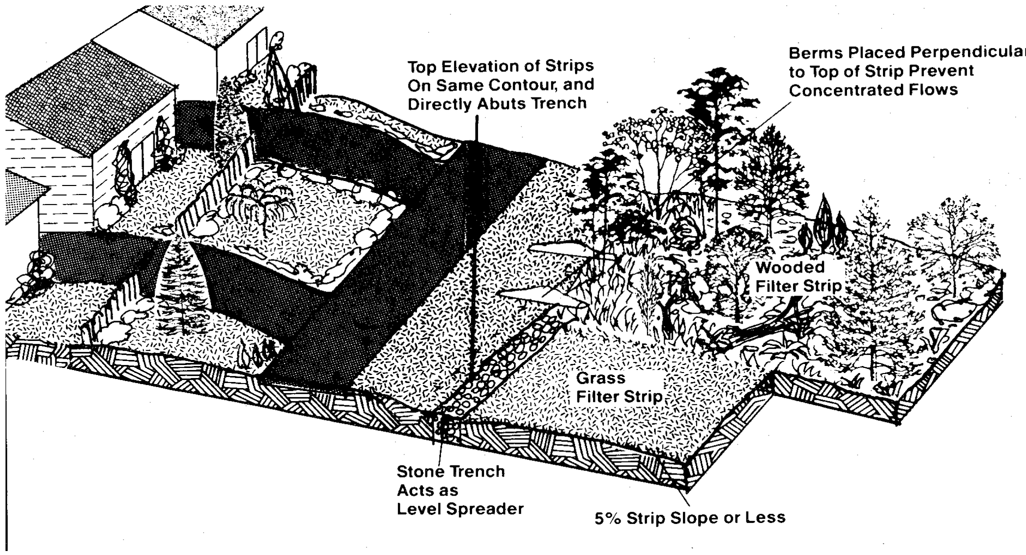


FIGURE 4-28
Filter Strip in Residential Area
Adapted from Schueler (1987)

4.4.10.2 General Design Considerations

The following criteria should be considered when designing filter strips.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–NO
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- Filter strips should be used to treat small drainage areas. Flow must enter the filter strip as sheet flow spread out over the width (long dimension normal to flow) of the strip, generally no deeper than 1 to 2 inches. As a rule, flow concentrates within a maximum of 75 feet for impervious surfaces and 150 feet for pervious surfaces (Center for Watershed Protection [CWP], 1996). For longer flow paths, special provision must be made to ensure that the design flows spread evenly across the filter strip.

- Filter strips should be designed for slopes between 2 and 6 percent. Greater slopes than this would encourage the formation of concentrated flow. Flatter slopes would encourage standing water.

- The filter strip should be at least 15 feet long to provide filtration and contact time for water quality treatment. A length of 25 feet is preferred (where available), although the length normally will be dictated by the design method.

- An effective flow spreader is to use a pea gravel diaphragm at the top of the slope (ASTM D 448 size No. 6, 1/8-inch to 3/8-inch). The pea gravel diaphragm (a small trench running along the top of the filter strip) serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the practice. Second, it acts as a level spreader, maintaining sheet flow as runoff flows over the filter strip. Other types of flow spreaders include a concrete sill, curb stops, or curb and gutter with "sawteeth" cut into it.

Other Constraints/Considerations.

- Pedestrian traffic across the filter strip should be limited through channeling onto sidewalks.
- Filter strips should not be used on soils that cannot sustain a dense grass cover with high retardance. Designers should choose a grass that can withstand relatively high velocity flows at the entrances, and during both wet and dry periods.

4.4.10.3 Advantages

- Can reduce particulate pollutants such as sediment, organic matter, and trace metals.
- Slow down the water and promote infiltration.
- Can be implemented as part of landscaping requirements.
- Mesh well in residential areas where they provide open space for recreation, help maintain riparian zones, and reduce stream bank erosion.

4.4.10.4 Disadvantages

- Not designed for high-velocity flows, so generally not applicable in large areas with intense development or steep slopes.
- Need sheet flow to operate effectively; may be difficult to avoid flow concentration, which may lead to gullies.
- Do not provide enough runoff storage or infiltration to significantly reduce peak discharges or volume of storm runoff, so function only as one component in a stormwater management system.

4.4.10.5 Design Procedures

Step 1: Compile contributing drainage area parameters

- Determine minimum filter strip size using Table 4-2.
- Calculate the contributing drainage area (A).
- Calculate the impervious percentage (I).
- Calculate the lope (S).
- Estimate Manning's "n" value (n).

Step 2: Calculate maximum discharge loading per foot of filter strip width

$$q = \frac{0.00236}{n} Y^{\frac{5}{3}} S^{\frac{1}{2}}$$

Where:

q = discharge per foot of width of filter strip (cfs/ft)

Y = allowable depth of flow (inches)

S = slope of filter strip (%)

n = Manning's "n" roughness coefficient. (use 0.15 for medium grass, 0.25 for dense grass, and 0.35 for very dense Bermuda-type grass)

Step 3. Compute runoff control volumes using the City's Site Review Tool

- Compute WQv using the City's Site Development Review Tool.

Step 4: Compute the water quality peak flow

- Compute the peak discharge for the water quality storm (Q_{wv}) based on 1.2 inches of rainfall for Auburn, assuming a 24-hour storm duration.

Step 5: Compute the minimum width of the filter strip

- $W_{fmin}= Q_{wv}/q$

4.4.10.6 Design Example

Step 1: Compile contributing drainage area parameters

Basic Data:

Small commercial lot 150 feet deep x 100 feet wide located in Auburn
Drainage area (A) = 0.34 acre
Impervious percentage (I) = 70 percent
Slope equals 4 percent, Manning's n = 0.25
CN = 96
t_c = 8 minutes (0.13 hour)

Step 2: Calculate maximum discharge loading per foot of filter strip width

- Calculate the maximum discharge loading per foot of filter strip width:

  q = 0.00236/0.25 * (1.0)5/3 * (4)1/2 = 0.019 cfs/ft

Step 3. Compute runoff control volumes using the City's Site Review Tool

- On the basis of the City's Site Review Tool, the WQv in inches for this example is 0.023 ac-ft.

Step 4: Compute the water quality peak flow

- Assuming that the t_c of the site is 0.34 hour, the peak flow for the water quality storm with a 24-hour, SCS Type II design storm calculated using TR-55 is 0.4 cfs.

<u>Step 5: Compute the minimum width of the filter strip</u>

- The minimum filter strip width is $W_{fmin} = Q_{wv}/q = 0.4$ cfs/0.019 cfs/ft = 21.05′ (say 21 feet)
- Because the width of the lot is 100 feet, the actual width of the filter strip will depend on the site grading and the ability to deliver the drainage to the filter strip in sheet flow through a pea gravel-filled trench.

4.4.10.7 Monitoring and Maintenance

During the first 1 or 2 years after construction, filter strips and level spreaders should be inspected for the proper distribution of flows and signs of erosion during and after major storm events. After the first 1 or 2 years, the strip may be inspected annually or biannually.

With minimal maintenance, filter strips can be effective indefinitely. Strips that are not maintained properly, however, may quickly become nonfunctional (Schueler et al., 1992). Maintenance involves routine activities such as mowing, trimming, and replanting when necessary. Strips that are used for sediment removal may require periodic regrading and reseeding of their upslope edges because deposited sediment can kill grass and change the elevation of the edge such that the stormwater no longer flows through the strip in thin sheets. Maintenance requirements are as follows:

- At least annually, remove deposited sediment, especially from the upstream edge, to maintain original contours and grading.
- Repair gullies and rills that form and regrade the filter strip to ensure that the runoff flows evenly in a thin sheet over the filter strip.
- Repair any level spreaders, if necessary, to prevent the formation of channels in the filter strip.
- Reseed and regrade the filter strip to maintain a dense growth of vegetation, especially if the strip has been used for sediment control (Schueler et al., 1992).
- Mow filter strips vegetated with grasses and harvest the clippings two to three times a year to promote the growth of thick vegetation with optimum pollutant removal efficiency. Forested filter strips do not require this type of maintenance.
- Keep the filter strip free of litter.
- Evaluate the runoff from adjacent areas to determine if it is providing enough water and nutrients or if additional irrigation and fertilizer are needed.
- Perform periodic aeration of the soil if excessive compaction is interfering with maintaining a good vegetative cover.
- Test the soil pH and compare it to the recommended pH for the specific vegetation. Add lime if indicated.

4.4.11 Manufactured BMP Systems (known as Oil-grit Separator; Oil-water Separator)

4.4.11.1 Description and Benefits

Estimated Pollutant Removal Efficiency Rates

- TSS ~ 40 percent
- Nutrients (TP/TN) ~ 5/ 5 percent

A manufactured BMP system is a custom-designed or proprietary device in which stormwater receives treatment before being discharged to another BMP or to a waterbody.

Manufactured BMP systems are designed to remove the following:

- Sediments
- Oil and grease (O&G)
- Other hydrocarbons
- Trash and debris
- Other floating substances from stormwater

A common application is in paved areas where motor vehicle fueling or maintenance is performed. These BMPs are flow-through devices with minimal storage capacity.

These technologies generally are proprietary designs sold by the manufacturer as prefabricated units. Some of these technologies include vortex separation, screening, adsorbent filter media, and baffling chambers. It is not possible to describe each of these technologies in detail because of the wide variation in configuration and applications. The performance of proprietary BMPs varies widely, and each system should be evaluated carefully to suit site conditions and treatment objectives. Some information regarding the performance of many types of proprietary BMPs can be found on the International Stormwater BMP Database at: (http://www.bmpdatabase.org/).

4.4.11.2 General Design Considerations

The following criteria should be considered when designing filter strips.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- Constraints vary based on the type of BMP used. Contact the vendor for additional details.

Other Constraints/Considerations.

- The location where the manufactured BMP is installed should be easily accessible for maintenance. Typically, these BMPs are installed close to roads or parking lots where a vacuum truck can access them.

4.4.11.3 Advantages

- Can be used effectively as part of a larger system of stormwater controls.
- Some designs can be tailored to a variety of removal scenarios by changing screen sizes and filter media.
- Especially useful in locations with space restrictions.
- Easily installed in most areas.
- Simple chambered designs can be fairly inexpensive.
- Underground location reduces visual impacts and limitations on site use.
- Can be distributed over a large drainage area in configurations that offer advantages over constructing a single large end-of-pipe structure, which can have space constraints.

4.4.11.4 Disadvantages

- Removal efficiencies are generally low for pollutants other than O&G, trash and debris, and relatively large sediment particles. The removal of suspended solids is highly dependent on the site-specific, particle-size distribution. Deviations from the distribution used in design have a direct impact on the removal efficiency.
- Require frequent cleanout of trapped pollutants to avoid resuspension and washout in subsequent storms. Some devices require frequent replacement of filter media cartridges.
- Clogging usually triggers flow-bypass mechanisms and often remains unnoticed, especially when inspections are not conducted according to the specified schedule.
- Odor problems may develop in some cases.
- Provisions must be made to handle the hazardous portion of wastes collected.
- Although infrequently used in the Auburn area, the salt used in deicing can cause density differentials in the collected water that affect the settling of particles.

4.4.11.5 Monitoring and Maintenance

Manufactured BMPs should be inspected regularly, initially after every storm and then at a reduced frequency as specified by the manufacturer and depending on the characteristics of the drainage area. Inspections should occur more frequently during the fall and after severe storms, when debris is likely to be present.

Manufactured BMPs should be cleaned frequently to remove sediment, accumulated O&G, floatables, and other pollutants. The manufacturer typically specifies the maintenance schedule, and many manufacturers require a maintenance contract when purchasing their products. Some of the wastes may be hazardous, so maintenance budgets must include funds for appropriate disposal.

4.4.11.6 Design Procedures

Proprietary BMP design is site specific and design support typically is provided by the manufacturer.

4.4.11.7 Design Example

Contact the Proprietary BMP manufacturer for the product of interest to verify that the selected BMP is appropriate for the proposed application and to request design examples.

4.4.12 Dry Extended Detention Basin

4.4.12.1 Description and Benefits

A dry ED basin is a permanent stormwater management facility that temporarily stores incoming stormwater, thus trapping suspended pollutants and reducing the frequency and severity of erosive runoff events.

> **Estimated Pollutant Removal Efficiency Rates**
>
> For dry ED basins, pollutant removal varies. These basins are designed to control peak flows, but also can provide limited pollutant removal benefits.

As the name of this BMP implies, these basins are typically dry between storm events (Figure 4-29). To qualify as a BMP, dry basins should incorporate the ED of runoff derived from small rainfall events.

In dry ED basins, a low-flow outlet slowly releases water retained below the primary outlet device over a period of days. This BMP can be applied in low-density residential, industrial, and commercial developments where sufficient space is available. The primary purpose of dry ED basins is to attenuate and delay stormwater runoff peaks for the following:

- Flood control
- Channel protection
- Moderate success at removing suspended solids and other pollutants, depending on the design

The outlet structure is what controls the discharge from the storage system. Simple outlets may be a circular riser, a rectangular grate, or open pipe. More complex inlets may consist of a series of items; for example, a grated inlet over a weir leading to an open pipe.

FIGURE 4-29
Dry Extended Detention Basin with Shallow Marsh

4.4.12.2 General Design Considerations

The following criteria should be considered when designing dry ED basins. Consult the City's Stormwater Management Manual for additional design considerations.

General Feasibility.

- Suitable for Residential Subdivision Usage–YES
- Suitable for High Density/Ultra Urban Areas–YES
- Regional Stormwater Control–NO

Physical Feasibility–Physical Constraints at Project Site.

- Applicable for drainage areas up to 75 acres.
- Vegetated embankments shall be less than 20 feet high and shall have side slopes no steeper than 2:1 (H:V) although 3:1 is preferred. Rip-rap-protected embankments shall be no steeper than 2:1. Geotechnical slope stability analysis is recommended for embankments greater than 10 feet high and is mandatory for embankment slopes steeper than those given above.
- The maximum depth of the basin should not exceed 10 feet.
- Areas above the normal high water elevations of the detention facility should be sloped toward the basin to allow drainage and to prevent standing water. Careful finish grading is required to avoid creating upland surface depressions that may retain runoff. The bottom area of storage facilities should be graded toward the outlet to prevent standing water conditions. A low-flow channel or pilot channel across the facility bottom from the inlet to the outlet (often constructed with rip-rap) is recommended to convey low flows and to prevent standing water conditions.

Other Constraints / Considerations.

- Adequate maintenance access must be provided for all dry ED basins..

4.4.12.3 Advantages

- Can effectively control peak runoff discharge rates from both small and large drainage areas, thereby reducing the potential for flooding and stream bank scour and erosion.
- Moderately effective at removing suspended solids and particulate matter.
- May allow for recreational and other open-space uses between storms.
- Present fewer hazards to the public than do wet basins because of the absence of a permanent pool of water.

4.4.12.4 Disadvantages

- Tends to develop a soggy bottom, which hinders facility maintenance and the growth of effective vegetative cover.
- Can be unsightly, especially if debris accumulates; appearance can be improved by planting hardy wildflowers in the bottom.
- Unless adequately drained, can be perceived as a nuisance and eyesore to residents because of standing water.
- Clogged outlets can cause overflow during large rainfall events and result in erosion and flooding in downstream areas.
- Poor or nonexistent maintenance of dry ED basins is a common problem throughout the City.
- Has limited effectiveness in removing dissolved substances.
- Can attract children and become a safety hazard. Fencing typically is considered unsightly.
- Sometimes requires large land areas, which can be expensive to maintain.

4.4.12.5 Monitoring and Maintenance

Section 7-5 of Chapter 7, Article I, of the City's Code specifies the following with respect to stormwater ponds:

(a) All existing and any future storm drain detention ponds approved by the city will have complete design data on file with the city engineer and will be subject to at least an annual inspection to ensure that they are functioning to their original design criteria. Specific items to be inspected and approved by the city engineer, or his designee, shall include, but not be limited to, the following: Vegetation cover, sediment, debris, fencing (if required), outlet structure and inlets.

(b) Any defects discovered by the city engineer during such inspection shall be furnished to the owner of the detention pond in writing and the owner shall have fifteen (15)

> *business days from the mailing of said notice to perform the maintenance and any corrective action specified by the city engineer. The city engineer may, at his discretion, allow the owner additional time as the city engineer deems appropriate for the corrective work.*

A dry ED basin should be inspected annually to verify that it is operating as designed and to schedule any required maintenance. If possible, inspections should occur during wet weather to verify that the facility is maintaining desirable retention times. In addition to regularly scheduled inspections, maintenance personnel should note deficiencies during any visits. One important purpose of inspections is to ascertain the operational condition and safety of the facility, particularly the condition of embankments, outlet structures, and other safety-related features.

The maintenance requirements for dry ED basins can be costly. Normal annual maintenance costs can be expected to range from 3 to 5 percent of construction costs (Schueler, 1987). Because the berms of dry ED basins typically are smaller than wet detention basins, however, maintenance costs for dry ED basins generally are less than those for wet detention basins.

An active program of preventive maintenance is required to ensure that the facility remains operational and safe. The following items should be part of the preventive maintenance procedures:

- Grass maintenance
- Control of noxious weeds and invasive plants
- Removal and disposal of trash and debris (at least twice annually)
- Removal and disposal of sediment (every 2 to 10 years)
- Maintenance of mechanical components
- Elimination of mosquito-breeding habitats
- Inspection of basin and reporting of results
- Maintenance of access roads
- Repair of root voids and animal burrows in the dam

4.4.12.6 Design Procedures

Dry detention basins do not include any stormwater quality features; the designer should consult Section 4 of the City's Stormwater Management Manual for design guidance.

4.4.12.7 Design Example

A design example for a dry detention basin is included in Appendix A of the City's Stormwater Management Manual.

4.4.13 Using Other or New Structural Stormwater Controls

Innovative technologies may be allowed and encouraged, providing there is sufficient documentation as to their effectiveness and reliability.

More specifically, new structural stormwater control designs will not be accepted for inclusion in the Manual until independent pollutant removal performance monitoring data determine that the practice can meet the TSS and other selected pollutant concentration removal targets, and that the structural control conforms to local and/or state criteria for treatment, maintenance, and environmental impact.

A copy of this independent testing data should be submitted to the City's WRM Department for review. The City's WRM Department reserves the right to accept or reject any alternative stormwater treatment technology based on the information submitted.

4.5 Structural Stormwater Control Pollutant Removal Capabilities

General and limited application structural stormwater controls are intended to provide water quality treatment for stormwater runoff. Although each of these structural controls provides pollutant removal capabilities, the relative capabilities vary between structural control practices and for different pollutant types.

Pollutant removal capabilities for a given structural stormwater control practice are based on a number of factors including the physical, chemical, and/or biological processes that take place in the structural control and the design and sizing of the facility. In addition, pollutant removal efficiencies for the same structural control type and facility design can vary widely depending on the contributing land use and area, incoming pollutant concentration, rainfall pattern, time of year, maintenance frequency, and numerous other factors.

To assist the designer in evaluating the relative pollutant removal performance of the various structural control options, Table 4-7 summarizes the performance characteristics for each of the general and limited application control practices recommended in this Manual. It should be noted that these values are conservative average pollutant reduction percentages for design purposes derived from sampling data, modeling, and professional judgment. A structural control design may be capable of exceeding these performances; however, the values in the table are minimum reasonable values that can be assumed to be achieved when the structural control is sized, designed, constructed, and maintained in accordance with the recommended specifications in this Manual.

Where the pollutant removal capabilities of an individual structural stormwater control are not deemed sufficient for a given site application, additional controls may be used in series in a “treatment train” approach. More details about using structural stormwater controls in series are provided in Section 4.6.1.1 of this Manual.

TABLE 4-7
Stormwater BMP Performance Characteristics
WRM Department Design and Construction Manual, Auburn, Alabama

Best Management Practice	Pollutants Addressed and Average Removal Efficiency Rates When Available							
	TP	TN	TKN	TSS/ Sediment	Oil/ Grease	Pathogens	Metals	BOD/COD
1. Stormwater Wetland	✓ 40%	✓ 30%	✓	✓ 80%	✓	✓ 70%	✓ 50%	✓
2. Bioretention Area	*✓ 60%	*✓ 50%	*✓	✓ 80%	✓	✓	✓	✓
3. Wet Detention Basin	*✓ 50%	*✓ 30%	*✓	✓ 80%		✓ 70%	✓ 50%	✓
4. Grassed Swale	✓ 50%	✓ 50%		✓ 80%			✓ 40%	✓
5. Infiltration Devices	✓ 60%	✓ 60%		✓ 80%	✓	✓ 90%	✓ 90%	
6. Buffers	✓ 40%	✓ 30%		✓ 85%	✓	✓ 70%	✓ 50%	✓
7. Permeable Pavement	✓ 80%	✓ 80%	✓		✓	✓	✓ 90%	✓
8. Sand Filter	✓ 50%	✓ 25%		✓ 80%	✓	✓ 40%	✓ 50%	✓
9. Filter Strip	✓ 20%	✓ 20%		✓ 50%			✓ 40%	✓
10. Manufactured BMP Systems	✓ 5%	✓ 5%		✓ 40%	✓			
11. Dry Extended Retention Basin	*✓	*✓	*✓	*✓	*✓	*✓	*✓	*✓

Notes:
*If properly designed and maintained for that function.
TP = total phosphorus
TN = total nitrogen
TKN = total Kjeldahl nitrogen
TSS = totals suspended solids
BOD = biochemical oxygen demand
COD = chemical oxygen demand

For additional information and data regarding the range of pollutant removal capabilities for various structural stormwater controls, reference the National Pollutant Removal Performance Database (2nd Edition), available at www.cwp.org and the National Stormwater BMP Database at www.bmpdatabase.org.

4.6 Structural Stormwater Control Selection

4.6.1 General Application Control Screening Process

This process is intended to assist the site designer and design engineer in the selection of the most appropriate structural controls for a development site and to provide guidance regarding factors to consider in their location.

In general, the following criteria should be evaluated to select the appropriate structural control(s) or group of controls for a development:

- General suitability
- Stormwater management suitability
- Hot spot application
- Flow attenuation efficiency
- Costs
- Monitoring and maintenance requirements
- Key advantages and disadvantages

In addition, the following site-specific factors should be considered to determine any design criteria or restrictions that need to be evaluated:

- Physiographic factors
- Soils
- Special watershed or stream considerations

Finally, environmental regulations that may influence the location of a structural control onsite, or that may require a permit, need to be considered.

The following text describes a selection process for comparing and evaluating various general application structural stormwater controls using two screening matrixes and a list of location and permitting factors. These tools are provided to assist the design engineer in selecting the subset of structural controls that will meet the stormwater management and design objectives for a development site or project.

4.6.1.1 Step 1–Applicability

Through the use of the first matrix (Table 4-8), the site designer evaluates and screens the overall applicability of the full set of general application structural controls, as well as the constraints of the site in question. The following are details regarding the various screening categories and individual characteristics used to evaluate the structural controls.

General Suitability.

The first columns of the BMP Selection Matrix define the capability of each structural control to provide protection and treatment under three different development levels–Residential Subdivision, High Density/Ultra Urban Areas, and Regional Stormwater Controls. This classification provides an overview of the specific site conditions or criteria that must be met for a particular structural control to be suitable. A check mark indicates that the control is suitable to meet the listed criteria. A blank entry means that the structural control typically is not used for a specific site condition. This does not necessarily mean that the control should be eliminated from consideration, but rather is a reminder that more than one structural control may be needed at a site:

- **Residential Subdivision Use**. This column identifies whether a structural control is suitable for typical residential subdivision development (not including high-density or ultra-urban areas).
- **High-Density/Ultra-Urban Areas**. This column identifies those structural controls that are appropriate for use in high-density (ultra-urban) areas or areas in which space is at a premium.
- **Regional Stormwater Controls**. This column identifies those structural controls that are appropriate for large areas, not necessarily highly populated or developed. Regional controls are designed and installed strategically to provide stormwater controls in a subwatershed rather than in small onsite controls. These structures will manage stormwater runoff from multiple projects, and individual properties may reduce or eliminate onsite controls.

TABLE 4-8
BMP Selection Matrix
WRM Department Design and Construction Manual, Auburn, Alabama

Best Management Practice	General Suitability: Residential Subdivision	General Suitability: High Density/Ultra Urban Areas	General Suitability: Regional Stormwater Control	Stormwater Management Suitability: Water Quality	Stormwater Management Suitability: Channel Protection	Stormwater Management Suitability: Overbank Flood Protection	Stormwater Management Suitability: Extreme Flood Protection	Hot spot Application	Flow Attenuation Efficiency: L	Flow Attenuation Efficiency: M	Flow Attenuation Efficiency: H	Costs: L	Costs: M	Costs: H	Monitoring and Maintenance Requirements: L	Monitoring and Maintenance Requirements: M	Monitoring and Maintenance Requirements: H	Key Advantages	Key Disadvantages
1. Stormwater Wetland	✓		✓	✓	✓	✓	✓	✓			✓			✓	✓			• Removes multiple pollutants. Attenuation of peak flows. Creation of wildlife habitat.	• Requires more land than other BMPs. Must maintain to control invasive species. Can attract waterfowl, which may increase pathogen levels.
2. Bioretention Area	✓	✓		✓	✓	✓					✓	✓				✓		• Removes multiple pollutants. Effective for reducing peak flow rates. May be used in small areas and integrated into existing or planned landscaping. Primary regular maintenance is basically landscaping and litter control.	• Requires regular maintenance including care for plants and replacement of mulch. May require frequent trash removal. Surface soil layer may clog over time, but can be replaced.
3. Wet Detention Basin	✓		✓	✓	✓	✓	✓	✓			✓		✓				✓	• Attenuation of peak flows. Perceived as ponds or lakes that enhance property value. Creates wildlife habitat. Appropriate in areas where infiltration is impractical.	• If not maintained, storm flows may resuspend sediments. Can become an eyesore and a nuisance if not maintained. Can attract waterfowl, which may increase pathogen levels. Not appropriate for areas with sensitive aquatic species due to potential thermal warming.
4. Grassed Swale	✓			✓	✓				✓			✓			✓			• Attenuation of peak flows. Inexpensive to construct and maintain. Can provide wildlife habitat.	• Standing water may provide habitat for mosquitoes. May channelize with concentrated flows. May pose traffic hazards if not properly designed.
5. Infiltration Devices	✓	✓		✓	✓						✓	✓	✓			✓		• Reduces frequency of flooding. Helps maintain shallow groundwater. Economical for small drainage areas.	• Can fail quickly compared to other types of BMPs. May clog easily and require pretreatment BMPs. Restricted to areas with permeable soils, deep water tables, and deep bedrock. Requires significant maintenance. Infiltration of stormwater has potential to contaminate groundwater.

TABLE 4-8
BMP Selection Matrix
WRM Department Design and Construction Manual, Auburn, Alabama

Best Management Practice	General Suitability			Stormwater Management Suitability					Flow Attenuation Efficiency			Costs			Monitoring and Maintenance Requirements				
	Residential Subdivision	High Density/Ultra Urban Areas	Regional Stormwater Control	Water Quality	Channel Protection	Overbank Flood Protection	Extreme Flood Protection	Hot spot Application	L	M	H	L	M	H	L	M	H	Key Advantages	Key Disadvantages
6. Buffers	✓	✓		✓	✓	✓				✓		✓			✓			• Aesthetic and passive recreational benefits. Provides water quality treatment, erosion control, and water temperature benefits. Co-located trails can build support for greenways of riparian forest. Very inexpensive to construct.	• Sometimes seen as dangerous or unkempt public areas. Bank-side vegetation can be perceived as interfering with views of streams. Can be abused as places for illegal dumping. Often limited effectiveness due to concentration and piping of flows in watershed.
7. Permeable Pavement	✓	✓			✓					✓				✓			✓	• Reduces stormwater runoff rate and volume. Reduces pollutant load by reducing runoff volume. Potential component of LID site designs.	• Potential for clogging of porous media by sediment. High maintenance requirements. Limited to areas with sufficient drainage. Higher cost than conventional pavements. Not applicable for high-traffic areas or for use by heavy vehicles. Must have a slope less than 0.5%.
8. Sand Filter		✓		✓	✓			✓		✓			✓			✓		• Highly effective at filtering TSS. Can filter flows from moderate to large areas. Larger units can attenuate runoff peaks, Useful where space is limited.	• Needs to integrate trash screens or grated inlets. If anoxic conditions develop, phosphorus levels can increase. May not be effective at controlling peak discharges. Can be unattractive without grass cover, or if trash accumulates on surface.

Notes:
L = Low
M = Moderate
H = High

Stormwater Management Suitability.

The second set of criteria in Table 4-8 examines the capability of each structural control option to provide water quality treatment, downstream channel protection, overbank flood protection, and extreme flood protection. A blank entry means that the structural control cannot be or typically is not used to meet a unified stormwater sizing criterion. This does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one structural control may be needed at a site (for example, a bioretention area used in conjunction with dry detention storage):

- **Ability to treat the WQv.** This indicates whether a structural control provides treatment of the WQv.
- **Ability to provide Qp25.** This indicates whether a structural control can be used to meet the Qp25 criteria. The presence of a check mark indicates that the structural control can be used to provide peak reduction of the 25-year storm event.
- **Ability to provide extreme flood protection (Qf).** This indicates whether a structural control can be used to meet the extreme flood protection criteria. The presence of a check mark indicates that the structural control can be used to provide peak reduction of the Qf.

Hot Spot Application.

This column indicates the capability of a structural control to treat runoff from designated hot spots. Hot spots are land uses or activities that have higher potential pollutant loadings. Examples of hot spots might include gas stations, convenience stores, marinas, public works storage areas, vehicle service and maintenance areas, commercial nurseries, and auto recycling facilities. A check mark indicates that the structural control may be used on a hot spot; however, it may have specific design restrictions. Please see the specific design criteria of the structural control for more details.

Flow Attenuation Efficiency.

This column generally describes the effectiveness of the particular BMP to control stormwater flow, especially the peaks that are expected as a result of the increase in impervious surfaces. This parameter is directly related to the ability of the BMP to provide channel protection.

Costs.

This column establishes a cost comparison among the recommended BMPs. Actual construction costs and maintenance costs will vary depending on a number of factors, including the size and location of the control, the pollutant loading to the control from the upstream watershed, and the type of maintenance that needs to be performed. Differences in construction costs also may be affected by the availability of land and other site-specific constraints.

Monitoring and Maintenance Requirements.

This column provides information regarding the relative monitoring and maintenance requirements for each BMP to work effectively and to comply with stormwater regulations. This information is useful and important because it may drive the O&M costs.

Key Advantages/ Disadvantages.
The last two columns briefly describe some of the advantages and disadvantages of installing these BMPs.

4.6.1.2 Step 2–Location and Permitting Considerations

In this step, a site designer assesses the physical and environmental features at the site to determine the optimal location for the selected structural control or group of controls. The checklist in Table 4-9 provides a condensed summary of current restrictions as they relate to common site features that may be regulated under local, state, or federal law. These restrictions fall into one of three general categories, as follows:

- Locating a structural control within an area that is expressly prohibited by law.
- Locating a structural control within an area that is strongly discouraged and is only allowed on a case-by-case basis. Local, state, and/or federal permits shall be obtained, and the applicant will need to supply additional documentation to justify locating the stormwater control within the regulated area.
- Structural stormwater controls must be set back a fixed distance from the site feature.

This checklist is only intended as a general guide to the location and permitting requirements as they relate to siting stormwater structural controls. Consultation with the appropriate regulatory agency is the best strategy.

TABLE 4-9
Location and Permitting Checklist
WRM Department Design and Construction Manual, Auburn, Alabama

Site Feature	Location and Permitting Guidance
Jurisdictional Wetland (Waters of the U.S.) U.S. Army Corps of Engineers Section 404 Permit	• Jurisdictional wetlands should be delineated prior to siting structural control. • Use of natural wetlands for stormwater quality treatment is contrary to the goals of the Clean Water Act and should be avoided. • Stormwater should be treated prior to discharge into a natural wetland. • Structural controls may also be *restricted* in local buffer zones, although they may be used as a non-structural filter strip (i.e., accept sheet flow). • Should justify that no practical upland treatment alternatives exist. • Where practical, excess stormwater flows should be conveyed away from jurisdictional wetlands.
Stream Channel (Waters of the U.S.) U.S. Army Corps of Engineers Section 404 Permit	• All Waters of the U.S. (streams, ponds, lakes, etc.) should be delineated prior to design. • Use of any Waters of the U.S. for stormwater quality treatment is contrary to the goals of the Clean Water Act and should be avoided. • Stormwater should be treated prior to discharge into Waters of the U.S. • In-stream ponds for stormwater quality treatment are highly discouraged. • Must justify that no practical upland treatment alternatives exist. • Temporary runoff storage preferred over permanent pools. • Implement measures that reduce downstream warming.

TABLE 4-9
Location and Permitting Checklist
WRM Department Design and Construction Manual, Auburn, Alabama

Site Feature	Location and Permitting Guidance
100-Year Floodplain Chapter 7, Article II, Auburn City Code	• Grading and fill for structural control construction is generally discouraged within the ultimate 100-year floodplain, as delineated by FEMA flood insurance rate maps, FEMA flood boundary, and floodway maps.
Stream Buffer Chapter 7, Article III, Section 7-76(c), Auburn City Code	• Flood control structures are discouraged in the streamside zone but are allowed.
Utilities Water Resource Management Director	• Call appropriate agency to locate existing utilities prior to design. • Note the location of proposed utilities to serve development. • Structural controls are discouraged within utility easements or rights of way for public or private utilities.
Roads Local Public Works Department or State DOT	• Consult local Public Works Department for any setback requirement from local roads. • Consult DOT for setbacks from state maintained roads. • Approval must also be obtained for any stormwater discharges to a local or state-owned conveyance channel.
Structures City Engineer	• Consult with the City Engineer for structural control setbacks from structures. • Recommended setbacks for each structural control group are provided in the performance criteria in this Manual.
Septic Drain Fields Water Resource Management Director	• Consult with the Water Resource Management Director. • Recommended setback is a minimum of 50 feet from drain field edge.
Water Wells Water Resource Management Director	• Recommended 100-foot setback for stormwater infiltration. • Recommended 50-foot setback for all other structural controls.

4.6.2 Limited Application Control Screening Process

This process is intended to assist the site designer and design engineer in the selection of the structural controls that might have limited applications and provides guidance regarding the factors to consider in their location.

The selection criteria follow the same format as stated above for most common structural control(s). Because of the nature and limitations of the BMPs under this category, special attention should be given to the following site-specific characteristics:

- Physiographic factors
- Soils
- Special watershed or stream considerations

For the limited application BMPs, environmental regulations may prevent their use; therefore, it is wise to consult the local permitting office before using them.

By using Table 4-10, the site designer can evaluate and screen the list of limited application structural controls to determine if a particular control or set of control(s) is appropriate.

As with the general application controls, the site designer should assess the physical and environmental features at the site to determine the optimal location for the selected structural control or group of controls.

4.6.3 Example Application

A 20-acre school is being constructed in a dense urban area within the City. The impervious coverage of the site is 40 percent. The site drains to an urban stream that is highly affected from hydrologic alterations (accelerated channel erosion). The stream channel is deeply incised; consequently, flooding is not a problem. The channel drains to an urban river that is a tributary to a phosphorus-limited drinking water reservoir. Low-permeability soils limit infiltration practices, as described below.

Objective: Avoid additional disruptions to the receiving channel and reduce pollutant loads for sediment and phosphorus to receiving waters.

Target Removals: Provide stormwater management to mitigate for accelerated channel incision and reduce loadings of key pollutants by the following:

- Sediment: 80 percent
- Phosphorus: 40 percent

Activity/Runoff Characteristics: The proposed site is to have large areas of impervious surface in the form of parking and structures. There will be a large contiguous portion of turf grass proposed for the front of the parcel; however, that will have a relatively steep slope (approximately 10 percent) and will drain to the storm drain system associated with the entrance drive. Stormwater runoff from the site is expected to exhibit fairly high sediment levels and seasonally high phosphorus levels (because of turf grass management).

Table 4-11 lists the results of the selection analysis described previously.

Although there is a downstream reservoir to consider, there are no special watershed factors and no physiographic factors that preclude the use of any of the practices from the General Application structural control list. Because of the size of the drainage area, however, most stormwater ponds and wetlands are removed from consideration. In addition, the impermeable soils onsite prevent infiltration trenches from being considered. Because of the need to provide overbank flood control, as well as channel protection storage, a micropool ED pond probably will be needed, unless some downstream regional storage is available to control the overbank flood.

TABLE 4-10
Limited Application BMPs
WRM Department Design and Construction Manual, Auburn, Alabama

Best Management Practice	General Suitability: Residential Subdivision	General Suitability: High Density/Ultra Urban Areas	General Suitability: Regional Stormwater Control	Stormwater Management Suitability: Water Quality	Stormwater Management Suitability: Channel Protection	Stormwater Management Suitability: Overbank Flood Protection	Stormwater Management Suitability: Extreme Flood Protection	Hot spot Application	Flow Attenuation Efficiency: L	Flow Attenuation Efficiency: M	Flow Attenuation Efficiency: H	Costs: L	Costs: M	Costs: H	Monitoring and Maintenance Requirements: L	Monitoring and Maintenance Requirements: M	Monitoring and Maintenance Requirements: H	Key Advantages	Key Disadvantages
1. Dry Extended Retention Basin	✓		✓	✓	✓	✓	✓	✓			✓			✓			✓	• Attenuation of peak flows. Provides channel protection. Moderately effective at reducing TSS. Can provide open space and recreational areas between storms.	• Limited pollutant removal and does not address multiple pollutants. Can become an eyesore and a nuisance if not maintained. Requires more land than other BMPs. Costly to maintain.
2. Filter Strip	✓			✓	✓				✓			✓			✓			• May be integrated into existing or planned landscaping. Effective at reducing sediment and particles bound to sediment. Low cost if land is available and minimal maintenance requirements. Aids in channel protection.	• Slows down water but does not attenuate peak flows or provide storage. Has to be designed for sheet flow and not concentrated flow to prevent gullies.
3. Manufactured BMP Systems	✓	✓		✓					✓				✓				✓	• Can tailor to specific pollutants. Useful in locations with space restrictions. Easily installed in most areas. Fairly inexpensive for simple chambered designs. Underground location reduces visual impacts.	• Low removal efficiencies except for O&G, trash and debris, and larger particles. Requires frequent cleanout or filter replacement. Clogging can remain unnoticed and trigger flow-bypass. Odor problems may develop.

Notes:
L = Low
M = Moderate
H = High

TABLE 4-11
Sample Structural Control Selection Matrix
WRM Department Design and Construction Manual, Auburn, Alabama

General Application Structural Control	General Suitability	Stormwater Management Suitability	Hot spot	Flow Attenuation Efficiency	Costs	Monitoring and Maintenance Requirements	Other Issues
Wet Pond	✓	X	✓	✓	✓	✓	
Wet ED Ponds	✓	X	✓	✓	✓	✓	
Micropool ED Ponds	✓	✓	✓	✓	X	✓	
Multiple Ponds	✓	X	✓	✓	✓	✓	
Shallow Wetland	✓	X	✓	✓	✓	✓	
ED Shallow Wetland	✓	X	✓	✓	✓	✓	
Pocket Wetland	✓	✓	✓	✓	✓	✓	Odor/ mosquitoes
Infiltration Trench	✓[1]	✓	X	X	X	✓	
Surface Sand Filter	✓[1]	✓[2]	✓	X	✓	✓	aesthetics
Perimeter SF	✓[1]	✓[2]	✓	X	✓	✓	Cost
Bioretention	✓[1]	✓[2]	X	✓	✓	✓	
Dry Swale	✓[1]	✓[2]	X	X	X	✓	
Wet Swale	✓[1]	✓[2]	X	X	X	✓	Odor/ mosquitoes

Notes:
[1]Only when used with another structural control that provides water quality control
[2]Can treat a portion of the site

To provide additional pollutant removal capabilities in an attempt to better meet the target removals, bioretention, surface sand filters, and/or perimeter sand filters can be used to treat the parking lot and driveway runoff. The bioretention provides some removal of phosphorus while improving the aesthetics of the site. Surface sand filters provide higher phosphorus removal at a comparable unit cost to bioretention, but are not as aesthetically pleasing. The perimeter sand filter is a flexible, easy-to-access practice (but at higher cost) that provides good phosphorus removal and additionally high O&G trapping ability.

The site drainage system can be designed so that the bioretention and/or sand filters drain to the micropool ED pond for redundant treatment. Vegetated dry swales also could be used to convey runoff to the pond, which would provide pretreatment. Pocket wetlands and wet swales were eliminated from consideration because of the potential for nuisance conditions. Underground sand filters also could be used at the site; however, the cost and aesthetic considerations were significant enough to eliminate these from consideration.

4.6.4 Online Versus Offline Structural Controls

Structural stormwater controls are designed to be either "online" or "offline." Online facilities are designed to receive, but not necessarily control or treat, the entire runoff volume up to the Qp25 or Qf event. Online structural controls must be able to handle the entire range of storm flows.

Offline facilities, on the other hand, are designed to receive only a specified flow rate through the use of a flow regulator (i.e., diversion structure, flow splitter, etc.). Flow regulators typically are used to divert the WQv to an offline structural control that is sized and designed to treat and control the WQv. After the design runoff flow has been treated and/or controlled, it is returned to the conveyance system. Figure 4-30 shows examples of an offline sand filter and an offline enhanced dry swale.

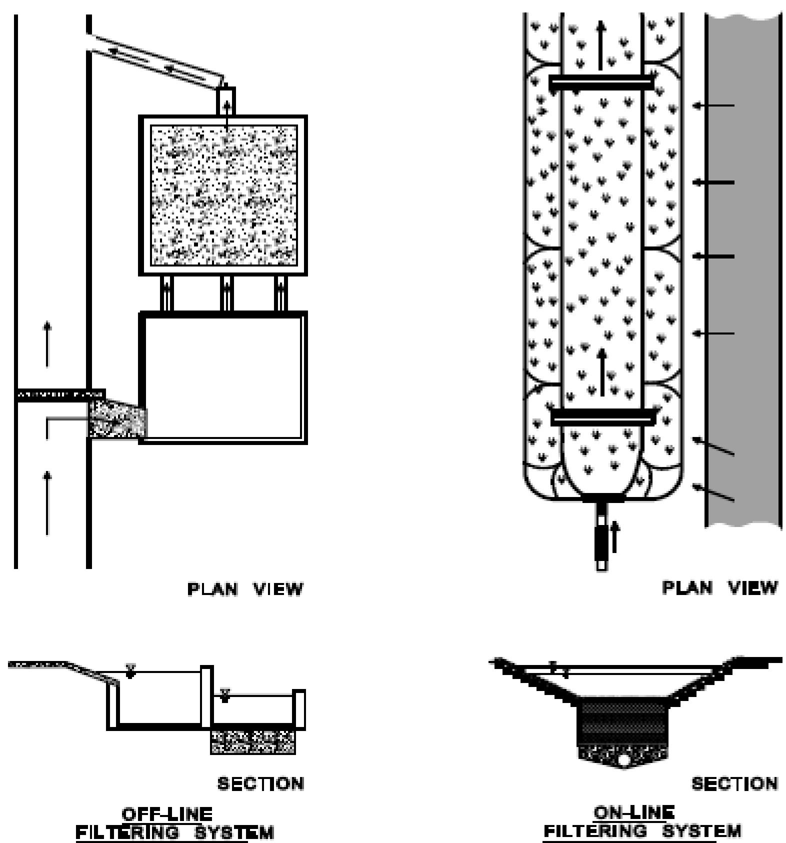


FIGURE 4-30
Example of Online versus Offline Structural Controls
Source: CWP (1996)

4.6.4.1 Flow Regulators

Flow regulation to offline structural stormwater controls can be achieved by either:

- Diverting the WQv or other specific maximum flow rate to an offline structural stormwater control
- Bypassing flows in excess of the design flow rate

Flow regulators can be flow-splitter devices, diversion structures, or overflow structures. Three examples of flow regulators are shown in Figures 5-31, 5-32, and 5-33.

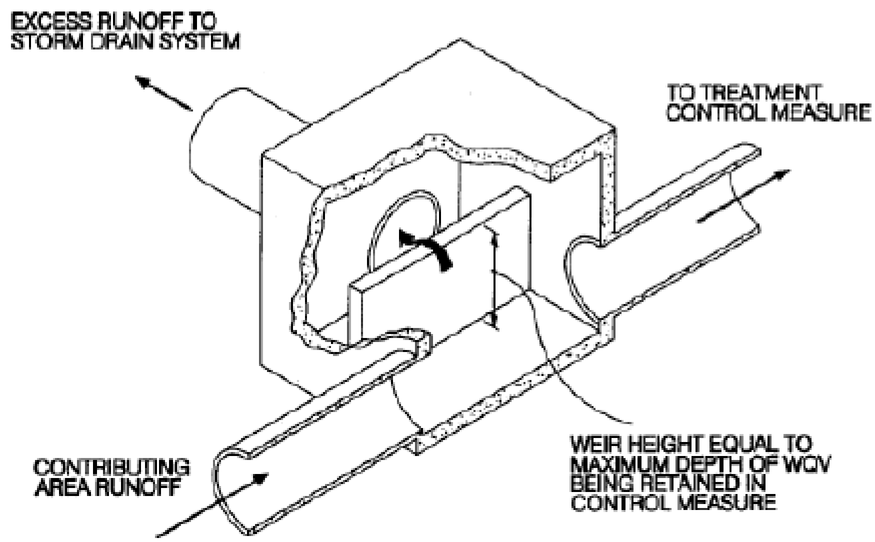


FIGURE 4-31
Pipe Interceptor Diversion Structure
Source: City of Sacramento (2000)

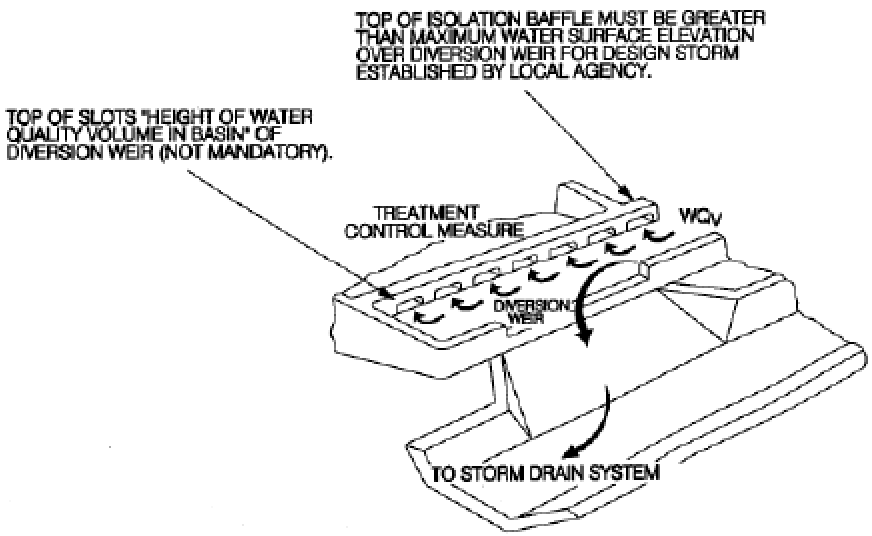


FIGURE 4-32
Surface Channel Diversion Structure
Source: City of Sacramento (2000)

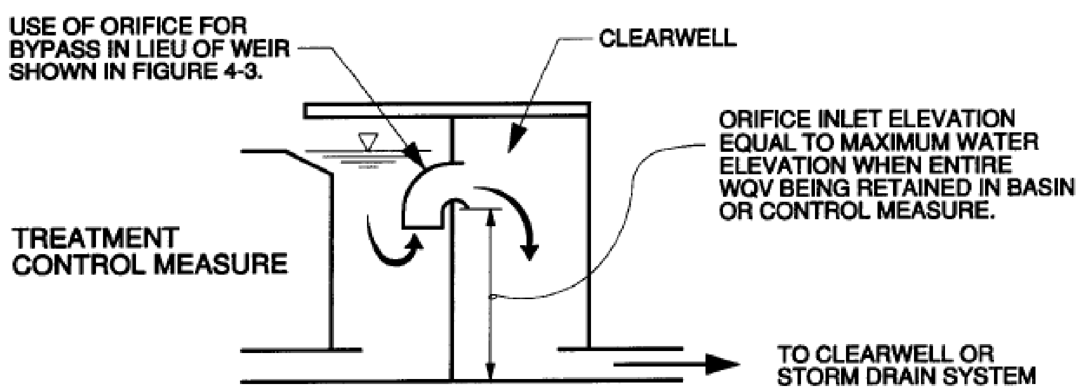


FIGURE 4-33
Outlet Flow Regulator
Source: City of Sacramento (2000)

4.6.5 Using Structural Stormwater Controls in Series

4.6.5.1 Stormwater Treatment Trains

The minimum stormwater management standards are an integrated planning and design approach whose components work together to limit the adverse impacts of urban development on downstream waters and riparian areas. This approach sometimes is called a stormwater "treatment train." When considered comprehensively, a treatment train consists of all of the design concepts and nonstructural and structural controls that work to attain water quality and quantity goals. This concept is illustrated in Figure 4-34.

FIGURE 4-34
Generalized Stormwater Treatment Train

Runoff and Load Generation–The initial part of the "train" is located at the source of runoff and pollutant load generation, and consists of better site design and pollution prevention practices that reduce runoff and stormwater pollutants.

Pretreatment–The next step in the treatment train consists of pretreatment measures. These measures typically do not provide sufficient pollutant removal to meet the 80-percent TSS reduction goal, but do provide calculable water quality benefits that may be applied toward meeting the WQv treatment requirement. These measures include the following:

- Using stormwater better site design practices and site design credits to reduce the WQv
- Limited application structural controls that provide pretreatment
- Pretreatment facilities such as sediment forebays on general application structural controls

Primary Treatment and/or Quantity Control–The last step is primary water quality treatment and/or quantity (channel protection, overbank flood protection, and/or extreme flood protection) control. This is achieved through the use of the following:

- General application structural controls
- Limited application structural controls
- Detention structural controls

4.6.5.2 Use of Multiple Structural Controls in Series

Many combinations of structural controls in series may exist for a site. Figure 4-35 provides a number of hypothetical examples of how the unified stormwater sizing criteria may be addressed by using structural stormwater controls.

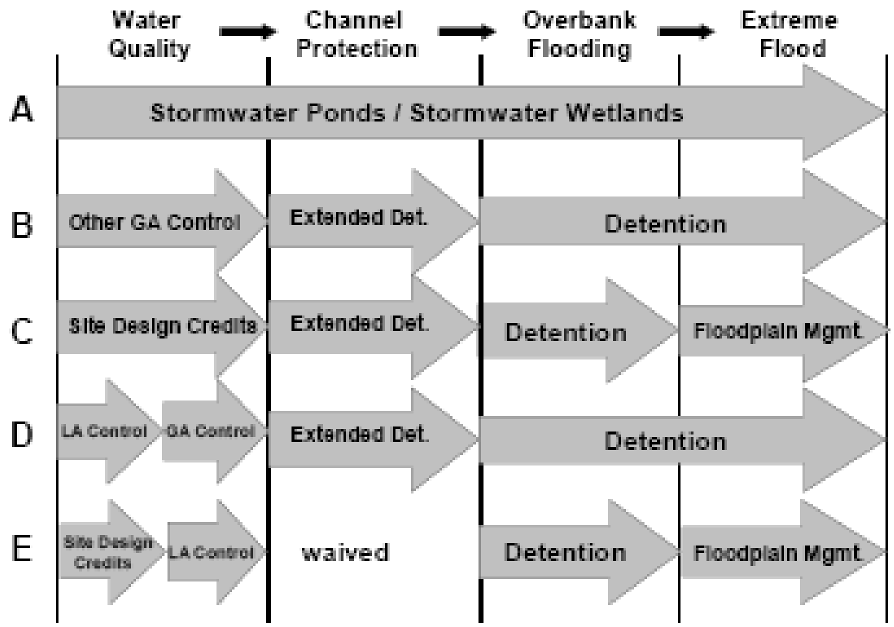


FIGURE 4-35
Examples of Structural Controls Used in Series

Referring to Figure 4-35 by line letter:

A. Two general application (GA) structural controls–stormwater ponds and stormwater wetlands–can be used to meet all of the unified stormwater sizing criteria in a single facility.

B. The other general application structural controls (bioretention, sand filters, infiltration trench, and enhanced swale) typically are used in combination with detention controls to meet the unified stormwater sizing criteria. The detention facilities are located downstream from the water quality controls either onsite or combined into a regional or neighborhood facility.

C. Line C indicates the condition where an environmentally sensitive large lot subdivision has been developed that can be designed to waive the water quality treatment requirement altogether. Detention controls may still be required, however, for downstream channel protection, overbank flood protection, and extreme flood protection.

D. Where a limited application (LA) structural control does not meet the 80-percent TSS removal criteria, another downstream structural control must be added. For example, urban hot spot land may be fit or retrofit with devices adjacent to parking or service areas designed to remove petroleum hydrocarbons. These devices also may serve as pretreatment devices by removing the coarser fraction of sediment. One or more downstream structural controls is then used to meet the full 80-percent TSS removal goal, as well as the water quantity control.

E. In line E, site design credits have been used to partially reduce the WQv requirement. In this case, for a smaller site, a well-designed and tested LA structural control provides adequate TSS removal, while a dry detention pond handles the overbank flooding criteria. For this location, direct discharge to a large stream and local downstream floodplain management practices have eliminated the need for channel protection volume and extreme flood protection structural controls onsite.

The combinations of structural stormwater controls are limited only by the need to employ measures of proven effectiveness and to meet local regulatory and physical site requirements. Figures 5-36 through 5-38 illustrate the application of the treatment train concept for a moderate-density residential neighborhood, a small commercial site, and a large shopping mall site, respectively. In Figure 4-36, rooftop runoff drains over grassed yards to backyard grass channels. Runoff from front yards and driveways reaches roadside grass channels. Finally, all stormwater flows drain to a micropool ED stormwater pond.

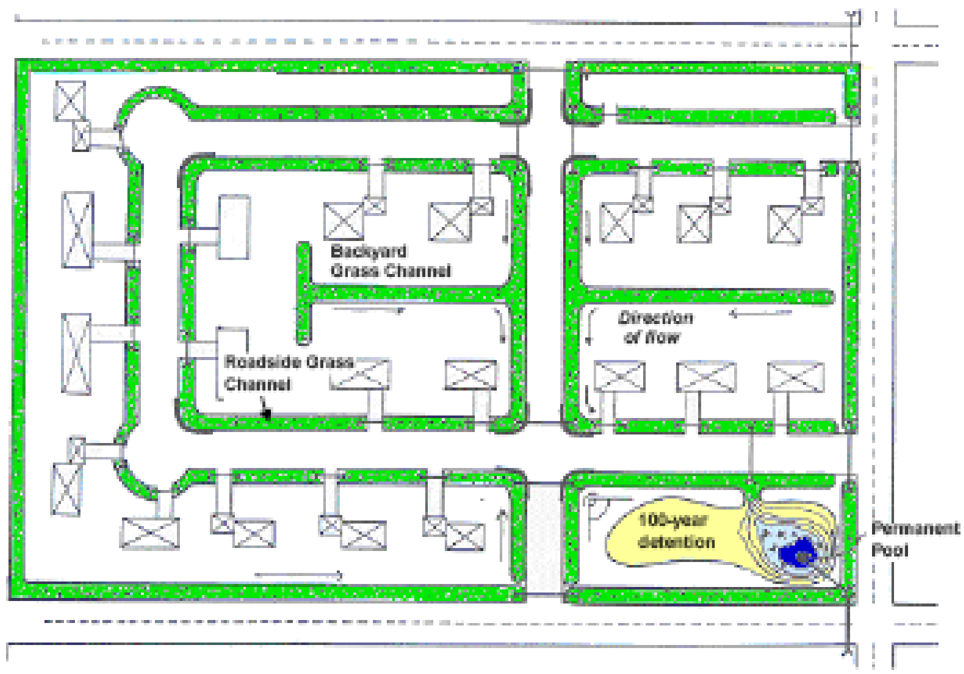


FIGURE 4-36
Example Treatment Train–Residential Subdivision
Adapted from: NIPC (2000)

A gas station and convenience store is depicted in Figure 4-37. In this case, the decision was made to intercept hydrocarbons and oils using a commercial gravity (oil-grit) separator located onsite before draining to a perimeter sand filter to remove the finer particles and TSS.

No stormwater control for channel protection is required because the system drains to the municipal storm drain pipe system. Overbank and extreme flood protection is provided by a regional stormwater control downstream.

Figure 4-38 shows an example treatment train for a commercial shopping center. In this case, runoff from rooftops and parking lots drains to depressed parking lots, perimeter grass channels, and bioretention areas. Slotted curbs are used at the entrances to these swales to better distribute the flow and to settle out the coarse particles at the parking lot edge for sweepers to remove.

Runoff is then conveyed to a wet ED pond for additional pollutant removal and channel protection. Overbank and extreme flood protection is provided through parking lot detention.

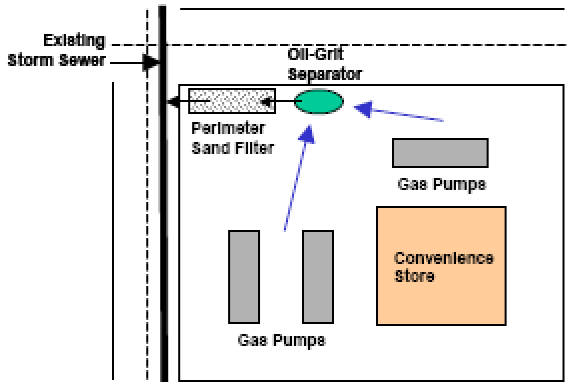


FIGURE 4-37
Example Treatment Train–Commercial Development

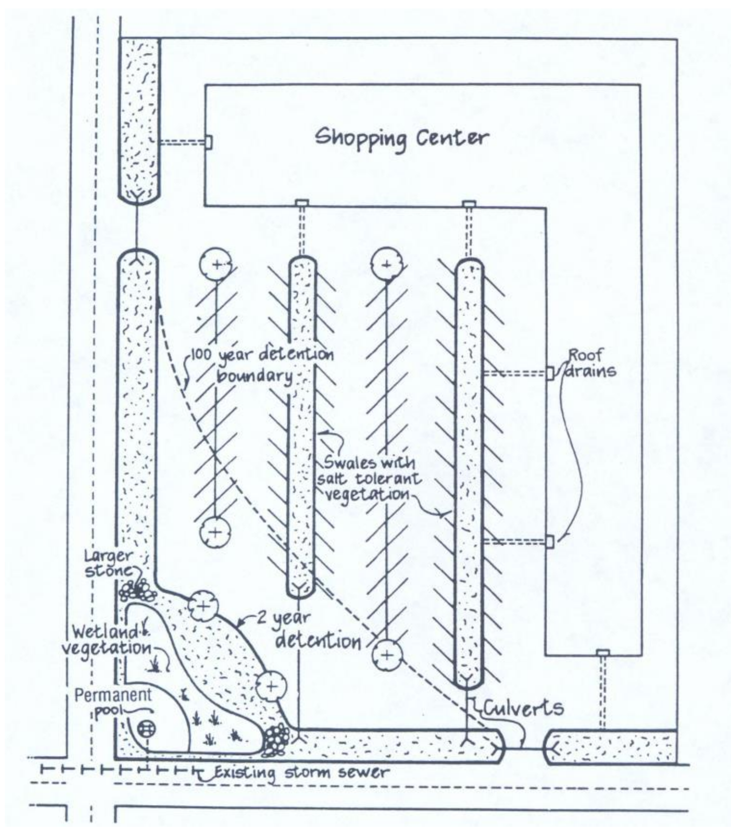


FIGURE 4-38
Example Treatment Train–Commercial Development
Source: NIPC (2000)

4.6.5.3 Calculation of Pollutant Removal for Structural Controls in Series

For two or more structural stormwater controls used in combination, it is often important to have an estimate of the pollutant-removal efficiency of the treatment train. Pollutant-removal rates for structural controls in series are not additive. For pollutants in particulate form, the actual removal rate (expressed in terms of percentage of pollution removed) varies directly with the pollution concentration and sediment size distribution of runoff entering a facility.

For example, a stormwater pond facility will have a much higher pollutant-removal percentage for turbid runoff than for clearer water. When two stormwater ponds are placed in series, the second pond will treat an incoming particulate pollutant load differently from the first pond. The upstream pond captures the easily removed larger sediment sizes, passing on an outflow with a lower concentration of TSS, but with a higher proportion of finer particle sizes. Hence, the removal capability of the second pond for TSS is considerably less than that of the first pond. Recent findings suggest that the second pond in series can provide as little as half the removal efficiency of the upstream pond.

To estimate the pollutant-removal rate of structural controls in series, a method is used in which the removal efficiency of a downstream structural control is reduced to account for the pollutant removal of the upstream control(s). The following steps are used to determine the pollutant removal:

- For each drainage area, list the structural controls in order, upstream to downstream, along with their expected average pollutant-removal rates from Table 4-7 for the pollutants of concern.
- For any GA structural control located downstream from another GA control or an LA structural control that has TSS removal rates equivalent to 80 percent, the designer should use 50 percent of the normal pollutant-removal rate for the second control in series. For a GA structural control located downstream from an LA structural control that cannot achieve the 80-percent TSS reduction goal, the designer should use 75 percent of the normal pollutant removal rate for the second control in series.
- For example, if a GA structural control has an 80-percent TSS-removal rate, then a 40-percent TSS-removal rate would be assumed for this control if it were placed downstream from another GA control in the treatment train (0.5 x 80 percent). If it were placed downstream from an LA structural control that cannot achieve the 80-percent TSS-reduction goal, a 60-percent TSS-removal rate would be assumed (0.75 x 80 percent). Use this rule with caution depending on the actual pollutant of concern and make allowances for differences among structural control pollutant removal rates for different pollutants. Actual data from similar situations, where available, should be used to temper or override this rule of thumb.
- For cases where an LA control is sited upstream from a GA control in the treatment train, the downstream GA structural control is given full credit for the removal of pollutants.

- Apply the following equation to calculate approximate total accumulated pollution removal for controls in series:

Final Pollutant Removal = (Total load * Control1 removal rate)
+ (Remaining load * Control2 removal rate)
+ … for other Controls in series.

Example.

TSS is the pollutant of concern and a commercial device is inserted that has a 20-percent sediment-removal rate. A stormwater pond is designed at the site outlet. A second stormwater pond is located downstream from the first one in series. What is the total TSS-removal rate? The following information is given:

Control 1 (Commercial Device) = 20% TSS removal

Control 2 (Stormwater Pond 1) = 80% TSS removal (use 1.0 x design removal rate)

Control 3 (Stormwater Pond 2) = 40% TSS removal (use 0.5 x design removal rate)

By applying the controls in order and working in terms of "units" of TSS starting at 100 units:

For Control 1: 100 units of TSS * 20% removal rate = 20 units removed

100 units – 20 units removed = 80 units of TSS remaining

For Control 2: 80 units of TSS * 80% removal rate = 64 units removed

80 units – 64 units removed = 16 units of TSS remaining

For Control 3: 16 units of TSS * 40% removal rate = 6 units removed

16 units – 6 units removed = 10 units TSS remaining

For the treatment train in total = 100 units TSS – 10 units TSS remaining = **90% removal**

4.6.5.4 Routing with WQv Removed

When offline structural controls such as bioretention areas, sand filters, and infiltration trenches capture and remove the WQv, downstream structural controls do not have to account for this volume during design. That is, the WQv may be subtracted from the total volume that otherwise would need to be routed through the downstream structural controls.

From a calculation standpoint, this would amount to removing the initial WQv from the beginning of the runoff hydrograph, thus creating a "notch" in the runoff hydrograph. Because most commercially available hydrologic modeling packages cannot handle this type of action, the following method has been created to facilitate removal from the runoff hydrograph of approximately the WQv:

- Enter the horizontal axis in Figure 4-39 with the impervious percentage of the watershed and read upward to the predominant soil type (interpolation between curves is permitted).

- Read left to the factor.
- Multiply the NC for the subwatershed that includes the water quality basin by this factor (this provides a smaller CN).

The difference in CN will generate a runoff hydrograph that has a volume less than the original volume by an amount approximately equal to the WQv. This method should be used only for bioretention areas, filter facilities, and infiltration trenches in cases where the drawdown time is ≥ 24 hours.

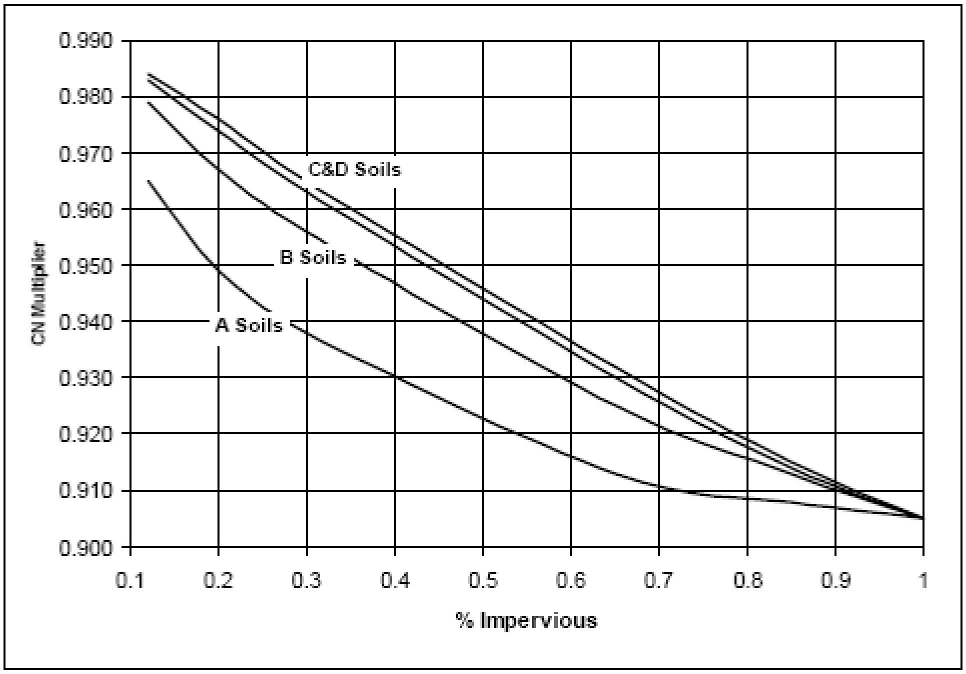


FIGURE 4-39
Curve Number Adjustment Factor

Example.
A site design employs an infiltration trench for the WQv and has a CN of 72, is B Type soil, and has an impervious percentage of 70 percent; the factor from Figure 4-39 is 0.92. The CN to be used in calculation of a runoff hydrograph for the quantity controls would be: (72*0.92) = 66.

4.7 City of Auburn Site Development Review Tool

The City's Site Development Review Tool was designed to assist engineers and developers in planning stormwater management features for proposed projects. Through the tool, users can make informed decisions regarding water quality protection and stormwater BMP design as a result of potential impacts from their developments.

The Site Development Review Tool was developed using a Microsoft® Excel format and can be used by engineers and developers to design and incorporate BMPs for City developments and to maximize the efficiency of runoff pollutant management following the construction of developments. The tool also can be used to meet the target pollutant removal efficiencies outlined in the City's Conservation Subdivision Regulations. This tool will provide pollutant removal estimates for site-specific conditions based on removal efficiencies for a variety of stormwater BMPs, including detention ponds, bioretention areas (rain gardens), and stormwater wetlands. The tool analyzes a variety of stormwater pollutants including nutrients (phosphorus and nitrogen) and TSS. City staff will use this tool during the plan review process to analyze development impacts on water quality within the Lake Ogletree watershed, as well as additional watersheds within the City. The Tool can be obtained from the City's web site at: http://www.auburnalabama.org/wrm/sitedevelopment.asp. Instructions about how to use the tool are included on a tab within the spreadsheet.

4.8 City of Auburn Conservation Subdivision Regulations

Article VI of the City's Subdivision Regulations (Amended March 2008) lists the regulations for Conservation Subdivisions. A Conservation Subdivision, as defined in the zoning regulations, is:

> *A development design technique that concentrates buildings on a part of the site to allow the remaining land to be used for open space or preservation of environmentally sensitive areas. The open space may be owned by either a private or public entity.*

Article VI applies to all divisions of land in the subdivision jurisdiction that lie within the Lake Ogletree Subwatershed that are 10 acres or more, and where the division creates more than four lots. In addition, the Conservation Subdivision regulations only apply to land within the corporate limits zoned as a Conservation Overlay District (COD) (for details, refer to the City's Zoning Ordinance, Section 513, COD).

With respect to stormwater quality, Article VI requires stormwater BMPs if the impervious surface ratio (ISR), the ratio impervious surface to gross area, of the subdivision exceeds 10 percent (Article VI, Section G). A Stormwater Management Plan for the proposed project also is required for an ISR greater than 10 percent.

A copy of the Subdivision Regulations dated March 2008 can be obtained from the City's web site at: http://www.auburnalabama.org/pl/Subdivision%20Regulations/03-18-08%20Amendments/Subdivision%20Regulations%20as%20Amended%20on%2003-18-08.pdf.

4.9 References

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Auburn. 2008. *Official Code*. City of Auburn, Alabama.

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Caltrans. 2000. *Erosion Control Pilot Study Report, June 2000.*

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Pitt, R. 1994. *Small Storm Hydrology*. University of Alabama–Birmingham. Unpublished manuscript. Presented at Design of Stormwater Quality Management Practices. Madison, Wisconsin. May 17 through May 19, 1994.

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Schueler, T. 1994. *The Importance of Imperviousness.* Watershed Protection Techniques 1(3): 100-111.

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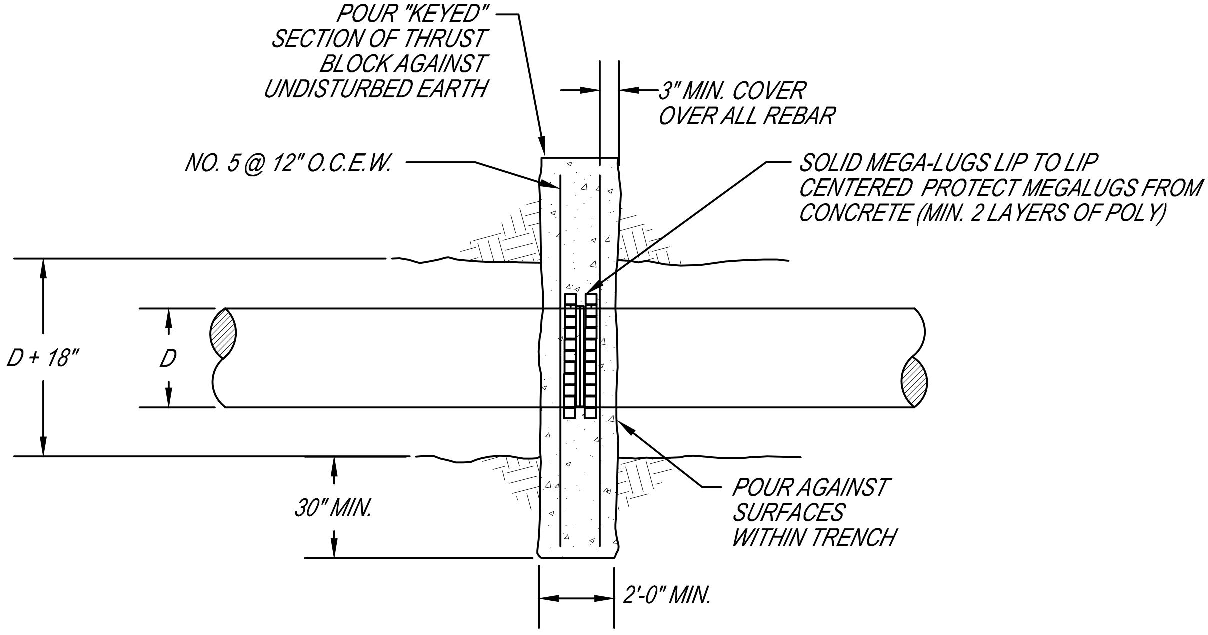
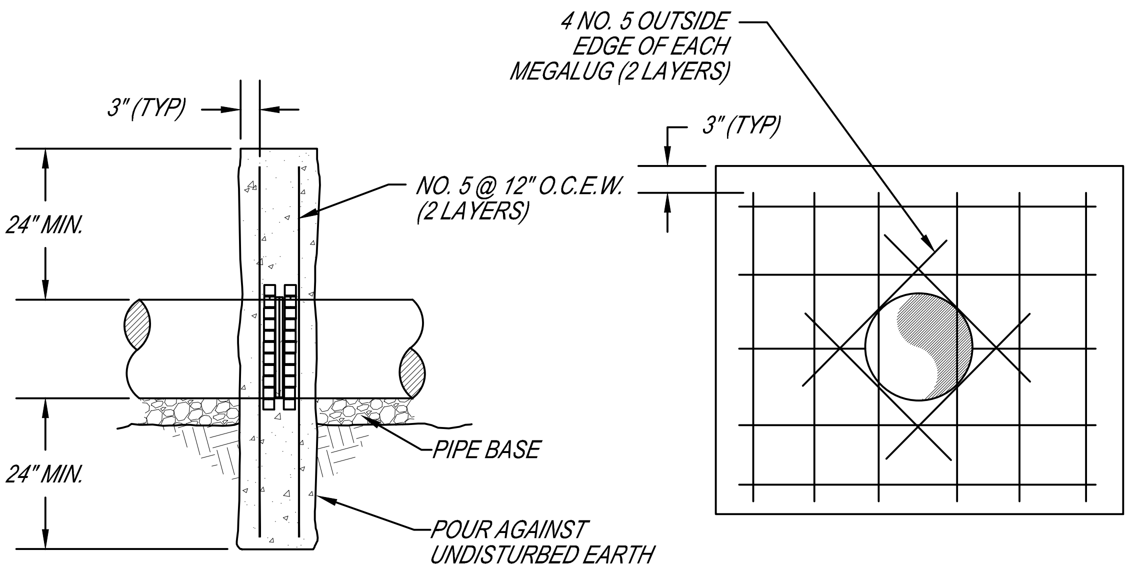
U.S. Department of Agriculture (USDA). 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division. Technical Release 55 (TR-55).

Appendix A
Standard Details

TYPICAL DEADMAN THRUST RESTRAINT



PLAN



PROFILE

FRONT

NOTES:

1. DEADMAN TO BE CENTERED ON FULL JOINT OF PIPE
2. ALL CONCRETE SHALL BE CLASS "A" (4000 PSI) IN ACCORDANCE WITH THE CITY OF AUBURN STANDARD SPECIFICATIONS
3. NO CALCIUM CHLORIDE CURING ACCELERATOR ALLOWED.
4. APPLICABLE FOR UP TO AND INCLUDING 12" DIAMETER PIPE. MAY BE USED FOR PIPES ABOVE 12" DIAMETER ON A CASE BY CASE BASIS.
5. TO BE USED ON EXISTING DUCTILE IRON OR CAST IRON PIPE IN GOOD CONDITION.

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL DEADMAN THRUST RESTRAINT

DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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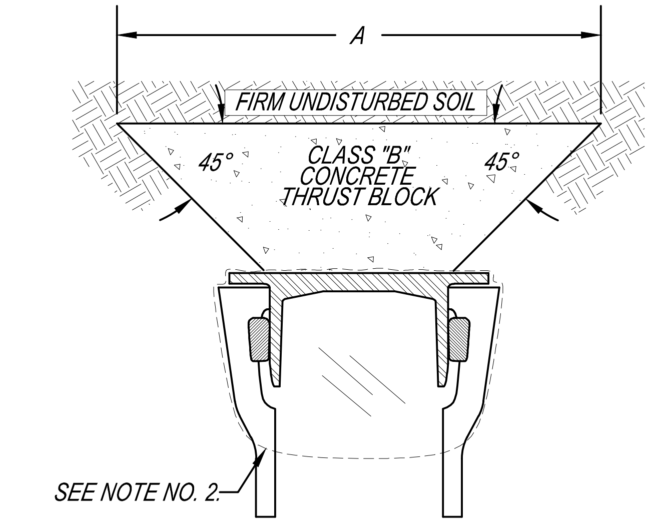
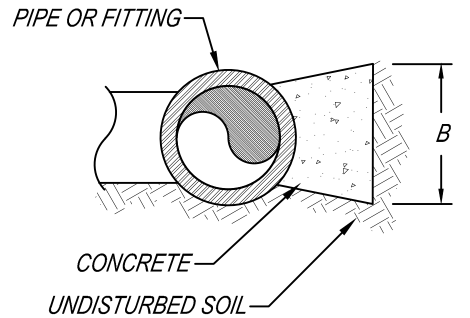
TYPICAL CONCRETE THRUST BLOCK DESIGN



BELL JOINT PLUG UNRESTRAINED TYPE

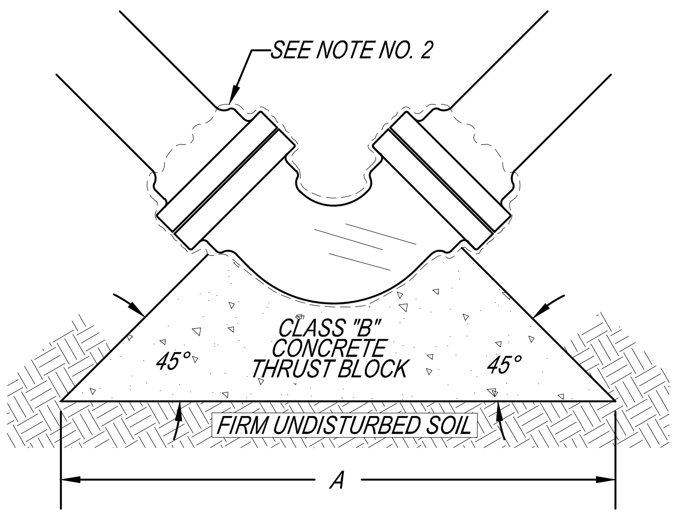


SIDE VIEW

BEARING AREA

AREA (SF) AGAINST UNDISTURBED SOIL

Size	Tee, Wye, Plug or 90° Bend	45° Bend	22.5° Bend	11.5° Bend
4"	1	1	1	1
6"	3	2	1.5	1
8"	5	3	2	1.5
10"	9	5	3	2
12"	12	8	4	3
16"	22	12	5	4
BASED ON 2500 LB/ft.^{2} SOIL				
BEARING AREA (SF) = A x B 1<(A / B)<3				
≤ 100 PSI STATIC PRESSURE (600 MSL OR HIGHER)				

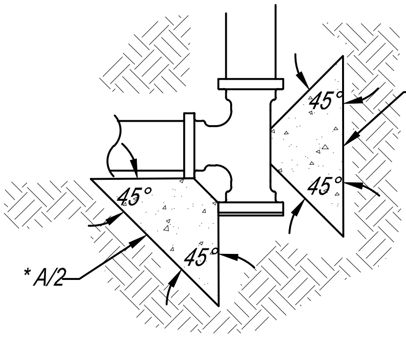


TYPICAL BEND THRUST BLOCK

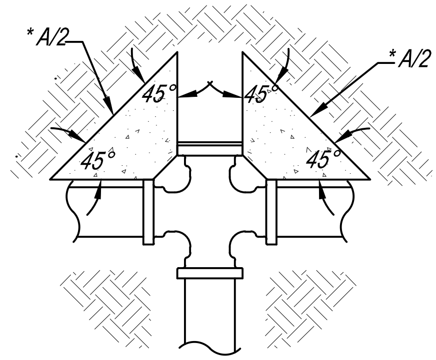
NOTES:

1. 45 DEGREE ANGLES REQUIRED FOR ALL THRUST BLOCKS.
2. NON STANDARD THRUST BLOCKING WILL REQUIRE SPECIAL DETAILING PROVIDED BY A LICENSED ENGINEER AND APPROVED BY THE CITY OF AUBURN.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS.
4. CLASS "B" CONCRETE SHALL BE AS DEFINED IN THE CITY OF AUBURN STANDARD SPECIFICATIONS SECTION II.
5. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

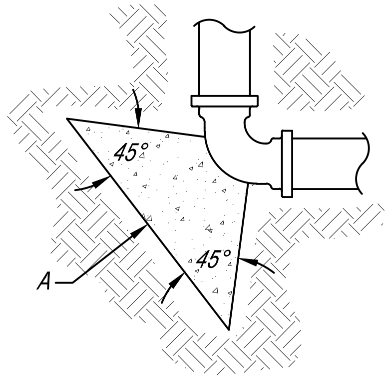
TYPICAL CONCRETE THRUST BLOCK LAYOUT



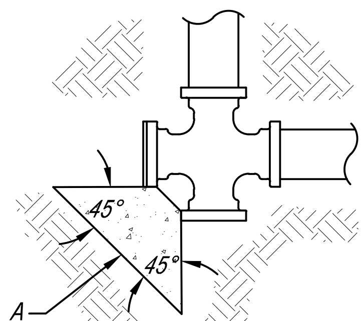
PLUGGED TEE



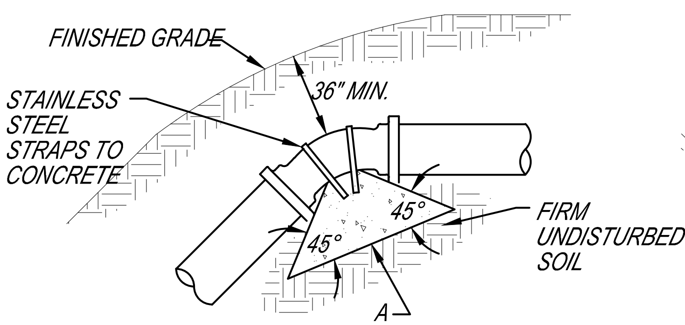
PLUGGED CROSS



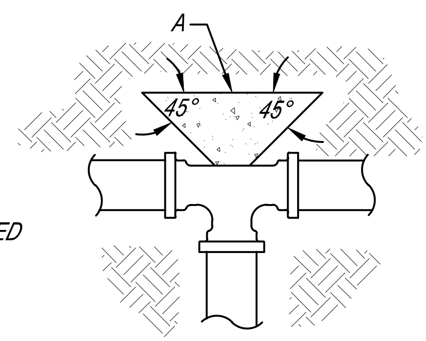
BEND



PLUGGED CROSS



VERTICAL BEND
(AGAINST DISTURBED SOIL)



TEE

NOTES:

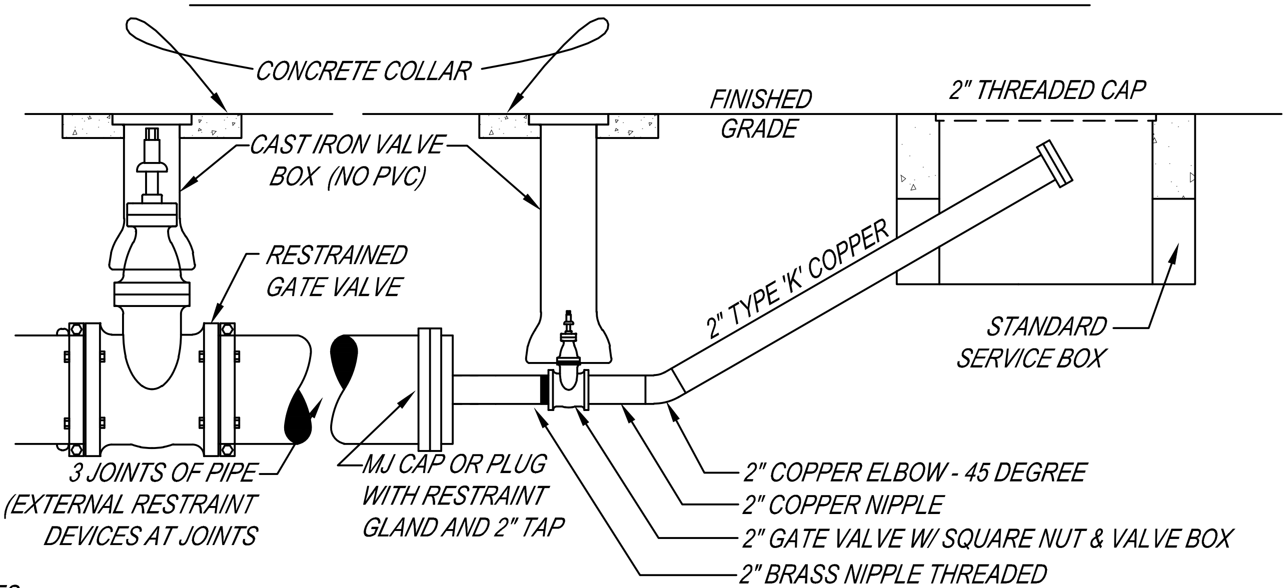
1. 45 DEGREE ANGLES REQUIRED FOR ALL THRUST BLOCKS.
2. NON STANDARD THRUST BLOCKING WILL REQUIRE SPECIAL DETAILING PROVIDED BY A LICENSED ENGINEER AND APPROVED BY THE CITY OF AUBURN.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS.
4. CLASS "B" CONCRETE SHALL BE AS DEFINED IN THE CITY OF AUBURN STANDARD SPECIFICATIONS SECTION II.
5. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL CONCRETE THRUST BLOCK LAYOUT		
DEPARTMENT: WRM	REVISIONS:	204
SCALE: N.T.S.		
DRAWN BY: CN		
REVIEWED BY: JC		
APPROVED BY: EC		
IMPLEMENTED: DCM 2010		

TYPICAL END OF MAIN FOR FUTURE EXTENSION



NOTES:

1. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
2. BLOW OFF SHALL BE PIPED TO CURB AND GUTTER IN ACCORDANCE WITH STANDARD DETAIL NO. 208, WHERE POSSIBLE.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL END OF MAIN FOR FUTURE EXTENSION		
DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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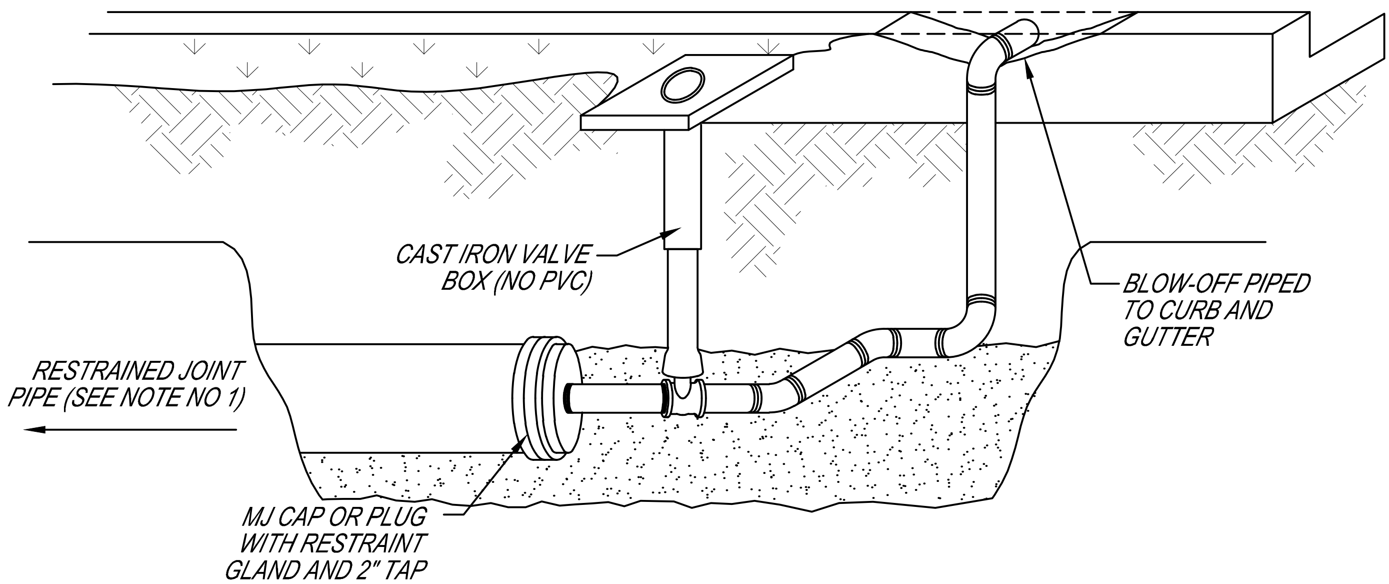
TYPICAL END OF MAIN IN CUL DE SAC



NOTES:

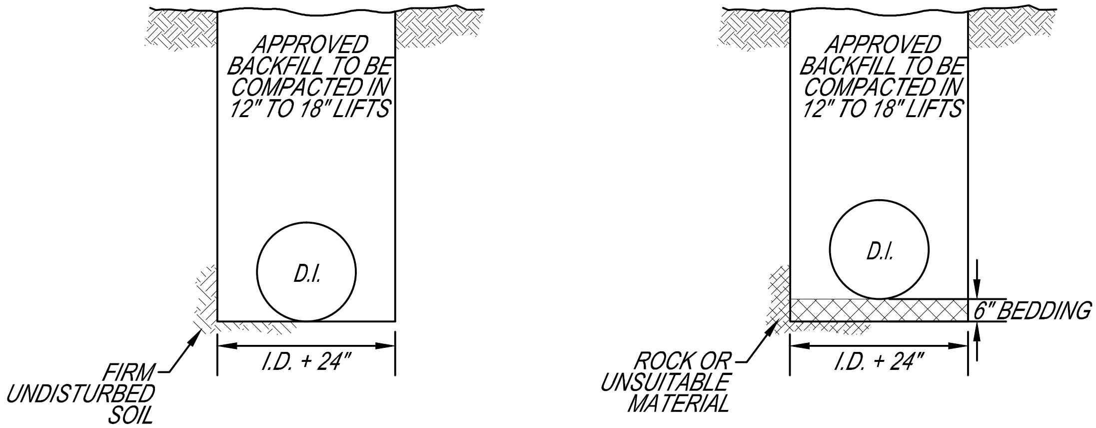
1. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

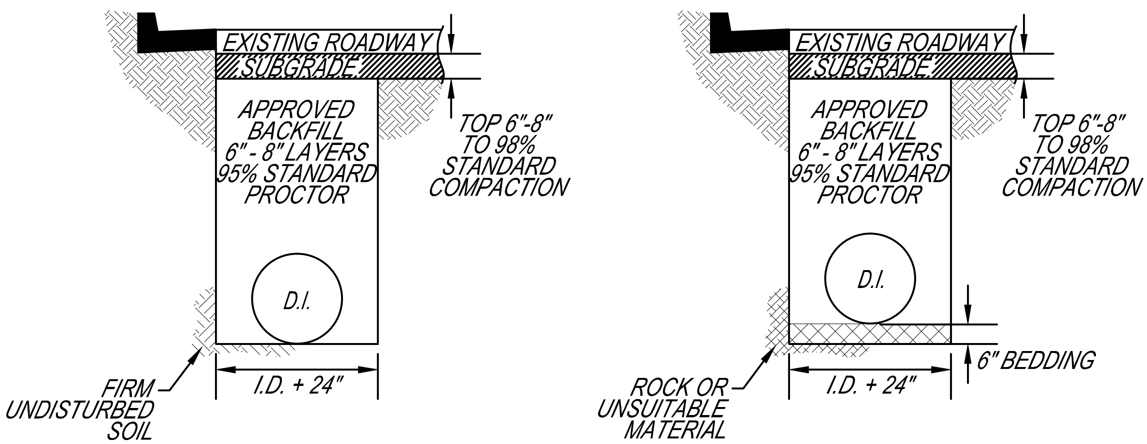
STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL END OF MAIN IN CUL DE SAC			
DEPARTMENT:	WRM	REVISIONS: BS-09-13-07	208
SCALE:	N.T.S.	DCM 2010	
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

BEDDING REQUIREMENTS FOR TRENCHES



NON-STREET TRENCH



STREET TRENCH

NOTES:

1. BEDDING MATERIALS SHALL BE 1/4" TO 1 1/2" GRADED CRUSHED STONE SUCH AS: 56,57,6,67,68,7, OR 78, STONE PER ALDOT STANDARD SPECS.
2. WIDTH VARIES BASED ON WALL STABILITY. STABLE WALLS WIDTH AS NEEDED TO JOIN PIPE AND COMPACT HAUNCHING AND INITIAL BACKFILL. UNSTABLE WALLS: WIDTH TO BE A MINIMUM OF FIVE TIMES PIPE DIAMETER.
3. FLOWABLE FILL CAN BE USED AS BACKFILL, BUT MUST HAVE PRIOR APPROVAL AND MUST BE ALLOWED TO SET FOR 24 HOURS PRIOR TO TOPPING.
4. APPROVED BACKFILL MATERIAL INCLUDES 825 B, FLOWABLE FILL AND APPROVED DIRT. ALTERNATIVE MATERIAL MUST BE APPROVED BY PROJECT MANAGER PRIOR TO USE.

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: BEDDING REQUIREMENTS FOR TRENCHES

DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07	210
SCALE:	N.T.S.		DCM 2010	
DRAWN BY:	GM			
REVIEWED BY:	EC			
APPROVED BY:	RG			
IMPLEMENTED:	02/2003			

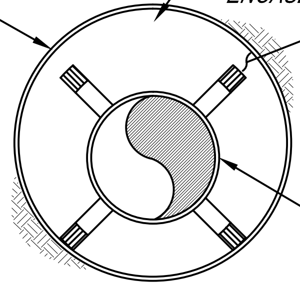
TYPICAL BORE ENCASEMENT

CARRIER PIPE		SPACER	STEEL ENCASEMENT	
NOMINAL PIPE DIAMETER	STANDARD PIPE BELL O.D.*	CASING SPACER BAND WIDTH	MINIMUM CASING THICKNESS	MINIMUM CASING DIAMETER**
4	6.40	8	0.25	14
6	8.60	8	0.25	16
8	11.16	8	0.25	18
10	13.25	8	0.25	20
12	15.22	8	0.25	22
14	17.73	12	0.25	24
16	19.86	12	0.3125	26
18	22.16	12	0.3125	30
20	24.28	12	0.3125	32
24	28.50	12	0.3125	36
30	34.95	12	0.5	42
36	41.37	12	0.5	48

ALL SIZES INDICATED ARE IN INCHES

*PIPE BELL OUTSIDE DIAMETER BASED ON PRESSURE CLASS 350 DUCTILE IRON PIPE.

**CASING DIAMETERS BASED ON BEING A MINIMUM OF 6 INCHES GREATER THAN THE OUTER DIAMETER OF THE JOINT BELL, TO THE NEAREST EVEN SIZE.

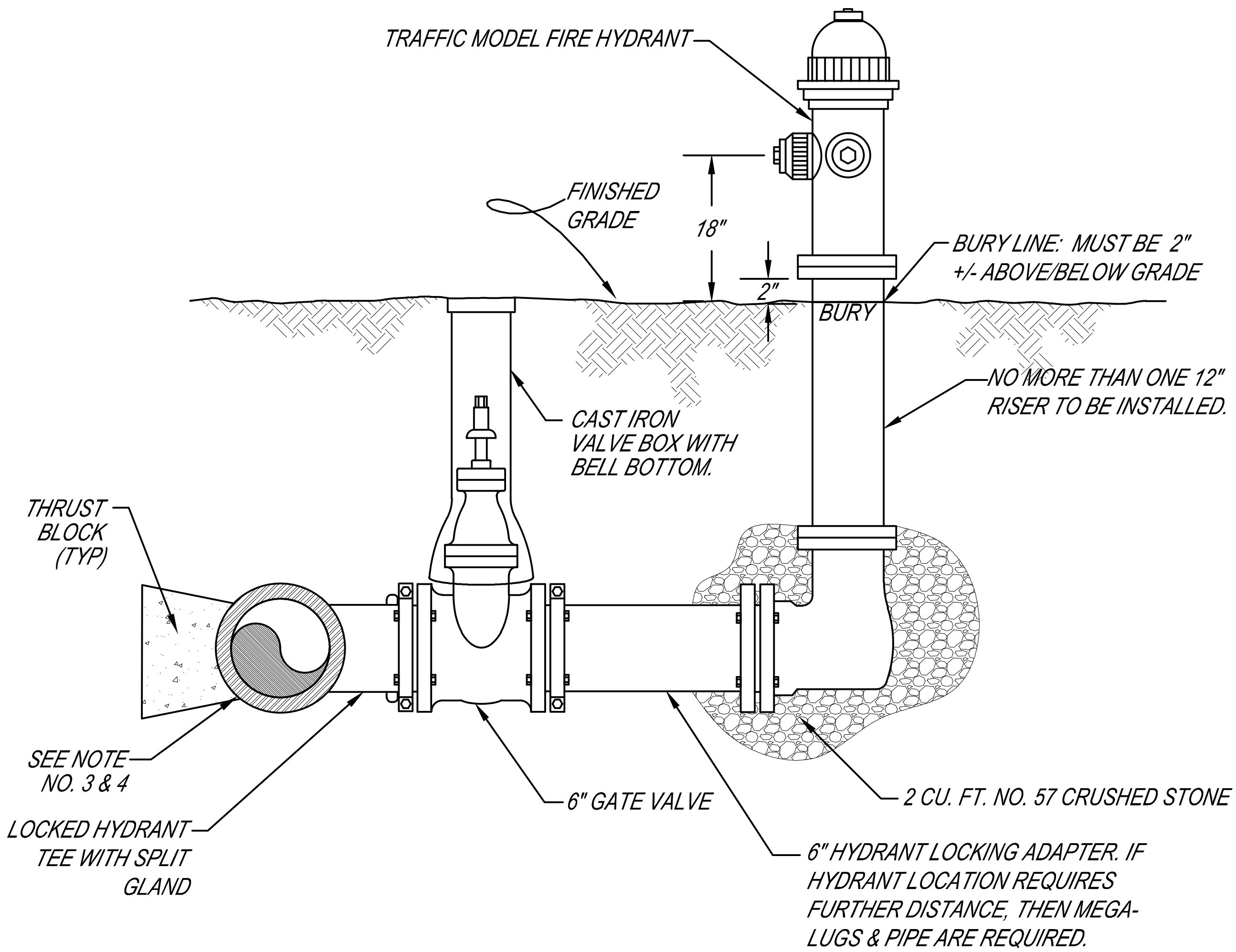


CASING SECTION

NOTES

1. ALL SPACER BANDS SHALL BE MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS.
2. ALL SPACERS SHALL HAVE A SYNTHETIC RUBBER OR PVC LINER TO INSULATE THE PIPELINE FROM THE SPACER.
3. ALL SPACERS SHALL HAVE 1.5" WIDE GLASS REINFORCED PLASTIC OR UHMW POLYMER RUNNERS TO INSULATE THE SPACER.
4. SPACERS TO BE MANUFACTURED BY CASCADE WATERWORKS MFG. CO. (PSI) PIPELINE SEAL AND INSULATOR, INC. OR EQUAL.
5. 6" THRU 12" DIAMETER PIPELINE SHALL USE 8" WIDE BANDS: GREATER THAN 12" DIAMETER PIPELINES SHALL USE 12" WIDE BANDS.
6. CENTERED RESTRAINED CASING SPACERS SHALL BE SPACED AT A MAXIMUM OF TEN FEET APART WITH A MINIMUM OF TWO SPACERS PER JOINT OF PIPE.

TYPICAL FIRE HYDRANT INSTALLATION



NOTES:

1. ALL FIRE HYDRANTS SHALL HAVE NATIONAL STANDARD THREADS, 4 1/2-INCH STEAMER & 2 1/2-INCH HOSE NOZZLE, AND SHALL BE MUELLER CENTURION, OR AMERICAN DARLING B-84-B, OR APPROVED EQUAL. BRONZE TO BRONZE SEATED. EPOXY COATED SHOES. WEATHER CAPS SHALL NOT BE MADE OF RUBBER.
2. ALL FIRE HYDRANTS SHALL BE LEVELED AND PLUMBED DURING INSTALLATION.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS.
4. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS. THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
5. USE MEGA-LUGS BETWEEN HYDRANT AND GATE VALVE.
6. HYDRANT LOCKING TEE TO BE USED IN LIEU OF STANDARD M.J. TEE ON ALL FIRE HYDRANT CONNECTIONS.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL FIRE HYDRANT ASSEMBLY		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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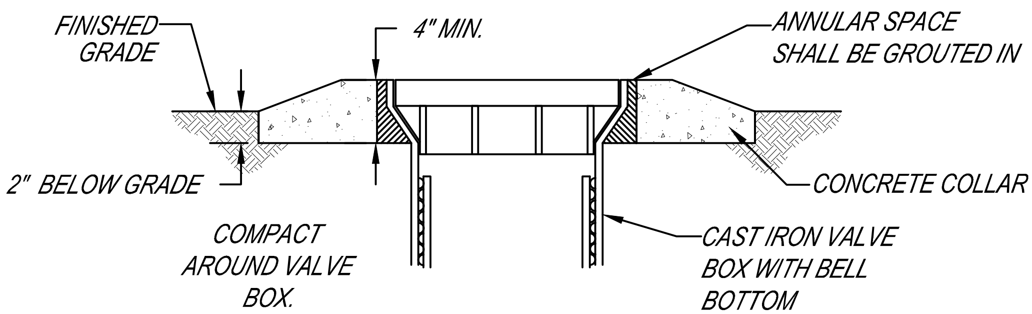
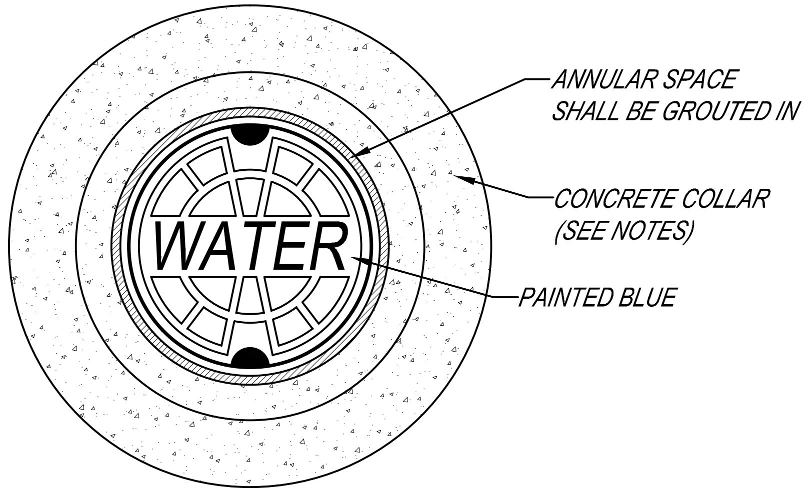
TYPICAL VALVE BOX INSTALLATION





NOTE:

1. CONCRETE COLLAR MAY BE CAST-IN-PLACE OR PRECAST AND MAY BE ROUND OR SQUARE IN SHAPE.
2. CONCRETE COLLAR SHALL BE A MIN. 4" THICK.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL VALVE BOX INSTALLATION		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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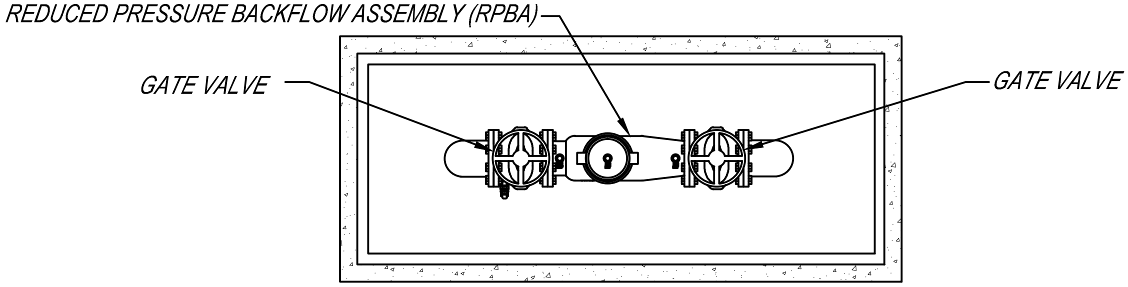
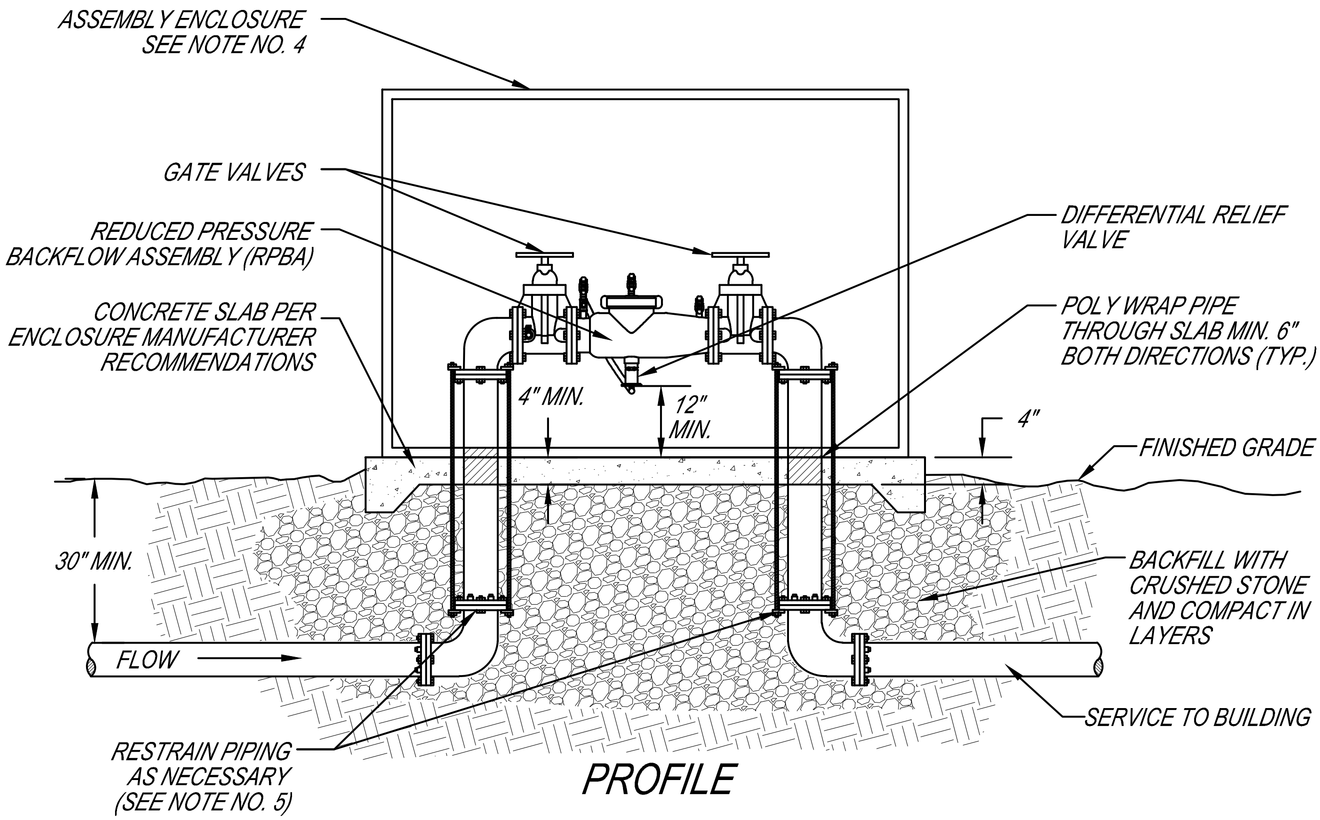
TYPICAL REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA)



PLAN



PROFILE

NOTES:

1. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. RPBA TO BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
4. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED SO AS TO ENSURE AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.
5. RESTRAINT SYSTEM SHALL BE DESIGNED FOR SPECIFIC INSTALLATION CONDITIONS. WHERE STATIC PRESSURES EXCEED 100 PSI, MEGA-LUG RESTRAINTS USED ON VERTICAL BENDS SHALL BE REINFORCED WITH S.S. RODS.

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA)

DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		JC-12-2012
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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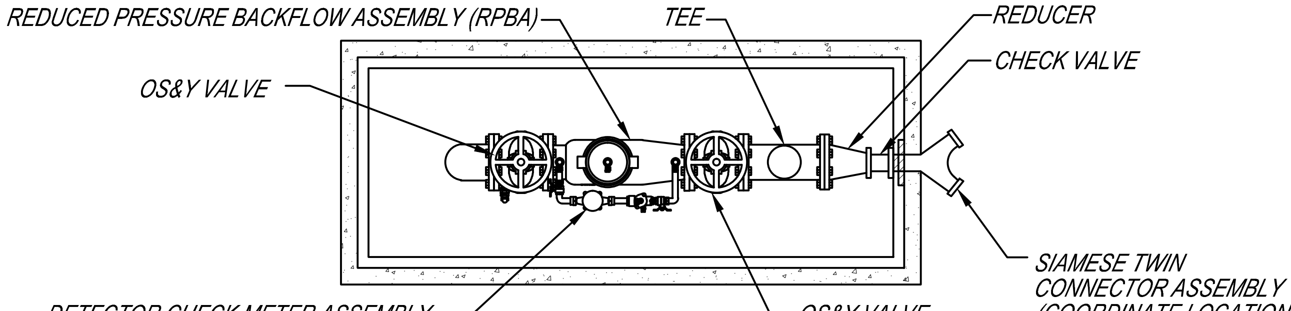
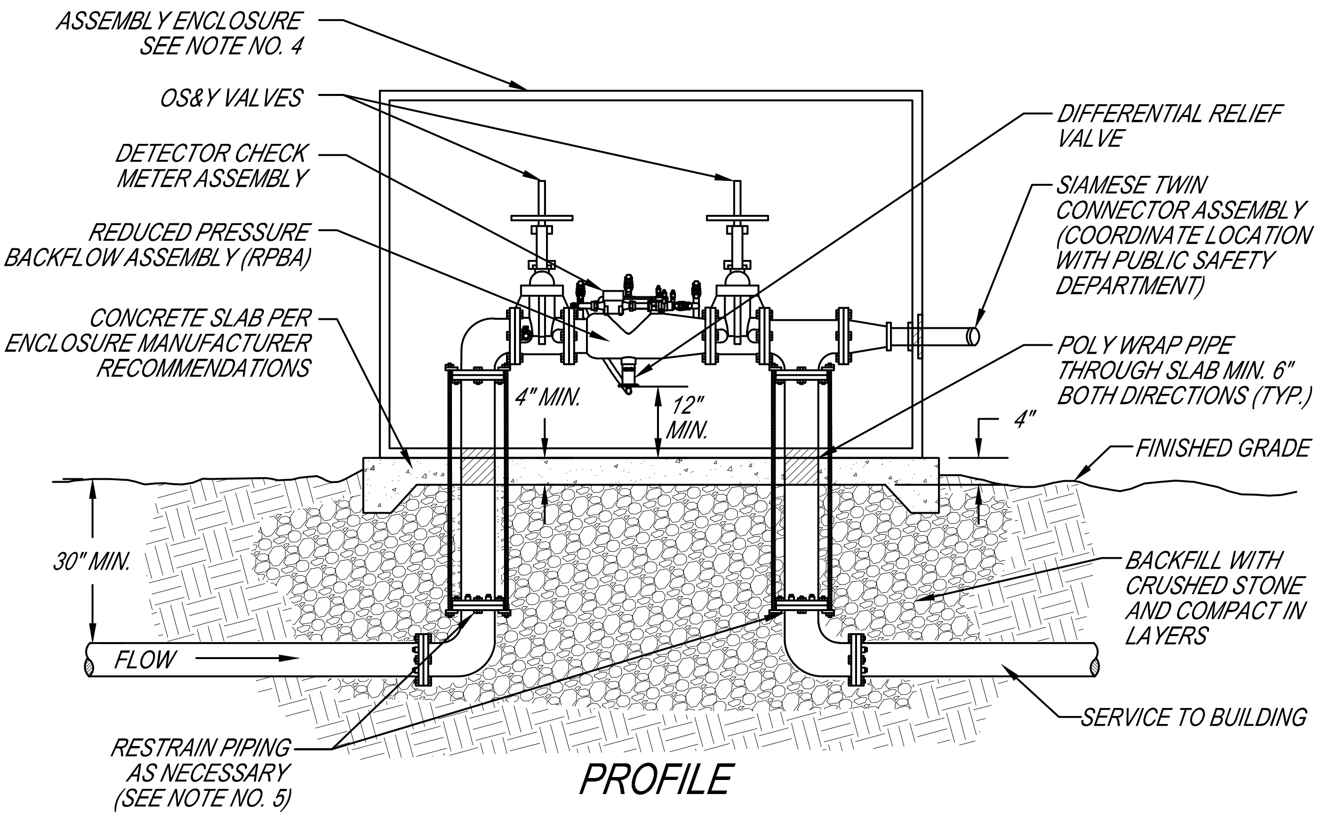
TYPICAL FIRE PROTECTION SYSTEM RPBA



PLAN



PROFILE

NOTES:

1. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. RPBA TO BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
4. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED TO PROTECT AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.
5. RESTRAINT SYSTEM SHALL BE DESIGNED FOR SPECIFIC INSTALLATION CONDITIONS. WHERE STATIC PRESSURES EXCEED 100 PSI, MEGA-LUG RESTRAINTS USED ON VERTICAL BENDS SHALL BE REINFORCED WITH S.S. RODS.

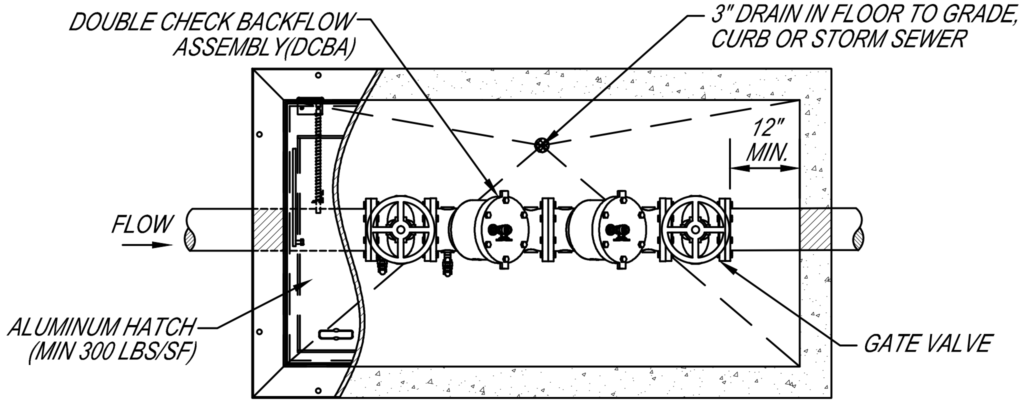
THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

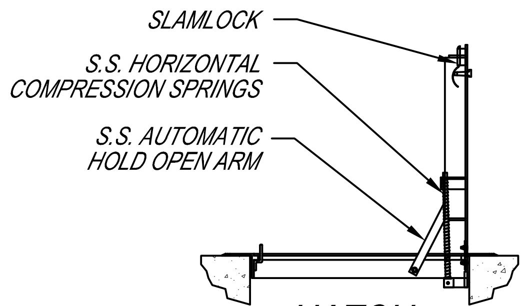
DRAWING TITLE: TYPICAL FIRE PROTECTION SYSTEM RPBA

DEPARTMENT:	WRM	REVISIONS:	DCM 2010	219
SCALE:	N.T.S.		JC-10-2011	
DRAWN BY:	BS		JC-12-2012	
REVIEWED BY:	JC			
APPROVED BY:	EC			
IMPLEMENTED:	12/2007			

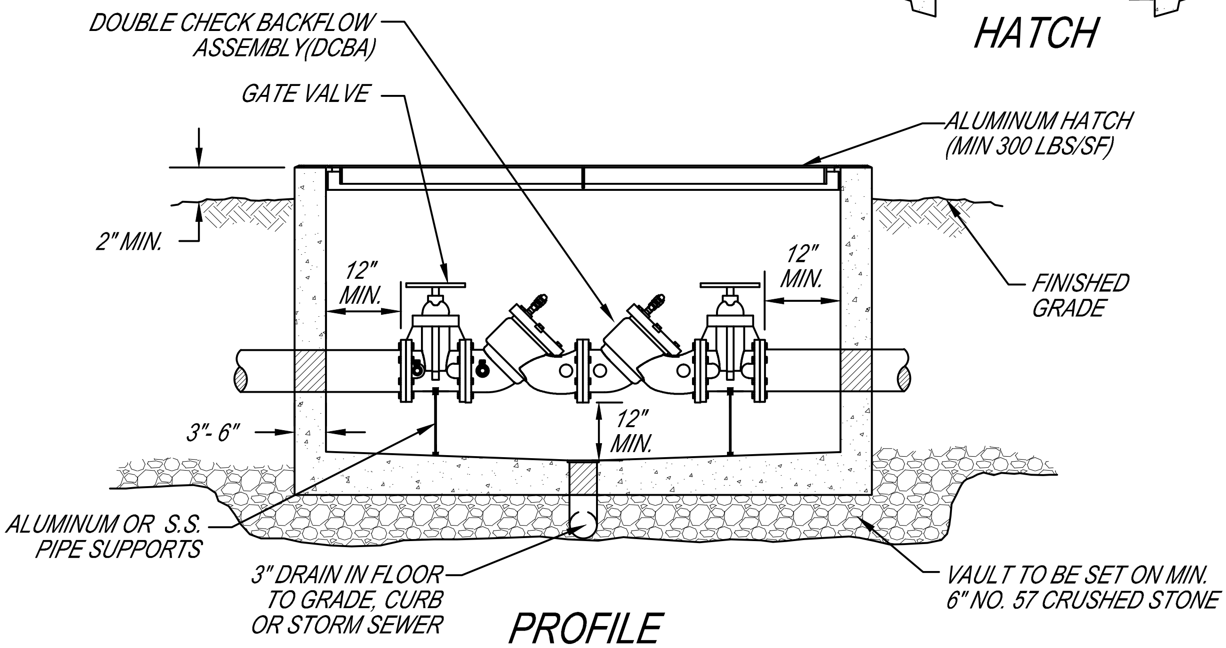
TYPICAL DOUBLE CHECK BACKFLOW ASSEMBLY (DCBA)



PLAN



HATCH



PROFILE

NOTES:

1. DOUBLE CHECK BACKFLOW ASSEMBLY SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

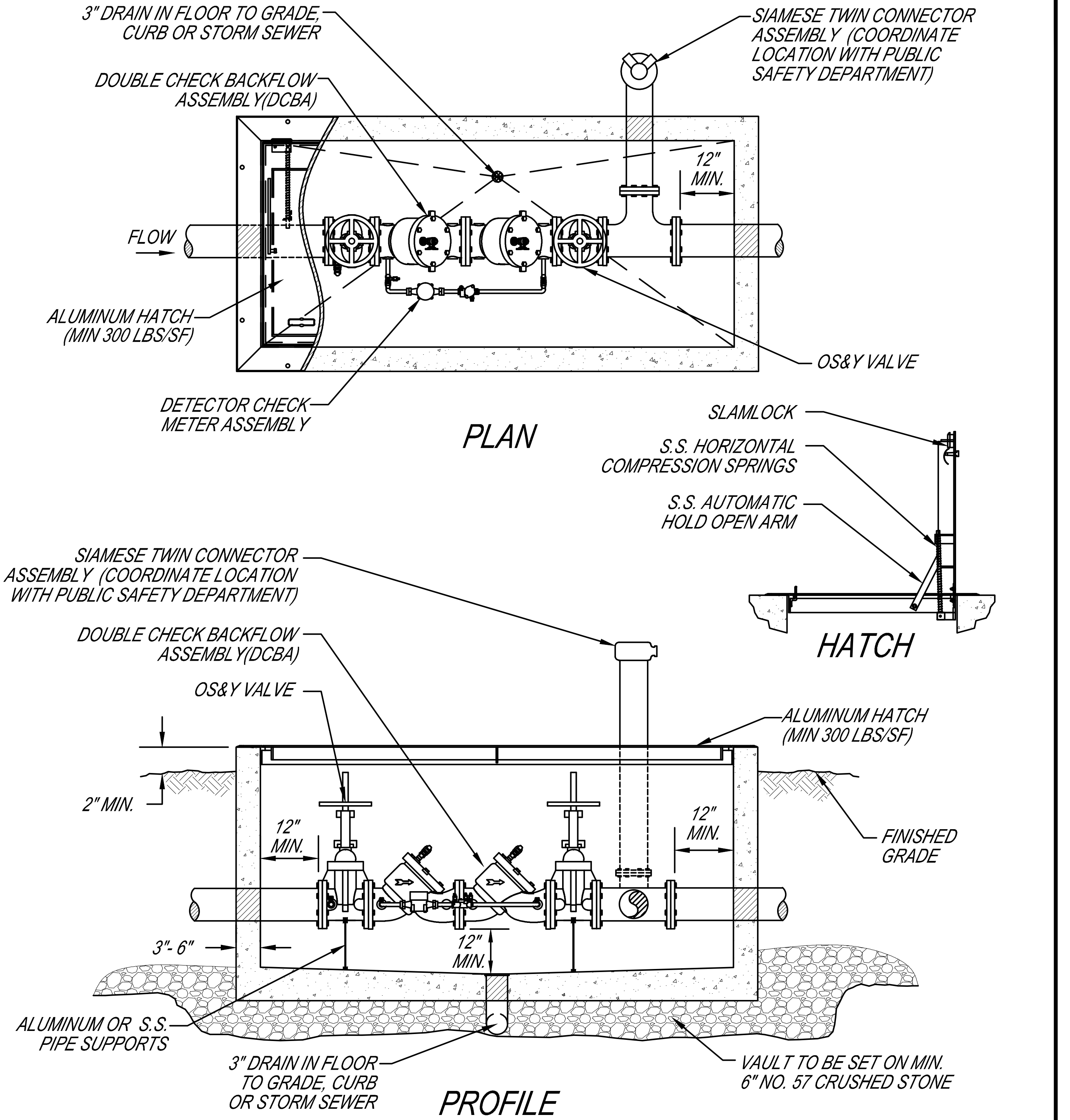
STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL DOUBLE CHECK BACKFLOW ASSEMBLY (DCBA)

DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

220

TYPICAL FIRE PROTECTION SYSTEM DCBA



NOTES:

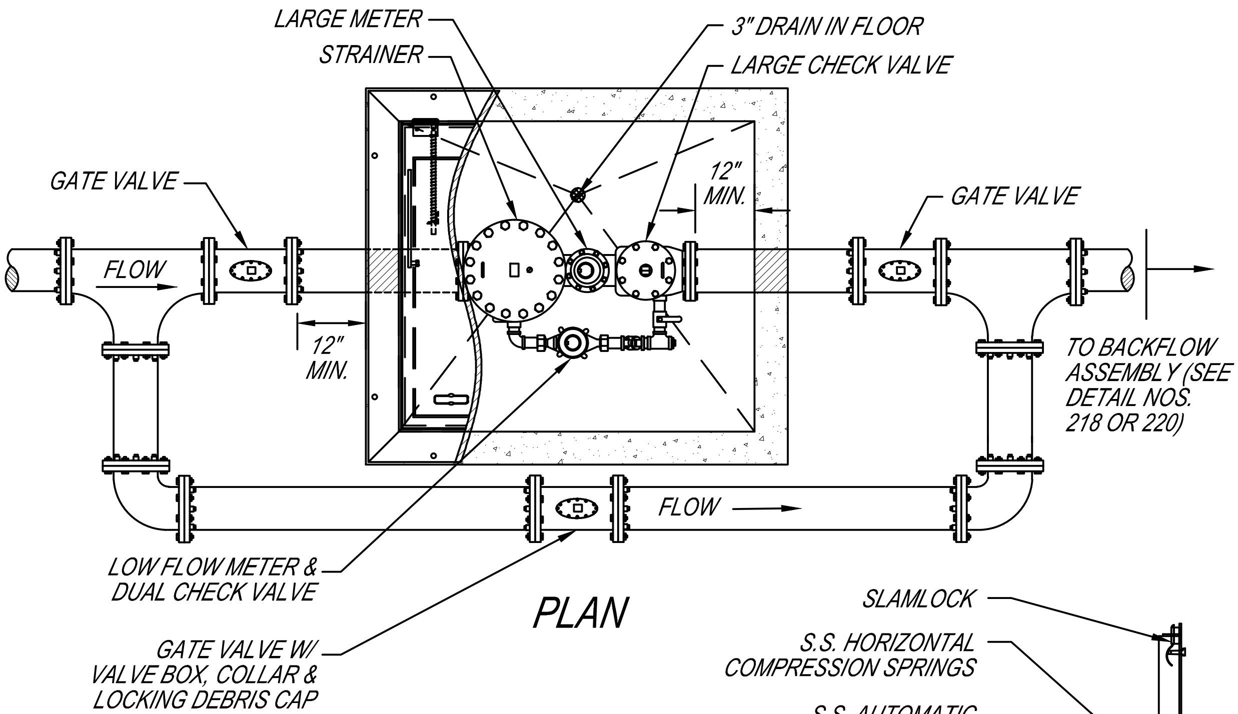
1. DOUBLE CHECK BACKFLOW ASSEMBLY SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

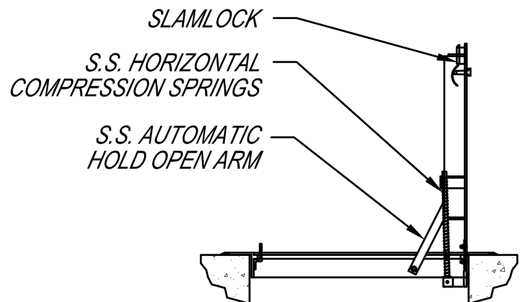
STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL FIRE PROTECTION SYSTEM DCBA		
DEPARTMENT:	WRM	REVISIONS: DCM 2010	221
SCALE:	N.T.S.	JC-10-2011	
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

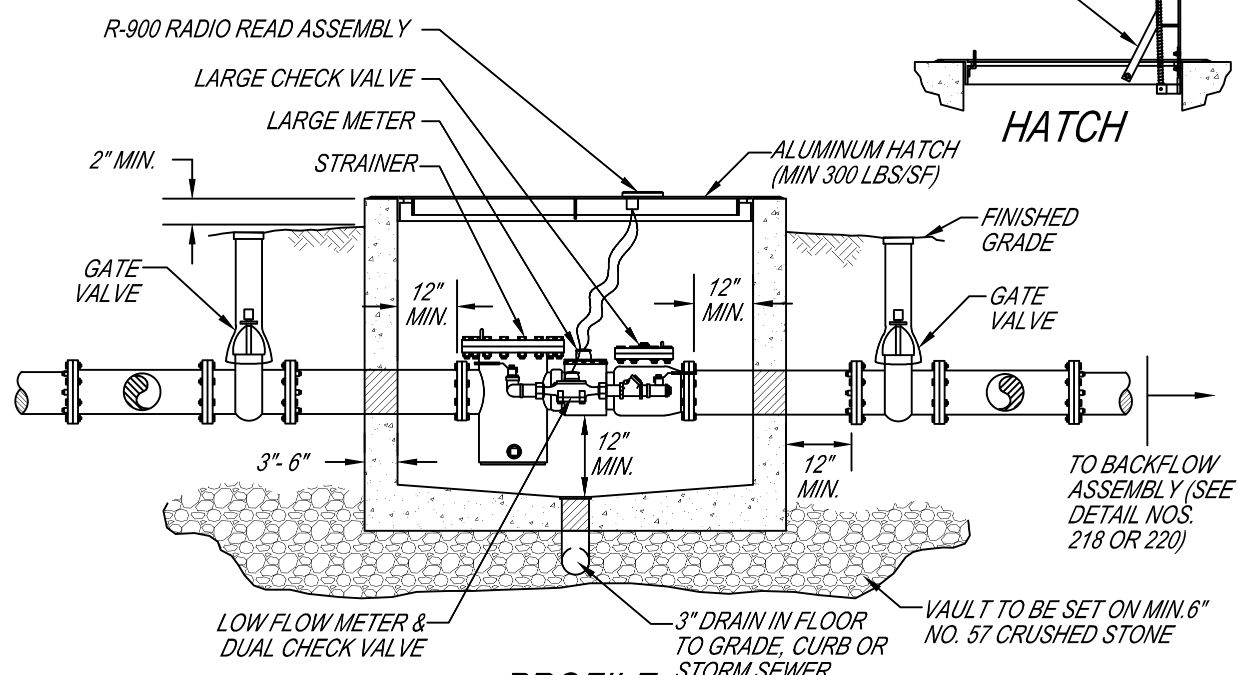
TYPICAL FIRE / DOMESTIC METER VAULT (4" AND LARGER)



PLAN



HATCH



PROFILE

NOTES:

1. COMBINATION FIRE / DOMESTIC METER SHALL BE NEPTUNE PROTECTUS III.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. THE APPROPRIATE BACKFLOW ASSEMBLY IN ACCORDANCE WITH STANDARD DETAIL NOS. 218 OR 220 SHALL BE INSTALLED IMMEDIATELY FOLLOWING THE METER ASSEMBLY.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL FIRE / DOMESTIC METER VAULT (4" AND LARGER)

DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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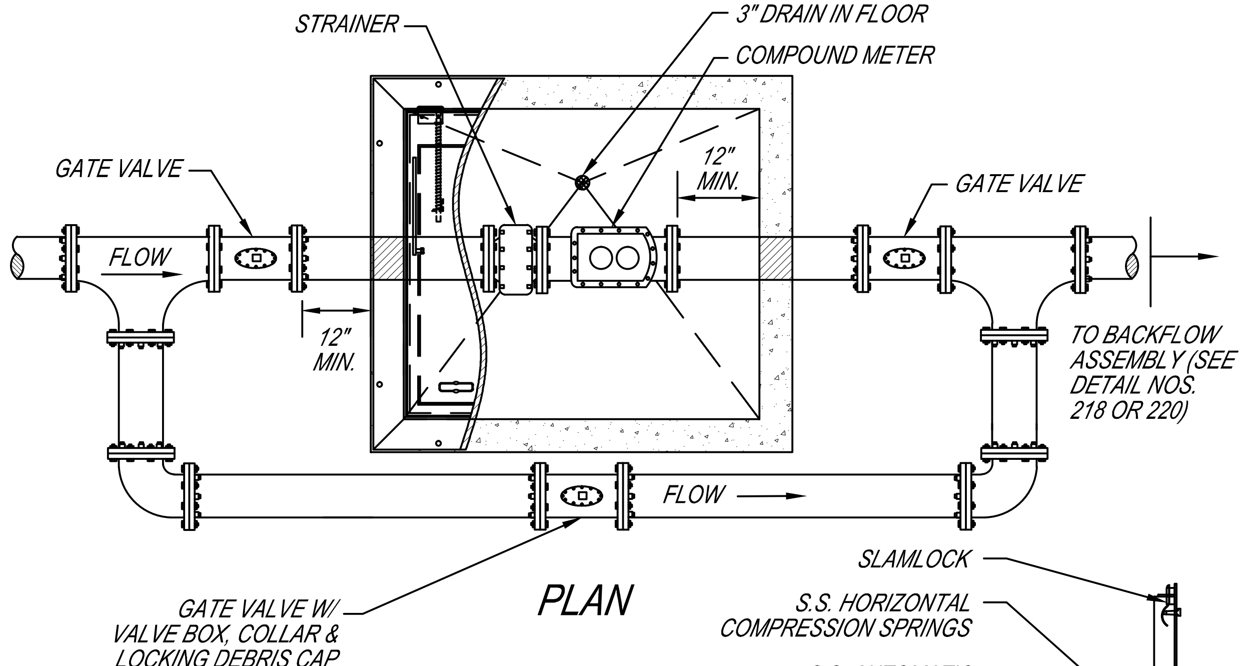
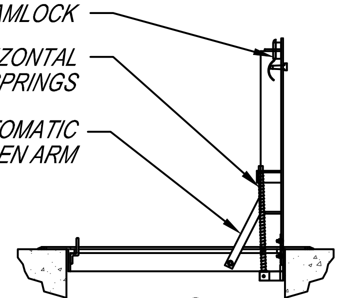
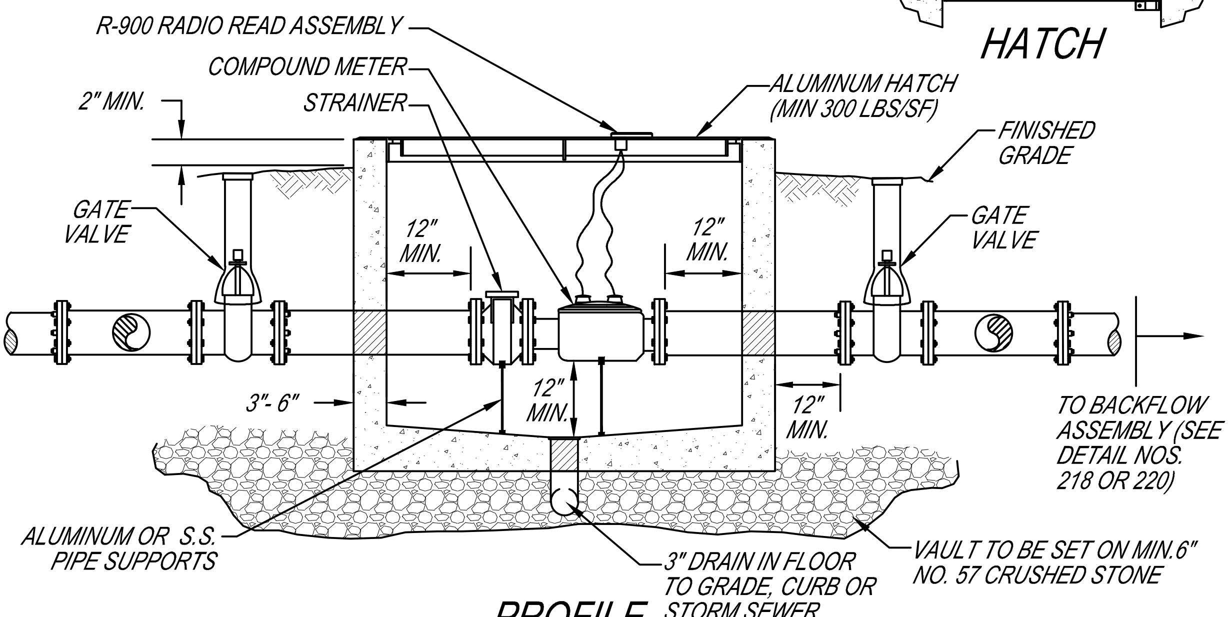
TYPICAL LARGE DOMESTIC METER VAULT (3" AND LARGER)



PLAN



HATCH



PROFILE

NOTES:

1. LARGE METER SHALL BE NEPTUNE TRU-FLOW COMPOUND METER.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. THE APPROPRIATE BACKFLOW ASSEMBLY IN ACCORDANCE WITH STANDARD DETAIL NOS. 218 OR 220 SHALL BE INSTALLED IMMEDIATELY FOLLOWING THE METER ASSEMBLY.

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL LARGE DOMESTIC METER VAULT (3" AND LARGER)		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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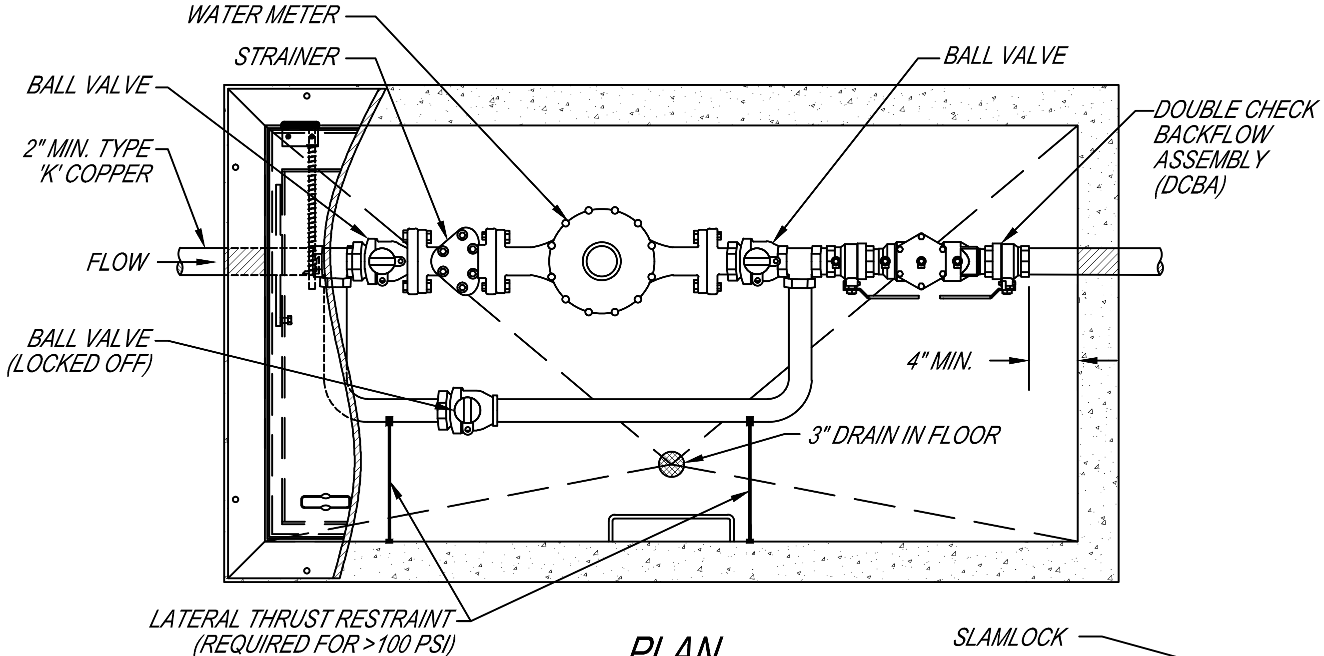
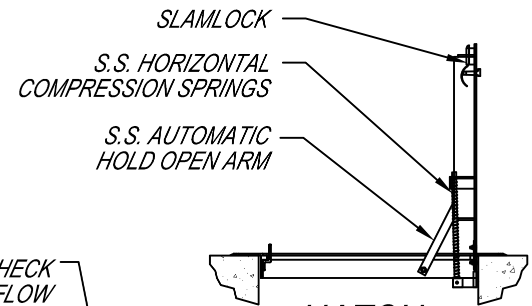
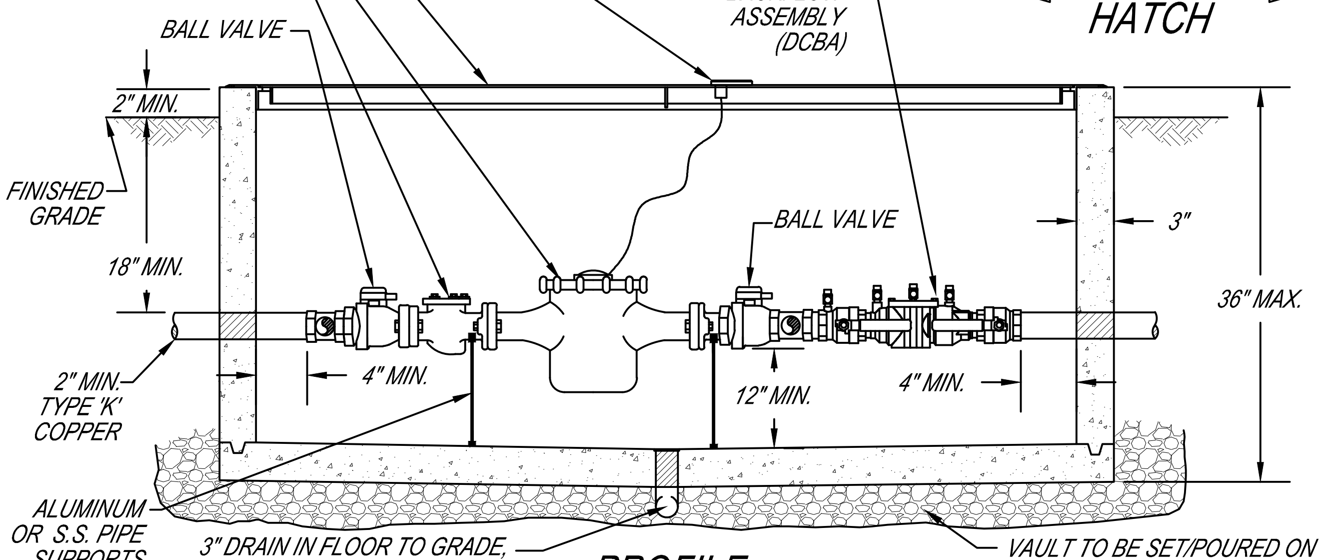
TYPICAL 1.5" TO 2.0" METER VAULT W/ DCBA



PLAN



HATCH



PROFILE

NOTES:

1. METER SHALL BE NEPTUNE T-10 METER, UNLESS OTHERWISE SPECIFIED AND APPROVED BY THE AWWB.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

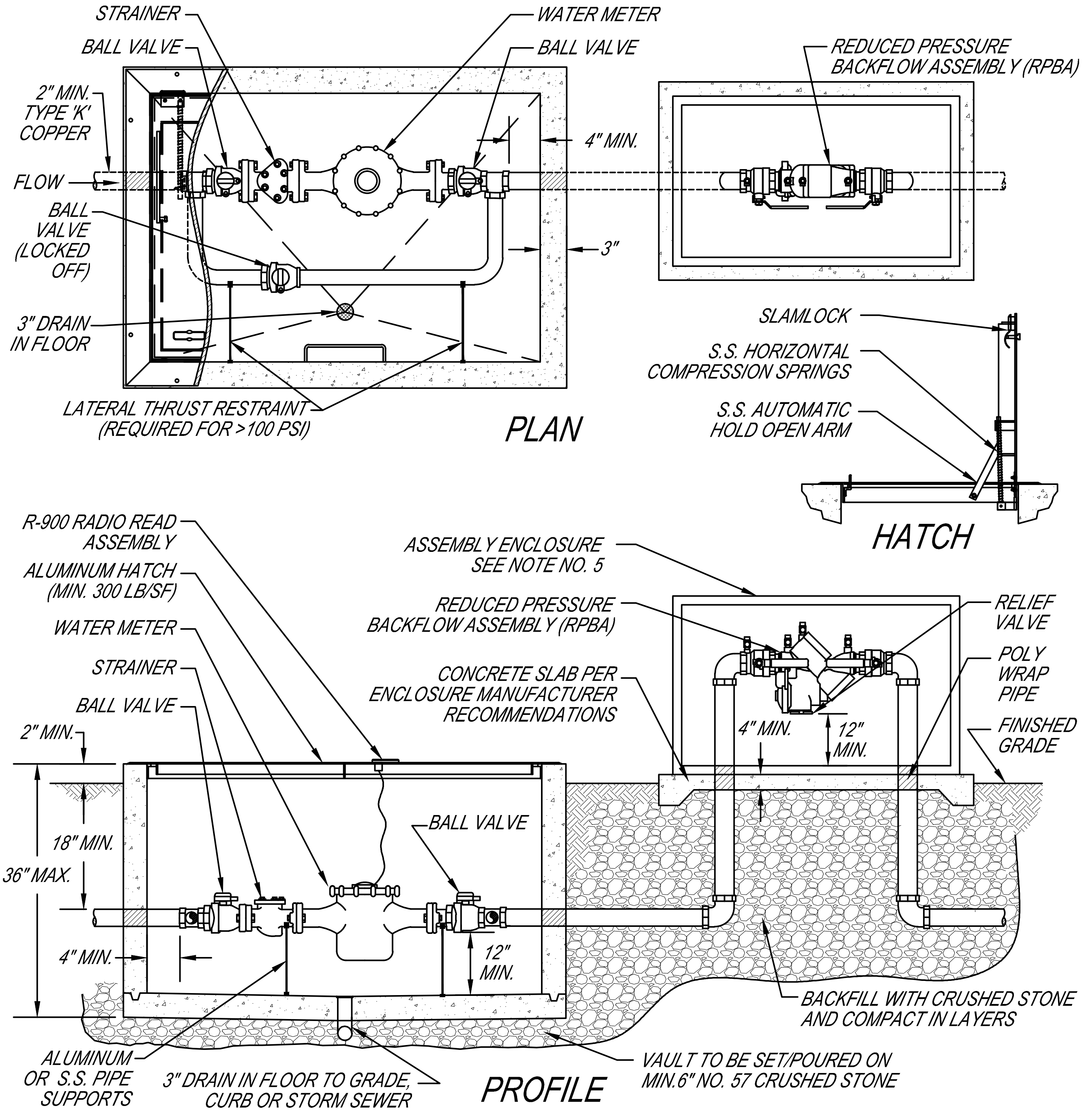
THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL 1.5" TO 2.0" METER VAULT W/ DCBA

DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07	226
SCALE:	N.T.S.		DCM 2010	
DRAWN BY:	GM		JC-10-2011	
REVIEWED BY:	EC			
APPROVED BY:	RG			
IMPLEMENTED:	02/2003			

TYPICAL 1.5" TO 2.0" METER VAULT W/ RPBA



NOTES:

1. METER SHALL BE NEPTUNE T-10 METER, UNLESS OTHERWISE SPECIFIED AND APPROVED BY THE AWWB.
2. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
3. VAULTS AND RPBA SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
4. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
5. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED TO PROTECT AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL 1.5" TO 2.0" METER VAULT W/ RPBA		
DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		JC-10-2011
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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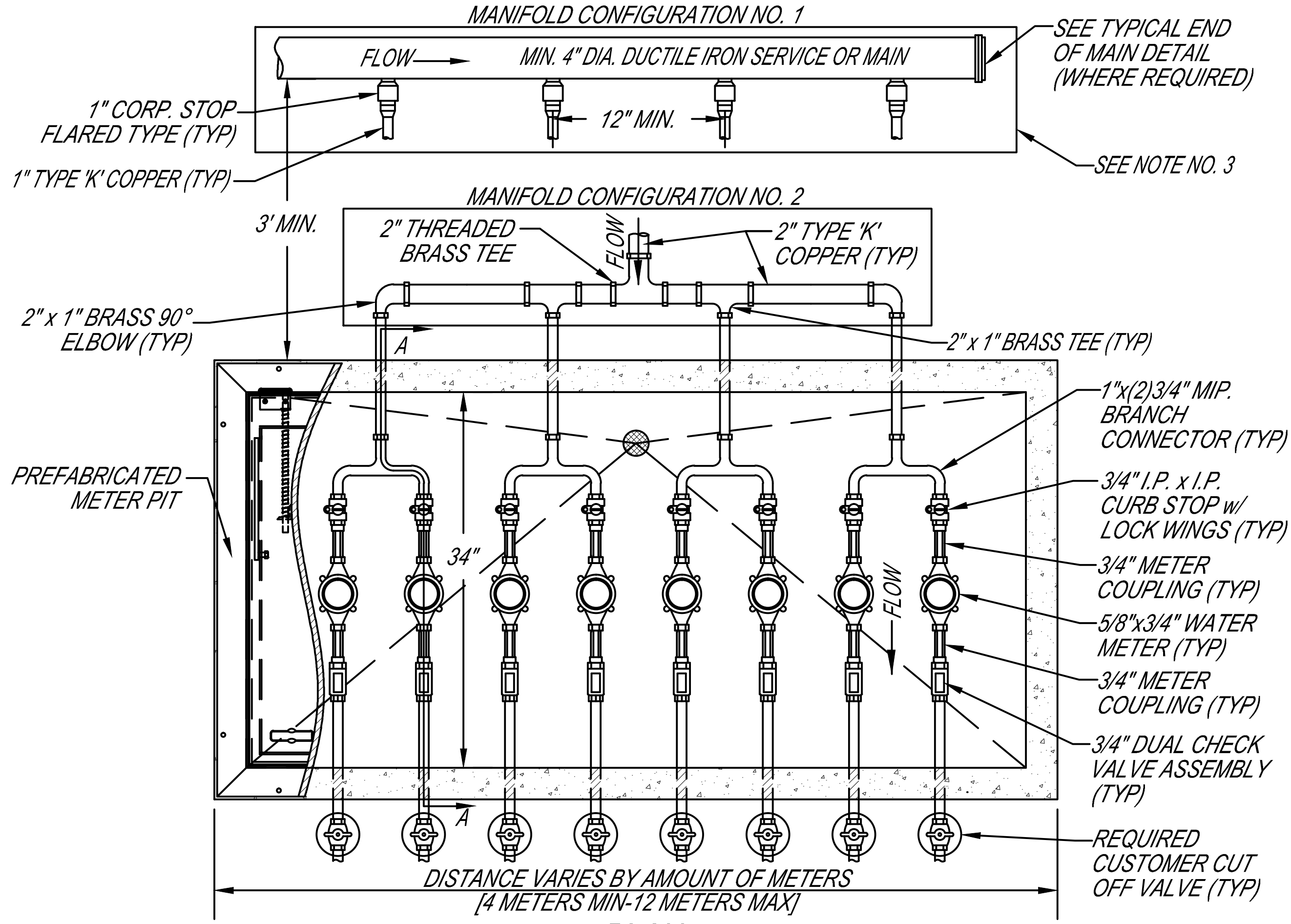
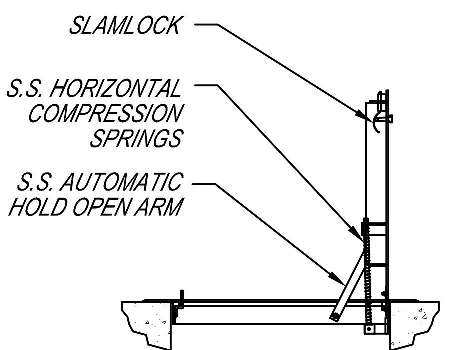
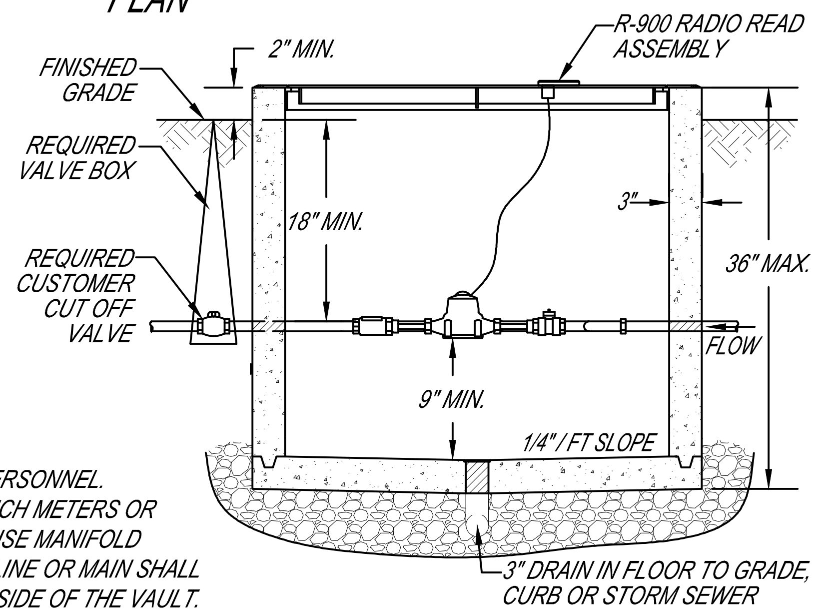
TYPICAL MULTIPLE METER VAULT



PLAN



HATCH



PLAN SECTION A - A

NOTES:

1. METER SHALL BE NEPTUNE T-10 METER.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL.
3. METER PITS WITH MORE THAN EIGHT 3/4-INCH METERS OR MORE THAN FOUR 1-INCH METERS SHALL USE MANIFOLD CONFIGURATION NO. 1, AND THE SERVICE LINE OR MAIN SHALL BE INSTALLED PARALLEL TO THE SERVICE SIDE OF THE VAULT.
4. ALL LONG SIDE CONNECTIONS SHALL INSTALL A SINGLE SERVICE FROM THE MAIN TO THE MANIFOLD AT THE METER PIT.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL MULTIPLE METER VAULT		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

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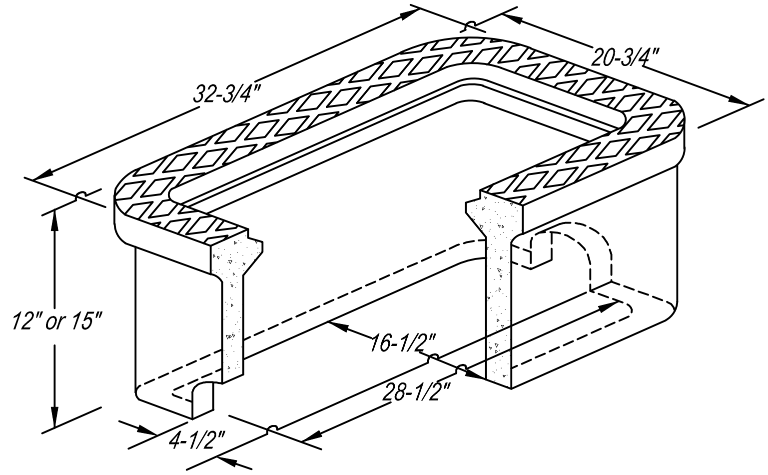
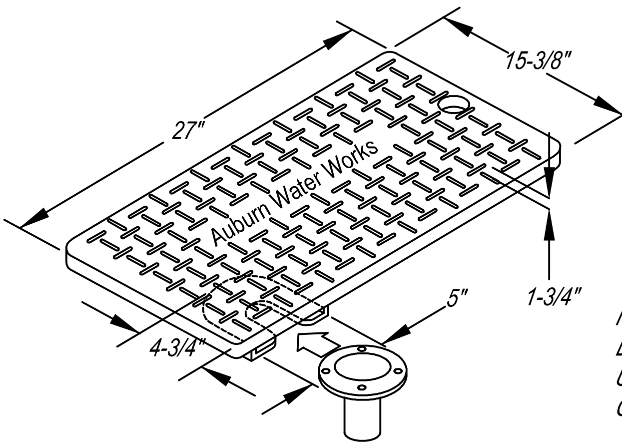
CONCRETE SERVICE BOX

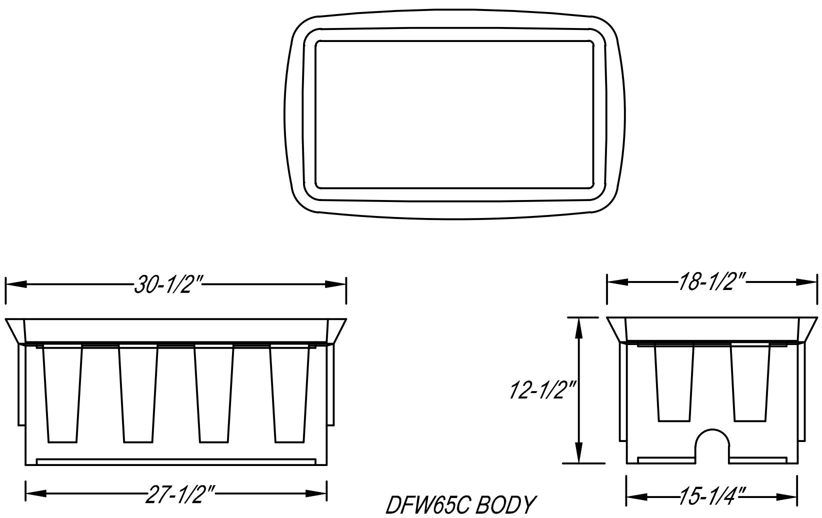


SERVICE BOX LID



NOTE:
DFW-65C LID SHALL BE
USED FOR PLASTIC OR
CONCRETE SERVICE BOX

REINFORCED PLASTIC SERVICE BOX



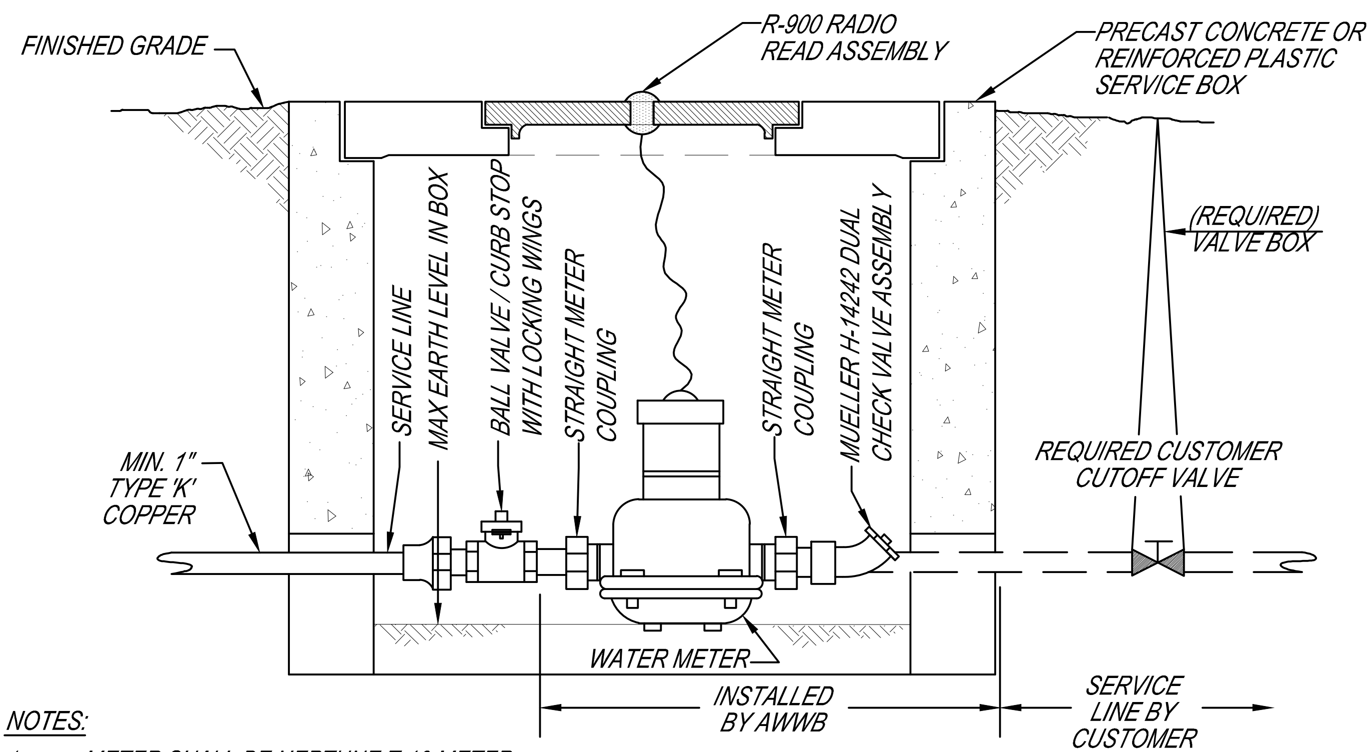
DFW65C BODY

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL SERVICE BOX AND LID		
DEPARTMENT:	WRM	REVISIONS: BS-09-13-07	230
SCALE:	N.T.S.	DCM 2010	
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

TYPICAL 3/4" TO 1" METER



NOTES:

1. METER SHALL BE NEPTUNE T-10 METER.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL 3/4" TO 1" METER		
DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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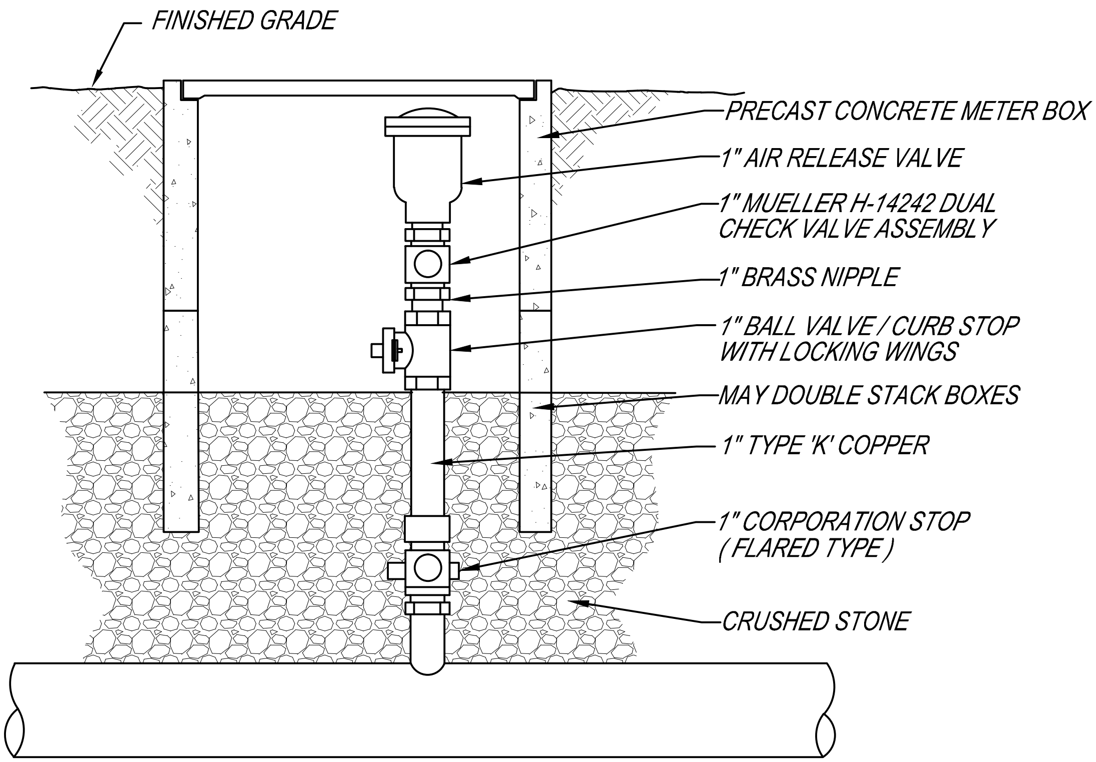
TYPICAL AUTOMATIC AIR RELEASE VALVE



THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL AUTOMATIC AIR RELEASE VALVE		
DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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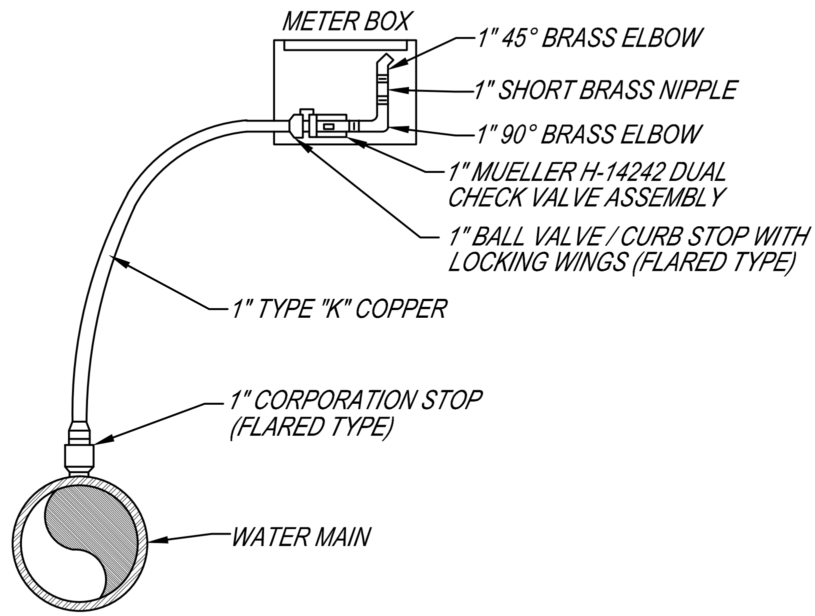
TYPICAL MANUAL AIR RELEASE VALVE

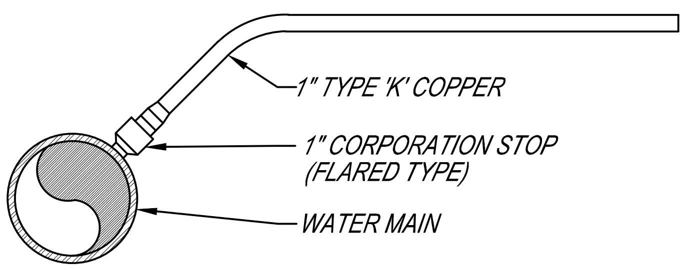


THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL MANUAL AIR RELEASE VALVE		
DEPARTMENT:	WRM	REVISIONS: BS-09-13-07	236
SCALE:	N.T.S.	DCM 2010	
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

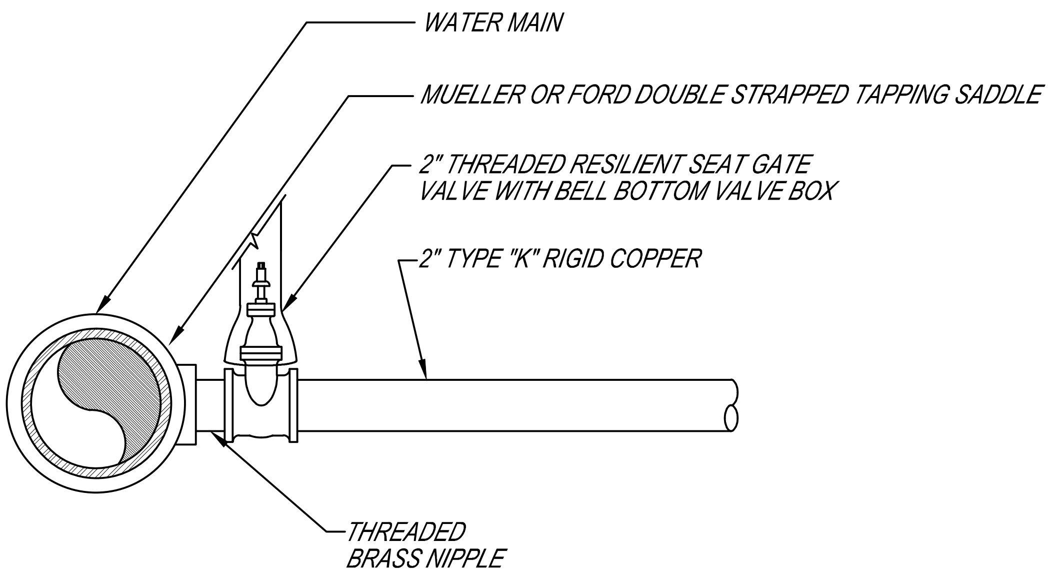
TYPICAL 1" SERVICE CONNECTION



NOTES:

1. TYPICAL 1" SERVICE CONNECTION SHALL BE USED AT A MINIMUM FOR ALL3/4" AND 1" METER INSTALLATIONS.

TYPICAL 2" SERVICE CONNECTION



NOTES:

1. TYPICAL 2" SERVICE CONNECTION SHALL BE USED AT A MINIMUM FOR ALL 1-1/2" AND 2" METER INSTALLATIONS.

THE WATER WORKS BOARD OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE: TYPICAL 2" SERVICE CONNECTION

DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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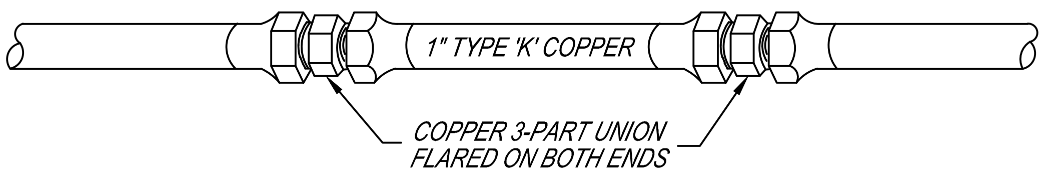
TYPICAL COPPER REPAIR (1" ONLY)

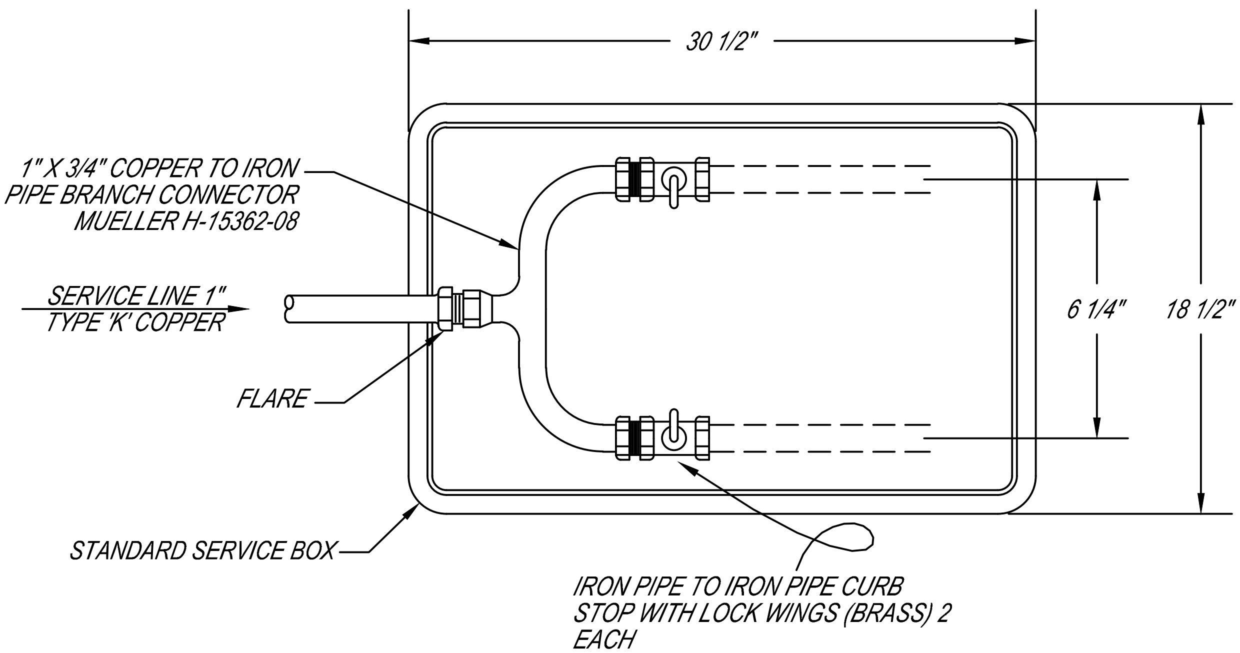


THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL COPPER REPAIR (1" ONLY)		
DEPARTMENT:	WRM	REVISIONS: BS-09-13-07	242
SCALE:	N.T.S.	DCM 2010	
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

TYPICAL DOUBLE SERVICE CONNECTION



THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

STANDARD WATER DETAILS

DRAWING TITLE:	TYPICAL DOUBLE SERVICE CONNECTION		
DEPARTMENT:	WRM	REVISIONS:	BS-09-13-07
SCALE:	N.T.S.		DCM 2010
DRAWN BY:	GM		
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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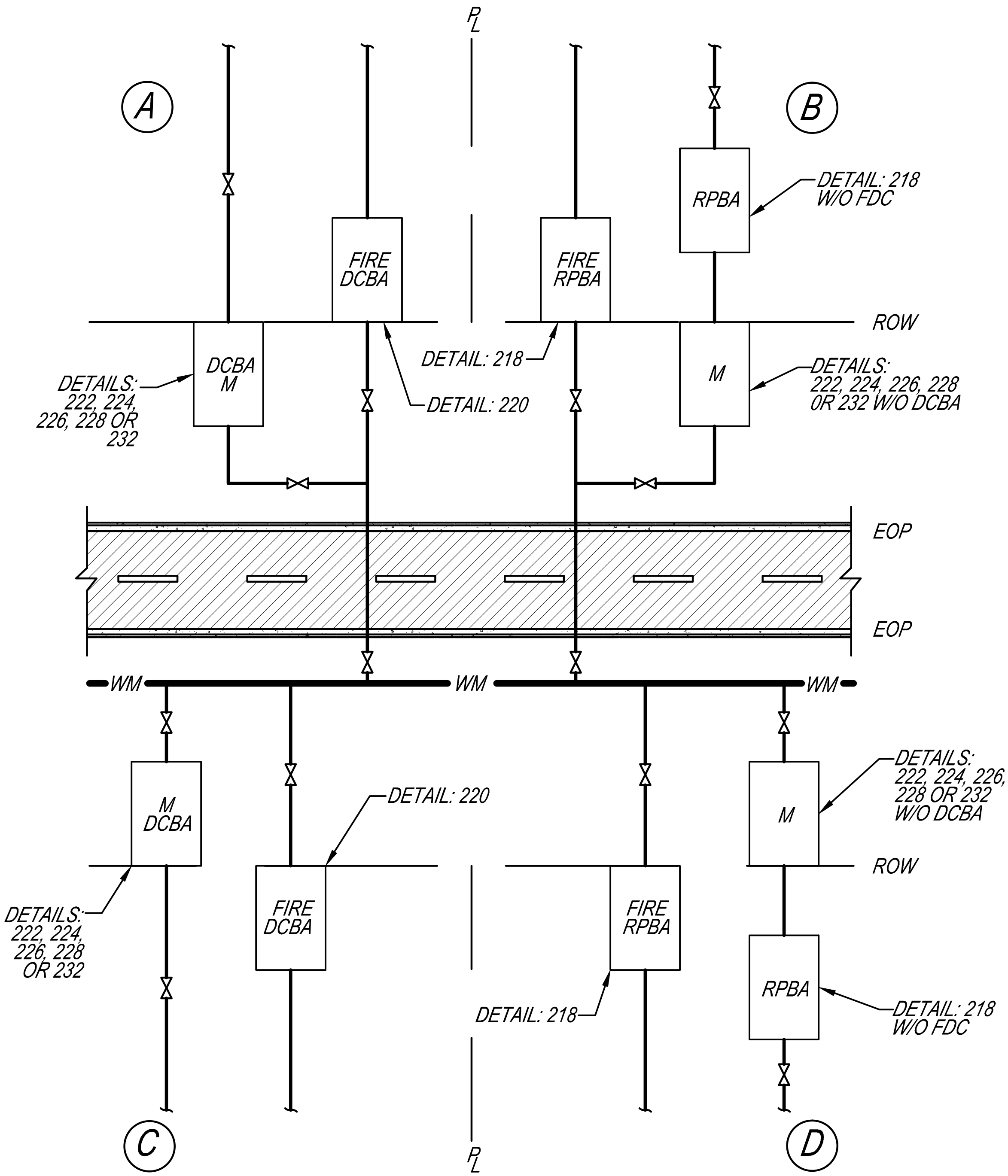
GENERAL SERVICE CONNECTION CONFIGURATIONS

LONG SIDE TAP CONFIGURATIONS



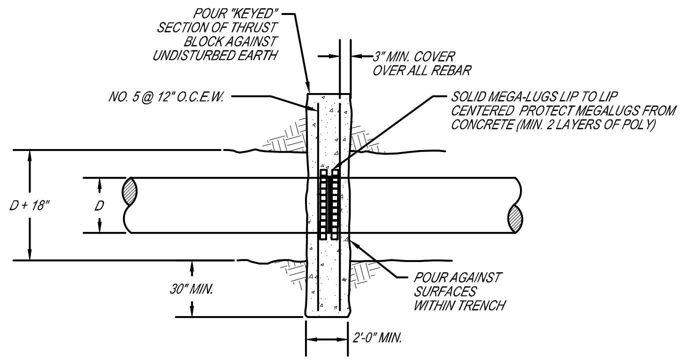
SHORT SIDE TAP CONFIGURATIONS

THE WATER WORKS BOARD
OF THE CITY OF AUBURN, AL

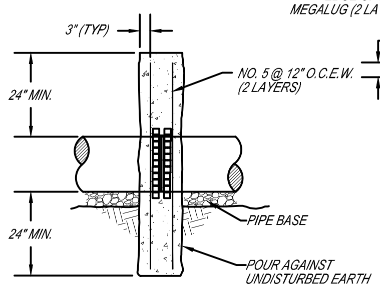
STANDARD WATER DETAILS

DRAWING TITLE:	GENERAL SERVICE CONNECTION CONFIGURATIONS		
DEPARTMENT:	WRM	REVISIONS:	246
SCALE:	N.T.S.		
DRAWN BY:	CN		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	DCM 2010		

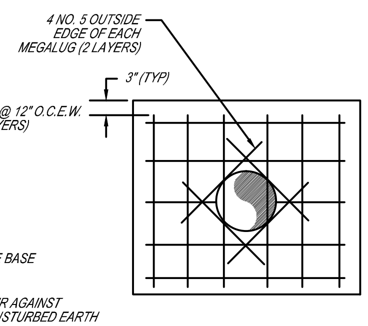
TYPICAL DEADMAN THRUST RESTRAINT



PLAN



PROFILE

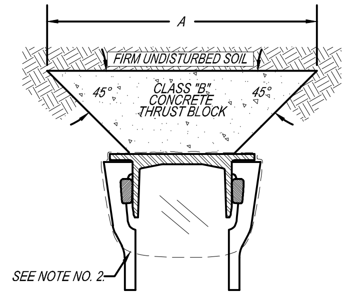


FRONT

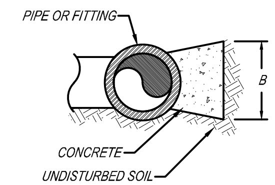
NOTES:

1. DEADMAN TO BE CENTERED ON FULL JOINT OF PIPE
2. ALL CONCRETE SHALL BE CLASS "A" (4000 PSI) IN ACCORDANCE WITH THE CITY OF AUBURN STANDARD SPECIFICATIONS
3. NO CALCIUM CHLORIDE CURING ACCELERATOR ALLOWED.
4. APPLICABLE FOR UP TO AND INCLUDING 12" DIAMETER PIPE. MAY BE USED FOR PIPES ABOVE 12" DIAMETER ON A CASE BY CASE BASIS.
5. TO BE USED ON EXISTING DUCTILE IRON OR CAST IRON PIPE IN GOOD CONDITION.

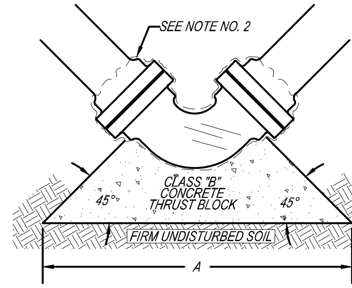
TYPICAL CONCRETE THRUST BLOCK DESIGN



BELL JOINT PLUG
UNRESTRAINED TYPE



SIDE VIEW



TYPICAL BEND THRUST BLOCK

BEARING AREA

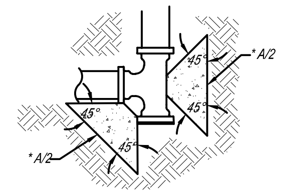
AREA (SF) AGAINST UNDISTURBED SOIL

Size	Tee, Wye, Plug or 90° Bend	45° Bend	22.5° Bend	11.5° Bend
4"	1	1	1	1
6"	3	2	1.5	1
8"	5	3	2	1.5
10"	9	5	3	2
12"	12	8	4	3
16"	22	12	5	4
BASED ON 2500 LB/ft.^{2} SOIL				
BEARING AREA (SF) = A x B 1<(A / B)<3				
≤ 100 PSI STATIC PRESSURE (600 MSL OR HIGHER)				

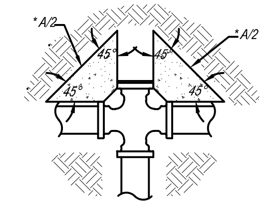
NOTES:

1. 45 DEGREE ANGLES REQUIRED FOR ALL THRUST BLOCKS.
2. NON STANDARD THRUST BLOCKING WILL REQUIRE SPECIAL DETAILING PROVIDED BY A LICENSED ENGINEER AND APPROVED BY THE CITY OF AUBURN.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS.
4. CLASS "B" CONCRETE SHALL BE AS DEFINED IN THE CITY OF AUBURN STANDARD SPECIFICATIONS SECTION II.
5. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

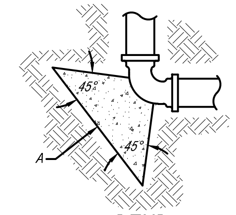
TYPICAL CONCRETE THRUST BLOCK LAYOUT



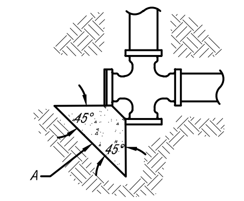
PLUGGED TEE



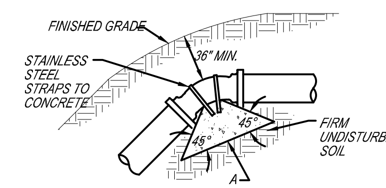
PLUGGED CROSS



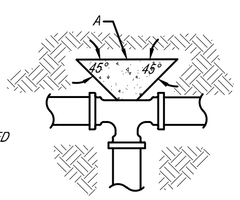
BEND



PLUGGED CROSS



VERTICAL BEND
(AGAINST DISTURBED SOIL)

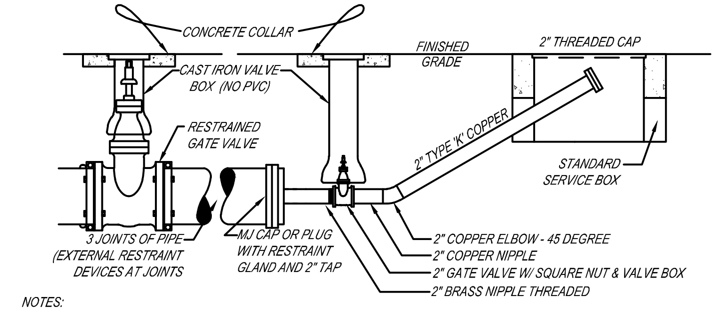


TEE

NOTES:

1. 45 DEGREE ANGLES REQUIRED FOR ALL THRUST BLOCKS.
2. NON STANDARD THRUST BLOCKING WILL REQUIRE SPECIAL DETAILING PROVIDED BY A LICENSED ENGINEER AND APPROVED BY THE CITY OF AUBURN.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS.
4. CLASS "B" CONCRETE SHALL BE AS DEFINED IN THE CITY OF AUBURN STANDARD SPECIFICATIONS SECTION II.
5. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

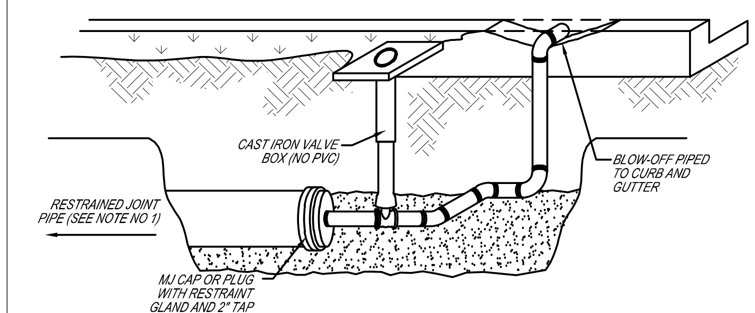
TYPICAL END OF MAIN FOR FUTURE EXTENSION



NOTES:

1. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
2. BLOW OFF SHALL BE PIPED TO CURB AND GUTTER IN ACCORDANCE WITH STANDARD DETAIL NO. 208, WHERE POSSIBLE.

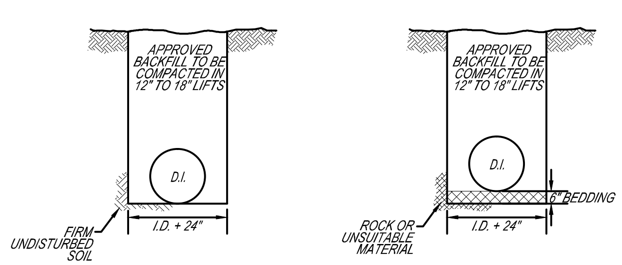
TYPICAL END OF MAIN IN CUL DE SAC



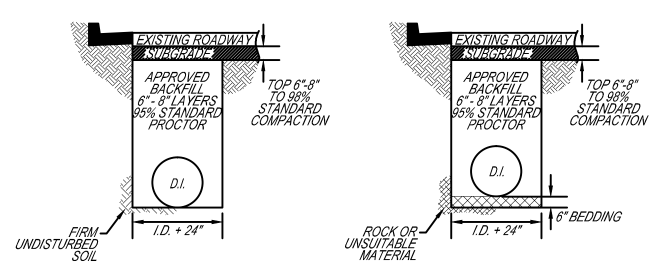
NOTES:

1. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.

BEDDING REQUIREMENTS FOR TRENCHES



NON-STREET TRENCH



STREET TRENCH

NOTES:

1. BEDDING MATERIALS SHALL BE 1/4" TO 1 1/2" GRADED CRUSHED STONE SUCH AS: 56,57,6,67,68,7,OR 78, STONE PER ALDOT STANDARD SPECS.
2. WIDTH VARIES BASED ON WALL STABILITY. STABLE WALLS WIDTH AS NEEDED TO JOIN PIPE AND COMPACT HAUNCHING AND INITIAL BACKFILL. UNSTABLE WALLS: WIDTH TO BE A MINIMUM OF FIVE TIMES PIPE DIAMETER.
3. FLOWABLE FILL CAN BE USED AS BACKFILL, BUT MUST HAVE PRIOR APPROVAL AND MUST BE ALLOWED TO SET FOR 24 HOURS PRIOR TO TOPPING.
4. APPROVED BACKFILL MATERIAL INCLUDES 825 B, FLOWABLE FILL AND APPROVED DIRT. ALTERNATIVE MATERIAL MUST BE APPROVED BY PROJECT MANAGER PRIOR TO USE.

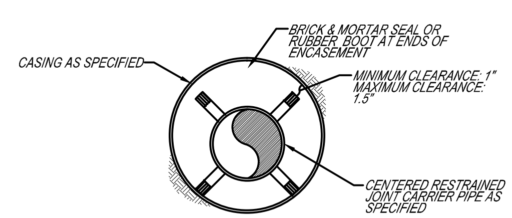
TYPICAL BORE ENCASEMENT

CARRIER PIPE		SPACER	STEEL ENCASEMENT	
NOMINAL PIPE DIAMETER	STANDARD PIPE BELL O.D.*	CASING SPACER BAND WIDTH	MINIMUM CASING THICKNESS	MINIMUM CASING DIAMETER**
4	6.40	8	0.25	14
6	8.60	8	0.25	16
8	11.16	8	0.25	18
10	13.25	8	0.25	20
12	15.22	8	0.25	22
14	17.73	12	0.25	24
16	19.86	12	0.3125	26
18	22.16	12	0.3125	30
20	24.28	12	0.3125	32
24	28.50	12	0.3125	36
30	34.95	12	0.5	42
36	41.37	12	0.5	48

ALL SIZES INDICATED ARE IN INCHES

*PIPE BELL OUTSIDE DIAMETER BASED ON PRESSURE CLASS 350 DUCTILE IRON PIPE.

**CASING DIAMETERS BASED ON BEING A MINIMUM OF 6 INCHES GREATER THAN THE OUTER DIAMETER OF THE JOINT BELL, TO THE NEAREST EVEN SIZE.

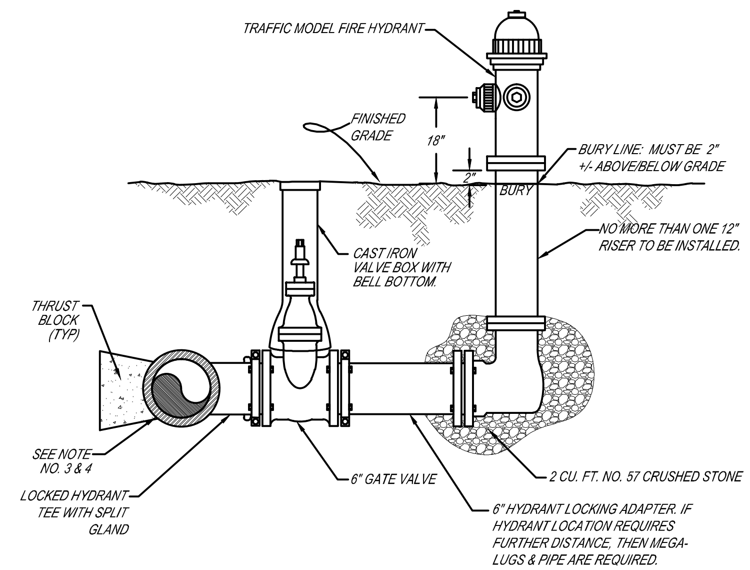


CASING SECTION

NOTES

1. ALL SPACER BANDS SHALL BE MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS.
2. ALL SPACERS SHALL HAVE A SYNTHETIC RUBBER OR PVC LINER TO INSULATE THE PIPELINE FROM THE SPACER.
3. ALL SPACERS SHALL HAVE 1.5" WIDE GLASS REINFORCED PLASTIC OR UHMW POLYMER RUNNERS TO INSULATE THE SPACER.
4. SPACERS TO BE MANUFACTURED BY CASCADE WATERWORKS MFG. CO. (PSI) PIPELINE SEAL AND INSULATOR, INC. OR EQUAL.
5. 6" THRU 12" DIAMETER PIPELINE SHALL USE 8" WIDE BANDS: GREATER THAN 12" DIAMETER PIPELINES SHALL USE 12" WIDE BANDS.
6. CENTERED RESTRAINED CASING SPACERS SHALL BE SPACED AT A MAXIMUM OF TEN FEET APART WITH A MINIMUM OF TWO SPACERS PER JOINT OF PIPE.

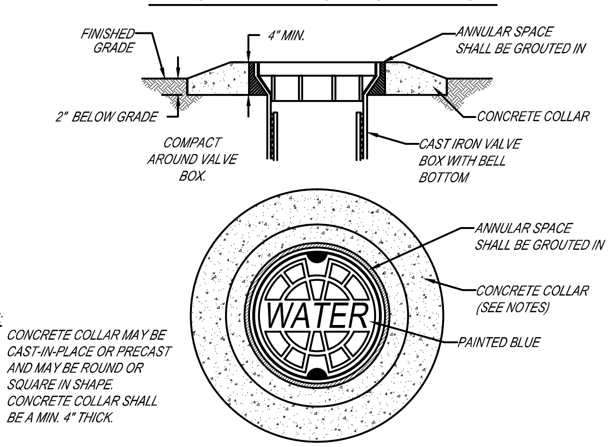
TYPICAL FIRE HYDRANT INSTALLATION



NOTES:

1. ALL FIRE HYDRANTS SHALL HAVE NATIONAL STANDARD THREADS, 4 1/2-INCH STEAMER & 2 1/2-INCH HOSE NOZZLE, AND SHALL BE MUELLER CENTURION, OR AMERICAN DARLING B-84-B, OR APPROVED EQUAL. BRONZE TO BRONZE SEATED. EPOXY COATED SHOES. WEATHER CAPS SHALL NOT BE MADE OF RUBBER.
2. ALL FIRE HYDRANTS SHALL BE LEVELED AND PLUMBED DURING INSTALLATION.
3. ALL MECHANICAL JOINT FITTINGS THAT REQUIRE THRUST BLOCKS SHALL BE WRAPPED IN PLASTIC. CONCRETE SHALL NOT BE POURED OVER JOINTS .
4. THE PREFERRED METHOD OF THRUST RESTRAINT SHALL BE THROUGH THE USE OF EXTERNALLY RESTRAINED JOINT DEVICES SUCH AS MEGA -LUGS IN LIEU OF CONCRETE BLOCKING. CONCRETE BLOCKING SHALL ONLY BE PERMITTED WHERE APPROVED BY THE AWWB AND SHALL NOT BE USED IN CONJUNCTION WITH MEGA-LUG RESTRAINTS . THE APPROPRIATE LENGTH OF RESTRAINT SHALL BE CALCULATED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
5. USE MEGA-LUGS BETWEEN HYDRANT AND GATE VALVE.
6. HYDRANT LOCKING TEE TO BE USED IN LIEU OF STANDARD M.J. TEE ON ALL FIRE HYDRANT CONNECTIONS.

TYPICAL VALVE BOX INSTALLATION



NOTE:

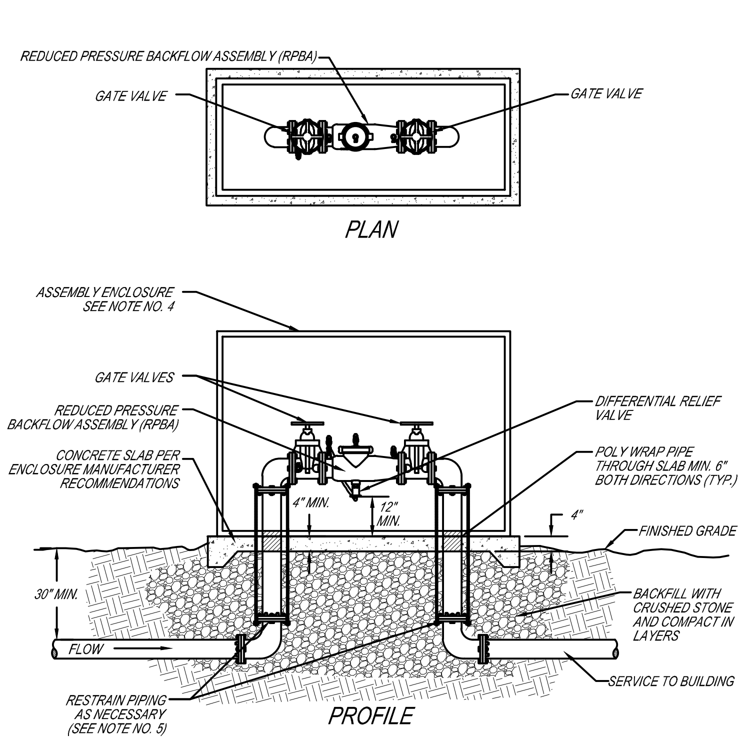
1. CONCRETE COLLAR MAY BE CAST-IN-PLACE OR PRECAST AND MAY BE ROUND OR SQUARE IN SHAPE.
2. CONCRETE COLLAR SHALL BE A MIN. 4" THICK.

STANDARD DETAILS: WATER - SHEET 1 OF 3

PROJECT TITLE:

DEPARTMENT:	WRM	REVISIONS:	GM-04/30/04
SCALE:	N.T.S.		BS-10-25-07
DRAWN BY:	GM		DCM 2010
REVIEWED BY:	JC		JC-10-2011
APPROVED BY:	EC		JC-12-2012
IMPLEMENTED:	JANUARY 2008		

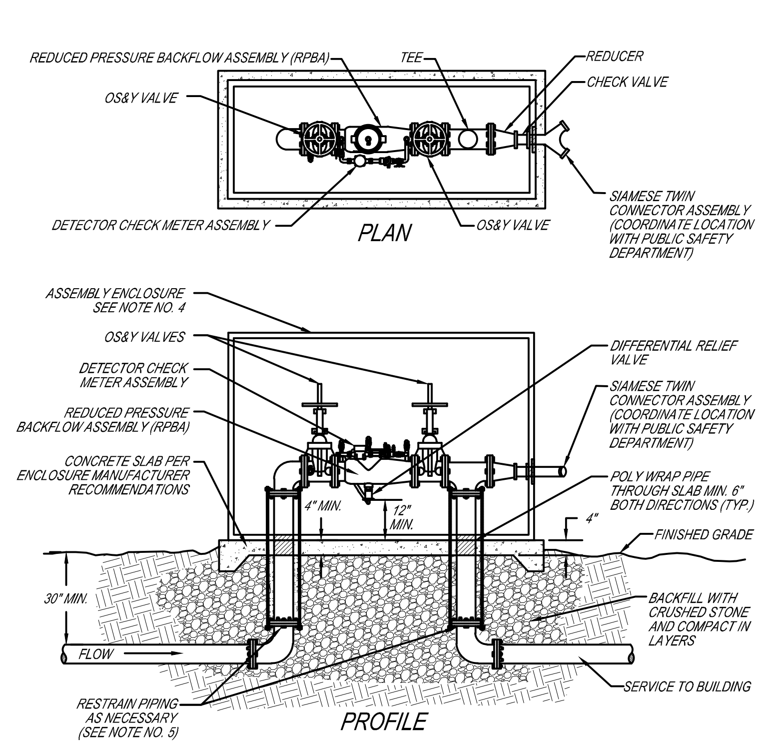
TYPICAL REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA)



NOTES:

1. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. RPBA TO BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
4. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED SO AS TO ENSURE AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.
5. RESTRAINT SYSTEM SHALL BE DESIGNED FOR SPECIFIC INSTALLATION CONDITIONS. WHERE STATIC PRESSURES EXCEED 100 PSI, MEGA-LUG RESTRAINTS USED ON VERTICAL BENDS SHALL BE REINFORCED WITH S.S. RODS.

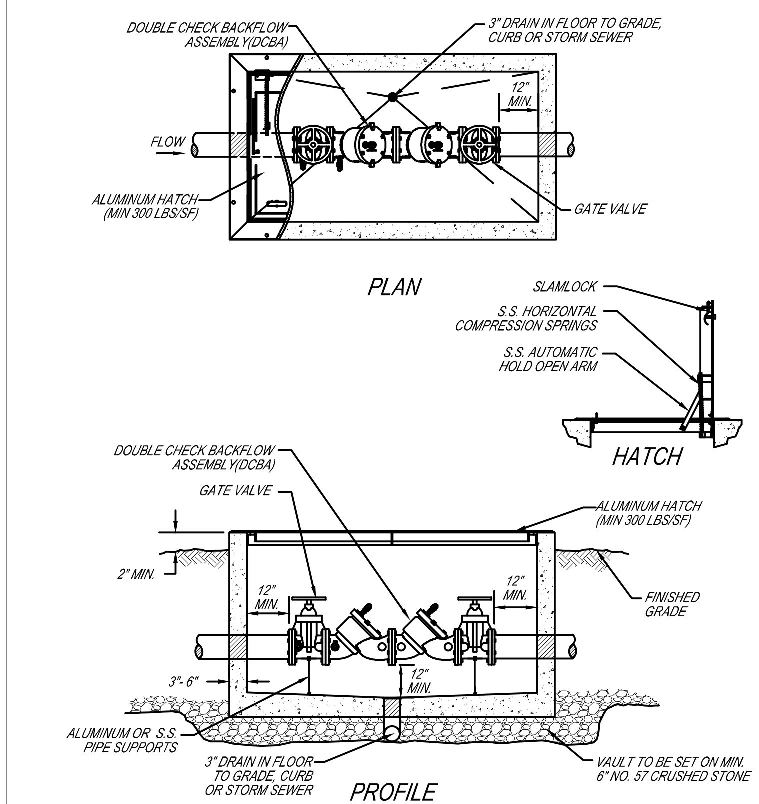
TYPICAL FIRE PROTECTION SYSTEM RPBA



NOTES:

1. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. RPBA TO BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
4. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED TO PROTECT AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.
5. RESTRAINT SYSTEM SHALL BE DESIGNED FOR SPECIFIC INSTALLATION CONDITIONS. WHERE STATIC PRESSURES EXCEED 100 PSI, MEGA-LUG RESTRAINTS USED ON VERTICAL BENDS SHALL BE REINFORCED WITH S.S. RODS.

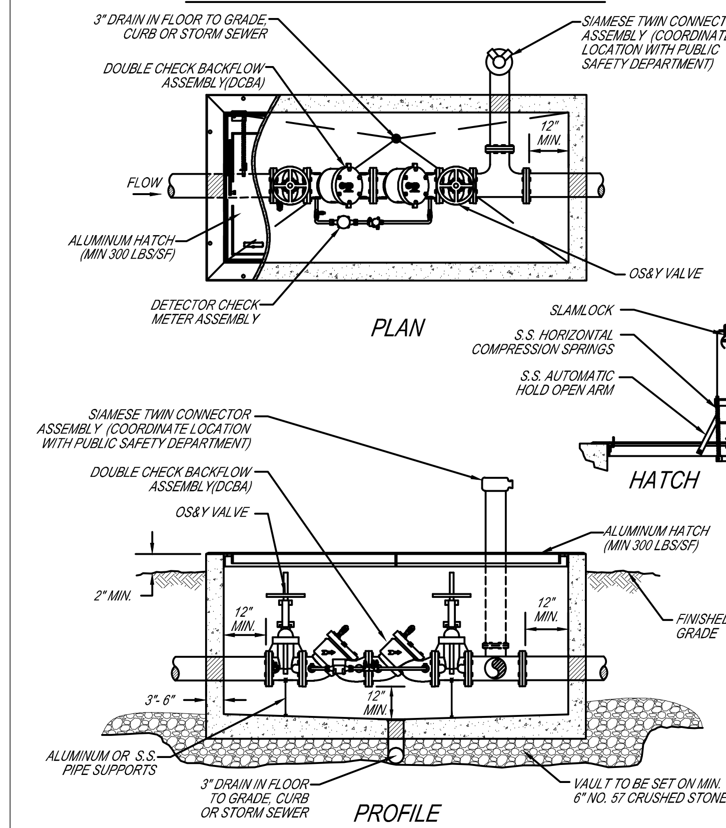
TYPICAL DOUBLE CHECK BACKFLOW ASSEMBLY (DCBA)



NOTES:

1. DOUBLE CHECK BACKFLOW ASSEMBLY SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

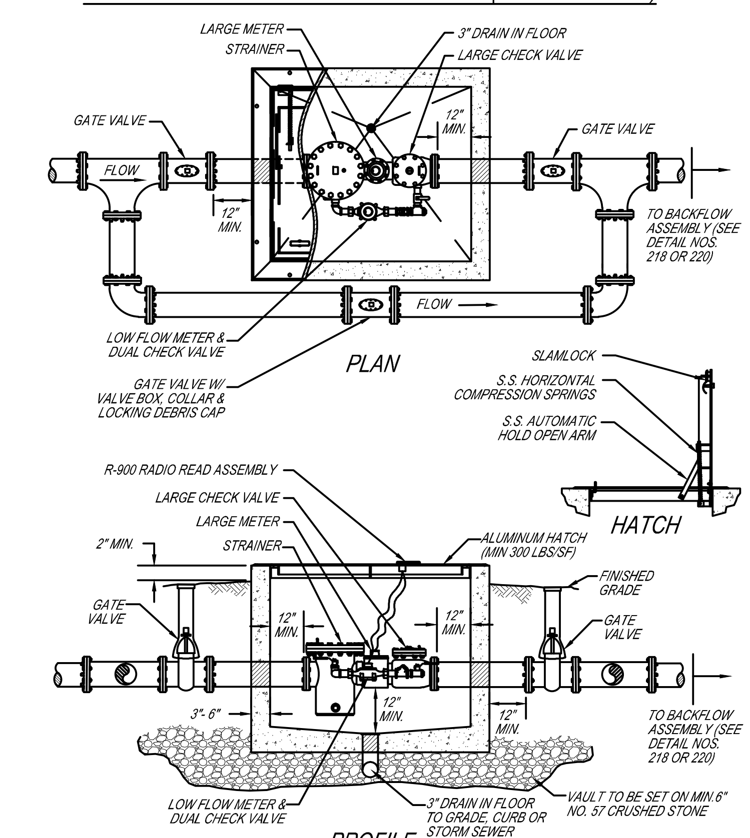
TYPICAL FIRE PROTECTION SYSTEM DCBA



NOTES:

1. DOUBLE CHECK BACKFLOW ASSEMBLY SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

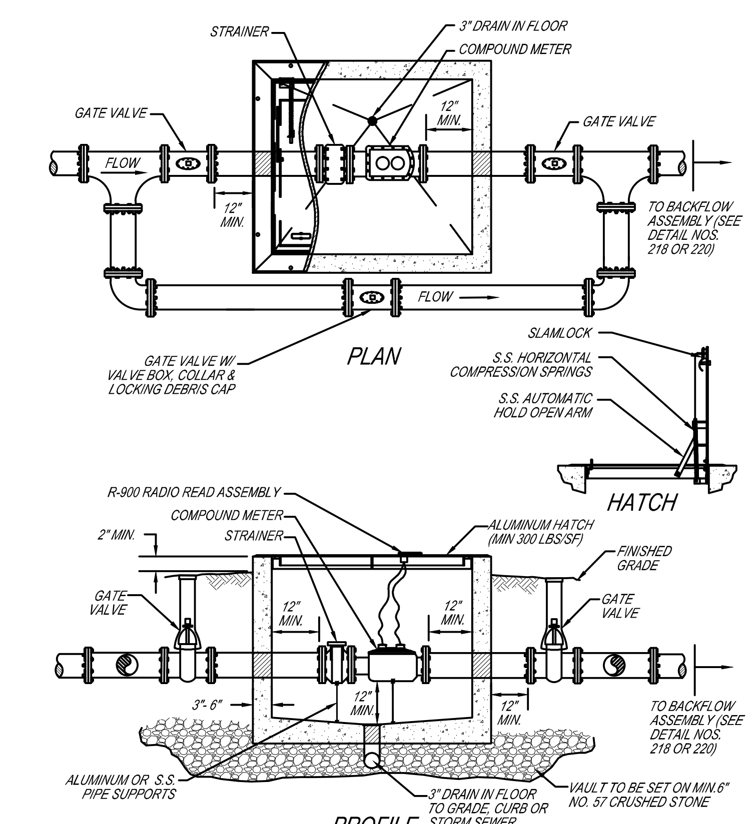
TYPICAL FIRE / DOMESTIC METER VAULT (4" AND LARGER)



NOTES:

1. COMBINATION FIRE / DOMESTIC METER SHALL BE NEPTUNE PROTECTUS III.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. THE APPROPRIATE BACKFLOW ASSEMBLY IN ACCORDANCE WITH STANDARD DETAIL NOS. 218 OR 220 SHALL BE INSTALLED IMMEDIATELY FOLLOWING THE METER ASSEMBLY.

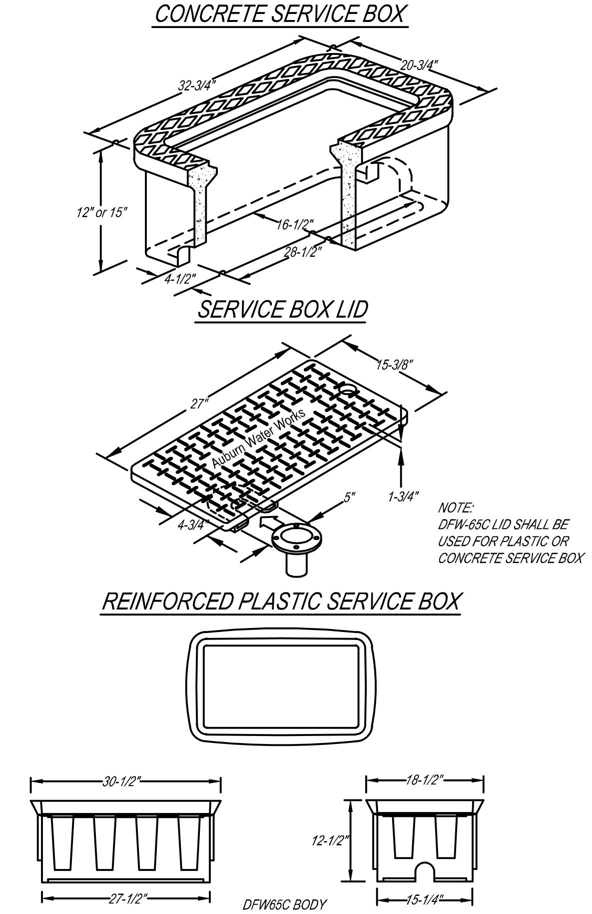
TYPICAL LARGE DOMESTIC METER VAULT (3" AND LARGER)



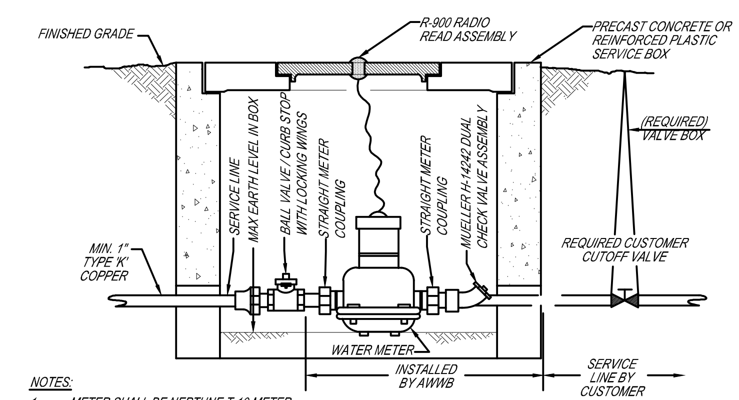
NOTES:

1. LARGE METER SHALL BE NEPTUNE TRU-FLOW COMPOUND METER.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
3. THE APPROPRIATE BACKFLOW ASSEMBLY IN ACCORDANCE WITH STANDARD DETAIL NOS. 218 OR 220 SHALL BE INSTALLED IMMEDIATELY FOLLOWING THE METER ASSEMBLY.

CONCRETE SERVICE BOX



TYPICAL 3/4" TO 1" METER



NOTES:

1. METER SHALL BE NEPTUNE T-10 METER.

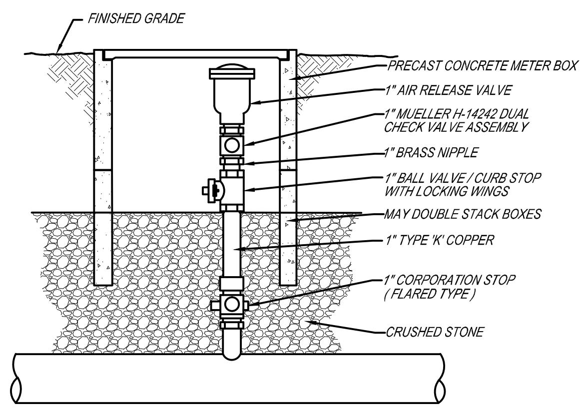
STANDARD DETAILS: WATER - SHEET 2 of 3

PROJECT TITLE:

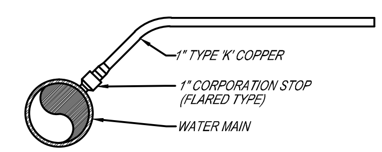
DEPARTMENT:	WRM	REVISIONS:	GM-04/2004
SCALE:	N.T.S.		BS-10-25-07
DRAWN BY:	GM		DCM 2010
REVIEWED BY:	JC		JC-10-2011
APPROVED BY:	EC		JC-12-2012
IMPLEMENTED:	JANUARY 2008		

WATER WORKS BOARD AUBURN

TYPICAL AUTOMATIC AIR RELEASE VALVE



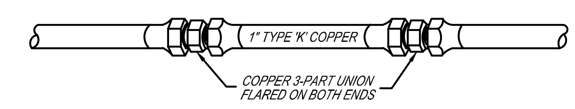
TYPICAL 1" SERVICE CONNECTION



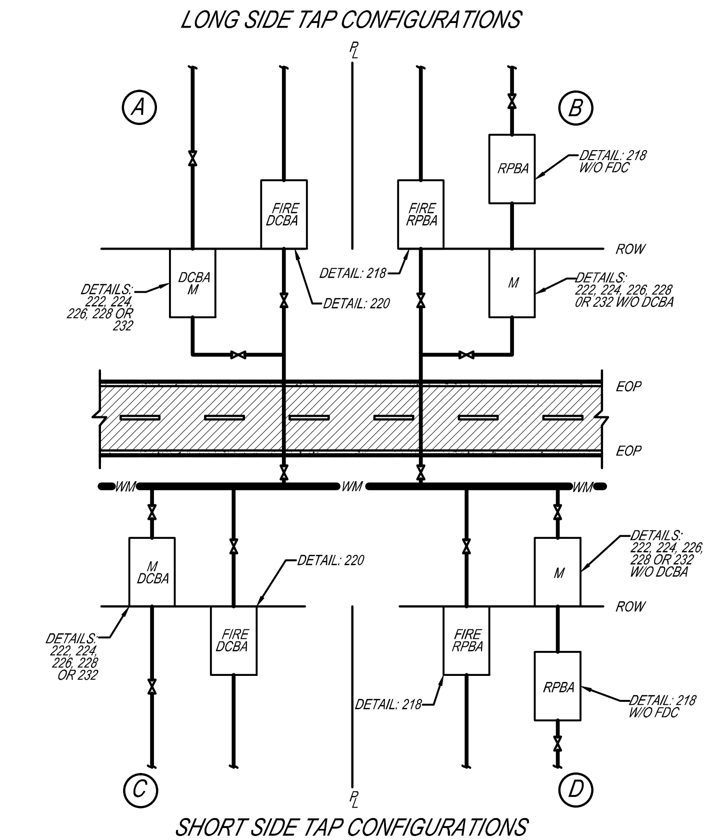
NOTES:

1. TYPICAL 1" SERVICE CONNECTION SHALL BE USED AT A MINIMUM FOR ALL3/4" AND 1" METER INSTALLATIONS.

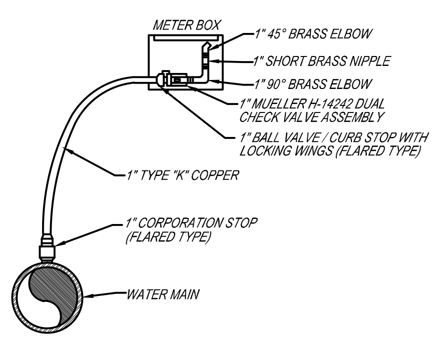
TYPICAL COPPER REPAIR (1" ONLY)



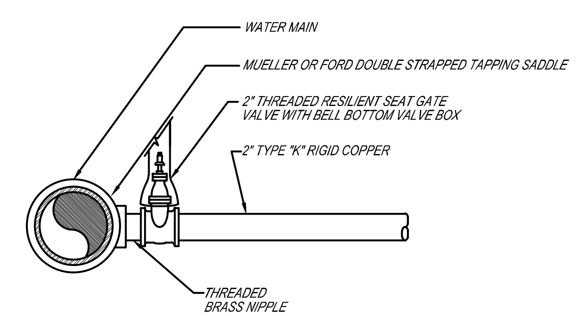
GENERAL SERVICE CONNECTION CONFIGURATIONS



TYPICAL MANUAL AIR RELEASE VALVE



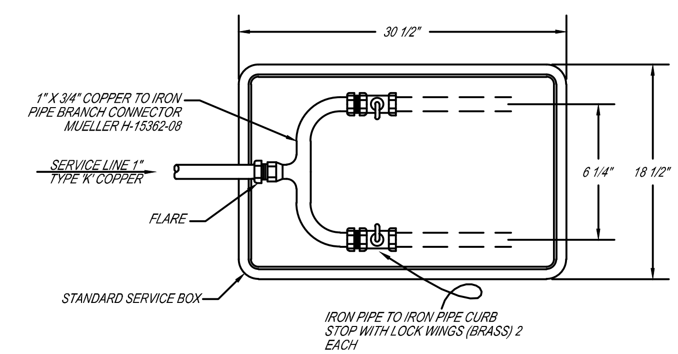
TYPICAL 2" SERVICE CONNECTION



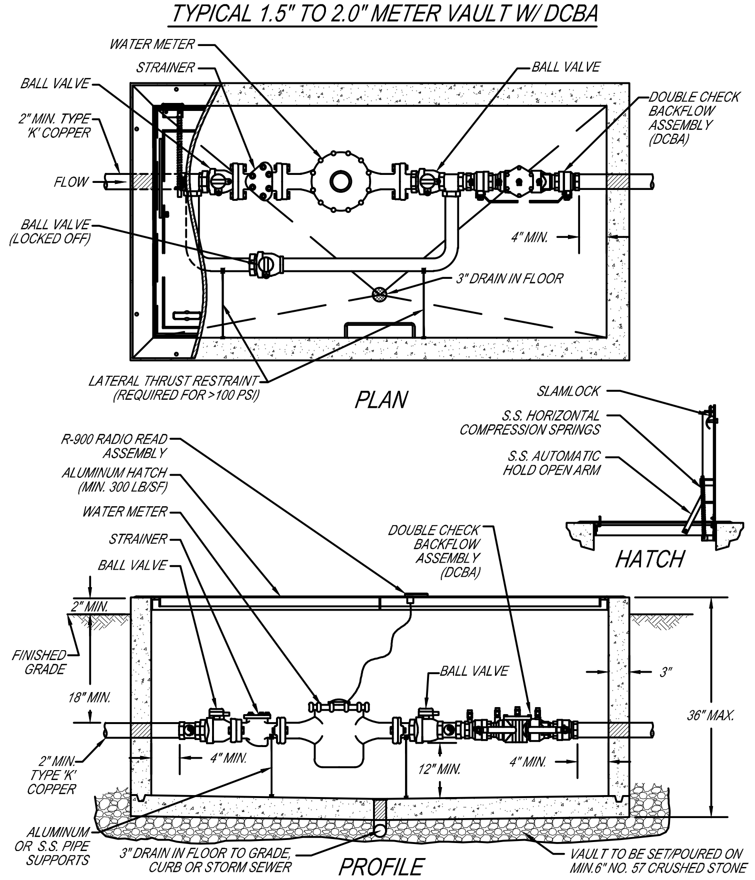
NOTES:

1. TYPICAL 2" SERVICE CONNECTION SHALL BE USED AT A MINIMUM FOR ALL 1-1/2" AND 2" METER INSTALLATIONS.

TYPICAL DOUBLE SERVICE CONNECTION



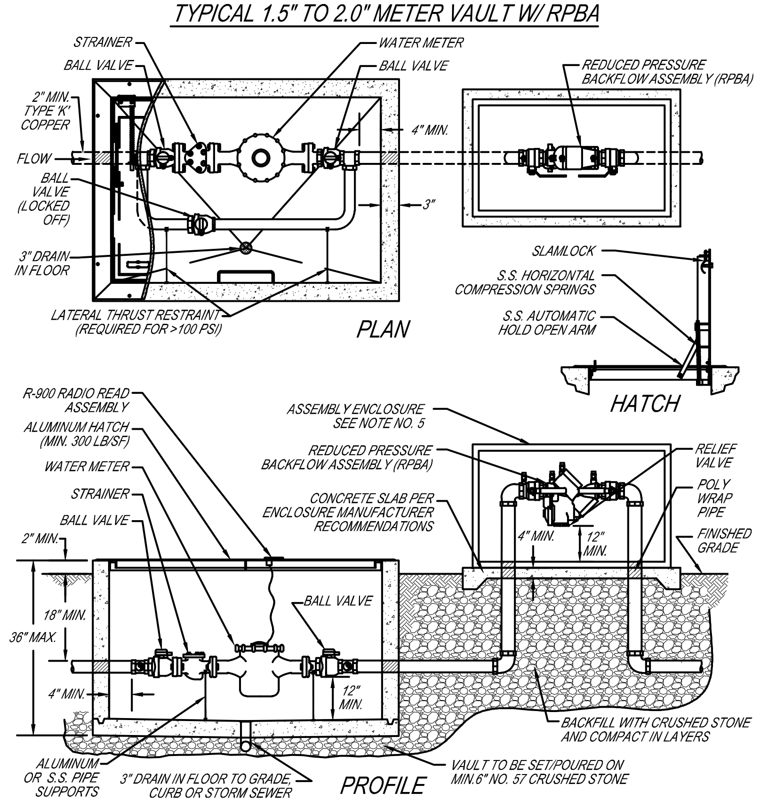
TYPICAL 1.5" TO 2.0" METER VAULT W/ DCBA



NOTES:

1. METER SHALL BE NEPTUNE T-10 METER, UNLESS OTHERWISE SPECIFIED AND APPROVED BY THE AWWB.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.

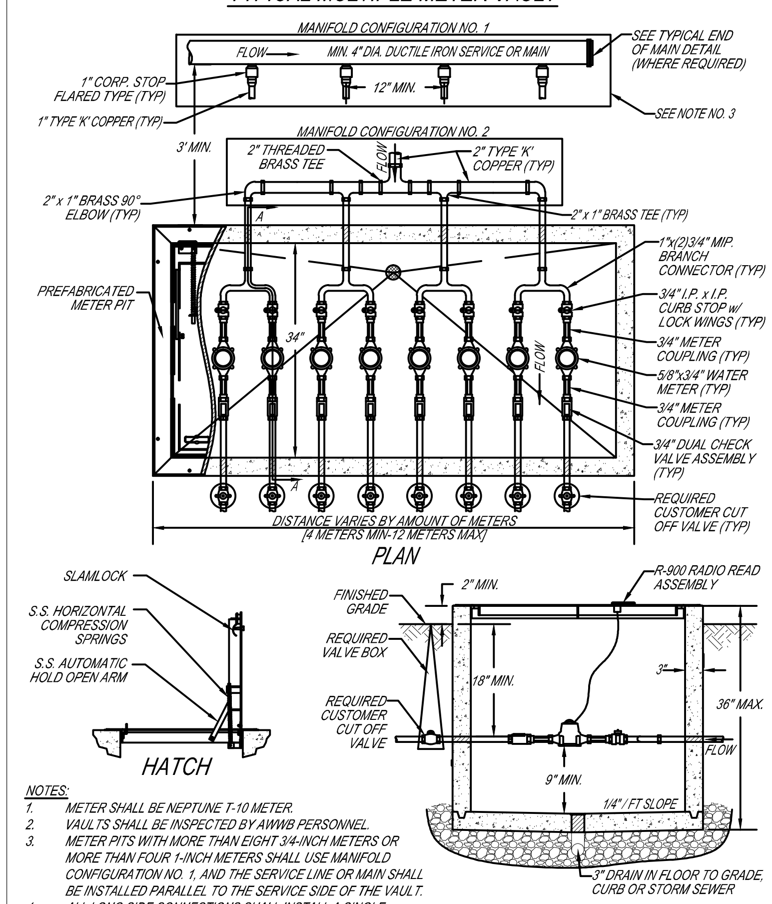
TYPICAL 1.5" TO 2.0" METER VAULT W/ RPBA



NOTES:

1. METER SHALL BE NEPTUNE T-10 METER, UNLESS OTHERWISE SPECIFIED AND APPROVED BY THE AWWB.
2. RPBA SHALL BE MANUFACTURED BY AMES, WATTS, OR AN APPROVED EQUAL.
3. VAULTS AND RPBA SHALL BE INSPECTED BY AWWB PERSONNEL IN ADDITION TO CITY OF AUBURN PROJECT INSPECTIONS.
4. RPBA's SHALL NOT BE BURIED OR INSTALLED IN BELOW GROUND VAULTS.
5. RPBA ENCLOSURES SHALL BE CONCRETE, REINFORCED ALUMINUM, OR FIBERGLASS CONSTRUCTION AND SHALL BE INSULATED AND/OR HEATED TO PROTECT AGAINST FREEZING. ENCLOSURES APPROVED FOR INSTALLATION INCLUDE: HYDROCOWL, HOT BOX, AND LOK BOX.

TYPICAL MULTIPLE METER VAULT



PLAN SECTION A - A

NOTES:

1. METER SHALL BE NEPTUNE T-10 METER.
2. VAULTS SHALL BE INSPECTED BY AWWB PERSONNEL.
3. METER PITS WITH MORE THAN EIGHT 3/4-INCH METERS OR MORE THAN FOUR 1-INCH METERS SHALL USE MANIFOLD CONFIGURATION NO. 1, AND THE SERVICE LINE OR MAIN SHALL BE INSTALLED PARALLEL TO THE SERVICE SIDE OF THE VAULT.
4. ALL LONG SIDE CONNECTIONS SHALL INSTALL A SINGLE SERVICE FROM THE MAIN TO THE MANIFOLD AT THE METER PIT.

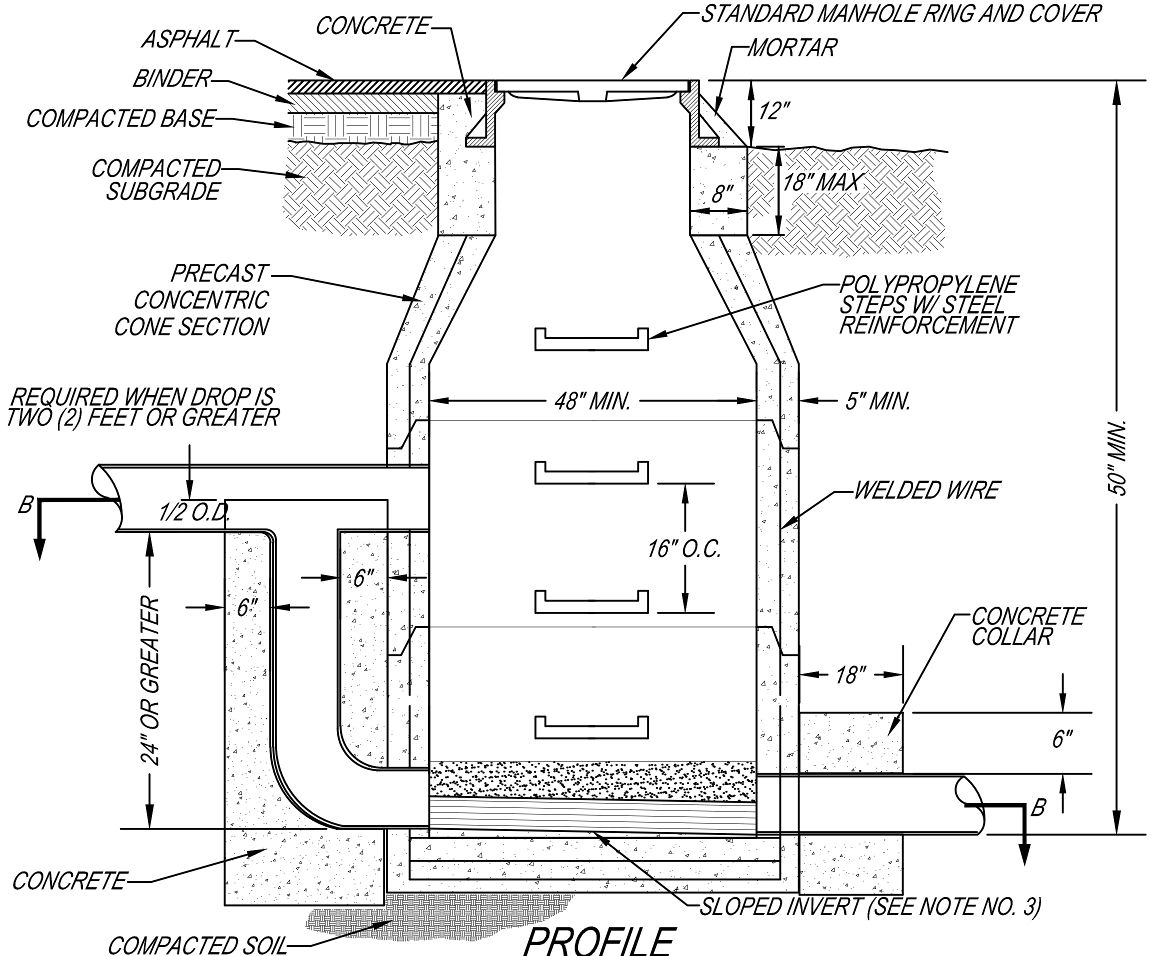
STANDARD DETAILS: WATER - SHEET 3 OF 3

PROJECT TITLE:

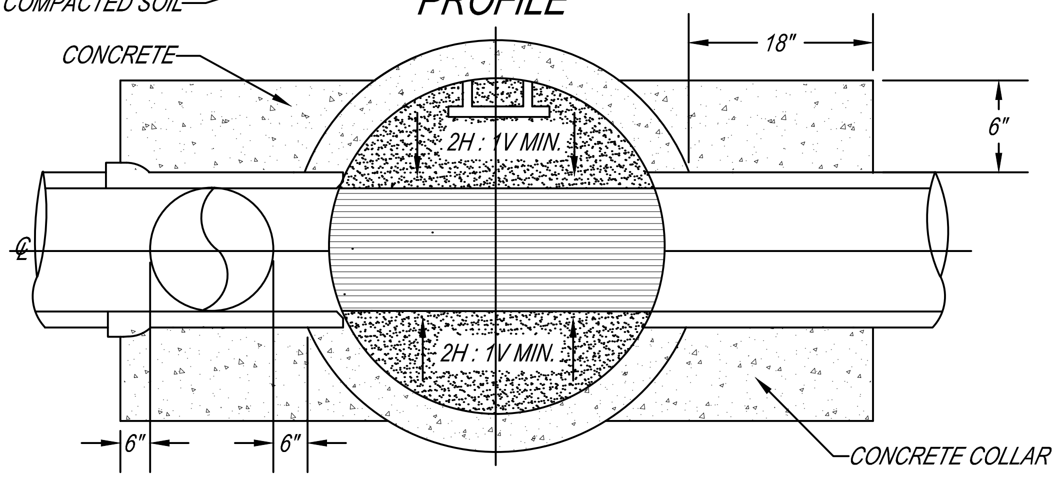
WATER WORKS BOARD AUBURN

DEPARTMENT:	WRM	REVISIONS:	GM-04/30/04
SCALE:	N.T.S.		BS-10-25-07
DRAWN BY:	GM		DCM 2010
REVIEWED BY:	JC		JC-10-2011
APPROVED BY:	EC		JC-12-2012
IMPLEMENTED:	JANUARY 2008		

TYPICAL DROP MANHOLE



PROFILE



PLAN SECTION B - B

NOTES:

1. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
2. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
3. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.
4. INVERT SLOPE SHALL PROVIDE A 0.10' DROP ACROSS THE MANHOLE WHERE THERE IS NOT A TURN GREATER THAN 22 DEGREES AND A 0.25' DROP ACROSS THE MANHOLE WHERE THE TURN IS GREATER THAN 22 DEGREES.

City of Auburn

THE CITY OF AUBURN, AL

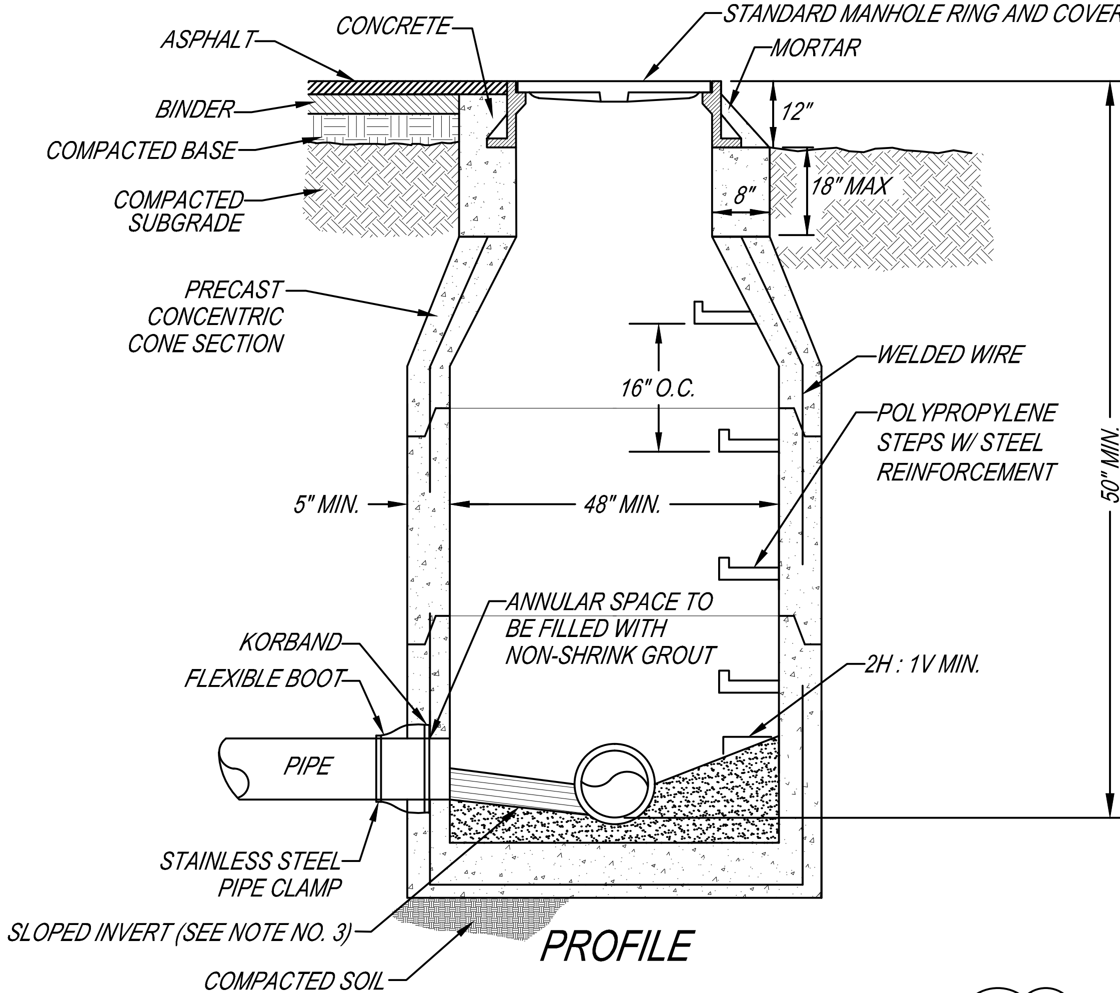
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: TYPICAL DROP MANHOLE

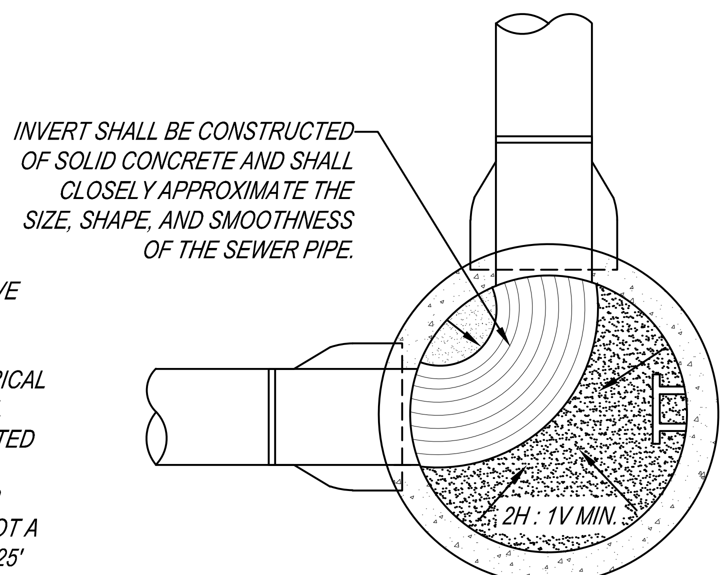
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

300

STANDARD MANHOLE



PROFILE



PLAN

NOTES:

1. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
2. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
3. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.
4. INVERT SLOPE SHALL PROVIDE A 0.10' DROP ACROSS THE MANHOLE WHERE THERE IS NOT A TURN GREATER THAN 22 DEGREES AND A 0.25' DROP ACROSS THE MANHOLE WHERE THE TURN IS GREATER THAN 22 DEGREES.

City of Auburn

THE CITY OF AUBURN, AL

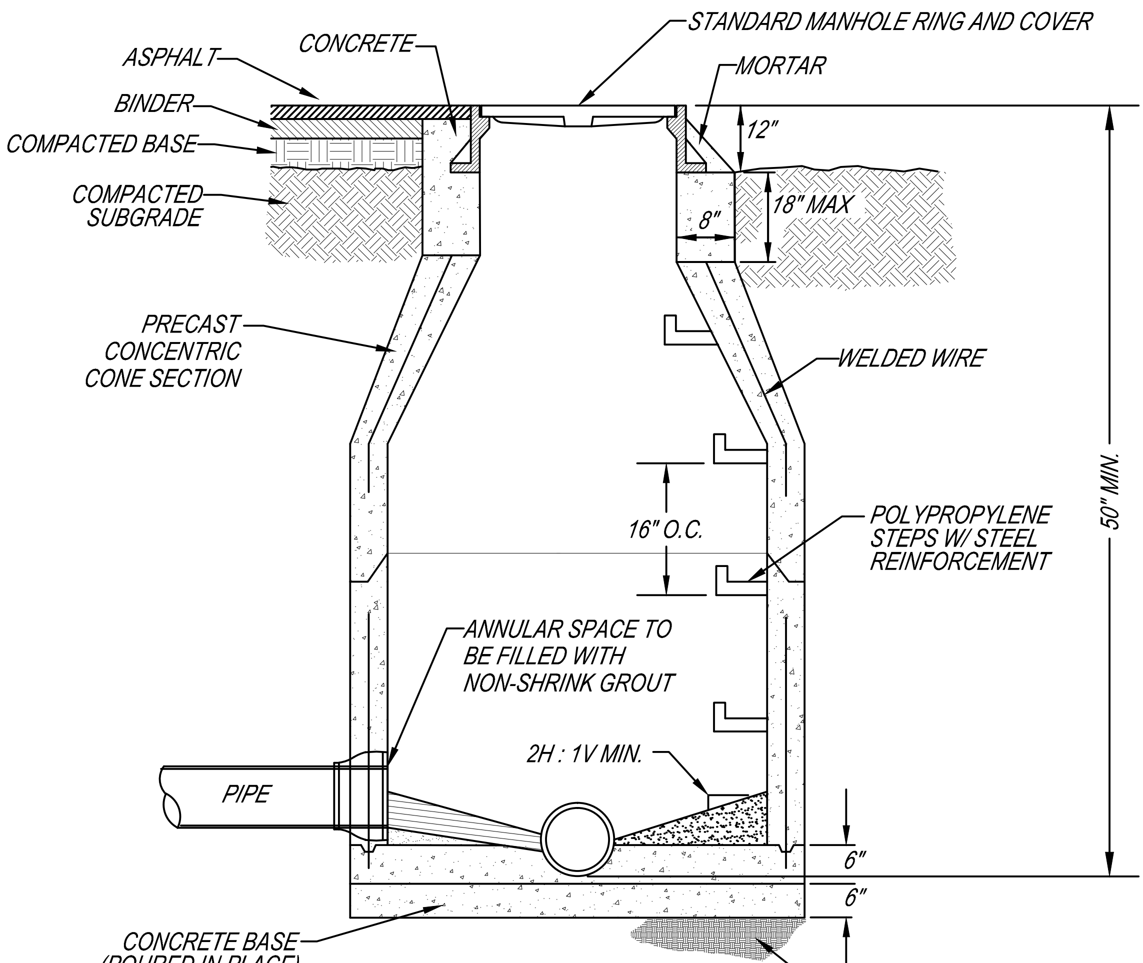
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: STANDARD MANHOLE

DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

302

TYPICAL SADDLE MANHOLE



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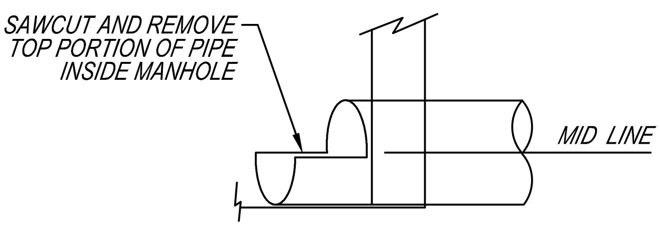
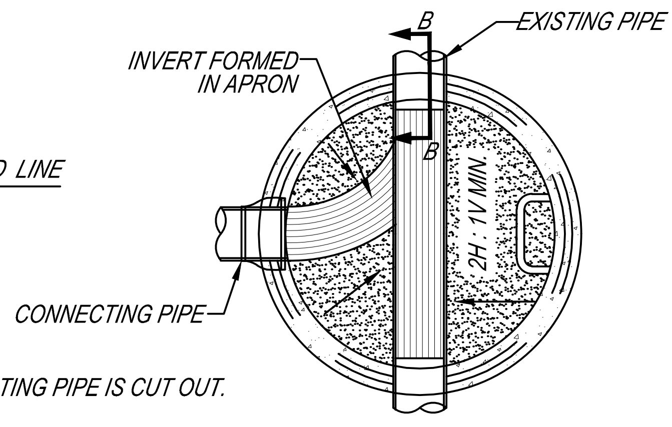


SECTION B - B



PLAN

NOTES

1. MANHOLES SHALL BE AIR TESTED BEFORE EXISTING PIPE IS CUT OUT.
2. MINIMUM 6" CONCRETE REQUIRED UNDER PIPE.
3. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
4. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
5. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.

City of Auburn

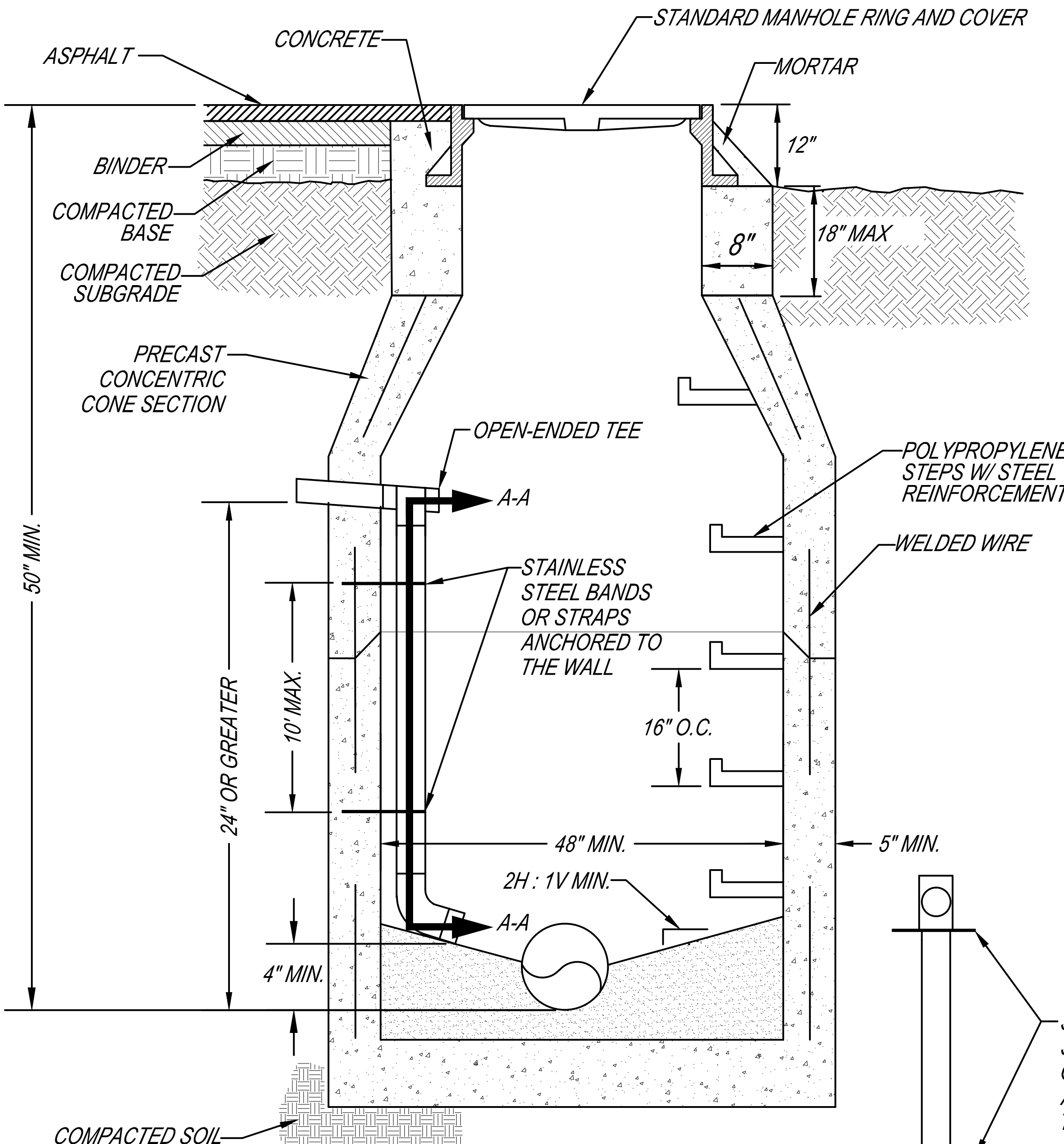
THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

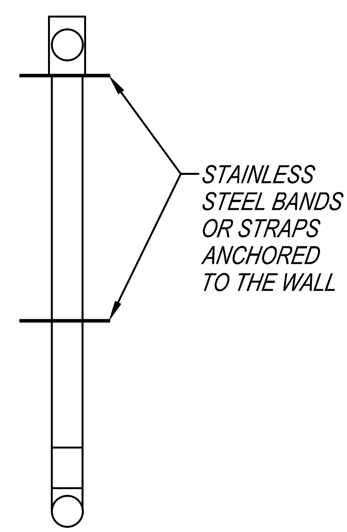
DRAWING TITLE:	TYPICAL SADDLE MANHOLE		
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

304

TYPICAL 4" OR 6" DROP SERVICE LINE



PROFILE



PLAN SECTION A - A

NOTES:

1. SERVICE LINES SHALL BE A MINIMUM OF FOUR (4) INCHES ABOVE THE INVERT OF THE MANHOLE OR FLOW LINE OF OUTGOING PIPE. SERVICE LINES ANGLED AGAINST THE DIRECTION OF FLOW SHALL BE A MINIMUM SIX (6) INCHES ABOVE THE FLOWLINE. IF THE ANGLE IS GREATER THAN 135 DEGREES, THE SERVICE LINE SHALL TIE TO THE MAIN.
2. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS IN THE MANHOLE.
3. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
4. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.

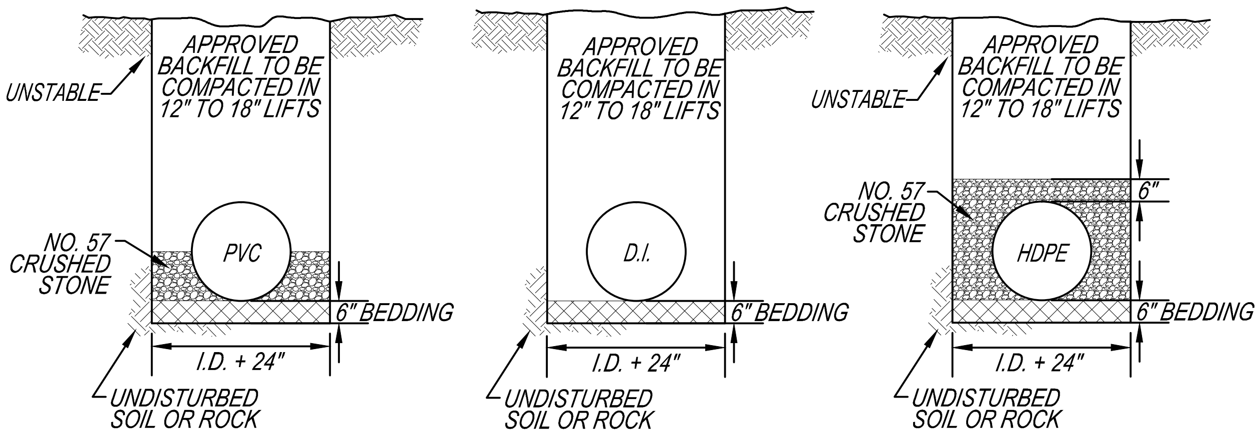
City of Auburn

THE CITY OF AUBURN, AL

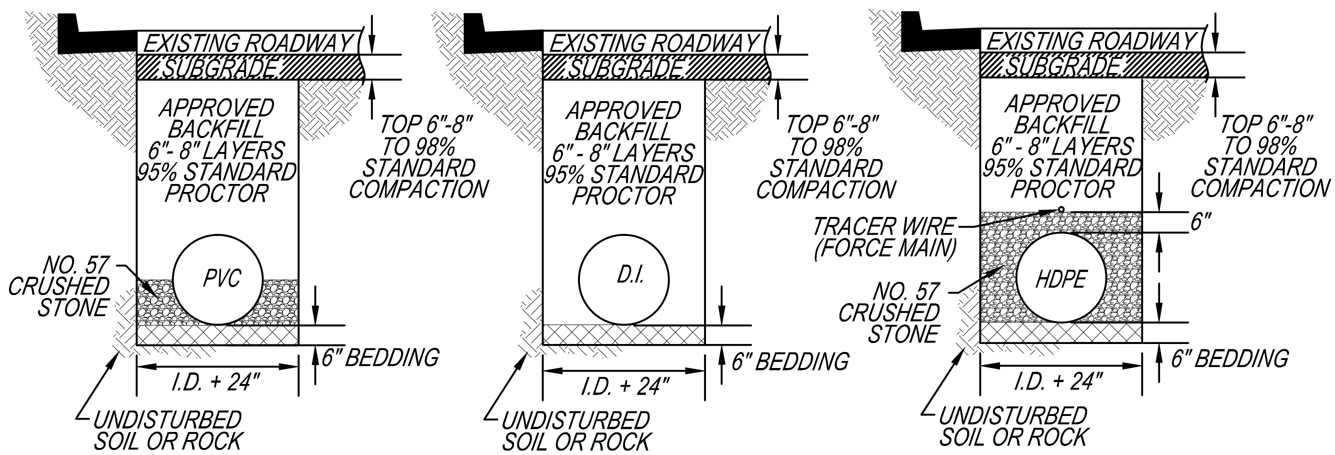
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	TYPICAL 4" OR 6" DROP SERVICE LINE			306
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04	
SCALE:	N.T.S.		BS-10-30-07	
DRAWN BY:	BS		DCM 2010	
REVIEWED BY:	EC			
APPROVED BY:	RG			
IMPLEMENTED:	02/2003			

BEDDING REQUIREMENTS FOR TRENCHES



NON-STREET TRENCH



STREET TRENCH

NOTES:

1. BEDDING MATERIALS FOR PVC AND HDPE PIPE SHALL BE 1/4" TO 1 1/2" GRADED CRUSHED STONE SUCH AS: 56,57,6,67,68,7,OR 78, STONE PER ALDOT STANDARD SPECS. SAND OR GRAVEL MAY BE USED AS BEDDING MATERIAL FOR D.I. PIPE.
2. WIDTH VARIES BASED ON WALL STABILITY. STABLE WALLS WIDTH AS NEEDED TO JOIN PIPE AND COMPACT HAUNCHING AND INITIAL BACKFILL. UNSTABLE WALLS: WIDTH TO BE A MINIMUM OF FIVE TIMES PIPE DIAMETER.
3. FLOWABLE FILL CAN BE USED AS BACKFILL, BUT MUST HAVE PRIOR APPROVAL AND MUST BE ALLOWED TO SETUP FOR 24 HOURS PRIOR TO TOPPING.
4. APPROVED BACKFILL MATERIAL INCLUDES 825 B, FLOWABLE FILL AND APPROVED DIRT. ALTERNATIVE MATERIAL MUST BE APPROVED BY PROJECT MANAGER PRIOR TO USE.

City of Auburn

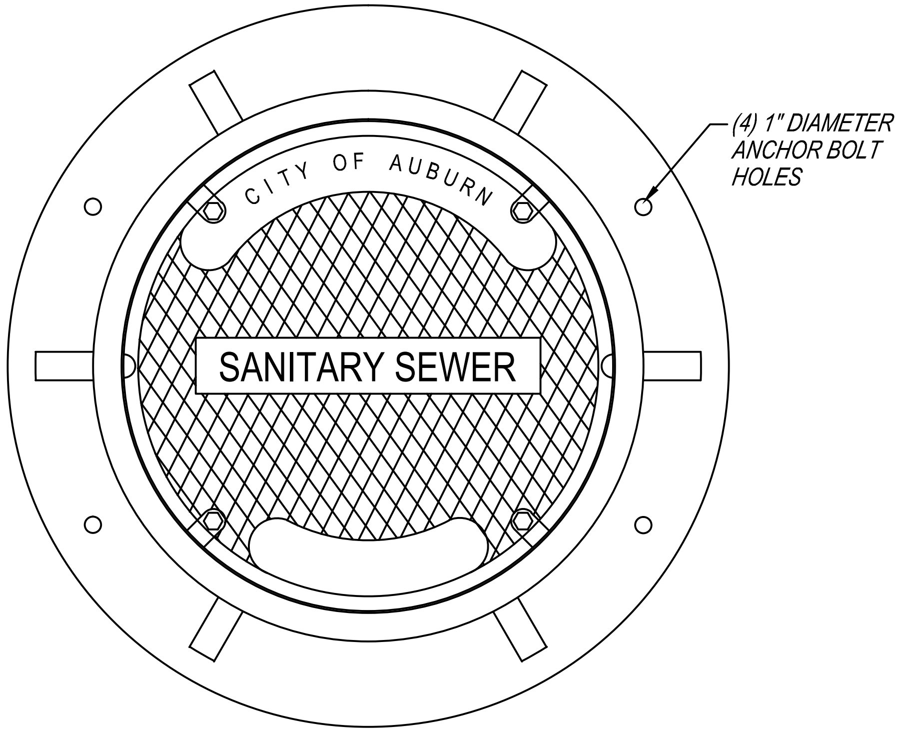
THE CITY OF AUBURN, AL
STANDARD SANITARY SEWER DETAILS

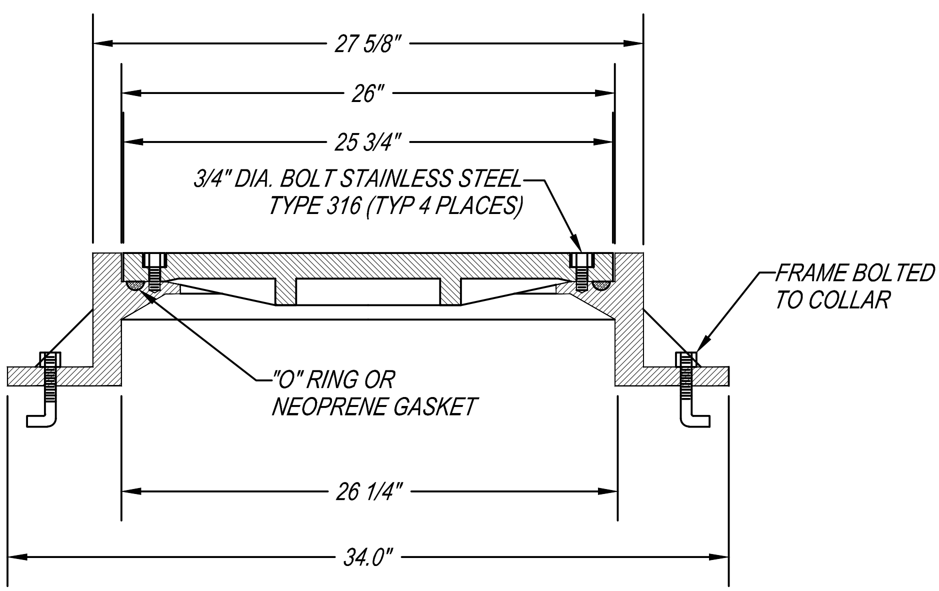
DRAWING TITLE: BEDDING REQUIREMENTS FOR TRENCHES

DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

308

TYPICAL WATERTIGHT MANHOLE COVER





NOTES:

1. REQUIRED FOR ALL MANHOLES WHERE THE RIM ELEVATION IS LESS THAN ONE (1) VERTICAL FOOT ABOVE THE 100 YEAR FLOODPLAIN ELEVATION.
2. CAST IRON FRAME AND COVER IN ROADWAY AND TRAFFIC SHALL BE INSTALLED FLUSH WITH FINISHED GRADE OF THE PAVEMENT IN FLAT OR STEEP GRADES.
3. THE FRAME AND COVER SHALL WEIGH APPROXIMATELY 370 POUNDS IN TRAFFIC AND NON TRAFFIC APPLICATIONS.
4. THE DIAMETER OF THE COVER FOR ALL SANITARY SEWER MANHOLES SHALL BE 25 3/4".
5. ALL COVERS SHALL BE MARKED "SANITARY SEWER" BY THE MANUFACTURER.
6. APPROVED DRAWINGS ARE FROM US FOUNDRY (USF-152-BV-BWT CITY OF AUBURN).

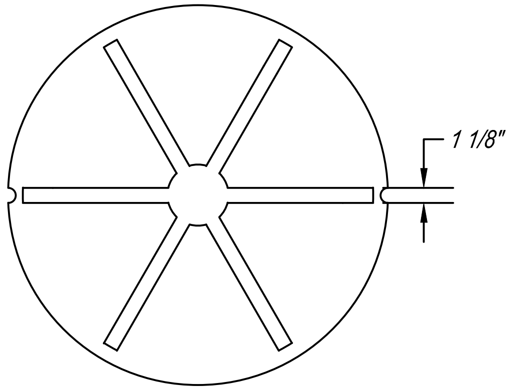
City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

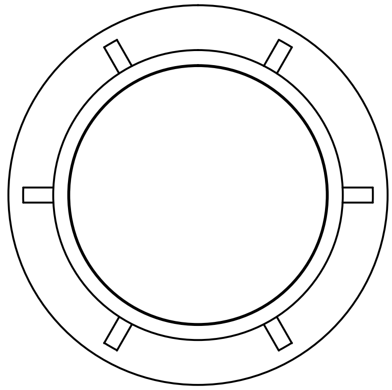
DRAWING TITLE:	TYPICAL WATERTIGHT MANHOLE COVER		
DEPARTMENT:	WRM	REVISIONS: GM-04-30-04	310
SCALE:	N.T.S.	BS-10-30-07	
DRAWN BY:	BS	DCM 2010	
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

STANDARD MANHOLE RING & COVER

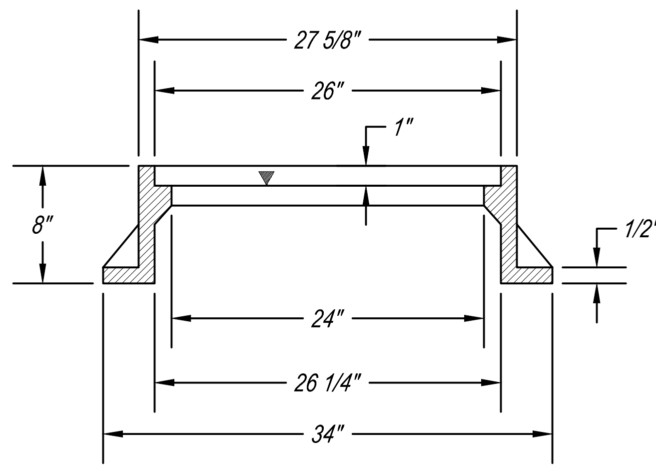


COVER BACK

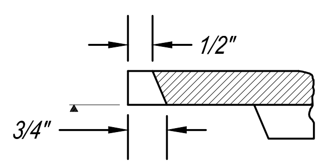
COVER FACE



FRAME PLAN

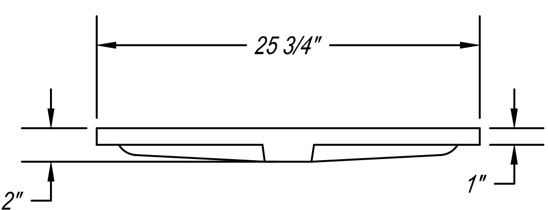


FRAME SECTION



(2) TYPE ONE PICKSLOTS

PICKSLOT DETAIL



COVER SECTION

NOTES:

1. CAST IRON FRAME AND COVER IN ROADWAY AND TRAFFIC SHALL BE INSTALLED FLUSH WITH FINISHED GRADE OF THE PAVEMENT IN FLAT OR STEEP GRADES.
2. THE FRAME AND COVER SHALL WEIGH APPROXIMATELY 370 POUNDS IN TRAFFIC AND NON TRAFFIC APPLICATIONS.
3. THE DIAMETER OF THE COVER FOR ALL SANITARY SEWER MANHOLES SHALL BE 25 3/4".
4. ALL COVERS SHALL BE MARKED "SANITARY SEWER" BY THE MANUFACTURER.
5. APPROVED DRAWINGS ARE FROM US FOUNDRY (USF-152-BV CITY OF AUBURN) OR SIGMA CORPORATION (RMH-2565) .

▼ MACHINED BEARING SURFACE

City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: STANDARD MANHOLE RING AND COVER

DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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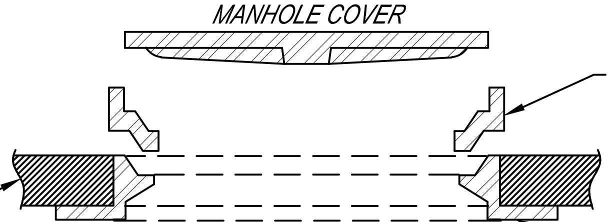
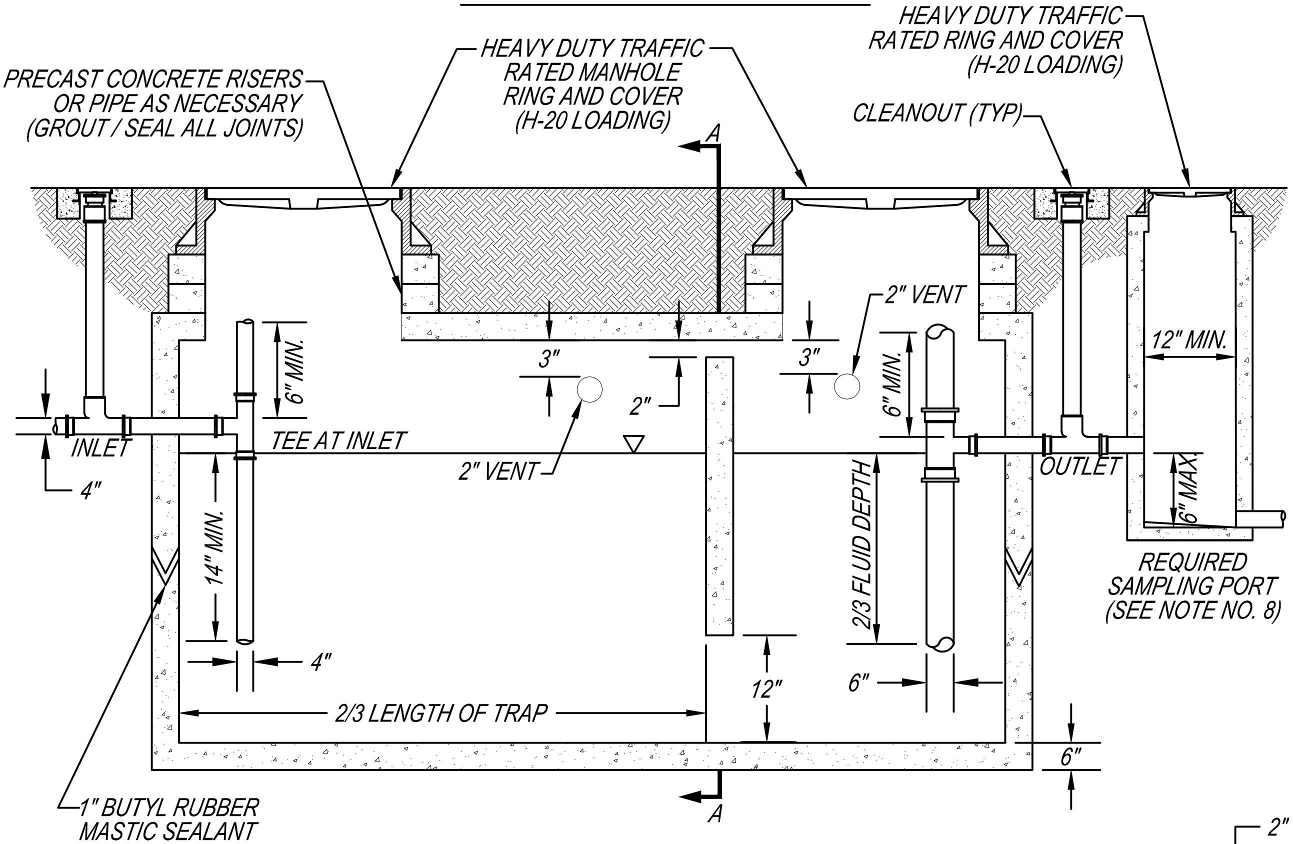
MANHOLE ADJUSTMENT RISER

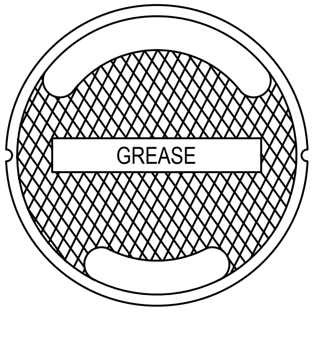


NOTES:

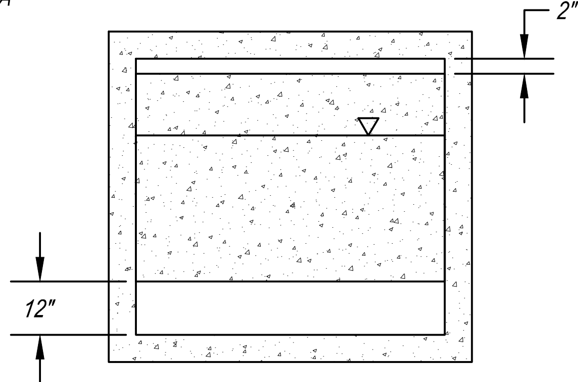
1. ONE PIECE CONSTRUCTION, NO WELDS. COATED TO PREVENT RUST.
2. MULTIPLE RISERS ARE NOT ALLOWED.
3. ALL MANHOLES IN PAVEMENT MUST BE FLUSH WITH THE BINDER LAYER. THE MANHOLE ADJUSTMENT RISER SHALL BE USED UPON PLACEMENT OF WEARING SURFACE.

TYPICAL GREASE TRAP





COVER FACE



SECTION A - A

NOTES:

1. MANHOLE, RING AND COVERS SHALL NOT BE COVERED, OR OBSCURED BY LANDSCAPING, PAVEMENT, ETC.
2. INLET AND OUTLET PIPES SHALL BE SCHEDULE 40 PVC, AND SHALL NOT BE COVERED OR CAPPED.
3. INLET PIPE MUST BE A MINIMUM OF 4" IN DIAMETER. VERTICAL PIPE ON OUTLET SIDE MUST BE A MINIMUM OF 6" IN DIAMETER.
4. TRAPS SHALL NOT BE LOCATED IN AN ENTRANCE, EXIT, DRIVE-THRU, OR UNDER A MENU BOARD.
5. SIZE TO BE PER STANDARD SIZING WORKSHEET (MIN. 500 GALLONS).
6. 2" DIAMETER VENTS TO BE CONNECTED TO BUILDING VENT SYSTEM (WHERE REQUIRED BY THE PLUMBING PLANS).
7. GREASE TRAPS SHALL MEET STATE OF ALABAMA HEALTH REGULATIONS SECTION 420-3-1-23: 420-3-1-24: 420-3-1-25
8. A DOWNSTREAM SAMPLING PORT OR MANHOLE WILL BE REQUIRED. NO OTHER CONNECTIONS ARE ALLOWED BETWEEN GREASE TRAP AND SAMPLING MANHOLE.
9. RESTROOM AND NON GREASE LADEN WASTE SHALL NOT PASS THROUGH THE GREASE TRAP.

City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: TYPICAL GREASE TRAP

DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		JC-10-2011
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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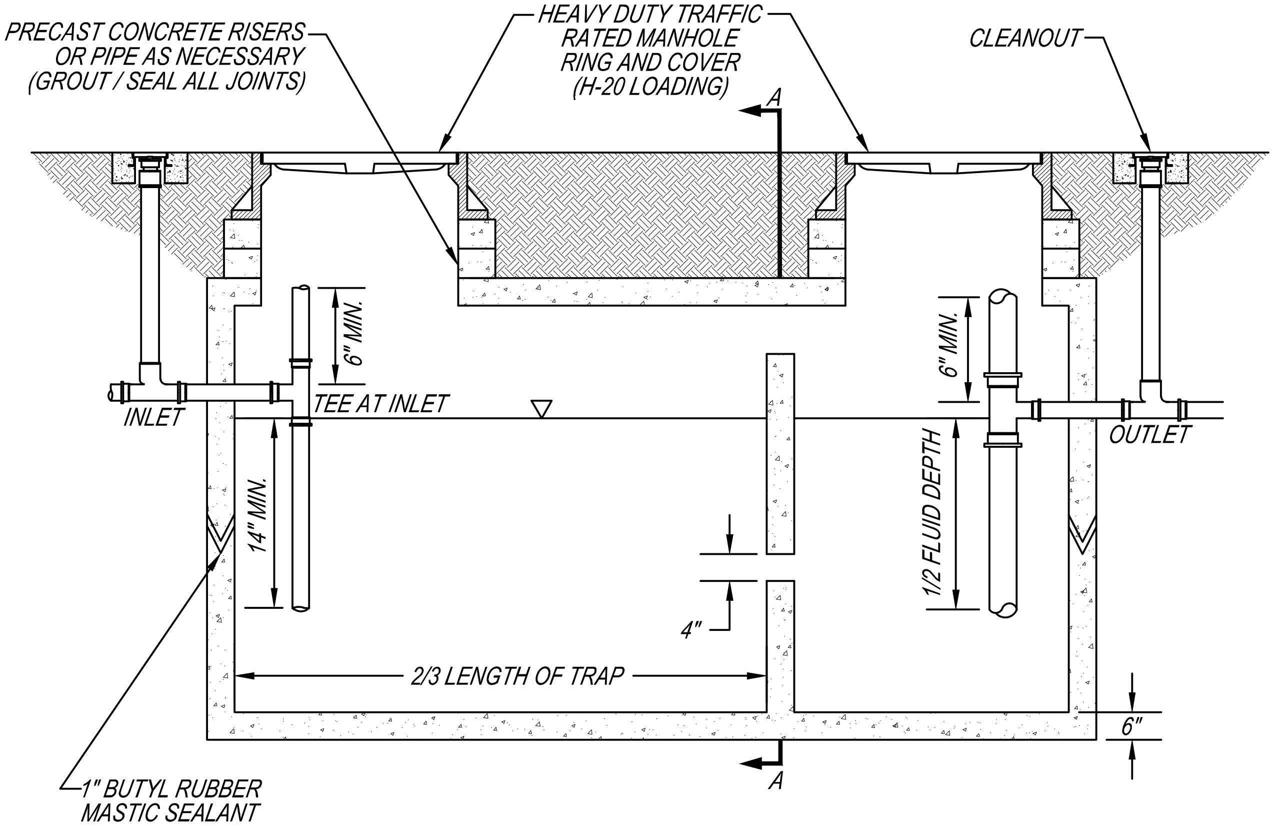
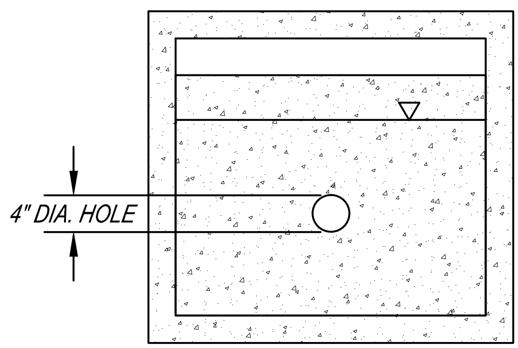
TYPICAL OIL/GRIT SEPARATOR





SECTION A - A

NOTES:

1. MANHOLE RING AND COVERS SHALL NOT BE COVERED, OR OBSCURED BY LANDSCAPING, PAVEMENT, ETC.
2. INLET AND OUTLET PIPES SHALL BE SCHEDULE 40 PVC, AND SHALL NOT BE COVERED OR CAPPED.
3. INLET PIPE MUST BE A MINIMUM OF 4" DIAMETER. VERTICAL PIPE ON OUTLET SIDE MUST BE A MINIMUM OF 6" IN DIAMETER.
4. SEPARATOR SHALL NOT BE LOCATED IN AN ENTRANCE, EXIT, DRIVE-THRU, OR UNDER A MENU BOARD.
5. MINIMUM SIZE: 1000 GALLONS.

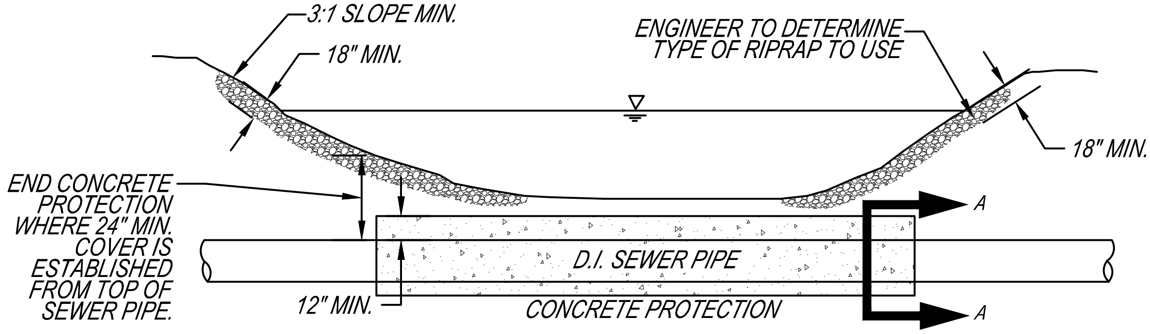
City of Auburn

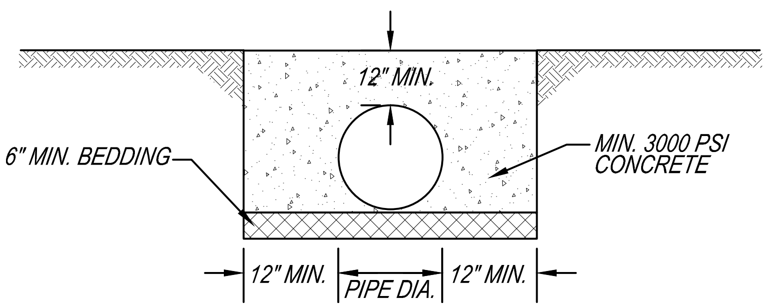
THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	TYPICAL OIL/GRIT SEPARATOR			
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04	318
SCALE:	N.T.S.		BS-10-30-07	
DRAWN BY:	BS		DCM 2010	
REVIEWED BY:	EC		JC-10-2011	
APPROVED BY:	RG			
IMPLEMENTED:	02/2003			

TYPICAL STREAM CROSSING





*END CONCRETE PROTECTION WHERE 24" MIN.
COVER IS ESTABLISHED FROM TOP OF SEWER PIPE.

DETAIL SECTION A - A

NOTES:

1. ALL CREEK CROSSINGS SHALL BE DUCTILE IRON, PRESSURE CLASS 350 PIPE.
2. PIPE SHALL HAVE LOCKING GASKETS OR RESTRAINED JOINTS WHERE LOCATED INSIDE STREAM BANKS.
3. END CONCRETE PROTECTION WHERE 24" MINIMUM COVER IS ESTABLISHED FROM THE TOP OF THE SEWER PIPE.

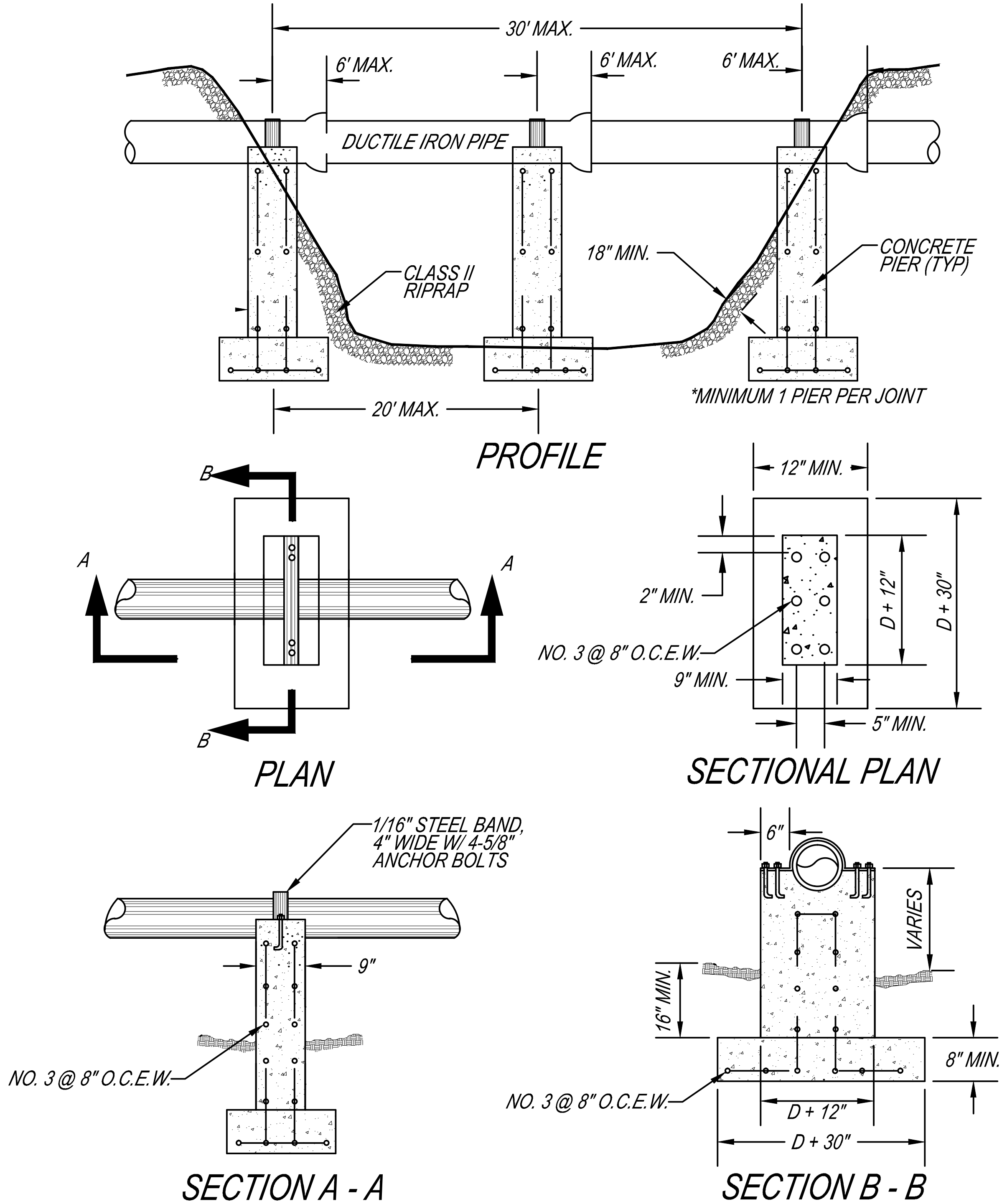
City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	TYPICAL STREAM CROSSING		
DEPARTMENT:	WRM	REVISIONS: GM-04-30-04	320
SCALE:	N.T.S.	BS-10-30-07	
DRAWN BY:	BS	DCM 2010	
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

TYPICAL AERIAL STREAM CROSSING



NOTES:

1. ALL CREEK CROSSINGS SHALL BE DUCTILE IRON, PRESSURE CLASS 350 PIPE.
2. FOUNDATION AND OR FOOTINGS FOR PIERS SHALL BE PLACED A MINIMUM OF TWO (2) FEET BELOW STREAM BED OR ANCHORED TO SOLID ROCK AND SHALL BE CERTIFIED BY A GEOTECHNICAL ENGINEER.
3. PIPE SHALL HAVE LOCKING GASKETS OR RESTRAINED JOINTS.

City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: TYPICAL AERIAL STREAM CROSSING			
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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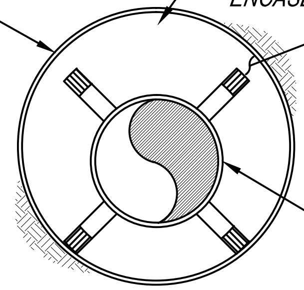
TYPICAL BORE ENCASEMENT

CARRIER PIPE		SPACER	STEEL ENCASEMENT	
NOMINAL PIPE DIAMETER	STANDARD PIPE BELL O.D.*	CASING SPACER BAND WIDTH	MINIMUM CASING THICKNESS	MINIMUM CASING DIAMETER**
4	6.40	8	0.25	14
6	8.60	8	0.25	16
8	11.16	8	0.25	18
10	13.25	8	0.25	20
12	15.22	8	0.25	22
14	17.73	12	0.25	24
16	19.86	12	0.3125	26
18	22.16	12	0.3125	30
20	24.28	12	0.3125	32
24	28.50	12	0.3125	36
30	34.95	12	0.5	42
36	41.37	12	0.5	48

ALL SIZES INDICATED ARE IN INCHES

*PIPE BELL OUTSIDE DIAMETER BASED ON PRESSURE CLASS 350 DUCTILE IRON PIPE.

**CASING DIAMETERS BASED ON BEING A MINIMUM OF 6 INCHES GREATER THAN THE OUTER DIAMETER OF THE JOINT BELL, TO THE NEAREST EVEN SIZE.



CASING SECTION

NOTES

1. ALL SPACER BANDS SHALL BE MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS.
2. ALL SPACERS SHALL HAVE A SYNTHETIC RUBBER OR PVC LINER TO INSULATE THE PIPELINE FROM THE SPACER.
3. ALL SPACERS SHALL HAVE 1.5" WIDE GLASS REINFORCED PLASTIC OR UHMW POLYMER RUNNERS TO INSULATE THE SPACER.
4. SPACERS TO BE MANUFACTURED BY CASCADE WATERWORKS MFG. CO. (PSI) PIPELINE SEAL AND INSULATOR, INC. OR EQUAL.
5. 6" THRU 12" DIAMETER PIPELINE SHALL USE 8" WIDE BANDS: GREATER THAN 12" DIAMETER PIPELINES SHALL USE 12" WIDE BANDS.
6. CENTERED RESTRAINED CASING SPACERS SHALL BE SPACED AT A MAXIMUM OF TEN FEET APART WITH A MINIMUM OF TWO SPACERS PER JOINT OF PIPE.

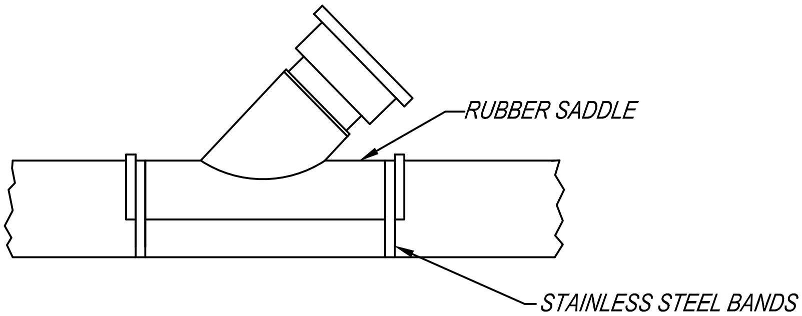
City of Auburn

THE CITY OF AUBURN, AL

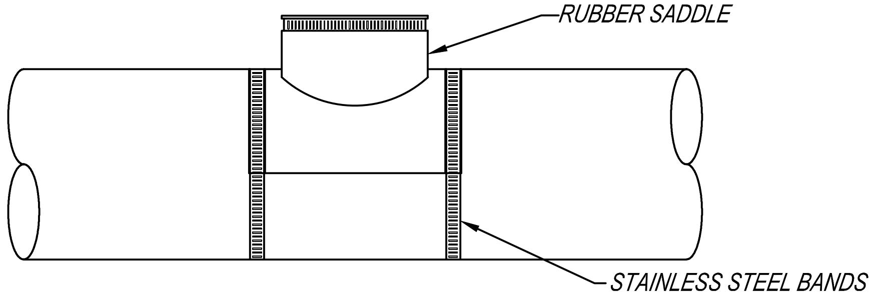
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	TYPICAL BORE ENCASEMENT		
DEPARTMENT:	WRM	REVISIONS: GM-04-30-04	324
SCALE:	N.T.S.	BS-10-30-07	
DRAWN BY:	BS	DCM 2010	
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

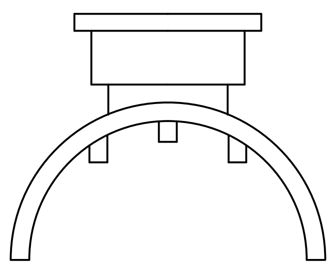
TYPICAL SERVICE CONNECTIONS



RUBBER WYE SADDLE



RUBBER TEE SADDLE



PVC TEE SADDLE

PVC SADDLE FOR USE WITH MAINS
3034 OR SCH. 40 - STAINLESS STEEL BANDS

NOTE:

1. ALL CONNECTIONS SHALL BE MADE WITH AN APPROVED TYPE SADDLE FITTING. THE SADDLE SHALL BE PLACED OVER A CAREFULLY CUT OPENING IN THE UPPER QUADRANT OF THE SEWER MAIN AND ATTACHED TO THE MAIN USING STAINLESS STEEL BANDS. UNDER NO CIRCUMSTANCES SHALL ANY LATERAL CONNECTION BE ALLOWED TO PROTRUDE INTO THE SEWER MAIN.

City of Auburn

THE CITY OF AUBURN, AL
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: TYPICAL SERVICE CONNECTIONS

DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

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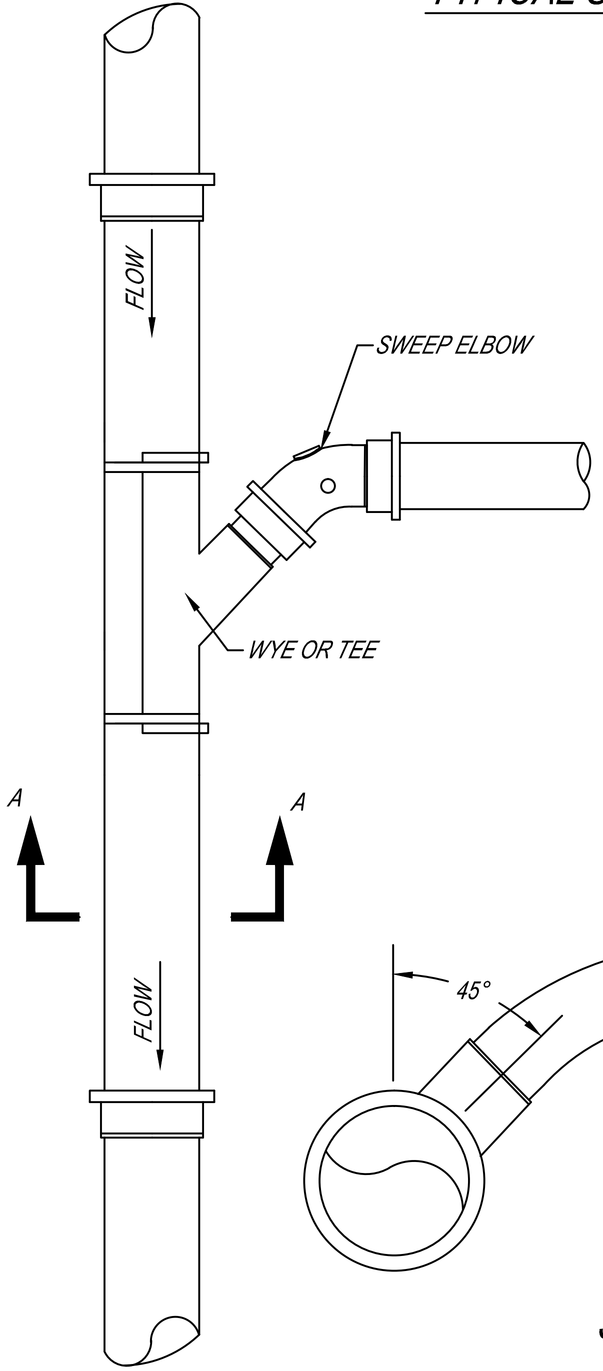
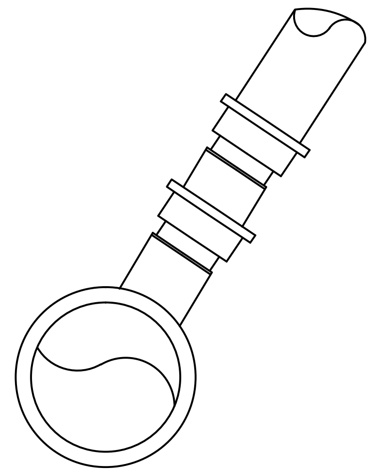
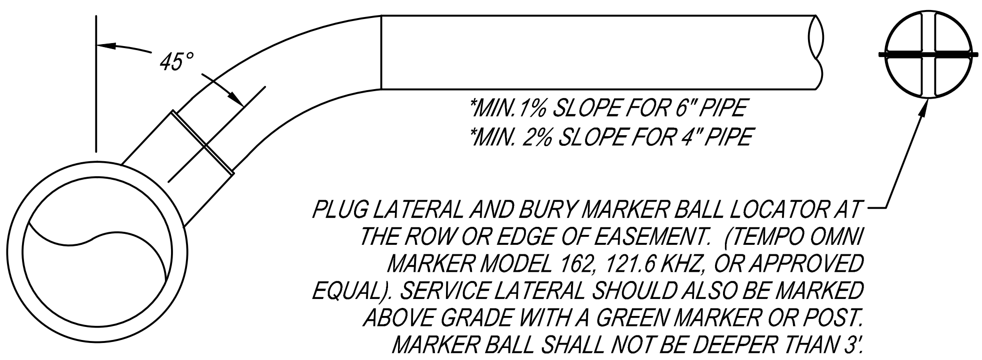
TYPICAL SERVICE LINE



PLAN



SECTION A - A (DEEP CUT)



SECTION A - A

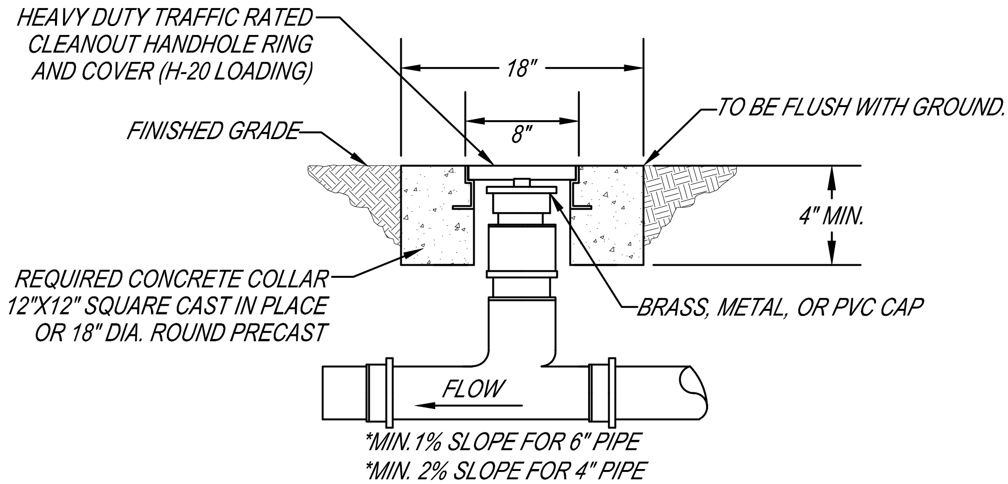
City of Auburn

THE CITY OF AUBURN, AL

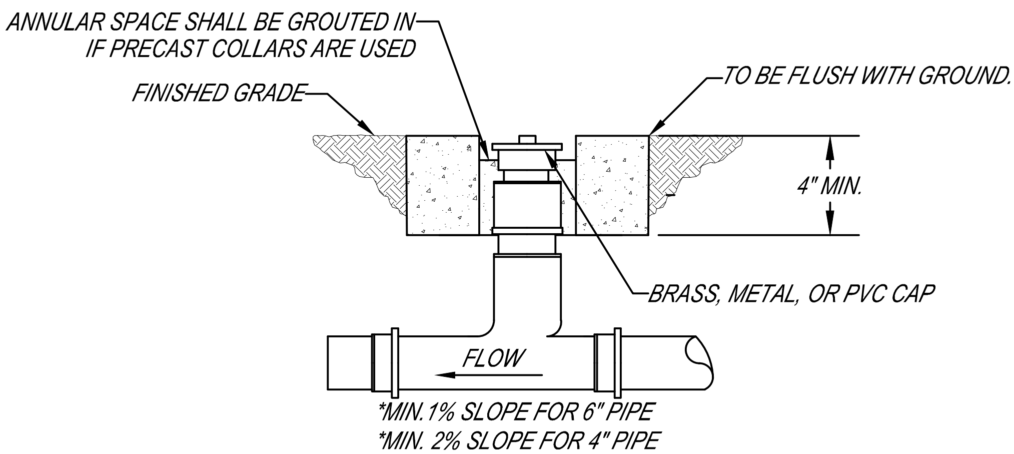
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: TYPICAL SERVICE LINE				
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04	328
SCALE:	N.T.S.		BS-10-30-07	
DRAWN BY:	BS		DCM 2010	
REVIEWED BY:	EC			
APPROVED BY:	RG			
IMPLEMENTED:	02/2003			

TYPICAL CLEANOUT



CLEANOUT IN PAVED AREAS



CLEANOUT IN NON-PAVED AREAS

NOTE:

1. CLEANOUTS ARE REQUIRED AT THE EDGE OF ALL EASEMENTS AND RIGHT OF WAYS, UNLESS APPROVED OTHERWISE.

City of Auburn

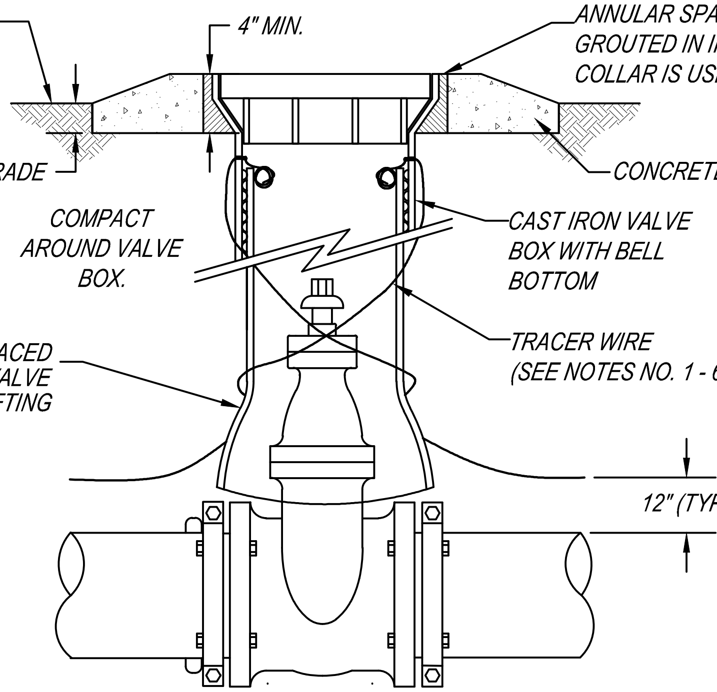
THE CITY OF AUBURN, AL

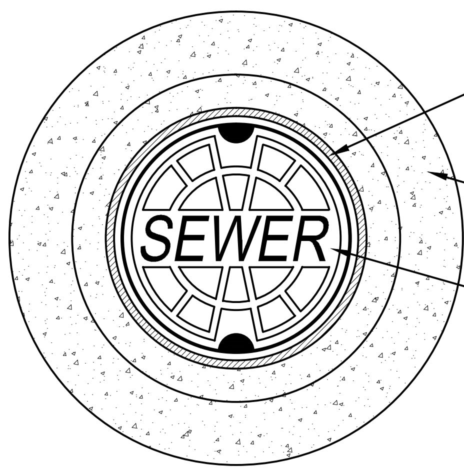
STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	TYPICAL CLEANOUT		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	02/2003		

330

TYPICAL VALVE BOX INSTALLATION





NOTES:

1. TRACER WIRE SHALL BE BROUGHT TO GRADE AT A MINIMUM OF EVERY 500 FEET IN A VALVE BOX.
2. TRACER WIRE SHALL BE WRAPPED AROUND THE VALVE BOX TO PREVENT MOVEMENT.
3. A 3/16" DIAMETER HOLE SHALL BE LOCATED IN THE VALVE BOX NO MORE THAN 6 INCHES BELOW GRADE FOR THE TRACER WIRE TO PULL THROUGH.
4. THE TRACER WIRE SHALL BE KNOTTED INSIDE THE VALVE BOX TO PREVENT SLIPPING BACK THROUGH THE HOLE.
5. A MINIMUM OF 12 INCHES OF EXCESS WIRE SHALL BE COILED AND LEFT IN THE VALVE BOX.
6. TRACER WIRE SHALL BE NO. 14 A.W.G. COPPER CLAD STEEL W/ POLYETHYLENE INSULATION.
7. CONCRETE COLLAR MAY BE CAST-IN-PLACE OR PRECAST AND MAY BE ROUND OR SQUARE IN SHAPE.
8. CONCRETE COLLAR SHALL BE A MIN. 4" THICK.

City of Auburn

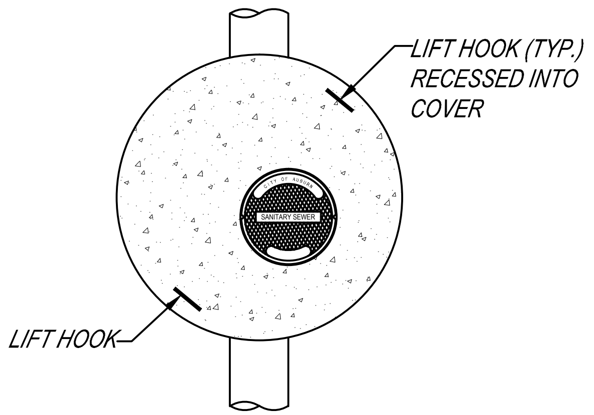
THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

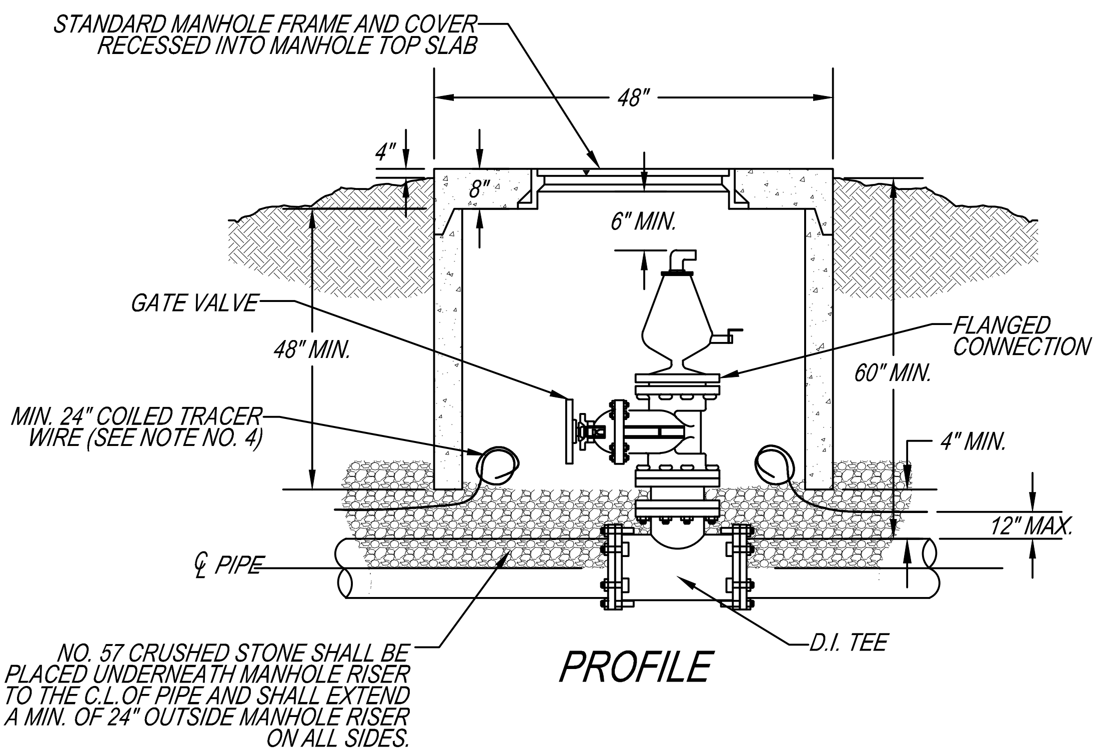
DRAWING TITLE:	TYPICAL VALVE BOX INSTALLATION		
DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	02/2003		

332

COMBINATION AIR RELEASE & AIR/VACUUM VALVE



PLAN



PROFILE

NOTES:

1. AIR RELEASE VALVES SHALL BE MANUFACTURED BY ARI OR APPROVED EQUAL.
2. VALVE BODY SHALL BE STAINLESS STEEL.
3. AIR RELEASE VALVES SHALL BE INSTALLED ON A LEVEL SECTION OF PIPE, EQUIDISTANT BETWEEN JOINTS.
4. TRACER WIRE SHALL BE NO. 14 A.W.G. COPPER CLAD STEEL W/ POLYETHYLENE INSULATION.

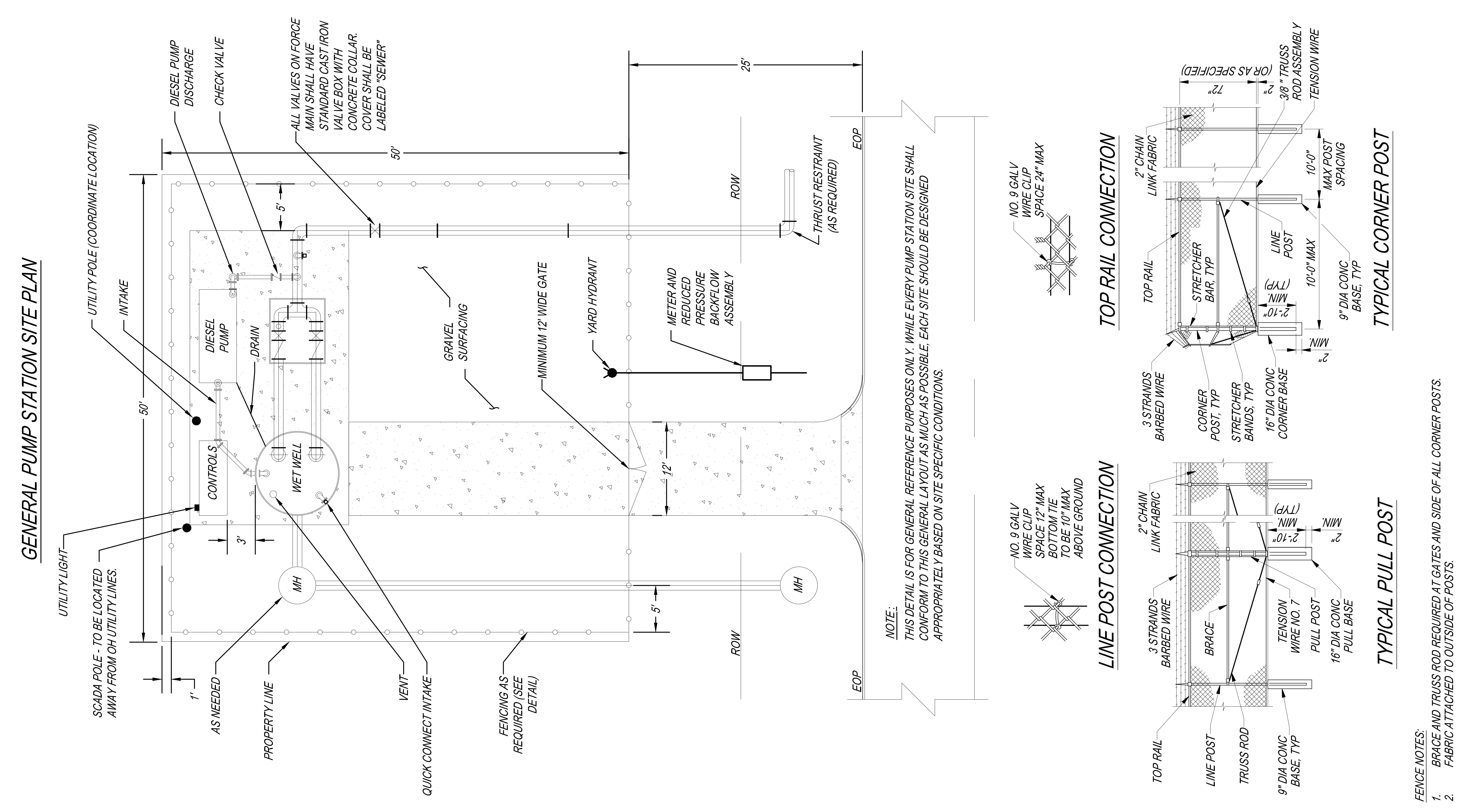
City of Auburn

THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE: COMBINATION AIR RELEASE & AIR/VACUUM VALVE			
DEPARTMENT:	WRM	REVISIONS:	GM-04-30-04
SCALE:	N.T.S.		BS-10-30-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	EC		
APPROVED BY:	RG		
IMPLEMENTED:	02/2003		

334



City of Auburn

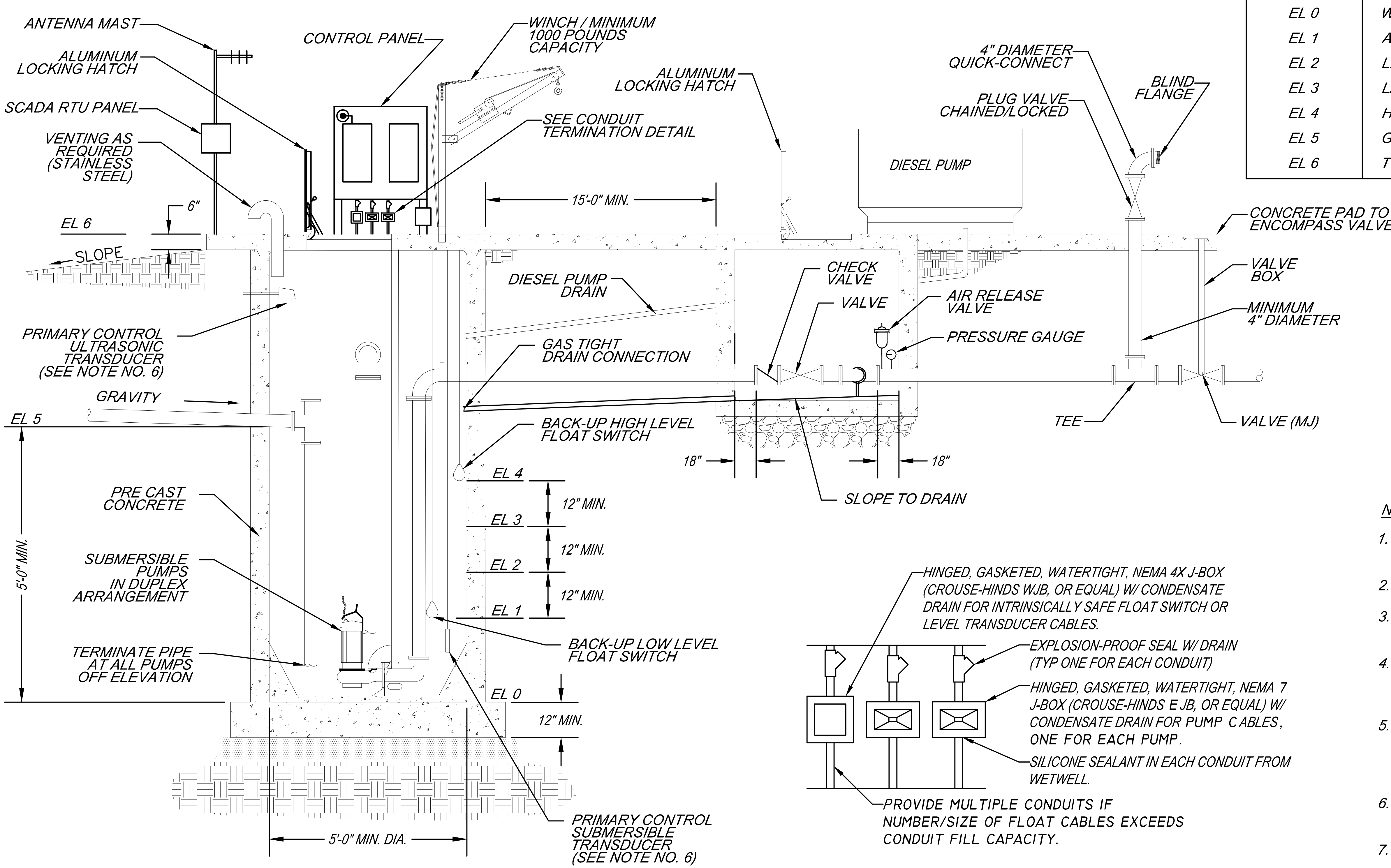
THE CITY OF AUBURN, AL

STANDARD SANITARY SEWER DETAILS

DRAWING TITLE:	GENERAL PUMP STATION SITE PLAN		
DEPARTMENT:	WRM	REVISIONS:	336
SCALE:	N.T.S.		
DRAWN BY:	CN		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	DCM 2010		

GENERAL PUMP STATION SITE SECTION

ELEVATION	DESCRIPTION	VALUE	NOTES
EL 0	WET-WELL INVERT		
EL 1	ALL PUMPS OFF		
EL 2	LEAD PUMP ON		
EL 3	LAG PUMP ON		
EL 4	HIGH LEVEL ALARM		
EL 5	GRAVITY INVERT		
EL 6	TOP OF WET-WELL		



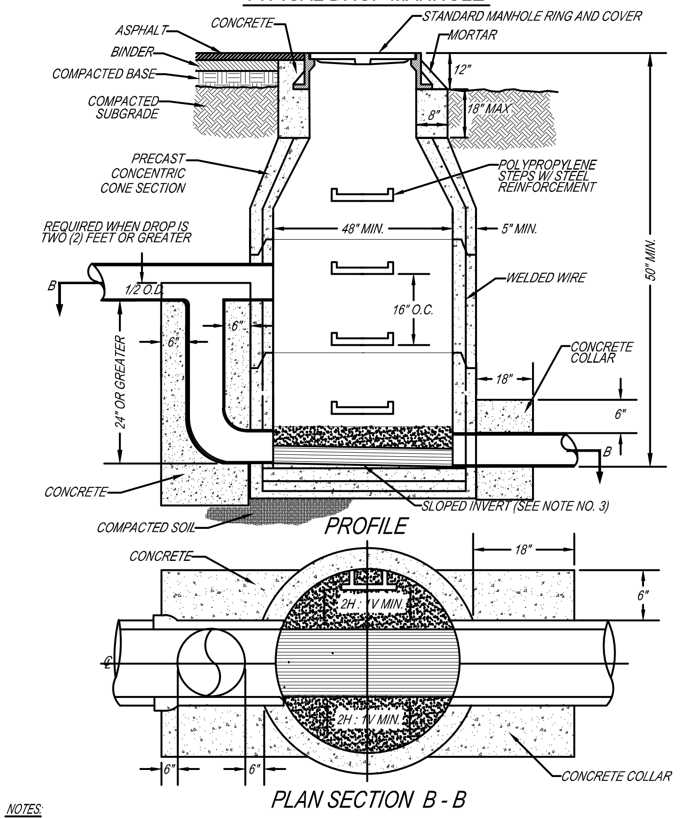
PUMP STATION - SECTION

CONDUIT TERMINATION DETAIL

NOTES:

1. ELEVATION OF THE TOP OF THE PUMP STATION SHALL BE A MINIMUM 2'-0" ABOVE THE 100 YEAR FLOOD ELEVATION.
2. INTERIOR OF WET WELL TO BE LINED WITH HDPE, PVC, OR APPROVED EPOXY LINING.
3. ALL PIPING ON SITE TO BE DUCTILE IRON WITH EPOXY LINING SUITABLE FOR WASTEWATER SERVICE.
4. DIESEL PUMP SHALL BE SIZED TO HANDLE THE PEAK HOURLY DISCHARGE OF THE STATION AND SHALL HAVE A MINIMUM 24 HOUR FUEL CAPACITY.
5. WET WELL SIZE TO BE BASED ON SPECIFIC DESIGN CRITERIA. MINIMUM 5'-0" DIAMETER AND 5'-0" DEPTH FROM THE LOWEST INCOMING PIPE INVERT TO THE WET WELL BOTTOM.
6. PRIMARY LEVEL CONTROL SHALL UTILIZE A 4-20mA SUBMERSIBLE OR ULTRASONIC TRANSDUCER, AS APPROVED.
7. THIS IS A GENERAL SCHEMATIC DRAWING. EACH STATION SHALL HAVE A DETAILED SITE SPECIFIC DESIGN.

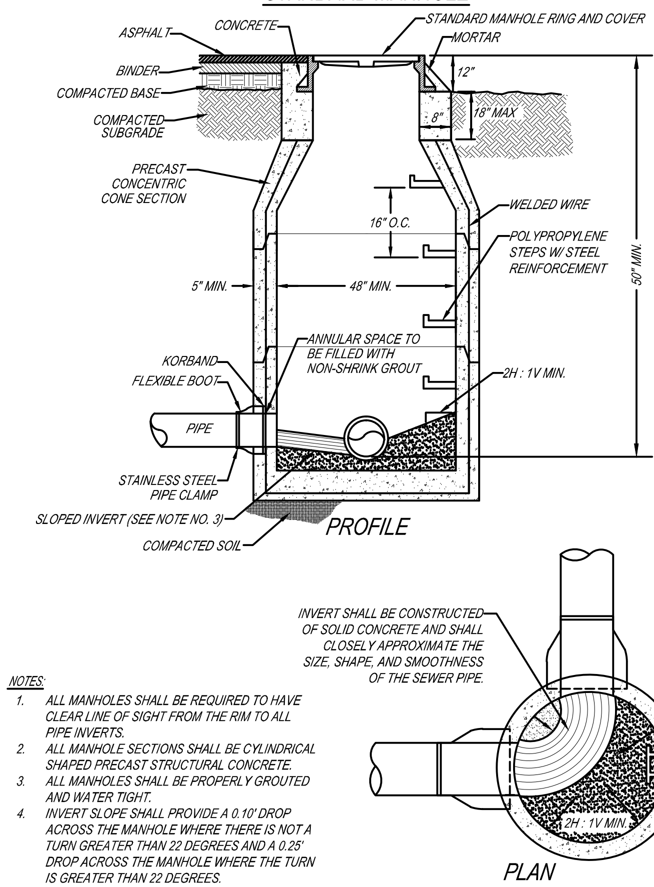
TYPICAL DROP MANHOLE



NOTES:

1. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
2. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
3. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.
4. INVERT SLOPE SHALL PROVIDE A 0.10' DROP ACROSS THE MANHOLE WHERE THERE IS NOT A TURN GREATER THAN 22 DEGREES AND A 0.25' DROP ACROSS THE MANHOLE WHERE THE TURN IS GREATER THAN 22 DEGREES.

STANDARD MANHOLE



NOTES:

1. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
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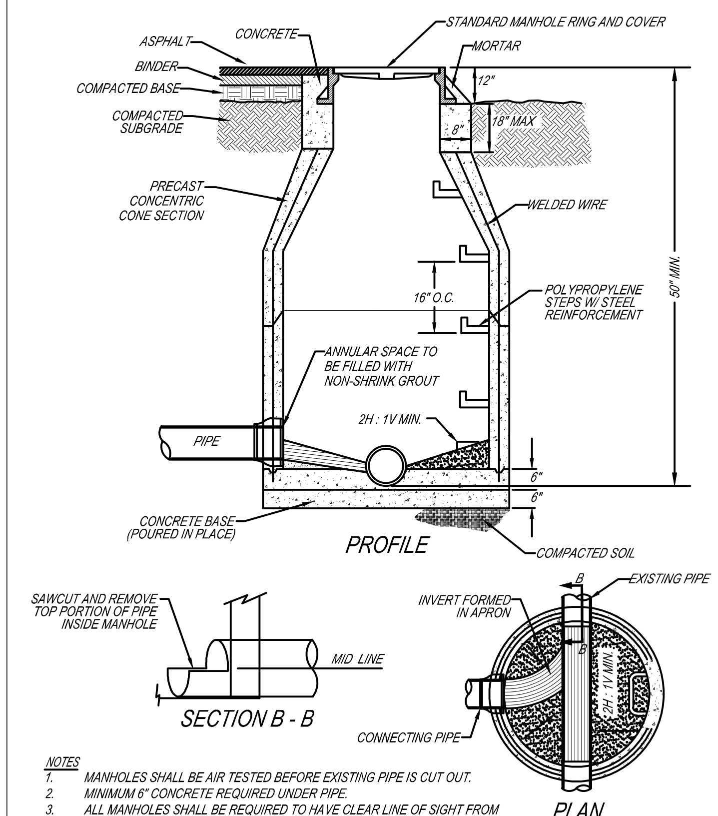
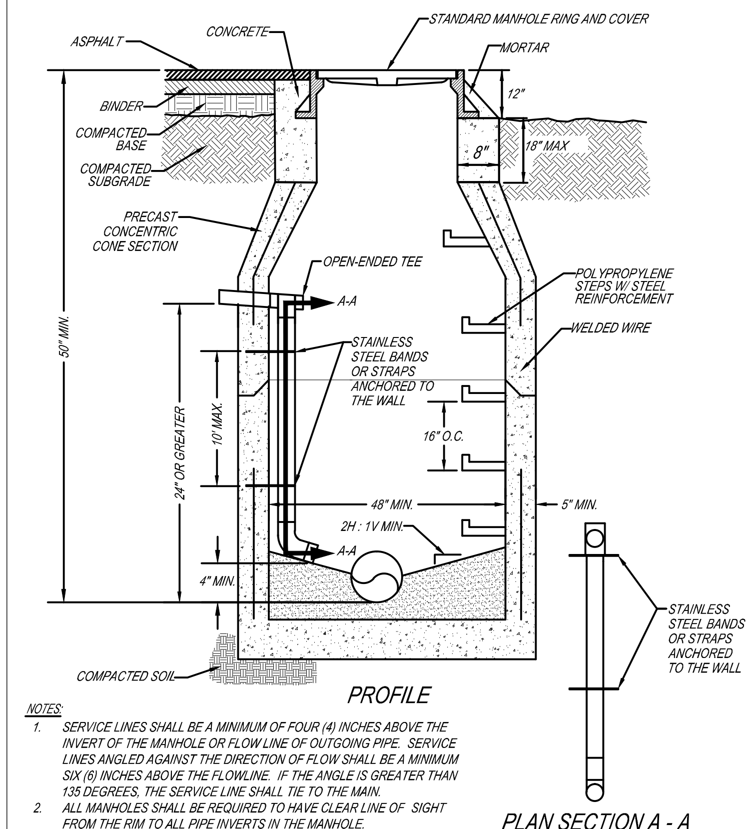
TYPICAL SADDLE MANHOLE



NOTES:

1. MANHOLES SHALL BE AIR TESTED BEFORE EXISTING PIPE IS CUT OUT.
2. MINIMUM 6" CONCRETE REQUIRED UNDER PIPE.
3. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS.
4. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
5. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.

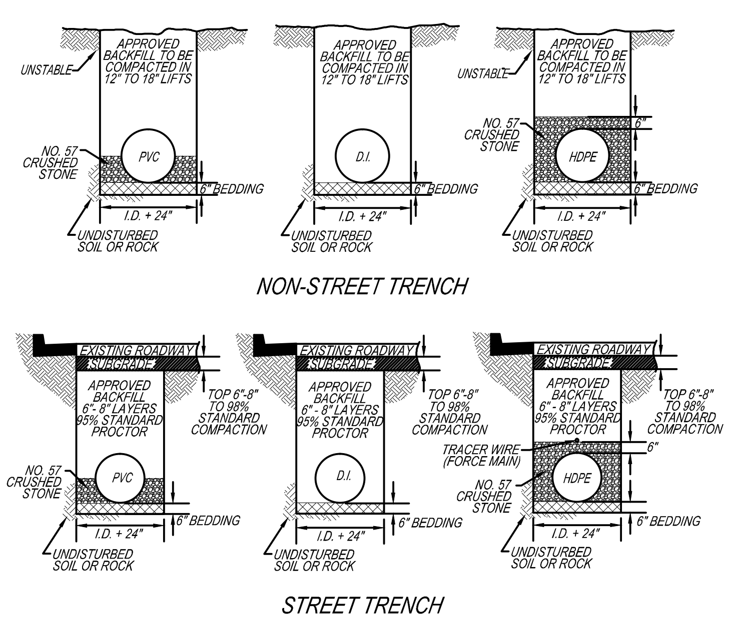
TYPICAL 4" OR 6" DROP SERVICE LINE



NOTES:

1. SERVICE LINES SHALL BE A MINIMUM OF FOUR (4) INCHES ABOVE THE INVERT OF THE MANHOLE OR FLOW LINE OF OUTGOING PIPE. SERVICE LINES ANGLED AGAINST THE DIRECTION OF FLOW SHALL BE A MINIMUM SIX (6) INCHES ABOVE THE FLOWLINE. IF THE ANGLE IS GREATER THAN 135 DEGREES, THE SERVICE LINE SHALL TIE TO THE MAIN.
2. ALL MANHOLES SHALL BE REQUIRED TO HAVE CLEAR LINE OF SIGHT FROM THE RIM TO ALL PIPE INVERTS IN THE MANHOLE.
3. ALL MANHOLE SECTIONS SHALL BE CYLINDRICAL SHAPED PRECAST STRUCTURAL CONCRETE.
4. ALL MANHOLES SHALL BE PROPERLY GROUTED AND WATER TIGHT.

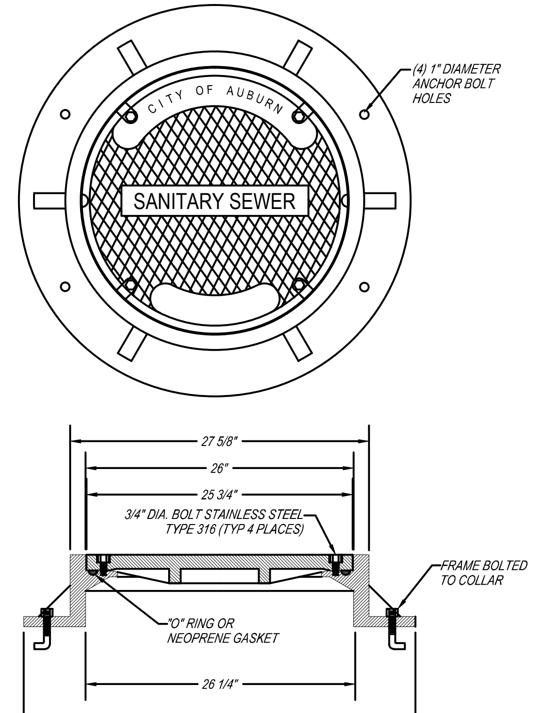
BEDDING REQUIREMENTS FOR TRENCHES



NOTES:

1. BEDDING MATERIALS FOR PVC AND HDPE PIPE SHALL BE 1/4" TO 1 1/2" GRADED CRUSHED STONE SUCH AS: 56,57,6,67,68,7,OR 78, STONE PER ALDOT STANDARD SPECS. SAND OR GRAVEL MAY BE USED AS BEDDING MATERIAL FOR D.I. PIPE.
2. WIDTH VARIES BASED ON WALL STABILITY. STABLE WALLS WIDTH AS NEEDED TO JOIN PIPE AND COMPACT HAUNCHING AND INITIAL BACKFILL. UNSTABLE WALLS: WIDTH TO BE A MINIMUM OF FIVE TIMES PIPE DIAMETER.
3. FLOWABLE FILL CAN BE USED AS BACKFILL, BUT MUST HAVE PRIOR APPROVAL AND MUST BE ALLOWED TO SETUP FOR 24 HOURS PRIOR TO TOPPING.
4. APPROVED BACKFILL MATERIAL INCLUDES 825 B, FLOWABLE FILL AND APPROVED DIRT. ALTERNATIVE MATERIAL MUST BE APPROVED BY PROJECT MANAGER PRIOR TO USE.

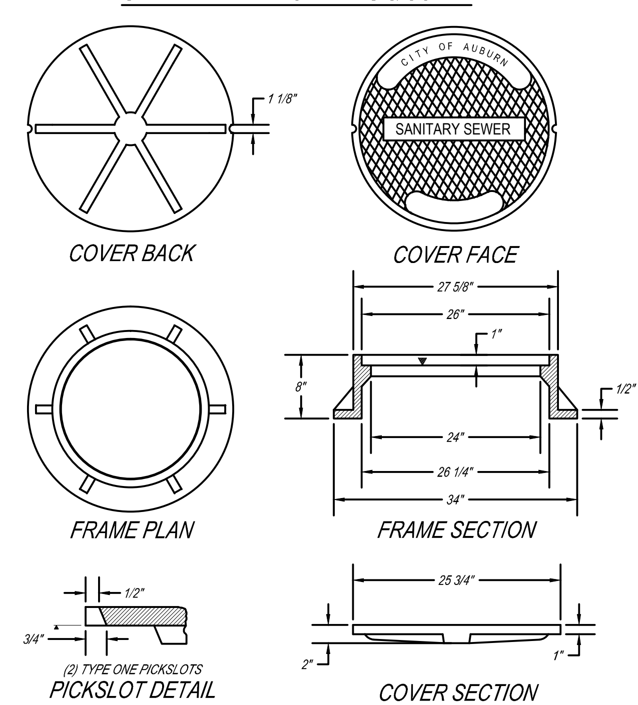
TYPICAL WATERTIGHT MANHOLE COVER



NOTES:

1. REQUIRED FOR ALL MANHOLES WHERE THE RIM ELEVATION IS LESS THAN ONE (1) VERTICAL FOOT ABOVE THE 100 YEAR FLOODPLAIN ELEVATION.
2. CAST IRON FRAME AND COVER IN ROADWAY AND TRAFFIC SHALL BE INSTALLED FLUSH WITH FINISHED GRADE OF THE PAVEMENT IN FLAT OR STEEP GRADES.
3. THE FRAME AND COVER SHALL WEIGH APPROXIMATELY 370 POUNDS IN TRAFFIC AND NON TRAFFIC APPLICATIONS.
4. THE DIAMETER OF THE COVER FOR ALL SANITARY SEWER MANHOLES SHALL BE 25 3/4".
5. ALL COVERS SHALL BE MARKED "SANITARY SEWER" BY THE MANUFACTURER.
6. APPROVED DRAWINGS ARE FROM US FOUNDRY (USF-152-BV-BWT CITY OF AUBURN).

STANDARD MANHOLE RING & COVER

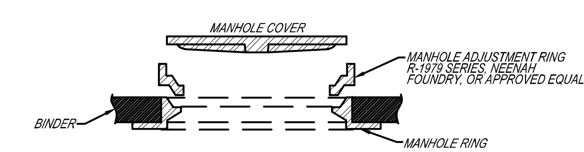


NOTES:

1. CAST IRON FRAME AND COVER IN ROADWAY AND TRAFFIC SHALL BE INSTALLED FLUSH WITH FINISHED GRADE OF THE PAVEMENT IN FLAT OR STEEP GRADES.
2. THE FRAME AND COVER SHALL WEIGH APPROXIMATELY 370 POUNDS IN TRAFFIC AND NON TRAFFIC APPLICATIONS.
3. THE DIAMETER OF THE COVER FOR ALL SANITARY SEWER MANHOLES SHALL BE 25 3/4".
4. ALL COVERS SHALL BE MARKED "SANITARY SEWER" BY THE MANUFACTURER.
5. APPROVED DRAWINGS ARE FROM US FOUNDRY (USF-152-BV CITY OF AUBURN) OR SIGMA CORPORATION (RMH-2565).

▼ MACHINED BEARING SURFACE

MANHOLE ADJUSTMENT RISER



NOTES:

1. ONE PIECE CONSTRUCTION, NO WELDS. COATED TO PREVENT RUST.
2. MULTIPLE RISERS ARE NOT ALLOWED.
3. ALL MANHOLES IN PAVEMENT MUST BE FLUSH WITH THE BINDER LAYER. THE MANHOLE ADJUSTMENT RISER SHALL BE USED UPON PLACEMENT OF WEARING SURFACE.

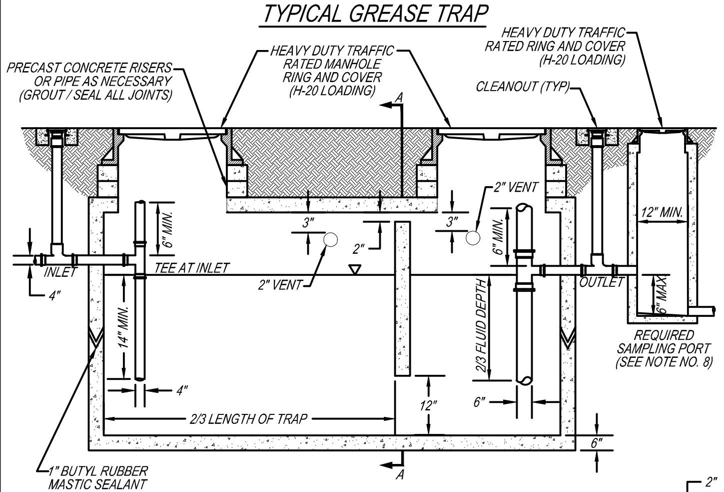
STANDARD DETAILS: SANITARY SEWER - SHEET 1 OF 3

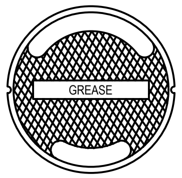
PROJECT TITLE:

City of Auburn

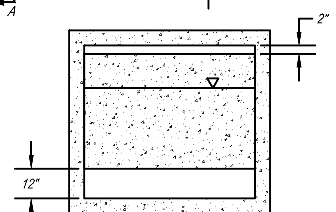
DEPARTMENT:	WRM	REVISIONS:	GM-04/30/04
SCALE:	N.T.S.		BS-10-25-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	JC		JC-10-2011
APPROVED BY:	EC		
IMPLEMENTED:	02/2003		

TYPICAL GREASE TRAP





COVER FACE

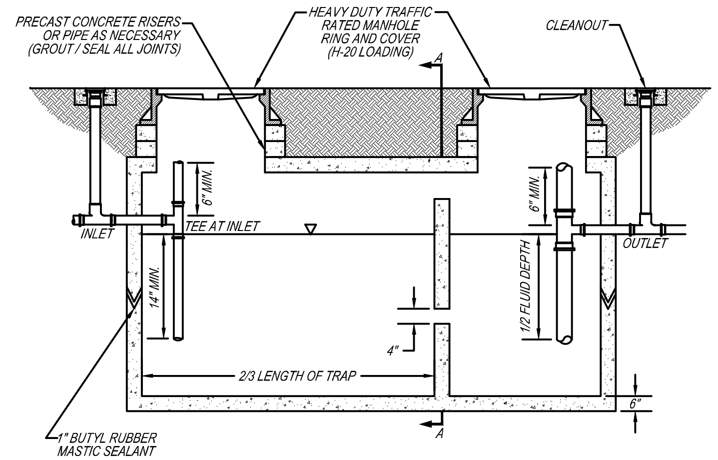


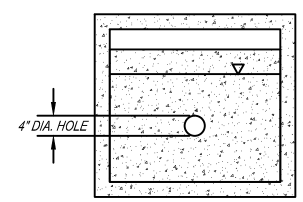
SECTION A - A

NOTES:

1. MANHOLE, RING AND COVERS SHALL NOT BE COVERED, OR OBSCURED BY LANDSCAPING, PAVEMENT, ETC.
2. INLET AND OUTLET PIPES SHALL BE SCHEDULE 40 PVC, AND SHALL NOT BE COVERED OR CAPPED.
3. INLET PIPE MUST BE A MINIMUM OF 4" IN DIAMETER. VERTICAL PIPE ON OUTLET SIDE MUST BE A MINIMUM OF 6" IN DIAMETER.
4. TRAPS SHALL NOT BE LOCATED IN AN ENTRANCE, EXIT, DRIVE-THRU, OR UNDER A MENU BOARD.
5. SIZE TO BE PER STANDARD SIZING WORKSHEET (MIN. 500 GALLONS).
6. 2" DIAMETER VENTS TO BE CONNECTED TO BUILDING VENT SYSTEM (WHERE REQUIRED BY THE PLUMBING PLANS).
7. GREASE TRAPS SHALL MEET STATE OF ALABAMA HEALTH REGULATIONS SECTION 420-3-1-23: 420-3-1-24: 420-3-1-25
8. A DOWNSTREAM SAMPLING PORT OR MANHOLE WILL BE REQUIRED. NO OTHER CONNECTIONS ARE ALLOWED BETWEEN GREASE TRAP AND SAMPLING MANHOLE.
9. RESTROOM AND NON GREASE LADEN WASTE SHALL NOT PASS THROUGH THE GREASE TRAP.

TYPICAL OIL/GRIT SEPARATOR



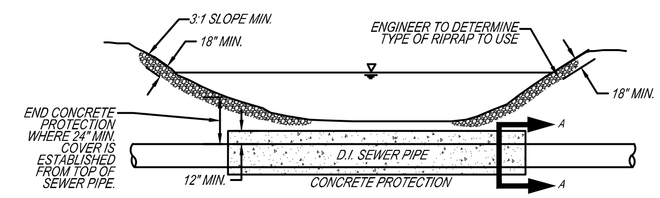


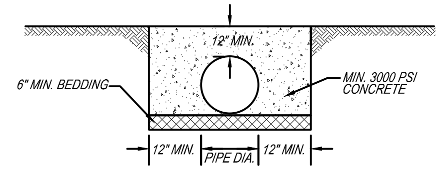
SECTION A - A

NOTES:

1. MANHOLE RING AND COVERS SHALL NOT BE COVERED, OR OBSCURED BY LANDSCAPING, PAVEMENT, ETC.
2. INLET AND OUTLET PIPES SHALL BE SCHEDULE 40 PVC, AND SHALL NOT BE COVERED OR CAPPED.
3. INLET PIPE MUST BE A MINIMUM OF 4" DIAMETER. VERTICAL PIPE ON OUTLET SIDE MUST BE A MINIMUM OF 6" IN DIAMETER.
4. SEPARATOR SHALL NOT BE LOCATED IN AN ENTRANCE, EXIT, DRIVE-THRU, OR UNDER A MENU BOARD.
5. MINIMUM SIZE: 1000 GALLONS.

TYPICAL STREAM CROSSING





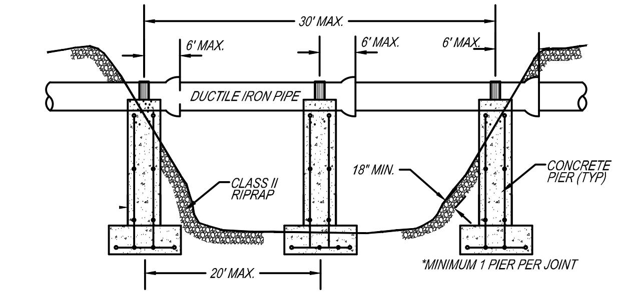
*END CONCRETE PROTECTION WHERE 24" MIN. COVER IS ESTABLISHED FROM TOP OF SEWER PIPE.

DETAIL SECTION A - A

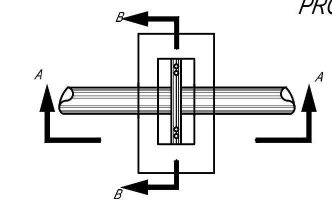
NOTES:

1. ALL CREEK CROSSINGS SHALL BE DUCTILE IRON, PRESSURE CLASS 350 PIPE.
2. PIPE SHALL HAVE LOCKING GASKETS OR RESTRAINED JOINTS WHERE LOCATED INSIDE STREAM BANKS.
3. END CONCRETE PROTECTION WHERE 24" MINIMUM COVER IS ESTABLISHED FROM THE TOP OF THE SEWER PIPE.

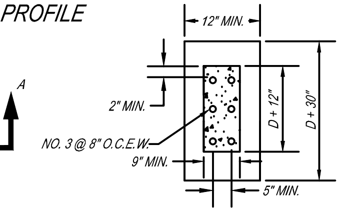
TYPICAL AERIAL STREAM CROSSING



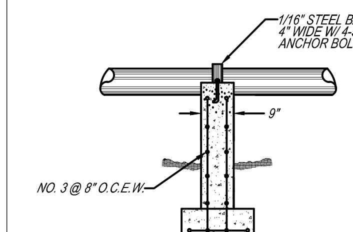
PROFILE



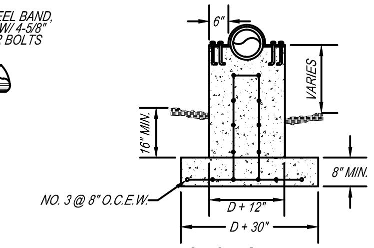
PLAN



SECTIONAL PLAN



SECTION A - A



SECTION B - B

NOTES:

1. ALL CREEK CROSSINGS SHALL BE DUCTILE IRON, PRESSURE CLASS 350 PIPE.
2. FOUNDATION AND OR FOOTINGS FOR PIERS SHALL BE PLACED A MINIMUM OF TWO (2) FEET BELOW STREAM BED OR ANCHORED TO SOLID ROCK AND SHALL BE CERTIFIED BY A GEOTECHNICAL ENGINEER.
3. PIPE SHALL HAVE LOCKING GASKETS OR RESTRAINED JOINTS.

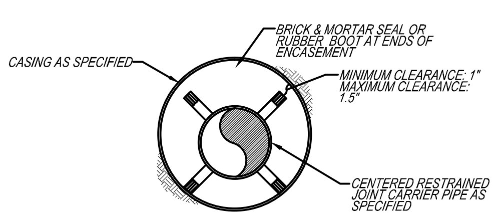
TYPICAL BORE ENCASEMENT

CARRIER PIPE		SPACER	STEEL ENCASEMENT	
NOMINAL PIPE DIAMETER	STANDARD PIPE BELL O.D.*	CASING SPACER BAND WIDTH	MINIMUM CASING THICKNESS	MINIMUM CASING DIAMETER**
4	6.40	8	0.25	14
6	8.60	8	0.25	16
8	11.16	8	0.25	18
10	13.25	8	0.25	20
12	15.22	8	0.25	22
14	17.73	12	0.25	24
16	19.86	12	0.3125	26
18	22.16	12	0.3125	30
20	24.28	12	0.3125	32
24	28.50	12	0.3125	36
30	34.95	12	0.5	42
36	41.37	12	0.5	48

ALL SIZES INDICATED ARE IN INCHES

*PIPE BELL OUTSIDE DIAMETER BASED ON PRESSURE CLASS 350 DUCTILE IRON PIPE.

**CASING DIAMETERS BASED ON BEING A MINIMUM OF 6 INCHES GREATER THAN THE OUTER DIAMETER OF THE JOINT BELL, TO THE NEAREST EVEN SIZE.

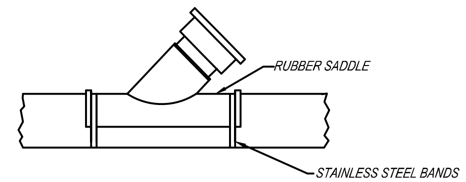


CASING SECTION

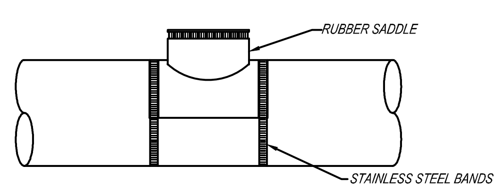
NOTES

1. ALL SPACER BANDS SHALL BE MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS.
2. ALL SPACERS SHALL HAVE A SYNTHETIC RUBBER OR PVC LINER TO INSULATE THE PIPELINE FROM THE SPACER.
3. ALL SPACERS SHALL HAVE 1.5" WIDE GLASS REINFORCED PLASTIC OR UHMW POLYMER RUNNERS TO INSULATE THE SPACER.
4. SPACERS TO BE MANUFACTURED BY CASCADE WATERWORKS MFG. CO. (PSI) PIPELINE SEAL AND INSULATOR, INC. OR EQUAL.
5. 6" THRU 12" DIAMETER PIPELINE SHALL USE 8" WIDE BANDS: GREATER THAN 12" DIAMETER PIPELINES SHALL USE 12" WIDE BANDS.
6. CENTERED RESTRAINED CASING SPACERS SHALL BE SPACED AT A MAXIMUM OF TEN FEET APART WITH A MINIMUM OF TWO SPACERS PER JOINT OF PIPE.

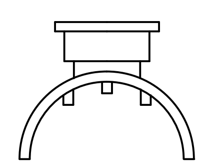
TYPICAL SERVICE CONNECTIONS



RUBBER WYE SADDLE



RUBBER TEE SADDLE



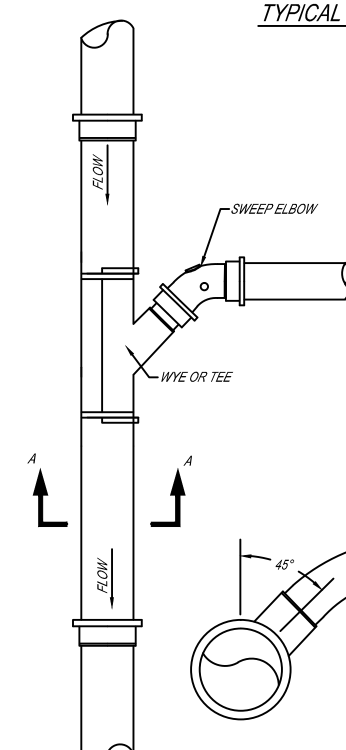
PVC TEE SADDLE

PVC SADDLE FOR USE WITH MAINS
3034 OR SCH. 40 - STAINLESS STEEL BANDS

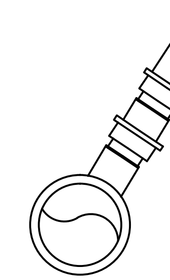
NOTE:

1. ALL CONNECTIONS SHALL BE MADE WITH AN APPROVED TYPE SADDLE FITTING. THE SADDLE SHALL BE PLACED OVER A CAREFULLY CUT OPENING IN THE UPPER QUADRANT OF THE SEWER MAIN AND ATTACHED TO THE MAIN USING STAINLESS STEEL BANDS. UNDER NO CIRCUMSTANCES SHALL ANY LATERAL CONNECTION BE ALLOWED TO PROTRUDE INTO THE SEWER MAIN.

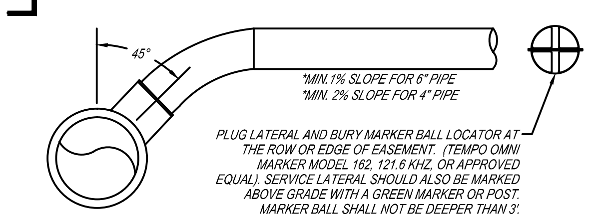
TYPICAL SERVICE LINE



PLAN

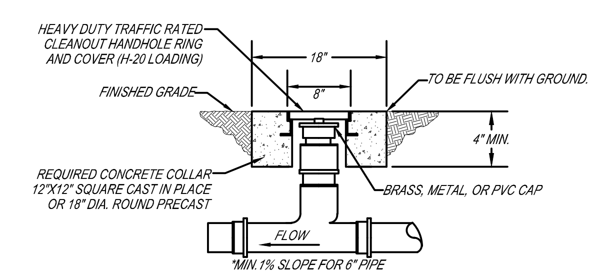


SECTION A - A (DEEP CUT)

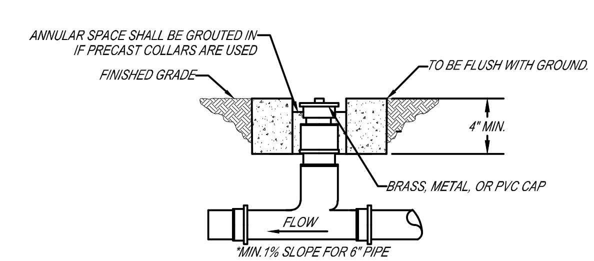


SECTION A - A

TYPICAL CLEANOUT



CLEANOUT IN PAVED AREAS



CLEANOUT IN NON-PAVED AREAS

NOTE:

1. CLEANOUTS ARE REQUIRED AT THE EDGE OF ALL EASEMENTS AND RIGHT OF WAYS, UNLESS APPROVED OTHERWISE.

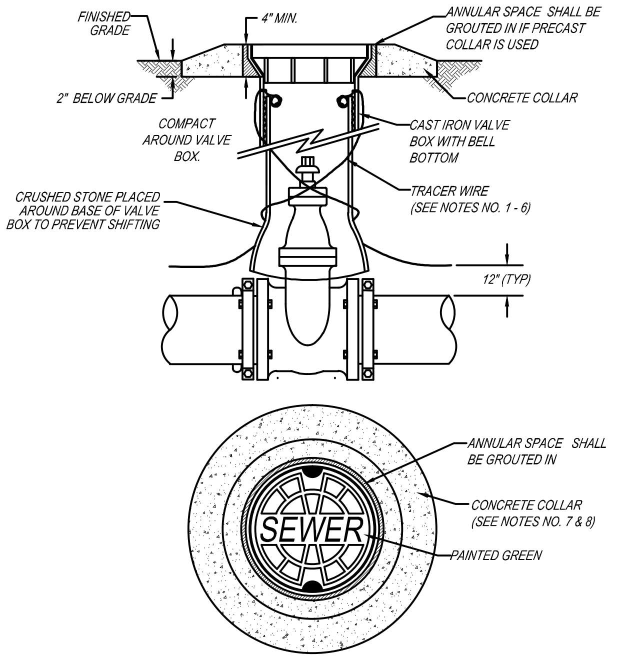
STANDARD DETAILS: SANITARY SEWER - SHEET 2 OF 3

PROJECT TITLE:

City of Auburn

DEPARTMENT:	WRM	REVISIONS:	GM-04/30/04
SCALE:	N.T.S.		BS-10-25-07
DRAWN BY:	BS		DCM 2010
REVIEWED BY:	JC		JC-10-2011
APPROVED BY:	EC		
IMPLEMENTED:	02/2003		

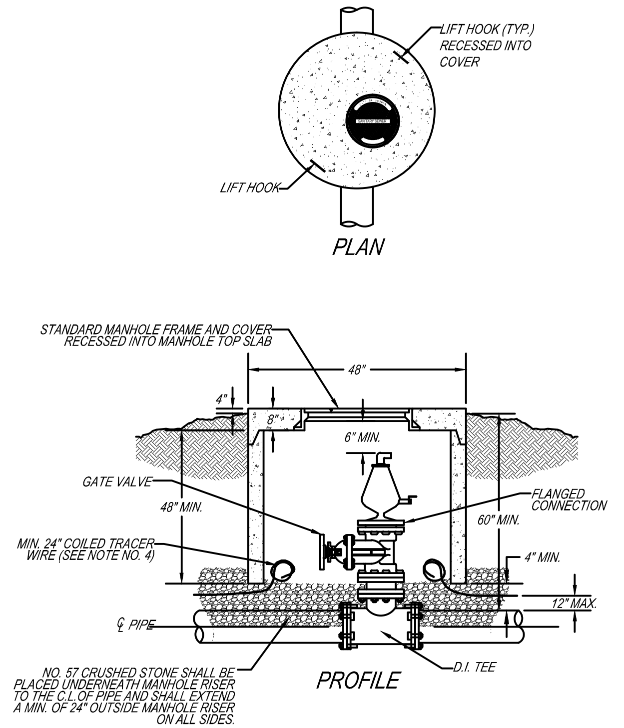
TYPICAL VALVE BOX INSTALLATION



NOTES:

1. TRACER WIRE SHALL BE BROUGHT TO GRADE AT A MINIMUM OF EVERY 500 FEET IN A VALVE BOX.
2. TRACER WIRE SHALL BE WRAPPED AROUND THE VALVE BOX TO PREVENT MOVEMENT.
3. A 3/16" DIAMETER HOLE SHALL BE LOCATED IN THE VALVE BOX NO MORE THAN 6 INCHES BELOW GRADE FOR THE TRACER WIRE TO PULL THROUGH.
4. THE TRACER WIRE SHALL BE KNOTTED INSIDE THE VALVE BOX TO PREVENT SLIPPING BACK THROUGH THE HOLE.
5. A MINIMUM OF 12 INCHES OF EXCESS WIRE SHALL BE COILED AND LEFT IN THE VALVE BOX.
6. TRACER WIRE SHALL BE NO. 14 A.W.G. COPPER CLAD STEEL W/ POLYETHYLENE INSULATION.
7. CONCRETE COLLAR MAY BE CAST-IN-PLACE OR PRECAST AND MAY BE ROUND OR SQUARE IN SHAPE.
8. CONCRETE COLLAR SHALL BE A MIN. 4" THICK.

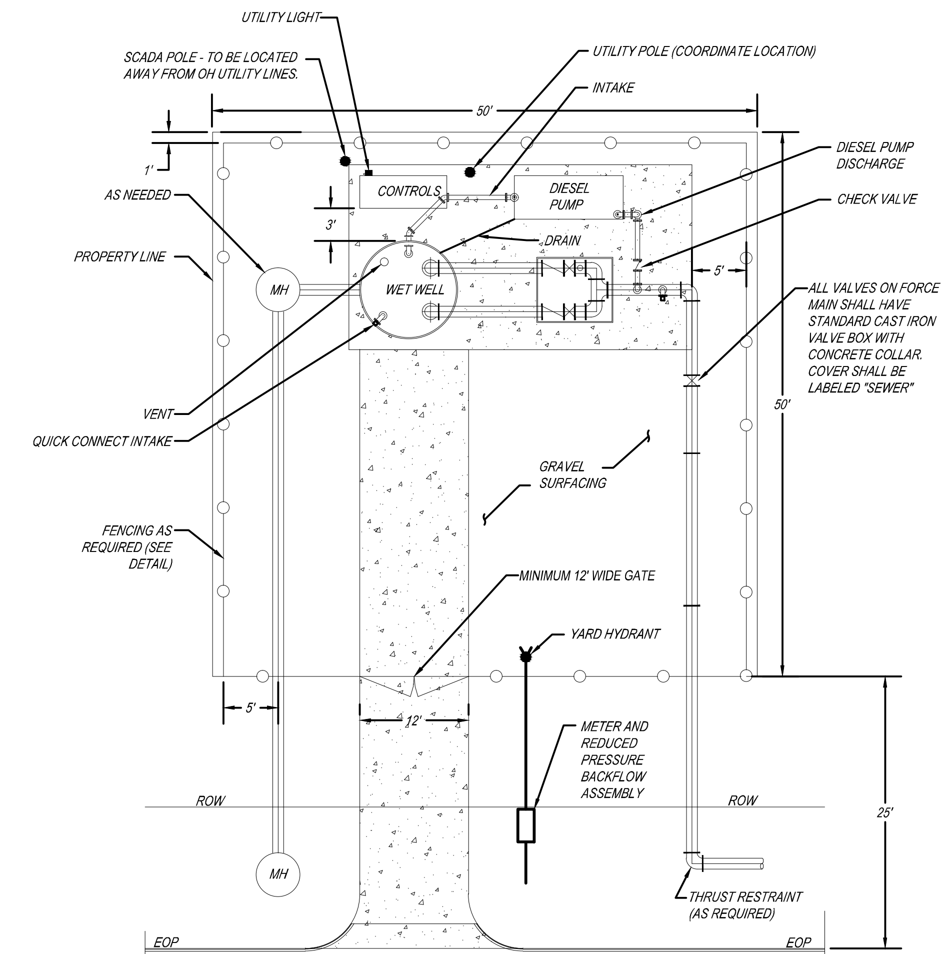
COMBINATION AIR RELEASE & AIR/VACUUM VALVE



NOTES:

1. AIR RELEASE VALVES SHALL BE MANUFACTURED BY ARI OR APPROVED EQUAL.
2. VALVE BODY SHALL BE STAINLESS STEEL.
3. AIR RELEASE VALVES SHALL BE INSTALLED ON A LEVEL SECTION OF PIPE, EQUIDISTANT BETWEEN JOINTS.
4. TRACER WIRE SHALL BE NO. 14 A.W.G. COPPER CLAD STEEL W/ POLYETHYLENE INSULATION.

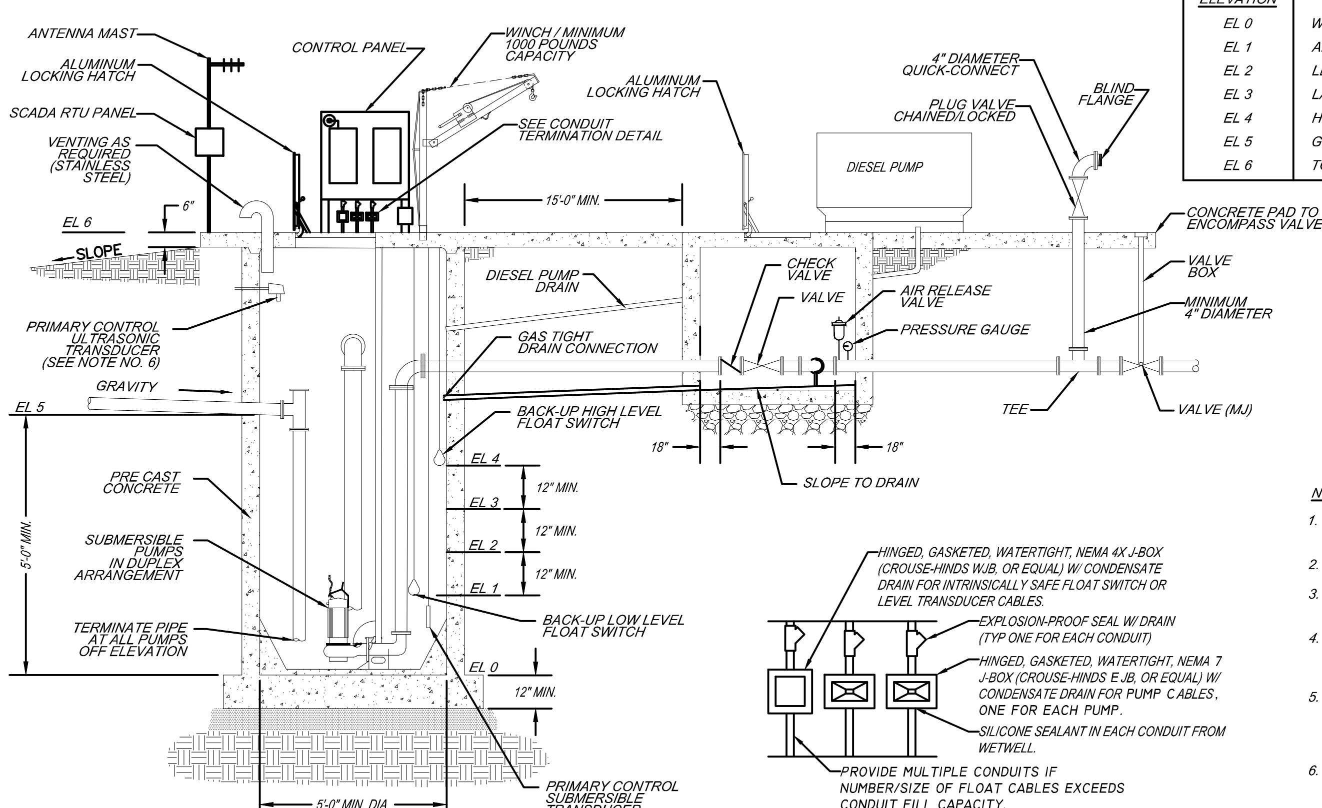
GENERAL PUMP STATION SITE PLAN



NOTE:

THIS DETAIL IS FOR GENERAL REFERENCE PURPOSES ONLY. WHILE EVERY PUMP STATION SITE SHALL CONFORM TO THIS GENERAL LAYOUT AS MUCH AS POSSIBLE, EACH SITE SHOULD BE DESIGNED APPROPRIATELY BASED ON SITE SPECIFIC CONDITIONS.

GENERAL PUMP STATION SITE SECTION



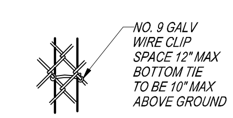
PUMP STATION - SECTION

ELEVATION	DESCRIPTION	VALUE	NOTES
EL 0	WET-WELL INVERT		
EL 1	ALL PUMPS OFF		
EL 2	LEAD PUMP ON		
EL 3	LAG PUMP ON		
EL 4	HIGH LEVEL ALARM		
EL 5	GRAVITY INVERT		
EL 6	TOP OF WET-WELL		

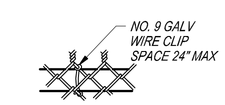
CONDUIT TERMINATION DETAIL

NOTES:

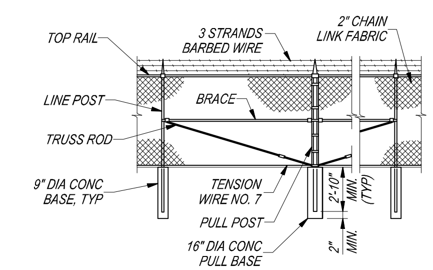
1. ELEVATION OF THE TOP OF THE PUMP STATION SHALL BE A MINIMUM 2'-0" ABOVE THE 100 YEAR FLOOD ELEVATION.
2. INTERIOR OF WET WELL TO BE LINED WITH HDPE, PVC, OR APPROVED EPOXY LINING.
3. ALL PIPING ON SITE TO BE DUCTILE IRON WITH EPOXY LINING SUITABLE FOR WASTEWATER SERVICE.
4. DIESEL PUMP SHALL BE SIZED TO HANDLE THE PEAK HOURLY DISCHARGE OF THE STATION AND SHALL HAVE A MINIMUM 24 HOUR FUEL CAPACITY.
5. WET WELL SIZE TO BE BASED ON SPECIFIC DESIGN CRITERIA. MINIMUM 5'-0" DIAMETER AND 5'-0" DEPTH FROM THE LOWEST INCOMING PIPE INVERT TO THE WET WELL BOTTOM.
6. PRIMARY LEVEL CONTROL SHALL UTILIZE A 4-20mA SUBMERSIBLE OR ULTRASONIC TRANSDUCER, AS APPROVED.
7. THIS IS A GENERAL SCHEMATIC DRAWING. EACH STATION SHALL HAVE A DETAILED SITE SPECIFIC DESIGN.



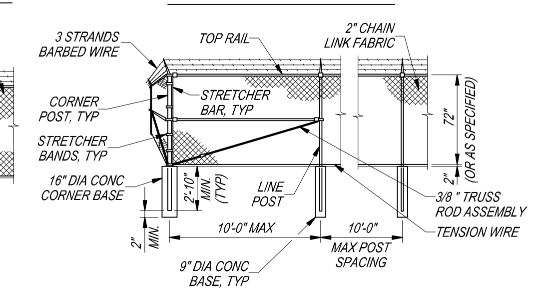
LINE POST CONNECTION



TOP RAIL CONNECTION



TYPICAL PULL POST



TYPICAL CORNER POST

FENCE NOTES:

1. BRACE AND TRUSS ROD REQUIRED AT GATES AND SIDE OF ALL CORNER POSTS.
2. FABRIC ATTACHED TO OUTSIDE OF POSTS.

STANDARD DETAILS: SANITARY SEWER - SHEET 3 OF 3

PROJECT TITLE:

City of Auburn

DEPARTMENT:	WRM	REVISIONS:	DCM 2010
SCALE:	N.T.S.		JC-10-2011
DRAWN BY:	BS		
REVIEWED BY:	JC		
APPROVED BY:	EC		
IMPLEMENTED:	12/2007		

EROSION CONTROL NOTES:

1. A CONSTRUCTION EXIT PAD MUST BE INSTALLED AT ALL POINTS OF INGRESS/EGRESS TO THE SITE.
2. EROSION CONTROL BLANKETS AND NETTING SHOULD BE USED ON STEEP SLOPES AND IN CHANNELS IN CONJUNCTION WITH PERMANENT VEGETATION.
3. MULCH ALL BARE AREAS IMMEDIATELY FOLLOWING INITIAL GRADING PROCEDURES.
4. BMP'S SHALL BE INSPECTED AT LEAST MONTHLY AND WITHIN 24 HOURS OF RAIN EVENTS OF 0.75 INCHES OR GREATER. MAINTENANCE AND REPAIR MUST BE MADE WITHIN 3 DAYS OF INSPECTIONS, UNLESS OTHERWISE DIRECTED. COPIES OF THE QUALIFIED CREDENTIALED PROFESSIONAL (QCP) / QUALIFIED CREDENTIALED INSPECTOR (QCI) INSPECTION REPORTS SHALL BE SUBMITTED TO THE CITY OF AUBURN WATER RESOURCE MANAGEMENT DEPARTMENT, ATTN: WATERSHED DIVISION, 1501 WEST SAMFORD AVENUE, AUBURN, ALABAMA 36832.
5. TEMPORARY SEEDING OF DISTURBED AREAS SHOULD BE IMPLEMENTED WHENEVER DISTURBED SOIL AREAS WILL NOT BE BROUGHT TO FINISHED GRADE FOR A PERIOD OF 15 CALENDAR DAYS OR LONGER.
6. THESE STANDARD DETAILS SHALL BE APPLICABLE TO ALL LAND DISTURBING ACTIVITIES AND ATTACHED TO THE RELEVANT SITE PLAN AND/OR SUBDIVISION DRAWINGS.
7. ALL EROSION CONTROL MEASURES ARE TO BE IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL, AND STORM WATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION), AND SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION ACTIVITIES.
8. SILT FENCE: REMOVE ACCUMULATED SEDIMENT WHEN DEPTH REACHES 1/4" THE HEIGHT OF THE BARRIER.

City of Auburn

THE CITY OF AUBURN, AL

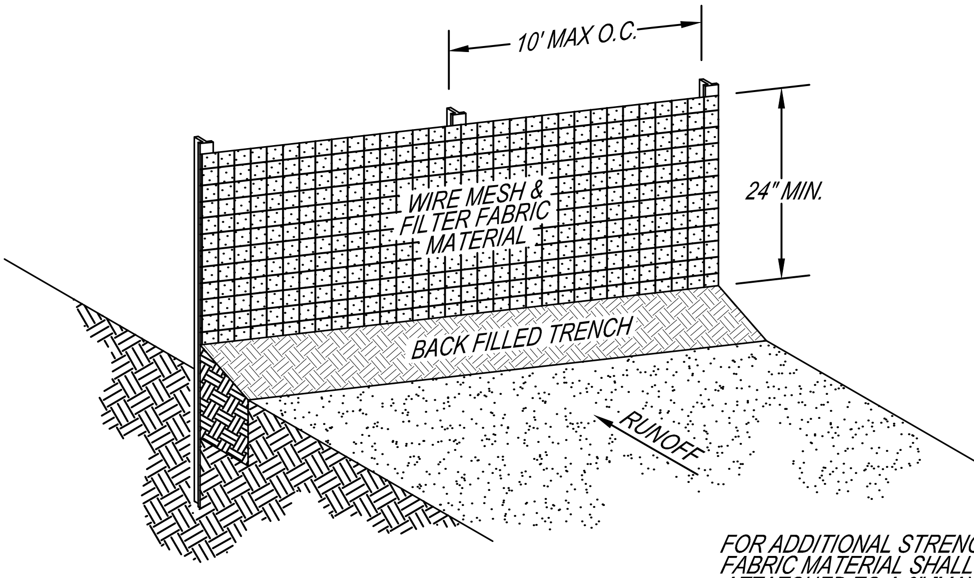
STANDARD EROSION CONTROL DETAILS

DRAWING TITLE: EROSION CONTROL NOTES

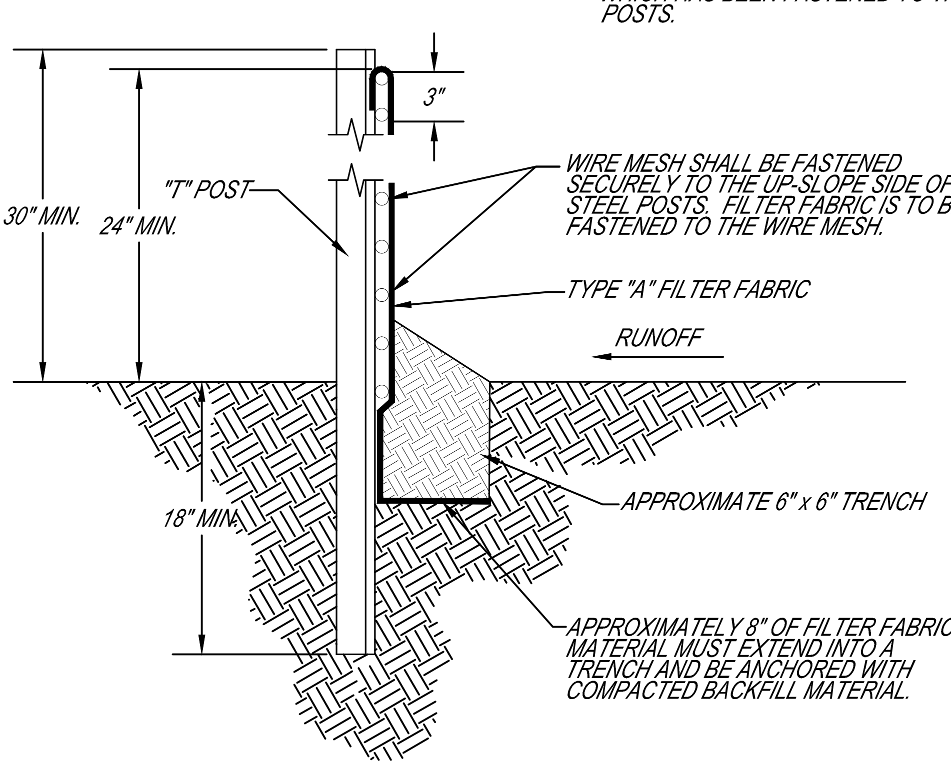
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

400

SILT FENCE W/ WIRE MESH (ALDOT TYPE A)



FOR ADDITIONAL STRENGTH, FILTER FABRIC MATERIAL SHALL BE ATTATCHED TO A 6" [MAX] MESH WIRE WHICH HAS BEEN FASTENED TO THE POSTS.



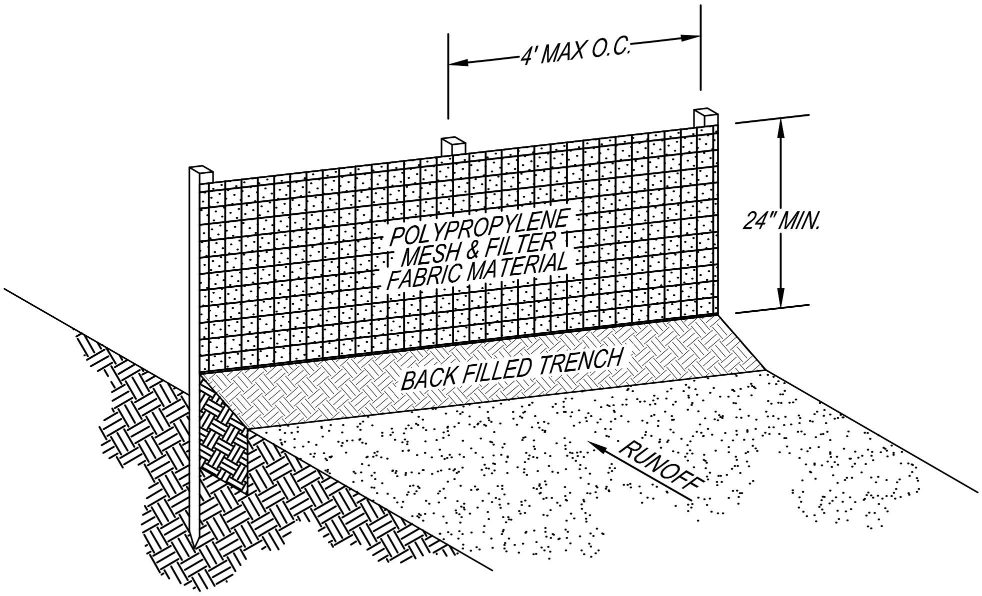
City of Auburn

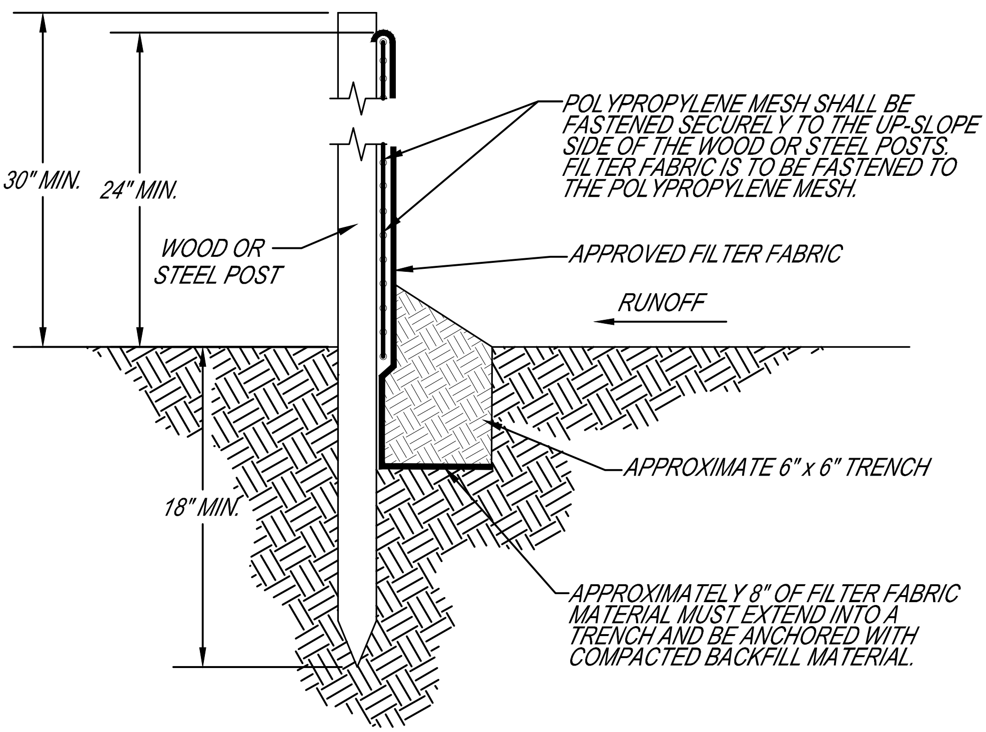
THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	SILT FENCE W/ WIRE MESH (ALDOT TYPE A)			
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07	402
SCALE:	N.T.S.		BS-10-05-07	
DRAWN BY:	BS/GM		DCM 2010	
REVIEWED BY:			JC-12-2012	
APPROVED BY:	MD			
IMPLEMENTED:	02/2003			

SILT FENCE W/ POLYPROPYLENE MESH (GDOT TYPE C)





City of Auburn

THE CITY OF AUBURN, AL

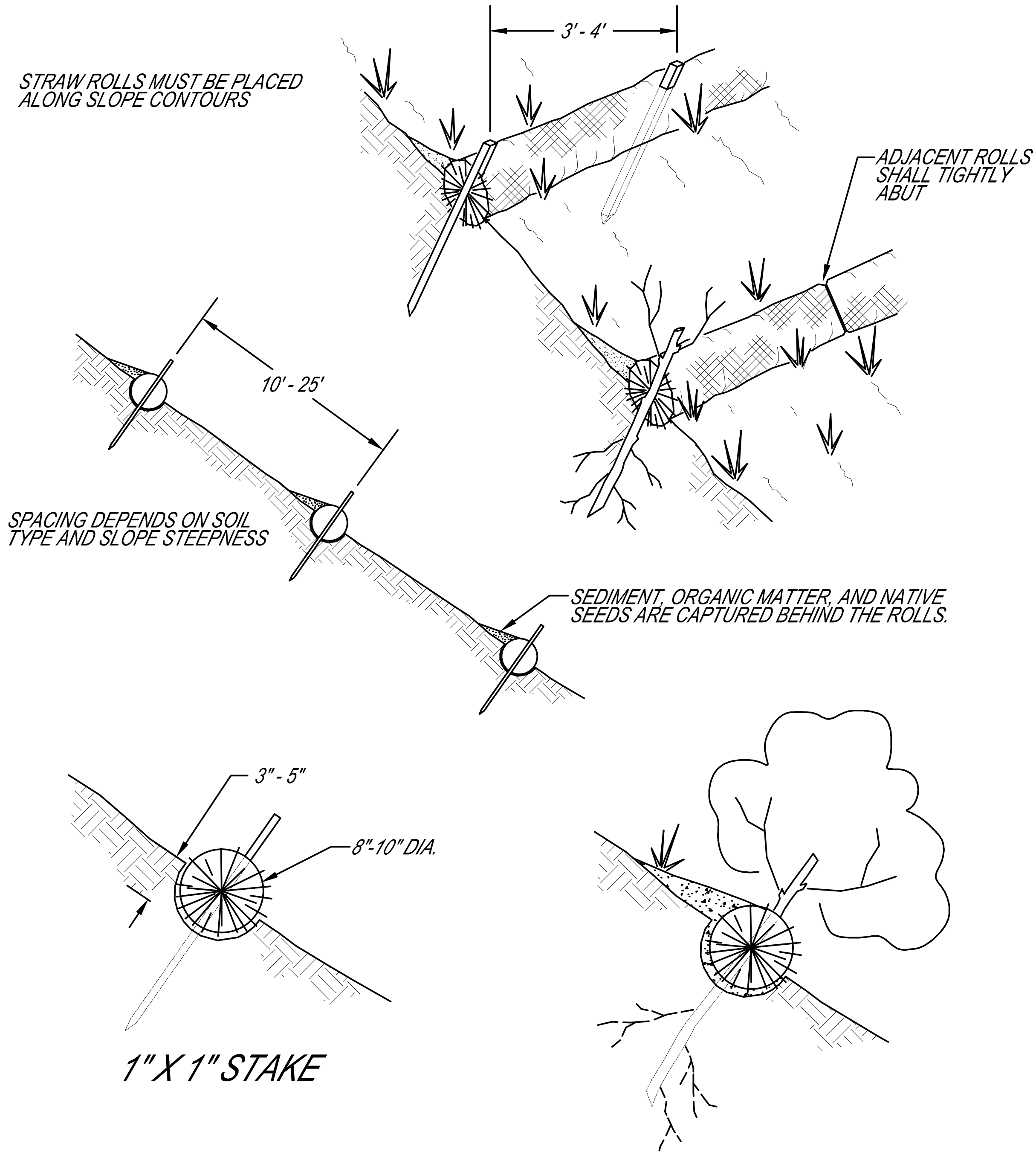
STANDARD EROSION CONTROL DETAILS

DRAWING TITLE: SILT FENCE W/ POLYPROPYLENE MESH (GDOT TYPE C)

DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			JC-12-2012
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

404

STRAW ROLL



LIVE STAKE

NOTE:

1. STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3"-5" DEEP, DUG ON CONTOUR. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

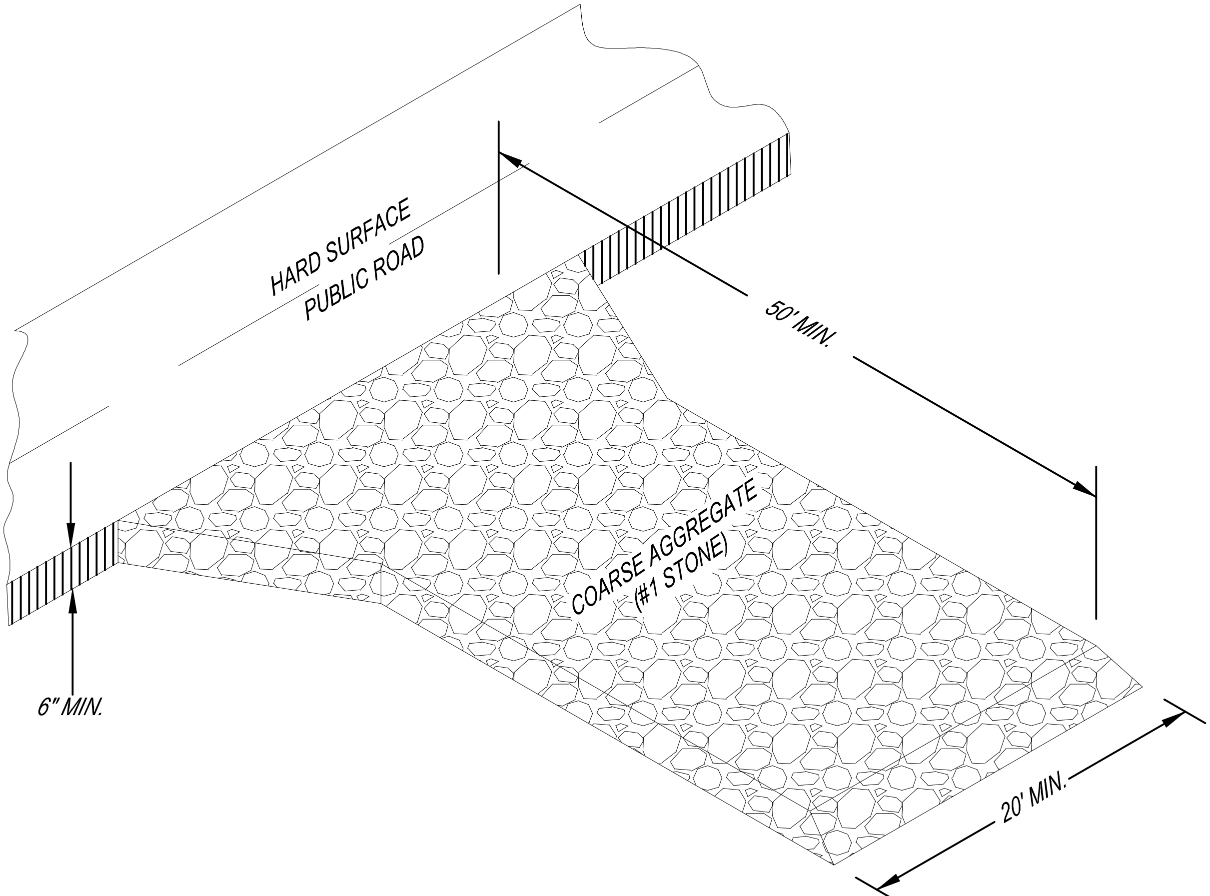
City of Auburn

THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	STRAW ROLL		
DEPARTMENT:	WRM	REVISIONS: AF-06-13-07	406
SCALE:	N.T.S.	BS-10-05-07	
DRAWN BY:	BS/GM	DCM 2010	
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

CONSTRUCTION EXIT PAD (CEP)



NOTE:
1. INSTALL GEOTEXTILE FABRIC UNDER THE #1 STONE TO EXTEND THE LIFE OF THE ENTRANCE.

City of Auburn

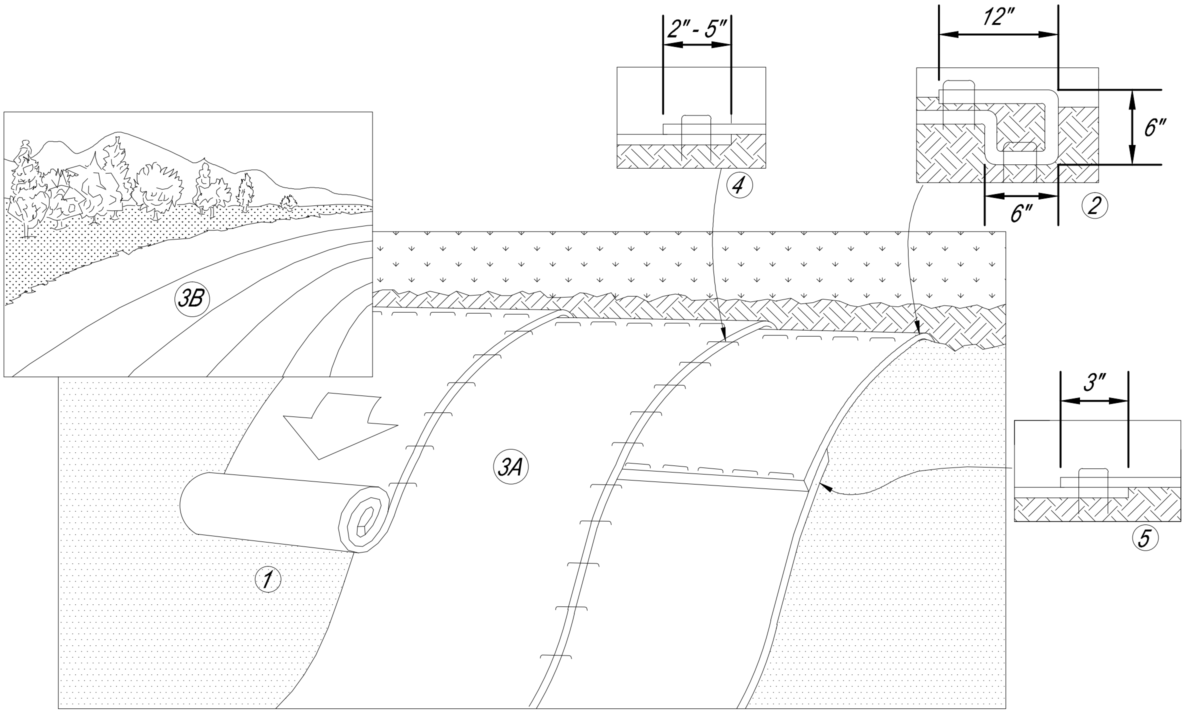
THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE: CONSTRUCTION EXIT PAD (CEP)			
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

408

SLOPE INSTALLATION



NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" - 5" OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE APPROXIMATE 3" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART ACROSS ENTIRE RECP's WIDTH.
6. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.
7. RECPS SHALL BE IDENTIFIED AND DESIGNED ACCORDING TO THE CLASSIFICATION DESIGNATION GIVEN IN TABLES ECB-1, ECB-2, ECB-3, AND ECB-4 OF THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

City of Auburn

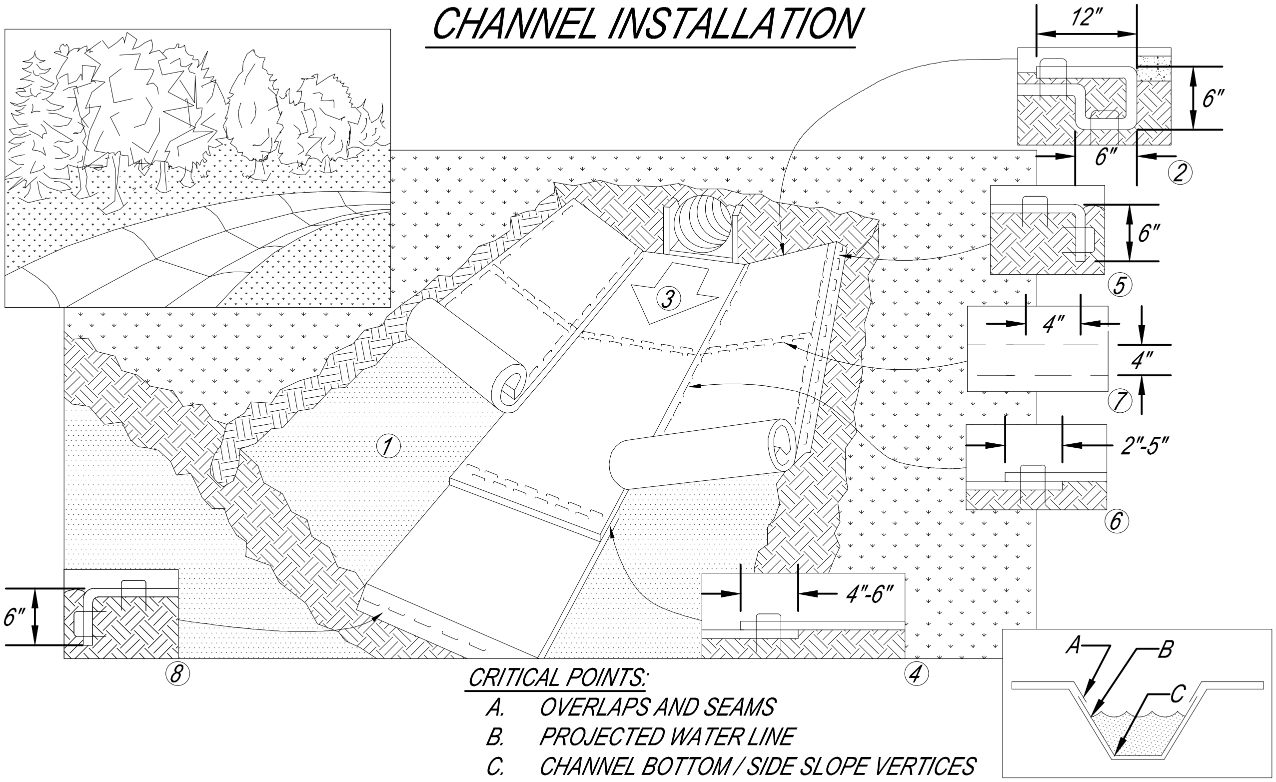
THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	SLOPE INSTALLATION		
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

410

CHANNEL INSTALLATION



CRITICAL POINTS:
A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM / SIDE SLOPE VERTICES

NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 4" - 6" OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" APART AND 4" ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (DEPENDING ON RECP's TYPE) AND STAPLED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" APART AND 4" ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
9. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY ANCHOR THE RECP's.
10. HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
11. RECPS SHALL BE IDENTIFIED AND DESIGNED ACCORDING TO THE CLASSIFICATION DESIGNATION GIVEN IN TABLES ECB-1, ECB-2, ECB-3, AND ECB-4 OF THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

City of Auburn

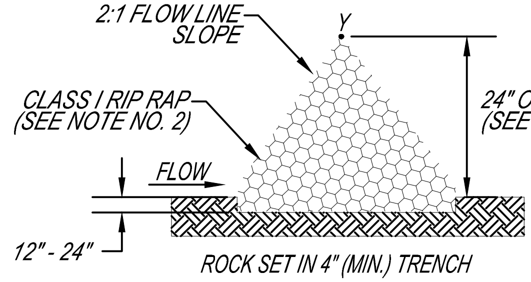
THE CITY OF AUBURN, AL

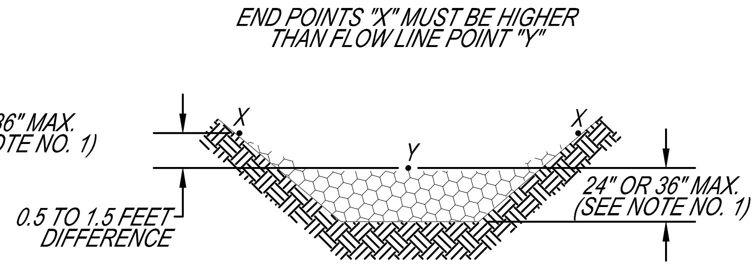
STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	CHANNEL INSTALLATION		
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

412

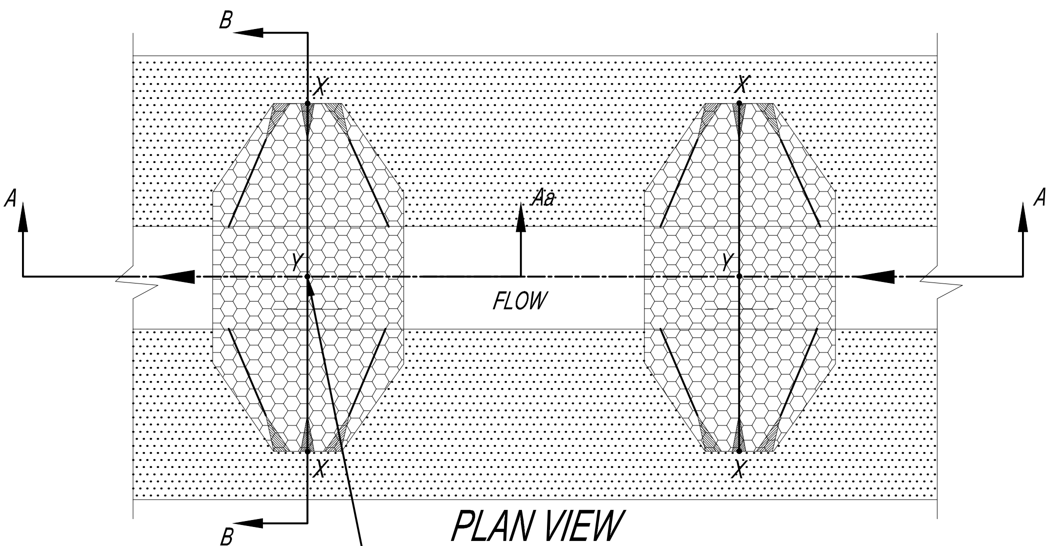
TYPICAL CHECK DAM (CD)



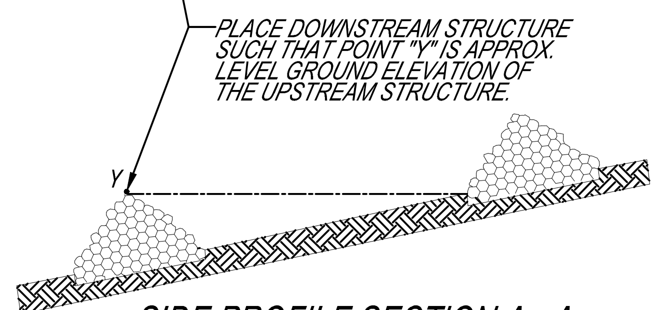


SIDE PROFILE SECTION A - Aa

FRONT PROFILE SECTION B - B



PLAN VIEW



SIDE PROFILE SECTION A - A

NOTE:

1. MAXIMUM HEIGHT SHALL BE 24 INCHES WHEN DRAINAGE AREA IS LESS THAN 5 ACRES AND 36 INCHES WHEN DRAINAGE AREA IS 5 TO 10 ACRES.
2. RIP RAP GRADATION SHALL CONFORM TO THE REQUIREMENTS OF CLASS I RIP RAP, ALABAMA HIGHWAY DEPARTMENT, STANDARD SPECIFICATION FOR HIGHWAY CONSTRUCTION.

D-50 OF ROCK (INCHES)	DOWNSTREAM FLOWLINE SLOPE OF STRUCTURE (FT/FT)					
	0.35	0.30	0.25	0.20	0.15	0.10
	MAXIMUM WATER DEPTH OVER ROCK (INCHES)					
3	0.6	0.7	0.8	1.0	1.3	1.9
6	1.2	1.4	1.6	2.0	2.6	3.9

RECOMMENDED ROCK SIZE AND FLOW DEPTHS

City of Auburn

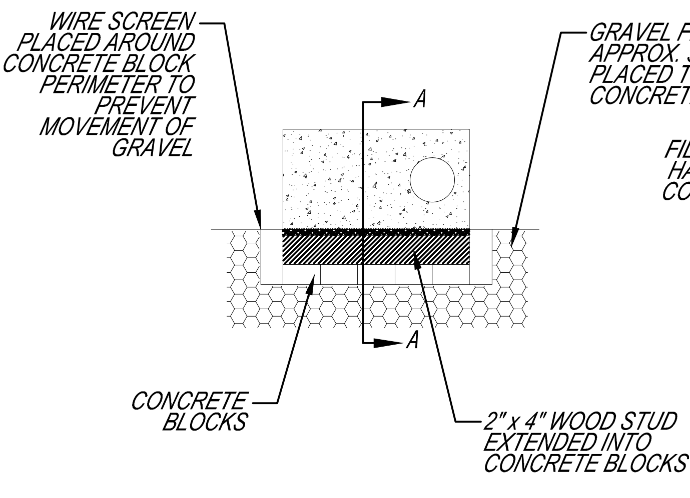
THE CITY OF AUBURN, AL

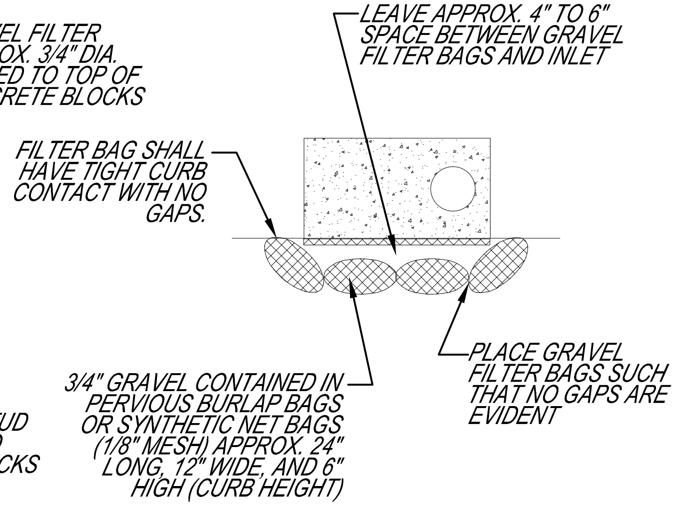
STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	TYPICAL CHECK DAM (CD)		
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

414

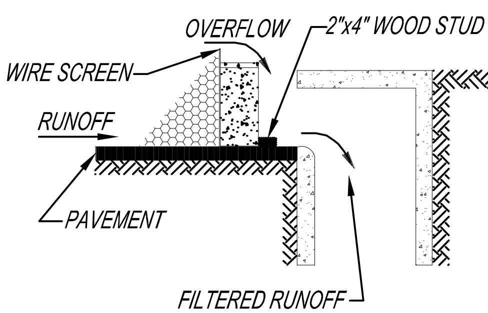
TYPICAL CURB INLET GRAVEL FILTER

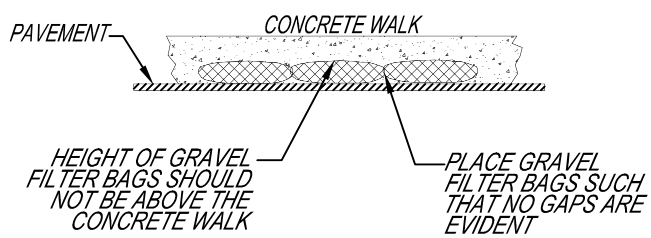




CONCRETE BLOCK FILTER
PLAN VIEW

GRAVEL FILTER BAGS
PLAN VIEW





CONCRETE BLOCK FILTER
PROFILE SECTION A-A

GRAVEL FILTER BAGS
PROFILE VIEW

NOTE:

1. GRAVEL FILTERS CAN BE USED ON PAVEMENT OR BARE GROUND.

City of Auburn

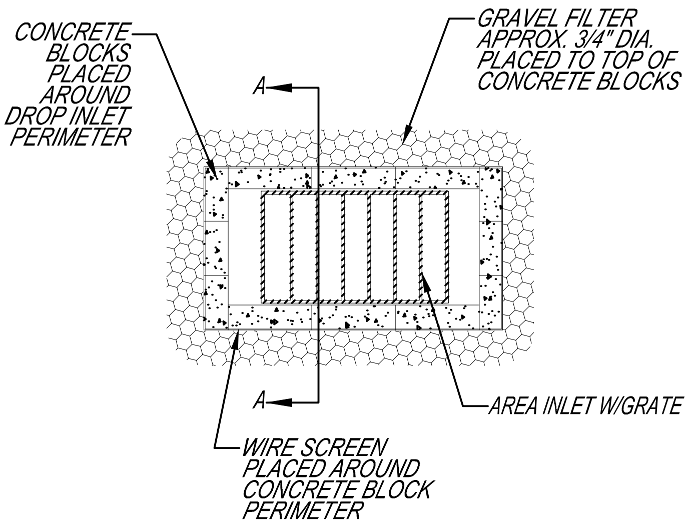
THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

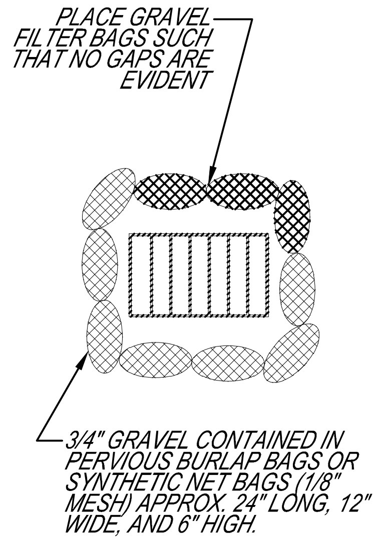
DRAWING TITLE:	TYPICAL CURB INLET GRAVEL FILTER		
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

416

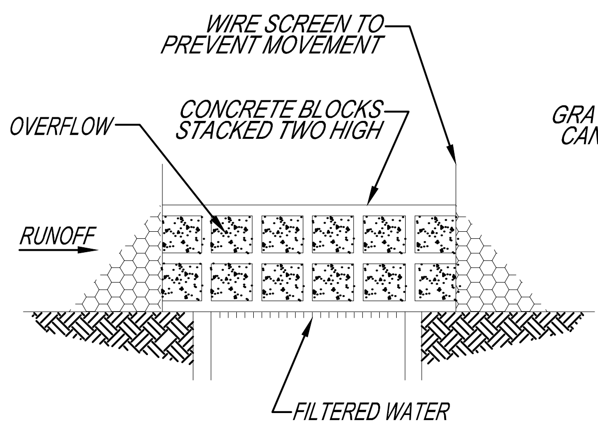
TYPICAL EXCAVATED DROP INLET PROTECTION (EIP)



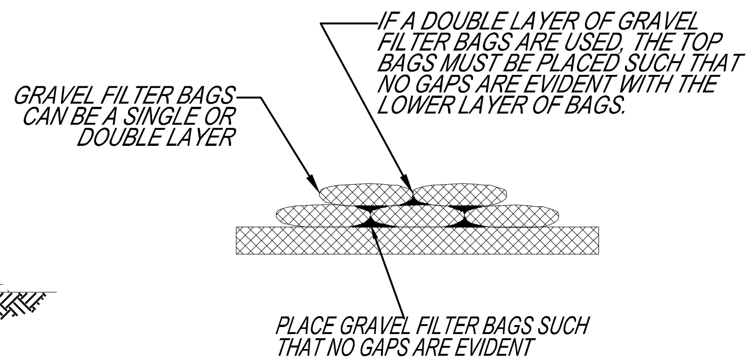
CONCRETE BLOCK FILTER
PLAN VIEW



GRAVEL FILTER BAGS
PLAN VIEW



CONCRETE BLOCK FILTER
PROFILE SECTION A-A



GRAVEL FILTER BAGS
PROFILE VIEW

NOTE:
1. GRAVEL FILTERS CAN BE USED ON PAVEMENT OR BARE GROUND.

City of Auburn

THE CITY OF AUBURN, AL
STANDARD EROSION CONTROL DETAILS

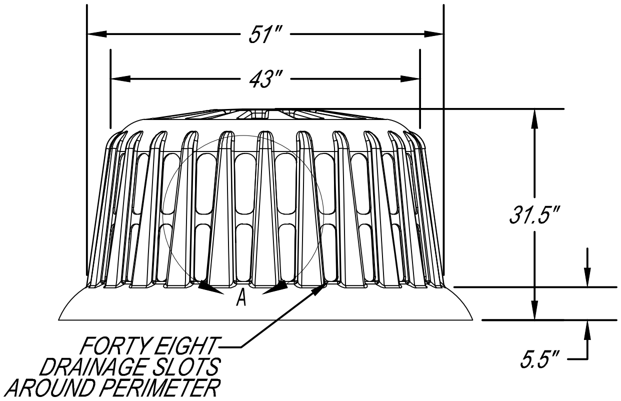
DRAWING TITLE: TYPICAL EXCAVATED DROP INLET PROTECTION (EIP)

DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

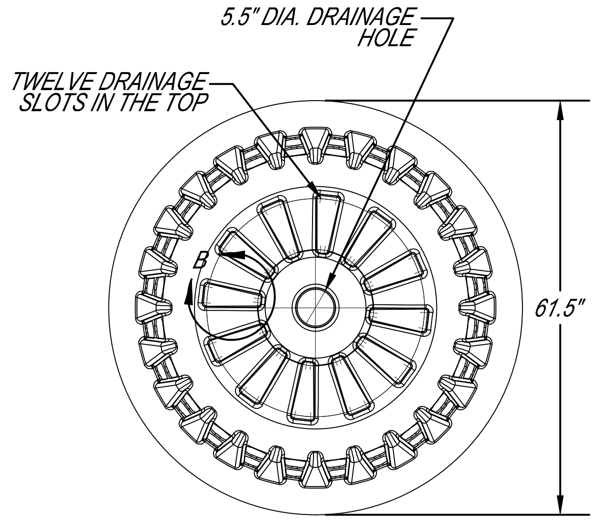
418

SILT-SAVER ROUND FRAME

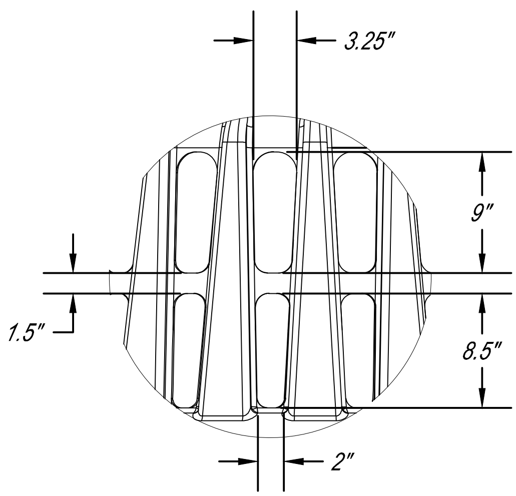
P/N SS-100



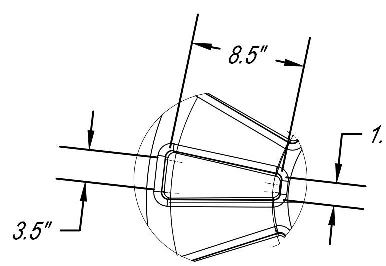
PROFILE VIEW



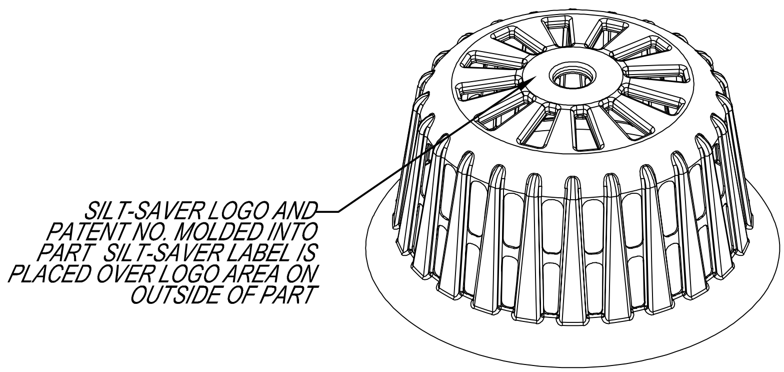
PLAN VIEW



DETAIL A



DETAIL B



ISOMETRIC VIEW

City of Auburn

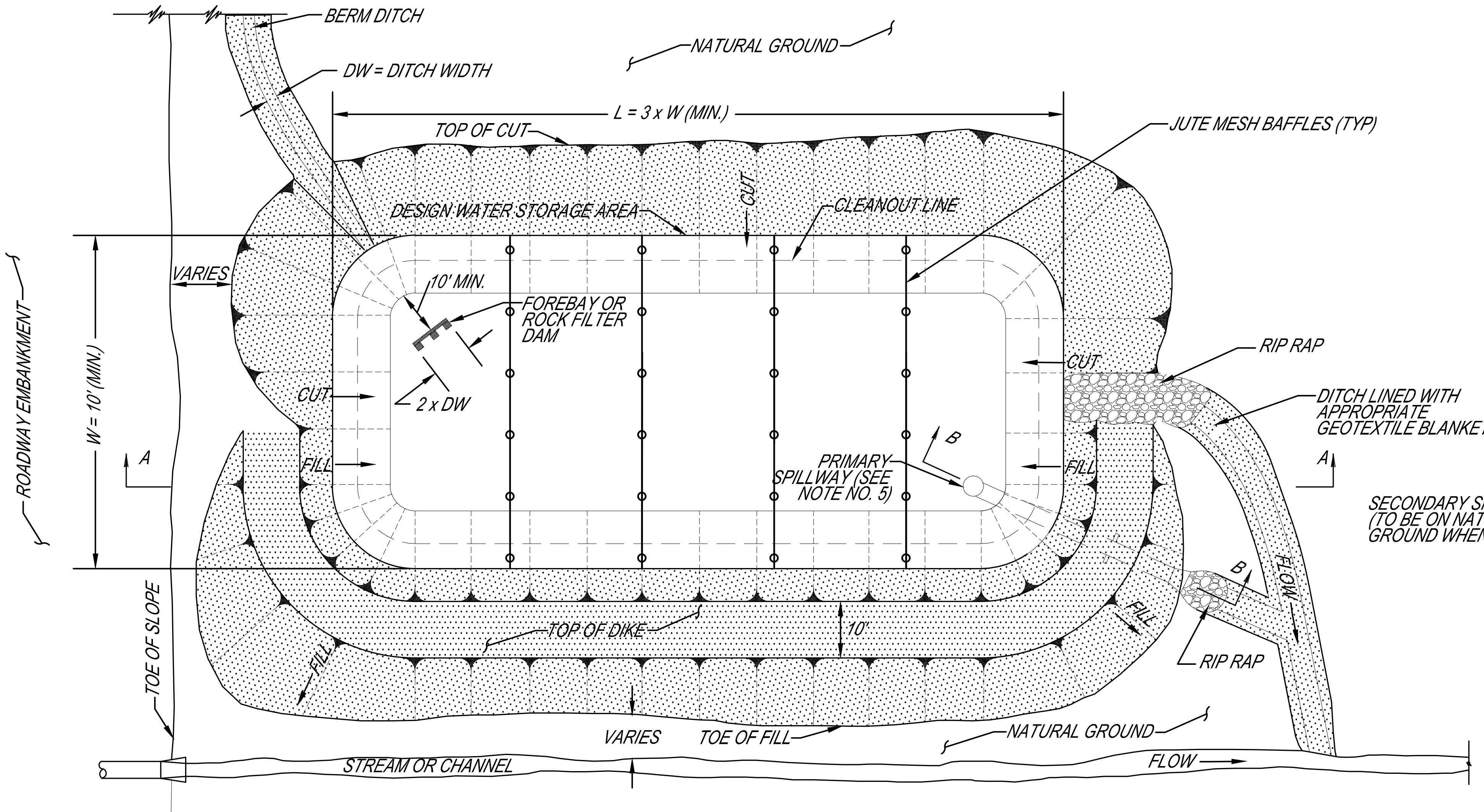
THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

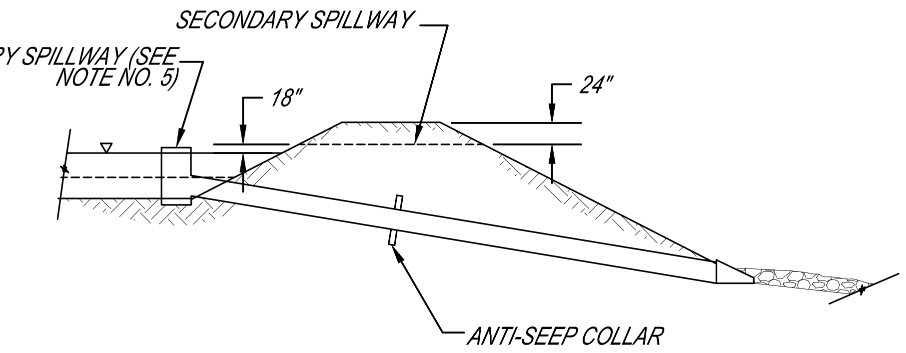
DRAWING TITLE:	SILT-SAVER ROUND FRAME			420
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07	
SCALE:	N.T.S.		BS-10-05-07	
DRAWN BY:	BS/GM		DCM 2010	
REVIEWED BY:				
APPROVED BY:	MD			
IMPLEMENTED:	02/2003			

TYPICAL SEDIMENT BASIN

FOR USE OUTSIDE NATURAL CHANNELS

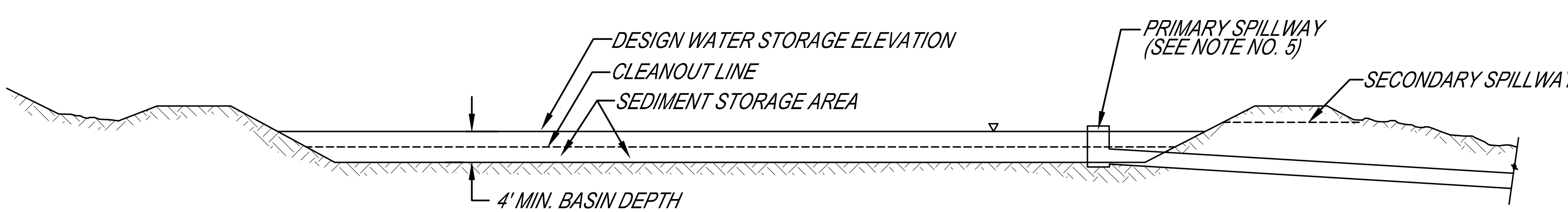


PLAN VIEW



PROFILE SECTION B-B

LOCATION	SIDE	REQUIRED VOLUME	BASIN DEPTH	W	L	PRIMARY SPILLWAY		SECONDARY SPILLWAY WIDTH
				AT DEPTH SHOWN		D_S	D_O	
		CU. FT.	FT.	FT.	FT.	IN.	IN.	FT.



PROFILE SECTION A-A

NOTES:

1. THIS IS A BASIN THAT IS EXCAVATED OR AN AREA THAT IS DAMMED. THE BASIN WILL BE DESIGNED TO HOLD A SEDIMENT LOAD OF 3600 CUBIC FEET OF VOLUME PER ACRE OF DRAINAGE AREA.
2. ALLOWABLE SEDIMENT DEPTH SHALL NOT EXCEED 1/3 TOTAL BASIN DEPTH.
3. RUNOFF FROM UNDISTURBED, ADJACENT LAND SHOULD BE ROUTED TO BYPASS SEDIMENT BASINS.
4. BASIN DEPTH 4'-0" MINIMUM, W & L MAY VARY TO CONFORM TO SITE CONDITIONS, PROVIDED REQUIRE VOLUME IS MAINTAINED, MINIMUM L = 2W.
5. PRIMARY SPILLWAY OUTLET STRUCTURE MAY BE CONVENTIONAL RISER TYPE (AS SHOWN) OR "SKIMMER" DEVICE, AS APPROVED. SEE THE APPROPRIATE STANDARD DETAILS FOR OUTLET STRUCTURE CONSTRUCTION.

City of Auburn

THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE: TYPICAL SEDIMENT BASIN			
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			JC-12-2012
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

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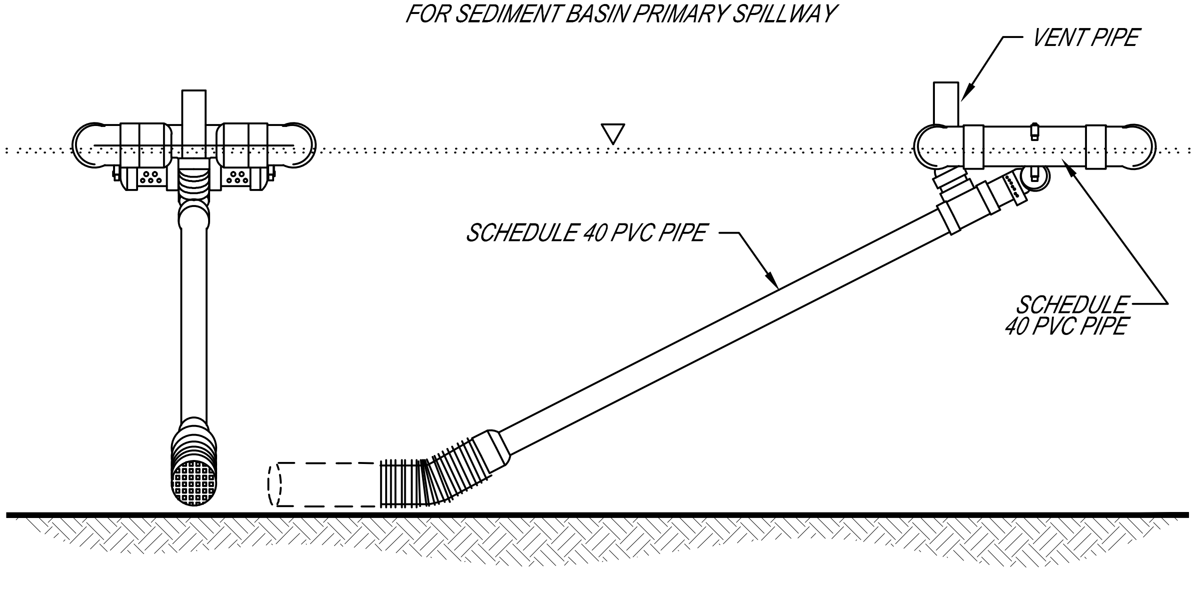
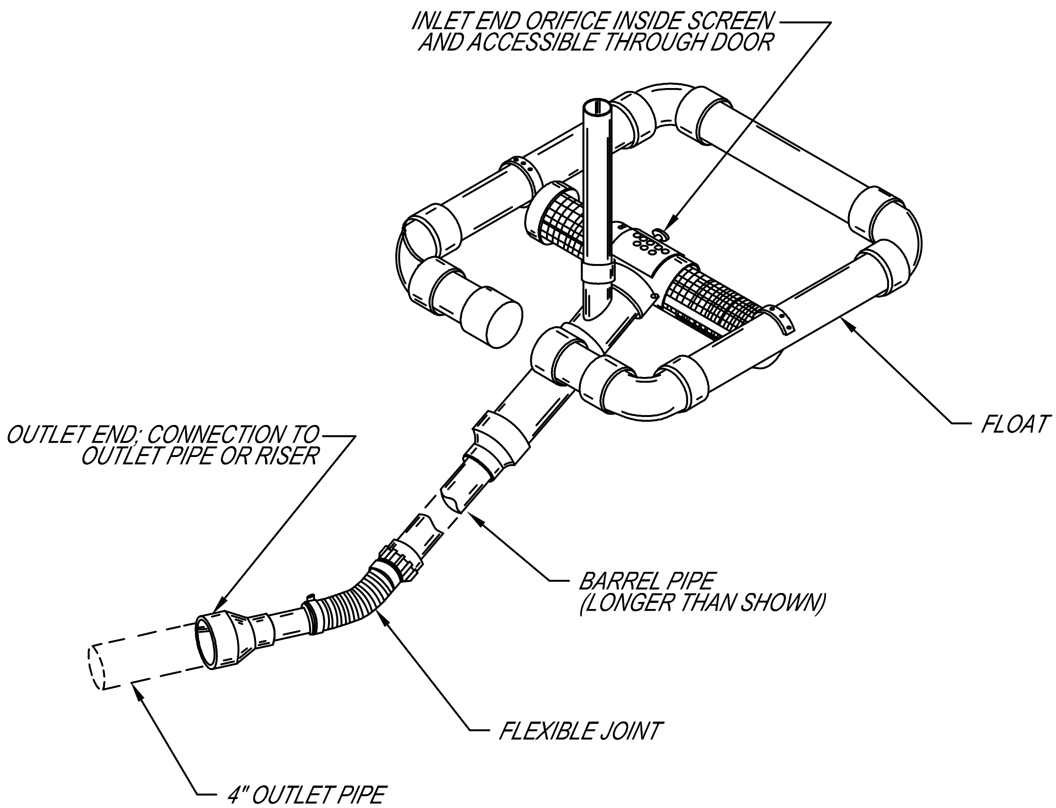
"SKIMMER" OUTLET STRUCTURE

FOR SEDIMENT BASIN PRIMARY SPILLWAY





NOTES:

1. THE MOST IMPORTANT DESIGN PARAMETER IS THE CONTROL OF ORIFICE SIZE, WHICH CAN CONTROL THE DESIRED DEWATERING TIME. THE LONGER THE DEWATERING TIME, THE BETTER THE QUALITY OF WATER DISCHARGED FROM THE SEDIMENT BASIN.
2. SKIMMER DESIGN BY: W. FAIRCLOTH, PATENT # 5,820,751
3. SKIMMER SHALL BE DESIGNED IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

City of Auburn

THE CITY OF AUBURN, AL

STANDARD EROSION CONTROL DETAILS

DRAWING TITLE:	"SKIMMER" OUTLET STRUCTURE	
DEPARTMENT:	WRM	REVISIONS:
SCALE:	N.T.S.	
DRAWN BY:	JC	
REVIEWED BY:		
APPROVED BY:	MD	
IMPLEMENTED:	DCM 2010	

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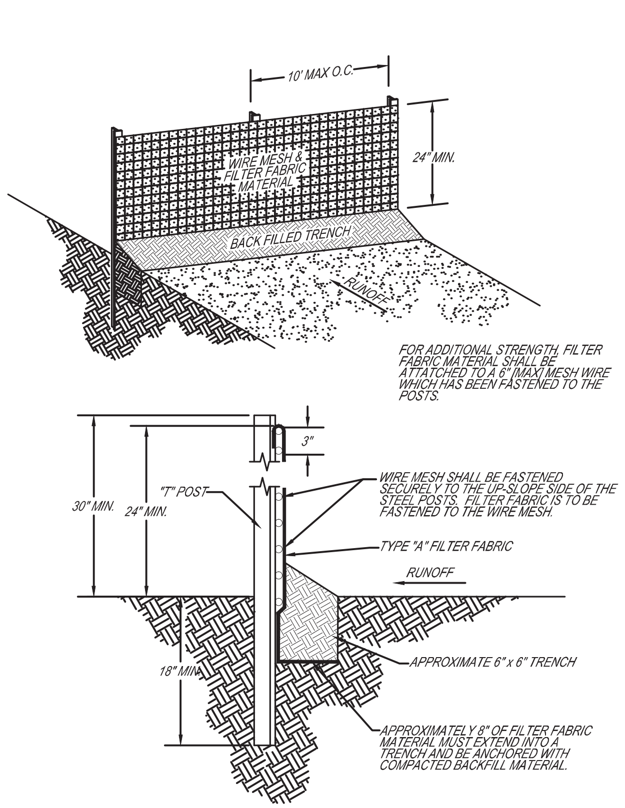
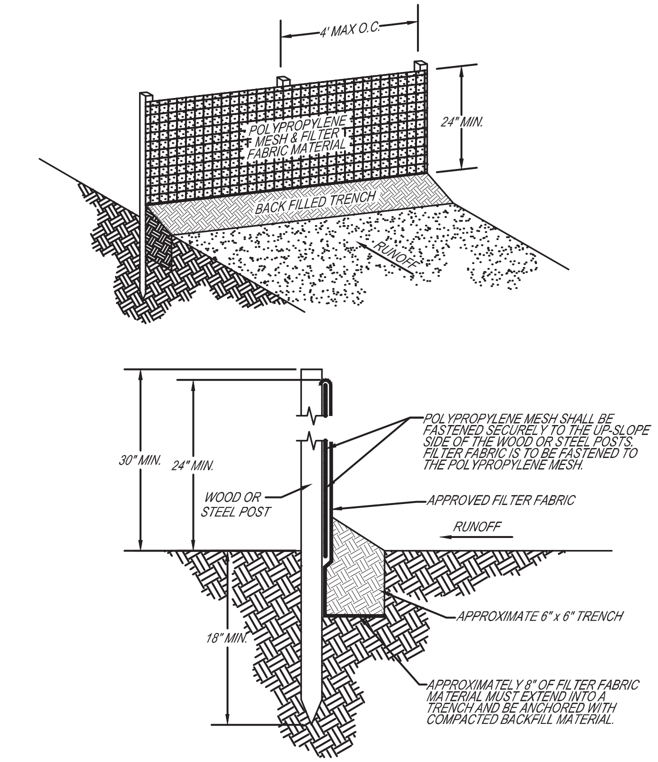
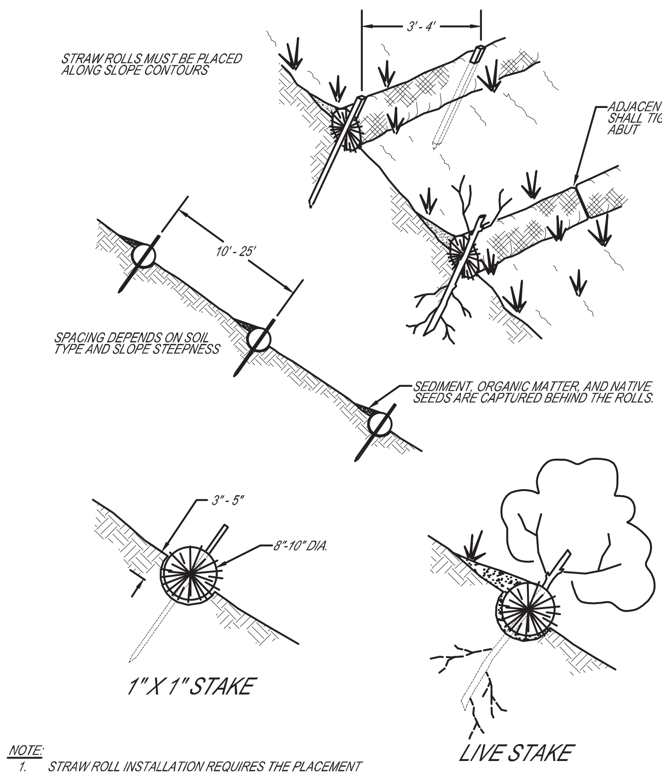
SILT FENCE W/ WIRE MESH (ALDOT TYPE A)



SILT FENCE W/ POLYPROPYLENE MESH (GDOT TYPE C)



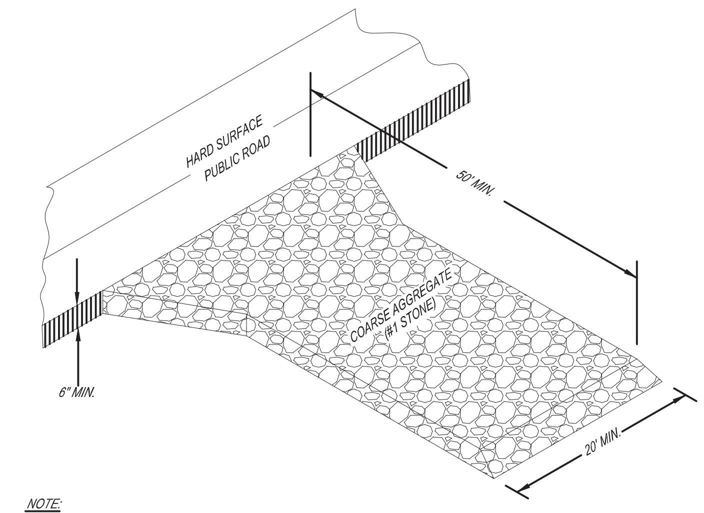
STRAW ROLL



NOTE:

1. STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3"-5" DEEP, DUG ON CONTOUR. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

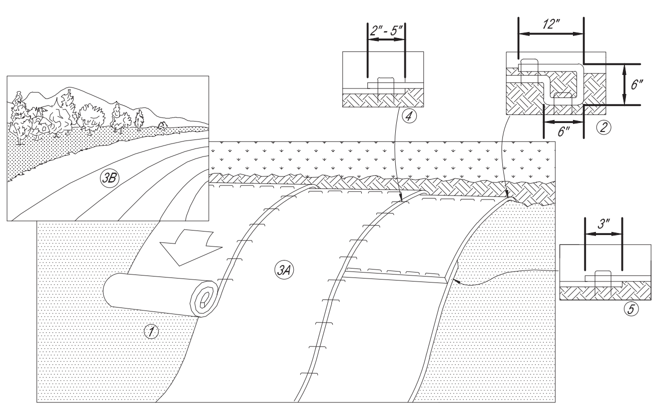
CONSTRUCTION EXIT PAD (CEP)



NOTE:

1. INSTALL GEOTEXTILE FABRIC UNDER THE #1 STONE TO EXTEND THE LIFE OF THE ENTRANCE.

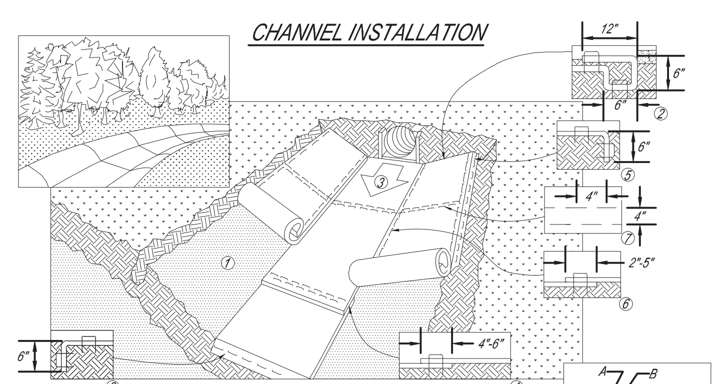
SLOPE INSTALLATION



NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" - 5" OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE APPROXIMATE 3" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART ACROSS ENTIRE RECP's WIDTH.
6. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.
7. RECPS SHALL BE IDENTIFIED AND DESIGNED ACCORDING TO THE CLASSIFICATION DESIGNATION GIVEN IN TABLES ECB-1, ECB-2, ECB-3, AND ECB-4 OF THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

CHANNEL INSTALLATION



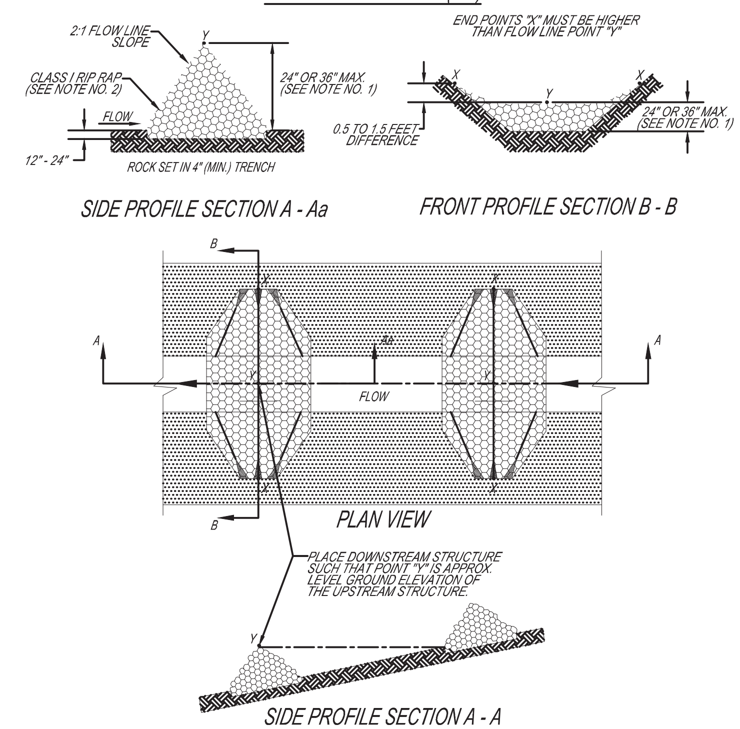
CRITICAL POINTS:

A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM / SIDE SLOPE VERTICES

NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 4" - 6" OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" APART AND 4" ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (DEPENDING ON RECP's TYPE) AND STAPLED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" APART AND 4" ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
9. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY ANCHOR THE RECP's.
10. HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
11. RECPS SHALL BE IDENTIFIED AND DESIGNED ACCORDING TO THE CLASSIFICATION DESIGNATION GIVEN IN TABLES ECB-1, ECB-2, ECB-3, AND ECB-4 OF THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

TYPICAL CHECK DAM (CD)



NOTE:

1. MAXIMUM HEIGHT SHALL BE 24 INCHES WHEN DRAINAGE AREA IS LESS THAN 5 ACRES AND 36 INCHES WHEN DRAINAGE AREA IS 5 TO 10 ACRES.
2. RIP RAP GRADATION SHALL CONFORM TO THE REQUIREMENTS OF CLASS I RIP RAP, ALABAMA HIGHWAY DEPARTMENT, STANDARD SPECIFICATION FOR HIGHWAY CONSTRUCTION.

D-50 OF ROCK (INCHES)	DOWNSTREAM FLOWLINE SLOPE OF STRUCTURE (FT/FT) 0.35	0.30	0.25	0.20	0.15	0.10
	MAXIMUM WATER DEPTH OVER ROCK (INCHES)					
3	0.6	0.7	0.8	1.0	1.3	1.9
6	1.2	1.4	1.6	2.0	2.6	3.9

RECOMMENDED ROCK SIZE AND FLOW DEPTHS

EROSION CONTROL NOTES:

1. A CONSTRUCTION EXIT PAD MUST BE INSTALLED AT ALL POINTS OF INGRESS/EGRESS TO THE SITE.
2. EROSION CONTROL BLANKETS AND NETTING SHOULD BE USED ON STEEP SLOPES AND IN CHANNELS IN CONJUNCTION WITH PERMANENT VEGETATION.
3. MULCH ALL BARE AREAS IMMEDIATELY FOLLOWING INITIAL GRADING PROCEDURES.
4. BMP'S SHALL BE INSPECTED AT LEAST MONTHLY AND WITHIN 24 HOURS OF RAIN EVENTS OF 0.75 INCHES OR GREATER. MAINTENANCE AND REPAIR MUST BE MADE WITHIN 3 DAYS OF INSPECTIONS, UNLESS OTHERWISE DIRECTED. COPIES OF THE QUALIFIED CREDENTIALED PROFESSIONAL (QCP) / QUALIFIED CREDENTIALED INSPECTOR (QCI) INSPECTION REPORTS SHALL BE SUBMITTED TO THE CITY OF AUBURN WATER RESOURCE MANAGEMENT DEPARTMENT, ATTN: WATERSHED DIVISION, 1501 WEST SAMFORD AVENUE, AUBURN, ALABAMA 36832.
5. TEMPORARY SEEDING OF DISTURBED AREAS SHOULD BE IMPLEMENTED WHENEVER DISTURBED SOIL AREAS WILL NOT BE BROUGHT TO FINISHED GRADE FOR A PERIOD OF 15 CALENDAR DAYS OR LONGER.
6. THESE STANDARD DETAILS SHALL BE APPLICABLE TO ALL LAND DISTURBING ACTIVITIES AND ATTACHED TO THE RELEVANT SITE PLAN AND/OR SUBDIVISION DRAWINGS.
7. ALL EROSION CONTROL MEASURES ARE TO BE IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL, AND STORM WATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION), AND SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION ACTIVITIES.
8. SILT FENCE: REMOVE ACCUMULATED SEDIMENT WHEN DEPTH REACHES 1/4" THE HEIGHT OF THE BARRIER.

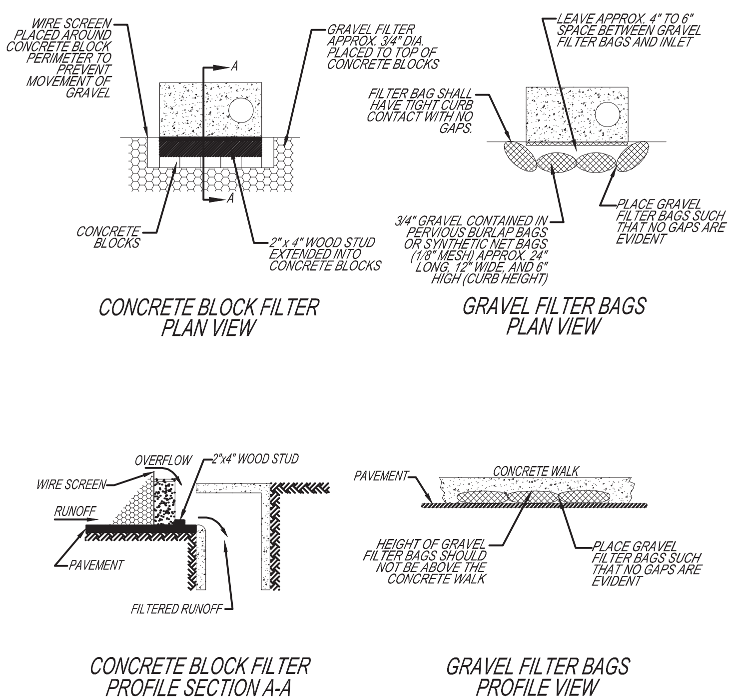
STANDARD DETAILS: EROSION CONTROL - SHEET 1 OF 2

PROJECT TITLE:

City of Auburn

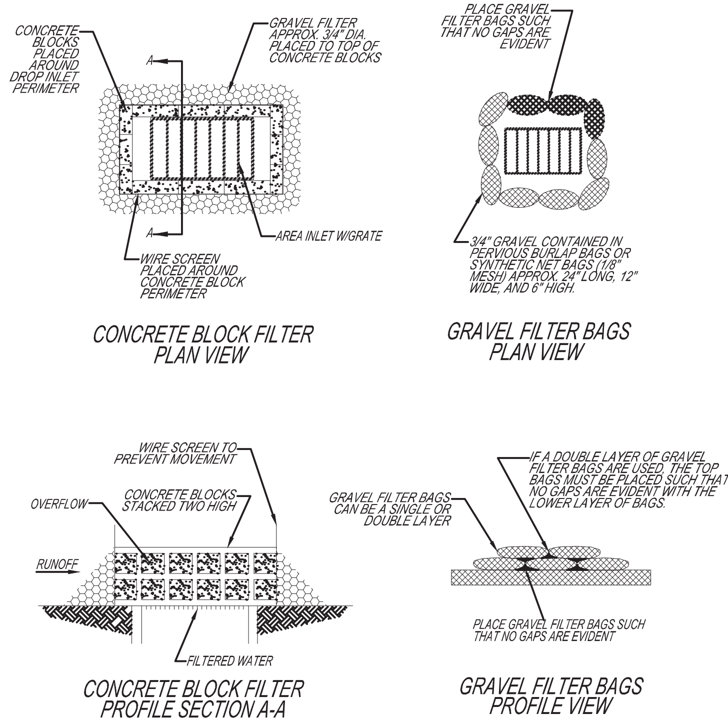
DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			JC-12-2012
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

TYPICAL CURB INLET GRAVEL FILTER



NOTE:
1. GRAVEL FILTERS CAN BE USED ON PAVEMENT OR BARE GROUND.

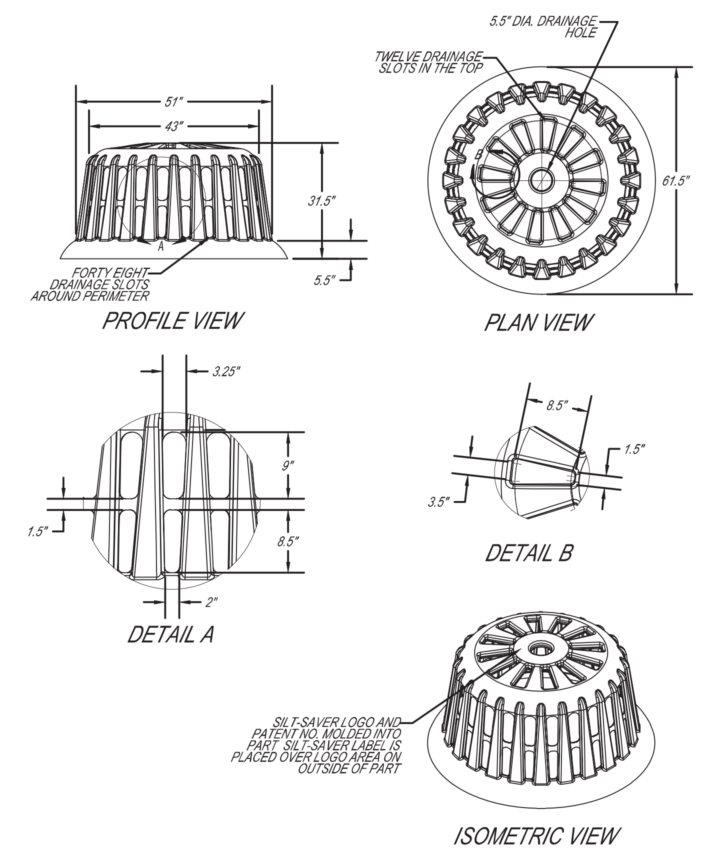
TYPICAL EXCAVATED DROP INLET PROTECTION (EIP)



NOTE:
1. GRAVEL FILTERS CAN BE USED ON PAVEMENT OR BARE GROUND.

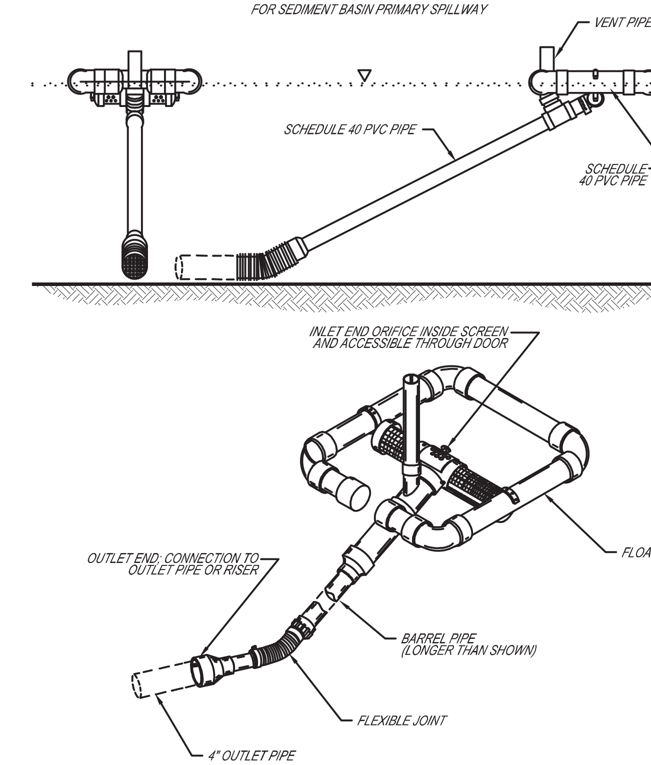
SILT-SAVER ROUND FRAME

P/N SS-100



"SKIMMER" OUTLET STRUCTURE

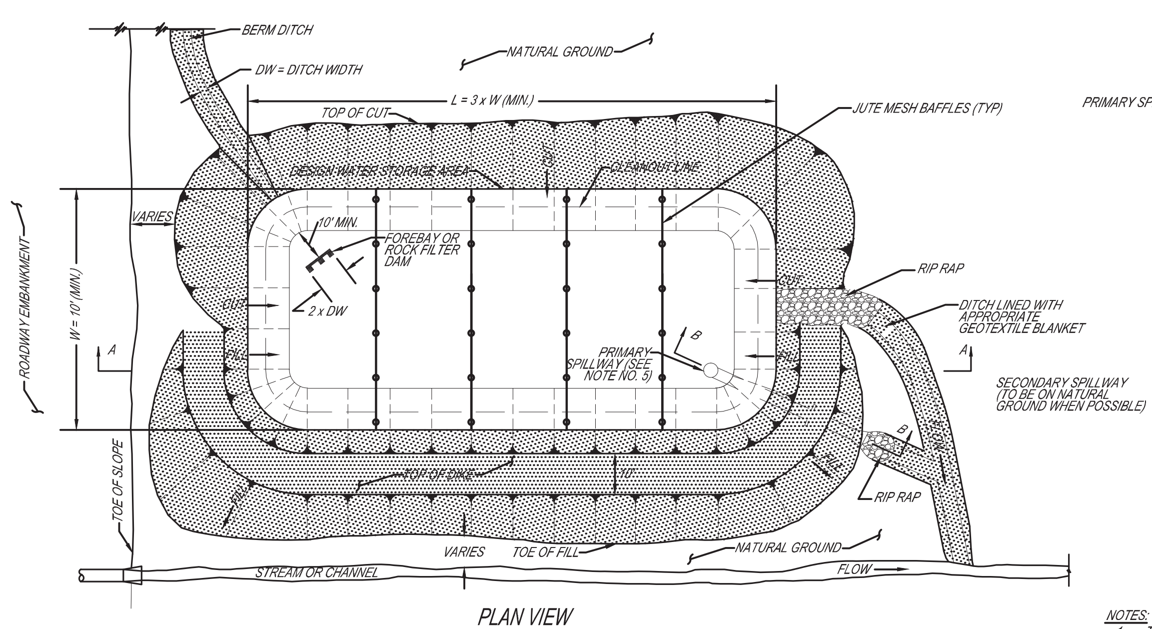
FOR SEDIMENT BASIN PRIMARY SPILLWAY

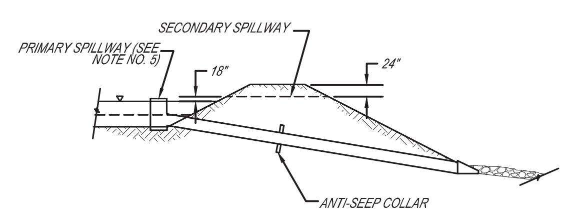


NOTES:
1. THE MOST IMPORTANT DESIGN PARAMETER IS THE CONTROL OF ORIFICE SIZE, WHICH CAN CONTROL THE DESIRED DEWATERING TIME. THE LONGER THE DEWATERING TIME, THE BETTER THE QUALITY OF WATER DISCHARGED FROM THE SEDIMENT BASIN.
2. SKIMMER DESIGN BY: W. FAIRCLOTH, PATENT # 5,820,751
3. SKIMMER SHALL BE DESIGNED IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS (LATEST EDITION).

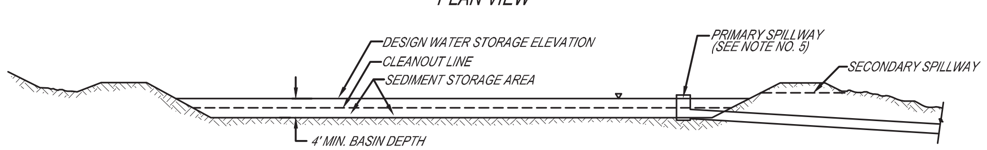
TYPICAL SEDIMENT BASIN

FOR USE OUTSIDE NATURAL CHANNELS





PROFILE SECTION B-B



PROFILE SECTION A-A

LOCATION	SIDE	REQUIRED VOLUME	BASIN DEPTH	W	L	PRIMARY SPILLWAY		SECONDARY SPILLWAY WIDTH
				AT DEPTH SHOWN		D_S	D_O	
		CU. FT.	FT.	FT.	FT.	IN.	IN.	FT.

NOTES:
1. THIS IS A BASIN THAT IS EXCAVATED OR AN AREA THAT IS DAMMED. THE BASIN WILL BE DESIGNED TO HOLD A SEDIMENT LOAD OF 3600 CUBIC FEET OF VOLUME PER ACRE OF DRAINAGE AREA.
2. ALLOWABLE SEDIMENT DEPTH SHALL NOT EXCEED 1/3 TOTAL BASIN DEPTH.
3. RUNOFF FROM UNDISTURBED, ADJACENT LAND SHOULD BE ROUTED TO BYPASS SEDIMENT BASINS.
4. BASIN DEPTH 4'-0" MINIMUM, W & L MAY VARY TO CONFORM TO SITE CONDITIONS, PROVIDED REQUIRE VOLUME IS MAINTAINED, MINIMUM L = 2W.
5. PRIMARY SPILLWAY OUTLET STRUCTURE MAY BE CONVENTIONAL RISER TYPE (AS SHOWN) OR "SKIMMER" DEVICE, AS APPROVED. SEE THE APPROPRIATE STANDARD DETAILS FOR OUTLET STRUCTURE CONSTRUCTION.

STANDARD DETAILS: EROSION CONTROL - SHEET 2 OF 2

PROJECT TITLE:

City of Auburn

DEPARTMENT:	WRM	REVISIONS:	AF-06-13-07
SCALE:	N.T.S.		BS-10-05-07
DRAWN BY:	BS/GM		DCM 2010
REVIEWED BY:			JC-12-2012
APPROVED BY:	MD		
IMPLEMENTED:	02/2003		

Appendix B
Forms

DRT Checklist for *Site Development* Construction Plans

Project Name: ______________________________

This checklist must be submitted with every set of engineering construction plans for site developents (conditional & permitted use projects). All items on the checklist shall be addressed. If the item is not applicable to this project check the box next to the item labeled "N/A", and provide comment. Items preceded by an asterisk (*****) are required for the submittal to be considered complete. If one of these items is missing from the submittal without a valid explanation, the entire submittal will be rejected. Note that this checklist is not intended to be all-inclusive, and fulfillment of this checklist does not alleviate the obligation of the designer to meet all City of Auburn code, regulations, ordinances, and specifications. The purpose of this checklist is to facilitate a more efficient plan review process for the designer and the review team.

	Description	Check	N/A	Comments
Required Plan Sheets				
	These are the basic sheets we expect to see in a set of plans. Some sheets may be combined on certain projects, or have different names (for example, water and sewer shown on one utility plan sheet for small projects).			
*	Title/Cover Sheet			
*	Project Notes			
*	Existing Conditions/Demo Plan			
*	Site Plan (engineering)			
*	Water Plan			
*	Sanitary Sewer Plan			
*	Sanitary Sewer Profiles (for public infrastructure)			
*	Grading & Drainage Plan			
*	Storm Sewer Profiles (for public infrastructure)			
*	Erosion & Sediment Control Plan			
*	Street Plan & Profiles (for public infrastrucutre)			
*	Miscellaneous Details, Cross-sections & Other Sheets			
*	City of Auburn Standard Details			
Title Sheet				
Title Sheet - Title Sheet - Ti	Project Title			
	Permit Numbers (USACE & ADEM)			
	Relevant Contact Information			
	Sheet Index			
	Vicinity Map (legible)			
	Engineer's Seal			
Project Notes				
Notes	Verify that project notes do not conflict with City of Auburn specifications			
	Provide Legend			
Existing Conditions / Demo Plan				
Existing Conditions - Existing Conditions - Existin	Include North arrow			
	Show locations of existing structures			
	Indicate if structures are being removed			
	Show existing topography with clearly labeled contours lines			
	Minimum 2ft contour intervals with every 10ft line labeled			
	Show existing water features including wetland areas			
	Show existing easements and right-of-ways			
	Show existing utilities			
	Indicate if being removed/abandoned			
	Show all property lines			
	Show the limits of clearing & grubbing			
Site Plan (engineering)				
Site Plan - Site Plan - Si	Show property lines, building layout, pavement, traffic/parking striping,			
	traffic signs, etc.			
	Indicate parking dimensions, lane widths, and corner radii			
	Show dumpster location			
	Verfiy Planning Commission resolutions have been met for Conditional Uses			
Water Plans				
Water Plans - Water Plans -	*Required water service submittals prior to or with plan submittal:			
	Development Application for Water and Sewer Service			
	Backflow Protection Information Sheet			
	Fire flow calculations (where applicable, coordinate with the WRM Department)			
	Include North arrow			
	If water layout requires multiple pages, include an overall plan sheet			

	Description	Check	N/A	Comments
Water Plans	The following **existing** water infrastructure should be shown:			
	Location, size, and material of all water mains and service lines			
	Location and size of all water meters			
	Location of the nearest main line valves for isolation of the site			
	Location of the nearest fire hydrants			
	Location of all blow-off valves and air release valves			
	The following **proposed** water infrastructure should be shown:			
	Location, size, and material of all water mains and service lines			
	Location and size of all water meters (place at edge of ROW or easement)			
	Location of all isolation valves, blow-off valves, and air release valves			
	Location of all fire hydrants			
	Location of FDC within 125 ft of a fire hydrant			
	Location of all backflow prevention devices, and vaults			
	Location of all bends, tees, and fittings (specify type and degree)			
	Location and detail of all necessary thrust restraint			
	Location of vault drain to grade or to storm sewer			
	Show all existing and proposed easements			
	Provide a general layout of other utilities (existing and proposed)			
	Clearly differentiate between existing and proposed utilities			
	Detail all main line connections showing appropriate tap configuration and fittings			
	Provide backflow prevention for all main line connections			
	Provide estimated static pressure (normally 830 - FFE / 2.31)			
	Use pressure reducing valves where static pressure > 70 psi			
	Size pipes to maintain a velocity not to exceed 10 ft/sec			
	Provide minimum cover of 30 inches for lines 8 inches and smaller			
	Provide minimum cover of 36 inches for lines larger than 8 inches			
	Provide minimum 18 inches vertical separation where water & sewer cross			
	Provide minimum 10 feet horizontal separation between water & sewer lines			
	Provide sprinkler count			
	Provide the following notes where applicable:			
	"Existing services to be abandoned shall be terminated at the main."			
	"Notify AWWB of any scheduled outages 7 days prior to the outage."			
	"Only AWWB personnel are authorized to operate AWWB valves."			
Sanitary Sewer Plans				
SS Plans	*Required sewer service submittals prior to or with plan submittal:			
	Development Application for Water and Sewer Service			
	Grease Trap Sizing Worksheet			
	Approved pump station design (coordinated with the WRM Department)			
	Include North arrow			
	If sewer layout requires multiple pages, include an overall plan sheet			
	Show all existing and proposed easements			
	Provide a general layout of other utilities (existing and proposed)			
	The following **existing** sewer infrastructure should be shown:			
	Location of all manholes with rim, and all invert elevations provided			
	Location, sizes, materials, and slopes of all sewer mains and laterals			
	Location, and size of grease traps and/or oil & grit separators			
	The following **proposed** sewer infrastructure should be shown:			
	Location of all manholes with rim, and all invert elevations provided			
	Location, sizes, materials, and slopes of all sewer mains and laterals			
	Location and size of grease traps where required			
	Location and size of oil & grit separators where required			
	Location of cleanouts at the edge of ROW or easement			
	Clearly differentiate between existing and proposed utilities			
	Label all manholes and pipes (correspond with labels on profile sheets)			
	Provide contours or specify finish floor elevations			
	Indicate how existing sewer mains or services are to be abandoned			
	Manholes shall be locked down if less than 1 foot above the 100-yr BFE			

Description	Check	N/A	Comments
Public sanitary sewer main requirements:			
Manholes shall be located in the center of the street where possible			
Design sewer lines for maximum capacity at half full			
DIP required where cover is greater than 12 feet or less than 3 feet			
DIP required where less than 2 feet of clearance between utilities			
DIP required within the 100-yr BFE or where bouyancy is a concern			
Provide consistent pipe material between manholes			
Minimum slope requirements:			
4"=2%, 6"=1%, 8"=0.60%, 10"=0.35%, 12"=0.30%			
Provide a minimum 0.10' drop across all straight through manholes			
Provide a minimum 0.25' drop across all turning manholes			
Manhole spacing should not exceed 400 feet			
Services tied into mains shall have a 3 feet minimum separation			
Service lines should connect to manholes where possible			
Use standard 4 inch drop for service lines into manholes			
Service lines angled against the flow use a minimum 6 inch drop			
If angle against the flow >135 degrees connect lateral directly to main			
No more than four laterals connected to a pass through manhole			
No more than five laterals connected to a beginning manhole			
Cleanouts to be located in traffic rated enclosure in paved areas			
Backflow prevention is required when any sewered portion of a building is less than 12 inches above the rim elevation of the nearest **upstream** manhole. Such lots shall be identified on the plans and the plat.			
Sanitary Sewer Pipe Profiles			
Indicate pipe material, size, slope and length			
Show all utility crossings			
Show existing and proposed grades			
Show all rim and invert elevations			
Show outside drop manhole where drop is 2 feet or greater			
Label all manholes and pipes (correspond with labels on plan sheets)			
Show existing mains and structures at all connection points			
Clearly differentiate between existing and proposed utilities			
Clearly differentiate between material types			
Grading & Drainage Plans			
Include North arrow			
If plans require multiple pages, include at least one overall plan sheet			
Show existing topographic contours			
Maximum 2ft contour intervals with every 10ft line labeled			
Used lighter or dashed line type for existing contour lines			
Show proposed contours			
Maximum 2ft contour intervals with every 10ft line labeled			
Proposed contour lines shoud tie-in to existing contour lines			
Show streams and other water features			
Show stream & wetland buffers			
Show 100-yr flood plain boundaries			
Indicate minimum FFE's for lots adjacent to water features			
Show all existing structures, utilities, and easements that will remain			
Show mitigation areas			
Indicate steep slopes (City of Auburn Zoning Ordinance)			
Show curb & gutter (2ft City of Auburn Std. C&G)			
Show all storm water inlets			
Max access spacing 500ft for 15in to 48in pipe (for public infrastrcture)			
Max access spacing 800ft for 54in or greater (for public infrastructure)			
Double-wing inlets only used in sags (for public infrastructure)			
Show all proposed culverts			
Indicate type and dimensions			
Show headwalls and energy dissipaters			
Show all storm sewer pipe			
Show headwalls at discharge points			
Show all manholes and junction boxes			
Extend discharge points at least 10 ft beyond building lines			
Show rip-rap or other energy dissipators at discharge points			
Show all proposed drainage & utility easement			
Show detention system(s)			
Fencing required around ponds for slopes steeper than 3:1			
Pipes discharge at bottom of pond slopes			
Show outlet structure(s)			

Description	Check	N/A	Comments
Storm Water Pipe Profiles (for public infrastructure only)			
Indicate pipe size, material, slope and length			
Pipe beneath streets shall be RCP			
Show rim & invert elevations			
Show 25-yr Hydraulic Grade Line			
Show existing and proposed grades			
Show all other utility crossings			
Show existing pipe & structures at tie-ins			
Erosion & Sediment Control Plans			
Used a phased plan when applicable			
Show clearing limits			
Show stream & wetland buffers. Drainage basin of stream should be delineated from the commencement point of the stream, to the point that it leaves the property. Basin area determines buffer widths (see ZO)			
Provide an ES&C legend			
Identify project sign location and provide project rain gauge on site			
Silt fencing shall be Class "A" (wire reinforced, metal staked, trenched) or C-POP			
Construction Entrance Pad (min 20ft x 50ft) Use #1 stone with geotextile fabric underneath. One CEP per site at any given time.			
Hay bales may not be used as stand-alone inlet protection. They can be used in conjunction with silt fence, silt savers, etc			
Use rock check dams, wattles, or silt fence check dams (rather than hay bales) where applicable.			
Design and show outlet protection at all discharges			
Show curb inlet protection devices (no stand-alone hay bales)			
Slopes greater than 3:1 require erosion control blankets. Specify types of blankets being used.			
Show all sediment basin locations, filter structures, and sediment volumes			
*Submit sediment storage calculations			
Attach City of Auburn standard erosion & sedimentation ctrl. details			
Include the following notes on the E&SC Plans[1]			
Street Plan & Profiles (for public infrastructure only)			
Plan view			
Include North arrow			
Show existing and proposed topography			
Show edge of pavement and curb/gutter			
Show ROW & easements			
Show station line			
Show horizontal curve radii			
Indicate tangent lengths (minimum 100ft between curves)			
Indicate street width (b/c to b/c)			
Indicate intersection corner property line radii (minimum 20ft)			
Show proposed sidewalks			
Profile View			
Show existing and proposed centerline grades			
Max grade for local streets = 15%			
Max grade for collector streets = 12%			
Max grade for minor arterial = 8%			
Max grade = 5% within 100ft of intersection			
Show vertical alignment with all vertical curve data			
Indicate the design speed used			
Local Street Design Speed = 25 mph			
Collector Street Design Speed = 35 mph			
Align stationing with the plan view station line			

	Description	Check	N/A	Comments
Miscellaneous Details, Cross-sections, & Other Sheets				
Miscellaneous Details, Cross-sections, & Oth	Collector or arterial (or other special) striping			
	Show details for improvements to off-site infrastructure			
	Turn lanes - including buildup and striping (meet with City on widening)			
	Off-site sewer, water, or storm water improvements			
	Detention outlet control structure details			
	Culvert details			
	HDPE installation details (for public infrastrucutre)			
	Tail ditch and/or swale details			
	Traffic control plan and detour plan			
	Proposed street classifications & buildups (for public infrastrucutre)			
City of Auburn Standard Details				
	Include all relevant City of Auburn standard details with the final plans			
Miscellaneous Design Requirements				
Miscellanous Design Requirements - Miscellanous Des	No trees within 10ft of center line of utilities			
	Sight distance analysis needed?			
	Storage/taper length calculations for turn lanes? (can be shown on plans)			
	are any wiavers or variances required?			
	The following note should be added to all utility plans and plats[2]			
	Easements shall be the greater of 20ft or 2 times the depth to the bottom			
	of the utility. Easement widths shall be in increments of 10ft.			
	Slope and grades of easements shall be passable by vehicles			
	(maximum easement cross slope of 4:1)			
	All topography should be relative to MSL (no assumed datum)			
	Utility stub outs for future development should be placed in easements			
	extending to the edge of the property line			

[1] a. Any area that has been disturbed and will remain so for more than 15 days shall be seeded and mulched within 5 days of being disturbed.
b. Additional BMPs may be required by the QCP and/or City of Auburn over the course of the project to minimize sediment release from the site
c. All BMPs shall be designed and installed in accordance with the Alabama Handbook for Erosion Control, Sediment Control, and Storm water Management on Construction Sites and Urban Areas and the City of Auburn standard erosion and sediment control details.
d. The use of floc-blocks, polyacrylamide (PAM), or other settling enhancement materials may be required by the QCP or City of Auburn during course of construction to minimize turbidity and sediment release from the site.

[2] No permanent structures may be constructed or placed on easements. Fences may be erected perpendicularly across the easement provided there is a minimum 12-foot wide access gate installed. If the gate is to be locked there must be a City-approved lock installed in conjunction with the owners lock. No trees shall be planted within 10 feet of utilities.

SIGNED: ____
(engineer of record)

DRT Checklist for *Subdivision* Construction Plans

Project Name: ______________________________

This checklist must be submitted with every set of engineering construction plans for subdivision improvements. All items on the checklist shall be addressed. If the item is not applicable to this project check the box next to the item labeled "N/A", and provide comment. Items preceded by an asterisk (*****) are required for the submittal to be considered complete. If one of these items is missing from the submittal without a valid explanation, the entire submittal will be rejected. Note that this checklist is not intended to be all-inclusive, and fulfillment of this checklist does not alleviate the obligation of the designer to meet all City of Auburn code, regulations, ordinances, and specifications. The purpose of this checklist is to facilitate a more efficient plan review process for the designer and the review team.

	Description	Check	N/A	Comments
Required Plan Sheets				
	These are the basic sheets we expect to see in a set of plans. Some sheets may be combined on certain projects, or have different names (for example, storm water profiles shown on the street plan & profile sheets).			
*	Title/Cover Sheet			
*	Project Notes			
*	Existing Conditions/Demo Plan			
*	Preliminary Plat			
*	Water Plan			
*	Sanitary Sewer Plan			
*	Sanitary Sewer Profiles			
*	Grading & Drainage Plan			
*	Storm Sewer Profiles			
*	Erosion & Sediment Control Plan			
*	Street Plan & Profiles			
*	Miscellaneous Details, Cross-sections & Other Sheets			
*	City of Auburn Standard Details			
Title Sheet				
	Project Title			
	Permit Numbers (USACE & ADEM)			
	Relevant Contact Information			
	Sheet Index			
	Vicinity Map (legible)			
	Engineer's Seal			
Project Notes				
	Verify that project notes do not conflict with City of Auburn specifications			
	Provide Legend			
Existing Conditions / Demo Plan				
	Include North arrow			
	Show locations of existing structures			
	Indicate if structures are being removed			
	Show existing topography with clearly labeled contours lines			
	Minimum 2ft contour intervals with every 10ft line labeled			
	Show existing water features including wetland areas			
	Show existing easements and right-of-ways			
	Show existing utilities			
	Indicate if being removed/abandoned			
	Show all property lines			
	Show the limits of clearing & grubbing			
Preliminary Plat				
	Include a copy of the approved Preliminary Plat			
	Indicate any changes from the approved plat			
	Verify planning commission resolutions were addressed			
Water Plans				
	*Required water service submittals prior to or with plan submittal:			
	Development Application for Water and Sewer Service			
	Backflow Protection Information Sheet			
	Fire flow calculations (where applicable, coordinate with the WRM Department)			
	Include North arrow			
	If water layout requires multiple pages, include an overall plan sheet			

	Description	Check	N/A	Comments
Water Plans	The following **existing** water infrastructure should be shown:			
	Location, size, and material of all water mains and service lines			
	Location and size of all water meters			
	Location of the nearest main line valves for isolation of the site			
	Location of the nearest fire hydrants			
	Location of all blow-off valves and air release valves			
	The following **proposed** water infrastructure should be shown:			
	Location, size, and material of all water mains and service lines			
	Location and size of all water meters (place at edge of ROW or easement)			
	Location of all isolation valves, blow-off valves, and air release valves			
	Location of all fire hydrants			
	Location of FDC within 125 ft of a fire hydrant			
	Location of all backflow prevention devices, and vaults			
	Location of all bends, tees, and fittings (specify type and degree)			
	Location and detail of all necessary thrust restraint			
	Location of vault drain to grade or to storm sewer			
	Show all existing and proposed easements			
	Provide a general layout of other utilities (existing and proposed)			
	Clearly differentiate between existing and proposed utilities			
	Detail all main line connections showing appropriate tap configuration and fittings			
	Provide backflow prevention for all main line connections			
	Provide estimated static pressure (normally 830 - FFE / 2.31)			
	Use pressure reducing valves where static pressure > 70 psi			
	Size pipes to maintain a velocity not to exceed 10 ft/sec			
	Provide minimum cover of 30 inches for lines 8 inches and smaller			
	Provide minimum cover of 36 inches for lines larger than 8 inches			
	Provide minimum 18 inches vertical separation where water & sewer cross			
	Provide minimum 10 feet horizontal separation between water & sewer lines			
	Provide sprinkler count			
	Provide the following notes where applicable:			
	"Existing services to be abandoned shall be terminated at the main."			
	"Notify AWWB of any scheduled outages 7 days prior to the outage."			
	"Only AWWB personnel are authorized to operate AWWB valves."			
Sanitary Sewer Plans				
SS Plans	*Required sewer service submittals prior to or with plan submittal:			
	Development Application for Water and Sewer Service			
	Grease Trap Sizing Worksheet			
	Approved pump station design (coordinated with the WRM Department)			
	Include North arrow			
	The following **existing** sewer infrastructure should be shown:			
	Location of all manholes with rim, and all invert elevations provided			
	Location, sizes, materials, and slopes of all sewer mains and laterals			
	Location, and size of grease traps and/or oil & grit separators			
	The following **proposed** sewer infrastructure should be shown:			
	Location of all manholes with rim, and all invert elevations provided			
	Location, sizes, materials, and slopes of all sewer mains and laterals			
	Location and size of grease traps where required			
	Location and size of oil & grit separators where required			
	Location of cleanouts at the edge of ROW or easement			
	If sewer layout requires multiple pages, include an overall plan sheet			
	Show all existing and proposed easements			
	Provide a general layout of other utilities (existing and proposed)			
	Clearly differentiate between existing and proposed utilities			
	Label all manholes and pipes (correspond with labels on profile sheets)			
	Provide contours or specify finish floor elevations			
	Indicate how existing sewer mains or services are to be abandoned			
	Manholes shall be locked down if less than 1 foot above the 100-yr BFE			

Description	Check	N/A	Comments
Public sanitary sewer main requirements:			
Manholes shall be located in the center of the street where possible			
Design sewer lines for maximum capacity at half full			
DIP required where cover is greater than 12 feet or less than 3 feet			
DIP required where less than 2 feet of clearance between utilities			
DIP required within the 100-yr BFE or where bouyancy is a concern			
Provide consistent pipe material between manholes			
Minimum slope requirements:			
4"=2%, 6"=1%, 8"=0.60%, 10"=0.35%, 12"=0.30%			
Provide a minimum 0.10' drop across all straight through manholes			
Provide a minimum 0.25' drop across all turning manholes			
Manhole spacing should not exceed 400 feet			
Services tied into mains shall have a 3 feet minimum separation			
Service lines should connect to manholes where possible			
Use standard 4 inch drop for service lines into manholes			
Service lines angled against the flow use a minimum 6 inch drop			
If angle against the flow >135 degrees connect lateral directly to main			
No more than four laterals connected to a pass through manhole			
No more than five laterals connected to a beginning manhole			
Cleanouts to be located in traffic rated enclosure in paved areas			
Backflow prevention is required when any sewered portion of a building is less than 12 inches above the rim elevation of the nearest **upstream** manhole. Such lots shall be identified on the plans and the plat.			
Sanitary Sewer Pipe Profiles			
Indicate pipe material, size, slope and length			
Show all utility crossings			
Show existing and proposed grades			
Show all rim and invert elevations			
Show outside drop manhole where drop is 2 feet or greater			
Label all manholes and pipes (correspond with labels on plan sheets)			
Show existing mains and structures at all connection points			
Clearly differentiate between existing and proposed utilities			
Clearly differentiate between material types			
Grading & Drainage Plans			
Include North arrow			
If plans require multiple pages, include at least one overall plan sheet			
Show existing topographic contours			
Maximum 2ft contour intervals with every 10ft line labeled			
Used lighter or dashed line type for existing contour lines			
Show proposed contours			
Maximum 2ft contour intervals with every 10ft line labeled			
Proposed contour lines shoud tie-in to existing contour lines			
Show streams and other water features			
Show stream & wetland buffers			
Show 100-yr flood zone boundaries			
Indicate minimum FFE's for lots adjacent to water features			
Show all existing structures, utilities, and easements that will remain			
Show mitigation areas			
Indicate steep slope areas as defined in the City of Auburn Zoning Ordinance			
Show curb & gutter (2ft City of Auburn Std. C&G)			
Show Inlets (single & double winged)			
Max access spacing 500ft for 15in to 48in pipe			
Max access spacing 800ft for 54in or greater			
Double-wing inlets only used in sags			
Show all proposed culverts			
Indicate type and dimensions			
Show headwalls and energy dissipaters			
Show all storm sewer pipe			
Show headwalls at discharge points			
Show all manholes and junction boxes			
Extend discharge points 10 ft beyond rear building lines			
Show rip-rap or other energy dissipators at discharges			

	Description	Check	N/A	Comments
Grading & Drainage -	Show all proposed drainage & utility easement			
	Show detention system(s)			
	Fencing required around ponds for slopes steeper than 3:1			
	Pipes discharge at bottom of pond slopes			
	Show outlet structure(s)			
Storm Water Pipe Profiles				
Storm Profiles - Storm Profiles	Indicate pipe size, material, slope and length			
	Pipe beneath streets shall be RCP			
	Show rim & invert elevations			
	Show 25-yr Hydraulic Grade Line			
	Show existing and proposed grades			
	Show all other utility crossings			
	Show existing pipe & structures at tie-ins			
Erosion & Sediment Control Plans				
E&SC Plans - E&SC Plans - E&SC Plans - E&SC Plans - E&SC Plans - E&SC Plans - E&SC Plans - E&SC Plans	Used a phased plan when applicable			
	Show clearing limits			
	Show stream & wetland buffers. Drainage basin of stream should be delineated from the commencement point of the stream, to the point that it leaves the property. Basin area determines buffer widths (see ZO)			
	Provide an ES&C legend			
	Identify project sign location and provide project rain gauge on site			
	All silt fencing shall be Class "A" (wire reinforced, metal staked, trenched) or C-POP			
	Construction Entrance Pad (min 20ft x 50ft) Use #1 stone with geotextile fabric underneath. One CEP per site at any given time.			
	Hay bales may not be used as stand-alone inlet protection. They can be used in conjunction with silt fence, silt savers, etc			
	Use rock check dams, wattles, or silt fence check dams (rather than hay bales) where applicable.			
	Design and show outlet protection at all discharges			
	Show curb inlet protection devices (no stand-alone hay bales)			
	Slopes greater than 3:1 require erosion control blankets. Specify types of blankets being used.			
	Show all sediment basin locations, filter structures, and sediment volumes			
	*Submit sediment storage calculations			
	Attach City of Auburn standard erosion & sedimentation ctrl. details			
	Include the following notes on the E&SC Plans[1]			
Street Plan & Profiles				
Street Plan & Profiles - Street Plan & Profiles - Street Plan & Profiles - Street Plan & Profiles - Street Plan & Profiles	**Plan view**			
	Include North arrow			
	Show existing and proposed topography			
	Show edge of pavement and curb/gutter			
	Show ROW & easements			
	Show station line			
	Show horizontal curve radii			
	Indicate tangent lengths (minimum 100ft between curves)			
	Indicate street width (b/c to b/c)			
	Indicate intersection corner property line radii (minimum 20ft)			
	Show proposed sidewalks			
	Profile View			
	Show existing and proposed centerline grades			
	Max grade for local streets = 15%			
	Max grade for collector streets = 12%			
	Max grade for minor arterial = 8%			
	Max grade = 5% within 100ft of intersection			
	Show vertical alignment with all vertical curve data			
	Indicate the design speed used (see PW Manual)			
	Align stationing with the plan view station line			

	Description	Check	N/A	Comments
Miscellaneous Details, Cross-sections, & Other Sheets				
Miscellaneous Details, Cross-sections, &	Collector or arterial (or other special) striping			
	Show details for improvements to off-site infrastructure			
	Turn lanes - including buildup and striping (meet with City on widening)			
	Off-site sewer, water, or storm water improvements			
	Detention outlet control structure details			
	Culvert details			
	Tail ditch and/or swale details			
	Traffic control plan and detour plan			
	Proposed street classifications & buildups			
City of Auburn Standard Details				
	Include all relevant City of Auburn standard details with the final plans			
Miscellaneous Design Requirements				
Miscellanous Design Requirements - Miscellanous Des	Sight distance analysis needed?			
	Storage/taper length calculations for turn lanes (can be shown on plans)			
	No trees within 10ft of center line of utilities			
	Are any waivers or variances required?			
	The following note should be added to all utility plans and plats[2]			
	Easements shall be the greater of 20ft or 2 times the depth to the bottom			
	of the utility. Easement widths shall be in increments of 10ft.			
	Slope and grades of easements shall be passable by vehicles			
	(maximum easement cross slope of 4:1)			
	All topography should be relative to MSL (no assumed datum)			
	Utility stub outs for future development should be placed in easements			
	extending to the edge of the property line			

[1]
a. Any area that has been disturbed and will remain so for more than 15 days shall be seeded and mulched within 5 days of being disturbed.
b. Additional BMPs may be required by the QCP and/or City of Auburn over the course of the project to minimize sediment release from the site
c. All BMPs shall be designed and installed in accordance with the Alabama Handbook for Erosion Control, Sediment Control, and Storm water Management on Construction Sites and Urban Areas and the City of Auburn standard erosion and sediment control details.
d. The use of floc-blocks, polyacrylamide (PAM), or other settling enhancement materials may be required by the QCP or City of Auburn during course of construction to minimize turbidity and sediment release from the site.

[2] No permanent structures may be constructed or placed on easements. Fences may be erected perpendicularly across the easement provided there is a minimum 12-foot wide access gate installed. If the gate is to be locked there must be a City-approved lock installed in conjunction with the owners lock. No trees shall be planted within 10 feet of utilities.

SIGNED: ____
(engineer of record)

City of Auburn

Application for Water and Sewer Service Instructions:

All applicable fields to be completed should be highlighted in blue

Page 1

Section A:

1. Fill out all project information in the blue highlighted fields
2. Check the appropriate type of development and complete the corresponding fields
   (for purposes of this application all developments that are not residential should be checked as commercial and all other categories that apply.)
3. Check the appropriate previous use(s) of the property and complete the corresponding fields

Section B:

1. Check the appropriate existing services that are available at the site
2. Complete the corresponding blue highlighted fields for each applicable service

Section C:

1. Check the appropriate proposed services that are being requested for the development
2. Complete the corresponding blue highlighted fields for each proposed service
3. Check all appropriate boxes under each proposed service as they apply to the development
4. Complete Section C.1.a. on Page 2 if a proposed Domestic (Drinking) Water service is requested
5. Complete Section C.4.a. on Page 2 if a proposed Sanitary Sewer service is requested
6. Complete all required forms for the proposed services and submit to WRM
   (separate forms are available for Backflow Protection, Grease Traps, and Pump Stations on the City's website)

Page 2

Section C.1.a:

Complete the applicable Water Demand Table for the proposed development

1. Insert the total number of fixtures in the blue highlighted fields for each applicable fixture type.
2. Add any necessary fixtures and the appropriate fixture values that are not listed
3. Add any additional known fixed demand (in GPM) on the domestic meter in the blue highlighted field
   (this could be for irrigation or any other demand that is not covered by the fixture type)

Section C.4.a:

Complete the applicable Wastewater Capacity Table for the proposed development

1. Insert the total number of units in the blue highlighted fields for the applicable type of development
2. Add any necessary type of development and the appropriate typical flow per unit that are not listed.

Application Submittal

The application should be emailed to wrmforms@auburnalabama.org prior to plans being submitted to DRT.
Any questions about the application or its use can also be directed to wrmforms@auburnalabama.org

The application will be reviewed by WRM with the plan submittal, and will be returned to the engineer and developer upon approval.

Water Resource Management
Application for Water and Sewer Service

City of Auburn

SECTION A - DEVELOPMENT INFORMATION

Name of Project: ______ Street Address: ______ Date: ______

Owner: ______ Email: ______ Phone: ______

Engineer: ______ Email: ______ Phone: ______

Maximum Site Elevation: ______ Static Water Pressure*: ______ Building Height: ______ Booster Pumps Required: ☐ Yes ☐ No

**Static pressure estimate is based on Auburn's primary pressure zone (tank elevation = 830' above MSL). Actual static pressure could vary upon site location and water supply conditions.*

Type of Development (Check all that apply): ☐ Residential ☐ Commercial ☐ Industrial ☐ Agricultural ☐ Institutional ☐ Restaurant

Number of Residential Units: ______ Efficiency ______ 1 Bedroom ______ Multiple Bedroom Commercial Space: ______ sf

Previous Use (Check all that apply): ☐ Vacant ☐ Residential ☐ Commercial ☐ Industrial ☐ Agricultural ☐ Institutional ☐ Restaurant

Number of Residential Units: ______ Efficiency ______ 1 Bedroom ______ Multiple Bedroom Commercial Space: ______ sf

SECTION B - EXISTING SERVICES

Existing water services must be verified with AWWB records for access fee credit. Please contact the Water Revenue office at 334-501-3050 for more information.

☐ **B.1. Domestic (Drinking) Water:**

Meters to be removed: Qty ______ Size ______ inch Qty ______ Size ______ inch Meters to remain: Qty ______ Size ______ inch

☐ **B.2. Irrigation:**

Meters to be removed: Qty ______ Size ______ inch Meters to remain: Qty ______ Size ______ inch

☐ **B.3. Fire Protection:**

Existing Backflow Prevention: ______ Existing Service Line Size: ______ inches Reuse ☐ Yes ☐ No

☐ **B.4. Sanitary Sewer:**

Existing Service Line Size: ______ inches Existing Service Line Material: ______ Reuse ☐ Yes ☐ No

SECTION C - SERVICES REQUESTED

The City of Auburn Backflow Protection Information Form shall be submitted with this application for proposed water services

☐ **C.1. Domestic (Drinking) Water: (Complete C.1.a. Water Demand Table)**

Requested Meters: Qty ______ Size ______ inch Qty ______ Size ______ inch Qty ______ Size ______ inch

Requested Service Line Size: ______ inches ______ inches ______ inches

☐ **C.2. Irrigation:**

Requested Meters: Qty ______ Size ______ inch Demand Per Meter: ______ GPM Requested Service Line Size: ______ inches

☐ **C.3. Fire Protection:**

Requested Backflow Prevention: ______ Requested Service Line Size: ______ inches

☐ **C.4. Sanitary Sewer: (Complete C.4.a. Wastewater Capacity Table)**

Requested Service Line Size: ______ inches Estimated Flow: Average ______ GPD Peak ______ GPD

Check all that apply: ☐ Grease Trap* ☐ Oil/Grit Separator ☐ Pump Station* ☐ Open Surface Drain to Sanitary ______ sq. ft.

**Requires separate WRM form submittal with plan submittal.* *(i.e., car wash, trash compactor, etc.)*

C.1.a. Water Demand Table (Derived from 2006 International Plumbing Code)

Commercial/Non-Residential Development

Type of Fixture	Total Fixtures		Fixture Value		Total Fixture Unit Value
Toilet (tank)		x	5	=	
Toilet (flush valve)		x	10	=	
Urinal (flush valve)		x	10	=	
Shower		x	4	=	
Bathtub		x	4	=	
Bathroom Sink		x	2	=	
Kitchen Sink		x	4	=	
Utility Sink		x	3	=	
Dishwasher		x	1.4	=	
Clothes washer		x	3	=	
Drinking Fountain		x	0.25	=	
Hosebib		x	1		
Other		x		=	
			Total Fixture Value =		

Estimated Peak Commercial Demand = ________ GPM
Additional Demand on Domestic Meter = ________ GPM
(i.e., irrigation demand on domestic meter)

Residential Development

Type of Fixture	Total Fixtures		Fixture Value		Total Fixture Unit Value
Toilet (tank)		x	2.2	=	
Shower Only		x	1.4	=	
Bathtub or Combo		x	1.4	=	
Bathroom Sink		x	0.7	=	
Kitchen Sink		x	1.4	=	
Utility Sink		x	1.4	=	
Dishwasher		x	1.4	=	
Clothes washer		x	1.4	=	
Hosebib		x	1	=	
Other		x		=	
			Total Fixture Value =		

Estimated Peak Residential Demand = ________ GPM
Additional Demand on Domestic Meter = ________ GPM
(i.e., irrigation demand on domestic meter)

C.4.a. Wastewater Capacity Table (Derived from Metcalf & Eddy: *Wastewater Engineering Treatment and Reuse* . Fourth Edition. Table 3-2.)

Commercial Development

Type of Development	Type of Unit	Number of Units	Typical Flow per Unit, GPD	Estimated Average Flow, GPD	Estimated Peak Flow, GPD
Office	Employee		13		
Restaurant	Customer		8		
Restaurant w/ bar	Customer		10		
Retail/Department Store	Restroom		400		
	Employee		10		
Hotel	Guest		70		
	Employee		10		
Shopping Center	Employee		10		
	Park Space		2		
Total Commercial Wastewater					

Residential Development

Type of Unit	Number of Units	Typical Flow per Unit, GPD	Estimated Average Flow, GPD	Estimated Peak Flow, GPD
Houses		250		
Townhouses		250		
Condominiums		250		
Apartments		150		
Mobile Homes		150		
Total Residential Wastewater				

Internal Use Only:

Water Service: Auburn   Sewer Service: Auburn   Lake Ogletree Watershed: No

Open Drain Surcharge Factor: ________ x Current Sewer Rate = Monthly Surcharge Amount

Access Fee Estimate:

Water Access Fee Credits: ________   Sewer Access Fee Credits: ________
Water Access Fee Charges: ________   Sewer Access Fee Charges: ________
Total Water Access Fees: ________   Total Sewer Access Fees: ________

*Total Access Fees Due for Development: ________

**Access fee computation is based on information provided for the project. This is only an estimate based on the published rates on the date of the estimate and is subject to change. Access fees are due prior to the issuance of a building permit, and shall be based on the published rates at the time the building permit is issued. This amount does not include any tap fees, meter set fees, or deposits that are applicable for the project. Please contact the Water Revenue office at 334-501-3050 for more information or for a detailed breakdown of credits and charges.*

Project Note: ________

Reviewed and Approved By: ________

Water Works Board of the City of Auburn
Backflow Protection Information Form

PROJECT INFORMATION

Project Name: ______________________________ **Date:** ______________

Premises Information:	Yes	No
Will premises be used for ***other than single family residential***?	☐	☐
Will premises have ***more than one connection to Board's system***?	☐	☐
Will premises have an ***irrigation*** system that ***uses*** pumps or wells?	☐	☐
Will premises have water meter ***larger*** than 1.5 inches?	☐	☐
Will premises' sewer system include any pumps or pressure mains?	☐	☐
If answers to above questions are ***ALL No***, skip to bottom of form.		
Commercial Development:		
Will premises have a ***fireline***?	☐	☐
Will premises have a ***fire pump***?	☐	☐
Will premises have a multi-story building?	☐	☐
Will premises have any of the following? Medical clinics, laboratories, medical facilities, medical offices, veterinarian clinics, dental offices, mortuaries?	☐	☐
Will premises have a boiler?	☐	☐
Will premises be used to store or process (including retail sale) petroleum products:	☐	☐
Will premises be used for manufacturing or processing of goods/products?	☐	☐
Will premises be used for or have a pressurized car washing system?	☐	☐

Please briefly describe the intended use of the premises:

____

____

____

____

____

____

Note: This information is collected for backflow protection considerations. If the use of the property changes in the future, the property owner/customer is required to notify the City.

OWNER INFORMATION

Owner: ______________________________

Phone Number/Contact Information: ______________________________

____

____

Agency/ Firm Providing Backflow Information: ______________________________

____

Water Works Board of the City of Auburn
Backflow Testing and Certification Form

BUSINESS OR DEVELOPMENT INFORMATION

Note: A separate Testing and Certification Form is required for EACH backflow protection device

Name: ______________________________ **Date:** ____________

Address: ______________________________ **Phone:** ____________

Description of Business or Development Type (Manufacturing, Medical, Residential, etc.): *Please be specific*

____

____

BACKFLOW PROTECTION DEVICE INFORMATION

Type of Backflow Protection Device: ______________________________

Manufacturer of Backflow Protection Device: ______________________________

Model Number of Backflow Protection Device: ______________________________

Serial Number of Backflow Protection Device: ______________________________

Location of Backflow Protection Device on Property (Attach sketch if necessary):

____

____

____

CERTIFIED TESTER INFORMATION

Only Plumbers certified to test backflow protection devices are allowed to certify the tests

Name of Company and Certified Tester: ______________________________

Contact: ______________________________ **Phone:** ____________

Repairs needed to the backflow protection device (if any):

____

____

____

____

I, ______________________________, a Certified Tester of backflow protection devices, do hereby acknowledge that I personally tested said backflow protection device described above and found it to be fully functional and operating correctly.

Signature: ______________________ **Testing Certification Number:** ____________

Date of Test: ____________

Water Works Board of the City of Auburn
Water Main Connection Permit Application

PROJECT INFORMATION

Project: ______________________________ **Date:** ______________

Address or Location: ______________________________

Contractor: ______________________________ **Phone:** ______________

Contractor Address: ______________________________

Size of Main: ____________________ **Size of Connection:** ______________

Scheduled Connection Date: ______________________________

Connection Type: ☐ Wet Tap ☐ Cut-in Tee **Right of Way:** ☐ City of Auburn ☐ Lee County ☐ ALDOT ☐ Easement

Approved By: ______________________________ **Date:** ______________

Note: ______________________________ **Permit Number:** ______________

Inspector: ______________________________ **Date:** ______________

City of Auburn

Water Resource Management
Pump Station Calculation Worksheet

City of Auburn

PROJECT INFORMATION

Name of Project: ______________________ Date: __________

Developer: ______________________ Telephone Number: __________

Engineer: ______________________ Telephone Number: __________

ESTIMATED AVERAGE DAILY FLOW (ADF)

1. Total acreage to be served by pump station (provide service area map): __________ Acres

2. Residential Unit Density (list for each area): ______________________

   Total Residential Units: __________ Units *Estimate 250 gallons per day per unit (GPD/unit)*

   Total Estimated Residential ADF (Total Units x 250 GPD/unit): __________ GPD = __________ GPM

3. Commercial Area (square feet): __________ SF Commercial Zoning: __________

   Type of Commercial Development: ______________________

   Total Estimated Commercial ADF: __________ GPD = __________ GPM *(provide calculations)*

   Estimation Criteria or Sources Used: ______________________

4. Total Estimated ADF (Residential + Commercial): __________ GPD = __________ GPM

ESTIMATED PEAK DESIGN FLOW (PDF)

PDF = ADF x Peaking Factor of 4.0

1. Estimated Residential PDF: __________ GPD = __________ GPM

2. Estimated Commercial PDF: __________ GPD = __________ GPM

3. Estimated Total PDF: __________ GPD = __________ GPM

DIMENSIONS AND ELEVATIONS

All elevations shall be provided in reference to Mean Sea Level (MSL)

1. Wet Well:
   - Shape: __________ Area: __________ SF
   - Wet Well Top or Rim Elevation (T): __________ FT
   - Lowest Incoming Gravity Invert Elevation (LI): __________ FT
   - Wet Well Bottom or Floor Elevation (B): __________ FT
   - Total Wet Well Storage Height (LI - B): __________ FT ≥ *5 Feet*

2. Floats:
   - Pump Off Float Elevation (OFF): __________ FT *(OFF - B ≥ 1 Foot)*
   - Lead Pump On Float Elevation (LEAD): __________ FT *(LEAD - OFF ≥ 1 Foot)*
   - Lag Pump On Float Elevation (LAG): __________ FT *(LAG - LEAD ≥ 1 Foot)*
   - Alarm Float Elevation (ALARM): __________ FT *(ALARM - LAG ≥ 1 Foot)*

3. Head Conditions:
   - High Point (HP): __________ FT Discharge Elevation (DE): __________ FT
   - Static Head (HP - OFF): __________ FT

STORAGE AND FILL TIME

1. Effective Storage:
   - Effective Height (EFH = ALARM - OFF): ________ FT ≥ *3 Feet*
   - Effective Volume (EFV = EFH x Area): ____________ CF = ____________ GALLONS
   - EFV Fill Time at ADF (EFV / ADF): ______________ Minutes
   - EFV Fill Time at PDF (EFV / Total PDF): ______________ Minutes ≥ *30 Minutes*

**Effective storage shall be calculated as the volume between the pump off elevation (OFF) and the alarm elevation (ALARM)*

2. Emergency Storage:
   - Emergency Height (EMH = LI - ALARM): ________ FT ≥ *1 Foot*
   - Emergency Volume (EMV = EMH x Area): ____________ CF = ____________ GALLONS
   - EMV Fill Time at ADF (EMV / ADF): ______________ Minutes
   - EMV Fill Time at PDF (EMV / Total PDF): ______________ Minutes ≥ *10 Minutes*

**Emergency storage shall be calculated as the volume between the alarm elevation (ALARM) and the lowest gravity invert elevation (LI)*

3. Total Storage:
   - Total Height (TH = LI - OFF): ________ FT ≥ *4 Feet*
   - Total Volume (TV = TH x Area): ____________ CF = ____________ GALLONS
   - TV Fill Time at ADF (TV / ADF): ______________ Minutes
   - TV Fill Time at PDF (TV / Total PDF): ______________ Minutes

**Total storage shall be calculated as the volume between the pump off elevation (OFF) and the lowest gravity invert elevation (LI)*

PUMP AND FORCE MAIN DESIGN

1. Force Main: Size: ____________ IN Material: ________________________
   Length: ____________ FT Friction Losses: ____________ FT

2. Pump Selection: Make: ________________ Model: ________________ Impeller: ________________

3. Motor Selection: Model: ________________ HP: ________ RPM: ________ Voltage Rating ________

4. Performance (1 Pump): *Compute System Curve*
   - a. Total Dynamic Head (TDH): ______________ FT
   - b. Pumping Capacity: ______________ GPM ≥ *PDF*
   - c. Force Main Velocity: ______________ FT/S ≥ *2 Feet/Second*
   - d. Efficiency: ______________ %

5. Performance (2 Pumps): *Compute System Curve*
   - a. Total Dynamic Head (TDH): ______________ FT
   - b. Pumping Capacity: ______________ GPM
   - c. Force Main Velocity: ______________ FT/S ≤ *8 Feet/Second*
   - d. Efficiency: ______________ %

ADDITIONAL DESIGN NOTES

____

____

____

____

____

STATE OF ALABAMA

LEE COUNTY

PUMP STATION COMPLETION BOND

KNOW ALL MEN BY THESE PRESENTS, that __________________________, as Principal, is held and firmly bound unto the City of Auburn, a municipal corporation, its successors and assigns, in the penal sum of _______________ Dollars ($____________) which sum is secured by irrevocable and auto-renewing Letter of Credit number dated __________, issued by_______(Bank)_____ our account for which payment, well and truly to be made and done, we bind ourselves, our successors, assigns, heirs, executors and administrators, jointly and severally, firmly by these presents. And we waive in favor of this Bond, all right to claim any exemption of personal property allowed by the Laws of the State of Alabama. The form of the letter of credit shall be reviewed by the City of Auburn Finance Director and must be acceptable to the City Finance Director in order to secure the subject completion bond.

SEALED with our seals and dated this the ______ day of ___________, __2015__.

THE CONDITION OF THE OBLIGATION IS SUCH that whereas, the above-bound are engaged in the construction of ____________________________ in the subdivision jurisdiction of the Planning Commission of the City of Auburn, inside of the corporate limits of said City, and are required by the City of Auburn to provide a bond in sufficient amount to secure the satisfactory completion of construction of the required sanitary sewer conveyance pump station, in said subdivision in accordance with the standards prescribed for such work by the Water Resource Management Director of the City of Auburn, with all associated work to be completed and first certificate of occupancy issued for said subdivision within _twelve_ (12) months from the date hereof. In the event said work is not completed and first certificate of occupancy is not issued for said subdivision within said twelve_12_ month period, the Bond and the letter of credit shall be automatically renewed for an additional twelve (12) month period until all obligations covered under the Bond are completed. If a certificate of occupancy is issued within said subdivision prior to completion of all work associated with said pump station, the City of Auburn shall, in its discretion, have the right to call and liquidate said Letter of Credit securing this Bond and

apply the proceeds derived therefrom to complete construction of the said sanitary sewer pump station or to replace any installed components of said pump station that have exceeded or failed to meet the original manufacturer's warranty or as deemed appropriate by the City of Auburn.

NOW, THEREFORE, if the above-bound shall well and truly construct or cause to be constructed said sanitary sewer conveyance pump station in keeping with the said standards prescribed for such work by the City of Auburn, and shall acquire a certificate of occupancy within said subdivision, and shall secure the final approval thereof from the Water Resource Management Director of the City of Auburn, the above-bound shall maintain said pump station installation to be free of all defects in workmanship, materials, electrical components, or mechanical components for a period of twelve (12) months from the date of acceptance by the Water Resource Management Director of the City of Auburn, and shall at such time furnish to the City of Auburn a maintenance bond in the amount of One Hundred percent (100%) of the value of this Subdivision Pump Station Completion Bond for said pump station in a form duly approved by the Council for the City of Auburn which said Bond secured by a corporate surety approved by the City or a Letter of Credit in a form acceptable to the City in the amount of said Bond, said Letter of Credit being for a period of twelve (12) months from the date of said Bond, then this obligation shall be void; otherwise this Bond shall remain in full force and effect.

By the execution of this Pump Station Completion Bond, __(principal name)___, authorizes the City of Auburn to draw under the above-described Letter of Credit in accordance with the terms and conditions of this Pump Station Completion Bond.

IN WITNESS WHEREOF, we have caused this bond to be executed by us this the day of _____________, _2015_.

(Principal Name)

BY:________________________________

As its ______________________________

Sworn to and subscribed before me this ________ of _________, 2015

____
Notary

Adams, Umbach, Davidson and White,
Attorneys for City of Auburn, Alabama

____
Rick Davidson, City Attorney **Date** ____________________

____
Chairman, Planning Commission **Date** ____________________

____
Eric A. Carson, Water Resource Management Director **Date** ____________________

STATE OF ALABAMA

LEE COUNTY

PUMP STATION WARRANTY BOND

KNOW ALL MEN BY THESE PRESENTS, that ___________________________, as Principal, is held and firmly bound unto the City of Auburn, a municipal corporation, its successors and assigns, in the penal sum of _______________ Dollars ($____________) which sum is secured by irrevocable and auto-renewing Letter of Credit number dated __________, issued by______(Bank)_____ our account for which payment, well and truly to be made and done, we bind ourselves, our successors, assigns, heirs, executors and administrators, jointly and severally, firmly by these presents. And we waive in favor of this Bond, all right to claim any exemption of personal property allowed by the Laws of the State of Alabama. The form of the letter of credit shall be reviewed by the City of Auburn Finance Director and must be acceptable to the City Finance Director in order to secure the subject completion bond.

SEALED with our seals and dated this the _____ day of ___________, __2015__.

THE CONDITION OF THE OBLIGATION IS SUCH that whereas, the above-bound engaged in the construction of ______________________________ pump station in the subdivision jurisdiction of the Planning Commission of the City of Auburn, inside of the corporate limits of said City, and has well and truly constructed or caused to be constructed said pump station in keeping with the standards prescribed for such work by the City of Auburn, and has acquired a certificate of occupancy within said subdivision, and has secured the final approval thereof from the Water Resource Management Director of the City of Auburn, and are required by the City of Auburn to provide a bond in sufficient amount to warrant said pump station to be free of all defects in workmanship, materials, electrical components, or mechanical components for a period of twelve (12) months from the date of acceptance by the Water Resource Management Director of the City of Auburn. If any defects are discovered in said pump station during said twelve (12) month period the City of Auburn shall make any necessary repairs to keep said pump station in operation and will invoice the above-bound for the labor and materials required to make said repairs. If the above-bound fails to make payment to the City of Auburn

within a sixty (60) day period the City of Auburn shall, in its discretion, have the right to call and liquidate said Letter of Credit securing this Bond and apply the proceeds derived therefrom to the associated cost to repair said pump station.

By the execution of this Pump Station Warranty Bond, ___(principal name)___, authorizes the City of Auburn to draw under the above-described Letter of Credit in accordance with the terms and conditions of this Pump Station Warranty Bond.

IN WITNESS WHEREOF, we have caused this bond to be executed by us this the day of _____________, __2015__.

(Principal Name)

BY:________________________________

As its ______________________________

Sworn to and subscribed before me this ________ of _________, 2015

____
Notary –

Adams, Umbach, Davidson and White,
Attorneys for City of Auburn, Alabama

____
Rick Davidson, City Attorney **Date ____________________**

____
Chairman, Planning Commission **Date ____________________**

____
Eric A. Carson, Water Resource Management Director **Date ____________________**

Water Resource Management
Grease Trap Size Calculation Data Sheet

City of Auburn

PROJECT INFORMATION

Name of Project: ____________________ Date: ________

Project Address: ____________________ Telephone Number: ________

DRAINAGE FIXTURE UNIT VALUES (DFU)

Enter the number of each fixture type connecting to the grease trap

QTY	Fixture Type	DFU	Total	QTY	Fixture Type	DFU	Total
	Dishwasher (domestic)	2	0		Other (1-1/4 inch trap)	1	0
	Kitchen, Bar, or Wash Faucet	2	0		Other (1-1/2 inch trap)	3	0
	Commercial Sink with food waste	3	0		Other (2 inch trap)	4	0
	Food Waste Grinder	3	0		Other (3 inch trap)	6	0
	Service or Mop Basin	3	0		Other (4 inch trap)	8	0
	Clothes Washer (domestic)	3	0		Other (7.5 to 15 GPM)	2	0
	Floor Drain	2	0		Other (15 to 30 GPM)	4	0
	Drinking Fountain or Water Cooler	0.5	0		Other (30 to 50 GPM)	6	0

Total Drainage Fixture Unit Value: 0

Drainage fixture unit values (DFU) are derived from the 2009 Uniform Plumbing Code (UPC), Table 7-3

FATS, OIL, AND GREASE (FOG) PRODUCTION CLASSIFICATION

Enter the appropriate FOG production classification for the proposed facility

Fats, Oil, and Grease Production Classification: Heavy

*Light FOG producers shall only be applicable to FSFs where the products used in food preparation and service contain little or no dairy, shortening, oil, butter, vegetable fat, animal fat, or other fatty compounds which are insoluble in water at room temperature, as deemed appropriate by the WRM Department.

GREASE TRAP SIZING

Light FOG Production Table*

DFU	Volume (Gallons)
8	500
21	750
35	1,000
90	1,250
172	1,500
216	2,000
307	2,500
342	3,000
428	4,000
576	5,000
720	7,500
2,112	10,000
2,640	15,000

Heavy FOG Production Table*

DFU	Volume (Gallons)
17.5	1,000
45	1,250
86	1,500
108	2,000
153.5	2,500
171	3,000
214	4,000
288	5,000
360	7,500
1,056	10,000
1,320	15,000

Required Grease Trap Size: 1,000 **Gallons**

Proposed Grease Trap Size: ________ **Gallons**

*Grease trap sizing is based on a 30-minute retention time for Light FOG producers and a 1-hour retention time for Heavy FOG producers as defined by the FOG Loading criteria. The retention time calculations are derived from the 2009 Uniform Plumbing Code (UPC) Fixture Unit Values in Table 7-3 and Gravity Grease Interceptor Sizing in Table 10-3.

Water Resource Management
Commercial Waste Manifest

ORIGINATOR INFORMATION

Originator Name ______________________ Contact Name ______________________

Address ______________________ Phone (____)______________________

City, State ______________________ Zip ______________ County ______________

WRM ID # ______________

Type of Trap: Grease Interceptor ☐ Oil/Water Separator ☐ Grit/Sand Trap ☐ Outside ☐ Inside ☐
Other: ______________________Trap Condition: ______________________

Tank #1 __________ gallons Tank#2 __________ gallons Service Frequency ________Weeks

Tank #3 __________ gallons Tank #4 __________ gallons

Generator Certifications: I hereby certify that the wastes listed under this consignment are not hazardous, as defined in regulations promulgated by the State of Alabama, Dept. of Environmental Management, and that the type wastes and quantity indicated are fully accurate.

Originator Name (Printed) ______________ Signature______________ Date__________ Time__________

TRANSPORTER INFORMATION

Company ______________________ Driver Name ______________ Address______________________

City, State ______________________ Zip ______________ Phone (____) ______________

City of Auburn Bus. License #: ______________

Transporter Certification: I hereby acknowledge receipt of the above listed waste and will transport and dispose of it in accordance with all applicable laws.

Driver Name (Printed) ______________ Signature______________ Date__________ Time__________

RECEIVER/DISPOSAL INFORMATION

Disposal Name ______________ Contact Name ______________ Address ______________

City, State ______________Zip ________ Phone (____) __________County ______________

NPDES # ______________ LAS # ______________ Solid Waste Handling # ______________ Industrial

Pretreatment Permit # ______________ Total Quantity Received Gallons __________

Certification of Receipt: The above waste was received by this facility within the authorized property boundaries and will be processed, disposed of, or recycled in accordance with all applicable laws.

Disposal Name (Printed) ______________ Signature______________ Date__________ Time__________

***Originator must return completed form to City of Auburn Water Resource Management Department, Sewer Division at: 1501 West Samford Avenue, Auburn, AL 36832. Form must be returned within 10 days upon completion.**

Shaded areas to be input by City of Auburn
Water Resource Management Department

B-25

INDEMNITY AND HOLD HARMLESS AGREEMENT

STATE OF ALABAMA

LEE COUNTY

WHEREAS, the City of Auburn, Alabama (hereinafter the "City") has a drainage and utility easement located along ____ ____ in Auburn, Alabama, and
(Right of way or location description)

WHEREAS, __________________________________ (hereinafter the "Owner") of property described as ____ ____, Auburn, Alabama, wishes to locate __________________________________ (hereinafter the "Obstruction") on the City's drainage and utility easement (shown by Exhibit A attached), and as a condition and obligation to the City for the granting of its consent to the Obstruction, the Owner, for itself and its successors in the ownership of the property on which Obstruction is located, has agreed to indemnify and hold harmless the City and holders of any interest in the easement where the Obstruction is located.

NOW, THEREFORE, in consideration of the granting of the consent of the undersigned to the placement of the Obstruction on and under the drainage and utility easement, the Owner does, for itself and its successors in the ownership of the property described, agree to indemnify, hold harmless and defend the City, its officials, representatives, agents, servants and employees from and against all liability and loss which the City and the holders of the interest in the drainage and utility easement on which the Obstruction is located may sustain as the result of claims, demands, costs or judgments arising out of the location of the Obstruction on the drainage and utility easement, including its reasonable costs in defending against any such claims. For the same consideration, the Owner agrees to release and discharge the City and The Water Works Board of the City of Auburn, Alabama from any damages to the Obstruction arising from utility maintenance work within the easement. The obligations of this indemnity shall be binding upon the successors and assigns of the Owner and shall be a covenant running with the land and shall be binding upon all future owners of the property on which the easement is located.

[Remainder of page intentionally left blank]

EXECUTED this the ______ day of ______________________, 20__.

____
Owner

By: ____________________________________
Its ________________________

CITY OF AUBURN, ALABAMA

By: ____________________________________
Its ________________________

THE WATER WORKS BOARD OF THE
CITY OF AUBURN, ALABAMA

By: ____________________________________
Its ________________________

STATE OF ALABAMA

LEE COUNTY

I, the undersigned authority, a Notary Public in and for said County, in said State, hereby certify that ____, whose name is signed to the foregoing instrument, on behalf of the Owner, and who is known to me, acknowledged before me on this date that, being informed of the contents of the foregoing document, he/she executed the same voluntarily on the day the same bears date.

Given under my hand and official seal this the ______ day of ___________________, 20___.

____
Notary Public
Commission Expires _______________

STATE OF ALABAMA

LEE COUNTY

I, the undersigned authority, a Notary Public in and for said County, in said State, hereby certify that ____, whose name is signed to the foregoing instrument, on behalf of the City of Auburn, Alabama, and who is known to me, acknowledged before me on this date that, being informed of the contents of the foregoing document, he/she executed the same voluntarily on the day the same bears date.

Given under my hand and official seal this the ______ day of ___________________, 20___.

____
Notary Public
Commission Expires ________________

STATE OF ALABAMA

LEE COUNTY

I, the undersigned authority, a Notary Public in and for said County, in said State, hereby certify that ____, whose name is signed to the foregoing instrument, on behalf of The Water Works Board of the City of Auburn, Alabama, and who is known to me, acknowledged before me on this date that, being informed of the contents of the foregoing document, he/she executed the same voluntarily on the day the same bears date.

Given under my hand and official seal this the ______ day of ___________________, 20___.

____
Notary Public
Commission Expires ________________

STATE OF ALABAMA)
) **LICENSE AGREEMENT**
COUNTY OF LEE)

This Agreement made and entered into on this the ______ day of _________, ______, by and between The City of Auburn, Alabama, a municipal corporation, hereinafter referred to as "Licensor" and ____, hereinafter referred to as "Licensee."

STATEMENT OF BACKGROUND INFORMATION

1. The City of Auburn, Alabama is the owner of that certain drainage and utility easement from ____, dated ____________________________, and recorded in the Office of the Judge of Probate of Lee County, Alabama in ____.

2. Licensee has requested that it be permitted to construct and install its ____ and associated appurtenances within said easement, being further described on that certain map marked "Exhibit A", attached hereto and made a part hereof by reference, and in consideration thereof has agreed to indemnify and hold harmless Licensor from any and all damages caused by its use of said easement. Licensee agrees to restore the drainage and utility easement to preconstruction conditions or better.

STATEMENT OF AGREEMENT

NOW, THEREFORE, for and in consideration of the above recitations and the mutual covenants and agreements contained herein, the parties do hereby agree as follows:

1. Licensee is hereby granted a revocable license or permit to install within the boundaries of the above-described easement its ____ and associated appurtenances in accordance with plans and specifications approved by the Licensor and at a location agreed upon by Licensor.

2. Licensee does hereby indemnify and hold harmless Licensor for any and all claims, damages and liability incurred by Licensor as a result of Licensee's ____ and associated appurtenances being located within said easement and shall further be responsible for the payment or reimbursement of all defense costs, including, but not limited to, attorneys' fees which result from the same.

3. Licensor may terminate this Agreement at any time by giving to Licensee sixty (60) days written notice thereafter to so terminate this license in which case Licensee shall remove its ____ and associated appurtenances as soon as practical thereafter at no expense to the Licensor.

IN WITNESS WHEREOF, the parties have executed this License Agreement on the date first written above.

THE CITY OF AUBURN, ALABAMA,
A MUNICIPAL CORPORATION,

BY: _________________________________
Bill Ham
ITS: Mayor

ATTEST:

BY: ____________________________
Charles M. Duggan, Jr.
ITS: City Manager

____
LICENSEE

BY:____________________________________ (L.S.)

ITS:____________________________________

STATE OF ALABAMA

LEE COUNTY

I, the undersigned authority, a Notary Public in and for said County, in said State, hereby certify that __________________________________, whose name is signed to the foregoing instrument, and who is known to me, acknowledged before me on this date that, being informed of the contents of this document, he/she executed the same voluntarily on the day the same bears date.

Given under my hand and official seal this the __ day of ____________________.

____
Notary Public
Commission Expires_________________

City of Auburn

Request For Design and Construction Standard Waiver

City of Auburn

PROJECT INFORMATION

Name of Project: ______________________________ Date: __________

Project Address: ______________________________ Telephone Number: __________

Agency/Firm: ______________________________

Brief Description of Your Waiver Request: ______________________________

____

____

____

Attachments (List all supporting documentation you are submitting with this form): __________

____

____

____

MANUAL TEXT CHANGES

Complete for each proposed modification. Attach additional sheets as necessary

Waiver Number 1 Manual Section Reference (Number and Title): __________

Existing Standard: ______________________________

____

____

____

Proposed Waiver: ______________________________

____

____

____

Waiver Number 2 Manual Section Reference (Number and Title): __________

Existing Standard: ______________________________

____

____

____

Proposed Waiver: ______________________________

____

____

____

STANDARD DETAIL CHANGES

Submit a hard copy of the standard detail showing each proposed modification encircled within a "cloud"

Waiver Number 1 Standard Detail Reference (Number and Title): __________

Waiver Number 2 Standard Detail Reference (Number and Title): __________

City of Auburn

Date: ____________________
Time: ____________________
Inspector: ____________________

Development/Construction Site: ____________________

Developer/Contractor/Permit Holder: ____________________

Location: ____________________

	Condition Assessment	Maintenance Required?	Comments/Considerations
Sediment Control Structures			
Sediment Trap	Good Fair Poor	Yes/No	
Filter Structure	Good Fair Poor	Yes/No	
Detention/Retention Pond	Good Fair Poor	Yes/No	
Outlet Structure	Good Fair Poor	Yes/No	
Flocculants (blocks, logs)	Good Fair Poor	Yes/No	
Discharge Headwall	Good Fair Poor	Yes/No	
Other: ____________________	Good Fair Poor	Yes/No	
Sheet Flow Barriers			
Hay Bales	Good Fair Poor	Yes/No	
Silt Fence	Good Fair Poor	Yes/No	
Stabilization of Barren Areas	Good Fair Poor	Yes/No	
Mulching	Good Fair Poor	Yes/No	
Seeding and Mulching	Good Fair Poor	Yes/No	
Chemical Stabilization	Good Fair Poor	Yes/No	
Other: ____________________	Good Fair Poor	Yes/No	
Channel Check Structures			
Rock Check	Good Fair Poor	Yes/No	
Silt Fence Check	Good Fair Poor	Yes/No	
Bale Check	Good Fair Poor	Yes/No	
Stream Bank Stabilization			
Chemical Stabilization	Good Fair Poor	Yes/No	
Rip Rap	Good Fair Poor	Yes/No	
Stream Crossing and Protection	Good Fair Poor	Yes/No	
Other: ____________________	Good Fair Poor	Yes/No	
Inlet Protection			
Hay Bales	Good Fair Poor	Yes/No	
Silt Fence	Good Fair Poor	Yes/No	
Inlet Barriers	Good Fair Poor	Yes/No	
Curb Inlet Protection	Good Fair Poor	Yes/No	
Other Prefabricated Measures	Good Fair Poor	Yes/No	
General Site Measures			
Construction Entrance	Good Fair Poor	Yes/No	
Posting of Permits	Good Fair Poor	Yes/No	
Buffer Areas Marked/Maintained	Good Fair Poor	Yes/No	
Construction Limits Marked	Good Fair Poor	Yes/No	

Are uncontrolled Releases of mud or muddy water from the site and/or deposits of sediment evident? YES NO

If yes, what corrective actions are necessary?

Do existing BMPs need to be modified or additional BMPs need to be installed?

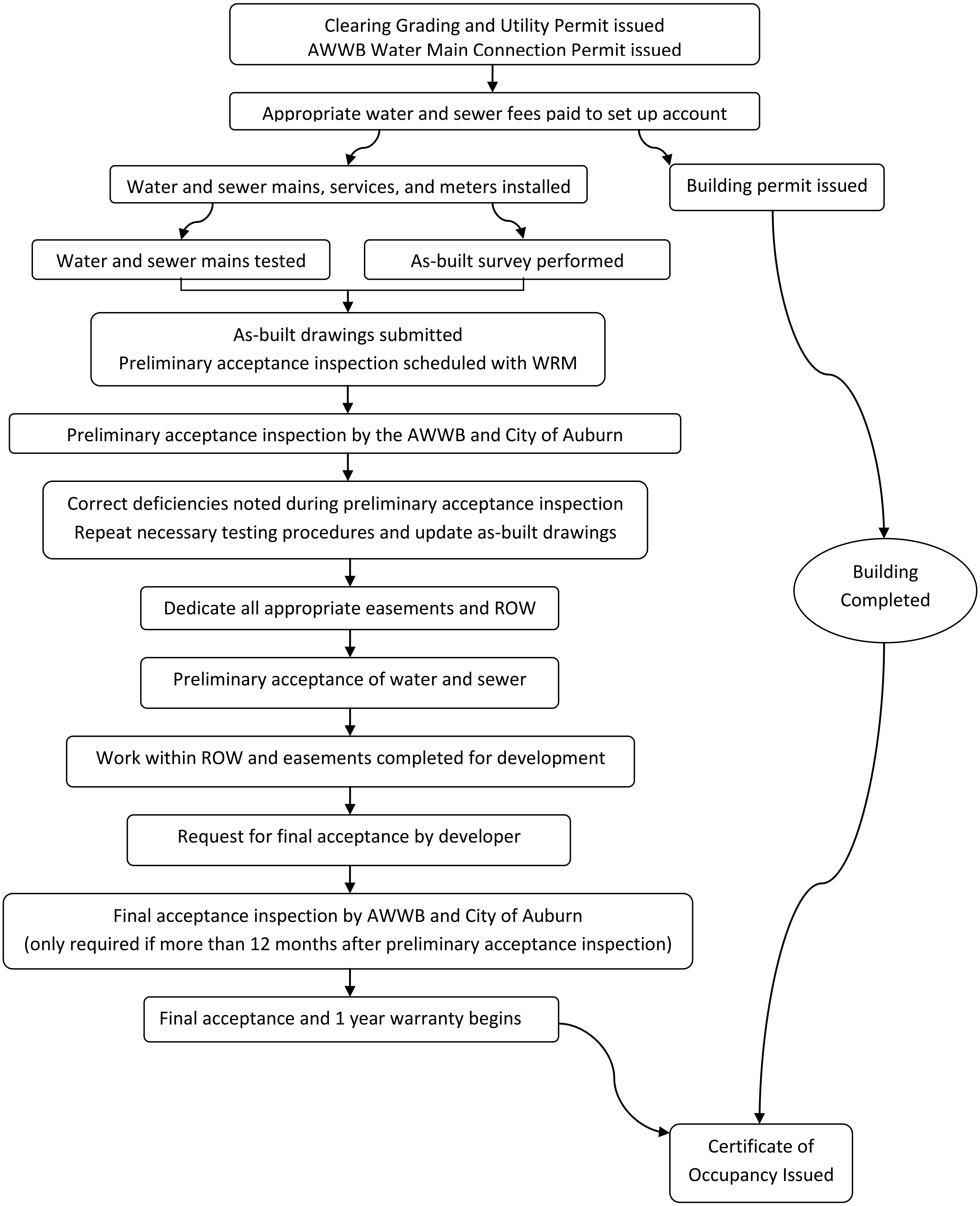
List Actions To Be Taken:

Additional comments:

Inspection completed on ________________________ by ____.
(signature)

Appendix C
Exhibits

Site Plan Development - Utility Installation Flow Chart



*Preliminary and final acceptance may be done simultaneously for site plan developments

Residential Subdivision - Utility Installation Flow Chart