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1. INTRODUCTION

1.1 AUTHORIZATION

Authorization for the preparation of the Storm Drainage and Environmental Criteria Manual (SDECM) was given by the Parker Town Council on July 18, 1983. The manual has since been updated in July, 1986; February, 1994; April, 1994; February 1996; March 1998; November 2002 and most recently with this 2014 revision.

1.2 PURPOSE AND SCOPE

This document contains minimum planning and design criteria for storm drainage systems within the Town of Parker, Colorado. The jurisdiction of the Town in this regard extends to both developed and undeveloped areas within the Town's corporate limits.

The purposes of this storm drainage criteria manual are as follows:

1. Improve the quality of drainage planning, analysis and design
2. Define acceptable practices and criteria
3. Clarify the Town's review process
4. Promote the practice of natural drainage
5. Improve stormwater quality
6. Provide for drainage infrastructure that enhances the community
7. Avoid uneconomic property losses.

All site plans, plats, planned unit developments or any other proposed construction submitted for approval shall conform to the criteria set forth in this manual.

The drainage policies, procedures and criteria presented in this document are intended to follow the provisions of the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual (MANUAL), where applicable. Policies and criteria not specifically addressed in this document shall follow the provisions of the MANUAL, latest revision, which is incorporated into these criteria by reference. Wherever conflicts exist between the MANUAL and these criteria, the criteria of this manual shall apply in the Town.

This manual is intended to provide a supplement to, and be consistent with, the Town of Parker Land Use and Development Code (CODE) and the Town of Parker Roadway Design and Construction Criteria Manual (Roadway Manual).

1.3 OFFICIAL TOWN CODE

The Town of Parker has adopted a Land Use and Development Code (CODE) which sets out Town policies with respect to zoning and other ordinances, subdivision regulations and construction specifications and details. The CODE is found at Title 13 of the Town of Parker Municipal Code.
Some of the CODE’s policies apply directly to drainage planning, analysis and design, and are therefore referenced throughout this manual. As a home rule municipality and in accordance with Title 31 of the Colorado Revised Statutes, the Town of Parker has the legal authority to establish, improve and regulate improvements such as those related to drainage. Although technically this document applies only to land within the incorporated boundary of the Town, other areas within the master planning area may be affected. As land surrounding the Town is considered for annexation, the provisions of this manual, as well as the CODE and subdivision and grading ordinances, will be considered applicable.

The Town’s adoption by reference of this Storm Drainage and Environmental Criteria Manual can be found in the CODE at 13.10.170.

## 1.4 DEFINITIONS

The following definitions are applicable at various places throughout these criteria. When appropriate, additional definitions are provided in specific chapters in order to clarify specific topics within the given chapter.

1. **Agricultural Activity** means grazing activity on agricultural lands consisting of no greater than 1 animal unit per 40 acres on agricultural lands, unless a soil conservation district approved grazing management plan is applied, and/or production of a commodity crop with operations such as tilling, seeding, planting, irrigation, and harvesting, on agricultural lands.

2. **Agricultural Lands** means "agricultural lands" as defined in the Authority's enabling legislation, C.R.S. § 25-8.5-102(1).

3. **Authority** means the Cherry Creek Basin Water Quality Authority established pursuant to Section 25-8.5-101 et seq., C.R.S.

4. **Best Management Practices (BMPs)**, as defined by the Control Regulation, 5 C.C.R. 1002-72 § 72.2(3), means the best schedules of activities, prohibitions or practices, operation and maintenance procedures, and other management practices to prevent or reduce the introduction of pollutants to state waters. BMPs include, but are not limited to, structural and nonstructural controls, treatment requirements, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs can be applied before, during, and after pollution-producing activities.

5. **Channel Storage** means the volume of water occupying a given length of channel for a specified flow rate, flood frequency or flow depth. When determined by the flow rate or flood frequency, channel storage is the volume of water below the water surface profile.

6. **Cherry Creek Watershed** means all lands that drain into the following: (a) the mainstem of Cherry Creek, from the source of East and West Cherry Creek to the inlet of Cherry Creek Reservoir (Segment 1), including alluvial groundwater; (b) Cherry Creek Reservoir (Segment 2), including alluvial groundwater; (c) all tributaries to Cherry Creek, including wetlands and alluvial groundwater, from the sources of East and West Cherry Creeks (parts of Segment 4); and all lakes and reservoirs in the Cherry Creek Reservoir watershed (Segment 5, in part) as described in the Classifications and Numeric Standards - South Platte River Watershed, Regulation #38 (5 CCR 1002-38).

7. **CODE** refers to the Town of Parker Land Use Development Ordinance.
8. **Construction BMPs (CBMPs)** means temporary BMPs, either structural or non-structural, required for Land Disturbance activities under Section 8.2 herein. Construction BMPs generally will remain in place for 2 years or less but may be converted into permanent BMPs.

9. **Detention** means the temporary storage of stormwater runoff on the surface (or below the surface) of the ground at or near where rainfall has occurred, and which is discharged or released later, typically less than 72-hours.

10. **Detention Storage** means water detained on the surface during a storm that may be discharged or released after the storm has ended. In the context of channel design, detention means the storage of stormwater runoff water for controlled release during or immediately following the design storm.

11. **Developer/Permittee** shall refer to any individual, land owner, applicant, contractor/construction company, developer, developer representative, special district, and/or corporate agency (public or private) proposing to develop land and/or construct(ing) improvements within the Town. Permittee shall further mean the holder of a permit issued by the Town.

12. **Development** See definition for "New Development and Redevelopment."

13. **Direct Runoff** means the total amount of surface and subsurface stormwater runoff that reaches stream channels.

14. **Disturbed Areas** means any site, area or lands in the Town of Parker where a Land Disturbance has commenced but has not been stabilized and/or revegetated.

15. **Drainage** means: (a) the removal of surface water from a given area either by gravity or by pumping (commonly applied herein to surface water); (b) the area from which water occurring at a given point or location on a stream originates (in such case the term is synonymous with the terms "drainage area" and "watershed"); or (c) generally, the flow of all liquids under the force of gravity.

16. **Drainage Area (or Catchment Area, Watershed and Basin)** means: (a) the tributary area to a specific point of interest, expressed in acres, square miles, or other unit of area; or (b) the area served by a drainage system receiving storm and surface water; or by a watercourse.

17. **Erosion** means the wearing away of the land surface by water, wind, ice or other geological agents, including the detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

18. **Erosive Velocity** means the velocity of water in a stream, channel, canal, ditch, etc., that, when exceeded, will cause erosion of banks or streambed. For the purposes of these requirements, erosive velocity is numerically defined as greater than 2 feet per second over bare ground.

19. **Grade** means: (a) the inclination of slope of a channel, canal, conduit, etc., or natural ground surface, usually expressed in terms of the percentage of number of units of vertical rise (or fall) per unit of horizontal distance; (b) the elevation of the invert of the bottom of a conduit, canal, culvert, sewer, etc.; or (c) the finished surface of a canal bed, road bed, top of an embankment, or bottom of an excavation.
20. **Imperviousness or impervious surface** means a hard surface area (e.g., parking lot or rooftop) that prevents or retards the infiltration of water into the soil, thus causing water to run off the surface in greater quantities and at an increased rate of flow relative to pervious areas.

21. **Infiltration** means: (a) water moving through the interstices or pores of a soil or other porous medium; (b) the quantity of groundwater which leaks into sewers or drain through defective joints; (c) water moving from the ground into a sewer or drain through breaks, defective joints, or porous walls; (d) the absorption of liquid water by the soil, either as it falls as precipitation, or from a stream flowing over the surface; or (e) rainfall that percolates into the ground surface and that, therefore, does not contribute directly to the stormwater runoff flow.

22. **Inlet** means: (a) an opening into a storm sewer system for the entrance of surface stormwater runoff, more completely described as a storm sewer inlet; (b) a structure at the diversion end of a conduit; or (c) the upstream connection between the surface of the ground and a drain or sewer, for the admission of surface or stormwater.

23. **Land Disturbance** means a manmade change in the natural cover or topography of the land, including grading, cutting and filling, building, paving, excavating and any other activities that may result in or contribute to soil erosion or sedimentation in waters or discharge of pollutants, as identified in Section 8.1.4.1 herein.

24. **Land Use Agency** means the municipality, county or other government entity that has land use authority within the Cherry Creek Watershed.

25. **Large Lot Single Family Development** means a land disturbance greater than one acre on a single-family residential lot with an area greater than or equal to two and one-half acres in size and having a total site imperviousness, including, but not limited to roadways, building footprints, and driveways, less than ten percent gross density.


27. **Major Drainage System** means a storm drainage system that carries stormwater runoff from a 100-year storm. A major drainage system will function whether or not it has been planned and designed, and whether or not improvements are situated on it. A major drainage system usually includes many features such as streets, gulches, and major drainage channels. Storm sewer systems may reduce the flow in many parts of a major drainage system by storing and transporting water underground.

28. **New Development or Redevelopment** means any land disturbances that result in an increase in impervious area.

29. **Outfall** means the point or location where stormwater runoff discharges from a storm drainage system to a stream or drainageway.

30. **Overland Runoff** means water flowing over the land surface before it reaches a definite stream channel or body of water.

31. **Owner** means the party or parties holding record fee title to a parcel of real property in the Town of Parker.
32. **Permanent BMPs** means BMPs, either structural or nonstructural, required for New Development, Redevelopment or Land Disturbance activities under Section 8.3 herein. Permanent BMPs generally will remain in place indefinitely.

33. **Permeability** means the property of a material that permits movement of water through it when saturated and actuated by hydrostatic pressure.

34. **Pervious** means the property of a material that permits water to pass through the material.

35. **Precipitation** means any moisture that falls from the atmosphere, including snow, sleet, rain, and hail.


37. **Runoff Event** means stormwater runoff resulting from a rainfall event that totals 0.1 inches or more in precipitation.

38. **Sedimentation** means the process by which solid materials, both inorganic (mineral) and organic, are deposited on the earth’s surface or into waters.

39. **Sediment** means particulate soil material, either inorganic or organic, that is suspended and transported by wind and water or the material deposited as a result of sedimentation.

40. **Storage** means the temporary detention of a portion of stormwater runoff that provides for sediment and debris collection.

41. **Storm Drainage System** means all facilities used for conducting stormwater runoff through and from a drainage area to the point of final outfall, consisting of any or all of the following: conduits and appurtenant features, canals, channels, ditches, streams, gulches, gullies, flumes, culverts, streets, and pumping stations.

42. **Stormwater Runoff** means the part of precipitation that reaches a stream, gulch, dry gulch, drain, etc., directly or indirectly via ground surface.

43. **Town** refers to the Town of Parker.

44. **UDFCD** refers to the Urban Drainage and Flood Control District.

45. **Velocity** means a time rate of change of position.

**1.5 REFERENCES**

References for the major sections of this manual will be listed at the end of each section, in the order of appearance in that section. Although this approach requires some duplication, it allows the reader to access references in a more logical manner than a single list at the end of the document.
2. DRAINAGE POLICY

2.1 PRINCIPLES

When planning drainage facilities, certain underlying principles provide direction. These principles are made operational through a set of policy statements. The application of the policy is in turn facilitated by technical criteria and data. When considered in a comprehensive manner, drainage facilities can be designed in an urban area that will: (1) avoid uneconomic property losses and disruption to lifestyle, (2) enhance the general health and welfare of the region, and (3) optimize economic and social relationships.

2.1.1 Legal Aspects

Stormwater management, through engineering and design, is closely tied to drainage law. It should be noted that basic drainage law in this manual cannot be construed as legal advice. Drainage law is continuously changing and a more concise understanding of its application should come from a qualified attorney.

The MANUAL presents a summary of the legal aspects associated with drainage law in Colorado. Some of the legal principles cited therein underlie the guidance provided in this manual and are summarized below.

2.1.1.1 Civil Law Rule (Modified)

Drainage law in the State of Colorado generally follows the modified civil law rule. The key elements of this rule are:

- A natural easement or servitude is placed upon the lower land for the drainage of surface water in its natural course;
- The natural flow of surface water cannot be obstructed by the servient owner to the detriment of the dominant owner; and
- Waters and natural drainage conditions can be altered by an upper proprietor provided the water is not sent down in a manner or quantity to do more harm than formerly and is consistent with other industry standards.

2.1.1.2 Basin Transfer

Extending from the precepts of the modified civil law rule is the principle that the planning and design of stormwater drainage systems shall not be based on the premise that problems can be transferred from one location to another. Specifically, the diversion of storm runoff from one basin to another introduces significant legal and social problems and should be avoided unless specific and prudent reasons justify and dictate such a transfer.

2.1.1.3 Water Rights

Planning and design of stormwater drainage systems shall avoid interfering with established water rights, including the quantity, quality, value, and use of those existing rights. Facility planning and design shall consider impacts upon water availability to points of diversion, the ability to divert, and to
existing seepage rights. The Office of the State Engineer (Colorado Division of Water Resources) shall be consulted for concerns or questions regarding water right impacts resulting from the construction of stormwater facilities, including infiltration Best Management Practices (BMPs).

2.1.2 Planning

2.1.2.1 Drainage as an Urban Sub-system

Stormwater drainage is an intrinsic sub-system of any urban development. As such, it exerts a competing demand for space in the planning and design of the total urban system and at the smaller scale of a particular site development. Land use planning and site development planning must consider the collection, conveyance, storage, and outfall requirements of required drainage systems at an early stage to avoid conflict with other land uses, to avoid water damages, and to avoid disruption with the functioning of other urban systems. Thus, it is a requirement that drainage studies be conducted and incorporated into the planning for all new development in the Town.

2.1.2.2 Multi-Purpose Resource

Stormwater runoff is both a problem to be managed and an urban resource to be beneficially utilized whenever possible. When treating stormwater runoff as a resource, its use must be compatible with Colorado water law and adjacent land uses. Multi-purpose use of runoff is encouraged in the Town to satisfy the competing demands placed on water within the urban environment. Use of drainage facilities to serve purposes other than drainage and use of other types of facilities for drainage purposes should be explored and incorporated into site planning whenever practical while complying with the criteria presented in this manual.

2.1.2.3 Multi-Jurisdictional and Master Planning

Drainage issues and design considerations are often regional in nature, extending beyond specific jurisdictional boundaries. In recognition of this fact, master drainage planning in the Town of Parker is performed from a basin approach, in cooperation with UDFCD and adjacent land use jurisdictions sharing a common interest in the basin.

Local drainage studies and design shall be consistent with basin master plans and shall include master plan improvements as further discussed in Section 2.4 herein.

2.1.2.4 Public Improvements

The Town requires that all new development and redevelopment shall design and construct required public improvements to include: the "local drainage system" (see Section 2.5 herein); the connection of the local drainage system to the major drainageway; and the major drainageway system within or adjacent to the development as defined by adopted master drainage plans (or "outfall systems plans", see Section 2.4 herein).

2.1.2.5 Runoff Attenuation (Detention Storage)

The Town requires onsite detention for all new development, expansion, and redevelopment in order to attenuate peak runoff to regulated levels as defined elsewhere in these criteria (see Section 7 herein). Exempted from this regulation are individual single family residences and residential developments two acres or less. The Town may waive the requirement for onsite detention and approve the substitution of regional facilities when deemed appropriate by the Town.
2.1.3 Natural Drainage

The term "natural drainage" often refers to the process that creates any drainage system which develops without the aid of man. Such a system usually consists of swales, creeks, gulches and rivers that either define or contribute to the system of major drainageways that carry storm runoff. Since the planning for storm runoff in developing rural and urban areas often requires a structural or other non-natural approach, it is not always practical to preserve purely "natural" drainage. However, the Town of Parker’s drainage policy is one that encourages the use of natural drainageways to the extent possible. For certain drainageways, Town CODE requires that “stream buffer areas” be protected from development and be preserved in their natural state.

2.1.3.1 Stream Protection Standards

Ordinance No. 3.171 was adopted by the Town in June, 2001 establishing Section 13.10.220 – Stream Protection Standards (Standards) in the CODE. The intent of the Standards is to provide for development adjacent to the Town’s streams in a manner that will preserve the multiple functions and quality of the streams and associated riparian areas and wetlands.

The Stream Protection Standards designate a “Stream Buffer” for Cherry Creek and other streams in the Town. Land disturbing activities are prohibited within a Stream Buffer, except as expressly allowed in the Standards. By restricting development activity in Stream Buffers, the Town intends to:

- Preserve and utilize existing natural drainageways for open space and stormwater detention;
- Maintain and provide required access for future maintenance of the Town’s stream channels;
- Protect and preserve wetlands
- Conserve and enhance existing vegetation communities
- Preserve critical wildlife habitats
- Minimize water pollution
- Preserve and enhance the beauty of the landscape

Developers/permittees and engineers working within the Town should ensure that proposed development is in compliance with the latest version of the Standards in the CODE. The Standards address the following topics:

- Guidance for identifying those streams with designated Stream Buffers
- Criteria for delineating Stream Buffer boundaries along a stream
- Permitted land disturbing activities within a Stream Buffer
- Platting restrictions relative to Stream Buffers
- Landowner rights for requesting a preliminary determination of Stream Buffer boundaries
• Minor Modification and Major Modification (Variance) procedures

• Exemptions

The Stream Protection Standards also require compliance with applicable federal wetland laws and regulations for those wetlands falling under the jurisdiction of the federal government and its agencies. The Town will not grant final approval to any development or activity in jurisdictional wetlands until it is documented that all federal approvals and permits have been obtained.

2.1.3.2 Natural Drainage Approach in Stormwater Management Planning

For the purposes of this manual, the term, "natural drainage" is used in a broader sense, referring to any attempt to keep storm runoff in its natural location, reduce its magnitude to historic levels or minimize the use of storm sewers, catch basins and other structures. In some cases, structures such as detention ponds may be necessary to achieve a quasi-natural state of storm runoff downstream. Within the context of the term as defined here, however, this is considered to be a "natural drainage" approach, especially if such facilities are integrated into a development for purposes other than stormwater detention. One of the most compelling reasons for this approach is the potential liability that both public and private entities may experience as a result of altering natural drainage patterns.

Several basic principles summarize a natural approach to the planning, analysis, design and construction of drainage systems. These principles are adopted from reports by Wright-McLaughlin Engineers (1977 and 1978), as well as from the experience of the early authors of these criteria.

• Stormwater management is a space-time allocation problem. It is a fact that a storm runoff event for a given frequency will require a certain amount of space and time. Not providing for a storm runoff event is an invitation to disaster.

• Where possible, streets should be located on high ground with individual lot drainage collecting directly into natural drainage swales. Drainage should be considered from the very beginning of a development plan rather than treating it as a nuisance problem to be solved at a later time. The developer/permittee should work around a drainage plan instead of having his engineer design a drainage plan around preconceived building locations on the site.

• Where possible, natural drainage paths and channels should be left in their natural state. While there may be other reasons for changing their location, proper stormwater management is made easier by preserving natural conditions to the extent possible.

• To the extent that drainage is routed away from its natural path, consideration should be given to greater-than-design storm events. Such events tend to return to the original drainage path, even though facilities have been designed to alter that path.

• Where structural solutions are necessary, channels and swales should normally be designed for slow velocity to the extent that space permits. Exceptions to this rule may be appropriate where specific floodplain encroachment problems exist (requiring a higher velocity), or where slow velocities would result in other problems.

• Storm sewers should be avoided where possible. However, it is recognized that they are often necessary to solve local drainage problems. Diverting gutter flow to swales when street flow criteria are exceeded is one way to avoid storm sewers. Slower drainage flows, as close as
practical to natural drainage paths, will normally reduce expense and liability for both the developer/permittee and the Town of Parker.

- Detention storage, slow-flow channels and other techniques normally used to approximate historic (natural) conditions should be used with expert judgment and caution. Otherwise, these techniques may result in larger peak flows downstream in some cases. This might occur, for example, in a long, narrow basin in which only the lower end is being urbanized.

- Where possible, stormwater management facilities should be combined with other uses. This tends to maximize benefits by turning flood-prone areas into resource opportunities rather than nuisances.

### 2.1.4 Floodplains

The flood hazard areas of the Town of Parker are subject to periodic inundation which can result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief and impairment of the tax base. All of the above, singularly or collectively, could adversely affect the public health, safety and general welfare of the Town. These flood losses could be caused by the cumulative effect of obstructions in areas of special flood hazards which would increase flood heights and velocities. When inadequately anchored, these obstructions could damage downstream properties. Structures that are inadequately flood-proofed, elevated, or otherwise unprotected from flood damage also contribute to the flood loss.

#### 2.1.4.1 Floodplain Regulations

The Town of Parker has adopted floodplain regulations as part of its CODE (see 13.05.010). The Town of Parker policy requires compliance with floodplain regulations along all major drainageways that have floodplain designation and, where necessary, the design and construction of that portion of the major drainageway improvements within the new development area. Any alteration of the floodplain must be authorized by the Town through a floodplain development permit. All the improvements to the major drainageways shall be in accordance with the master plans adopted by the Town and UDFCD including Major Drainageway Outfall System Planning Reports and the requirements presented in this manual.

As stated in the CODE, it is the purpose of the Town’s floodplain regulations to promote the public health, safety and general welfare, and to minimize public and private losses due to flood conditions by provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to critical facilities, public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in areas of special flood hazard;
- Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas;
- Ensure that potential buyers are notified that property is in an area of special flood hazard; and
• Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

As stated in the CODE, in order to accomplish its purposes, the floodplain regulations include methods and provisions for:

• Restricting or prohibiting uses which are dangerous to health, safety and property due to water or erosion hazards, or which result in damaging increases in erosion, flood heights, or velocities.
• Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction.
• Controlling the alteration of natural floodplains, stream channels, and natural protective barriers which help accommodate or channel flood waters.
• Controlling the filling, grading, dredging, and other development which may increase flood damage.
• Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

2.1.4.2 Floodplain Management
Floodplain management is generally defined as a comprehensive program of preventative and corrective measures to reduce losses associated with flooding. Floodplain management measures may include, but are not limited to, land use regulations (including new development and construction policy), construction of flood control projects, flood-proofing, floodplain preservation, acquisition of flood prone properties, education, and implementation of early warning systems.

a) Standard Level of Protection. The standard of practice, as defined by the Federal Emergency Management Agency (FEMA), the Urban Drainage and Flood Control District (UDFCD), the Colorado Water Conservation Board (CWCB), and the Town, requires implementation of floodplain management criteria within the 100-year floodplain. The 100-year floodplain is the land area that will be inundated or flooded, based on the stormwater runoff produced by the 100-year storm event. The 100-year storm event is defined as the rainfall event that has a 1% probability of being equaled or exceeded in any given year. All development in the regulatory floodplain is required to be protected at 2 feet above the 100-year base flood elevation.

b) National Flood Insurance Program. The Town participates in the National Flood Insurance Program which is a federal program enabling property owners to purchase insurance protection against losses from flooding. Participation in the National Flood Insurance Program is based on an agreement between local communities and the federal government, which states that if a community will implement and enforce measures to reduce future flood risks to new construction in Special Flood Hazard Areas or designated floodplains, the federal government will make flood insurance available within the community. The Town, through participation in the program, has agreed to adopt and enforce floodplain development regulations that meet or exceed the minimum outlined in 44 Code of Federal Regulations, Part 60.

1. Colorado Water Conservation Board. The Colorado Water Conservation Board is the State Coordinating Agency of the National Flood Insurance Program. The CWCB has adopted floodplain management regulations that exceed the minimum regulations outlined in 44 Code of Federal Regulations. The Town has also adopted these regulations.
2. **Community Rating System.** The Town participates in the Community Rating System which is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance rates are discounted to reflect the reduced flood risk resulting from the community actions.

c) **Sources and Use of Existing Floodplain Information.** There are numerous resources available that provide floodplain information. The Town’s Floodplain Management Code and Criteria are enforced based on the regulatory floodplain as adopted by FEMA.

1. **FEMA Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study.** The latest adopted FIRMs are considered the official regulatory maps published by FEMA, and therefore must be used when determining limits of the Special Flood Hazard Area, and for complying with the floodplain regulations. The purpose of these maps is to identify flood prone areas, by approximate or more detailed methods, and to establish flood risk zones for insurance rate purposes. Special Flood Hazard Area designations that were developed by approximate methods (Zone A) are generally less accurate and Base Flood Elevations are not provided. For drainageways that have a detailed study, Base Flood Elevations are provided on the maps and information is available in the Flood Insurance Study regarding floodplain and floodway widths, drainage areas, and peak discharges at select locations. FIRMs and Flood Insurance Studies are available for review at the Town of Parker Public Works Department. Maps can also be acquired through the FEMA Region 8 Office in Denver, or on-line at www.fema.gov.

2. **UDFCD Flood Hazard Area Delineation Studies.** UDFCD’s Flood Hazard Area Delineation studies and maps are prepared by UDFCD and participating local governments. Flood Hazard Area Delineation studies provide relatively accurate representations of floodplain limits. In many cases, Flood Hazard Area Delineation Studies have been used as the basis for updating the FIRMs.

3. **Other Floodplain Information.** Floodplain data may be obtained from other sources, including the Colorado Water Conservation Board, special districts that have completed floodplain studies and mapping for their respective districts, County or other local government initiated studies, and studies that have been prepared by private property owners or developers.

2.1.4.3 **Policy**

a) **Development.** The Town’s floodplain regulations limit development in the floodplain.

All new planned developments, subdivisions, site plans and building permits for new buildings shall preclude any development within a designated one-hundred year floodplain, with the exception of necessary roads, utilities, trails and other facilities found to be acceptable to the Planning Commission and the Town Council. . . . (13.05.010(e)(1)b.1)

The term “development” is defined in the regulations to mean:

Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations located within the area of special flood hazard (13.05.010(b))

Floodplain Development Permit:
A floodplain development permit shall be obtained before construction or development begins within any area of special flood hazard. . . . (13.05.010(d)(1)(a))

Floodplain Development Permit forms may be obtained at the Town of Parker Public Works Department or on-line at www.parkeronline.org. Specific requirements can be found in the CODE (13.05.010(d).

b) Plan Requirements. All annexation/rezoning plans, development plans, sketch plans, preliminary plans, final plats, site plans, and drainage plans shall identify and show the limits of all regulatory floodplains adopted by the Town and approved by FEMA. Other types of floodplain delineation may also be important and should be evaluated. For instance, regulatory base flood elevations, when mapped against project topographic mapping may delineate a floodplain which differs substantially from the regulatory floodplain. UDFCD planning studies may also show different floodplain limits based upon developed land use conditions. All significant deviations or conflicts between floodplains should be identified and discussed in the accompanying drainage report. The Town’s floodplain administrator will make the final determination of floodplain limits relative to the proposed development.

Subdivision applications that include portions of major drainageways for which base flood elevations have not been previously determined shall provide accurate base flood elevations and floodplain delineation in order that the Town’s floodplain regulations be properly administered.

c) FIRM Revisions. When floodplain alterations are approved by the Town, the developer/permittee shall be responsible for preparing map revision requests to FEMA. The Town of Parker requires FEMA approval when floodplain modifications are required. All required information should be prepared in accordance with FEMA’s criteria and shall be submitted to the Town for review and approval prior to submission to FEMA. The Town will request Colorado Water Conservation Board and/or UDFCD review of the map revision request when deemed appropriate by the Town. The developer/permittee shall first apply for a Conditional Letter of Map Revision from FEMA, prior to the start of any activities that will result in the alteration of the floodplain. Once the proposed modifications are complete, then the developer/permittee must apply for the final Letter of Map Revision from FEMA. No sales, permits or certificates of occupancy for any properties in the regulated floodplain will be allowed until the final Letter of Map Revision is issued, without approval of the Public Works Department.

d) Floodplain Dedication. Portions of the Cherry Creek floodplain that are included in an area to be platted shall be dedicated to the Town as open space. Floodplain areas for all other major drainageways should be dedicated as open space tracts, or, at a minimum, shall be covered by a drainage easement.

2.1.5 Environmental Protection (Stormwater Quality)

Nonpoint source pollution has become recognized as being one of the major contributors of pollution to Colorado's streams and reservoirs. Section 8 herein presents environmental criteria that have been developed to significantly reduce the impact of nonpoint source pollution through stormwater quality management. The criteria and procedures of Section 8 herein address the requirements of two major environmental policies that regulate stormwater quality management in the Town.
2.1.5.1 Stormwater Quality Regulation (Phase II) under the Clean Water Act

Due to its population and its location within the Denver urban area, the Town of Parker falls under the permitting requirements of the Phase II Stormwater Program of the Clean Water Act. The Phase II regulations were promulgated in 1999 with the intent of reducing the amount of pollutants entering streams, lakes, and rivers as a result of runoff from residential, commercial, and industrial areas. In Colorado, stormwater discharge permits are issued under the Colorado Discharge Permit System (CDPS), administered by the Water Quality Control Division of the Colorado Department of Public Health and Environment. The Town of Parker’s municipal separate stormwater system (MS4) is authorized under a CDPS general permit.

As a requirement of the Phase II general permit, the Town has developed and administers programs that meet the requirements of six stormwater management programs, or minimum measures. These six minimum measures are:

1. Public education and outreach
2. Public participation/involvement
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management
6. Pollution prevention/good housekeeping for municipal operations

The most important of the minimum measures, as they pertain to new development within the Town, are: construction site stormwater runoff control and post-construction stormwater management. The environmental criteria presented in Section 8 herein present the regulations and procedures that shall be followed to comply with these two minimum measures.

It is anticipated that the EPA will implement a new “Phase” to the Stormwater Program that will include additional performance standards for discharge from new construction and redevelopment projects. These new standards are reported to promote practices which mimic natural processes including infiltration and evapotranspiration. Additional information regarding these modifications to the Stormwater Program requirements will be provided by the Town as it becomes available.

2.1.5.2 Cherry Creek Reservoir Control Regulations

Due to its location within the Cherry Creek Reservoir watershed, the Town is particularly sensitive to preserving water quality in the Basin and Reservoir. In addition to the requirements set forth in the Town’s CDPHE Phase II permit, the Town is required to implement water quality controls as adopted by the Cherry Creek Basin Water Quality Authority pursuant to the Authority’s responsibility for implementing the Cherry Creek Control Regulation, 5 C.C.R. 1002-72. The Basin Authority has developed a guidance document entitled Control Regulation 5 CCR 1002-72 Stormwater Permit Guidance Document which summarizes the additional requirements for construction stormwater runoff control and post-construction stormwater management for all new development and redevelopment as required by the Cherry Creek Control Regulation. It is recommended that this Guidance Document be reviewed prior to designing stormwater facilities within the Town.

The environmental criteria provided in Section 8 incorporate construction stormwater runoff control and post-construction water quality requirements as established by the Cherry Creek Control Regulation.
2.1.6 Operations and Maintenance

An important part of all storm drainage facilities is the continued maintenance of the facilities to ensure they will function as designed. For example, maintenance of detention facilities may include removal of debris and sediment. Such tasks are necessary to preclude the facility from becoming unhealthy (from stagnant water) and to retain the effectiveness of the detention basin. Sediment and debris must also be periodically removed from channels and storm sewers. Trash racks and street inlets must be regularly cleared of debris to maintain system capacity. Channel bank erosion, damage to drop structures, crushing of pipe inlets and outfalls, and damage to the facilities must be repaired to avoid reduced conveyance capability, unsightliness and ultimate failure.

As described in Section 3 herein, the Town of Parker has established a Stormwater Management Utility to operate, maintain, and repair stormwater facilities accepted into the Utility as public facilities. This may include eligible facilities located on private property and covered by drainage easements dedicated to the Town. Operations and maintenance of stormwater facilities accepted by the Utility will be provided by the Utility, limited to the extent that funds are available for this purpose through the Stormwater Utility Fee. Ultimate responsibility for operations and maintenance of these facilities shall remain with the property owner.

Property owners will continue to be responsible for operating and maintaining stormwater facilities not eligible for Utility acceptance. For these facilities, Town policy requires that legal and physical access still be provided to assure continuous operational capability of the system. The Town of Parker will not, however, accept ownership of private drainage facilities. When appropriate, drainage features outside of the public right-of-way must be in a HOA or Metropolitan District tract, and a drainage easement, dedicated to the Town, must cover the entire tract. The Town will review design and construction of these features. The drainage report must address annual maintenance cost and inspection needs.

The developer/permittee must establish requirements to develop HOA articles of incorporation that outline HOA responsibilities for maintaining open space areas and private drainage facilities, and that provides for funding to meet those responsibilities. The property owner, developer/permittee, or HOA shall be solely responsible for the maintenance of all drainage facilities including inlets, pipes, culverts, channels, ditches and detention basins located on privately held land and that are not accepted into the Utility unless modified by the development agreement. Should the owner (or developer/permittee) fail to adequately maintain said facilities, the Town of Parker has the right to enter said land for the purposes of operations and maintenance and all such maintenance costs will be refunded to the Town of Parker by the property owner or developer/permittee. The Town of Parker reserves the right to conduct inspections and report the findings to the Public Works and HOA.

2.2 PLANNING SUBMITTAL PROCEDURES

Development in the Town of Parker is authorized through the subdivision and/or site plan process as defined in the CODE. Subdivision for typical single-family residential development involves three steps: sketch plan, preliminary plan, and final plat. For single-family subdivisions of four or fewer lots and for qualifying non-residential and multi-family developments, a one-step process known as the minor development plat, is available. The site plan process is utilized for planning review and approval of structures and buildings associated with all non-single family residential uses. The CODE provides specific information and instruction regarding submittal procedures for development within the Town.
All subdivision, re-subdivision, site plan, and amended site plan applications within the jurisdiction of the Town of Parker shall provide for the planning and construction of adequate drainage facilities that comply with the criteria presented in this manual. Drainage planning and design is presented to the Town for review and approval through submission of drainage reports and construction plans/specifications. Table 2.1 lists the drainage submittal requirements for the various planning steps of the subdivision and site plan process.

See the Roadway Manual for comprehensive checklists detailing plan submittal requirements, ROW permit requirements, roadway improvements and traffic improvements.

**TABLE 2.1**

**PARKER PLANNING PROCESS REQUIREMENTS FOR DRAINAGE SUBMITTALS**

<table>
<thead>
<tr>
<th>Planning Step</th>
<th>Report</th>
<th>Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBDIVISION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sketch Plan</td>
<td>Conceptual Drainage Report</td>
<td>Existing Condition Plan</td>
</tr>
<tr>
<td></td>
<td>Geologic Hazard Report</td>
<td>Preliminary Grading Plan</td>
</tr>
<tr>
<td>Preliminary Plan</td>
<td>Preliminary Drainage Report</td>
<td>Preliminary Grading Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preliminary CBMP Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preliminary Utility Plan</td>
</tr>
<tr>
<td>Final Plat</td>
<td>Final Drainage Report</td>
<td>Drainage Construction Plans</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (public improvements)</td>
<td>Grading Plan</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (Erosion Control)</td>
<td>CBMP Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utility Plan</td>
</tr>
<tr>
<td>Minor Development Plat</td>
<td>Final Drainage Report</td>
<td>Drainage Construction Plans</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (public improvements)</td>
<td>Grading Plan</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (Erosion Control)</td>
<td>CBMP Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utility Plan</td>
</tr>
<tr>
<td><strong>SITE PLAN</strong></td>
<td>Final Drainage Report</td>
<td>Drainage Construction Plans</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (public improvements)</td>
<td>Grading Plan</td>
</tr>
<tr>
<td></td>
<td>Cost Estimate (Erosion Control)</td>
<td>CBMP Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utility Plan</td>
</tr>
<tr>
<td><strong>ANNEXATION/REZONING</strong></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>USE BY SPECIAL REVIEW</strong></td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

1. Reports and plans required if significant additions or modifications to previously approved drainage design from subdivision are proposed.
2. Plan exhibits shall show natural and man-made water courses, retention/detention areas, streams, lakes, and 100-year floodplains.
3. Relevant drainage features and issues should be presented and discussed as needed.
4. To be secured with a Grading Permit. See Section 2.3.2 herein.

**ADDITIONAL NOTES:**
- See Section 4 herein for detailed description of requirements for the reports and plans listed above.
- See the Roadway Manual for complete submittal requirements, including roadway and traffic improvements.
- See Appendix A for drainage report checklists.
2.3 CONSTRUCTION SUBMITTAL PROCEDURES

The procedures, requirements, and responsibilities for constructing public improvements in the Town of Parker are presented in the Town’s Roadway Manual. These provisions also apply to all drainage improvements to be constructed within the jurisdiction of the Town that are to be classified as “public facilities” for purposes of acceptance into the Town’s Stormwater Management Utility. “Public facilities” and the Stormwater Management Utility are further discussed in Section 3 herein.

The following sub-sections discuss some particular provisions of the Roadway Manual, as they pertain to construction of drainage improvements.

2.3.1 Security

The CODE (13.07.120) requires financial guarantee (“security”) in the form of an irrevocable letter of credit or cash arrangement in the amount of 110% of the total construction cost of the public improvements. See the Roadway Manual for detailed information regarding security requirements. With respect to drainage and water quality facilities, the term “public improvements” shall be meant to include all public facilities for which acceptance into the Stormwater Utility is intended, whether those public facilities lie within the public right-of-way or within a drainage easement on private property. Security will be required for all drainage improvements classified as public facilities.

2.3.2 Grading Permit

Chapter 11.10 of the CODE regulates grading and earth movement activities in the Town of Parker in order to minimize soil erosion and movement of sediment and to protect water quality during and after construction. A grading permit, issued by the Public Works Department, is required prior to commencing grading and earth movement activities in the Town.

2.3.2.1 Grading Permit Requirements

The requirements for obtaining a Grading Permit include the following:

1. A completed Grading/Excavation Permit application (Must include original ink signatures).

2. A certificate of insurance listing the “Property Owner” or “General Contractor” as the insured. The Town of Parker must be listed as the “Certificate Holder” and “Additionally Insured” and the policy must meet the monetary requirements on the attached page. Please ensure that the policy expiration date is appropriate.

3. Submit Lot addresses with acreage. (Lot Permits only)

4. A full size (24” x 36”), CAD drawing, disturbance area plan that clearly shows all areas of proposed soil disturbance. A bolded line must be used to delineate all areas of proposed soil disturbance. The total acreage must be accurately computed and clearly stated. The plan must show all areas of soil disturbance including: areas of proposed grading, off-site areas such as proposed underground infrastructure alignments, vehicle access points, construction easements, etc.

5. Projects which are 40 acres or greater in size will require a Town approved phasing plan.

6. A disclosure statement of borrow or waste sites to be utilized, import and/or export volumes and proposed haul routes within the Town limits.
7. One (1) copy of the State of Colorado Storm Water Discharge Permit for Construction Activities (part of the Colorado Discharge Permit System). This Permit is required for any construction activity that disturbs at least 1 acre or more of land (or is part of a larger common plan of development or site that will disturb at least 1 acre). Contact the Colorado Department of Public Health and Environment, Water Quality Control Division at (303) 692-3500 or http://www.colorado.gov/cs/Satellite/CDPHE-WQ/CBON/1251596875260 for additional information.

8. Projects located in a drainageway or wetland area will require a 404 permit issued by the U.S. Army Corps of Engineers. Any projects located in a floodplain will require a Town of Parker Floodplain Permit.

9. Grading Permit base fee (see Grading Permit).

10. Grading and BMP securities (see Grading Permit). The Town of Parker will only accept a letter of credit (LOC) from a bank or cash.

Please see the Town of Parker Roadway Criteria Manual for more information.

2.3.2.2 CBMP Cost Estimate

BMP Cost Estimates shall be prepared using the Town’s Cost Opinion Spreadsheet. This spreadsheet can be found in Appendix E herein.

2.3.2.3 Exemptions

Grading and earth movement activities that are exempt from the requirement for a grading permit are listed in Section 8.1.4.2 herein.

2.3.3 Approval and Acceptance

All stormwater facilities identified as public facilities, as described above, are subject to the public improvement approval, probationary acceptance, and final acceptance requirements presented in the Roadway Manual.

As constructed plans (i.e., As Builts) for all public facilities shall be attested to by a Registered Professional Engineer licensed to practice in the state of Colorado and submitted to the Town prior to probationary acceptance. A pond certification must be completed for all detention basins and certifies the 100-year volume, excess urban runoff volume, spillway elevations and dimensions, and size and elevations of outlet structures. This pond certification form can be found in the Roadway Manual and must be completed in order to receive acceptance of the pond.

The format of electronic and “as-built” deliverables shall be prepared in accordance with the Roadway Manual. The construction drawings that have been approved with the building and/or grading permit are acceptable if they remain the same after construction and are attested to by a Registered Engineer to represent “As Built” conditions. See the Chapter 11 of Roadway Manual for Record Drawing requirements.
2.4 MAJOR DRAINAGE BASINS AND MAJOR DRAINAGEWAYS

2.4.1 Overview

The Town of Parker lies entirely within the Cherry Creek watershed. Nine major drainage basins have been defined in the Town, with each major basin having one or more major drainageways that outfall directly to Cherry Creek or to another major drainageway within the basin. Many of the major drainageways in the Parker planning area have identified regulatory floodplains and floodways as presented in the Town of Parker Flood Insurance Study (FIS) and as represented on the Parker Flood Insurance Rate Maps (FIRMs). Additionally, many of the major drainageways have been master planned through cooperative efforts with the UDFCD. Table 2.2 presents a listing of the major drainage basins and the more significant drainageways that lie within each basin. The table identifies whether a regulatory floodplain has been delineated for each drainageway and whether base flood elevations have been determined. The table also indicates whether a Flood Hazard Area Delineation Study (FHAD) and an Outfall Systems Planning Study (OSP) has been completed, or is in progress, for each drainageway. The references at the end of this section list the relevant documents upon which the table is based.

2.4.2 Major Drainageways

For purposes of this subsection, the term “major drainageway” is specifically defined to mean any flow path with a tributary area of 130 acres or more, or any drainageway of less than 130 acres that has been identified in a UDFCD master plan. This definition is purposely defined to coincide with UDFCD’s criteria for major drainageways that are the focus of UDFCD’s master planning studies and which are generally considered eligible for inclusion into UDFCD’s Maintenance Program.

2.4.2.1 Master Plan Improvements

The Town of Parker policy requires the design and construction of that portion of the major drainageway improvements within new development areas. All the improvements to the major drainageways shall be in accordance with UDFCD’s Major Drainageway Outfall System Planning Studies. In certain instances, the Town may consider it beneficial to defer construction of all, or a portion of, the master plan improvements due to timing issues and coordination with other related projects, or because the planned improvements would unnecessarily disturb a stable drainageway in advance of anticipated impacts from future development. When it is determined that master plan improvements to major drainageways will not be constructed as part of the adjacent development, the Town will require the developer/permittee to submit payment in lieu to the Utility in the amount of the estimated cost to construct the drainageway improvements as set forth in the master plan document. Such estimated costs are subject to review and revision by the Town, if warranted, and shall be adjusted for cost escalation as may have occurred since publication of the master plan. The Utility will then assume responsibility for constructing those improvements when conditions warrant and in accordance with the capital improvement program established by the Utility.
### TABLE 2.2

**TOWN OF PARKER DRAINAGE BASINS AND MAJOR DRAINAGEWAYS**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Major Drainageway</th>
<th>FIRM Floodplain Zone A</th>
<th>FIRM Floodplain Zone AE</th>
<th>FHAD Study</th>
<th>OSP Study</th>
<th>MDP Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonwood</td>
<td>Cherry Creek</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Apache Plume</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Compark South</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cottonwood</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sierra Vista</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Valley High</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Baldwin Gulch</td>
<td>Baldwin Gulch</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>See Note 7</td>
</tr>
<tr>
<td>Lemon Gulch</td>
<td>Lemon Gulch</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>4600-09</td>
<td>Cherry Creek</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hot Springs Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Unnamed Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Long's Way Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mostenbocker Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Newlin Gulch</td>
<td>Newlin Gulch</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>See Note 7</td>
</tr>
<tr>
<td>Upper Jordan Road Tributary</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Lower Jordan Road Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sulphur Gulch</td>
<td>Sulphur Gulch</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Pine Gulch</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mainstreet North Trib. (Hope Gulch)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sara Gulch</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Pine Gulch</td>
<td>Pine Gulch</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Tallman Gulch</td>
<td>Tallman Gulch</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>East Tallman Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cherry Creek East</td>
<td>Cherry Creek</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Drainageway 'A'</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Drainageway 'B'</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Kinney Creek</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cherry Creek West</td>
<td>Cherry Creek</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unnamed Tributary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>KOA Tributary</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Oak Gulch</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Drainageway 'C'</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Drainageway 'D'</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Happy Canyon Creek</td>
<td>Happy Canyon Creek</td>
<td>-</td>
<td>X</td>
<td>See Note 7</td>
<td>-</td>
<td>See Note 7</td>
</tr>
<tr>
<td>Green Acres Tributary</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. Floodplain information as of May 1, 2005. Some studies may still be in progress.
2. Zone A indicates floodplain determined by approximate methods, no base flood elevations.
3. Zone AE indicates base flood elevations have been determined through detailed analysis.
4. FHAD = Flood Hazard Area Delineation.
5. OSP = Outfall Systems Plan.
6. MDP = Major Drainageway Planning.
7. Baldwin Gulch, Newlin Gulch and Happy Canyon Creek are the subject of MDP Studies to be conducted by UDFCD in 2013 and 2014.
8. See the UDFCD website ([www.udfcd.org](http://www.udfcd.org)) for basin locations.
2.4.2.2 UDFCD Maintenance Program

The Town of Parker policy requires that all major drainage facilities located outside of street rights-of-way be eligible for UDFCD’s maintenance program as a pre-condition to approval. UDFCD has established policies regarding the eligibility for maintenance assistance of flood control facilities constructed by, or approved for construction by, local public bodies. Those policies include the following:

- The design of the facility must be in accordance with UDFCD’s Urban Storm Drainage Criteria Manual;
- The design of the facility must be approved by UDFCD;
- A certification acceptable to UDFCD must be provided which certifies that construction of the completed facility has been accomplished in accordance with the approved design; and
- Satisfactory maintenance access and public access easements or rights-of-way must be provided in order to adequately maintain the facility.

Further guidance is provided in the most recent version of UDFCD’s document “Maintenance Eligibility Program Guidelines for Flood Control Facilities Constructed by Others.” UDFCD requires that requests for review and submittals come directly from the Town. Developers/permittees are required to provide the Town a separate copy of development plans and drainage reports to be forwarded to UDFCD for that purpose.

2.5 LOCAL DRAINAGE SYSTEMS

The local drainage system consists of curb and gutter, inlets and storm sewers, culverts, bridges, swales, ditches, channels, detention areas and other drainage facilities to convey the initial and major storm runoff to major drainageways. The recurrence intervals to be used in designing for the initial and major storm runoff event for all land uses in the Town are provided in Table 2.3.

### TABLE 2.3

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Initial Storm</th>
<th>Major Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Open Space/Agricultural</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>School</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Commercial/Business/Industrial</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Arterial Roadways</td>
<td>5</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: The Arterial Roadway initial storm designation is 5-year, regardless of the adjacent land use.

The Town of Parker’s policy requires all new development to include the planning and construction of the local drainage system within the development and all required connections of the local drainage system to the major drainageway in accordance with requirements presented in this manual. The local drainage system should be capable of conveying the initial storm runoff with minimum disruption to the...
urban environment and the major storm runoff with minimum threat to health and life hazards, damage to structures, and interruption to traffic and services.

### 2.5.1 Streets

Streets are an integral part of the urban drainage system and may be used for transporting storm runoff up to design limits. The design engineer should recognize that the primary purpose of streets is for traffic. Therefore, use of streets for storm runoff must be limited.

Although street criteria are formulated to allow certain drainage, streets should not routinely be considered as major drainageways. The Town of Parker prohibits the practice of discharging offsite culverts and other non-local drainage outfalls onto streets. Storm drains should not outfall onto streets, but should be piped to suitable outfalls in a swale, channel, or detention basin. Street criteria should be applied to storm runoff flows emanating from building lots and other streets rather than discharges from major offsite drainageways flowing into streets.

Town of Parker criteria for allowable uses and depth of flow for initial and major storm runoff events is presented in Tables 2.4 through 2.7.

**TABLE 2.4**

**ALLOWABLE USE OF STREETS FOR INITIAL STORM RUNOFF**

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Maximum Theoretical Encroachment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>No curb overtopping. Flow may spread to crown of street.</td>
</tr>
<tr>
<td>Collector</td>
<td>No curb overtopping. Flow spread must leave at least a 10 foot width free of water. (5-feet on each side of crown for roads without median. 10-feet on each side of median for roads with a median.)</td>
</tr>
<tr>
<td>Arterial</td>
<td>No curb overtopping. Flow spread must leave at least two lanes free of water, one 10 foot lane each direction, excluding auxiliary lanes.</td>
</tr>
</tbody>
</table>

Note: Where no curbing exists, encroachment should not extend past the street right-of-way. The maximum allowable street flow shall be the product of the flow calculated at "maximum theoretical street encroachment" and required reduction factor. See Section 6.3 herein.

**TABLE 2.5**

**ALLOWABLE USE OF STREETS FOR MAJOR STORM RUNOFF**

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Maximum Theoretical Encroachment and Required Freeboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local and Collector</td>
<td>The depth of water at the gutter flowline shall not exceed 12 inches. A minimum of 18-inches must be provided from the water surface elevation to the lowest floor elevation or window well opening elevation for structures that are adjacent to the roadway (this includes residential dwellings, public, commercial and industrial buildings).</td>
</tr>
<tr>
<td>Arterial</td>
<td>The depth of water shall not exceed six inches at the street crown or 12 inches at the gutter flowline, whichever is more restrictive. A minimum of 18-inches must be provided from the water surface elevation to the lowest floor elevation or window well opening elevation for structures that are adjacent to the roadway (this includes residential dwellings, public, commercial and industrial buildings).</td>
</tr>
</tbody>
</table>

Note: The maximum allowable street flow should be the product of the flow calculated at the "maximum theoretical depth" and the required reduction factor. See Section 6.3 herein.
TABLE 2.6
ALLOWABLE ROAD AND CROSS STREET FLOW

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Initial Storm Runoff</th>
<th>Major Storm Runoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Six inches depth at cross pan or gutter flowline</td>
<td>12 inches depth at gutter flowline</td>
</tr>
<tr>
<td>Collector</td>
<td>Six inches depth at cross pan or gutter flowline</td>
<td>12 inches depth at gutter flowline</td>
</tr>
<tr>
<td>Arterial</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Note: Cross street flow can occur when surface runoff from adjacent streets and/or offsite basins exceeds the capacity of the roadway and travels over the roadway crown (i.e. at an intersection). See Table 2.7 and Section 6.4 herein for street overtopping criteria for culvert crossings. The use of transverse crosspans will not be allowed.

TABLE 2.7
ALLOWABLE ROADWAY OVERTOPPING AT BRIDGES AND CULVERTS ALONG MINOR DRAINAGEWAYS

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>10-Year Storm</th>
<th>100-Year Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>No Overtopping Allowed</td>
<td>Overtopping at crown governed by maximum allowable depth at gutter flowline (see Table 2.6).</td>
</tr>
<tr>
<td>Collector</td>
<td>No Overtopping Allowed</td>
<td>Overtopping at crown governed by maximum allowable depth at gutter flowline (see Table 2.6).</td>
</tr>
<tr>
<td>Arterial</td>
<td>No Overtopping Allowed</td>
<td>No Overtopping Allowed.</td>
</tr>
</tbody>
</table>

Note: No overtopping is allowed for Major Drainageways in the 10- or 100-year storm events.

2.6 EASEMENTS

Drainage easements granting the Town legal access to all stormwater facilities located outside the public right-of-way is a requirement to ensure proper construction and maintenance. Easements should be dedicated by plat during the subdivision process. The Town’s standard dedication statement (see CODE Chapter 13.07.13) includes language dedicating drainage easements. When drainage facilities are to be constructed within tracts covered by a blanket easement, a plat note should be added specifically identifying those tracts as being covered by drainage easements. Easements by separate document may be necessary when drainage facilities are proposed to be constructed on previously platted parcels.

Drainage easements in residential subdivisions shall only be approved when those easements lie within a tract. Drainage easements through platted residential lots will not be permitted.

2.6.1 Storm Sewers

The minimum acceptable easement widths for storm sewers can be found in Table 2.8 below. The required easements widths are necessary to ensure adequate space is provided for the construction and maintenance of the storm sewer facilities. In situations where multiple utilities (water, sanitary sewer, storm sewer, etc.) will be located within the same easement, a minimum 50-foot wide easement is required as noted in Table 2.8 below.
TABLE 2.8
REQUIRED OPERATIONS AND MAINTENANCE EASEMENT FOR STORM SEWERS

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Easement Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 36” diameter</td>
<td>25 feet</td>
</tr>
<tr>
<td>Equal to or greater than 36” diameter</td>
<td>30 feet</td>
</tr>
<tr>
<td>Easement Used by Multiple Utilities (water, sanitary sewer, storm sewer, etc.), “Multi-Use Easement”</td>
<td>50 feet</td>
</tr>
</tbody>
</table>

Note: Easement width may need to be increased in order to meet Occupational Safety and Health Administration (OSHA) and/or construction requirements

The easement widths provided in the above table assume a shallow depth pipe. For pipes that are installed at greater depths, additional easement may be required in order to be constructed in accordance with Occupational Safety and Health Administration (OSHA) requirements and to provide adequate room for future repair or replacement. Pipes shall be constructed at one-third of the easement width to provide adequate room for stockpiling of material on one side of the construction trench.

Impact to adjacent structures shall be taken into consideration when determining required easement width. It shall be verified that the structural integrity of any adjacent structures (located outside of the easement) will not be impacted by future excavations for pipe maintenance or repair.

Storm sewer easements shall be designed to allow access for inspection and maintenance to the storm sewer as well as convey the 100-year storm water flows in the event that the storm sewer structures become clogged. A minimum of 2-feet of freeboard must be provided from the 100-year water surface elevation to the lowest point of entry elevation of any adjacent structures. Of the required 2-feet of freeboard, 1-foot is required from the 100-year water surface elevation to the easement line. The remaining 1-foot of freeboard can be achieved across the adjacent property. Surface treatment for storm sewer easements shall be limited to grass or minor landscaping (i.e. rock and small shrubs) as approved by the Town. Any landscaping or other surface improvements must be designed and installed as to minimize erosion, blockage and damage as a result of surface overflows being conveyed through the easement. Improvements that shall not be located within an easement include structures, retaining walls, permanent fences, trees or any other item that would be costly to replace as determined by the Town. Adequate vehicle access to all manhole structures, storm sewer outfalls and other appurtenances must be provided via easements or from the public right-of-way. The Town reserves the right to require additional easement for access as necessary to inspect and maintain storm sewer structures.

For privately owned and maintained storm sewer systems, excluding landscaping and roof drains, a drainage easement shall be dedicated to the Town as part of the associated development site plan or plat. Drainage easements for private storm sewer systems are necessary in the event the property owner fails to adequately maintain the system, which in turn impacts public property and/or adjacent private property. In these situations, the drainage easement allows the Town to perform the necessary maintenance on the drainage facility and to mitigate any defects or maintenance deficiencies. The costs associated with these maintenance activities shall be the responsibility of the property owner, as described in the Town’s standard dedication language for plats, or standard drainage easement agreement form when dedicated by separate document.
For privately owned storm sewer systems, all trees and structures shall be located outside of the drainage easement. Certain structures and trees, with prior approval by the Public Works Department, can be located within the drainage easements. However, in no case shall trees and/or structures be located within seven (7) feet of the edge of a drainage structure or storm pipe.

2.6.2 Culverts and Bridges

Typically culvert and bridges are constructed within public right-of-way. Additional easements or right-of-way may be required in order to complete construction and/or future maintenance of the structure. Inspection and maintenance shall be considered during the structure design and appropriate measures must be taken in order to facilitate maintenance (i.e. access bench) if necessary. Adequate easements shall be provided to allow for inspection and maintenance of erosion protection both upstream and downstream of the structure.

2.6.3 Open Channels

All proposed construction located adjacent to a stream or waterway in the Town of Parker is subject to the Town’s Stream Preservation Ordinance (see CODE Chapter 13.10.220). Easement requirements for open channels located within a Stream Preservation Zone are summarized in Table 2.9 below.

<table>
<thead>
<tr>
<th>Open Channel Flowrate</th>
<th>Easement Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q100 less than 20 cfs</td>
<td>30 feet</td>
</tr>
<tr>
<td>Q100 more than 20 cfs</td>
<td>The greater of the Stream Buffer (see CODE) or the 100-year water surface + required freeboard + maintenance/access trail</td>
</tr>
</tbody>
</table>

For those channels not located within the Town’s Stream Buffer Zone, required easement widths shall be determined based upon several factors including: design flowrate, required freeboard, and access for maintenance. As a guideline for determining appropriate easement widths along natural channels not located within the Town’s Stream Buffer Zone, the following relationship was developed:

\[
\text{Minimum Easement Width (ft) = 0.06*Q}_{100} + 60
\]

where \( Q_{100} \) = 100-year discharge in cfs

This formula for easement width was developed to provide adequate width if the channel is to be completely reconstructed according to design criteria for natural and grass channels. This formula is presented in graphical form in Figure 2.1. For 100-year flowrates less than 20 cfs, the easement width shall be 30 feet. For 100-year flowrates greater than 2000 cfs, the required easement width can be determined by applying the equation above. Proposed easement widths less than indicated in Figure 2.1 will be subject to approval by the Town.
2.6.4 Detention Storage Facilities
Easements for detention storage facilities shall be provided to allow access to the detention facility for inspection and maintenance operations. The minimum easement requirement for detention storage facilities must include adequate storage and water quality capture volume plus freeboard, all associated facilities including outlet structures and perimeter access (as defined in Section 7 herein). If the detention storage facility is not adjacent to public right-of-way then access to the facility must be provided with an easement.

2.6.5 Infiltration BMPs
Easements for infiltration BMPs shall be provided to allow access to the facility for inspection and maintenance operations. The minimum easement requirement for infiltration BMP facilities must include the entire BMP and all associated facilities including outlet structures and perimeter access (as defined in Section 8 herein). If the infiltration BMP is not adjacent to public right-of-way then access to the facility must be provided with an easement.

2.7 USE OF TOWN PROPERTY FOR PRIVATE DRAINAGE FACILITIES
Stormwater facilities to be constructed for purposes of collecting, conveying or detaining runoff from development on private property shall not be placed upon land owned by the Town of Parker, unless specifically permitted by the Planning Director and Public Works Director.

2.8 STATE AND FEDERAL REGULATIONS AND PERMITS
Development in the Town of Parker is required to comply with all state and federal regulations, including but not limited to, those regulations pertaining to wetlands, waters of the U.S., threatened
and endangered species, floodplain encroachment, and construction activities. Identification of state and federal regulatory issues, reporting requirements, and obtaining the required permits are the sole responsibility of the developer/permittee. The final plat shall include an acknowledgement that subdivision approval by the Town does not obviate the property owner’s responsibilities under the Endangered Species Act (see CODE Chapter 13.07.103).

Copies of all applicable state and federal permits, including application for those permits, shall be submitted to the Town prior to final approval of any development. Copies of state construction activity permits can be submitted with the grading permit application.

2.9 VARIANCES

Consideration shall be given for variances from the design standards in appropriate cases. It is the sole responsibility of the developer/permittee to request variances from these criteria in writing, and provide supporting documentation. The variance process shall be in accordance with the procedures described in the Town’s Roadway Manual.

2.10 REFERENCES

3. Urban Drainage and Flood Control District, November 2010 (with revisions), Urban Storm Drainage Criteria Manual Volume 3
4. Urban Drainage and Flood Control District, June 2001 (with revisions), Urban Storm Drainage Criteria Manual Volumes 1 and 2
9. Urban Drainage and Flood Control District, March 2006, Maintenance Eligibility Program Guidelines for Flood Control Facilities Constructed by Others
10. Colorado Department of Public Health and Environment, amended December 2011, Colorado Discharge Permit System Regulations, Water Quality Control Commission Regulation No. 61, Colorado Discharge Permit System
11. Colorado Department of Public Health and Environment, amended October 2012, Colorado Discharge Permit System Regulations, Water Quality Control Commission Regulation No. 72, Cherry Creek Reservoir Control Regulation
12. Colorado Department of Public Health and Environment, October 2001, Colorado’s Phase II Municipal Guidance, Water Quality Control Division

13. Cherry Creek Basin Water Quality Authority, Cherry Creek Reservoir Watershed, April 11, 2011, Control Regulation 5 CCR 1002-72 Stormwater Permit Requirements Guidance Document

14. Visit [http://udfcd.gisworkshop.com/](http://udfcd.gisworkshop.com/) for a list of all major basins within the Town of Parker, including all FHAD, OSP and MDP studies.
3. STORMWATER MANAGEMENT UTILITY

3.1 AUTHORITY

The Stormwater Management Utility ("Utility") was created pursuant to Municipal Ordinance No. 8.22, adopted July 6, 1999. The ordinance is codified as the "Town of Parker Stormwater Management Program" as Chapter 4.08, of the Parker Municipal Code.

3.2 PURPOSE

The Stormwater Management Utility is established in the Town of Parker to finance, coordinate, design, construct, manage, operate, and maintain public facilities for stormwater in the Town. The need for the Utility was recognized as a result of drainage problems that have resulted from increases in impervious area generated by residential and non-residential development in the Town. Prior to the Utility, the financial burden of operating, maintaining, and repairing stormwater facilities that lay outside the public right-of-way was the responsibility of each subdivision or commercial property owner, usually through the Homeowners’ Association or Metro District. The Utility was created to relieve the private interests of that responsibility and by so doing improve the functionality of these vital systems for managing stormwater in the Town.

The Utility is funded through payment of a Stormwater Utility Fee assessed against the owner of each parcel of real property in the Town as prescribed in Section 4.08.070 of Parker Municipal Code. The funds generated by this fee can be spent by the Utility for the following purposes.

- Administration, coordination, engineering, planning, professional services, design, construction, installation, repair, maintenance, operation, management, improvement, replacement, and reconstruction of facilities in the Town necessary for the Utility to reasonably handle stormwaters in the Town; and

- The purchase of interests in real property including without limitation fee simple ownership and easements that may be necessary for the Utility to construct and maintain facilities and otherwise implement the purposes of the Utility.

- The retirement of the principal and interest of revenue or general obligation bonds issued by the Town for financing any of the activities and improvements set forth in the first stated purpose.

- Participation with UDFCD or other public entity or private party having a common interest in storm drainage projects or facilities that benefit the Utility.

3.3 STORMWATER FACILITY ELIGIBILITY

3.3.1 Basis for Determining Eligibility

Chapter 4.08 of the Municipal Code provides the basis for determining which stormwater facilities are to be placed under the responsibility of the Utility and which are to continue to be privately owned and privately maintained. The following key provisions of Chapter 4.08 provide the basis for the Utility
policy guidelines presented in Section 3.3.2 herein. (Note: the underlining has been added herein for emphasis.)

- Section 4.08.020, **Intent and Purpose**, states the purpose, “To establish a stormwater management utility to finance, coordinate, . . . , and maintain the public facilities described herein”.

- Section 4.08.030, **Definitions**, defines public facilities to mean “stormwater infrastructure accepted by the Town as provided in Section 4.08.090 of the Code”.

- Section 4.08.090, **Responsibility for Accepted Public Facilities**, states, “All public facilities . . . shall, upon acceptance become property of the Town . . .” It also states, “The Town shall maintain all accepted public facilities located within public lands, rights-of-way and easements and may maintain other accepted public facilities located within or adjacent to the Town. Such public facilities do not include facilities not accepted by the Town . . , or privately owned and/or maintained drainage facilities.”

### 3.3.2 Stormwater Facility Eligibility Policy

The following are policy guidelines for determining stormwater facilities that are eligible for inclusion into the Stormwater Management Utility.

1. The Utility shall provide maintenance assistance only for public facilities that have been accepted into the Utility.

2. Public facilities include stormwater facilities located on property owned by the Town, located within the public right-of-way, or that are otherwise publicly owned.

3. Public facilities may also include stormwater facilities located on private land that lie within recorded drainage easements dedicated to the Town, that have been shown on Town approved construction plans, and that are otherwise considered eligible by these criteria. This includes:
   
   (a) Stormwater facilities to which public conveyance facilities outfall;
   
   (b) Onsite detention and water quality basins and outlet facilities that discharge into major drainageways or other conveyance facilities operated and maintained by the Utility; and
   
   (c) Drainageways and related drainage structures in HOA owned tracts that are accessible to the public.

4. Public facilities include major drainageways and gulches that lie within drainage easements dedicated to the Town.

5. For public facilities to be “accepted” into the Utility, developers/permittees are required to follow the public improvement acceptance procedures, including surety, outlined in Section 2.3.3 herein.

6. Stormwater facilities constructed and in operation prior to the establishment of the Utility will not have to comply with the public improvement acceptance procedures to be accepted into the Utility. Acceptance into the Utility will be conditional upon the granting of legal access to those pre-existing public facilities located on private property, but not now covered by a drainage easement.
7. Drainage facilities that are not eligible for acceptance into the Utility include, but are not limited to, the following:
   
   (a) Facilities for which the property owner does not allow access for the purpose of maintenance or inspection, or, facilities on private property that are not covered by a drainage easement dedicated to the Town.
   
   (b) Stormwater conveyance facilities that lie “upstream” of detention/water quality basins on non-residential parcels and that convey runoff from non-public lands.
   
   (c) “Back-lot swales” that convey runoff from one or more lots and which lie on private property that is not publicly accessible.
   
   (d) Parking lot detention facilities as permitted by these criteria.
   
   (e) Underground detention facilities as permitted by these criteria.
   
   (f) Infiltration BMPs. As defined in Section 8.3 herein, infiltration BMPs are permitted but are not eligible for maintenance assistance from the Town. In order to receive approval for the construction of infiltration BMPs, an Operation and Maintenance (O&M) Manual must be generated for the facility and approved by the Town. See Section 8.3 herein for additional information regarding O&M Manual requirements. Sample O&M Manuals can be found in Appendix G, herein.
   
   (g) Underdrain systems that are designed to capture or convey groundwater from foundations, footings or any other improvements, whether located within or outside the Town’s Right-of-Way.
   
8. The Utility will not be responsible for conveying water across private property, nor will the Utility be responsible for dealing with adjacent landowners that improperly convey water across their property.
   
9. It is not the intent of the Utility to assert ownership claims to private lands. Privately owned land containing public facilities that are accepted into the Utility remains in private ownership, unless otherwise deeded to the Town.
   
10. The Utility will not be responsible for maintaining improved landscaping (e.g. irrigated turf, shrub beds, etc.) associated with public facilities. The ground cover for public facilities shall be native vegetation wherever possible. If the property owner desires more extensive, improved landscaping, than the owner shall be responsible for the maintenance of the additional landscaping. The additional landscaping must be approved by the Utility and comply with standards of the Town, the Cherry Creek Basin Water Quality Authority, and UDFCD where required.

Identification of stormwater facilities proposed for acceptance into the Utility shall be made in the Preliminary Drainage Report submitted with Preliminary Plan. The Utility will review and comment on the proposed list during the review process. Utility concurrence of facilities to be considered eligible will be required before Public Works can recommend approval of Preliminary Plan. It is the responsibility of the owner/developer/permittee to follow all acceptance guidelines and satisfy all eligibility requirements to ensure the eligible facilities are accepted into the Utility.
3.4 RESPONSIBILITIES

3.4.1 Stormwater Management Utility

The following subsections outline the principle responsibilities of the Utility for the different types of stormwater facilities accepted into the Utility. The Utility’s responsibilities shall be limited to the funds that are available to the Utility through the Stormwater Utility Fee.

Control and removal of noxious weeds at public facilities located on private property are not the responsibility of the Utility. Noxious weed control remains the responsibility of the property owner.

3.4.1.1 Detention/Water Quality Basins
- Mow native vegetation up to twice per year.
- Perform trash removal up to twice per year
- Remove accumulated sediment as required to maintain stormwater conveyance and/or stormwater release in accordance with the design standards
- Repair drainage structures, outlet boxes, grating, riprap, trickle channels
- Upgrade water quality facilities to the latest water quality treatment standards

3.4.1.2 Inlets and Storm Sewers
- Trash and sediment removal as required
- Structure repair as required

3.4.1.3 Major Drainageways
- Assume primary maintenance responsibility as required under UDFCD’s major drainageway maintenance program
- Trash and sediment removal as required
- Structure repair as required

In addition to the routine maintenance and restorative work listed above, the Utility may undertake larger scale rehabilitative work. This includes replacing deteriorated or failed facilities or construction of new drainage facilities. Examples of rehabilitative work include:

- Reconstructing deteriorated or inadequate drainage structures and channel improvements
- Rebuilding channel side slopes and overbanks to restore the intended conveyance capability to the drainageway
- Improvements to existing drainage facilities to enhance their stability and maintainability.

3.4.2 Developer/Permittee

The following list outlines the principle responsibilities of the developer/permittee for the different types of stormwater facilities to be accepted into the Utility.

- Design and construct all new stormwater facilities in accordance with the latest revision of the SDECM and the latest local, state, and federal laws regulating wetlands and stormwater.
- Provide drainage easements over all stormwater facilities
• Follow public improvement acceptance procedures, including surety, for all public facilities (i.e. Utility eligible).

3.4.3 Property Owner
The following list outlines the principle responsibilities of the property owner (or HOA, Metro District, merchants association, etc.) for the different types of stormwater facilities to be accepted into the Utility.

- Control noxious weeds
- Maintain improved landscaping (turf grass, shrubs, etc.)
- Operate, maintain, and repair stormwater facilities not accepted into the Utility and in accordance with the applicable O&M Manual for that facility.

3.5 EXEMPTIONS
The following land uses are exempt from the Stormwater Utility Fee.

- All public park land and open space;
- All public or private ponds, lakes, reservoirs, rivers, creeks, natural water courses, or irrigation ditch/canal rights-of-way;
- All public or private streets, highways, rights-of-way, and alleys;
- All railroad rights-of-way;
- All cemeteries;
- Golf courses; and
- All real property located within the A-Agricultural District as described in Section 13.04.050 of the CODE.

3.6 REFERENCES
1. Town of Parker Ordinance 8.22, July 6, 1999
4. PLANNING SUBMITTAL REQUIREMENTS

4.1 INTRODUCTION

In accordance with The Town of Parker subdivision ordinance (CODE), a drainage report prepared by a Professional Engineer registered in Colorado shall accompany the submittal requirements for all subdivision plats, planned unit developments and any other proposed construction which would alter the existing drainage system. Generally, drainage reports will be submitted in a three phase process: conceptual drainage report (CDR), preliminary drainage report (PDR), and final drainage report (FDR). The three phase process is designed to coincide with the three step subdivision process of: sketch plan, preliminary plan, and final plat. Depending upon the size and complexity of the drainage system and the combining of subdivision steps as permitted by the Planning Director, it may be appropriate to combine phases in the drainage report submittal process.

Site plan applications shall also be accompanied by a final drainage report if significant additions or modification are proposed to previously approved drainage design from subdivision.

Minor development plat applications shall be accompanied by a final drainage report that meets the requirements of this section as described for final plat.

It is also required that construction drawings, including a detailed grading plan and detailed design of all stormwater facilities prepared in accordance with Town criteria, shall be submitted to the Town. The specific requirements for these submittals as well as the review process by the Town are presented in the following sections.

4.2 GENERAL REQUIREMENTS

The Town of Parker submittal review process is defined in the CODE, and has been summarized in Section 2.2 herein. In this section, the particular requirements for each of the various submittals that are required during the planning process are summarized. Checklists for the Sketch Plan, Preliminary Plan, Final Plat and Construction Plan requirements can be found in the Roadway Manual. These checklists are intended to assist the development community by clearly defining expectations for each type of submittal in order to avoid unnecessary delays in the planning process. The checklists should be used by developers/permittees to guide document preparation and to verify the completeness of their materials prior to submitting to the Town.

Drainage reports are a critical element in the Town’s review of a development proposal. In this respect, the significant role of the report’s narrative cannot be overstated. Appendix A herein includes a checklist to be used as guidance when submitting each Drainage Report (Conceptual, Preliminary, and Final). Developers/permittees are encouraged to further develop this checklist to clearly and concisely present the background, the constraints, and the rationale behind the drainage design for their site. The narrative should describe the overall concept of the drainage design, the impacts and coordination with adjacent offsite areas and major drainageways, items of special interest, site constraints, and compliance with the Town’s criteria. Standard “boilerplate” language, copied from previous reports, should be avoided, or at a minimum, reviewed carefully to ensure it is accurate and informative. The narrative should support the appendix calculations and assist the reviewer in understanding what calculations are included, what assumptions were used, and how they were
performed. A well prepared drainage report can be an extremely valuable tool for demonstrating a development’s compliance with the Town’s criteria, thereby expediting the proposal’s advancement through the planning process.

A response letter shall accompany all resubmittals of revised drainage reports, sketch plans, preliminary plans, final plats, site plans, construction plans, and/or erosion control plans. The letter shall respond to each review comment from the previous submittal, explaining what change has been made or providing justification for not making the requested modification.

4.3 CONCEPTUAL DRAINAGE REPORT

A conceptual drainage report (CDR) shall accompany all sketch plan applications. The intent of a sketch plan is to provide a conceptual layout of the subdivision and to examine the feasibility of a project by reviewing the concept design, legal ability to obtain water and sanitation, location of geologic hazards, identification of environmentally sensitive areas and wildlife habitat areas, and conformance with the Town Master Plan, zoning requirements, and the CODE. The sketch plan exhibit requirements and accompanying developmental reports are summarized in the Roadway Manual. A more detailed listing of requirements can be found in the CODE.

The purpose of the CDR is to identify and define conceptual solutions to the problems which may occur on site and off site as a result of development. In addition, problems that exist on site prior to development shall be identified and addressed in a preliminary manner during the sketch plan phase.

All reports will be typed on 8 1/2" x 11" paper and bound. Any drawings, figures, plates and tables shall be bound with the report or included in a folder/pocket attached inside the back cover of the report. The report shall be prepared by or under the supervision of a Registered Professional Engineer licensed to practice in the state of Colorado.

Appendix A herein presents a checklist of items to be included in the CDR. It should be emphasized that it may not be possible to meet many of the requirements included in the checklist. For example, there may be no master drainage plan or defined floodplain for a particular major drainageway. Where this is the case, these facts shall be discussed and the absence of certain information noted. The checklist is intended to be a guideline and as such shall not necessarily prohibit the completion of a drainage study due to a lack of specific information. However, the report shall be as complete as the situation will allow.

The checklist in Appendix A herein includes an item for a table of volumes and release rates for detention facilities. The following summary table for each detention pond should be included in the report and on the drainage plan:

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EURV volume (including WQCV) (acre-ft)</td>
<td></td>
</tr>
<tr>
<td>100-year volume (including EURV) (acre-ft)</td>
<td></td>
</tr>
<tr>
<td>100-year peak inflow (cfs)</td>
<td></td>
</tr>
<tr>
<td>100-year peak outflow (cfs)</td>
<td></td>
</tr>
</tbody>
</table>
4.4 PRELIMINARY DRAINAGE REPORT

A preliminary drainage report (PDR) shall accompany all preliminary plan applications. The purpose of the preliminary plan is to review the technical requirements, design standards and improvement requirements of the Town, ensuring that the standards imposed on the proposed subdivision can be met. Site planning characteristics and compatibility with adjoining land uses are reviewed, as are compliance with zoning requirements, circulation patterns, and desired open space. The preliminary plan exhibit requirements and accompanying developmental reports are summarized in the Roadway Manual. A more detailed listing of requirements can be found in the CODE.

The purpose of the PDR is to further develop solutions to the problems identified in the conceptual drainage report. The PDR presents the preliminary design of the required grading and stormwater facilities that will be required to meet the drainage criteria of this manual. Hydrologic and hydraulic calculations are required in sufficient detail to support that the preliminary plan will comply with all criteria without significant revision during the final plat and construction plan phase.

Identification of drainage facilities that are proposed to be submitted for acceptance into the Stormwater Utility shall be identified during preliminary plan as discussed in Section 3 herein.

All reports will be typed on 8 1/2" x 11" paper and bound. Any drawings, figures, plates and tables shall be bound with the report or included in a folder/pocket attached inside the back cover of the report. The report shall be prepared by or under the supervision, of a Registered Professional Engineer licensed to practice in the state of Colorado and shall contain a signed certification page as follows:

This report for the preliminary design of (Name of Development) was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

____________________________
Signature

____________________________
Colorado P.E. License No.

____________________________
Seal and Date

Appendix A herein presents a checklist of items to be included in the PDR. When it is not possible to meet the requirements of the checklist in Appendix A, the reasons shall be discussed and the absence of that information noted. The report shall be as complete as the situation will allow.

The checklist in Appendix A herein includes an item for a table of volumes and release rates for detention/water quality facilities. The following summary table for each detention pond shall be included in the report and on the drainage plan of both the PDR and the FDR.
The drainage plan for both the PDR and FDR shall also include a table showing the direct peak flow and accumulated peak flow to each design point for both the initial and major storm event. The table should indicate the direct basin and all contributing upstream basins.

### 4.5 FINAL DRAINAGE REPORT

A final drainage report (FDR) shall accompany all final plat, minor development plat, and Site Plan submittals. The final plat submittal provides for the review of the final engineering plans, the subdivision improvement agreement, public dedication and other legal agreements. The final plat and minor development plat exhibit requirements and accompanying developmental reports are summarized in the Roadway Manual. A more detailed listing of requirements can be found in the CODE.

The purpose of the FDR is to update the concepts and present design details for drainage facilities discussed in the preliminary drainage report. Construction plans accompany the FDR. The FDR should present the full and complete design analysis and calculations to support the design plans and details in the construction plans. As with the PDR, the FDR shall be prepared by, or under the supervision, of a Registered Professional Engineer licensed to practice in the State of Colorado and shall contain a signed certification page as follows:

*This report for the final design of (Name of Development) was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.*

____________________________
Signature

____________________________
Colorado P.E. License No.

____________________________
Seal and Date
Appendix A herein presents a checklist of items to be included in the FDR. When it is not possible to meet the requirements of Appendix A herein, the reasons shall be discussed and the absence of that information noted. The report shall be as complete as the situation will allow.

4.6 CONSTRUCTION PLANS AND SPECIFICATIONS

Where drainage improvements are to be constructed in accordance with a separate detailed engineering design, construction plans and specifications shall be submitted for review and approval prior to construction. All construction drawings shall be comprehensive including roads, grading, drainage, sediment and erosion control, and storm sewer plan and profile along with corresponding detail sheets. A reproducible copy of the construction plans shall be submitted to the Town of Parker for approval and its files. The plans and specifications shall include at least the following items, related to drainage and erosion control where applicable:

1. Illustration of storm sewers, inlets and outfalls.
2. Illustration of culverts, end sections and inlet/outfall protection.
3. Channels, channel drops, ditches and swales and illustrations of cross-sections.
4. Erosion control facilities.
5. Detention pond grading, trickle channels, outfalls and landscaping.
6. Other drainage related structures and facilities.
7. Sediment (i.e, traps/basins, barriers, etc.) and erosion control measures.
8. Maintenance access considerations.

Information required for the drawings and specifications shall be in accordance with sound engineering and hydrologic/hydraulic principles, this drainage manual, and the Roadway Manual. Construction documents shall include geometric, dimensional, and structural information; foundations, bedding, hydraulic, landscaping, sediment and erosion control and other details as needed to construct storm drainage facilities and to implement effective environmental control practices.

4.7 REFERENCES

5. HYDROLOGIC CRITERIA

5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation–Frequency Atlas of the Western United States, Volume III–Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

\[ I = \frac{28.5P_1}{(10+t_c)^{0.786}} \]

Where,
- \( I \) = rainfall intensity (in/hr)
- \( P_1 \) = one-hour point rainfall depth (in)
- \( t_c \) = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.
### TABLE 5.1

<table>
<thead>
<tr>
<th>Frequency of Design Event (yr)</th>
<th>One-hour Point Rainfall, P₁ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.99</td>
</tr>
<tr>
<td>5</td>
<td>1.39</td>
</tr>
<tr>
<td>10</td>
<td>1.64</td>
</tr>
<tr>
<td>25</td>
<td>1.98</td>
</tr>
<tr>
<td>50</td>
<td>2.31</td>
</tr>
<tr>
<td>100</td>
<td>2.60</td>
</tr>
</tbody>
</table>

### 5.3 FLOOD HYDROLOGY OVERVIEW

Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency’s Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.
TABLE 5.2
COMPARISON OF HYDROLOGICAL METHODS

<table>
<thead>
<tr>
<th>Hydrologic Information Desired:</th>
<th>Is the Rational Method Applicable?</th>
<th>Is CUHP/UDSWM Applicable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff peak discharge</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Combining peak flows from separate sub-watersheds</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Runoff volume ( (V = I \times A \times \text{Duration}) )</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Runoff hydrograph</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Watershed Size (Acres)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5 to 90</td>
<td>Yes</td>
<td>Yes²</td>
</tr>
<tr>
<td>90 to 160</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>160 to 3,000</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Greater than 3,000</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

¹ Subdividing watersheds into smaller sub-watersheds may be desirable to obtain runoff information at multiple design points or to accurately model areas of different character. The maximum sub-watershed size shall be approximately 130-acres in accordance with UDFCD master planning guidance.

² Time of concentration must be estimated and entered into CUHP.

As shown in Table 5.2, either the Rational Method or CUHP/UDSWM may be used for watershed sizes from 5 to 160-acres. The following considerations may direct the user to one or the other of these methods.

- If no detention facilities are planned, hydrograph information is not required and the Rational Method would be the simpler of the two methods.
- If detention facilities are to be sized based on hydrograph routing, or if hydrograph information is desired for any other reason, CUHP/UDSWM must be used. See the MANUAL, Storage chapter for additional discussion on detention facility sizing methods.
- If more detailed information on time to peak, duration of flow, rainfall losses, or infiltration is desired, CUHP/UDSWM offers this information.

Regardless of the method used, the maximum sub-watershed size shall be approximately 130-acres in accordance with UDFCD master planning guidelines. This is to reduce discrepancies in peak flow predictions between master plan hydrology and flow estimates based on single sub-watersheds significantly larger than 130-acres.

5.4 THE RATIONAL METHOD

The Rational Method is presented in the Runoff section of the MANUAL. Within the Town of Parker, peak discharges shall be determined for the initial storm and major storms by use of the Rational Method for drainage areas less than 90 acres. The Rational Method can be used for basins up to 160 acres in size. See Table 5.2 herein for additional guidance. The MANUAL provides spreadsheets for the Rational Method calculations.
5.4.1 Time of Concentration ($t_c$)

The MANUAL presents a discussion of the calculation of the time of concentration used in the Rational Method. Within the Town of Parker, the overland flow component of the time of concentration has the following requirements:

- When the historic conditions are non-urbanized, the length of overland flow shall be a minimum of 500 feet (unless the defined historic basin configuration is less than 500 feet long, in which case a shorter length may be used).
- In the developed conditions analysis, the length of overland flow shall be a maximum of 300 feet.

The minimum time of concentration, $t_c$, shall be 10 minutes under non-urbanized conditions. The minimum $t_c$ shall be 5 minutes under urbanized conditions.

5.4.2 Runoff Coefficient (C)

The runoff coefficient (C) represents the integrated effects of infiltration, evaporation, retention, flow routing and, interception, all of which affect the time distribution and peak rate of runoff. The MANUAL now includes a methodology for determining C based on the Natural Resources Conservation Service Hydrologic Soil Group and the percent imperviousness of the basin.

5.5 COLORADO URBAN HYDROGRAPH PROCEDURE (CUHP)

For urbanized basins larger than 90 acres, flood flows should be calculated using CUHP. See Table 5.2 herein for additional guidance. CUHP is a method whereby a synthetic unit hydrograph is derived using coefficients based upon data collection and studies financed by the City of Denver, the Denver Regional Council of Government and the Urban Drainage and Flood Control District. Since the synthetic unit hydrograph provides a method to analyze the hydrologic characteristics of a basin where no rainfall-runoff data are available, CUHP is a means whereby hydrologic conditions for the Denver area can be represented and analyzed.

5.6 UDSWM HYDROGRAPH ROUTING PROCEDURE

For urbanized basins larger than 90 acres, flood flows hydrographs should be combined and routed using UDSWM. UDSWM represents the watershed by an aggregate of idealized channels, gutters and pipes. Detention basins with specified storage-outflow relationships may also be modeled. The program can accept rainfall hyetographs and make a step by step accounting of rainfall infiltration losses in pervious areas, surface retention, overland flow, and gutter flow leading to the calculation of hydrographs. However, this portion of the model is normally not used because the calculation of hydrographs for each sub-catchment is generally carried out using the CUHP software.
FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO
5.7 REFERENCES


3. Urban Drainage and Flood Control District, June 2001 (with revisions), Urban Storm Drainage Criteria Manual Volumes 1 and 2
6. HYDRAULIC CRITERIA

6.1 INTRODUCTION

This section addresses technical criteria for hydraulic evaluation and design of drainage facilities in the Town of Parker. The drainage facilities include open channels, storm sewers and inlets, streets, culverts, riprap, drop structures, energy dissipators, and bridges. The information presented herein is considered to be a minimum standard. In many instances, special design or evaluation techniques will be required.

Except as modified herein, all hydraulic criteria shall be in accordance with the MANUAL as well as the Town of Parker CODE. Within the MANUAL, the sections addressing hydraulic design of drainage facilities include: Open Channels, Streets/Inlets/Storm Sewers, Hydraulic Structures, and Culverts. Engineers using this document are assumed to possess a stormwater drainage engineering background including a working knowledge of hydraulics. The user is encouraged to review the many referenced materials for additional information.

As discussed in Section 2.4.2.2 herein, drainage design and construction for facilities that are to be made eligible for UDFCD’s maintenance program should meet the requirements and follow the process defined by UDFCD.

6.2 OPEN CHANNELS

Open channels consist of natural streams, constructed drainageways, and smaller swales and ditches that convey watershed runoff. As described in the Open Channels chapter of the MANUAL, natural streams provide a number of beneficial functions, including:

1. Stable conveyance of baseflow and storm runoff.
2. Support of riparian and wetland vegetation.
3. Creation of habitat for wildlife and aquatic species.
4. Slowing down and attenuating floodwater by spreading out flows over vegetated overbanks.
5. Promotion of infiltration and groundwater recharge.
7. Provision of corridors for trails and open space.
8. Enhancement of property values and quality of life.

However, increased peak discharges, frequency, and volume of runoff associated with urban development can place stresses on natural stream systems, leading to degradation and a loss of beneficial functions. Impacts of stream degradation include:

1. Removal of riparian vegetation.
2. Increase in flow velocities.
3. Damage to infrastructure.
4. Lowering of water table and drying out of overbank vegetation.
5. Impairment of water quality.
6. Increase in capital and maintenance costs.

Work in open channels is intended to reflect a natural stream character, attained by preserving and restoring existing natural drainageways and, when necessary, creating new drainageways with natural features. Natural channel meanders and cross-sectional geometry, riparian vegetation, and natural grade control features are to be emulated wherever possible.

The goal is to go beyond just stabilizing a channel against erosion (which could be accomplished by lining the channel with concrete), and to implement enhanced stream stabilization. Enhanced stream stabilization includes creating natural streams and well-vegetated floodplains that are physically and biologically healthy, with all of the beneficial functions identified above. This goal is just as critical to improving watershed water quality as addressing the quality of runoff flowing from a development site and into a receiving stream.

6.2.1 Preservation and Stabilization of Natural Streams

6.2.1.1 Preservation of Natural Streams

It is intended that natural drainageways and floodplains be preserved. Initial development planning documents shall accurately identify all existing drainageways, floodplains and other site features that should be protected and preserved. The features that are proposed to be left in place and preserved or restored must be clearly shown on initial development planning documents. Areas shown to be protected will be subject to review by the Town.

The Town has adopted Ordinance No. 3.171 which established Section 13.10.220 – Stream Protection Standards (Standards) in the CODE. These Standards were developed to preserve the multiple functions and quality of the streams and associated riparian areas and wetlands. Further discussion regarding the Town’s Stream Protection Standards and natural drainage approach to stormwater management planning can be found in Section 2.1.3 herein.

6.2.1.2 Stabilization of Natural Streams

The Town will require the stabilization of streams as a condition of development approval. Because the increased runoff from urbanization typically leads to channel erosion, it is not acceptable to simply “leave a stream alone”, even when preserving streams as discussed in Section 6.2.1.1 herein. Natural drainageways should be stabilized using one of the three approaches described below.

1. Preserving Streams Not Yet Impacted. Streams that have not yet experienced degradation from increased urban runoff or other forms of erosion shall be preserved by implementing the following improvements:
   - Grade control structures to limit degradation in the low flow channel, stabilize any existing headcutting and to establish a flatter equilibrium slope than may have existed previously.
   - Bank stabilization at select locations where existing instability or the potential for future instability is evident.
• The planting of supplemental vegetation to provide for the transition to species suited for “wetter” urban hydrology. Additional moisture can sustain wetland and riparian vegetation. These grasses, sedges and rushes, shrubs, and trees can help to stabilize the channel and provide a diverse habitat for wildlife.

2. **Restoring Impacted Streams.** Channels that have already experienced significant erosion and downcutting are to be addressed differently than streams that are not degraded. Restoration of these channels require the following improvements:

   • Eroded, incised channels, if possible, shall not be stabilized in a manner that retains the incised geometry with steep side banks, but shall be restored by raising the channel invert up to its historic condition and encouraging high flows to spread out, avoiding deep, concentrated flood flows within the channel.

   • Grade control structures to raise the channel invert and to establish a flatter equilibrium slope.

   • Utilization of vegetated overbank benches adjacent to the base flow channel to allow high flows to spread out and dissipate energy.

   • Bank stabilization at select locations where existing instability exists or there is potential for future instability.

   These elements are discussed further in the Open Channels chapter of the MANUAL. The goal of preservation or restoration improvements is to avoid disturbing existing drainageways more than what is necessary to provide a stable, sustainable stream system. However, the greater the extent of existing degradation, the more work and disturbance will be required.

3. **Constructing New Natural Drainageways.** Where it can be demonstrated that it is not feasible or practicable to preserve a natural drainageway (generally for small channels that are not located within the Town’s designated “Stream Buffer”), or if surface channels are desired in areas where no existing drainageways are evident, construction of a new natural drainageway may be accepted. It is the intent of the Town that such constructed channels be designed to emulate natural drainageways with all of their beneficial functions. See the Open Channels chapter of the MANUAL for more guidance on the design and construction of new natural channels.

The Town requires that channel stabilization measures be implemented on all streams that are either contained within the development or are adjacent to the property. The need for additional measures downstream of the development shall be determined on a case by case basis. All development projects, including those which do not contain or are not adjacent to a channel may be required to provide or participate in channel stabilization improvements to protect the project from future erosion and to address water quality concerns within the channel, which are a direct result of the development.

### 6.2.2 Swales

Swales are defined as shallow, grass or rock-lined drainage conveyances with a 100-year flowrate less than or equal to 100 cubic feet per second. The Town prefers the use of grass lined swales, although riprap lined swales may be required under certain conditions. The Open Channels chapter of the MANUAL provides detailed discussion on the design and construction of swales.
6.2.3 Design Considerations
Refer to the Planning Chapter of the MANUAL for a thorough discussion of open channel planning considerations. The designer is also referred to the following sections for guidance on urban effects, route considerations, and drainageway layout within a site.

6.2.3.1 Master Planning
UDFCD Outfall Systems Planning and Major Drainageway Planning Studies, commonly referred to as master plans, have been developed for many of the watersheds in the Town. These studies typically provide standard channel cross-sections and details to depict the selected channel type and/or improvements for the specific reaches of the drainageway. It is recognized that many of the master plans were completed several years ago and may not have been updated to reflect current approaches and design details, technology, and philosophies regarding channel stabilization improvements. The master plans shall be used as a basis, where appropriate, for general stabilization concepts, but will be subject to re-evaluation with regard to the standards presented in this chapter and in the Open Channels chapter of the MANUAL.

6.2.3.2 Design Flows
The design flow for open channel improvements shall be the discharge for the 100-year event assuming a fully urbanized watershed. Future developed conditions shall be based on the estimated imperviousness of the upstream watershed, or actual imperviousness if the basin is fully developed. In addition to the 100-year event, the design must also consider baseflows and frequent storm events, including the 2-year flow and any other events the designer judges may produce a critical design condition. Roughly the 2-year discharge is commonly referred to as the “bankfull” or “channel forming” discharge for natural streams and is considered to have morphologic significance because it typically represents the breakpoint between the processes of channel formation and floodplain formation (FISRWG, 2001).

Design flow rates have been calculated in master planning documents. Prior to the use of these, or other published flow rates, a check should be made to verify that the assumptions used in the determination of the flow rates are valid. If design flow rates are not available, the design engineer shall be responsible for providing the appropriate analysis to determine the design flow rate. The final design flow rate shall be approved by the Town and UDFCD, when appropriate.

6.2.3.3 Flow Computations
Uniform flow and critical flow computations shall be in accordance with the Open Channels chapter of the MANUAL.

6.2.4 Permitting and Regulations
Drainageway planning and design along existing natural channels can be a multi-jurisdictional process, and therefore, must comply with regulations and requirements ranging from local criteria and regulations to Federal laws. Discussions with the relevant permitting authorities should be held early in the design process and throughout construction to ensure that all permitting and regulatory requirements are being met.

Development in the Town of Parker is required to comply with all state and federal regulations, including but not limited to, those regulations pertaining to wetlands, waters of the U.S., threatened
and endangered species, floodplain encroachment, and construction activities. See Section 2.8 herein for additional guidance on regulations and required permits.

### 6.2.5 New Development and Redevelopment in Stream Preservation Areas

Any new development or redevelopment within the Town located within a Stream Preservation Area may be required to meet specific BMP requirements. See Section 8.6 herein for detailed discussion regarding these requirements.

### 6.3 STREETS, INLETS, AND STORM SEWERS

With regard to drainage, the urban street evaluation consists mainly of determining the allowable gutter flow capacity. When the allowable capacity is equaled or exceeded, a storm sewer system is required to reduce the storm runoff in the streets to acceptable values. The allowable capacity is a function of the street classification, the storm frequency under consideration, and physical properties such as longitudinal and cross slope, width, and gutter or ditch configuration. Also considered in the allowable capacity are the safety and maintenance aspects of storm runoff within the street. For the Town of Parker, the procedures and basic data to be used to evaluate streets, inlets and storm sewers for drainage capacity shall be in accordance with the MANUAL Volume 1, Streets/Inlets/Storm Sewers Chapter and as further clarified herein.

#### 6.3.1 Street Drainage

The amount of storm runoff that can be theoretically carried in the curb and gutter is determined by the physical properties of the street (street cross-section, longitudinal slope, and curb & gutter type). The theoretical capacity is then reduced to account for the various losses that occur during actual flow conditions and to reduce the high hazard created by the flow on steep streets. The losses include the velocity and friction losses generated by sand and silt debris, variations in pavement and gutter properties, parked cars, and other physical obstructions. The allowable street capacity is then determined based upon the street classification (see Section 2.5 herein).

Table 6.1 tabulates maximum street capacity values for the initial storm runoff as a function of street classification and gutter type. These values were determined using UD-Inlet Version 3.12. Table 6.1 can be used to estimate street capacity and initial inlet placement during preliminary design. The most recent version of UD-Inlet should be used to determine street capacity for the major storm and for final design of the inlets and storm sewer system. Instructions for use of the software can be found in the MANUAL. Major storm allowable street capacity shall be determined using the criteria set forth in Section 2.5 herein.
### TABLE 6.1
MAXIMUM ALLOWABLE GUTTER CAPACITY FOR INITIAL STORM FOR ½ OF STREET SECTION (CFS)

<table>
<thead>
<tr>
<th>Street Grade (S₀)</th>
<th>Arterial Vertical Curb &amp; Gutter</th>
<th>Residential Collector Vertical Curb &amp; Gutter</th>
<th>Residential Boulevard Collector Vertical Curb &amp; Gutter</th>
<th>Non-Residential Collector Vertical Curb &amp; Gutter</th>
<th>Residential Local Vertical Curb &amp; Gutter</th>
<th>Non-Residential Local Vertical Curb &amp; Gutter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>12.5</td>
<td>5.7</td>
<td>2.5</td>
<td>10.9</td>
<td>3.4</td>
<td>13.8</td>
</tr>
<tr>
<td>2%</td>
<td>17.7</td>
<td>8</td>
<td>3.5</td>
<td>15.4</td>
<td>4.8</td>
<td>19.5</td>
</tr>
<tr>
<td>3%</td>
<td>17.8</td>
<td>9.8</td>
<td>4.3</td>
<td>17.8</td>
<td>5.9</td>
<td>17.8</td>
</tr>
<tr>
<td>4%</td>
<td>16.3</td>
<td>11.3</td>
<td>5</td>
<td>16.3</td>
<td>6.8</td>
<td>16.3</td>
</tr>
<tr>
<td>5%</td>
<td>15.2</td>
<td>12.7</td>
<td>6.1</td>
<td>15.2</td>
<td>7.6</td>
<td>15.2</td>
</tr>
<tr>
<td>6%</td>
<td>14.4</td>
<td>13.9</td>
<td>6.6</td>
<td>14.4</td>
<td>8.3</td>
<td>14.4</td>
</tr>
<tr>
<td>7%</td>
<td>13.8</td>
<td>13.8</td>
<td>7.1</td>
<td>13.8</td>
<td>9.0</td>
<td>13.8</td>
</tr>
<tr>
<td>8%</td>
<td>13.2</td>
<td>13.2</td>
<td>7.1</td>
<td>13.2</td>
<td>9.6</td>
<td>13.2</td>
</tr>
</tbody>
</table>

| Max Allow Spread (ft) | 18 | 13 | 9 | 17 | 17 | 17 | 20 |

Notes:  
1. Flowrates provided based upon UD-Inlet Version 3.12, November 2012.  
2. Mannings n for Street = 0.016  
3. Street Cross Slope = 2.0%  
4. Calculations Based Upon Initial Storm Criteria Provided in Section 2.5.1 herein.  

#### 6.3.2 Inlets

Storm sewer inlets shall be designed in accordance with the standards and technical criteria presented in the MANUAL Volume 1, Streets/Inlets/Storm Sewers Chapter, except where superseded by specific requirements of this criteria manual. The MANUAL has adopted the Federal Highway Administration (FHWA) Hydraulic Engineering Circular (HEC) No. 22 procedure for inlet design.

Curb opening inlets are preferred within the Town. Combination inlets will be considered on a case-by-case basis. An example of where a combination inlet may be accepted is where there is insufficient space behind the curb for a curb-opening inlet. In locations where combination inlets are approved, bicycle safe grates shall be used.

Flanking inlets may be required on either side of sump inlets where the length of the sag vertical curve may result in violation of the street capacity criteria presented in Section 2.5 herein. In sag vertical curves, the longitudinal street slope gradually approaches zero at the low point. Runoff will tend to spread further towards the crown as it approaches the sag inlet. For vertical curves greater than 200 feet in length, supporting calculations must be included in the drainage report that show the spread width is within street capacity criteria at a point 100 feet on either side of the low point. The instantaneous slope 100 feet from the low point shall be used in calculating the spread width and flow depth to verify compliance with the criteria.
When calculating carryover flows for inlets on continuous grade, the flow not intercepted by any inlet shall be reduced by 50% and added to the direct flow at the next downhill inlet. The 50% reduction is an approximation of the time lag effect for the runoff to reach the next downstream inlet. The Town may accept calculated carryover flows based on routed modeling on a case by case basis if the supporting calculations can be clearly justified.

The Town of Parker requires the use of UD-Inlet for hydraulic evaluation and capacity calculations of inlets. The latest version of this spreadsheet can be found on UDFCD’s website. Other software packages/spreadsheets may be used for inlet calculations, but require prior approval by the Town.

Appendix B herein contains inlet capacity charts for Type C and Type R inlets located in sump conditions. When using these charts, it must be verified that the depth of the ponded water shall not exceed the maximum allowable water depth for the given street classification as summarized in Section 2.5 herein. In addition, special consideration shall be given to vertical roadway curves exceeding 200 feet. All calculations for inlets located in a sump shall conform to the procedures, variables and coefficients provided in the Streets/Inlets/Storm Sewers chapter of the MANUAL.

6.3.3 Storm Sewers

Storm sewers are a part of the initial drainage system and may be required when the other parts of the initial system, primarily curb, gutter and roadside ditches, no longer have capacity for additional runoff. As discussed in Section 2.1 herein, properly designed urban developments may be able to minimize or eliminate the need for storm sewers.

Except as modified herein, the design of storm sewers shall be in accordance with the MANUAL Volume 1, Streets/Inlets/Storm Sewers chapter. Reference is made to follow specific chapters in the MANUAL for clarity. The user is referred to the MANUAL and other references cited for additional discussion and basic design concepts. Criteria presented in this manual are intended to be consistent with that document. Refer to Colorado Department of Transportation (CDOT) M-Standard details for typical design features related to storm sewers.

All storm sewer pipe shall be reinforced concrete. All other proposed materials for storm sewers will require a variance and must be approved by the Public Works Director.

6.3.3.1 Vertical Alignment

The storm sewer grade shall be such that a minimum cover is maintained to withstand AASHTO HS-20 loading on the pipe. The minimum cover depends upon the pipe size, type and class, and soil bedding condition, but shall be not less than one foot at any point along the pipe.

Manholes will be required whenever there is a change in size, direction, elevation, grade or where there is a junction of two or more sewers. In addition, the maximum spacing between manholes for various pipe sizes shall be in accordance with Table 6.2 below.

<table>
<thead>
<tr>
<th>Vertical Dimension of Pipe (Inches)</th>
<th>Maximum Allowable Distance Between Manholes and/or Cleanouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 to 36</td>
<td>400 Feet</td>
</tr>
<tr>
<td>42 and Larger</td>
<td>500 Feet</td>
</tr>
</tbody>
</table>
The minimum clearance between storm sewer and water main, either above or below, shall be 18 inches. Concrete encasement of the water line will be required for clearances of 12 inches or less when such clearances are specifically permitted by the applicable water & sanitation district and the Public Works Department.

The minimum clearance between storm sewer and sanitary sewer, either above or below, shall also be 18 inches (per requirements of Parker Water & Sanitation District). In addition, when a sanitary sewer main lies above a storm sewer, or within 18 inches below, the sanitary sewer shall have an impervious encasement or be constructed of mortar lined ductile iron pipe for a minimum of ten feet on each side of where the storm sewer crosses. Clearances less than 18 inches shall require the approval of the applicable water & sanitation district and the Public Works Department.

6.3.3.2 Horizontal Alignment

Storm sewer alignment between manholes shall be straight, except when approved in writing by the Public Works Department. Storm sewers constructed with curvilinear alignment by the pulled-joint method, pipe bends, or by radius pipe is prohibited. Storm sewer laterals shall enter inlets entirely in the walls of inlet box, not into the corners.

The preferred location of the storm sewers is within the street section with the centerline of the storm sewer located 5 feet plus half of the storm sewer outside diameter from the lip of the gutter (where there are no other utility conflicts). The minimum distance between storm sewer and water mains shall be 10 feet. The minimum distance between storm sewer and sanitary sewer shall be 7 feet. Although not preferred by the Town, the storm sewer may be located behind the curb but should still be located within the Right-of-Way. In areas where storm sewer is located behind the curb, landscaping improvements should be restricted. No trees shall be planted within 7-feet of the edge of the storm sewer pipe in order to minimize root intrusion into the system and to facilitate future maintenance of the storm sewer if needed. See Appendix A of the Roadway Manual for a graphical representation of the typical locations for storm sewers and other utilities within the roadway section. Refer to Section 2.6 herein for additional information regarding easement requirements for storm sewers located outside of the public Right-of-Way.

For privately owned and maintained storm sewer systems, excluding landscaping and roof drains, a drainage easement shall be dedicated to the Town as part of the associated development site plan or plat. Drainage easements for private storm sewer systems are necessary in the event the property owner fails to adequately maintain the system and it becomes necessary for the Town to perform maintenance. See Section 2.6.1 herein for additional information and requirements for easements along privately owned storm sewer systems.

When storm sewer is located behind the street and/or pavement curb, manholes shall be located and constructed so that the manhole lid is located either outside of the sidewalk (preferred), or totally within the sidewalk near the centerline of the walk. Manhole lids shall be of a type suitable for pedestrians.
6.3.3.3 Pipe Size

Table 6.3 presents the minimum pipe size for storm sewers.

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum Equivalent Pipe Diameter</th>
<th>Minimum Cross-Sectional Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Trunk</td>
<td>18 in.</td>
<td>1.77 sq. ft.</td>
</tr>
<tr>
<td>*Lateral from Inlet</td>
<td>18 in.</td>
<td>1.77 sq. ft.</td>
</tr>
</tbody>
</table>

*Minimum size of lateral shall also be based upon a water surface inside the inlet or a minimum distance of 1 foot below the grate or throat

Any variations from the design criteria presented in Table 6.3 require prior approval from the Public Works Department.

6.3.3.4 Hydraulic Design

In both the initial and major storm events, inlets are constructed when the flow in the roadway exceeds the allowable roadway capacity, as defined in Section 2.5 herein. These inlets intercept runoff and convey it to the storm sewer. The storm sewer pipe size, longitudinal slope, alignment, etc. are all determined using the criteria summarized in the prior sections. The pipe hydraulics must then be evaluated to ensure that the following criteria are met:

- In the initial storm event, the hydraulic grade line must be located below the crown of the pipe;
- In the major storm event, the hydraulic grade must be located 12-inches below finished grade as a maximum condition.

Using the procedures outlined in the MANUAL, Volume 1, Streets/Inlets/Storm Sewers, the hydraulic grade line shall be calculated by accounting for pipe friction losses and pipe form losses. Total hydraulic losses will include friction, expansion, contraction, bend, and junction losses. Care shall be taken to provide emergency overflow paths that protect structures in the event the storm sewer, or inlet(s), is blocked, forcing all or a portion of the flow along a surface path.

An important aspect to the hydraulic evaluation of storm sewers is determining the appropriate tailwater conditions at the storm sewer outfall. Procedures for calculating hydraulic and energy grade lines in a storm sewer system begin at the outfall, so the assumptions for tailwater can have a huge impact on the hydraulic evaluation of the storm sewer. The coincidental hydrologic event in the downstream channel (outfall) will directly influence the resulting tailwater elevation. Chapter 7 of HEC-22 provides a comprehensive discussion on considerations for determining tailwater conditions.

The Town of Parker allows the use of StormCAD or UD-Sewer for the hydraulic evaluation of storm sewers. UD-Sewer is the software package created to supplement the MANUAL Volume 1, Streets/Inlets/Storm Sewers Chapter. The latest version of this software can be found on UDFFCD’s website. Other software packages may be used for the hydraulic evaluation of storm sewers, but require prior approval by the Town.
6.4 CULVERTS

A culvert is defined as a conduit for the passage of surface drainage water under a highway, railroad, canal or other embankment. Culverts may be constructed with many shapes and materials including reinforced concrete and corrugated metal. The procedures for the design of culverts are presented herein.

6.4.1 Hydraulics

The procedures and basic data to be used for the hydraulic evaluation and design of culverts in the Town of Parker shall be in accordance with the MANUAL, Volume 2 Culverts Chapter. The reader is also referred to the many texts covering the subject for additional information such as Linsley & Franzini, 1979; ACPA, 1992; and HDS-5, 1985.

6.4.1.1 Design Standards and Pipe Material

The minimum pipe size for culverts within a public ROW shall be 24 inches diameter round culvert or shall have a 24” equivalent diameter for arch and elliptical shapes. Swale culverts for driveways, trails and sidewalks shall be minimum 18” diameter or equivalent for non-circular shapes.

Within the Town of Parker, culverts can be constructed of reinforced concrete pipe or corrugated aluminized steel, Type 2 (AASHTO M-274, ASTM A-929) Other materials for construction are subject to approval by the Public Works Director. Reinforced concrete is acceptable for all pipe sizes and corrugated metal pipe can only be used for culverts that are 48-inches or less in diameter.

Reinforced concrete pipe (RCP) is available in round, elliptical or arch cross sections, in sizes ranging from 12 inches to 108 inches in diameter (ACPA, 1970). Large size culverts may also be cast-in-place. Reinforced Concrete Box Culverts (RCBC) can be constructed with generally any rectangular cross section, the only limitations being the physical site constraints and the structural requirements. Pre-cast box culverts are also available in several standard dimensions.

Corrugated Metal Pipe (CMP) culverts are available in round or arch cross sections (AISI, 1971). Sections of corrugated metal can also be bolted together to form several other cross sectional shapes, such as elliptical and pear shapes forming structural plate pipe (SPP). Corrugations also come in various dimensions, which affect the hydraulics of the pipe flow. All CMP installed within the Town of Parker shall be aluminized Type II steel. Table 6.4 below summarizes other material requirements for culverts constructed with CMP within the Town.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Required Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>24” or less</td>
<td>16</td>
</tr>
<tr>
<td>30” to 36”</td>
<td>14</td>
</tr>
<tr>
<td>42” to 48”</td>
<td>12</td>
</tr>
</tbody>
</table>

All CMP must be aluminized Type II steel. Maximum diameter of CMP allowed within the Town is 48-inches.

6.4.1.2 Inlet and Outfall Configuration

Within the Town of Parker, all culverts are to be designed with headwalls and wingwalls, or with flared-end sections at the inlet and outfall.
Additional protection in the form of riprap will also be required at the inlet and outfall due to the potential scouring velocities. Refer to Section 6.5.2 herein and the MANUAL, Volume 2, Culverts and Hydraulic Structures Chapters.

### 6.4.1.3 Hydraulic Data

There are many charts, tables, and curves in the literature as well as software programs for the computation of culvert hydraulic capacity. To assist in the review of the culvert design computations and to obtain uniformity of analysis, the following data shall be used:

- **All Pipe**: Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Denver, Colorado 2001 with revisions.
- **Concrete Pipe**: Concrete Pipe Design Manual, ACPA Arlington, Virginia, February 1970.

Copies of the product manuals may be obtained through the local pipe suppliers.

### 6.4.1.4 Velocity Considerations

In design of culverts both the minimum and maximum velocities must be considered. A minimum velocity of 3 fps of flow in the initial storm event is recommended to assure a self-cleansing condition of the culvert.

The maximum velocity is dictated by the channel conditions at the outfall. If the outfall velocities are low and encounter grassed channels, then the minimum amount of protection may be required due to the eddy currents generated by the flow transition. Higher outfall velocities will require substantially more protection. Inlet and outfall protection shall be designed using the standards and technical criteria in the MANUAL, Volume 2, Culverts and Hydraulic Structures Chapters.

### 6.4.1.5 Headwater Considerations

The maximum headwater for the 100-year design flows shall be 1.5 times the culvert diameter or culvert rise dimension for shapes other than round. In some cases, physical constraints at the inlet may require the culvert be designed to operate at lower headwater depths.

### 6.4.1.6 Structural Design

As a minimum all culverts shall be designed to withstand an HS-20 loading in accordance with the design procedures of AASHTO "Standard Specifications for Highway Bridges" and with the pipe manufacturers recommendations.

### 6.4.2 Culvert Sizing Criteria

The sizing of a culvert is dependent upon three factors, the street classification (i.e., local, collector or arterial), allowable street inundation, and the classification of the drainageway being conveyed by the culvert (i.e. minor or major drainageway). The allowable street inundation for the various street classifications is set forth in Section 2.5 herein. In addition to this policy, a criteria requirement that no street overtopping occur for a 10-year frequency storm has been established for culverts conveying a minor drainageway and passing beneath local, collector and arterial roadways. For culverts conveying a minor drainageway beneath an arterial, culvert design shall provide for passage of the 100-year discharge so that no street overtopping shall occur (see Table 2.6 herein). **No overtopping is allowed in the 10-year or 100-year events for culverts conveying a major drainageway.**
Therefore, as a minimum design standard for street crossings at minor drainageways, the following procedure shall be used:

1. Using the future developed conditions 100-year runoff, the allowable street overtopping shall be determined from overflow rating curves developed from the street profile crossing the waterway.
2. The culvert is then sized for the difference between the 100-year runoff and the allowable overtopping.
3. If the resulting culvert is smaller than that required to pass the 10-year flood peak without overtopping, the culvert shall be increased in size to pass the 10-year flow.
4. Culverts capable of passing the 100-year runoff without overflowing to the cross street are required when the cross street is in a continuous grade that would cause an unwanted diversion of major storm runoff from the minor drainageway served by the culvert.

The criteria is considered a minimum design standard and must be modified where other factors are considered more important. For instance, if the procedure still results in certain structures remaining in the 100-year floodplain, the culvert size may need to be increased.

### 6.4.3 Trash Racks

The use of trash racks at culvert inlets can provide certain benefits with respect to public safety and culvert maintenance. However, field experience has shown that culvert performance can be significantly impaired when it is most needed during heavy runoff due to debris clogging of the grated inlet. The use of trash racks will be considered on a case-by-case basis, weighing the specific site hazards which may result from debris blockage of the culvert entrance against the public safety and long-term maintenance benefits of the site. In all cases, trash racks will not be allowed on the downstream end of a culvert or storm sewer.

Trash racks shall be designed in accordance with the standards and technical criteria for trash rack in the MANUAL, Volume 2, Culverts Chapter.

### 6.5 HYDRAULIC STRUCTURES

Hydraulic structures are used in storm drainage work to control the flow of the runoff. Therefore, consideration must be given to proper design of these structures.

The energy associated with flowing water has the potential to create damage to the drainage works, especially in the form of erosion. Hydraulic structures, including energy dissipators, drop structures, check structures, and bridges, all control the energy and minimize the damage potential of storm runoff.

The criteria to be used in the design of hydraulic structures shall be in accordance with the MANUAL Volume 2, Hydraulic Structures chapter. The specific criteria to be used with the modifications for the Town of Parker are presented herein.

### 6.5.1 Grade Control Structures

UDFCD has developed preferred design procedures for grade control structures which are to be utilized in open channel designs. Grade control structures allow mild, stable slopes to be constructed and maintained while also providing for a controlled and protected area for energy dissipation to occur.
Grade control structures are commonly classified as either drop structures or check structures. Drop structures may be designed and constructed to span the full 100-year channel or can be constructed with a more limited extent by only protecting the low flow portion of the drainageway. Check structures typically consist of a vertical concrete wall that traverses the entire waterway and are designed to protect the drainageway from future degradation. Check structures are frequently used in natural drainageway settings, where the intent is to protect and preserve the natural appearance of the drainageway while providing some protection against future degradation with minimal disturbance.

Guidance for the appropriate placement of grade control structures can be found in the MANUAL Volume 1, Open Channels. In addition, the design and construction of grade control structures shall follow the standards and technical criteria provided in the MANUAL Volume 2, Hydraulic Structures.

6.5.2 Conduit Outfall Protection

Bank and channel scour at culvert and storm sewer outfalls is a common problem due to the high energy dissipation resulting from rapidly decelerating and turbulent flow conditions at the outfall. In most cases riprap lining, or low-tailwater riprap basins provide satisfactory protection. Riprap protection downstream of conduit outfalls shall be designed and constructed in accordance with the standards and technical criteria in the MANUAL Volume 2, Hydraulic Structures chapter. When the hydraulic properties of an outfall exceed the parameters for riprap protection, a USBR Type IV impact basin shall be used per the MANUAL, Hydraulic Structures chapter.

6.5.3 Bridges

The hydraulic design of bridges within the Town of Parker shall be in accordance with the MANUAL Volume 2, Hydraulic Structures Chapter. The MANUAL provides guidance on the hydraulic evaluation and backwater analysis for bridge openings as well as recommendations for freeboard and scour analysis.

6.5.4 Riprap

The design of the riprap protection for culverts, channel banks, and check drop structures, bridges, or other areas subject to erosion shall be in accordance with the MANUAL Volume 1, Open Channels and Volume 2, Hydraulic Structures. For all major drainage structures and within major drainageway channels, the minimum size of riprap allowed will be Type M.

6.6 REFERENCES


5. Urban Drainage and Flood Control District, June 2001 (with revisions), Urban Storm Drainage Criteria Manual Volumes 1 and 2


7. FLOOD ROUTING AND STORAGE

7.1 INTRODUCTION

The intent of the Town's detention storage criteria is to keep downstream peak flows at or lower than historic levels. This generally means that for local drainage which flows directly across a downstream site, detention storage will be required to avoid legal and other liabilities. It is recognized that detention storage may increase the peak flow from a watershed where property is located adjacent to a major drainageway. However, to satisfy Colorado drainage law, detention storage is required. The intent of this policy is to prevent the increase of downstream peak flows over historic levels. Adequate erosion protection measures are required for all structures.

Whether or not it is planned for, all storm runoff is stored. This is true of both natural and post development conditions for any drainage basin. The purpose of managing storm runoff is to minimize the extent to which this storage takes place in inconvenient or hazardous places such as streets, basements or commercial buildings. The recognition that storm runoff is a space allocation problem is the first step toward effectively managing it in a beneficial (or least detrimental) manner (Wright-McLaughlin Engineers, 1977). In general, there are three types of flood storage: retention, detention and conveyance. Each of these may contribute in a significant way to the management of stormwater in a particular basin.

1. **Retention storage** occurs when runoff is stored without release during a flood event. An example of this type of storage is a pond or reservoir that fills up during a storm and either infiltrates into the soil or is put to some beneficial use at a later time. The volume of water stored in such a facility would essentially be removed from the flood event and would not contribute to downstream flooding.

2. **Detention storage** results from the routing of a storm hydrograph through a storage facility which has an open outlet. When the outlet capacity is less than inflow, a portion of the flood water is temporarily stored. Once the inflow falls below the outlet capacity, the stored water begins to drain out. There is usually no attempt to retain water in this type of facility beyond the time that it would normally drain out.

3. **Conveyance storage** describes the dynamic storage that takes place in channels, pipes, floodplains and other locations where water is stored in a transient form. By designing for low velocities and large cross sectional areas, conveyance storage can be used to attenuate flood peaks, and complement other types of storage.

Although retention and conveyance storage are rarely addressed in urban drainage plans, they can be used to further reduce flood peaks below levels resulting from detention storage alone. In general, the main justification for retention storage is water resource development, rather than flood control. Since water rights constraints may severely limit or prohibit such water development for the Town of Parker, the retention of stormwater is not discussed further. However, both detention storage and conveyance storage can provide outstanding stormwater management benefits.

In keeping with the Town of Parker's policy of natural drainage, the design of drainage facilities to coincide with other uses is recommended. For example, detention ponds can be constructed...
coincident with athletic fields and parks. Likewise, slow flow channels and other conveyance storage systems can be planned along bike paths and walkways. When designing multi-use storage facilities it is advisable that athletic field and active park areas be located in areas of infrequent flooding, above the inundation level of the 2-year event as a minimum.

The use of multipurpose planning by the developer/permittee can lower the cost of drainage systems, while meeting the Town requirements and reducing liability. In general, the closer to the point of rainfall that storm runoff is stored, the more efficient the storage system.

7.1.1 Regional, Sub-Regional, and On-Site Detention Facilities

There are three basic approaches for location and configuration of storage facilities which include regional, sub-regional and on-site detention.

1. **Regional detention** can be construction on-line or off-line and serves multiple property owners. Regional facilities typically serve an upstream watershed area between 130-acres and one-square mile. Regional detention is typically more cost effective to construct and maintain while providing an opportunity for a multi-use facility (i.e. park, open space, trail systems).

   Regional detention facilities are generally sited on major drainageways and are required to be designed and constructed with UDFCD approval and inspection. All regional facilities must be eligible for the UDFCD’s maintenance program upon completion. Additional discussion regarding regional detention can be found in the Storage chapter of the MANUAL.

2. **Sub-regional detention** serves multiple properties with a cumulative upstream watershed less than 130-acres. Sub-regional facilities offer many of the same benefits of regional facilities when compared to on-site detention.

3. **On-site detention** refers to a facility that serves one lot, generally commercial or industrial sites with an upstream watershed area less than 20 acres. On-site detention is less desirable than regional or sub-regional detention due to the required total land area for multiple on-site facilities when compared to regional facilities serving multiple lots. On-site facilities can also become a nuisance to the community if not properly maintained by the property owner.

The Storage chapter of the MANUAL Volume 2 provides additional discussion and illustrations of the 3 approaches for detention facility configuration.

7.1.2 Definitions

The following definitions apply to specific topics discussed in Section 7. Additional definitions can be found in Section 1.4 herein.

1. **Excess Urban Runoff Volume (EURV)** means the volume difference between developed and pre-developed runoff for the range of storms that produce runoff from pervious land surfaces, generally from the mean annual to the 100-year storm.

2. **Full Spectrum Detention (FSD)** means an extended detention basin specifically designed to capture and release 100% EURV over an extended period, plus detains the 100-year event to levels below pre-development conditions, in accordance with these criteria.

3. **Retention Storage** means the storage of stormwater runoff without release. Stormwater runoff is retained to infiltrate, evaporate or stored for other purposes.
4. **Water Quality Capture Volume (WQCV)** means the runoff retention capacity of a BMP that is designed to capture and treat, at a minimum, the 80th percentile runoff event from an entire site, i.e., 80 percent of the most frequent occurring storms are fully captured and treated and larger events are partially treated.

### 7.2 STORAGE FACILITY SIZING CRITERIA

The criteria and procedures governing the sizing and design of detention storage facilities in the Town of Parker shall be in accordance with the MANUAL Volume 2, Storage chapter, except where further qualified or superseded by specific requirements presented in this criteria manual. To ensure Town policy is consistent and up-to-date with that of the UDFCD, the MANUAL criteria are not repeated here. The developer/permittee or engineer should consult the latest version of the MANUAL to guide the planning and design of detention facilities.

#### 7.2.1 Full Spectrum Detention

In accordance with the MANUAL Volume 2, Storage Chapter, the Town of Parker requires full-spectrum detention to be implemented at all new residential subdivisions, new commercial development and new industrial development. Detention requirements for development areas with an area of two acres or less will be evaluated on a case by case basis. Use of regional or sub-regional detention ponds is strongly encouraged.

Full-spectrum detention is designed to control the peak discharge over a full spectrum of runoff events, from frequent storms up to the 100-year event. Outflow hydrographs from full-spectrum facilities replicate the volume of historic hydrographs. As a result, full-spectrum detention has been shown to reduce urban runoff peaks to levels similar to the pre-development conditions even when multiple full-spectrum detention facilities are implemented within a watershed.

#### 7.2.1.1 Excess Urban Runoff Volume

The excess urban runoff volume (EURV) is the difference between the developed condition runoff volume and the pre-development volume. The EURV is typically two to three times the water quality capture volume (WQCV) and the release rates are generally comparable. Standard criteria recommend that the WQCV portion of the EURV maintain the appropriate drain time for the type of WQCV facility used.

#### 7.2.1.2 Water Quality Capture Volume and Full-Spectrum Detention

Full-spectrum detention can be combined with WQCV treatment permanent best management practices (BMP’s). The permanent BMP’s that can be designed to incorporate full-spectrum detention include extended detention basins, retention ponds, constructed wetland ponds, sand filter basins and bioretention (rain gardens). Further discussion regarding the design of extended detention basins can be found in Section 7.3 of this chapter. Design of the other permanent BMP’s is discussed in Section 8 herein.

The Storage Chapter of the MANUAL Volume 2 provides detailed explanations and illustrations of potential configurations for WQCV, EURV and 100-year volumes for permanent BMP’s.

#### 7.2.2 Storage Volume Determination

The MANUAL Volume 2, Storage Chapter summarizes the methods for determining full-spectrum detention storage requirements. These methods include a simplified equation and the “UD-FSD”
spreadsheet. Refer to the Storage chapter of the MANUAL for additional information regarding the use of these tools for storage volume determination. It is important to regularly visit the UDFCD’s website to check for updates to the UD-FSD spreadsheet as it is subject to unannounced improvements and updates.

For sites in excess of 90 acres, hydrograph routing is required using the UDFCD approved Colorado Urban Hydrograph Procedure (CUHP) and the Storm Water Management Model (SWMM). The combined software has the capability to develop, route, and combine storm hydrographs in an integrated model. The software also allows the input of storage facilities and controlled release from storage. For sites where CUHP and SWMM analysis is required, the simplified methods discussed above are not appropriate for final design. Instead, detention requirements will be determined through the CUHP and SWMM analysis.

### 7.2.3 Storage Release Rate Determination

Peak historic unit discharges (in cfs/acre) for a watershed should be determined using the equations provided in the MANUAL Volume 2, Storage chapter. The equation varies depending upon the return period and the hydrologic soil group predominant at a site. Upper and lower limits are in place for watersheds less than 20 acres and greater than 2,000 acres. The restrictions for these basins are summarized in the MANUAL Volume 2, Storage chapter.

After determining the historic unit discharge for a watershed using the equations in the MANUAL, the rate is to be multiplied by the total tributary catchment’s area to obtain the historic peak discharge in cubic feet per second (cfs). As described in the MANUAL, the design 100-year release rate for a full-spectrum detention facility is found by multiplying the historic discharge by 90%.

### 7.2.4 Compensatory Storage

Compensatory storage is a practice wherein detention facility design is modified so that overall storage volume and release criteria for a site are met even though runoff from a portion of the site is released undetained. Compensatory storage will only be permitted in those cases where it is clearly impractical to route all runoff from the developed site through the detention facility. A common example of this may be where landscape berming along the edge of the property will direct overland runoff to the adjacent right-of-way or drainageway. When compensatory storage is permitted the following criteria must be met.

- The tributary area for use in the calculation of detention volume shall include the entire property, including those areas not routed through the detention basin.
- The total release rate from the site must be less than the historic release from the site or the release calculated using the empirical formulas, whichever is less. The total release rate from the site is the sum of the peak runoff from undetained subbasin(s) and the peak release rate from the detention facility. The peak release rate from detention storage must be adjusted to meet this criterion.
- The flows leaving the site undetained do not impact downstream properties any more than previously.

The use of compensatory storage does not, in general, relieve the developer/permittee from the requirements of water quality treatment as discussed in Section 8 herein.
7.3 STORAGE FACILITY DESIGN CRITERIA

The following sections summarize the Town’s criteria for specific design components of storage facilities within the Town of Parker. The Town requires that water quality treatment be incorporated into all storage facilities; therefore the design requirements presented in this section include the components for water quality treatment.

7.3.1 Introduction to Extended Detention Basins (EDB)

Extended detention basins provide for the slow release of the water quality capture volume which promotes sedimentation of the particulate form and some soluble form of pollutants. Extended detention basins are eligible for maintenance assistance from the Town of Parker Stormwater Management Utility, pending approval from the Town. All extended detention basins constructed within the Town require an Operations and Maintenance Plan as described in Section 8.3.6 herein, unless the facility is intended to be accepted into the Town’s Stormwater Management Utility for maintenance assistance and the Developer/Permittee follows the acceptance procedures as described in Section 3.3.2 herein and the Roadway Manual.

7.3.2 Base Design Information

Extended detention basins are to be designed in accordance with the Storage Chapter of the MANUAL Volume 2, as supplemented by this Manual. An extended detention basin is typically combined with Excess Urban Runoff Volume and 100-year detention. Discussion and criteria for Excess Urban Runoff Volume and 100-year detention are described in Section 7.2 herein.

Extended detention basins may be used as a sub-regional or regional water quality detention facility or as an on-site water quality facility for those cases where a sub-regional or regional approach is not possible. Extended detention basins shall comply with the selection criteria shown in Table 8.2 herein.

7.3.3 Excavated or Embankment Slopes

All excavated or embankment slopes from the pond bottom to the 100-year water surface elevation shall be no steeper than 4 (horizontal) to 1 (vertical). Excavated slopes above the 100-year water surface elevation and the slope on the downstream side of embankments shall be 3 to 1 or flatter. Embankments shall be provided with a top width of at least 10-feet. An emergency overflow spillway shall be provided as described in Section 7.3.12 herein. All earthen slopes shall be covered with a minimum of 6-inches of topsoil and revegetated.

It is the responsibility of the design engineer to ensure that the design of any earthen embankment is based on specific recommendations of a geotechnical engineer. In addition, the design and construction of large embankments or dams may fall under the jurisdiction of the Office of the State Engineer.

7.3.4 Freeboard Requirements

The minimum required freeboard for detention facilities is 1.0-foot above the computed water surface elevation assuming the outlet is blocked and the emergency spillway is conveying the future development 100-year undetained discharge (or the maximum design flow, whichever is greater). Section 7.3.12 herein provides design information for the emergency spillway and embankment protection.
7.3.5 Inlet Facilities

Unless otherwise accepted by the Town, runoff shall enter a detention facility via a stabilized drainageway, a 100-year drop structure, sheet flow over stable, irrigated grasses or a storm sewer with energy dissipater. Riprap rundowns are generally not accepted due to a history of erosion problems.

7.3.6 Sediment Forebay

Forebays provide locations for debris and coarse sediment to drop out and accumulate, extending the functionality of the main portion of an extended detention basin. Forebays shall be sized based on the MANUAL, Volume 3. Figures 7.1 and 7.2 herein show concepts for concrete lined and boulder lined sediment forebays, both approved by the Town.

7.3.7 Low Flow Channels

All grassed-bottom detention ponds shall include a low flow channel sized to convey a minimum of 1% of the 100-year peak inflow. The low flow channel shall be constructed of concrete; concrete with boulder edges, soil-riprap, or other materials accepted by the Town and shall have a minimum depth of 0.5-feet. The minimum longitudinal slope shall be 0.5-percent and this longitudinal slope should ensure that non-erosive velocities are maintained adjacent to the low flow channel when the design capacity is exceeded.

If accepted by the Town, an unlined low flow channel may be used. The unlined low flow channel shall be at least 1.5-feet deep below adjacent grassed benches and shall be vegetated with herbaceous wetland vegetation or riparian grasses, appropriate for the anticipated moisture conditions. The minimum longitudinal slope shall be 0.5-percent and the minimum width of the grassed bench adjacent to the low flow channel shall be 10-feet where equipment can access. The maximum side slope below the bench shall be 4 to 1 and the maximum bottom width of the channel shall be 12-feet.

Typical cross-sections of low flow channels are shown in Figure 7.3 herein.

7.3.8 Bottom Slope

For grassed detention facilities with lined low flow channels, the pond bottom shall be sloped at least 4-percent for the first 25-feet and at least 1- to 2-percent thereafter to drain toward the low flow channel or outlet, measured perpendicular to the low flow channel. The benches above unlined low flow channels, if approved, shall slope at least 1- to 2-percent toward the low flow channel.

7.3.9 Micropool

Micropools are an essential part of EDB function, as they are designed in conjunction with the trashrack protecting the control orifices to reduce the potential for trashrack and orifice plugging. The trashrack is designed to extend down to the bottom of the micropool. The micropool functions to keep the middle portion of the trashrack clear. Sediment accumulates on the bottom of the pool and floatable debris accumulates on the top. Experience has shown that extended detention basins that have been constructed without micropools tend to clog at the orifices or trashrack and result in shallow flooding and boggy conditions in the bottom of the pond. Micropools SHALL be integrated into the outlet.
structure as shown in Figure 7.5 herein. Provisions for safety and maintenance access such as steps, ramps or a sloped perimeter bench shall be provided.

7.3.10 Outlet Structure

Detention basin outlets shall be functional for controlling the design release rates, provided with oversized safety/debris grates to reduce the potential for debris plugging, easy to maintain, and designed with favorable aesthetics. Outlet structures include a column of orifices to control releases from the Water Quality Capture Volume and Excess Urban Runoff Volume (sized based on the Storage Chapter of the MANUAL Volume 2). Outlet structures also include a trash rack to protect the orifices and a drop box for flood flows with a grate and control orifice.

Figure 7.5 herein is a standard detail for an EDB outlet structure for full spectrum detention. The flood-flow orifice shall be sized to provide the allowable 100-year release rate when the 100-year detention volume is completely full. The weir crest at the top of the Excess Urban Runoff Volume shall pass the allowable 100-year release rate at a head that is at least 0.5-feet below the completely-full 100-year volume, maintaining control at the 100-year orifice in the design event.

Orifice spacing may be adjusted based on the discussion in the next section if approved by the Town. A sealant must be specified behind the orifice plate to prevent leakage around the plate. All hydraulic sizing, concrete structure dimensions, reinforcing, and metalwork details for outlet structures shall be the responsibility of the design engineer.

7.3.11 Trash Racks

The minimum net open area of the trash rack protecting the Excess Urban Runoff Volume orifices and the flood control orifice shall comply with Figure OS-1 of the MANUAL Volume 3’s Treatment BMP Fact Sheets. The safety grate criteria discussed in the Culverts section of the MANUAL Volume 1 shall also apply. The trash rack protecting the orifices must extend to the bottom of the micropool so that flow can pass through the rack below the level of any floating debris and make its way through the orifices.

If the control orifices are 2.5-inches or greater in diameter or 2-inches square, standard fabricated bar grating (with nominal openings of 1- by 4-inches) may be used as a debris grate instead of well-screen. The larger grate may reduce the potential for clogging with debris. If approved by the Town, the vertical spacing between orifices may be increased to 8-inches or 12-inches and the orifice areas increased by a factor of two (for 8-inch spacing) or three (for 12-inch spacing) to enable larger orifices and larger trash rack openings.

Bar grating may be used on parallel sloping wingwalls, either as the primary debris grate (if orifices are at least 2.5 inches in diameter) or as a course screen and safety grate in lieu of handrail. Sloping bar grating shall have one hinged section at least 2-feet square to allow access to the orifice plate or well-screen. Manhole steps shall be provided on the side of the wingwall directly under the hinged opening. A 3.5 inch by 18 inch opening should be provided in front of the well-screen/orifice plate to allow quick access with a rake for clearing the well-screen/orifice plate. The bearing bars for steel bar grating shall be designed to withstand hydrostatic loading up to the spillway crest (assuming the grate is clogged and bears the full hydrostatic head), but generally not designed for larger loads (like vehicular
loads) so that the hinged panels are not excessively heavy. Panels of bar grating shall be no more than 3-
feet wide and all parts of the grating and support frames shall be hot-dipped galvanized. Bar grating shall
be fastened down to the outlet structure. See Figure 7.5 herein for additional information regarding	rash rack layout and other requirements.

7.3.12 Emergency Spillway and Embankment Protection

Whenever a detention basin uses an embankment to contain water, the embankment shall be protected
from catastrophic failure due to overtopping. Overtopping can occur when the pond outlet becomes
obstructed or when a storm larger than a 100-year event occurs. Erosion protection for the
embankment may be provided in the form of a buried riprap layer on the entire downstream face of the
embankment or a separate emergency spillway constructed of buried riprap or concrete. In either case,
the protection shall be constructed to convey the 100-year developed flow from the upstream
watershed without accounting for any flow reduction within the detention basin.

The invert of the emergency spillway shall be set at the 100-year water surface elevation. A concrete
wall shall be constructed at the emergency spillway crest extending at least to the bottom of the riprap
and bedding layers located immediately downstream. The crest wall shall be extended at the sides up
to one foot above the emergency spillway design water surface.

Riprap embankment protection shall be sized based on methodologies developed specifically for
overtopping embankments. Two such methods have been documented by Colorado State University
(USNRC, 1988) and by the US Department of Agriculture (ASAE, 1998) and designers are referred to
these publications for a complete description of sizing methodology and application information. Figure
7.6 herein illustrates typical rock sizing for small (under 10-feet high) embankments based on these
procedures that may be used during preliminary design to get an approximate idea of rock size. Final
design shall be based on the more complete procedures documented in the referenced publications. The
thickness and bedding requirements shall be based on the criteria identified in the MANUAL.

The emergency spillway is also needed to control the release point and direction of the overflow. The
emergency spillway and the path of the emergency overflow downstream of the spillway and
embankment shall be clearly depicted on the drainage plan. Structures shall not be permitted in the
path of the emergency spillway or overflow. The emergency overflow water surface shall be shown on
the detention facility construction drawings.

7.3.13 Retaining Walls

The use of retaining walls within detention basins is generally discouraged due to the potential increase
in long-term maintenance costs and concerns regarding the safety of the general public and maintenance
personnel. If retaining walls are proposed, footings shall be located above the Excess Urban Runoff
Volume. Wall heights not exceeding 30-inches are preferred, and walls shall not be used on more than
50-percent of the pond circumference. If terracing of retaining walls is proposed, adequate horizontal
separation shall be provided between adjacent walls. The horizontal separation shall ensure that each
wall is loaded by the adjacent soil, based on conservative assumptions regarding the angle of repose.
Separation shall consider the proposed anchoring system and equipment and space that would be
needed to repair the wall in the event of a failure. The failure and repair of any wall shall not impact or
affect loading on adjacent walls. In no case shall the separation be less than 2 times the adjacent wall
height, such that a plane extended through the bottom of adjacent walls shall not be steeper than 2 (horizontal) to 1 (vertical). The maximum ground slope between adjacent walls shall be 4-percent.

Walls shall not be used where live loading or additional surcharge from maintenance equipment or vehicle traffic could occur. The horizontal distance between the top of a retaining wall and any adjacent sidewalk, roadway, or structure shall be at least three times the height of the wall. The horizontal distance to any maintenance access drive not used as a sidewalk or roadway shall be at least 4-feet. Any future outfalls to the pond shall be designed and constructed with the detention basin out to a distance sufficient to avoid disturbing the retaining walls when the future pipeline is connected to the outfall.

Any wall exceeding a height of 30-inches requires perimeter fencing, safety railing, or guardrail depending on the location of the wall relative to roadways, parking areas, and pedestrian walkways. Any wall exceeding a height of 4-feet (measured from the bottom of the footing to the top of the wall) requires a Building Permit.

A Professional Engineer licensed in the State of Colorado shall perform a structural analysis and design the retaining wall for the various loading conditions the wall may encounter; including the differences in hydrostatic pressure between the front and back of the wall. A drain system should be considered behind the wall to ensure that hydrostatic pressures are equalized as the water level changes in the pond. The wall design and calculations shall be stamped by the professional engineer and submitted to the Town. The structural design details and requirements for the retaining wall(s) shall be included in the construction drawings.

Retaining walls shall not be used within the limits of any impermeable lining of water quality basins or detention ponds.

**7.3.14 Landscaping Guidelines**

Integration of detention and site landscaping requirements is encouraged. Consideration to the type and quantity of landscaping materials should be given, to ensure that the capacity of the pond is maintained, and that future maintenance activities can be performed with minimal disruption of vegetated areas. All proposed landscaping within water quality facilities shall be shown on the landscaping plans included in the overall civil construction plan set. The following is a list of recommendations for pond grading and landscaping:

a. Wherever possible, involve a landscape architect in the design of detention facilities to provide input regarding layout, grading, and the vegetation plan.

b. Create a basin with a pleasing, natural shape that is characterized by variation in the top, toe, and slopes of banks. Avoid boxy, geometric patterns that are easy to draw using CAD. Better results are usually achieved by creating a grading plan by hand and then smoothly digitizing the proposed contours in to the design drawings. A “golf course look” is more attractive than straight lines and straight slopes.

c. Grass selection and plant materials are both key in softening the appearance of a detention area and blend it in with the surrounding landscaping and natural features. Species are to be suitable for the particular hydrologic conditions in the basin; with wetland or riparian species selected for the
bottom areas subject to frequent and prolonged inundation. Bluegrass rarely works well in the lowest, water quality portion of a basin. Guidelines for revegetation, along with recommended seed mixes, are provided in the MANUAL.

d. Multipurpose detention facilities are encouraged with recreation activities such as passive open space areas, pedestrian paths, children’s play areas, and active recreation areas. It is recommended that active recreation facilities be located above the EURV water surface to avoid frequent inundation.

e. To reduce the potential for clogging of debris grates, no straw mulch shall be used within the Excess Urban Runoff Volume of a detention basin. Instead, erosion control blanket shall be installed for a width of at least 6-feet on both sides of the concrete low flow channels or up to a depth of 1-foot in soil riprap or benched low flow channels. Additionally, hydraulically applied wood fiber mulch, stabilized fiber matrix, or flexible growth medium shall be used in all other areas within the Excess Urban Runoff Volume pool of the detention basin. The blanket and hydraulically applied mulch shall comply with the materials and installation requirements for erosion control blankets as required by the Town’s CBMP program, and where applicable, the product manufacturer. Additional blanket or other erosion control measures may be required by the Town.

f. Trees shall not be planted within the excess urban runoff volume or within the limits of the detention basin spillway. Trees such as Cottonwood, Willow, and Aspen shall not be planted within the 100-year water surface of a detention basin to avoid nuisance spreading of root systems within the facility.

7.3.15 Designing for Maintenance

Detention facilities shall be designed to facilitate ongoing maintenance operations. The following provisions for maintenance shall be required:

Access for Sediment Removal
A stable access and working bench shall be provided so that equipment can remove accumulated sediment and debris from the detention basin and perform other necessary maintenance activities at all components of the facility. Unless otherwise approved by the Town, the horizontal distance from the working bench to the furthest point of removal for the forebay, bottom of the detention basin, or outlet structure shall be no more than 24-feet. The working bench and access drive shall slope no more than 10-percent. The maintenance access drive shall be a minimum of 10-feet wide in straight segments, 12-feet wide for a centerline radius of 80-feet and greater and at least 14-feet wide for a centerline radius between 50- and 80-feet. The minimum centerline radius shall be 50-feet. Unless otherwise approved, the working bench and access drive shall be constructed of the following materials:

Below EURV water surface: A 12-inch thick layer of 3-inch to 4-inch fractured face granite mixed with Class 6 roadbase, on top of Tensar® BX1100™ Geogrid, Marifi® BasXGrid 11™ or approved equal. Refer to Figure 7.4 herein.
Above the **Excess Urban Runoff Volume**: The access ramp shall be a minimum 8-inch thick layer of 3-inch to 4-inch fractured face granite mixed with Class 6 roadbase, on top of Tensar® BX1100™ Geogrid, Marifi® BasXGrid 11™ or approved equal. Refer to Figure 7.4 herein.

The use of reinforced turfgrass meeting applicable UDFCD criteria, if proposed in this zone for an access drive, will be considered by the Town on a site-specific basis. If used, a system of marking the edges is required so that its location is evident to maintenance crews. Also, shrubs, trees, sprinkler heads and valve boxes shall not be located in the reinforced turfgrass area.

As stated above, any retaining walls shall to be laid out in a manner that avoids access restrictions. Any handrails or fences, likewise, shall permit vehicular access. The entrance to an access drive from a roadway or parking lot shall be located so that traffic safety is not compromised.

**Other Improvements to Facilitate Maintenance**

Other improvements that could facilitate maintenance operations in the future are encouraged. These could include:

a. Providing adequate room for staging the equipment involved in clean-out operations.

b. Providing a power receptacle adjacent to the detention basin to enable dewatering operations using an electric pump. Electric pumps are quieter and require less attention in the event pumps need to operate overnight.

c. For larger, natural sites, it may be worthwhile to reserve a suitable location for disposing sediment that is cleaned out of the pond. This has to be carefully thought through, however, to make sure it is feasible to dump the material on-site, allow it to dry, then spread it and re-seed and much the area, without causing erosion problems.

d. Designing configuration and dimensions of grates to allow debris to be raked off using standard garden tools.

**7.3.16 Modified Extended Detention Basins**

On a site-specific basis, the Town may allow modified extended detention basins on small sites, as shown in Table 8.2 herein. Figure 7.7 herein shows a representative layout of a modified extended detention basin for a small site, if approved. Modified extended detention basins shall utilize sediment forebays integrated into pipe outfalls, as shown in Figure 7.8 herein and an outlet structure with an integral micropool as shown in Figures 7.9 herein. The sediment forebays should be sized according to the MANUAL Volume 3, or as approved by the Town. A maintenance road and a forebay access ramp is not necessary for a modified extended detention basin assuming maintenance operations can be completed using shovels, wheelbarrows, etc. The Town reserves the right to require maintenance access roads/benches as deemed feasible or where maintain access is of great concern to the Town.

**7.3.17 Plan Requirements**

Plan submittal requirements for standard and modified extended detention basins shall meet the same requirements set forth for all Permanent BMP Plans as outlined in Section 8.3.1 herein.
7.4 ADDITIONAL TYPES OF STORAGE

There are a variety of ways that detention storage can be provided in addition to an extended detention basin. Some of these are discussed herein. Special approval is required from the Town if a permittee/developer would like to use any of these methods to reduce peak runoff to historic conditions.

7.4.1 Rooftop Storage

Although many designers reject this alternative, rooftop storage offers an alternative in difficult applications for highly impervious sites with relatively little parking or landscaped area. Maximum depth should be no more than four inches. A special outlet control ring, provided by manufacturers for their roof drains, can serve as a control for runoff rates.

7.4.2 Parking Lot Storage

Use of parking lots for detention storage is discouraged and will be considered on a case by case basis by the Public Works Director. However, under certain circumstances it may be feasible to allow the 100-year water surface to extend into parking areas adjacent to the onsite detention pond. In no case should the ponding depth for the 100-year event exceed 9-inches anywhere in the parking lot. In no case shall the ponded water surface associated with runoff detention for the EURV extend into any parking lot.

To assure that the detention facility performs as designed, any repaving of the parking lot shall be evaluated for impact on volume and is subject to approval by the Public Works Department.

7.4.3 Underground Storage

Underground storage facilities may be considered on a case by case basis by the Public Works Director for smaller sites with unusual site constraints. Underground storage is not preferred because of the reduced opportunity for infiltration and evaporation, maintenance, access, and cost. Where underground storage is approved for use, water quality treatment shall still be required to be provided above ground.

7.4.4 Slow–Flow Drainageways

Relatively flat, wide, slow-velocity grass channels can have a remarkable effect on peak runoff rates, even if a significant amount of conveyance storage is not available. Caution should be exercised where infiltration of stormwater would cause problems such as saturating expansive soils. In these areas, there may have to be a trade-off between storage requirements and potential structural problems. An extension of the slow-flow concept is to provide small checks or weirs on the downstream ends of swales or channels, creating a network of linear reservoirs. Often, these slow-flow channels can be designed to replace (or at least reduce the number of) storm sewers.

7.4.5 Farm Ponds

Small ponds in rural areas built by farmers or soil conservation programs typically provide some flood routing benefit due to their retention storage effect. However, these ponds are sometimes constructed without adequate design and erosion protection to prevent washing out. Many are designed for the 25-year storm, under undeveloped watershed conditions, which means that they may overtop during the 100-year event upon which major drainage planning is based. Therefore, their stormwater detention or retention benefits should not be relied upon unless embankments are properly designed and constructed. Because of the possibility of their failure during a severe thunderstorm, it may be
prudent to breach these dams for public safety reasons. In any event, careful analysis of these ponds should be undertaken where they exist upstream of potential development. A review of the classification of such dams with the State Engineer's Office should be accomplished as an absolute minimum.

### 7.5 REFERENCES


4. Urban Drainage and Flood Control District, November 2010 (with revisions), Urban Storm Drainage Criteria Manual Volume 3

5. Urban Drainage and Flood Control District, June 2001 (with revisions), Urban Storm Drainage Criteria Manual Volumes 1 and 2


FIGURE 7.1
STANDARD EXTENDED DETENTION BASIN (EDB)
CONCRETE LINED FOREBAY DETAILS

FOREBAY PLAN

SECTION A

FOREBAY NOTES:
1. It is the responsibility of the design engineer to determine if a handrail should be included. Handrails are recommended for structures adjacent to coarse grating and/or where pedestrian traffic will be in close proximity of the structure.
2. It is the responsibility of the design engineer to size, design and detail all forebay structures, including, but not limited to, the required steel reinforcement in concrete structures.
FIGURE 7.2
STANDARD EXTENDED DETENTION BASIN (EDB)
BOULDER LINED FOREBAY DETAILS

FOREBAY PLAN

FOREBAY NOTES:
1. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DETERMINE IF A HANDRAIL SHOULD BE INCLUDED. HANDRAILS ARE RECOMMENDED FOR STRUCTURES ADJACENT TO COARSE GRATING AND/OR WHERE PEDESTRIAN TRAFFIC WILL BE IN CLOSE PROXIMITY OF THE STRUCTURE.
2. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO SIZE, DESIGN AND DETAIL ALL FOREBAY STRUCTURES, INCLUDING, BUT NOT LIMITED TO, THE REQUIRED STEEL REINFORCEMENT IN CONCRETE STRUCTURES.

SECTION 7. FLOOD ROUTING AND STORAGE
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FIGURE 7.3
STANDARD EXTENDED DETENTION BASIN (EDB)
TRICKLE CHANNEL DETAILS

CONCRETE LINED

RIPRAP LINED
MUST BE APPROVED BY TOWN PRIOR TO USE

BENCHED SYSTEM (UNLINED)
MUST BE APPROVED BY TOWN PRIOR TO USE

NOTE:
SOIL RIPRAP SHALL BE SIZED BY ENGINEER BASED ON ACTUAL HYDRAULIC CONDITIONS.
FIGURE 7.4
STANDARD EXTENDED DETENTION BASIN (EDB)
MAINTENANCE ROAD DETAILS

CROSS SECTION
ABOVE EURV WATER SURFACE

CROSS SECTION
BELOW EURV WATER SURFACE
FIGURE 7.5
STANDARD EXTENDED DETENTION BASIN (EDB)
OUTLET STRUCTURE DETAILS

OUTLET STRUCTURE NOTES:
1. THE DESIGN ENGINEER IS ENCOURAGED TO ELIMINATE THE NEED FOR A WELL SCREEN BY INCREASING CONTROL ORIFICES TO A MINIMUM OF 2.5 INCHES IN DIAMETER OR 2 INCHES SQUARE WITH A MAXIMUM OF 12 INCHES VERTICAL SPACING PER THE REQUIREMENTS DISCUSSED IN SECTION 7.3.11.
2. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DETERMINE IF A HANDRAIL SHOULD BE INCLUDED. HANDRAILS ARE RECOMMENDED FOR STRUCTURES ADJACENT TO COARSE GRATING AND/OR WHERE PEDESTRIAN TRAFFIC WILL BE IN CLOSE PROXIMITY OF THE STRUCTURE.
3. "STANDARD BAR GRATING" REFERS TO METAL BAR GRATING WITH A NOMINAL OPENING OF 1 INCH BY 4 INCHES. BEARING BARS FOR STANDARD BAR GRATING SHALL BE Sized FOR A UNIFORM LOAD BETWEEN 100 AND 150 POUNDS PER SQUARE FOOT.
4. "COARSE BAR GRATING" REFERS TO METAL BAR GRATING WITH MAXIMUM CLEAR SPACING OF 4".
5. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO SIZE, DESIGN AND DETAIL ALL EDB STRUCTURES, INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING:
   • STEEL REINFORCEMENT IN CONCRETE STRUCTURES
   • ORIFICE PLATE, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   • WELL SCREEN, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   • STANDARD BAR GRATING, INCLUDING HINGED PANEL AND CONNECTION TO CONCRETE STRUCTURE
   • COARSE BAR GRATING, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   • STEEL TABS USED TO HOLD BAR GRATING INTACT, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   • ALL OTHER METAL WORK CONNECTIONS NECESSARY FOR CONSTRUCTION OF THE OUTLET STRUCTURE.
FIGURE 7.6
STANDARD EXTENDED DETENTION BASIN (EDB)
EMERGENCY SPILLWAY DETAILS AND ROCK SIZING CHART

PROFILE

CHANNEL SECTION
(AT CREST AND ON DOWNSTREAM SIDE OF EMBANKMENT)
FIGURE 7.7
MODIFIED EXTENDED DETENTION BASIN (EDB)
EXAMPLE PLAN

NOTES:
1. THE TRICKLE CHANNEL FOR MODIFIED EXTENDED DETENTION BASINS SHALL CONFORM TO THE DETAILS FOR STANDARD EXTENDED DETENTION BASINS. THE WIDTH OF THE CONCRETE TRICKLE CHANNEL MAY BE REDUCED TO A MINIMUM OF 2" WIDE.

2. EMERGENCY SPILLWAY FOR MODIFIED EXTENDED DETENTION BASINS SHALL MEET THE REQUIREMENTS FOR STANDARD EXTENDED DETENTION BASINS. DOWNSTREAM ROCK LINING CAN BE ELIMINATED FOR EMBANKMENTS LESS THAN 1" IN HEIGHT.
FIGURE 7.8
MODIFIED EXTENDED DETENTION BASIN (EDB)
FOREBAY DETAILS

FOREBAY NOTES:
1. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DETERMINE IF A HANDRAIL SHOULD BE INCLUDED. HANDRAILS ARE RECOMMENDED FOR STRUCTURES ADJACENT TO COARSE GRATING AND/OR WHERE PEDESTRIAN TRAFFIC WILL BE IN CLOSE PROXIMITY OF THE STRUCTURE.
2. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO SIZE, DESIGN AND DETAIL ALL FOREBAY STRUCTURES, INCLUDING, BUT NOT LIMITED TO, THE REQUIRED STEEL REINFORCEMENT IN CONCRETE STRUCTURES.
FIGURE 7.9
MODIFIED EXTENDED DETENTION BASIN (EDB)
OUTLET STRUCTURE DETAILS

OUTLET STRUCTURE PLAN

OUTLET STRUCTURE NOTES:
1. THE DESIGN ENGINEER IS ENCOURAGED TO ELIMINATE THE NEED FOR A WELL SCREEN BY INCREASING CONTROL ORIFICES TO A MINIMUM OF 2.5 INCHES IN DIAMETER OR 2 INCHES SQUARE WITH A MAXIMUM OF 12 INCHES VERTICAL SPACING PER THE REQUIREMENTS DISCUSSED IN SECTION 7.3.11.
2. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DETERMINE IF A HANDRAIL SHOULD BE INCLUDED. Handrails are recommended for structures adjacent to coarse gratings and/or where pedestrian traffic will be in close proximity of the structure.
3. "STANDARD BAR GRATING" REFERS TO METAL BAR GRATING WITH A NOMINAL OPENING OF 1 INCH BY 4 INCHES. Bearing bars for standard bar grating shall be sized for a uniform load between 100 and 150 pounds per square foot.
4. "COARSE BAR GRATING" REFERS TO METAL BAR GRATING WITH MAXIMUM CLEAR SPACING OF 4.".
5. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO SIZE, DESIGN AND DETAIL ALL EDB STRUCTURES, INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING:
   - STEEL REINFORCEMENT IN CONCRETE STRUCTURES
   - ORIFICE PLATE, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   - WELL SCREEN, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   - STANDARD BAR GRATING, INCLUDING HINGED PANEL AND CONNECTION TO CONCRETE STRUCTURE
   - COARSE BAR GRATING, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   - STEEL TABS USED TO HOLD BAR GRATING INTACT, INCLUDING CONNECTION TO CONCRETE STRUCTURE
   - ALL OTHER METAL WORK CONNECTIONS NECESSARY FOR CONSTRUCTION OF THE OUTLET STRUCTURE.
8. ENVIRONMENTAL CRITERIA

8.1 GENERAL PROVISIONS

8.1.1 Purpose

The purpose of the Town of Parker’s Environmental Criteria is to provide recommended substantive requirements to control the quality of stormwater runoff in the Cherry Creek Basin from private and public property and to reduce the loads of contaminants reaching Cherry Creek and Cherry Creek Reservoir in furtherance of health, safety, and general welfare in the Cherry Creek Basin. These criteria apply to both construction and post-construction development. In addition, the recommended stormwater quality Best Management Practice (BMP) requirements set forth in these criteria, or BMP requirements substantially equivalent hereto, are necessary to reduce and maintain nonpoint source phosphorus loads, in accordance with the Cherry Creek Control Regulation.

The criteria and procedures presented in this Chapter abide by the requirements of Regulation 61 of the Colorado Discharge Permit System (CDPS) as amended, Regulation 72 – Cherry Creek Reservoir Control Regulation as amended, and are also intended to satisfy the Town’s obligation for meeting the construction site stormwater runoff control and post-construction stormwater management minimum measures that are required under the CDPS Phase II general permit, as discussed in Section 2.1.5 herein.

8.1.2 Authority

As a Land Use Agency in the Cherry Creek Basin, the Town of Parker is required to implement water quality controls as adopted by the Cherry Creek Basin Water Quality Authority (Authority). These controls are in addition to those that are required under the CDPS Phase II General Permit. The Authority is a quasi-municipal corporation and political subdivision of the State that has primary responsibility for water quality in the Cherry Creek Basin. The Authority is specifically empowered to develop and implement plans for water quality controls for the Reservoir, drainage basin and watershed (Authority's enabling legislation --C.R.S. § 25-8.5-101, et seq.).

The criteria presented in this section are adapted from the Authority’s Control Regulation 5 CCR 1002-72, Stormwater Permit Requirements Guidance Document, (“Guidance Document”) as published by the Authority on April 11, 2011. The adoption and implementation of environmental criteria based on the model ordinance is an integral part of the Authority's Master Plan and water quality controls for the Cherry Creek Basin.

The CDPS Phase II General Permit as well as the Authority’s Guidance Document provides the basis for the Town’s environmental criteria. In certain circumstances, and when allowable under the regulations, the Town’s criteria may differ from the Phase II General Permit and/or Guidance Document. These special provisions are included to address particular concerns of the Town, or to preserve existing practices that have proven successful in the Town.

8.1.3 General Requirements

These environmental criteria require the implementation of temporary (construction) and permanent stormwater quality BMPs for Land Disturbances, as defined in Section 1.4(23) herein, in the Town of Parker. Developers/permittees applying for a Land Disturbance must submit and receive approval for
site-specific BMP plans that delineate the BMP measures to be taken at Development sites. Land Disturbances are prohibited unless in compliance with the Construction BMP (Section 8.2 herein) and Permanent BMP (Section 8.3 herein) requirements of these criteria. Land Disturbances at Industrial Facilities also must comply with the Industrial Permanent BMP requirements delineated in Section 8.4 herein. Agricultural Activity Land Disturbances shall comply with the Agricultural BMP requirements identified in Section 8.5 herein, and Land Disturbances in Stream Preservation Areas, as defined in Section 8.1.4.5(8) herein, must comply with the special requirements and procedures set forth in Section 8.6 herein.

8.1.4 Applicability

8.1.4.1 Regulated Activities

These requirements apply to Land Disturbance activities in the Town of Parker that disturb land, including, but not limited to, the following:

a) Clearing, grading, or excavation of land;

b) Construction, including expansion or alteration, of a residential, commercial or industrial site or Development;

c) Any construction activity that requires a Town of Parker Grading Permit.

d) Any construction activity that requires a permit from the Water Quality Control Division for stormwater discharges associated with construction activity or industrial activity; and

e) Construction of public improvements and facilities such as roads, transportation corridors, airports, and schools.

8.1.4.2 Exclusions

The following activities are automatically excluded from the construction site stormwater runoff control requirements:

a) Agricultural Activities; (i.e., agricultural and silvicultural activities generating nonpoint source discharges, including runoff from orchards, cultivated crops, pastures, range lands, and forest lands, but not CAFOs. This exclusion does not extend to the construction of facilities or other activities generating stormwater runoff associated with industrial (i.e., construction) activity);

b) Emergency and routine repair and maintenance operations for all underground utilities;

c) Land disturbances at residential or commercial subdivisions that already have adequate Construction BMPs and Post-construction BMPs installed and operating for the entire subdivision, approved in compliance with this regulation, and where the original owner who obtained approval retains legal authority;

d) Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility (maintenance operations performed by the permittee may still be covered under Municipal Operations minimum control measure); and

e) Emergency operations related to flood, fire, or other force majeure.

The following activities may be excluded from the construction site stormwater runoff control requirements if authorized through a developed procedure for determination that water quality is
adequately protected without imposing the requirements. This procedure may either be on a site-specific basis, upon submission by the owner of a written request for exemption to the permittee, or, if the determination can be simplified to allow for determination by the owner, through certification by the owner to the permittee that the waiver criteria have been met.

a) Construction of a sidewalk or driveway; and

b) Underground utility construction including the installation and maintenance of all utilities under hard surfaced roads, streets, or sidewalks, provided such land disturbance activity is confined to the area which is hard surfaced and provided that stormwater runoff and erosion from soil and materials stockpiles are confined and will not enter the drainage system.

For specific situations that have not been identified, and when in conformance with the regulations, the Town of Parker reserves the right to determine when the requirements are and are not applicable.

8.1.4.3 Individual Homes

Individual Home Constructions, as defined in Section 8.1.4.5(1) herein, are included within the scope of this ordinance, but such activities are subject only to the specific requirements provided in Section 8.2.3 herein.

8.1.4.4 Stream Preservation Areas

This ordinance provides special requirements and procedures for Land Disturbances in Stream Preservation Areas, which, in the Town of Parker, includes lands overlying the Cherry Creek alluvium; and all lands within 100-year floodplains, as recognized by Urban Drainage Flood Control District (UDFCD).

The Stream Preservation Areas can be modified if site-specific alluvium and groundwater recharge data demonstrate a more constrained area.

8.1.4.5 Definitions

The following definitions apply to specific topics discussed in Section 8 herein. Additional definitions can be found in Section 1.4 herein.

1. **Individual Home Construction** means any Land Disturbance or Development for a single home, not including Land Disturbances for roads, road gutters or road improvements, that disturbs less than one acre of land and where the Owner of the single home holds a permit for construction of only one dwelling within the subdivision, if any, containing the single home.

2. **Industrial and Commercial Activity** for the purpose of this section of the SDECM, means manufacturing; material, and product handling, including loading and unloading; vehicle and equipment maintenance, storage, parking, and washing; waste containment, painting, material and product storage; and fueling areas.

3. **Roadway Maintenance** for the purpose of this section of the SDECM, means activities associated with the maintenance, repair, preservation, and associated minor modifications to roadways, and associated appurtenant features that do not permanently change the original footprint of the roadway surfaces.

4. **Stream Preservation Areas** means those areas within the Town of Parker that transport a higher percentage of stormwater runoff and associated pollutants to the water system and Reservoir.
Stream Preservation Areas for the Town of Parker include lands overlying the Cherry Creek alluvium; and all lands within 100-year floodplains, as recognized by FEMA and/or the Town of Parker.

Stream Preservation Areas for the Cherry Creek mainstem channel are defined as the Cherry Creek alluvium or 100-year floodplain, as defined by FEMA, whichever is greater. Stream Preservation Areas for Cherry Creek tributary channels are defined as the 100-year floodplain, as defined by FEMA. Stream Preservation Areas can be modified if site-specific alluvium and groundwater recharge data demonstrate a more constrained area. Drainage tributary areas less than 160 acres are not subject to the stream preservation area provision.

5. **Tier 1 Development and Redevelopment** as defined by the Control Regulation, 5 C.C.R. 1002-72 § 72.7(1)(f), means any land disturbance less than one acre that is developed independently of a larger common plan of development or sale, and which results in less than 500 square feet of imperviousness for new development or 500 square feet of increased imperviousness for redevelopment.

6. **Tier 2 Development and Redevelopment** as defined by the Control Regulation, 5 C.C.R. 1002-72 § 72.7(1)(g), means any land disturbance less than one acre that is developed independently of a larger common plan of development or sale, and which results in more than 500 square feet but less than 5,000 square feet of imperviousness for new development, or more than 500 square feet and less than 5,000 square feet of increased imperviousness for redevelopment, including disturbances of existing impervious areas.

7. **Tier 3 Development and Redevelopment** as defined by the Control Regulation, 5 C.C.R. 1002-72 § 72.7(1)(h), means any land disturbance greater than one acre, or which results in more than 5,000 square feet of imperviousness for new development or 5,000 square feet of increased imperviousness for redevelopment, including disturbances of existing impervious areas.

8.2 **CONSTRUCTION BMP REQUIREMENTS**

When necessary, temporary construction erosion and sediment controls (CBMPs) shall be implemented for all Land Disturbances and Developments identified in Section 8.1.4.1 herein, within the Town of Parker, with the exception of Individual Home Construction as discussed in Section 8.2.3 herein. The purpose of this requirement is to minimize soil erosion, sedimentation and the conveyance of other potential pollutants in an effort to protect water quality and soil surfaces during and after construction.

The CBMPs for Land Disturbances will be approved during the development review process and prior to the issuance of a grading permit. All initial-stage CBMPs must be installed and approved prior to the issuance of the Grading Permit. Initial-stage CBMPs may include:

1. Perimeter sediment control devices,
2. Construction fence,
3. Inlet protection on existing inlets,
4. Vehicle Tracking Control (VTC) pads,
5. Portable toilet protection.
Subsequent CBMPs may be required and shall be installed when directed by the Town of Parker. See Appendix C herein for the Town of Parker CBMP standard details.

8.2.1 Modifications and Substitutions of Criteria and Construction BMPs

The Town of Parker reserves the right to allow modifications and substitutions to the criteria within this section, including the CBMP notes and details when such modifications and substitutions offer the same level of protection as the standard requirements based upon the specific situation, as determined by Town staff. Due to the insignificance and regularity of such modifications and substitutions, the approval of such variations may not be documented by Town staff. Common examples of these modifications and substitutions include, but are not limited to:

1. Utilizing sediment control logs (SCLs) in lieu of silt fence (SF).
2. The style, configuration, and materials used for inlet protection.
3. The length and/or width of vehicle tracking control (VTC) pads, etc.

This allowance applies to all criteria and CBMPs with the following exception(s):

1. Temporary Sediment Basin (TSB) sizing.

All TSB sizing must be performed by the design engineer(s) associated with the project.

8.2.2 Submittal Requirements

8.2.2.1 Construction BMP Plan

a) General. For Land Disturbances subject to this ordinance, developers/permittees must submit a CBMP Plan for their Development site to the Town. The developer/permittee shall address all referral comments of the Town to obtain the Town’s approval prior to implementation of any CBMPs required in these criteria.

b) Individual Home Construction. For any Individual Home Construction as defined in Section 8.1.4.5 (1) herein, owners shall prepare a basic CBMP Plan that meets the minimum site specific requirements for Construction BMPs, as directed by the Town.

8.2.2.2 CBMP Plan Requirements

The CBMP Plan shall be developed in conformance with the CBMP Checklist located in Appendix D herein and submitted to the Town for review.

8.2.2.3 Required Construction BMPs

For applicable Land Disturbances in the Town of Parker, developers/permittees shall satisfy all of the requirements in each of the six BMP categories enumerated in this Section. BMP Categories 1 to 4 must be implemented before any Land Disturbance begins or shortly thereafter as directed by Town staff, and BMP Categories 5 and 6 shall be implemented within 14 days after the soil is disturbed. The applicable BMPs must also be implemented as necessary when the project progresses through its various stages (e.g. infrastructure installation, vertical construction, landscaping). The BMPs in these categories must also be maintained throughout the construction period in accordance with this Manual. Unless otherwise noted, developers/permittees may choose one or more of the specified approved BMPs within a category to satisfy the requirements for that BMP category. The approved BMPs included in the following sections are explained in more detail in the CBMP Notes and Details. Please
note that on many projects, a minimum of two BMPs from one or more of the six categories will need to be installed in order to effectively control erosion and sedimentation and keep the project in compliance with the applicable permits.

8.2.2.4 BMPs In-Place Before Construction

The following four categories of Construction BMPs must be implemented and operating prior to commencement of Land Disturbances or shortly thereafter as directed by Town staff.

a) Category 1: Phase Construction. These phasing requirements shall only apply to Land Disturbances on sites one acre or larger. Developers/permittees shall schedule construction activities to minimize the total amount of soil exposed, including stockpiles, at any given time in order to reduce the period of accelerated soil erosion. In addition, areas of Land Disturbance equal to 40 acres or greater must not be exposed for more than 30 consecutive days without temporary or permanent stabilization.

The Permittee may allow authorized exemptions to the 40-acre limit for removal and storage of cut material where geotechnical limitations restrict the use of temporary or permanent stabilization of the stored material (e.g. swelling soils, rock).

b) Category 2: Reduce Stormwater Runoff Flow to Non-Erosive Velocities. Developers/permittees shall reduce Stormwater Runoff Flow to Non-Erosive Velocities when practicable using BMPs. In most instances, specific BMPs will be required by the Town of Parker due to their appropriateness for the situation. When such BMPs are not required, the developers/permittees shall implement, but not be limited to, one or more of the following approved BMPs:

1. Diversion Ditch (DD)
2. Surface Roughening (SR)
3. Slope diversion dikes (to be designed by the project engineer)
4. Terracing/Contouring (to be designed by the project engineer),
5. Slope drains (to be designed by the project engineer), and/or
6. Check dams (CD)

c) Category 3: Protect Drainageways from Erosion and Sediment Damages. Developers/permittees shall use BMPs to protect streams and drainageways located on construction sites. In most instances, specific BMPs will be required by the Town of Parker due to their appropriateness for the situation. When such BMPs are not required, the developers/permittees shall implement, but not be limited to, one or more of the following approved BMPs:

1. Waterway crossing protection (to be designed by the project engineer)
2. Diversion Ditch (DD), and/or
3. Bank stabilization (to be designed by the project engineer).

d) Category 4: Control Sediment Before it Leaves Construction Site. Developers/permittees shall implement, but not be limited to, the following measures to effectively reduce accelerated soil erosion, sediment movement, and deposition off site.

1. Sediment Entrapment. All stormwater runoff from Disturbed Areas shall pass through at least one sediment control BMP before the stormwater exits the site. In most instances, specific
BMPs will be required by the Town of Parker due to their appropriateness for the situation. When such BMPs are not required, the developers/permittees shall implement, but not be limited to, one or more of the following approved BMPs:

a) Silt fences (SF)
b) Sediment control logs (SCL)
c) Filter strips,
d) Sediment basins, and/or
e) Straw bale barriers.

Please note that “inlet protection” does not qualify as sediment entrapment.

2. **Vehicle Tracking.** Developers/permittees shall reduce deposition of sediment off-site by controlling vehicle tracking onto paved surfaces. Whenever sediment is transported onto an impervious area such as a street, parking lot, gutter, etc., the area shall be thoroughly cleaned in accordance with the CBMP Notes and Details. Furthermore, these areas must also be thoroughly cleaned by the end of each day. In addition, developers/permittees must implement, but not be limited to, one or more of the following approved CBMPs to satisfy the requirements for vehicle tracking:

a) Grates, and/or
b) Vehicle tracking control (VTC) pads.
c) Impervious area cleaning throughout the day as necessary.

**8.2.2.5 BMPs Installed During Construction**

The following two remaining categories of Construction BMPs must be installed and operating within 14 days of Land Disturbance. Schedules for requiring stabilization and revegetation may be modified by the permittee to allow for physical considerations, including, but not limited to constraints on establishing vegetation due to weather, such as temporary excessive soil moisture conditions, adverse to stabilization or revegetation goals.

a) **Category 5: Stabilize Soils.** All Disturbed Areas that remain exposed and where construction activities are not taking place for longer than 14 days shall be stabilized to protect the soils from erosion, using BMPs such as, but not limited to:

1. Surface roughening (SR),
2. Straw mulching and crimping (combined with surface roughening),
3. Erosion control blanketing,
4. Seeding, mulching and crimping (combined with surface roughening),
5. Hydraulically-applied mulching (with Town approval prior to mulching).

Note that in most cases, the Town will request surface roughening (SR) to satisfy this request due to its effectiveness and comparatively lower cost.

b) **Category 6: Re-vegetate Disturbed Soils.** Within 14 days after construction activity has temporarily or permanently ceased, developers/permittees shall plant temporary and, where applicable, permanent vegetative cover on Disturbed Areas.
1. **Temporary Revegetation.** Owners must provide temporary revegetation on all Disturbed areas that will be exposed prior to completion of Land Disturbance activities. When seeding is not practicable (e.g., growing seasons constraints), the permittee may allow for temporary stabilization until planting is practicable.

2. **Permanent Revegetation.** Owners must provide permanent revegetation and/or stabilized landscaping on all Disturbed Areas that will be exposed for more than one year or for an indeterminate amount of time.

Schedules for requiring stabilization may be modified by the permittee to allow for special considerations such as stabilizing access areas and areas in close proximity to continuing construction. Additionally, the permittee may allow for alternative approaches to stabilization if they can be shown to have erosion control capabilities similar to temporary or permanent vegetation.

### 8.2.3 Individual Home Construction

For any Individual Home Construction in the Town of Parker, as defined in Section 8.1.4.5(1) herein, developers/permittees shall satisfy the requirements for sediment entrapment of Category 4 (see, part 1 of Category 4 in Section 8.2.2.4(d)(1) herein) only, and developers/permittees are not required to satisfy the remaining CBMP requirements of Section 8.2 herein.

### 8.2.4 Operation and Maintenance

Developer/permittee is responsible for operation and maintenance of Construction BMPs and shall make any necessary repairs to Construction BMPs as soon as possible, immediately in most cases.

### 8.2.5 Security and Acceptance

#### 8.2.5.1 Security

Land Disturbances are authorized through issuance of a Grading Permit, and are subject to submission of proof of security to insure rehabilitation of the disturbed land. Requirements for a Grading Permit are described in Section 2 herein.

#### 8.2.5.2 Grading Security Release Requirements

a) **Developable Property.** In order for the grading security to be released, the site must meet items 1-8 or item 9 below.

1. All soil-disturbing activities associated with the grading permit have permanently ceased.

2. Uniform perennial vegetation cover has been established with an individual plant density of at least seventy percent (70%) of pre-disturbance levels.

3. All CBMPs have been properly removed from the site.

4. If any erosion is present, it is insignificant and is not leaving the site and/or leading into any on-site drainage infrastructure that may convey surface water off site.

5. Weeds represent no more than fifty percent (50%) of the total vegetation on the site.
6. No weeds are present from List A of the Colorado Noxious Weed List, as amended.

7. The site is predominantly free of weeds from List B of the Colorado Noxious Weed List, as amended.

8. Weeds are evenly distributed throughout the site with no large concentrations present.

9. A new grading permit and replacement security has been submitted and approved for the applicable site OR assignment as provided by Section 11.10.150 of the CODE. It is the property owner’s obligation at the time of closing to ensure that the new site owner has provided the Town with a replacement security.

b) Nondevelopable property. In order for the grading security to be released, the site must meet items 1-8 and 10, or items 9 and 10 below.

1. All soil-disturbing activities associated with the grading permit have permanently ceased.

2. All CBMPs have been properly removed from the site.

3. Erosion is negligible, if even present.

4. The vegetation represents a perennial stand of a dense, uniform surface of grass with no area greater than one (1) square foot that is barren of desirable vegetation. Infrequent, widely scattered areas where native vegetation has not yet taken hold may qualify for acceptance at the discretion of the Town.

5. Weeds represent no more than ten percent (10%) of the total vegetation on site.

6. No weeds are present from List A of the Colorado Noxious Weed List, as amended.

7. The site is predominantly free of weeds from List B of the Colorado Noxious Weed List, as amended.

8. Weeds are evenly distributed throughout the site with no large concentrations present.

9. A new grading permit and replacement security has been submitted and approved for the applicable site OR the grading permit has been assigned as provided by Section 11.10.150 of the CODE. It is the property owner’s obligation, at the time of closing on the sale of a site that is subject to a grading permit, to ensure that the new property owner has provided the Town with a replacement security.

10. All known drainage issues associated with the project have been mitigated and a sufficient amount of time has passed to ensure that such issues have been corrected. This requirement does not include those drainage issues originating on residential lots.
8.3 PERMANENT BMP REQUIREMENTS

This section contains Permanent BMP (PBMP) requirements applicable to all New Development and Redevelopment in the Town as defined in Section 1.4 herein. Section 8.4 herein contains special requirements for New Development and Redevelopment at Industrial Facilities in the Town. In addition, New Development and Redevelopment in Stream Preservation Areas must follow the special procedures and requirements set forth at Section 8.6 herein. All PBMPs must be approved before installation. Individual Home Construction, as defined in Section 8.1.4.5(1) herein that satisfy the criteria of Section 8.2.3 herein are exempt from these PBMP requirements.

All New Development and Redevelopment in the Town are divided into 3 categories named Tier 1, Tier 2, and Tier 3. Each category (Tier) is defined by the land disturbance area and the amount of new or increased impervious area. The following table summarizes the tiered approach to PBMPs.

<table>
<thead>
<tr>
<th>Land Disturbance Area</th>
<th>New or Increased Impervious Area (SF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-499</td>
</tr>
<tr>
<td>&lt; 1 Acre</td>
<td>Tier 1</td>
</tr>
<tr>
<td>1 Acre+</td>
<td>Tier 3</td>
</tr>
</tbody>
</table>

Further discussion regarding specific PBMP requirements for each Tier listed above can be found in Section 8.3.2.1 herein. Exemptions to these requirements are discussed in Section 8.3.8 herein.

The following requirements are based on a standard technology based approach. Phosphorus removal effectiveness is a function of the type of BMP and is documented in the MANUAL Volume 3 and Urban Runoff Quality Management (American Society of Civil Engineers Manual and Report on Engineering Practice No. 87, Water Environment Federation Manual of Practice No. 23) for various BMPs. Refer to Section 2.1.1.3 herein for guidance regarding water rights issues for infiltration PBMP’s.

8.3.1 Submittal Requirements

8.3.1.1 Permanent BMP Plan

Developers/permittees must submit a PBMP Plan for their Development to the Town. A PBMP Plan consists of both a report and construction drawings. Non-residential or multi-family development projects are not required to prepare a conceptual or preliminary PBMP Plan. However, all of the information required of the conceptual and preliminary PBMP plans must be included in the required final PBMP Plan. The developer/permittee shall address all referral comments and obtain the Town’s approval prior to commencement of Land Disturbances on their property. PBMP Plans may be submitted separately, but are more commonly incorporated in an overall set of civil construction plans with design information, calculations and narrative within a separate stormwater quality section or chapter in the conceptual, preliminary and final drainage reports. To avoid duplication, developers/permittees may cross-reference information in other sections of the drainage reports.
8.3.1.2 Report Requirements

The PBMP Report shall be incorporated with the conceptual, preliminary, and final drainage reports. The purpose of the Conceptual PBMP Report is to identify and define the proposed New Development/Redevelopment and proposed PBMPs. The Preliminary PBMP Report should further define and expand on the concepts provided in the Conceptual PBMP Report and present the calculations developed for the proposed PBMPs. The Final PBMP Report shall further develop and refine the earlier information and present the final design calculations and details for the PBMPs. Refer to Appendix A which contains checklists summarizing the requirements for each drainage report.

a) Conceptual PBMP Report. Each Conceptual PBMP Report shall contain the following information:

1. Narrative description of Development project;
2. Location map showing location of proposed Development;
3. Site map showing drainage area, areas of Land Disturbance and impervious areas, Tier category (1, 2 or 3) and proposed locations of PBMPs (if known);
4. Description of soil conditions and geologic features of site;
5. Relation to regional, drainage, and stormwater quality plans for the region and the Town;

b) Preliminary PBMP Report. Each Preliminary PBMP Report shall include and expand upon information presented in the conceptual PBMP report (including any items not known at the concept level), and should also include the following additional information:

1. Detailed description and design criteria of PBMPs proposed to be implemented and analysis as to how BMPs satisfy the water quality and pollutant removal requirements at Section 8.3.2.1 herein;
2. WQCV calculations and outlet design calculations per the MANUAL Volume 3 procedures; and
3. Verify that all PBMPs are designed to follow maintenance and inspection protocols to ensure continued effectiveness of BMPs. See Section 8.3.6 herein for long-term Operation and Maintenance requirements and related documentation for PBMPs. Commitments from responsible agency/Owner to maintain PBMPs should also be provided.
4. Identify and justify any site runoff that will not be routed through water quality BMPs.

c) Final PBMP Report. Each Final PBMP Report shall include information presented in the preliminary PBMP Report and the following additional information:

1. Updates for all information submitted in the Preliminary BMP Report;
2. Final design and technical details for PBMPs selected, including size, specification, and descriptions of BMPs;
3. Schedule for construction and operation of BMPs; and
4. Dedication by easements or other legal means for access at the PBMP sites for operation, maintenance, and inspection of PBMPs.
8.3.1.3 Drawing Requirements
The PBMP Drawings shall be incorporated into the conceptual, preliminary, and final civil construction plans for the proposed Development/Redevelopment. The following provides a summary of the specific items that should be included in the PBMP drawings, in addition to the requirements provided in the Roadway Manual.

a) Conceptual PBMP Drawings. The Conceptual PBMP Drawings shall contain the following information:
   1. Site map showing existing topography of site; proposed excavation, grading and fill areas; and proposed final topography of site (if known);

b) Preliminary PBMP Drawings. The Preliminary PBMP Drawings shall include and expand upon information presented in the conceptual PBMP drawings (including any items not known at the concept level), and should also include the following additional information:
   1. Location of PBMPs proposed.
   2. Schematics or diagrams of proposed BMPs;

c) Final PBMP Drawings. The Final PBMP Drawings shall include information presented in the preliminary PBMP Drawings and the following additional information:
   1. Updates for all information submitted in the Preliminary PBMP Drawings;
   2. Final design and technical details for PBMPs selected, including size, location, details, etc.

8.3.1.4 Review Procedures
The Town shall review the PBMP Plans as part of the overall land use or development project submittal. Approval of the PBMP Plan is required prior to the approval of the associated land use application and grading permit.

8.3.2 Permanent BMPs for Land Disturbance and Development Activities

8.3.2.1 Permanent BMP Requirements
Permanent BMP requirements for New Development and Redevelopment is determined based upon the Tier classification in which the New Development/Redevelopment falls, as defined at the beginning of Section 8.3 herein. The following summarizes the PBMP requirements for each Tier.

a) Tier 1 New Development and Redevelopment are not required to provide PBMPs, but are encouraged to implement runoff reduction measures.

b) Tier 2 New Development and Redevelopment must install, operate and maintain PBMPs that are not required to include WQCV, but are required to meet one or more of the following conditions:
   1. The WQCV storm event is assumed not to leave the site, as demonstrated by suitable hydrologic analysis.
   2. Runoff is discharged as sheet flow across a grass buffer area designed in accordance with Section 8.3.3.4 herein.
3. Runoff is discharge from the site through a grass swale in combination with implementation of Minimize Directly Connected Impervious Areas (MDCIA) practices.

4. Runoff is discharged from the site through a constructed wetland channel.

5. Runoff is discharged across undisturbed and vegetated land a minimum distance of 50 feet or 3 times the distance criteria for grass buffers, whichever is greater, with a slope not exceeding 4 percent over that distance.

6. Allowed discharge of a storm event adequately protects water quality, as demonstrated by a hydrologic analysis and accepted by the Town.

7. Alternative BMPs and/or site condition requirements may be used if they are shown to have comparable or better nutrient removal characteristics for the given use, in comparison to the above listed BMPs/site condition requirements, when properly design and implemented. These BMPs/site condition requirements must be determined to be acceptable by the Town on a case-by-case basis, or, if appropriate, may be added to the list of acceptable BMPs.

c) **Tier 3 New Development and Redevelopment** must install and operated PBMPs that provide WQCV designed and constructed to capture and treat, at a minimum, the 80th percentile runoff event, in accordance with this SDECM and the MANUAL Volume 3. Approved PBMPs for use in the Town are summarized in Section 8.3.3 herein.

### 8.3.2.2 On-Site or Sub-Regional Facilities

To achieve the WQCV and pollutant removal requirements, developers/permittees must implement one of the approved PBMPs. Developers/permittees may implement one or more of the approved individual PBMPs (Section 8.3.3 herein), or any other approved measures (Section 8.3.4 herein) to satisfy the WQCV and pollutant removal requirements. The PBMPs must be designed in accordance with the MANUAL Volume 3 and the criteria set forth in this chapter. Developers/permittees are encouraged to refer to the MANUAL Volume 3 for additional design guidance.

### 8.3.2.3 Regional Facilities

Developers/permittees may, and are encouraged to, collaborate with other Developments and Owners to establish regional facilities. Regional facilities, which shall accomplish the WQCV and pollutant removal requirements for all tributary areas, may be more cost-effective than individual-site PBMPs and may be integrated into open space, parks, and golf courses. If the developer/permittee participates in a regional facility that provides adequate pollutant removal for the site, the developer/permittee is exempt from these requirements except if the New Development/Redevelopment is in a Stream Preservation area. Regional facilities located in a Stream Preservation Area do not exempt the developer/permittee from protecting runoff from the site and in some cases may require additional onsite PBMPs.

a) **Discharge to State Waters.** If the New Development/Redevelopment discharges to waters-of-the-state then the developer/permittee must, at a minimum, implement on-site PBMPs, such as a grass swale, designed in accordance with this SDECM and the MANUAL Volume 3. For example, if a New Development/Redevelopment is served by a regional, stormwater quality facility design in accordance of these criteria, and stormwater from the development is discharged to an open conveyance system before reaching the regional facility, then onsite PBMPs must be provided. The
onsite PBMPs do not need to be based on WQCV, but can be other approved PBMPs, such as those identified under Tier 2 in Section 8.3.2.1 herein.

b) Not a Discharge to State Waters. If a regional PBMP is located prior to discharging into state waters, then the regional PBMP can be used to meet the PBMP requirement and additional onsite PBMPs may only be needed to assist in the function of the regional PBMP.

If a New Development or Redevelopment discharges to a regional stormwater quality facility via storm drain, then the discharge is not considered to be into waters-of-the-state and additional PBMPs are not required. Developers/permittees are still encouraged to implement onsite PBMPs to further improve the quality of stormwater discharge.

8.3.2.4 Additional PBMP Guidelines

Design of PBMPs in the Town shall follow the MANUAL Volume 3 recommendations regarding maximum limits for catchment areas draining to individual PBMPs. Onstream WQCV facilities shall be designed to serve the entire upstream watershed, including all catchment areas upstream of the development, based on future development conditions. In the event that there are existing WQCV facilities located upstream of the proposed facility, the benefits from the existing facilities may not be accounted for unless it is publicly maintained and the existing facilities are included in the analysis of the proposed facility, verifying its benefit to water quality. UDFCD imposes a further requirement that onstream WQCV facilities serve a maximum 640 acre tributary area unless the facility has been specifically analyzed and a custom engineering design has been reviewed and approved. Alternatively, offstream PBMPs are not required to provide treatment of offsite, upstream flow.

8.3.3 Design Criteria for Approved Permanent BMPs

8.3.3.1 Extended Detention Basin (EDB)

Extended detention basins provide for a slow release of water quality capture volume which promotes sedimentation of particulates and of some soluble pollutants. Specific design criteria for extended detention basins can be found in Section 7.3 herein.

8.3.3.2 Sand Filter Basin (SFB)

A sand filter basin is an infiltration PBMP that consists of a surcharge zone with a sand bed containing an underdrain system. Sand filter basins are not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and require an Operations and Maintenance Plan as described in Section 8.3.6 herein.

1. **Base Design Information.** Sand filter basins are to be designed in accordance with information provided in the MANUAL Volume 3, as supplemented by the following criteria.

2. **Combining with Flood Detention.** A sand filter basin may be used as a stand-alone water quality capture volume basin, may be combined with excess urban runoff volume, or may be combined with excess urban runoff volume and 100-year detention. Criteria for excess urban runoff volume and 100-year detention are described in Section 7 herein.

3. **Selection Criteria.** Sand filter basins may be used as a sub-regional facility or as an on-site water quality facility for those cases where a sub-regional approach to water quality detention is not possible. Sand filter basins shall comply with the selection criteria shown in Table 8.2 herein. Although sand filter basins with sediment forebays can handle a small amount of inflowing
sediment, sand filter basins in general are not well suited for high sediment loads.

4. **Basin Storage Volume.** The minimum surface area of the filter media of the sand filter basin shall be the actual area required to contain the MANUAL Volume 3 WQCV assuming a depth of 3.0-feet extending vertically upward from the bed (although the actual basin will normally provide 4 to 1 slopes or flatter around the sand bed). The bottom of the basin shall be flat for the entire area of the sand bed. If the excess urban runoff volume and 100-year volume is included, the aerial extent of the sand bed is to stay the same and the overflow drop-inlet is to be designed to control the excess urban runoff volume and 100-year outflows. The sand filter comprises the flat bottom of the basin, with stable landscaped slopes required all around.

5. **Outlet Structure.** Figure 8.3 herein shows the layout of a typical outlet structure.

6. **Underdrain Piping.** Underdrains are required for all sand filter basins constructed in the Town and shall be designed per the MANUAL Volume 3.

7. **Scour Protection at Inflow Points.** Stable protection against scour at all inflow points is required. See the MANUAL Volume 3 or Section 7.3.5 herein for additional information.

8. **Sediment Forebay.** Based on Table 8.2 herein, sand filter basins serving more than an acre or that accept runoff from drainage areas that may have some non-irrigated native grasses require a sediment forebay at each inflow point. Forebays provide locations for debris and coarse sediment to drop out, extending the functionality of the main portion of a sand filter basin. Section 7 herein includes example drawings for forebays. The final design of forebays for sand filter basins must be approved by the Town.

9. **Perimeter Separation Walls.** Proper construction and maintenance of sand filter basins require that the sand filter material be separated from the native material surrounding the filter. A permanent barrier must be provided for the perimeter of the sand filter material. Barrier walls may consist of concrete, plastic sheet piling, stacked block, or other methods approved by the Town. Barrier walls shall be designed by the engineer and detailed on the construction plans. The plans shall include methods for attaching or wrapping the geotextile fabric or liner, and for the surface treatment above the wall.

10. **Liners.** The determination whether or not an impermeable liner is required for the sand filter basin shall be based on the recommendation of a licensed geotechnical engineer. Sections 8.3.5.1 and 8.3.5.2 herein provide additional information and design considerations when an impermeable liner is required.

11. **Retaining Walls.** Section 8.3.5.3 herein provides design information regarding retaining walls and sand filter basins. All retaining walls shall be designed in accordance with the criteria specified in Section 7.3.13 herein.

12. **Designing for Maintenance.** Design requirements for maintenance operations are specified in Section 7.3.15 herein.
13. **Landscaping Considerations.** Detailed information regarding landscaping of sand filter basins is presented in Section 8.3.5.4 herein.

14. **Plan Requirements.** PBMP plans for sand filter basins shall meet the requirements set forth in Section 8.3.1 herein.

15. **Construction of Sand Filter Basins.** Because of their high potential for clogging during the construction of the development, sand filter basins shall not be installed until the site has been stabilized with pavement and permanent landscaping. CBMPs should remain in place until the site is permanently stabilized.

### 8.3.3.3 Porous Landscape Detention (PLD) (Bioretention)

Porous landscape detention (also referred to as Bioretention) consists of a depressed vegetated area underlain by a sand bed with an underdrain pipe. Runoff ponds in the vegetated zone and infiltrates into the underlying filter material, filling the voids. Porous landscape detention is not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and requires an Operations and Maintenance Plan as described in Section 8.3.6 herein.

1. **Base Design Information.** Porous landscape detention facilities are to be designed in accordance with information provided in the MANUAL Volume 3, as supplemented by the following criteria.

2. **Combining with Flood Detention.** Porous landscape detention may be used as a stand-alone water quality capture volume basin, may be combined with excess urban runoff volume, or may be combined with excess urban runoff volume and 100-year detention volume. Criteria for excess urban runoff volume and 100-year detention are described in Section 7 herein. As stated in Section 7 herein, the maximum allowable depth of ponded water in a parking lot for the 100-year event is 9-inches.

3. **Selection Criteria.** Porous landscape detention shall only be used as an on-site water quality facility. On-site facilities shall only be used for those cases where a sub-regional or regional approach to water quality detention is not possible. Porous landscape detention shall comply with the selection criteria shown in Table 8.2 herein. Porous landscape detention shall only be used in locations that receive runoff from upstream pavement, roofs, or fully stabilized landscape areas (irrigated sod or planting beds with stable mulch layer).

4. **Basin Storage Volume.** The minimum area of the filter media of the porous landscape detention basin shall be actual area required to contain the MANUAL Volume 3 WQCV assuming a maximum depth of 12-inches extending vertically upward above the bed, or to contain the excess urban runoff volume assuming a maximum depth of 2-feet extending vertically above the bed. In each case the side slopes will normally be 4:1 or flatter, so the actual depths will be less than assumed. For porous landscape detention basins located adjacent to paved areas, like those shown in Figures 8.1 and 8.2 herein, the surface of the filter media shall be no more than 18-inches below the elevation of the adjacent pavement, unless otherwise approved. The bottom of the basin shall be flat for the entire area of the growing media. If the excess urban runoff volume and 100-year volumes are included, the aerial extent of the growing media stays the same and the overflow drop-inlet is designed to control the excess urban runoff volume and 100-year outflows as shown in...
5. Outlet Structure. Figure 8.3 herein shows the layout of a typical outlet structure for three outflow conditions. The structure receives the underdrain collection piping from the porous landscape detention and includes a drop box for flood flows with a grate and one or more control orifices.

6. Underdrain Piping. Underdrains are required for all porous landscape detention facilities constructed in the Town and shall be designed per the MANUAL Volume 3.

7. Scour Protection at Inflow Points. Stable protection against scour at all inflow points is required. This may consist of stable, irrigated grasses if runoff enters via sheet flow or other methods depicted in Figure 8.4 herein.

8. Perimeter Separation Walls. Proper construction and maintenance of porous landscape detention facilities require that the filter material and growing media be separated from the native material surrounding the filter. A permanent barrier must be provided for the perimeter of the filter material. Barrier walls may consist of concrete, plastic sheet piling, stacked block, or other methods approved by the Town. Barrier walls shall be designed by the engineer and detailed on the construction plans. The plans shall include methods for attaching or wrapping the geotextile fabric or liner, and for the surface treatment above the wall.

In limited cases where porous landscape detention facilities are incorporated into unconstrained, open landscape areas located away from pavement, the perimeter separation walls may be eliminated as shown in Figure 8.5 herein, if approved by the Town.

9. Liners. The determination whether or not an impermeable liner is required for the porous landscape detention shall be based on the recommendation of a licensed geotechnical engineer. Sections 8.3.5.1 and 8.3.5.2 herein provide additional information and design considerations when an impermeable liner is required.

10. Retaining Walls. No retaining walls shall be used within the area of any liners, except for the buried separation walls between the filter media and the earth. Section 8.3.5.3 herein provides design information regarding retaining walls and porous landscape detention. All retaining walls shall be designed in accordance with the criteria specified in Section 7.3.13 herein.

11. Designing for Maintenance. Design requirements for maintenance operations are specified in Section 7.3.15 herein.

12. Landscaping Considerations. Detailed information regarding landscaping porous landscape detention basins is presented in Section 8.3.5.4 herein.

13. Plan Requirements. PBMP plans for porous landscape detention shall meet the requirements set forth in Section 8.3.1 herein.

14. Construction of Porous Landscape Detention. Because of their high potential for clogging during the construction of the development, porous landscape detention shall not be installed until the site
has been stabilized with pavement and permanent landscaping. CBMPs should remain in place until the site is permanently stabilized.

### 8.3.3.4 Grass Buffers and Grass Swales (GB/GS)

Grass buffers and grass swales are densely vegetated to promote filtration, infiltration and settling to reduce runoff volume and pollutants. Grass buffers and grass swales are approved individual or stand-alone PBMPs which meet the requirements of Tier 2 New Development or Redevelopment. For Tier 3 New Development or Redevelopment, grass buffers and grass swales must be used in combination with other PBMPs to meet the water quality requirements. Grass buffers and grass swales are not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and require an Operations and Maintenance Plan as described in Section 8.3.6 herein.

1. **Base Criteria.** Grass buffers and grass swales shall be designed in accordance with information provided in the MANUAL Volume 3, as supplemented by the following criteria. These criteria pertain to shallow urban roadside swales and to grass buffers and swales not associated with a roadway.

2. **Definition of Terms.** Figure 8.6 herein illustrates four variables that are associated with the principle of reducing directly connected impervious area. These are defined in Appendix A of the Runoff chapter of the MANUAL Volume 1. The pavement and roof area that is directly connected to a curb and gutter or storm sewer is termed the directly connected impervious area. The rest of the impervious area on the site, draining to landscape or porous pavement, is termed the unconnected impervious area. The directly connected impervious area and the unconnected impervious area add up to the total impervious area. The portion of the landscape area that receives runoff from the unconnected impervious area and is wetted during the 2-year storm is called the receiving pervious area. The remaining landscape area is called the separate pervious area.

3. **Sizing and Design Criteria.** The objective on any urban site is to minimize directly connected impervious area and maximize receiving pervious area and to achieve the on-site requirements associated with regional and sub-regional water quality facilities on jurisdictional streams. This is accomplished by laying out grass buffers and swales in proximity to roofs and pavement to receive as much impervious area runoff as possible and convey it through the site.

   It is desirable to lay out grass buffers and swales with ample flow width and relatively flat slopes to slow down flow velocities and increase contact time with the soil and vegetation, but not so flat as to create standing water. Maximum slopes shall be dictated by the criteria shown in Table 8.3 herein. Swales exceeding the maximum slope criteria may be allowed if lined with soil riprap, subject to approval of the Town.

   Figure 8.7 herein illustrates concepts for grass swales, including an urban roadside grass swale and details for an underdrain and soil riprap lining.
TABLE 8.3
GRASS BUFFER AND SWALE DESIGN CRITERIA

<table>
<thead>
<tr>
<th></th>
<th>Grass Buffer</th>
<th>Grass Swale¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max. Slope</td>
<td>Max. Slope</td>
</tr>
<tr>
<td>Irrigated Bluegrass Sod¹</td>
<td>25%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Irrigated Native Turf Grass¹</td>
<td>10%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Non-Irrigated Native Turf Grass</td>
<td>4%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

¹ If swale slope is less than 2.0%, an underdrain is required
² Minimum swale slope is 0.2%

4. **Determination of Receiving Pervious Area.** The receiving pervious area is the wetted area of the buffers, swales, porous pavement, or upland treatment swales in the 2-year storm. A quick approximation of the wetted area may be obtained by summing the buffer areas, the bottom of any trapezoidal swales, and the side slopes of swales assuming an average flow depth of a few inches. As the overall size of the receiving pervious area is finalized, a refined estimate of area may be determined by calculating average 2-year flow rates for each buffer, swale, or other component, computing flow depths and top widths, and summing the wetted area of the components.

The following guidelines apply when estimating the size of the receiving pervious area for purposes of achieving the requirements associated with regional or sub-regional water quality.

a) The size of the unconnected impervious area needs to be estimated as a percentage of upstream directly connected impervious area for each tributary or outfall draining to a jurisdictional drainageway upstream of the regional or sub-regional water quality facility.

b) The size of the receiving pervious area needs to be estimated as a percentage of upstream unconnected impervious area for each tributary or outfall.

c) Areas that, in the judgment of the designer, may not be fully wetted in the 2-year event due to short-circuiting or other reasons, should not be included in the receiving pervious area.

d) The unconnected impervious area and receiving pervious area shall be clearly indicated on the drainage plan and construction drawings, as well as the percentages described in a. and b. above.

5. **Pavement Edge Treatment.** A concrete edger is recommended in urban areas for asphalt streets and parking areas adjacent to grass buffers and swales. The formed concrete provides a neat edge adjacent to the grassed area that can be constructed at a controlled grade. The concrete edger, a concept for which is shown in Figure 8.8 herein, can also serve to cut off the flow of water from the buffer or swale toward the pavement subgrade.

6. **Reducing Wheel Rut Impacts.** Because standard curb and gutter is typically not used at the edge of pavement adjoining grass buffers or swales, inadvertent tracking of vehicles onto the grassed area
can be an issue. One of several options may be considered for reducing the impact of wheel rutting on grass buffers and swales adjacent to access and parking areas.

a) *Wheel stops.* Concrete wheel stops can be used in parking lots adjacent to grass buffers or swales to keep vehicles off the grass area.

b) *Intermittent curb.* Curb and gutter with frequent openings in the curb may be used to direct runoff to a grass buffer or swale, while still impeding inadvertent tracking off the pavement. The unit runoff rates shown for grass buffers in the MANUAL Volume 3 shall not be exceeded through the openings in the curb. Curb ends shall be shaped or sloped to reduce impacts on snow removal equipment.

c) *Cobble strip.* A layer of exposed rock several feet wide can reduce wheel rutting impacts to grass buffers and swales. The rock shall be large enough to resist movement during the design runoff event.

d) *Reinforced turf.* Several feet of reinforced turf, one of the porous pavement options described in the MANUAL Volume 3, may be considered to reduce wheel rutting impacts to grass buffers and swales adjacent to pavement.

7. **Landscaping Considerations.** Dense turf grass, either bluegrass or sod-forming native grasses, shall be used for grass buffers and swales. An irrigation system is required for grass buffers and grass swales; if sod-forming native grasses are used, the irrigation system will help to establish a dense stand of turf grass and maintain it in periods of low precipitation. Erosion control shall be used during grass establishment in buffers and swales if native grasses are used. Shrub and tree plantings may be considered within grass buffers and swales, although their effect on capacity must be taken into account.

8. **Underdrain Piping.** Underdrain piping shall be consistent with the MANUAL Volume 3.

9. **Plan Requirements.** PBMP plans for grass buffers and grass swales shall meet the requirements set forth in Section 8.3.1 herein.

### 8.3.3.5 Constructed Wetlands Basin (CWB)

Shallow retention ponds with wide bottoms and flat grades create constructed wetlands in the presence of a sufficient amount of water to maintain vegetation. They provide treatment by sedimentation, filtering, and uptake by vegetation and microorganisms. Constructed wetland basins are not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and require an Operations and Maintenance Plan as described in Section 8.3.6 herein.

1. **Base Design Information.** Constructed wetlands basins are to be designed in accordance with information provided in the MANUAL Volume 3, as supplemented by the following criteria.

2. **Combining with Flood Detention.** A constructed wetlands basin is typically combined with the excess urban runoff volume and 100-year detention volume. Criteria for excess urban runoff volume and 100-year detention are described in Section 7 herein.
3. **Selection Criteria.** Constructed wetlands basins may be used as a sub-regional or regional water quality detention facility where hydrology is adequate to support the wetlands and where any water rights issues have been addressed. Constructed wetlands basins are typically not used for small on-site facilities due to their requirement for adequate hydrology. Constructed wetlands basins shall comply with the selection criteria shown in Table 8.2 herein.

4. **Basin Storage Volume.** Provide extended detention storage volume above the permanent wetlands water surface equal to the applicable water quality capture volume computed according to the MANUAL Volume 3. For combined facilities, the basin shall include the excess urban runoff volume and 100-year detention volumes based on the methods in Section 7 herein.

5. **Outlet Structure.** The layout and sizing of the outlet structure for a constructed wetlands basin is the same as specified in Section 7.3.10 herein for an extended detention basin, with the wetlands water surface corresponding to the micropool water surface.

6. **Scour Protection at Inflow Points.** Stable protection against scour at all inflow points is required. This may consist of stable, irrigated grasses if runoff enters via sheet flow, or as described in Section 7.3.5 herein.

7. **Sediment Forebay.** Forebays provide locations for debris and coarse sediment to drop out and accumulate, extending the functionality of the constructed wetlands basin. Forebays may be located upstream of the constructed wetlands basin, as long as all runoff entering the constructed wetlands basin flows through a forebay. Concepts for sediment forebays can be found in Section 7 herein. The use and sizing of forebays at pipe outfalls shall be approved by the Town.

8. **Retaining Walls.** All retaining walls shall be designed in accordance with the criteria specified in Section 7.3.13 herein.

4. **Designing for Maintenance.** Design requirements for maintenance operations are the same as specified in Section 7.3.15 herein.

10. **Landscaping Considerations.** If there is an adequate base flow to support the wetland vegetation and provide circulation in the pools, a constructed wetlands basin can be a very attractive natural feature. Establishing proper species of emergent and riparian vegetation is key to the basin’s success. A detailed landscaping plan shall be developed by the appropriate specialists and included in the construction drawing set. Recommendations for shaping and making the most of recreation opportunities are discussed in Section 7.3.14 herein.

13. **Plan Requirements.** PBMP plans for a constructed wetland basin shall meet the requirements set forth in Section 8.3.1 herein.

**8.3.3.6 Retention Ponds (RP)**

Retention ponds have a permanent pool of water that is replaced by stormwater during storm events. Retention ponds provide treatment by improved sedimentation and biological uptake by shoreline vegetation. Retention ponds are not eligible for maintenance assistance from the Town of Parker.
Stormwater Management Utility and require an Operations and Maintenance Plan as described in Section 8.3.6 herein.

1. **Base Design Information.** Retention ponds are to be designed in accordance with information provided in the MANUAL Volume 3, as supplemented by the following criteria.

2. **Combining with Flood Detention.** A retention pond is typically combined with excess urban runoff volume and 100-year detention volumes. Criteria for excess urban runoff volume and 100-year detention are described in Section 7 herein.

3. **Selection Criteria.** Retention ponds may be used as a sub-regional or regional water quality detention facility where hydrology is adequate to support the permanent pool and where any water rights issues have been addressed. Retention ponds are typically not used for small on-site facilities due to their requirement for adequate hydrology. Retention ponds shall comply with the selection criteria shown in Table 8.2 herein.

4. **Basin Storage Volume.** Provide extended detention storage volume above the permanent water surface equal to the applicable water quality capture volume computed according to the MANUAL Volume 3 and Section 7 herein. Additional sediment storage volume above the water surface is not necessary, since sediment storage will occur under the water surface. If the excess urban runoff volume is included above the permanent pool, no specific volume requirements are necessary for the pool other than providing the littoral zone shaping and pool depths specified in the MANUAL Volume 3.

5. **Outlet Structure.** The layout and sizing of the outlet structure for a retention pond is the same as specified in Section 7.3.10 herein for an extended detention basin, with the permanent water surface corresponding to the micropool water surface.

6. **Retaining Walls.** All retaining walls shall be designed in accordance with the criteria specified in Section 7.3.13 herein.

3. **Designing for Maintenance.** Design requirements for maintenance operations are the same as specified in Section 7.3.15 herein.

4. **Landscaping Considerations.** If there is an adequate base flow to maintain the permanent pool and provide circulation, a retention pond can be an attractive natural feature. Establishing proper species of emergent and riparian vegetation along the shoreline is essential for the pond’s success. A detailed landscaping plan shall be developed by the appropriate specialists and included in the construction drawing set.

5. **Plan Requirements.** PBMP plans for a retention pond shall meet the requirements set forth in Section 8.3.1 herein.
8.3.4 Individual BMPs Requiring Special Approval

8.3.4.1 Porous Pavement Detention (PPD)

Porous pavement detention consists of modular block pavement (perforated concrete slab units filled and underlain with gravel). This PBMP provides treatment by capturing sediment (adsorption), filtration, and infiltration (if suitable subsoils).

Porous pavement detention is not a preferred PBMP in the Town of Parker. Its use shall only be allowed for small sites, generally one acre or less, where it can be demonstrated that the use of an extended detention basin is not feasible. The use of porous pavement detention will require special approval from the Public Works Director. Porous pavement detention shall be designed based on the criteria set forth in the MANUAL Volume 3. Porous Pavement Detention is not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and requires an Operations and Maintenance Plan as described in Section 8.3.6 herein.

8.3.4.2 Proprietary Permanent BMPs

The use of proprietary PBMPs will be evaluated by the Town on a case-by-case basis. Refer to the MANUAL Volume 3 for design discussion and guidance for the use of proprietary PBMPs. The use of proprietary PBMPs will require special approval from the Public Works Director and are not eligible for maintenance assistance from the Town of Parker Stormwater Management Utility and therefore require an Operations and Maintenance Plan as described in Section 8.3.6 herein.

8.3.5 Other Permanent BMP Design Considerations

8.3.5.1 Geotextile Separator Fabric Design Considerations for Sand Filter Basin and Porous Landscape Detention

Typically a geotextile separator fabric is not required for a SFB or a PLD. When specified by a geotechnical engineer, geotextile separator fabric can be installed between the filter material and subgrade when they are not compatible. Proper specification and installation of the geotextile separator fabrics are significant elements in ensuring that sand filter and porous landscape detention basins function properly over an extended time period.

In those cases where a geomembrane liner is required, the geomembrane liner provides the barrier between the filter material layer and the native material subgrade and geotextile separator fabric is required on each side of the liner to protect the liner. When a geomembrane liner is required, the geotextile separator fabric must be attached with the liner to perimeter walls and outlet structures with the batten bar. See the MANUAL Volume 3 for additional design and construction guidance for geotextile separator fabric.

8.3.5.2 Geomembrane Liner Design Considerations

In some cases, developing sites or parcels may have expansive soils or sensitive environmental resources that must be protected. The Town, the design engineer, or the project geotechnical engineer may require that a geomembrane liner be specified to protect structures or sensitive resources in the vicinity of proposed sand filter and porous landscape detention basins. There are a number of important design, construction, and inspection requirements and considerations that must be addressed to ensure that the geomembrane liner is properly installed and that the liner functions as intended. Some of the considerations include, but are not limited to, proper material specifications, liner pre-assembly,
proper welding and testing of seams, provisions for pipe penetrations, careful subgrade preparation, liner attachment to trench walls and outlet structures, handling and protection of the liner during construction, anchoring of the liner, and the design of an underdrain system, if needed to mitigate potential impacts from a high groundwater table. See the MANUAL Volume 3 for additional design and construction guidance.

8.3.5.3 Retaining Wall Use in Sand Filter Basins and Porous Landscape Detention

In general, the use of above grade retaining walls in the design of sand filter and porous landscape detention basins is discouraged. In most cases, the buried perimeter wall is needed to separate the filter media from the adjacent native soils during construction, but the use of above grade retaining walls shall be limited. A goal of the overall site design and layout should be to minimize the depth of sand filter and porous landscape detention basins and to allow for a smooth transition into adjacent impervious or landscaped areas. Utilizing sheet or shallow channel flow to convey runoff to the facilities rather than using underground storm sewer can also help reduce the depth between the filter media and the grade adjacent to the facility. The use of retaining walls adjacent to a sand filter or porous landscape detention basins limits the ability to easily access the filter media and other components for maintenance. In no case shall dry stack retaining walls be used below the top of the filter media or the design water surface when a geomembrane liner is required.

8.3.5.4 Sand Filter Basin and Porous Landscape Detention Landscaping Requirements

There are specific considerations and landscaping requirements for sand filter and porous landscape detention basins. In general, porous landscape detention basins offer more options than sand filter basins for vegetative treatments which complement and enhance the overall site landscaping.

In the design of a sand filter basin, no vegetation or mulch shall be specified in the filter media of a sand filter basin. Irrigated turf grass sod or mulched shrub beds may be used on the slopes above the WQCV water surface, if a geomembrane liner is not required. Irrigation systems provided to supply water to the slopes shall be located outside of the filter media.

In the design of a porous landscape detention basin, potential vegetative treatments within the filter media include a full cover of native grasses established by seeding, or “clump-type” vegetation comprised of ornamental clump grasses or small native shrubs. Spacing of plants shall be specified such that hand raking can take place between plants to remove accumulated sediment. Rock, wood, mulch, etc. shall not be used. Shrubs with mulch or irrigated turf grass may be used on the slopes of the basin, outside of the filter media. An irrigation system shall be provided to supply adequate water to all vegetated areas within and adjacent to the porous landscape detention basin. Irrigation heads and laterals shall be located outside of the filter media.

Tree plantings adjacent to porous landscape or sand filter basin installations shall be isolated from the basin using concrete or sheet pile barriers to ensure that the root structure does not impact the filter media or underdrain system. The barriers shall be placed adjacent to the basin, outside the water quality capture volume elevation, if a geomembrane liner is required. For either type of basin, the layout of landscaping on the adjacent slopes shall allow for necessary maintenance access.
8.3.6 Operation and Maintenance

The Town’s Stormwater Management Utility provides assistance for operation and maintenance of non-infiltration BMPs (i.e. extended detention basins). The ultimate responsibility for maintenance lies with the property owner. Owners are required to provide sufficient legal access, by dedicating easements for the sites of the PBMPs and access thereto for the Town to perform inspections, and for the Town to perform operations and maintenance as needed.

Operation and Maintenance (O&M) Plans are not required for PBMPs accepted into the Town’s Stormwater Management Utility for maintenance assistance given that the developer/permittee follows the guidelines described in Section 3.3.2 herein. O&M Plans are required for all PBMPs not maintained by the Town’s Stormwater Management Utility. These plans are intended to provide information and guidance for the entities that will be responsible for the long term maintenance of the PBMP. All PBMPs that are either not eligible or no longer receiving maintenance assistance from the Town’s Stormwater Management Utility must develop and implement an O&M Plan.

Appendix G herein contains multiple guidance documents and examples for reference when developing an O&M plan. A facilities map checklist in addition to sample facilities maps for both commercial and residential sites can be found in the appendix. Sample plan, profile and detail sheets for the most frequently used PBMPs are included in Appendix G herein, including document outlines for Standard Operating Procedures (SOPs) for the PBMPs.

In order to ensure the long-term operation and maintenance of all PBMPs, the associated plat, easement agreement or other recorded document for the property must include a reference to the O&M Plan(s). This reference should include the name and date of the O&M Plan(s) as well as ownership, and maintenance responsibilities for the PBMP facility.

8.3.7 Special Considerations to Protect Groundwater Drinking Water Supplies

Stormwater PBMPs promote reduction in stormwater flow velocity and infiltration, but the Cherry Creek alluvial groundwater is also a drinking water supply that needs protection. Many stormwater PBMPs remove a large portion of settleable sediments and contaminants. Once stormwater is intercepted by a PBMP, any contaminants present can remain in the surrounding soil or move to the groundwater in varying proportions, depending on the chemical characteristics of a contaminant. The soil is a natural filter that removes contaminants, but since some contaminants such as chlorides, nitrates, and organics can dissolve and move with groundwater, PBMP designs shall consider site-specific conditions.

The general potential for groundwater contamination from stormwater depends on the prevalence of contaminants in stormwater and the tendency to remain dissolved (more mobile). The U.S. Environmental Protection Agency believes the largest threat to groundwater from stormwater results from spills and chemical misuse. Therefore, the industrial PBMPs identified in Section 8.4 herein are an essential component of protecting groundwater supplies.

In addition, PBMPs that have the potential to impact groundwater supplies through enhanced infiltration (i.e. infiltration PBMPs) shall incorporate the following design considerations.

8.3.7.1 Minimum Setback from Drinking Water Wells

The travel distance of a contaminant will vary depending on factors such as soil type, permeability, groundwater flow, and water table fluctuations. Infiltration PBMPs shall generally maintain setbacks
greater than 400 feet from any alluvial water well, unless a site-specific hydrogeological study

demonstrates a lack of connection with the well. In some cases, site-specific hydrogeological conditions
may warrant setbacks greater than 400 feet.

**8.3.7.2 Minimum Separation from Water Table**

Since many contaminants adsorb to soil, a soil filter shall be retained between the bottom elevation of
the PBMP and the seasonal high water table. All infiltration PBMPs shall maintain a minimum of 10
feet between the bottom PBMP elevation and the seasonal high water table.

**8.3.7.3 Prohibition from Wellhead Protection Areas**

Infiltration PBMPs should not be installed within a designated wellhead protection area or within 400
feet of a public alluvial drinking water supply well without consulting the water utility. The water
utility may require modifications to PBMP design to enhance groundwater protection, but
modifications shall not reduce PBMP requirements identified in Section 8.3.2 herein.

**8.3.7.4 Consideration of Impermeable Barriers**

To prevent infiltration of pollutants to groundwater, impermeable barriers are recommended for
consideration. These could include natural and synthetic liners, which have a permeability less than
1 x 10^-4 cm/second.

**8.3.8 Exemptions**

**8.3.8.1 Automatic Exemptions**

The following activities are exempt from PBMP requirements:

a) Agricultural Activities, as defined in Section 1.4(1) herein (i.e., pollutants from nonpoint source
agricultural and silvicultural activities, including runoff from orchards, cultivated crops, pastures,
range lands, and forest lands, but not concentrated animal feeding operations (CAFOs). This
exclusion does not extend to the construction of buildings).

b) Emergency and routine repair and maintenance operations for all underground utilities.

c) Land Disturbances at approved residential or commercial subdivisions that already have adequate
post-construction BMPs installed and operating for the entire subdivision and with adequate
capacity to treat any additional discharges.

d) Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity,
or original purpose of the facility.

e) Emergency operations related to flood, fire, or other force majeure that maintain the original line
and grade, hydraulic capacity or original purpose of the facility.

f) Land disturbance to undeveloped land that will remain undeveloped following the disturbance and
will be reclaimed in accordance with the Town’s construction BMP requirements.

g) Roadway maintenance as defined in Section 8.1.4.5(3) herein.

h) Large lot single family development, provided that the water quality storm event is effectively
prevented from leaving the site.
i) Underground utility construction, including the installation and maintenance of all utilities under hard surfaced roads, streets, or sidewalks, provided such land disturbance activity is confined to the area which is hard surfaced, and provided that stormwater runoff and erosion from soil and material stockpiles are confined and will not enter the drainage system.

Developers/permittees subject to these exemptions are not required to submit exemption requests.

8.3.8.2 Authorized Exemptions

a) Activities. Exemptions from PBMPs may be granted by the Town for the following site conditions on an approved site-specific basis, upon submission of a written request for exemption and upon review and approval.

1. Construction of a sidewalk or driveway authorized by a valid permit.
2. Rural road construction and maintenance provided that the developer/permittee provides post construction BMPs in accordance with the Authority’s Guidance Document, Chapter VII.
3. Trails construction, provided that the developer/permittee provides post construction BMPs in accordance with the Authority’s Guidance Document, Chapter X.

b) Requests for Exemption. Requests for exemption must be submitted in writing to the Town. Requests shall specify the exemption requested and briefly describe why the exemption applies to the proposed activity. All decisions on exemption requests shall be deemed final.

8.4 INDUSTRIAL BMP REQUIREMENTS

8.4.1 Submittal Requirements

Industrial developers/permittees must submit Preliminary and Final PBMP Plans required for all New Development and Redevelopment in accordance with all of the requirements of Section 8.3.1 herein. In addition to the requirements of Section 8.3.1 herein, PBMP Plans submitted by developers/permittees of Industrial Facilities must include the following information as part of their Preliminary and Final PBMP Plans.

8.4.1.1 Plan Requirements

a) Permits. Developer/Permittee at an Industrial Facility must submit a copy of their approved stormwater discharge permit and Stormwater Management Plan (SWMP) to the Town, if the developer/permittee's Standard Industrial Classification (SIC) code requires a permit application to the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) for stormwater discharges associated with the following:

1. Light Industrial Activity (Permit Number COR–010000);
2. Heavy Industrial Activity (Permit Number COR–020000);
3. Metal Mining (Permit Number COR-040000);
4. Auto Recyclers (Permit Number COR-060000); and
5. Sand and Gravel Mining (Permit Number COR-500000).

b) Industrial Activity Information. If an Industrial developer/permittee’s SIC code or industrial activities do not fall into the categories enumerated above or if no permit or SWMP have been
issued for developer/permittee, developer/permittee shall provide the following information in the PBMP Plan.

1. Description of potential pollutant sources and material inventory, including:
   (a) Type of material, products, by-products or finished product at facility;
   (b) Storage locations;
   (c) Loading and unloading areas; and
   (d) Locations for:
       • raw materials, by-products and finished product storage;
       • vehicle and equipment washing, maintenance and storage; and
       • outside manufacturing areas.

2. Stormwater quality control information, including:
   (a) Spill containment for fuel areas or other liquid storage containers;
   (b) For the items listed in item (1)(a) above, identify means to minimize contact with stormwater by enclosures, or minimize discharges of stormwater containing pollutants by:
       • containment,
       • treatment, and/or
       • other means; and
   (c) Measures for spill and leak containment and emergency response.

8.4.1.2 Review Procedures
The Town shall review the PBMP Plans as part of the overall land use or development project submittal. Approval of the PBMP Plan is required prior to the approval of the associated land use application and grading permit.

8.4.2 Industrial Uses - Permanent BMP Requirements
All New Development and Redevelopment at Industrial Facilities and commercial facilities that have a high pollutant potential (i.e., auto repair and gas stations) shall satisfy the following special PBMP requirements.

8.4.2.1 Industrial Permanent BMP Requirements
Developers/permittees at Industrial Facilities must comply with all of the PBMP requirements for Land Development activities enumerated at Section 8.3 herein. In addition, developers/permittees of Industrial Facilities shall satisfy the following additional special PBMP requirements designed to prevent or reduce the amount of pollutants generated or released from an Industrial Development.

a) Exposure Controls. The developer/permittee must implement PBMPs that reduce the potential for stormwater coming in contact with pollutant by installing covers or enclosures for all industrial activities. If covers or enclosures are not installed, then the developer/permittee must implement all of the following:
   1. Provide secondary containment area to collect leaks and spills, or other illicit discharges, or fuels, lubricants, and other chemicals.
   2. Segregate or divert stormwater runoff away from or around pollutant generating activity.
3. Route site drainage to recycling or otherwise preventing direct discharge of vehicle or equipment wash-water.

b) **Treatment Controls.** Developer/permittee must implement emergency response and recovery procedures should a spill or leak occur. If the Town determines that an oil spill or leak, or other illicit discharge, is probable, then the developer/permittee shall construct and maintain additional PBMPs for treatment of the potential illicit discharge.

c) **Prevention Measures.** Developer/permittee shall implement the following prevention measures.

1. Scheduled maintenance, signs and labels, and security systems.
2. Visual inspections to identify illegal dumping or disposal activities.
3. Scheduled preventative inspection and maintenance.
4. Spill prevention by controlling material handling and storage practices, and loading/unloading methods to minimize or prevent spill and leak occurrences.
5. Signage to clearly identify locations and handling requirements for significant materials.
6. Employee training in materials handling, storage, and safety procedures.
7. Record keeping and reporting.
8. Recycling vehicle or equipment wash-water.

### 8.4.3 Exemptions

#### 8.4.3.1 Authorized Exemptions

Exemptions from the special PBMP requirements for Industrial Facilities may be granted by the Town for the following site categories on a site-specific basis, upon submission of a written request for exemption and upon review and determination:

- The industrial development has been issued a “No Exposure Certificate” from the CDPHE. This document certifies that all industrial activities and materials are completely sheltered. A copy of this Certification must be submitted to the Town.

- A Colorado discharge permit is not required by the Water Quality Control Division due to the SIC code for the Industrial Facility. However, an exemption from the special PBMP requirements for Industrial Facilities does not constitute an exemption from the PBMP requirements for all New Development and Redevelopment enumerated at Section 8.3 herein.

#### 8.4.3.2 Requests for Exemption

Requests for exemption must be submitted in writing to the Town. Requests shall specify the exemption requested and briefly describe why the exemption applies to the proposed activity. All decisions on exemption requests shall be deemed final.
8.5 AGRICULTURAL BMP REQUIREMENTS

8.5.1 Permanent BMP Requirements

Agricultural land uses are recognized as Development and a potential source of pollutant loading. The CDPHE WQCD has identified recommended BMPs for Agriculture and Silviculture as part of the Colorado Nonpoint Source Management Program. Agricultural Activities, identified in Section 1.4(1) herein are exempt from the construction and permanent BMP requirements of Sections 8.2 and 8.3 herein. However, this ordinance encourages developer/permittees of all agricultural New Development/Redevelopment to implement applicable BMPs as identified in the Colorado Nonpoint Source Management Program. The Colorado Nonpoint Source Management Program recommends the installation of BMPs on a voluntary, nonregulatory basis.

Information on BMPs for specific agricultural uses is available with the Colorado Nonpoint Source Management Program. Each agricultural BMP contains a specifications guide of possible conservation practices.

8.6 STREAM PRESERVATION AREAS

In addition to the PBMP requirements listed in Section 8.3 and 8.4 herein, Tier 2 and Tier 3 New Development and Redevelopment within Stream Preservation Areas, must meet the additional PBMP requirements enumerated below.

8.6.1 Tier 3 New Development and Redevelopment PBMP Requirements

For all Tier 3 New Development and Redevelopment located in Stream Preservation Areas, the developer/permittee shall mitigate for the loss of alluvial recharge and filtration of stormwater through the alluvium resulting from construction of additional impervious areas in the Stream Preservation Area. Mitigation requirements will be determined on a case-by-case basis by the Town and may include one or more of the following:

a) Implementation of channel reclamation measures. See Section 2.1.3 herein for additional information.

b) Minimizing directly connected impervious area in accordance with the MANUAL Volume 3.

c) Implementing one of the following PBMPs per the Town’s criteria:

1. Porous Landscape Detention
2. Constructed Wetland Basin
3. Sand Filter Basin

d) Or, implement one or more of the following PBMPs in combination with Extended Detention Basins:

1. Grass Swales. All surface stormwater runoff from onsite impervious surfaces must be conveyed over grass swales before being discharged from the site, designed in accordance with Section 8.3.3.4 herein.
2. Constructed Wetland Channels. All surface stormwater runoff from onsite impervious surfaces must be conveyed through wetlands before being discharged from the site, designed in accordance with the MANUAL Volume 3.

e) Other PBMPs, which are not included in this document, could also be applied within Stream Preservation Areas to achieve the goal of maximizing phosphorus removal. If developer/permittee selects this option, the developer/permittee must implement PBMPs that can provide the expected probable pollutant removal efficiencies equivalent to, or greater than, the individual or combination BMPs described above.

8.6.2 Tier 2 New Development and Redevelopment PBMP Requirements

For all Tier 2 New Development and Redevelopment located in Stream Preservation Areas, the developer/permittee shall mitigate for the loss of alluvial recharge and filtration of stormwater through the alluvium resulting from construction of additional impervious areas in the Stream Preservation Area. Mitigation requirements will be determined on a case-by-case basis by the Town and include the following:

a) Minimizing directly connected impervious area in accordance with the MANUAL Volume 3.

b) Other PBMPs that promote filtration and infiltration, in accordance with the MANUAL Volume 3.

8.6.3 Review of PBMP Plans

The Town shall review the PBMP Plans as part of the overall land use or development project submittal. Approval of the PBMP Plan is required prior to the approval of the associated land use application and grading permit.

8.7 ENFORCEMENT

The Town of Parker has primary responsibility for implementing, monitoring and enforcing compliance with the requirements set forth in these Stormwater Quality Regulations. The regulations shall be enforced in accordance with Chapter 11.10 and Section 11.12.080 of the CODE as amended.

The Town may impose penalties or other measures set forth in Chapters 6.01 and 11.10 and Section 11.12.080 of the CODE as amended, for violations of the Stormwater Quality Regulations.

8.8 REFERENCES

1. Urban Drainage and Flood Control District, November 2010 (with revisions), Urban Storm Drainage Criteria Manual Volume 3

2. Urban Drainage and Flood Control District, June 2001 (with revisions), Urban Storm Drainage Criteria Manual Volumes 1 and 2


4. Colorado Department of Public Health and Environment, amended December 2011, Colorado Discharge Permit System Regulations, Water Quality Control Commission Regulation No. 61, Colorado Discharge Permit System
5. Colorado Department of Public Health and Environment, amended October 2012, Colorado Discharge Permit System Regulations, Water Quality Control Commission Regulation No. 72, Cherry Creek Reservoir Control Regulation

6. Cherry Creek Basin Water Quality Authority, Cherry Creek Reservoir Watershed, April 11, 2011, Control Regulation 5 CCR 1002-72 Stormwater Permit Requirements Guidance Document


8. Colorado Department of Public Health and Environment, June 2002, Qualifying Local Programs for Small Construction Sites – Application Guidance
# TABLE 8.2
## SELECTION MATRIX FOR WATER QUALITY CAPTURE VOLUME FACILITIES

<table>
<thead>
<tr>
<th>Type of WQCV Facility</th>
<th>Eligible for Maintenance Assistance from Town?¹</th>
<th>Regional, Sub-Regional or Onsite</th>
<th>Drainage Area</th>
<th>Development Type</th>
<th>Upstream Land Cover</th>
<th>Hydrology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended Detention Basin</td>
<td>Yes</td>
<td>Regional, sub-regional or onsite</td>
<td>Generally 10 to 640 acres</td>
<td>Single-family residential or commercial/ office/ multi-family/ industrial</td>
<td>Can accept native, non-irrigated grass areas or upstream natural channels</td>
<td>Can handle baseflows, but baseflows are not needed</td>
</tr>
<tr>
<td>Constructed Wetlands Basin</td>
<td>No</td>
<td>Regional or sub-regional</td>
<td>Generally 20 to 640 acres</td>
<td>Single-family residential or commercial/ office/ multi-family/ industrial</td>
<td>Can accept native, non-irrigated grass areas or upstream natural channels</td>
<td>Baseflows are required; adequate water must be available for evapotranspiration</td>
</tr>
<tr>
<td>Retention Pond</td>
<td>No</td>
<td>Regional or sub-regional</td>
<td>Generally 20 to 640 acres</td>
<td>Single-family residential or commercial/ office/ multi-family/ industrial</td>
<td>Can accept native, non-irrigated grass areas or upstream natural channels</td>
<td>Baseflows are required; adequate water must be available for evapotranspiration</td>
</tr>
<tr>
<td>Modified Extended Detention Basin</td>
<td>Yes</td>
<td>Sub-regional or onsite</td>
<td>Generally less than 10 acres ²</td>
<td>Single-family residential or commercial/ office/ multi-family/ industrial</td>
<td>Can accept limited² native, non-irrigated grass areas or upstream natural channels</td>
<td>No baseflows are expected</td>
</tr>
<tr>
<td>Sand Filter Basin with Sedimentation Basin</td>
<td>No</td>
<td>Sub-regional or onsite</td>
<td>Generally 1 to 20 acres</td>
<td>Commercial/ office/ multi-family/ industrial</td>
<td>Can accept limited² native, non-irrigated grass areas</td>
<td>No baseflows are expected</td>
</tr>
<tr>
<td>Sand Filter Basin</td>
<td>No</td>
<td>Sub-regional or onsite</td>
<td>Generally Less Than 10 acres</td>
<td>Commercial/ office/ multi-family/ industrial</td>
<td>Requires 100% stable land cover (pavement, irrigated turfgrass, or stable mulches)</td>
<td>No baseflows are expected</td>
</tr>
<tr>
<td>Porous Landscape Detention</td>
<td>No</td>
<td>Onsite</td>
<td>Generally less than 1 acre</td>
<td>Commercial/ office/ multi-family/ industrial</td>
<td>Requires 100% stable land cover (pavement, irrigated turfgrass, or stable mulches)</td>
<td>No baseflows are expected</td>
</tr>
<tr>
<td>Porous Pavement Detention</td>
<td>No - requires special approval from the Town</td>
<td>Onsite</td>
<td>Generally less than 1 acre</td>
<td>Commercial/ office/ multi-family/ industrial</td>
<td>Requires 100% stable land cover (pavement, irrigated turfgrass, or stable mulches)</td>
<td>No baseflows are expected</td>
</tr>
</tbody>
</table>

¹ WQCV facilities NOT eligible for maintenance assistance from the Town of Parker Stormwater Utility require an Operations and Maintenance Plan as described in Section 8.3.6.

² For drainage areas less than 2 acres, the Town may consider alternative designs that reduce structural elements associated with forebay, low flow channel and outlet structure.

³ For upstream land cover defined as "limited native non-irrigated grass"; total land cover cannot consist of more than 20% native non-irrigated grass.
FIGURE 8.1
CONCEPT FOR POROUS LANDSCAPE DETENTION IN PARKING LOT

SEE VOLUME 3 OF THE UDOCD MANUAL FOR ADDITIONAL INFORMATION REGARDING THE DESIGN AND CONSTRUCTION OF POROUS LANDSCAPE DETENTION IN PARKING LOTS.

OPTIONAL - MAY BE PROVIDED AT DOWNSTREAM FACILITY
FIGURE 8.2
CONCEPT FOR POROUS LANDSCAPE DETENTION IN PARKING LOT
(DETAILED VIEW)

MAX. DEPTH BELOW PAVEMENT SHALL BE 12" FOR WQCV, ONLY AND 15" FOR EURV, UNLESS OTHERWISE APPROVED BY TOWN.

CONCRETE DIMENSIONS AND REINFORCING SHALL BE THE RESPONSIBILITY OF THE DESIGN ENGINEER.

UNDERDRAIN PIPE  GROWING MEDIA  PIPE SIZED FOR 100-YR RELEASE

DEBRIS GRATE: SIZE BASED ON FIG 7 UDFCD MANUAL (VOL. 3) 2

ORIFICE FOR EURV: MAX. RELEASE PER TABLE 50-1, UDFCD MANUAL FOR 2-YR EVENT. MAX. DRAIN TIME = 30 HRS 2

SEE FIGURE 8-4 FOR INFLOW OPTIONS

GEOMEMBRANE LINER SEALED TO PERIMETER WALLS IF REQUIRED BY GEOFECTNICAL ENGINEER. SEPARATOR FABRIC OTHERWISE.

OPTIONAL - MAY BE PROVIDED AT DOWNSTREAM FACILITY

1 IF APPROVED BY TOWN, ORIFICE MAY BE ELIMINATED AND EURV MAY BE DRAINED THROUGH FILTER MEDIA AND UNDERDRAIN
FIGURE 8.3
CONCEPTS FOR POROUS LANDSCAPE DETENTION OUTLET STRUCTURES⁴

OUTLET STRUCTURE WHERE WOCV, EURV, AND 100-YEAR DETENTION ARE COMBINED IN A SINGLE FACILITY

OUTLET STRUCTURE WHERE WOCV AND EURV ARE COMBINED; 100-YEAR DETENTION IS PROVIDED DOWNSTREAM

OUTLET STRUCTURE WHERE WOCV STANDS ALONE; EURV AND 100-YEAR DETENTION ARE PROVIDED DOWNSTREAM

⁴ OUTLET STRUCTURE SHOWN MAY ALSO BE USED FOR SAND FILTER BASIN

⁵ IF APPROVED BY TOWN, ORIFICE MAY BE ELIMINATED AND EURV MAY BE DRAINED THROUGH FILTER MATERIAL AND UNDERDRAIN

⁶ MAXIMUM 100-YR DEPTH = 9" IN PAVEMENT AREAS
FIGURE 8.4
CONCEPTS FOR INFLOWS TO POROUS LANDSCAPE DETENTION IN PARKING LOT

OPTION 1. SHEET FLOW (IF APPROVED BY TOWN)

OPTION 2. CURB OPENING

OPTION 3. INLET
FIGURE 8.5
CONCEPT FOR POROUS LANDSCAPE DETENTION IN LANDSCAPE AREA
(IF APPROVED BY THE TOWN)
FIGURE 8.6
TERMS FOR MINIMIZING DIRECTLY CONNECTED IMPERVIOUS AREA

Conventional Approach: Curb, Gutter and Storm Sewer

Minimizing DCIA: Sheet Flow Off Parking Lot to Grass Buffer and Swale

LEGEND
- Directly Connected Impervious Area
- Unconnected Impervious Area
- Receiving Pervious Area
- Separate Pervious Area
FIGURE 8.7
CONCEPTS FOR GRASS SWALES

URBAN ROADSIDE GRASS SWALE

GRASS SWALE

UNDERDRAIN DETAIL, IF USED

SOIL RIPRAP DETAIL, IF USED

See Table 8.3 for maximum slopes and velocities and for underdrain criteria.
FIGURE 8.8
CONCEPT FOR CONCRETE EDGER

Concrete Edger

2'-0"

1" Chamfer or Tooled Edge

Grass Buffer and Swale

2"

Pavement

2% Min.

12" Min.
9. CONSTRUCTION SPECIFICATIONS

9.1 INTRODUCTION

This section should be used as a supplement to the Roadway Manual to address construction criteria related to the installation of drainage, permanent erosion and permanent sediment control facilities within the Town of Parker. It is intended to provide model information and minimum construction standards to all engineers, contractors, builders, developers, permittees and other interested parties or firms. With the exception of temporary erosion and sediment control, The Town of Parker conforms to the Colorado Department of Transportation (CDOT) current edition of Standard Specifications for Road and Bridge Construction (Standard Specifications), and all standard special provisions currently used by CDOT, with modifications set forth in this section. This chapter only applies to drainage and stormwater infrastructure; for all other types of infrastructure, see the Roadway Manual.

This section makes frequent references to the Designated Town Authority (DTA). The DTA is the Town of Parker Public Works Director acting directly or through an authorized representative who is responsible for engineering and administrative supervision of the project. See Section 1.7 of the Roadway Manual for a comprehensive definition of the Town of Parker DTA.

9.2 GENERAL REQUIREMENTS

All storm drainage public improvements are subject to compliance with the current edition of this Manual and the following standards which are used by the Town of Parker or other governing agencies:

2. All other Town standards (including, but not limited to, Construction Specifications and Design Considerations for Parks, Trails, and Streetscapes Manual)
3. The municipal code and current development regulations

Water and sanitation districts are not Town agencies and the developer/permittee must contact the appropriate district to review all development plans.

It is the developer/permittee’s responsibility to acquire and comply with all applicable current Town criteria. Copies of these criteria can be found on the Town’s website or may be purchased from the Town of Parker at the Town Hall, 20120 East Mainstreet, Parker, CO 80138. These documents can also be viewed at the Town Clerk’s office.

The technical methodology may be amended from time to time by the Public Works Director. Any such amendment will be available online or for purchase at prices established by the Town.

The Roadway Design and Construction Criteria Manual provides information related to the planning process, design review, sureties, construction process, post construction acceptance, and warranties for development within the Town. The following items are reiterated in this section:
1. All Contractors must notify the DTA at least 48 hours prior to the start of construction.

2. A pre-construction meeting must be arranged by the Contractor and held prior to the start of any work. The DTA, Contractor, and Developer/Permittee, or Owner's Engineer must be represented at this meeting, which shall be held either on the construction site or at the office of the Town of Parker. Reference is made to the Roadway Design and Construction Criteria for additional pre-construction meeting criteria.

3. Approved plans and specifications must be kept on the job site by the Contractor at all times.

4. Prior to probationary acceptance, onsite detention ponds shall be resurveyed in order to verify final detention volumes. A Colorado registered engineer shall provide as-built certification in accordance with SDECM, Section 2.3 herein.

5. All drainage infrastructure (pipes, manholes, inlets, forebays, trickle channels, etc.) shall be cleared and free of construction debris, and other foreign material prior to probationary/final inspections.

6. Manhole rims and covers shall be adjusted to within one-fourth inch (1/4") to one-half inch (1/2") below grade in paved areas or one inch (1") above grade in non-paved areas. A concrete collar, in accordance with CDOT M&S Standard Plan No. M-604-20, shall be installed on all manhole rings/covers in non-paved areas.

9.3 TECHNICAL SPECIFICATIONS

9.3.1 Governing Specifications

All drainage improvements designed and constructed within the Town shall be governed by the included plans, and the technical specifications. The technical specifications are comprised of the following components:


3. The Town of Parker Standard Special Provisions as included in this section.

4. Project Special Provisions if applicable and approved by the Town.

All temporary erosion control measures and related activities shall be in accordance with the criteria set forth in the Construction Best Management Practices which are included in this Manual. The only exception to this requirement may be joint jurisdictional projects.

Measurement and payment for work performed under private contract between a developer/permittee and a Contractor shall be as specified in that contract.

The Town of Parker Standard Special Provisions and the Plans are intended to be complimentary to each other. In case of discrepancy, the order of precedence for interpretation shall be as follows:

2. The Town of Parker Storm Drainage and Environmental Criteria Manual
3. Plans
   a. Detail Drawings
b. General Drawings (Plan and Profile Sheets)  
c. Standard Details (Town of Parker and CDOT)  

9.3.2 Exclusions from the CDOT Standard Specifications  
The Town of Parker Construction Best Management Practices is an all-inclusive program established in order to satisfy the requirements of the Town’s municipal separate stormwater system (MS4) as authorized under a CDPS general permit. As a result, the following sections of the CDOT Standard Specifications are deleted from the list of CDOT Standard Specifications for all projects located within the Town of Parker:  

Section 208 Erosion Control  
Section 212 Seeding, Fertilizer, Soil Conditioner and Sodding  
Section 213 Mulching  
Section 214 Planting  
Section 215 Transplanting  
Section 216 Soil Retention Covering  

9.3.3 Index of Town of Parker Standard Special Provisions  
The following revised sections of the "CDOT Standard Specifications for Road and Bridge Construction" 2011 Edition, prepared by the Colorado Department of Transportation (CDOT), as amended, should be used as they apply to individual projects. The technical specifications represent minimum compliance. At the design engineer’s discretion, Project Special Provisions may be generated to provide more restrictive specifications, as the conditions warrant, or as directed and approved by the DTA.  

Revision of Section 101 Definitions and Terms  
Revision of Section 107 Legal Relations and Responsibility to Public (Water Quality Control)  
Revision of Section 201 Clearing and Grubbing  
Revision of Section 203 Excavation and Embankment  
Revision of Section 206 Excavation and Backfill for Structures  
Revision of Section 501 Steel Sheet Piling  
Revision of Section 506 Riprap and Soil Riprap  
Revision of Section 506 Grouted Boulders  
Revision of Section 601 Structural Concrete  
Revision of Section 603 Culverts and Sewers  
Revision of Section 604 Manholes, Inlets, and Meter Vaults  
Revision of Section 706 Concrete and Clay Pipe
REVISION OF SECTION 101
DEFINITIONS AND TERMS

Section 101 of the Standard Specifications is hereby revised as follows.

Revise the following subsections with the corresponding definition:

101.10 CDOT Resident Engineer. Designated Town Authority (DTA)
101.17 Contract. Documents that constitute the agreement between the Town and the Developer/Permittee
101.28 Department. Department of Public Works, Town of Parker, Colorado
101.29 Engineer. Designated Town Authority (DTA)
101.51 Project Engineer. Designated Town Authority (DTA)
101.76 State. Where the term "State" is used in reference to ownership of the project it shall mean the Town of Parker.

Add the following subsections:

101.96 Division. Town of Parker.
101.97 Owner. Town of Parker.
101.98 Staff Construction Engineer. Designated Town Authority (DTA).
101.100 UDFCD. Urban Drainage and Flood Control District.
Page intentionally left blank.
REVISION OF SECTION 107
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC (WATER QUALITY CONTROL)

Section 107 of the Standard Specifications is hereby revised as follows:

107.25 Water Quality Control

Item (b) Construction Requirements shall include the following:

25. The Contractor shall comply with the “Cherry Creek Reservoir Control Regulation No. 72” (5 CCR 1002-72). In the event of conflicts between these requirements and water quality control laws, rules, or regulations of other Federal, or State agencies, the more restrictive laws, rules, or regulations shall apply.

26. Any diversion or bypass of water from structures or facilities that are provided to maintain compliance with the Contract is prohibited except, (1) where unavoidable to prevent loss of life or severe property damage, or (2) where excessive storm drainage or runoff would damage the structures. If diversion or bypass of the structures occurs, the Contractor shall immediately notify the DTA in writing of the occurrence, and will accept or reject the course of action proposed by the Contractor, or detail an alternative course of action.

27. Use of heavy equipment in or around state waters, including wetlands, will not be allowed, except as specified in the Contract and/or permits unless otherwise directed by the DTA. In this case the equipment shall be of such type that will produce minimal environmental damage. Where practical, equipment shall be operated from banks or shoulder above riparian and wetland areas.

28. The Contractor shall not dispose of plastic, concrete or any other construction material in state waters, including wetlands.

29. The construction activity shall not block the movement of those species of aquatic life indigenous to the body of water.

30. Discharges into breeding areas of migratory waterfowl, or into fish spawning areas during spawning seasons shall not be permitted unless allowed by permits from appropriate regulatory agencies.
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REVISION OF SECTION 201
CLEARING AND GRUBBING

Section 201 of the Standard Specifications is hereby revised as follows:

DESCRIPTION

201.01

*This section shall include the following:*

This work includes removal and disposal of trash of any kind within the limits of the right-of-way, easement areas, and other areas shown in the contract or required by the work. These items shall be removed and disposed of by the Contractor during construction and prior to final acceptance of the project.

CONSTRUCTION REQUIREMENTS

201.02

*The third paragraphs of this section shall be deleted and replaced with the following:*

The limits of clearing and grubbing shall be confined to the limits of work. Areas of protection shall be established by the Engineer prior to construction. All trees, shrubs, plants, grasses and other vegetative materials within those areas of protection shall remain, except as designated by the Engineer.

The Contractor shall identify and mark each tree or shrub mass over 100 square feet to be removed. The Engineer shall be notified for inspection and approval of these marked trees. No tree or shrub shall be removed without prior approval by the Engineer. Trees removed without prior approval of the Engineer shall be replaced at the Contractor’s expense. Replacement trees shall be of the caliper or size, and type of tree removed as approved by the Engineer in accordance with the Town requirements. Any object that is not designated to be removed and is damaged shall be repaired or replaced as directed by the Engineer, at the Contractor’s expense.

Existing grasses do not need to be mowed or scalped and may be incorporated into the topsoil stripping of the site.

Clearing and grubbing shall include the pruning of all trees that will remain within the final right-of-way. Pruning of trees shall include removal of all branches that conflict with construction of the proposed improvements and all dead branches.

The unnecessary removal of trees or shrubs shall be avoided; for example, aerial portions of trees and shrubs that hang over a project area and interfere with equipment shall be pruned.

Migratory birds, as well as their eggs and nests, are protected under the Migratory Bird Treaty Act (MBTA). The active nesting season for most migratory bird species in Colorado is between April 1 and
August 15. To avoid a violation of the MBTA, conduct habitat-disturbing activities (tree removal, clearing and grubbing, etc.) in the non-breeding season (August 16 to March 31). If work activities are planned between April 1 and August 15, remove or alter vegetation within construction footprints and road right-of-ways (ROW) prior to April 1 to discourage nesting within areas scheduled for summer construction. If the Contractor is unable to meet these requirements, the Contractor shall notify the Engineer prior to any vegetation removal.

Once all clearing and grubbing is completed and approved, no additional clearing shall be allowed unless approved, in writing, by the Engineer.
REVISION OF SECTION 203
EXCAVATION AND EMBANKMENT

Section 203 of the Standard Specifications is hereby revised as follows:

DESCRIPTION

203.03 Embankment

Item (a)1. Soil Embankment shall include the following:

Any material used for embankments which retain water (i.e. detention pond) must conform to the requirement set forth by the geotechnical engineer.

CONSTRUCTION REQUIREMENTS

203.05 Excavation

Item (b) Unclassified shall include the following:

Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments shall become the property of the Contractor and disposed of outside the project limits.

203.06 Embankment

The fourth paragraph of this section shall be deleted and replaced with the following:

Broken concrete, broken asphalt, or other solid materials more than 6 inches in greatest dimension, shall be removed from the project and shall become the property of the contractor.

This section shall include the following:

Moisture and compaction requirements for embankments shall be as set forth by the geotechnical engineer.
Page intentionally left blank.
REVISION OF SECTION 206
EXCAVATION AND BACKFILL FOR STRUCTURES

Section 206 of the Standard Specifications is hereby revised as follows:

MATERIALS

206.02 General

This section shall include the following:

At the Contractor's option, Structure Backfill (Squeegee) meeting the following gradation requirements may be substituted for Structure Backfill (Class 1) or (Class 2) for backfilling concrete culvert pipes, concrete storm sewer pipes, manholes and inlet structures. The top 2 feet below subgrade elevation shall be the required embankment material. Structure Backfill (Squeegee) may not be substituted as backfill for steel or metal pipes.

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Passing Squared Mesh Sieves % By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 Inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>60-90</td>
</tr>
<tr>
<td>No. 8</td>
<td>0-45</td>
</tr>
<tr>
<td>No. 16</td>
<td>0-25</td>
</tr>
<tr>
<td>No. 50</td>
<td>0-6</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-2</td>
</tr>
</tbody>
</table>

CONSTRUCTION REQUIREMENTS

206.03 Structure Excavation and Structure Backfill

This section shall include the following:

Subgrade shall be prepared for drainage structures as follows:

Before concrete placement begins, the structure subgrade area shall be graded and shaped to the lines and grades shown on the plans. Subgrade in all areas under concrete structures shall be scarified to a minimum depth of 8 inches and recompacted to at least 95 percent of maximum density and within 2 percent of optimum moisture content according to AASHTO T 99.

The Contractor's water control method shall be designed so that concrete is placed in dewatered conditions. All dewatering costs incurred shall be included under Item 208 Surface Water and Groundwater Control.

Preparation of the subgrade shall be completed and approved no more than twenty-four (24) hours prior to the beginning of concrete placement on the prepared subgrade. The subgrade moisture
content shall be maintained within 2 percent of optimum condition until placement of the concrete. Concrete shall not be placed until subgrade preparation has been approved by the Engineer.

Where subgrade cannot be compacted as specified, or in areas identified by the Engineer that display yielding, or excessive rutting during construction activities, one of the following approaches shall be used, as approved by the Engineer.

(1) In areas where, in the opinion of the Engineer, inadequate dewatering methods or effort are being employed by the Contractor, the Contractor shall modify/improve the dewatering efforts and recompact or may overexcavate over-moist areas and backfill and compact with suitable material at their own expense.

(2) Alternatively and as directed by the Engineer, in areas where, in the opinion of the Engineer, adequate dewatering methods or effort are being employed by the Contractor, over-moist material shall be excavated up to two feet below the design top of subgrade with the prior approval of the Engineer, and then backfilled with Filter Material (Class A). This approach will only be allowed in certain areas where the granular material will not adversely affect seepage cutoff.

Compaction testing of Structure Backfill will not be required if Structure Backfill (Squeegee) is used. Compactive effort shall be applied to ensure the complete backfill of the trench storm sewer and structures.
REVISION OF SECTION 501
STEEL SHEET PILING

Section 501 of the Standard Specifications is hereby revised as follows:

MATERIALS

501.03

This section shall include the following:

The interlocks between steel sheet pile sections shall be configured such that the average width of the annular space between all contact points of the interlocks shall be a maximum of one-eighth (1/8) inch, as determined by the Engineer.

All steel sheet piling shall be new and unspliced material throughout unless otherwise reviewed and accepted by the Engineer.

If handling holes are provided, they shall be two (2) standard 2-9/16 inch diameter handing holes located six (6) inches from one end. The holes shall be plugged by welding a piece of steel over the hole prior to installing any riprap, backfill or drop structure cap. The plated hole shall be watertight.

CONSTRUCTION REQUIREMENTS

501.04

This section shall include the following:

Do not begin sheet pile installation until the earthwork in the area where the piles are to be driven has been completed to the extent that the grade elevation is at no more than twelve (12) inches above or below the top of the piling elevation as indicated on the Drawings.

Steel sheet piling shall be assembled before driving and then driven as a continuous wall, progressively in stages to keep the piles aligned correctly and minimize the danger of breaking the interlock between the sheets. The piling shall be driven within the following tolerances:

a) Alignment: sheet pile shall be driven to form a relatively straight line between the termini points shown on the Drawings. Horizontal deviation of any point from a straight line connecting the two ends of the wall section shall be a maximum of six (6) inches.

b) Plumbness: each individual sheet pile section shall be driven vertical, within a horizontal tolerance of two percent (2%) of any vertical length measured along the pile.
c) Elevation: tops of sheet pile sections shall be within a tolerance of one (1) inch from plan elevations. The Contractor shall not be paid for excess sheet pile trimmed off the end of the pile to meet final grade.

Steel Z piling shall be driven with the ball-end leading. Proper care and planning shall be used to allow for this construction procedure in both immediate and possible future walls.

Alternate Z piles must be reversed end for end for proper interlocking in the "normal" position. Piles shall also be aligned properly to maintain a "normal" driving width.

For sheet piles driven into the native soils, pre-drilled soils, or excavated soils, a vibratory driver may be used as long as the required depth is obtained. For sheet piles being driven into bedrock, an approved hammer utilizing a minimum hammer energy of 19,000 foot-pounds per square inch of steel section shall be used to obtain the required depth or virtual refusal. Contractor shall submit verification from the manufacturer that the hammer can deliver the required energy. The hammer shall be clearly marked so that it can be identified at the job site.

Steel sheet piling shall be driven to the depths shown on the Drawings or to virtual refusal. Virtual refusal is defined as ten (10) blows per inch with an approved pile hammer. A pile hammer shall be used to determine virtual refusal. The hammer shall be operating at the manufacturer's recommended stroke and speed when virtual refusal is measured.

Care shall be taken during driving to keep from causing deformations of the top of the piles, splitting of section, or breaking of the interlock between sections. Care shall also be taken during driving to prevent and correct any tendency of steel sheet piles to twist or get out of plumb. Steel sheet piling shall be driven to form a tight bulkhead. A driving head shall be used and any piling which is damaged in driving or which has broken interlocks between sections shall be pulled and replaced at the Contractor’s expense.

Steel sheet pile that is full length as shown on the drawings and is required to be driven below the specified cutoff elevation shall be spliced with additional steel sheet piling with a full penetration butt weld. Splice locations, if necessary, must be reviewed and accepted by Engineer prior to installation.

The Contractor shall brace and/or provide soil grading as necessary during construction operations in order to provide lateral stability for the sheet pile wall. The sheet pile wall has been designed for the soils grades of the final configuration denoted on the drawings only. Other temporary configurations during the construction period shall not be allowed.

Any fill along the alignment of the sheet pile must be in place to sub-grade elevations and compacted prior to driving the sheet pile. Fill material (except riprap, boulders, bedding and grout) is not to be placed around the sheet pile after the sheet pile is in place.
REVISION OF SECTION 506
RIPRAP AND SOIL RIPRAP

Section 506 of the Standard Specifications is hereby revised as follows:

MATERIALS

506.02

The first paragraph, second paragraph and Table 506-1 shall be replaced with the following:

Rock used for riprap shall be hard, durable, angular in shape, and free from cracks, overburden, shale, and organic matter. Neither breadth nor thickness of a single stone shall be less than one-third its length and rounded stone shall be avoided. The rock shall sustain a loss of not more than 40% after 500 revolutions in an abrasion test (Los Angeles machine - ASTM C535-69) and shall sustain a loss of not more than 10% after 12 cycles of freezing and thawing (AASHTO Test T103 for ledge rock procedure A). Rock having a minimum specific gravity of 2.65 is preferred; however, in no case shall rock have a specific gravity less than 2.50. Rhyolite rock shall not be used for riprap. At the request of the Engineer, the Contractor shall furnish laboratory test results indicating that the material meets the aforementioned requirements.

The following table summarizes the CDOT riprap designations and the equivalent UDFCD Manual nomenclature. This table is for information purposes only and is intended to clarify any confusion regarding the terminology used by CDOT and UDFCD

<table>
<thead>
<tr>
<th>CDOT Pay Item</th>
<th>UDFCD Equivalent Riprap Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riprap (6 inch)</td>
<td>Type VL</td>
</tr>
<tr>
<td>Riprap (9 inch)</td>
<td>Type L</td>
</tr>
<tr>
<td>Riprap (12 inch)</td>
<td>Type M</td>
</tr>
<tr>
<td>Riprap (18 inch)*</td>
<td>Type H*</td>
</tr>
<tr>
<td>Riprap (24 inch)*</td>
<td>Type VH*</td>
</tr>
</tbody>
</table>

* CDOT and UDFCD gradation tables vary slightly. Either gradation is acceptable to the Town of Parker.

CONSTRUCTION REQUIREMENTS

506.03

This section shall include the following:
Where "soil riprap" is designated on the Contract Drawings, riprap voids are to be filled with native soil material. The soil used for mixing shall be native topsoil, as defined in Section 207, stripped from the project site. The riprap shall be pre-mixed with the native soil at the following proportions by volume: 65 percent riprap and 35 percent soil. The mixing of riprap and soil shall be done at the stockpile location, not at the location where the soil riprap is to be placed. When mixing, additional moisture and control procedures shall be used that assure a homogenous mixture, where the soil fills the inherent voids in the riprap without displacing riprap.

A layer of smaller soil riprap of approximate $d_{50}$ thickness shall be placed first. Then place the top layer with surface rocks that are largely $d_{50}$ or greater, filling voids as necessary with hand placed riprap. The mixture shall be consolidated by large vibratory equipment or backhoe bucket to create a tight, dense interlocking mass. The soil shall be further wetted to encourage filling the voids with soil. Any large voids shall be filled with rock and small voids filled with soil. Excessively thick zones of soil prone to washing away shall not be created (e.g., no thicknesses greater than six (6) inches). For buried soil riprap, the top surface shall be covered with a layer of topsoil as specified in the Contract Drawings, such that no rock points are protruding. The final surface shall be thoroughly wetted for good compaction, smoothed and compacted by vibrating equipment. The topsoil surface layer shall be compacted to approximately 85 percent of maximum density and within two percentage points of optimum moisture in accordance with ASTM D698. Topsoil shall be added to any areas that settle.

The Contractor shall install a test section of at least 100 square feet of soil riprap for the review and approval of the Engineer prior to installation of the remaining soil riprap.
REVISION OF SECTION 506
GROUTED BOULDERS

For all work pertaining to the placement of grouted boulders, Section 506 of the Standard Specifications is hereby revised as follows:

DESCRIPTION

506.01

The subsection shall be replaced with the following:

This work consists of the construction of grouted boulders in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

MATERIALS

506.02

This subsection shall include the following:

The materials for boulders and grout shall conform to the following:

A. The specific gravity of the boulders and riprap shall be 2.65 or greater.

B. Neither breadth nor thickness of a single boulder shall be less than two-thirds of its length.

C. A small representative sample of the boulder shall be submitted to the Engineer for approval of the color prior to any deliveries to the project site.

D. Minimum density for acceptable boulders shall be one hundred sixty five (165) pounds per cubic foot. The specific gravity shall be according to the bulk-saturated, surface-dry basis, AASHTO T85.

E. The boulders shall have a percentage loss of not more than ten percent (10%) after five (5) cycles when tested in accordance with AASHTO Test T104 for ledge rock using sodium sulfate.

F. The boulders shall have a percentage loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing when tested in accordance with AASHTO Test T103 for ledge rock, procedure A.

G. Rhyolite rock shall not be used for any grouted boulders.

H. Control of gradation will be by visual inspection. However, in the event Engineer determines the boulders to be unacceptable, Engineer shall pick two random truckloads to be dumped and checked for gradation. Mechanical equipment and labor needed to assist in checking gradation shall be
provided by Contractor at no additional cost to Owner if the boulders do not meet the specified gradation.

<table>
<thead>
<tr>
<th>Boulder Size (inches)</th>
<th>Range in Smallest Dimension of Individual Boulders (inches)</th>
<th>Maximum Ratio of Largest to Smallest Dimension of Individual Boulders</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>17-20</td>
<td>2.5</td>
</tr>
<tr>
<td>24</td>
<td>22-26</td>
<td>2.0</td>
</tr>
<tr>
<td>30</td>
<td>28-32</td>
<td>2.0</td>
</tr>
<tr>
<td>36</td>
<td>34-38</td>
<td>1.75</td>
</tr>
<tr>
<td>42</td>
<td>40-44</td>
<td>1.65</td>
</tr>
<tr>
<td>48</td>
<td>45-51</td>
<td>1.50</td>
</tr>
</tbody>
</table>

1. Concrete for the grout shall be an approved batch meeting the following requirements: All concrete shall develop 4,000 psi compressive strength within 28 days; one cubic yard of grout shall have a minimum of 6 sacks of Type II Portland cement; the aggregate shall be comprised of 70% natural sand (fines) and 30% 3/8-inch rock (coarse); the slump shall be within a range of 4 to 6 inches and air entrainment shall be 5.5 – 7.5%. A stiffer mix or other measures can be used as approved by Engineer for steeper slopes or for vertical joints. The water/cement ratio shall not exceed 0.48. The grout shall contain 1.5 pounds per cubic yard of synthetic fiber reinforcement per manufacturer’s instructions. The Contractor shall submit a mix design in writing to Engineer for approval prior to placement of any grout.

Contractor shall furnish laboratory test results that the boulders meet the gradation, specific gravity requirements and the abrasion resistance/compressive strength requirements.

CONSTRUCTION REQUIREMENTS

506.03

This subsection shall include the following:

Grouted boulders shall be placed at the locations as shown on the Drawings and installed with the following requirements:

A. Prior to placement of boulders, the Engineer shall be notified in order to approve the depth and limits of boulders and riprap.

B. The subgrade to receive each boulder shall be excavated and any unstable material shall be removed. Approved material shall be placed and compacted in a maximum of 6-inch lifts to 95% of Maximum Standard Proctor Density (ASTM D698) and within 2 percent of optimum moisture to re-establish the subgrade of each boulder. Removal and replacement of unstable material shall only be completed at the direction of the Engineer.

C. The top elevation of all boulders shall be as indicated on the Drawings. Finished grades and subgrades for boulders will be determined from the height of each boulder used.
D. Boulders shall be carefully picked and arranged so that rock surfaces match the design elevations within 2 inches in top elevation and 2 inches along the vertical exposed face or channel side of rock (unless otherwise indicated in the drawings). Boulders shall be placed such that adjacent boulders “touch” each other and voids do not exceed 4-inches. It is the intent of construction to minimize voids and the visibility of grout placed in between boulders. Boulders shall be arranged in a step-like fashion and/or in rows to form “steps” as indicated on the Contract Drawings. A minimum vertical overlap of 12 inches shall be maintained from one boulder to the next.

E. Prior to placing the grout, all debris, fines, smaller rock, and silt shall be removed from around or under the boulders. Boulder placement shall be approved by the Engineer prior to placing the grout.

F. Dewatering shall be implemented to ensure that the grout will not be placed in water and for a period of 24 hours after the grout has been placed.

G. Clean boulders by brushing and washing with water before grouting. Boulders receiving grout shall be kept wet when receiving grout. The concrete grout shall be placed by means of a low pressure (less than 10 psi) grout pump using a 2-inch diameter nozzle to ensure complete penetration of the grout into the boulder layer as shown on the drawings. A "pencil" vibrator shall be used to make sure all voids are filled between and under the boulders. The intent is to fill all voids from the subgrade level around the boulders to the depth indicated. In all cases, grout must penetrate to the subgrade of boulders.

H. The operator shall be able to stop the flow and will place grout in the voids and not on the surface of the rocks. Any spillage of grout on exposed boulder faces shall be cleaned and washed before the grout sets. The visual surfaces of the rocks shall be free of grout to provide a clean natural appearance. If washing does not clean off grout residue, then the Contractor shall wash off any grout residue with muratic acid and water, using a brush to scrub off the residue.

I. All grout between boulders shall be finished with a broom finish.

J. Batching and mixing requirements, time constraints, and hot and cold weather limitations for grout placement shall conform to specifications in Section 601. Grout shall not be placed when the air temperature is below 40 degrees F. Grout shall not be placed if the weather conditions are such that the grout being placed cannot be completely protected before the advent of damaging weather (such as overnight below 35 degrees F, cold fronts, rainstorms, etc.).

K. All finished grout surfaces shall be cured immediately after placement by applying a clear membrane forming curing compound as specified in Section 601.13(b). In addition, curing as described in Subsection 601.13 shall be used in cold weather to maintain the grout surface at a temperature above 40 degrees F and in a moist condition during the first 7 days after placement. The minimum curing period shall be 7 days. Curing conditions and temperature will be monitored by the Engineer during the curing period.
Page intentionally left blank.
Section 601 of the Standard Specifications is hereby revised as follows:

CONSTRUCTION REQUIREMENTS

601.09 Forms.

This section shall include the following:

For all drainage related structures, chamfer strips (three-quarters [¾] inch or as shown on the drawings) shall be placed in the corners of forms and at the tops of walls or up-turned footings, to produce beveled edges on permanently exposed concrete surfaces or as otherwise specified by the Town. Interior angles of intersecting concrete surfaces and edges of construction joints shall not be beveled unless otherwise indicated in the drawings. The chamfer strip may be made of wood or polyvinyl chloride (PVC).

601.14 Finishing Hardened Concrete Surfaces.

Section (a) shall be deleted and replaced with the following:

(a) General. All exposed concrete surfaces shall be finished with a Class 2 rubbed Finish unless otherwise specified by the Town.
Page intentionally left blank.
REVISION OF SECTION 603
CULVERTS AND SEWERS

Section 603 of the Standard Specifications is hereby revised as follows:

MATERIALS

603.02

This section shall include the following:

All RCP shall have a minimum pipe strength of Class III. Nonreinforced concrete pipe shall not be allowed. The joints for the RCP shall be rubber gasketed type conforming to ASTM C433.

Shop drawings and Certificates of Compliance shall be provided from the pipe manufacturer that shows that pipe and end sections conform in all respects to these Specifications and other non-conflicting requirements of the referenced ASTM and AASHTO specifications.

CONSTRUCTION REQUIREMENTS

603.03 General

This section shall include the following:

When testing is specified by the contract, or as directed by the Engineer, procedures shall be in accordance with:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C 924</td>
<td>Concrete Pipe Sewer Lines By Low-Pressure Air Test Method</td>
<td></td>
</tr>
<tr>
<td>ASTM C 969</td>
<td>Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines</td>
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</tr>
<tr>
<td>ASTM C 1103</td>
<td>Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines</td>
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</tr>
</tbody>
</table>

603.04 Excavation

This section shall include the following:

Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the approved drawings or as otherwise approved by the Engineer. All excavations shall meet OSHA requirements. Any water which may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of the work. The cost of removing water from the trench shall be included in the cost of the pipe.
Where excavation is inadvertently carried below subgrade and/or foundation elevations, suitable provisions shall be made at the expense of the Contractor for adjustment of same, as directed by the Engineer to meet requirements incurred by the deeper excavation beneath pipe or structures. Over-depth excavation in such location shall be rectified by backfilling with approved sand and/or graded gravel, and shall be compacted to provide a firm and unyielding subgrade and/or foundation, as directed by the Engineer. Hand methods for excavation shall be employed in locations directed by the Engineer. In other locations, the Contractor may use trench digging machinery or employ hand methods.

All excavations shall be properly supported in the manner as required by OSHA or as required by state laws and as may be necessary to protect life, property, and the work. Excavations shall be braced, sheeted and supported so that they will be safe, and the ground alongside the excavation will not slide or settle. Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the withdrawing or removing of sheeting, shoring, bracing and timbering to prevent the caving or collapsing of the excavation faces which are being supported.

The Contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains.

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the Engineer. Dewatering for the storm sewer lines shall commence when groundwater is first encountered, and shall be continuous until such time as water can be allowed to rise in accordance with the provisions of this section.

The Contractor shall dispose of the water from the work in a suitable manner, and in compliance with Federal and State regulations, without damage to adjacent property. No water shall be drained into work, built or under construction, without prior consent of the Engineer.

If excessively wet, soft, spongy, unstable or similarly unsuitable materials are encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Engineer.

For areas accessible to the public, barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.
603.06 Placing Conduit

This section shall include the following:

All pipe shall be laid without grade breaks from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade shown on the approved plans and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. The interior of the storm sewer pipe shall be cleaned of all dirt and superfluous material of all descriptions as the work progresses.

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the day as well as overnight.

Whenever obstructions not shown on the Plans are encountered during the progress of the work and interfere to such an extent that an alteration in the approved Plans is required, the Engineer shall have the authority to change the Plans and order a deviation from the line and grade.

All pipe shall be protected during handling against impact shocks and free fall and no pipe shall be placed in the sewer line that has been damaged while lowering into the ditch. Bell holes shall be dug under the bells of all pipe, regardless of the type of bedding used in the trench and the entire length of barrel of all sewer pipe shall rest firmly on the bedding material used in the trench and the weight of the sewer pipe in no case shall be supported by the bells of the pipe.

After lowering into the ditch, both the bell and spigot shall be thoroughly cleaned and free from any foreign material.

Pipe joints of the same inside diameter as the adjoining pipe shall be placed at the inlet and outlet to each manhole or structure as shown on the details. When connecting pipe to a structure with a rigid or grouted connection, utilize pipe lengths no longer than 4 feet.

When jacked pipe is specified, the Contractor shall submit to the Engineer for approval, a complete plan and schedule for pipe jacking prior to the commencement of such work. The submission shall include details of the materials and equipment pertinent to the jacking operations. Jacking tolerances shall be within 0.10 feet for vertical alignment and 0.20 feet for horizontal alignment.

603.07 Joining Conduit

This section shall include the following:

Pipe bells shall not be cast into manholes or structures. The bell shall be cut off so that no recess or offset appears on the exposed face from the inside wall of the pipe to the outside wall of the pipe (to be a plain end, flush with the inside wall of the manhole or structure, or as shown on the details.)

Average joint gap that exceeds ½-inch shall be filled with an approved flexible plastic sealant.

603.09 Backfilling
This section shall include the following:

Structure backfill (Class 1) shall be compacted to conform to subsection 206.03. Structure backfill (Class 2) shall conform to subsection 203.07.

Final Clean Up
After backfill has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition, as close to its original condition as possible, and to the satisfaction of the Engineer.
REVISION OF SECTION 604
MANHOLES, INLETS, AND METER VAULTS

Section 604 of the Standard Specifications is hereby revised as follows:

DESCRIPTION

604.01

This section shall be replaced with the following:

This work shall include the construction of inlets, manholes, and drainage structures in accordance with these specifications, and in conformation with the lines, grades and details shown on the plans.

MATERIALS

604.02

This section shall include the following:

All storm sewer manhole covers shall be provided with the Town of Parker standard logo and language.

CONSTRUCTION REQUIREMENTS

604.04 Manholes, Inlets, and Meter Vaults

This section shall include the following:

All inlets within the Town must be cast-in-place with the exception of Type C and D inlets. Precast Type C and D inlets are allowed within unpaved portions of the Town’s Right-of-way. All storm sewer manholes within the Town shall utilize a cast-in-place base slab. The use of precast slab base manholes is not allowed.

In areas where storm sewer lines are placed in easements and outside of pavement, all manholes shall be identified with a 4" (Four Inch) Schedule 40 steel pipe offset as directed by the Engineer and painted yellow, with the distance to the manhole and the appropriate identifying initials stenciled in black. This marker post shall be installed in accordance with Parker Water and Sanitation District standard details.
Section 706 of the Standard Specifications is hereby revised as follows:

**706.02 Reinforced Concrete Pipe**

_This section shall include the following:_

Shop drawings and Certificates of Compliance shall be provided from the pipe manufacturer that shows that new RCP conform in all respects to these Specifications and other nonconflicting requirements of the referenced ASTM and AASHTO specifications.

Joint material for circular conduits sections shall be manufactured in strict accordance with "Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets," ASTM C 443, latest revision.

Where specified, joint material for non-circular sections shall be manufactured in strict accordance with "External Sealing Bands for Non-Circular Concrete Sewer, Storm Drain, and Culvert Pipe," ASTM C 877, latest revision or ASTM C 443, or ASTM 1677.

Crushing strength requirements for reinforced concrete pipe and fittings shall equal or exceed the minimum strength, as set forth in ASTM C 76, latest revision, when tested by the Three Edge Bearing Method in accordance with "Testing Concrete Pipe or Tile," ASTM C 497, latest revision.

In addition to any special markings specified in the contract or order, marking for shipment shall be in accordance with ASTM C 76, latest revision.
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APPENDIX A

CHECKLIST OF DRAINAGE REPORT REQUIREMENTS
## Checklist of Drainage Report Requirements

### Project Name:

<table>
<thead>
<tr>
<th>Initial or N/A</th>
<th>Item No.</th>
<th>Description</th>
<th>Conceptual Drainage Report (CDR)</th>
<th>Preliminary Drainage Report (PDR)</th>
<th>Final Drainage Report (FDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>COVER SHEET with title, date, applicant, preparer</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>2</td>
<td>TABLE OF CONTENTS</td>
<td>X</td>
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<tr>
<td></td>
<td>3</td>
<td>PE Certification and Seal</td>
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### GENERAL LOCATION & DESCRIPTION

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<tbody>
<tr>
<td>1</td>
<td>Township, range, section, quarter section</td>
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<td>X</td>
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<tr>
<td>2</td>
<td>Local streets within and adjacent to the subdivision</td>
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<tr>
<td>3</td>
<td>Major drainageway and facilities</td>
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</tr>
<tr>
<td>4</td>
<td>Names of surrounding subdivisions</td>
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<td>5</td>
<td>Area in acres (verify with plat if available)</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Existing ground cover (trees, scrubs, etc.)</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Existing soil conditions</td>
<td>X</td>
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<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Proposed land use</td>
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### DRAINAGE BASINS AND SUB-BASINS

#### Major Basin Description

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<tr>
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<tbody>
<tr>
<td>9</td>
<td>Reference major drainageway planning study</td>
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<tr>
<td>10</td>
<td>Reference flood hazard delineation report</td>
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<tr>
<td>11</td>
<td>Reference FEMA flood insurance study</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>12</td>
<td>Identify presence of regulatory floodplains/floodways at site. Discuss any proposed disturbance to floodplain.</td>
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<td>X</td>
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<tr>
<td>13</td>
<td>Supporting and labeled FEMA flood insurance map included (if applicable)</td>
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<td>Will a FEMA LOMR be required?</td>
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<td>15</td>
<td>Reference previous drainage studies affecting the site</td>
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<tr>
<td>16</td>
<td>Coordination with surrounding subdivision plans</td>
<td></td>
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<tr>
<td>17</td>
<td>Basin drainage characteristics - existing and planned land uses affecting the site</td>
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### Site Sub-Basin Description

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<tr>
<td>18,19</td>
<td>Discussion of historic drainage pattern of the property</td>
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<tr>
<td>19</td>
<td>Discussion of off-site drainage flow patterns onto the site</td>
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<td>Supporting off-site delineation map included</td>
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<td>Identify presence or absence of any major drainageways on the site with total tributary area &gt;130 acres</td>
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<tr>
<td>22</td>
<td>Discussion of development of off-site basins and impact on site</td>
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### DRAINAGE DESIGN CRITERIA

#### Regulations

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<tr>
<td>23</td>
<td>Discussion of compliance with the Town's floodplain ordinance</td>
<td>X</td>
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#### Discussion of compliance with Town's Stream Preservation Standards

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<td>24</td>
<td>Stream Buffers in project area</td>
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<td>25</td>
<td>Permitted uses planned, if any</td>
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<td>26</td>
<td>Discussion of Minor or Major Modification requested</td>
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<td>27</td>
<td>Discussion of compliance with UD&amp;FCD maintenance eligibility review</td>
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#### Development Criteria Reference and Constraints

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<tbody>
<tr>
<td>28</td>
<td>Discussion of previous drainage studies for the site</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</table>
## Checklist of Drainage Report Requirements

### Project Name:

- **Conceptual**  
- **Preliminary**  
- **Final**

### Initial or N/A | Item No. | Description | Conceptual Drainage Report (CDR) | Preliminary Drainage Report (PDR) | Final Drainage Report (FDR) |
<table>
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<td>29</td>
<td>[ ] 29 Complies with previous study/Does not comply (Discussion on changes from the previous study)</td>
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<td>[ ] 30 Discussion of coordination with adjacent drainage studies</td>
<td>X</td>
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<tr>
<td></td>
<td>31</td>
<td>[ ] 31 Discussion of site drainage constraints (such as streets, utilities, existing structures, etc.)</td>
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<td><strong>Hydrology Criteria</strong></td>
<td>32</td>
<td>[ ] 32 Identify design rainfall event, frequency, and duration</td>
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<td></td>
<td>33</td>
<td>[ ] 33 Identify runoff calculation method used</td>
<td>X</td>
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<td>X</td>
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<tr>
<td></td>
<td>34</td>
<td>[ ] 34 Identify calculation method for detention storage requirement</td>
<td>X</td>
<td>X</td>
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<td>[ ] 35 Identify calculation method for detention discharge</td>
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<td>36</td>
<td>[ ] 36 Discussion and justification of criteria or methods not referenced by SDECM</td>
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<td><strong>Hydraulic Criteria</strong></td>
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<td>[ ] 38 Identify other capacity references</td>
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<td>[ ] 40 Identify check/drop structure criteria used</td>
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<td>[ ] 41 Discussion of drainage facility design criteria not referenced by SDECM</td>
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<td><strong>Variance from Criteria</strong></td>
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<td>[ ] 42 Identify provision by section number for which a variance is requested</td>
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<td>43</td>
<td>[ ] 43 Provide justification and discussion for each variance requested</td>
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<td><strong>General Concept</strong></td>
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<td>[ ] 47 Discussion of tables, charts, figures, drawing, etc. presented in the appendix</td>
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## Checklist of Drainage Report Requirements

**Project Name:**

- [ ] Conceptual
- [ ] Preliminary
- [ ] Final

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### ENVIRONMENTAL PROTECTION CRITERIA

#### General

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<td>Discuss compliance with State and Federal environmental permitting regulations</td>
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#### Construction BMP Plan

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#### Permanent BMP Plan

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<td>Supporting labeled calculations for storage volume requirements</td>
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<td>Supporting labeled calculations for outlet structure design</td>
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### CONCLUSIONS

#### Compliance with Standards

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<td>Major drainageway plans (UDFCD Outfall Systems Plan)</td>
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<td>Town floodplain regulations</td>
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<td>Stream Preservation Standards</td>
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#### Drainage Concept

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<td>Effectiveness of design to control storm runoff</td>
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<td>Discussion of maintenance responsibility for public and private drainage facilities</td>
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<td>Discuss impact of proposed development on the Major Drainageway Planning Studies recommendations</td>
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# Checklist of Drainage Report Requirements

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- Conceptual ___ Preliminary ___ Final

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<td>Suitability of site soils for development</td>
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<td>Certification statement and PE seal and signature</td>
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**REFERENCES**

- 97 List all drainage reports and technical information used
- 98 List all computer software used in analysis

**APPENDICES**

**Hydrologic Computations (Historic)**

- 99 Historic basin delineation, onsite and offsite
- 100 Runoff coefficient determination, including composite "C" calculation
- 101 Rational Method analysis for each basin, initial and major storm
- 102 Rational method analysis for each design point (i.e., routed cumulative flow), initial and major storm
- 103 Schematic figure illustrating routing for basins and design points
- 104 CUHP/UDSWM input and output data
- 105 Schematic figure illustrating routing of CUHP basins and UDSWM elements

**Hydrologic Computations (Developed)**

- 106 Developed basin delineation, onsite and offsite
- 107 Runoff coefficient determination, including composite "C" calculation
- 108 Rational Method analysis for each basin, initial and major storm
- 109 Rational method analysis for each design point (i.e., routed cumulative flow), initial and major storm
- 110 Schematic figure illustrating routing for basins and design points
- 111 CUHP/UDSWM input and output data
- 112 Schematic figure illustrating routing of CUHP basins and UDSWM elements

**Hydraulic Computations (Extended Detention Basin)**

- 113 Volume of storage required (WQCV, EURV and 100-year event)
- 114 Volume of designed detention pond (maximum volume)
- 115 Does maximum water surface elevation allow for one foot minimum freeboard requirement (may require profile of pond)
- 116 Inflow(s) energy dissipater (see hydraulic computations for storm sewer)
- 117 Forebay - volume and drain pipe/weir

**Hydraulic Computation (EDB Outlet Structure)**

- 118 Calculation of Historic release rates based on UDFCD Volume 2, Storage Chapter
- 119 Calculation of allowable 100-year release rate based on UDFCD Volume 2, Storage Chapter
- 120 Water quality orifice plate geometry
- 121 Water quality trash rack/screen geometry and open area
- 122 Orifice or weir sizing for 100-year release rate
- 123 Orifice or weir placement for 100-year water surface elevation
- 124 Trash Rack (overflow) sizing calculation
- 125 Calculations for emergency overflow
- 126 Capacity, velocity, and Froude number calculations for outlet structure storm sewer pipe
- 127 Calculations for outlet protection for outlet structure pipe
## Checklist of Drainage Report Requirements

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### DRAINAGE DRAWING CONTENTS

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<td>Existing contours at minimum 2 foot contour interval (dashed-shaded) extending minimum of 100' beyond property lines</td>
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<td>178</td>
<td>Proposed contours at minimum 2 foot contour interval (solid) extending minimum of 100' beyond property lines</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>179</td>
<td>All property and lots lines shown</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>180</td>
<td>All easements and tracts shown and labeled with purpose</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>181</td>
<td>Streets shown (with ROW width, flowline, sidewalk, etc. for PDR and FDR)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>182</td>
<td>Existing drainage facilities shown with structures, ditches, drainageways, gutter flow, culverts, etc.</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>183</td>
<td>Existing drainage facilities labeled with material, size, shape, slope, and location</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>184</td>
<td>Stream Buffer areas</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>185</td>
<td>Overall drainage area boundary shown (including any off-site basins)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>186</td>
<td>Drainage area sub-boundary shown</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>187</td>
<td>Basin and sub-basin descriptor (which includes identification, area, runoff coefficients or flows)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>188</td>
<td>Directional flow arrows</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>189</td>
<td>Table showing routing and accumulation of flow at design points for major &amp; initial event</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>190</td>
<td>Proposed type of street flow (detail if necessary)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>191</td>
<td>Drainage ditches, swales, gutter, and cross pans shown (Generally shown for CDR)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>192</td>
<td>Proposed storm sewer shown including size and type of pipe, inlets, manholes, outfall, riprap, etc. shown (Generally shown for CDR)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>193</td>
<td>Existing storm sewer shown including size and type of pipe, inlets, manholes, outfall, riprap, etc. labeled (if any)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>194</td>
<td>Proposed open drainage channels shown including drop and check structures, riprap, channel lining, side slope, channel slope, etc. shown (Generally shown for CDR)</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>195</td>
<td>Existing open drainage channels shown including drop and check structures, riprap, channel lining, side slope, channel slope, etc.</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>196</td>
<td>Detention pond with extent of pond delineated</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>197</td>
<td>Shaded area of 100-year water surface shown for detention pond</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>198</td>
<td>Table of volumes and release rates for water quality/detention facilities</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
## Checklist of Drainage Report Requirements

**Project Name:**

---

### Conceptual  Preliminary  Final

<table>
<thead>
<tr>
<th>Initial or N/A</th>
<th>Item No.</th>
<th>Description</th>
<th>Conceptual Drainage Report (CDR)</th>
<th>Preliminary Drainage Report (PDR)</th>
<th>Final Drainage Report (FDR)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>199</td>
<td>Detail information on EDB outlet structure</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>Profile of EDB outlet structure showing water surface elevations, outlet pipe, water quality orifice plate, and discharge orifices</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>201</td>
<td>Detail of water quality orifice plate showing size of perforations, number of rows, and spacing</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>202</td>
<td>Detail information on Permanent BMPs</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>203</td>
<td>Profile of Permanent BMP outlet structure showing water surface elevations, outlet pipe, water quality orifice plate, and discharge orifices</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>204</td>
<td>Location and elevation (if known) for all existing and proposed utilities by of affecting the drainage design</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>205</td>
<td>Routing of off-site flows thru the development (around detention basins, not through)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>206</td>
<td>Definition of flow path leaving the development through downstream properties to a major drainageway (if applicable)</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>207</td>
<td>Location of all FEMA floodplains affecting the site (both existing and proposed)</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>
APPENDIX B

INLET CAPACITY CHARTS FOR SUMP CONDITIONS
Note:
1. The Town of Parker standard inlet parameters must apply to use these charts. See the Roadway Manual.
INLET CAPACITY CHART SUMP CONDITIONS
CURB OPENING (TYPE R) INLET

Note:
1. The Town of Parker standard inlet parameters must apply to use this chart. See the Roadway Manual.
- CD: CHECK DAM
- CF: CONSTRUCTION FENCE
- CP: CULVERT PROTECTION
- CWA: CONCRETE WASHOUT AREA
- D: DEWATERING
- DD: DIVERSION DITCH
- DP: DETENTION POND PROTECTION
- DTC: DEBRIS TRASH CONTROL
- ECB: EROSION CONTROL BLANKET
- IPAN: INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
- IPAP: INLET PROTECTION FOR AREA INLETS IN PAVEMENT
- IPCOG: INLET PROTECTION, CURB ON-GRADE, TYPE R INLET
- IPCOS: INLET PROTECTION, CURB ON SUMP, TYPE R INLET

CBMP
CONSTRUCTION BEST MANAGEMENT PRACTICES
LOT PROTECTION

MASONRY WORK PROTECTION

PORTABLE TOILET PROTECTION

ROUGH CUT STREET CONTROL

ROCK SOCK

ROCK SOCK IN SWALE

STRAW BALE

SEDIMENT CONTROL LOGS

SILT FENCE

SEEDING, MULCHING AND CRIMPING

SURFACE ROUGHING

STABILIZED STAGING AREA

SIDEWALK TRANSITION PROTECTION
1. GRADING, DRILLING, CLEARING, EXCAVATING, BACK-FILLING, SOIL STRIPPING, SOIL IMPORTING EXPORTING OR ANY OTHER FORM OF SOIL DISTURBANCE SHALL NOT COMMENCE UNTIL A TOWN OF PARKER GRADING/EXCAVATION PERMIT HAS BEEN ISSUED.

2. THE TOWN OF PARKER GRADING/EXCAVATION PERMIT IS VALID FOR A PERIOD OF 2 YEARS FROM THE DATE OF ISSUANCE. ANY LAPSE IN PERMIT COVERAGE MAY RESULT IN THE ISSUANCE OF A STOP WORK ORDER AND/OR FINES.

3. ALL EROSION AND SEDIMENT CONTROL BMPS SHALL BE INSTALLED ACCORDING TO THE CBMP PLAN INSTALLATION NOTES AND DETAILS AND/OR PERMITTED VARIANCES. ALL MATERIALS, WORKMANSHIP AND INSTALLATION METHODS ARE SUBJECT TO INSPECTION BY THE TOWN’S INSPECTOR. THE TOWN OF PARKER RESERVES THE RIGHT TO ACCEPT OR REJECT ANY SUCH MATERIALS, WORKMANSHIP AND/OR INSTALLATION METHODS THAT DO NOT CONFORM TO THE CBMP PLAN AND/OR PERMITTED VARIANCES.

4. THE EROSION CONTROL SUPERVISOR SHALL REVISE OR MODIFY THE EROSION AND SEDIMENT CONTROL MEASURES IF IT BECOMES APPARENT THAT THE ORIGINAL PLAN IS INADEQUATE, OR AS A RESULT OF DEFICIENCIES IDENTIFIED DURING INSPECTIONS PERFORMED BY THE TOWN’S INSPECTOR.

5. THE INSTALLATION OF ADDITIONAL EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPS) MAY BE REQUIRED OF THE EROSION CONTROL SUPERVISOR, PROPERTY OWNER, SITE DEVELOPER, CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS AT ANY TIME THROUGHOUT THE DURATION OF THE PROJECT CONSTRUCTION AND/OR SUBSEQUENT REVEGETATION PERIOD.

6. THE EROSION CONTROL SUPERVISOR SHALL BE RESPONSIBLE FOR ENSURING THAT THE SITE REMAINS IN COMPLIANCE WITH THE NOTICE OF NUISANCE REPORTS (a.k.a. CONSTRUCTION SITE RUNOFF CONTROL INSPECTION REPORTS), APPROVED CBMP PLAN(S) AND THE TOWN OF PARKER STORM DRAINAGE AND ENVIRONMENTAL CRITERIA MANUAL.

7. THE EROSION CONTROL SUPERVISOR SHALL BE READILY AVAILABLE TO DISCUSS AND CORRECT ANY PROBLEMS THAT MAY ARISE RELATING TO GRADING, EROSION AND SEDIMENT CONTROL.

8. IF IT IS ANTICIPATED THAT ALL OR A PORTION OF THE PROJECT WILL OCCUR DURING SEASONS SUSCEPTIBLE TO SNOWFALL, THE USE OF CERTAIN EROSION AND SEDIMENT CONTROL BMPS ADJACENT TO PUBLIC ROADWAYS MAY NEED TO BE RECONSIDERED DUE TO THE NATURE OF SNOW REMOVAL OPERATIONS. AN APPROVED ALTERNATIVE MAY BE NECESSARY TO MINIMIZE DAMAGE FROM THESE OPERATIONS. THE TOWN OF PARKER ASSUMES NO RESPONSIBILITY FOR DAMAGE TO ANY BMPS AS A RESULT OF SNOW PLOWING AND SNOW REMOVAL.

9. AREAS OF LAND DISTURBANCE EQUAL TO 40 ACRES OR GREATER SHALL NOT BE EXPOSED FOR MORE THAN 30 CONSECUTIVE DAYS WITHOUT TEMPORARY OR PERMANENT STABILIZATION.

10. AUTHORIZED EXEMPTIONS MAY BE ALLOWED TO THE 40-ACRE LIMIT FOR REMOVAL AND STORAGE OF CUT MATERIAL WHERE (A) GEOTECHNICAL LIMITATIONS RESTRICT THE USE OF TEMPORARY OR PERMANENT STABILIZATION OF THE STORED MATERIAL (E.G., SWELLING SOILS, ROCK) AND (B) WHEN THE OWNER CAN DEMONSTRATE THAT THE 40-ACRE LIMIT IS PHYSICALLY AND/OR FINANCIALLY IMPRACTICABLE. FOR SITES GRANTED THIS EXEMPTION, A PHASING AND EARTHWORK QUANTITIES PLAN SHALL BE SUBMITTED TO THE PUBLIC WORKS DEPARTMENT AND APPROVED PRIOR TO THE COMMENCEMENT OF LAND DISTURBANCE ACTIVITIES. SUBMITTAL REQUIREMENTS INCLUDE:

   (i) PHASING PLAN SHOWING CUT AND FILL VOLUMES AND LOCATIONS FOR EACH PHASE AND PROJECT TOTALS.

   (ii) EARTHWORK QUANTITY PLAN SHOWING CUT AND FILL VOLUMES AND LOCATIONS FOR EACH PHASE AND PROJECT TOTALS.

   (iii) BMP PLAN SHOWING SPECIFIC EROSION AND SEDIMENT CONTROLS FOR EACH PHASE.
11. ANY EROSION AND SEDIMENT CONTROL BMPs THAT ARE DAMAGED OR IN NEED OF MAINTENANCE OR REPLACEMENT SHALL BE CORRECTED AS SOON AS POSSIBLE, IMMEDIATELY IN MOST CASES.

12. ALL DEFICIENCIES LISTED ON THE NOTICE OF NUISANCE FORM SHALL BE COMPLETED AS SOON AS POSSIBLE, IMMEDIATELY IN MOST CASES. ALL REQUIRED ACTIONS MUST BE IN THE CORRECTED FORM DURING THE FOLLOW-UP INSPECTION.

13. THE EROSION CONTROL SUPERVISOR IS RESPONSIBLE FOR ENSURING THAT ALL STREETS, CURBS, GUTTERS, SIDEWALKS, DRIVeways, PARKING LOTS, ALLEYS, TRICKLE CHANNELS, AND/OR OTHER IMPERVIOUS SURFACES IMPACTED BY CONSTRUCTION ACTIVITIES ARE THOROUGHLY CLEANED THROUGHOUT THE DAY IF THEY BECOME SOILED. THESE AREAS MUST ALSO BE THOROUGHLY CLEAN BEFORE THE END OF THE WORK DAY.

14. BULK STORAGE STRUCTURES FOR PETROLEUM PRODUCTS AND OTHER CHEMICALS SHALL HAVE ADEQUATE PROTECTION SO AS TO CONTAIN ALL SPILLS AND PREVENT ANY SPILLED MATERIAL FROM ENTERING STATE WATERS.

15. ALL TRASH RECEPTACLES ON SITE SHALL BE FREE OF HOLES, CRACKS, GAPS, AND/OR OTHER PERMEABLE AREAS THAT MAY ALLOW FOR THE DISCHARGE OF POLLUTANTS.

16. ALL TRASH RECEPTACLES ON SITE SHALL BE EMTIED AT A FREQUENCY AS TO ENSURE THAT THE TRASH REMAINS CONFINED TO THE RECEPTACLE.

17. ALL LOOSE TRASH AND LITTER ASSOCIATED WITH THE PROJECT MUST BE REMOVED AND PROPERLY DISCARDED ON A DAILY BASIS.

18. ALL PORTABLE TOILETS SHALL BE STAKED DOWN AT ALL TIMES USING U-SHAPED REBAR STAKES. THE PORTABLE TOILETS SHALL ALSO BE PLACED A MINIMUM DISTANCE OF 10 FEET FROM ALL IMPERVIOUS SURFACES, INCLUDING, BUT NOT LIMITED TO STREETS CURBS, GUTTERS, SIDEWALKS AND PARKING LOTS.

19. THE EROSION CONTROL SUPERVISOR SHALL MAINTAIN STRICT ADHERENCE TO THE LIMITS OF CONSTRUCTION AND PROPERTY LIMITS FOR ALL MATERIALS, VEHICLES AND EQUIPMENT. FAILURE TO ABIDE BY THIS REQUIREMENT MAY RESULT IN THE ISSUANCE OF A STOP WORK ORDER.

20. ALL CONSTRUCTION TRAFFIC MUST ENTER AND EXIT THE SITE THROUGH THE APPROVED ACCESS POINT(s). A VEHICLE TRACKING CONTROL PAD IS REQUIRED AT ALL APPROVED ACCESS POINTS TO THE SITE. EXCEPTIONS MAY BE CONSIDERED FOR CONSTRUCTION ACTIVITY OCCURRING IMMEDIATELY ADJACENT TO PAVED AREAS AND WHERE ALTERNATIVE BMP's ARE IMPLEMENTED. SUCH ACTIVITY MAY INCLUDE, BUT NOT BE LIMITED TO RESIDENTIAL CONSTRUCTION, UTILITY CONSTRUCTION, ETC.

21. NO PERMANENT SLOPES GREATER THAN 3:1 ARE ALLOWED.

22. ALL PERMANENT SLOPES STEEPER THAN 4:1 (HORIZONTAL TO VERTICAL) SHALL REQUIRE EROSION CONTROL BLANKET(s). TEMPORARY SLOPES IN TEMPORARY SEDIMENT BASINS THAT ARE STEEPER THAN 4:1 MAY REQUIRE EROSION CONTROL BLANKETS.

23. THE EROSION CONTROL SUPERVISOR SHALL BE RESPONSIBLE FOR CORRECTING ANY ADVERSE IMPACTS THAT OCCUR TO NEIGHBORING PROPERTIES. THE EROSION CONTROL SUPERVISOR MUST OBTAIN PERMISSION FROM LAND OWNERS PRIOR TO ENTERING SUCH PROPERTY.

24. A WATER SOURCE SHALL BE AVAILABLE ONSITE DURING CONSTRUCTION ACTIVITIES, AND UTILIZED TO MINIMIZE FUGITIVE DUST. ALTERNATIVE BMPs MAY BE REQUIRED IF INITIAL ATTEMPTS TO SUPPRESS DUST ARE UNSUCCESSFUL.
25. All chemical or hazardous material spills, including concrete washout water, which may enter waters of the State of Colorado, which includes but are not limited to, surface water, ground water, dry gullies or storm sewers leading to surface water, shall be immediately reported to the Colorado Department of Public Health and Environment (CDPHE) PER 25-8-601, and the Town of Parker. Releases of petroleum products and certain hazardous substances listed under the Federal Clean Water Act (40 CFR Part 116) must be reported to the National Response Center and the CDPHE. Spills that pose an immediate safety hazard shall be reported to 911.

26. The cleaning of concrete trucks and equipment is restricted to the approved concrete washout location on the job site. Concrete wash water shall not be discharged to state waters or storm sewer systems.

27. Vehicle and equipment degreasing is prohibited on the job site.

28. All de-watering on site shall be coordinated with the Town’s Inspector. A state permit may be required for de-watering. The erosion control supervisor is responsible for obtaining and adhering to all applicable permits.

29. Hydraulic seeding and/or hydraulic mulching are only allowed in areas under temporary or permanent irrigation or for the purpose of temporary soil stabilization.

30. Applicable construction BMPs shall remain in place and properly maintained until all landscaping has been installed and the desirable vegetation has reached a point in which erosion and sedimentation is no longer a concern as determined by the Town’s Inspector.

31. Grading Security Release Requirements:

1) Developable Property: In order for the grading security to be released, the site must meet items A–H or item I (below).

   A. All soil-disturbing activities associated with the grading permit have permanently ceased.
   B. Uniform perennial vegetation cover has been established with an individual plant density of at least seventy percent (70%) of pre-disturbance levels.
   C. All CBMPS have been properly removed from the site.
   D. If any erosion is present, it is insignificant and is not leaving the site and/or leading into any on-site drainage infrastructure that may convey surface water off site.
   E. Weeds represent no more than fifty percent (50%) of the total vegetation on the site.
   F. No weeds are present from list A of the Colorado Noxious Weed List, as amended.
   G. The site is predominately free of weeds from list B of the Colorado Noxious Weed List, as amended.
   H. Weeds are evenly distributed throughout the site with no large concentrations present.
   I. A new grading permit and replacement security has been submitted and approved for the applicable site or assignment as provided by Section 11.10.150 of the Town of Parker Municipal Code. It is the property owner’s obligation at the time of closing to ensure that the new site owner has provided the Town with a replacement security.
2) NONDEVELOPABLE PROPERTY: IN ORDER FOR THE GRADING SECURITY TO BE RELEASED, THE SITE MUST MEET ITEMS A – H AND J, OR ITEMS I AND J (BELOW).

A. ALL SOIL-DISTURBING ACTIVITIES ASSOCIATED WITH THE GRADING PERMIT HAVE PERMANENTLY CEASED.
B. ALL CBMPS HAVE BEEN PROPERLY REMOVED FROM THE SITE.
C. EROSION IS NEGLIGIBLE, IF EVEN PRESENT.
D. THE VEGETATION REPRESENTS A PERENNIAL STAND OF A DENSE, UNIFORM SURFACE OF GRASS WITH NO AREA GREATER THAN ONE (1) SQUARE FOOT THAT IS BARREN OF DESIRABLE VEGETATION. INFREQUENT, WIDELY SCATTERED AREAS WHERE NATIVE VEGETATION HAS NOT YET TAKEN HOLD MAY QUALIFY FOR ACCEPTANCE AT THE DISCRETION OF THE TOWN.
E. WEEDS REPRESENT NO MORE THAN TEN PERCENT (10%) OF THE TOTAL VEGETATION ON SITE.
F. NO WEEDS ARE PRESENT FROM LIST A OF THE COLORADO NOXIOUS WEED LIST, AS AMENDED.
G. THE SITE IS PREDOMINANTLY FREE OF WEEDS FROM LIST B OF THE COLORADO NOXIOUS WEED LIST, AS AMENDED.
H. WEEDS ARE EVENLY DISTRIBUTED THROUGHOUT THE SITE WITH NO LARGE CONCENTRATIONS PRESENT.
I. A NEW GRADING PERMIT AND REPLACEMENT SECURITY HAS BEEN SUBMITTED AND APPROVED FOR THE APPROPRIATE SITE OR THE GRADING PERMIT HAS BEEN ASSIGNED AS PROVIDED BY SECTION 11.10.150 OF THE TOWN OF PARKER MUNICIPAL CODE. IT IS THE PROPERTY OWNER'S OBLIGATION, AT THE TIME OF CLOSING ON THE SALE OF A SITE THAT IS SUBJECT TO A GRAZING PERMIT, TO ENSURE THAT THE NEW PROPERTY OWNER HAS PROVIDED THE TOWN WITH A REPLACEMENT SECURITY.
J. ALL KNOWN DRAINAGE ISSUES ASSOCIATED WITH THE PROJECT HAVE BEEN MITIGATED AND A SUFFICIENT AMOUNT OF TIME HAS PASSED TO ENSURE THAT SUCH ISSUES HAVE BEEN CORRECTED. THIS REQUIREMENT DOES NOT INCLUDE THOSE DRAINAGE ISSUES ORIGINATING ON RESIDENTIAL LOTS.

(D) NOXIOUS WEEDS MUST BE CONTROLLED AS PROVIDED UNDER STATE LAW AND SECTION 6.01.260 OF THE TOWN OF PARKER MUNICIPAL CODE. FAILURE TO CONTROL NOXIOUS WEEDS ON THE SITE MAY CONSTITUTE A NUISANCE, SUBJECT TO THE PENALTIES CONTAINED IN THE CODE.

DEFINITIONS:

DEVELOPABLE PROPERTY MEANS ANY LAND THAT HAS BEEN GRADED AND IS PART OF A PLATTED LOT OR PLATTED TRACT OF RECORD, THAT WAS PLATTED FOR FUTURE DEVELOPMENT, INCLUDING RESIDENTIAL HOME CONSTRUCTION OR PUBLIC IMPROVEMENTS.

NONDEVELOPABLE PROPERTY MEANS LAND THAT HAS BEEN GRADED AND WILL NOT BE FURTHER DISTURBED AS PART OF ANY FUTURE DEVELOPMENT. EXAMPLES INCLUDE, BUT ARE NOT LIMITED TO: PARKS, OPEN SPACE, HOMEOWNER ASSOCIATION OR BUSINESS ASSOCIATION PLATTED TRACTS, DETENTIONTextAreaPONDS AND DRAINAGeways.

32. FAILURE TO COMPLY WITH ANY OF THE REQUIREMENTS DESCRIBED IN THIS SECTION MAY RESULT IN THE ISSUANCE OF: A NOTICE OF INTENT TO ISSUE A STOP WORK ORDER, A STOP WORK ORDER AND/OR THE REMEDIES/penalties DESCRIBED IN CHAPTER 11.10 OF THE TOWN OF PARKER MUNICIPAL CODE.

33. ANY PERSON CONVICTED OF VIOLATING ANY PROVISION OF THE TOWN OF PARKER, GRADING & EARTH MOVEMENT SECTION OF THE MUNICIPAL CODE SHALL BE GUILTY OF A MISDEMEANOR AND, UPON CONVICTION, BE PENALIZED BY A FINE OF NOT MORE THAN FOUR HUNDRED NINETY NINE DOLLARS ($499.00) FOR EACH SEPARATE OFFENSE. EACH DAY A VIOLATION CONTINUES SHALL CONSTITUTE A SEPARATE OFFENSE. THE TOWN ALSO MAY SEEK IN MUNICIPAL COURT AN INJUNCTION, ABATEMENT, RESTITUTION OR ANY OTHER REMEDY TO PREVENT, ENJOIN, ABATE OR REMOVE THE VIOLATION. A PERSON CONVICTED OF VIOLATING CHAPTER 11.10 OF THE TOWN OF PARKER MUNICIPAL CODE SHALL BE LIABLE FOR THE ACTUAL COST OF REHABILITATING THE PROPERTY. THE COSTS MAY BE RECOVERED AS RESTITUTION IN MUNICIPAL COURT PROCEEDINGS OR IN A SEPARATE CIVIL ACTION.

34. THE TOWN OF PARKER RESERVES THE RIGHT TO ALLOW MODIFICATIONS AND SUBSTITUTIONS TO THE CBMP NOTES AND DETAILS. WHEN SUCH MODIFICATIONS AND SUBSTITUTIONS OFFER THE SAME LEVEL OF PROTECTION AS THE STANDARD REQUIREMENTS BASED UPON THE SPECIFIC SITUATION, AS DETERMINED BY TOWN STAFF. DUE TO THE INSIGNIFICANCE AND REGULARITY OF SUCH MODIFICATIONS AND SUBSTITUTIONS, THE APPROVAL OF SUCH VARIATIONS MAY NOT BE DOCUMENTED BY TOWN STAFF.
SECTION B

SECTION C

NOTE: SECTION C IS LOCATED IMMEDIATELY UPSTREAM AND DOWNSTREAM OF THE CHECK DAM, THEREFORE NO ROCK IS SHOWN WITHIN THE CHANNEL FLOW AREA.

L = THE DISTANCE SUCH THAT POINT A AND B ARE OF EQUAL ELEVATION.

SPACING BETWEEN CHECK DAMS

CHECK DAM
CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION(S) OF CHECK DAMS.

2. CHECK DAMS SHOWN ON CBMP PLAN SHALL BE INSTALLED WHEN DIRECTED BY THE TOWN'S INSPECTOR.

3. RIPRAP UTILIZED FOR CHECK DAMS SHALL HAVE A D50 MEDIAN STONE SIZE OF 12”.

4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1’-8”.


CHECK DAM INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE CHECK DAMS.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE SEDIMENT HAS REACHED A DEPTH EQUAL TO 1/2 THE HEIGHT OF THE CREST OR AS OTHERWISE DIRECTED BY THE TOWN'S INSPECTOR.

3. CHECK DAMS SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN'S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN'S INSPECTOR.

4. WHEN CHECK DAMS ARE REMOVED, THE TOWN'S INSPECTOR MAY REQUIRE EXCAVATIONS TO BE FILLED WITH SUITABLE COMPACTED TOPSOIL AND ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE CHECK DAMS BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN'S SPECIFICATIONS (SEE DETAIL SMC).

5. IN SOME Instances, CHECK DAMS MAY REMAIN IN PLACE PERMANENTLY.
NOTE:
CONSTRUCTION FENCE SHALL BE SECURELY FASTENED TO EACH TEE POST OR APPROVED EQUAL.
CONSTRUCTION FENCE INSTALLATION NOTES

1. THE CONSTRUCTION FENCE SHALL BE SECURELY FASTENED TO EACH POST OR APPROVED EQUAL.

CONSTRUCTION FENCE INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE CONSTRUCTION FENCE AND MAKE ANY NECESSARY REPAIRS.

2. CONSTRUCTION FENCE SHALL BE REPAIRED WHEN THE FENCING MATERIAL FALLS OUT OF COMPLIANCE WITH THE NOTES AND DETAILS.
ROCK SOCK SHALL EXTEND UP THE EMBANKMENT. ADDITIONAL BMPS MAY BE NEEDED TO COMPLIMENT CULVERT PROTECTION.

FLOW

ROCK SOCK
SEE DETAIL RS

CULVERT END SECTION

PLAN

CULVERT END SECTION

FLOW

ISOMETRIC

CULVERT PROTECTION (INLET)
CULVERT PROTECTION (INLET) INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION(S) OF CULVERT PROTECTION (INLET).

2. ROCK SOCK SHALL BE CONSTRUCTED ACCORDING TO THE DETAIL (SEE DETAIL RS).

3. ROCK SOCK SHALL BE APPROXIMATELY 12” IN DIAMETER.

4. ROCK SOCK SHALL EXTEND ABOVE THE FLOW LINE ELEVATION ON BOTH SIDES OF THE CULVERT END SECTION.

CULVERT PROTECTION (INLET) INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE CULVERT PROTECTION (INLET).

2. AT A MINIMUM, ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE SEDIMENT HAS REACHED A DEPTH EQUAL TO 1/2 THE HEIGHT OF THE ROCK SOCK.

3. CULVERT PROTECTION (INLET) IS TO REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.

4. WHEN THE CULVERT INLET PROTECTION IS REMOVED, THE TOWN’S INSPECTOR MAY REQUIRE ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE CULVERT INLET PROTECTION TO BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).
NOTE:
A VTC PAD IS NOT NECESSARY IF THERE IS ANOTHER VTC PAD IN BETWEEN THE CWA AND ROADWAY, PARKING LOT, DRIVE AISLES, ETC.

VEHICLE TRACKING CONTROL (IF NECESSARY) SEE DETAIL VTC

PLAN VIEW

SECTION A

EXISTING GRADE

36" MIN.

2% SLOPE MIN.

1 22±

6' MIN.
CONCRETE WASHOUT AREA INSTALLATION NOTES

1. CONCRETE WASHOUT AREAS SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT ON SITE.

2. A VEHICLE TRACKING CONTROL PAD IS REQUIRED AT THE ACCESS POINT TO ALL CONCRETE WASHOUT AREAS WHEN NO OTHER VTC PAD EXISTS IN BETWEEN THE CWA AND THE ROADWAY.

3. IF GROUNDWATER IS ENCOUNTERED WHEN DIGGING THE PIT, A NEW LOCATION SHOULD BE SELECTED. IF NO OTHER LOCATION CAN BE FOUND, A ONE-PIECE IMPERVIOUS LINER SHALL BE REQUIRED ALONG THE BOTTOM AND SIDES OF THE SUBSURFACE PIT.

CONCRETE WASHOUT AREA INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE CONCRETE WASHOUT AREA.

2. CONCRETE WASHOUT MATERIALS SHALL BE REMOVED BEFORE IT'S CAPACITY HAS BEEN REACHED.

3. CONCRETE WASHOUT AREAS SHALL BE ENLARGED AS NECESSARY TO MAINTAIN CAPACITY FOR WASTED CONCRETE AND ASSOCIATED WASH WATER.

4. CONCRETE WASHOUT WATER, WASTED PIECES OF CONCRETE AND ALL OTHER DEBRIS IN THE SUBSURFACE PIT SHALL BE TRANSPORTED FROM THE JOB SITE AS NECESSARY TO ENSURE ADEQUATE CAPACITY.

5. CONCRETE WASHOUT AREAS SHALL REMAIN IN PLACE UNTIL ALL CONCRETE FOR THE PROJECT IS PLACED.

6. WHEN CONCRETE WASHOUT AREAS ARE REMOVED, THE TOWN'S INSPECTOR MAY REQUIRE EXCAVATIONS TO BE FILLED WITH SUITABLE COMPACTED BACKFILL AND TOPSOIL, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE CONCRETE WASHOUT AREAS SHALL BE RUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN'S SPECIFICATIONS (SEE DETAIL SMC).
COORDINATION WITH TOWN INSPECTOR IS REQUIRED TO DETERMINE APPROPRIATE OUTLET LOCATION AND END TREATMENT

PUMP SUCTION LINE

A PLASTIC 5 GALLON BUCKET WITH 3/8" DIAMETER HOLES DRILLED AT 2" MAXIMUM SPACING AROUND AND ON THE BOTTOM OF THE BUCKET.

PUMP SUCTION LINE OR SUBMERSIBLE PUMP CENTERED AND LOCATED AT BOTTOM OF BUCKET

1.5" CRUSHED ROCK PLACED A MINIMUM OF 1.0' AROUND AND UNDER THE 5 GALLON BUCKET.

TYPICAL DEWATERING SUMP

NOTE:
IT IS THE CONTRACTOR’S RESPONSIBILITY TO DETERMINE APPROPRIATE MEASURES TO PROTECT PUMPING EQUIPMENT AND MINIMIZE SEDIMENT. USE OF A PLASTIC 5 GALLON BUCKET IS SUGGESTED BUT NOT REQUIRED. THE CONTRACTOR SHALL NOT HOLD THE TOWN LIABLE FOR DAMAGE TO PUMPING EQUIPMENT REGARDLESS OF METHODS USED.
DEWATERING INSTALLATION NOTES

1. IT IS THE EROSION CONTROL SUPERVISOR’S RESPONSIBILITY TO ENSURE THAT ALL DEWATERING IS PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE).

DEWATERING MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL INSPECT THE DEWATERING OPERATION TO ENSURE THAT THE DISCHARGE WATER IS DRAINING TO THE PROPER LOCATION(S) AND PERFORM ANY NECESSARY REPAIRS OR MAINTENANCE ON A FREQUENT BASIS.
DIVERSION DITCH SECTION LINED CHANNEL

DIVERSION DITCH SECTION UNLINED CHANNEL

NOTE: DITCH LINING THICKNESS HAS BEEN EXAGGERATED FOR CLARITY.
DIVERSION DITCH INSTALLATION NOTES

1. SEE THE PLAN VIEW FOR THE LOCATION(S) OF THE DIVERSION DITCHES.

2. A PLASTIC LINER, RIPRAP, OR EROSION CONTROL BLANKET MAY BE NECESSARY TO PROTECT THE DIVERSION DITCH. THE REQUIRED LINING MATERIAL SHALL BE OBTAINED FROM THE CBMP PLANS VIA THE DESIGN ENGINEER.

3. ALL MATERIAL EXCAVATED FROM THE DITCH MAY BE USED TO CONSTRUCT THE BERM ON THE DOWNHILL SIDE OF THE DITCH.

4. THE DIVERSION DITCH SHALL BE A MINIMUM OF 20” DEEP WITH APPROX. 3:1 SIDE SLOPES. THE ADJACENT BERM SHALL BE A MINIMUM OF 20” IN HEIGHT WITH APPROX. 3:1 SIDE SLOPES. ALL EMBANKMENTS SHALL BE FIRMLY COMPACTED.

5. THE DISCHARGE FROM THE DIVERSION DITCH SHALL BE DIRECTED TOWARDS AN APPROPRIATELY SIZED TEMPORARY SEDIMENT BASIN OR OTHER APPROVED AREA.

DIVERSION DITCH INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE DIVERSION DITCH.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE THE SEDIMENT HAS REACHED A DEPTH EQUAL TO 1/2 (10”) THE CREST HEIGHT.

3. DIVERSION DITCHES SHALL BE RE-GRDED FOLLOWING THE SIGNS OF MODERATE OR MORE SOIL EROSION OR ANY DAMAGE.

4. DIVERSION DITCHES ARE TO REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR. ALTERNATIVELY, THE DIVERSION DITCHES MAY BE REMOVED WHEN THE SITE’S TOPOGRAPHY CHANGES SUCH THAT SIGNIFICANT RUNOFF IS NO LONGER POSSIBLE. IN SOME INSTANCES, THE DIVERSION DITCHES MAY REMAIN IN PLACE PERMANENTLY.
DETENTION POND PROTECTION INSTALLATION NOTES

1. DETENTION POND PROTECTION SHALL BE INSTALLED IMMEDIATELY FOLLOWING THE CONSTRUCTION OF THE TRICKLE CHANNEL AND FOREBAY.

2. CRUSHED ROCK SHALL BE 2.0”–3.0” IN SIZE WITH A FRACTURED FACE (ALL SIDES).

3. ROCK SOCK FOR OUTLET STRUCTURE AND FOREBAY PROTECTION SHALL BE ONE CONTINUOUS PIECE (SEE DETAIL RS).

DETENTION POND PROTECTION INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE OUTLET STRUCTURE PROTECTION.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED IMMEDIATELY.

3. OUTLET STRUCTURE PROTECTION SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.
NOTE:

1. THE EROSION CONTROL SUPERVISOR IS RESPONSIBLE FOR ENSURING THAT ALL STREETS, CURBS, GUTTERS, SIDEWALKS, DRIVEWAYS, PARKING LOTS, ALLEYS, TRICKLE CHANNELS, AND/OR OTHER IMPERVIOUS SURFACES IMPACTED BY CONSTRUCTION ACTIVITIES ARE THOROUGHLY CLEANED THROUGHOUT THE DAY IF THEY BECOME SOILED. THESE AREAS MUST ALSO BE THOROUGHLY CLEAN BEFORE THE END OF THE WORK DAY. FURTHERMORE, ALL LOOSE TRASH AND LITTER ASSOCIATED WITH THE PROJECT MUST BE REMOVED AND PROPERLY DISCARDED ON A DAILY BASIS.
DEBRIS CONTROL NOTES:

1. A COMBINATION OF SURFACE SCRAPING AND SWEEPING MAY BE NECESSARY TO PROPERLY CLEAN THESE AREAS.

2. ALL CHEMICAL SPILLS AND/OR STAINS ON THE SITE SHALL BE CLEANED TO THE MAXIMUM EXTENT PRACTICABLE. IN SOME CASES IT MAY BE NECESSARY TO USE PRESSURIZED WATER AND A VAC-TRUCK.

3. ON-SITE PERSONNEL, DELIVERY DRIVERS, ETC., SHOULD BE EDUCATED ON THE NEED FOR CONTINUOUS DEBRIS AND TRASH CONTROL.
START EROSION BLANKET AT THE TOP OF SLOPE AND EXTEND PAST THE TOE OF SLOPE. BLANKET SHALL BE PLACED PERPENDICULAR TO THE TOP AND BOTTOM OF THE SLOPE. COMPLETE SUBSEQUENT ROWS IN THE SAME MANNER, OVERLAPPING THE BLANKETS A MINIMUM OF 1.0'.

NOTE: STAPLES SHALL BE INSTALLED PER MANUFACTURERS RECOMMENDATION. IF MANUFACTURER INFO IS NOT AVAILABLE THEN ABOVE STAPLE PATTERN SHALL BE USED. WOODEN STAKES SHALL NOT BE USED FOR EROSION CONTROL BLANKET ON SLOPES.

NOTE: WHEN NECESSARY, ALL SEEDING SHALL BE COMPLETED PRIOR TO THE PLACEMENT OF EROSION CONTROL BLANKETS. PLEASE SEE DETAIL SMC FOR SEEDING, MULCHING, AND CRIMPING REQUIREMENTS.

EROSION CONTROL BLANKET (SLOPE)
TOE OF SLOPE ANCHOR TRENCH

TOP OF SLOPE ANCHOR TRENCH

JOINT ANCHOR TRENCH USED TO JOIN BLANKETS TOGETHER (LONGITUDINAL)

SAW 2" x 4" LUMBER ON DIAGONAL

WOOD STAKE DETAIL
ALTERNATIVE WOOD STAKE PRODUCTS MAY BE USED WITH APPROVAL FROM THE TOWN.

NOTES:
1. WOOD STAKES SHALL BE INSTALLED SUCH THAT ONLY 1" IS EXPOSED ABOVE THE GROUND.
2. WHEN NECESSARY, ALL SEEDING SHALL BE COMPLETED PRIOR TO THE PLACEMENT OF EROSION CONTROL BLANKETS. PLEASE SEE DETAIL SMC FOR SEEDING, MULCHING, AND CRIMPING REQUIREMENTS.

STAKING PATTERN
NOTE: STAKES SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATION. IF MANUFACTURER INFO IS NOT AVAILABLE THEN ABOVE STAKING PATTERN SHALL BE USED. STAPLES SHALL NOT BE USED FOR EROSION CONTROL BLANKET IN CHANNELS.

EROSION CONTROL BLANKET (CHANNEL)

CBMP
CONSTRUCTION BEST MANAGEMENT PRACTICES
EROSION CONTROL BLANKET INSTALLATION NOTES

1. SEE THE PLAN VIEW FOR THE LOCATION(S) OF THE EROSION CONTROL BLANKETS.

2. EROSION CONTROL BLANKETS USED FOR CHANNEL PROTECTION SHALL BE PROPERLY SELECTED BY THE DESIGN ENGINEER BASED ON CURRENT AND FUTURE FLOW RATES WITHIN THE CHANNEL. BASED ON THESE CALCULATIONS, TURF REINFORCEMENT MATTING OR RIPRAP MAY BE NECESSARY IN LIEU OF EROSION CONTROL BLANKETS.

3. IMMEDIATELY PRIOR TO BLANKET INSTALLATION, SOIL SURFACE SHALL BE SMOOTH AND FREE OF ANY CAPS, VOIDS, WEEDS, ROCKS, STICKS, OR OTHER MISCELLANEOUS DEBRIS.

4. EROSION CONTROL BLANKET SHALL THEN BE INSTALLED ACCORDING TO THE DETAILED DRAWINGS.

5. ANY DAMAGED OR REMAINING STAPLES OR STAKES SHALL BE REMOVED FROM THE SITE.

6. ALL EROSION CONTROL BLANKETS FOR SLOPE PROTECTION INSTALLED IN THE TOWN SHALL BE DOUBLE NET, STRAW OR EXCELSIOR.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
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<tbody>
<tr>
<td>NORTH AMERICAN GREEN</td>
<td>S150</td>
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<tr>
<td>APPROVED EQUAL</td>
<td>APPROVED EQUAL</td>
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7. IN MOST CASES, EROSION CONTROL BLANKETS FOR SLOPE PROTECTION ARE TO REMAIN IN PLACE PERMANENTLY.

EROSION CONTROL BLANKET MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE EROSION CONTROL BLANKETS AND MAKE ANY NECESSARY REPAIRS.
Inlet protection for area inlets not in pavement

**Inlet Protection for Area Inlets Not in Pavement**

**Section A**
- Typical straw bales
- See detail SB
- Silt fence
- See detail SF

**Section B**
- Typical straw bales
- See detail SB
- Silt fence
- See detail SF

**Area Inlet with Concrete Apron**
- Plan View
- Typical straw bales
- See detail SB
- Silt fence
- See detail SF

**Area Inlet**
- Plan View
- Typical straw bales
- See detail SB
- Silt fence
- See detail SF

**Isometric**
- Straw bale and silt fence not shown to reveal inlet
- Area inlet

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**Town of Parker, Colorado**

**CBMP**

**Construction Best Management Practices**

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**IPAN**

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**NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF THE TOWN OF PARKER.**
AREA INLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION(S) OF AREA INLET PROTECTION.

2. THE AREA INLET PROTECTION SHOWN ON CBMP PLANS SHALL BE INSTALLED ON EXISTING INLETS PRIOR TO ANY LAND DISTURBING ACTIVITIES OR IMMEDIATELY AFTER THE INSTALLATION OF NEW INLETS. AN INTERIM STYLE OF INLET PROTECTION MAY BE ALLOWED UNTIL THE INSTALLATION OF THE GUTTER AND/OR PAVEMENT.

AREA INLET PROTECTION INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE AREA INLET PROTECTION.

2. AREA INLET PROTECTION SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.

3. WHEN THE AREA INLET PROTECTION IS REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE AREA INLET PROTECTION MAY NEED TO BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).

4. ACCUMULATED SEDIMENT SHALL BE REMOVED AS SOON AS POSSIBLE, IMMEDIATELY IN MOST CASES.
INLET PROTECTION FOR AREA INLETS IN PAVEMENT
ROCK SOCK (SEE DETAIL RS) SHALL BE PLACED TIGHTLY AGAINST CURB FACE AND SHALL BE PLACED 5.0’ UPSTREAM FROM THE INLET OPENING.

SEEDMENT CONTROL LOG (AS REQUIRED) SEE DETAIL SCL

TOP BACK CURB (TYP.)

FLOWLINE (TYP.)

LIP OF CURB (TYP.)

TUBULAR MARKER MUST BE SECURED TO THE END OF THE ROCK SOCK AND WIRE-TIED WITH REBAR TIE WIRE OR A TOWN APPROVED EQUIVALENT.

PLAN VIEW

CURB INLET

SEEDMENT CONTROL LOG (AS REQUIRED) SEE DETAIL SCL

TUBULAR MARKER MUST BE SECURED TO THE END OF THE ROCK SOCK AND WIRE-TIED WITH REBAR TIE WIRE OR A TOWN APPROVED EQUIVALENT.

ISOMETRIC

PLAN VIEW FOR MULTIPLE ROCK SOCKS

INLET PROTECTION, CURB ON-GRADE, TYPE R INLET

CBMP

CONSTRUCTION BEST MANAGEMENT PRACTICES
REFLECTIVE MARKING

36" MIN

TRAFFIC MARKER POST BASE

16" ±

TRAFFIC MARKER POST BASE

16" ±

ELEVATION

BASE

TUBULAR TRAFFIC MARKER DETAIL
INLET PROTECTION, CURB ON-GRADE INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF ON-GRADE INLET PROTECTION.

2. CRUSHED ROCK SHALL BE 2.0”–3.0” IN SIZE WITH A FRACTURED FACE (ALL SIDES).

3. ROCK SOCK FOR ON-GRADE INLET PROTECTION SHALL BE ONE CONTINUOUS PIECE.

4. ROCK SOCK SHALL BE CONSTRUCTED USING CHICKEN WIRE OR OTHER APPROVED MATERIAL, Sized TO KEEP ROCK FROM SPILLING OUT.

5. ROCK SOCK SHALL BE PLACED 5.0’ UPHILL OF THE INLET OPENING.

6. TUBULAR MARKER SHALL BE A MINIMUM OF 3.0’ HIGH WITH REFLECTIVE BANDS AND OCTAGON SHAPED BASES.

7. THE CURB INLET PROTECTION SHOWN ON CBMP PLAN SHALL BE INSTALLED ON EXISTING INLETS PRIOR TO ANY LAND DISTURBING ACTIVITIES OR IMMEDIATELY AFTER THE APPLICABLE INSTALLATION OF THE FIRST LIFT OF ASPHALT ON ROADWAYS DRAINING TO THE INLET.

ON-GRADE INLET PROTECTION INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE ON-GRADE INLET PROTECTION.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED AS SOON AS POSSIBLE, IMMEDIATELY IN MOST CASES.

3. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED OR DAMAGED.

4. ON-GRADE INLET PROTECTION SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.
A minimum of 3’ of rock sock must run along the curb face on each side of the inlet.

Tubular marker must be secured to the end of the rock sock and wire–tied with rebar tie wire or a town approved equivalent.

**PLAN VIEW**

Top of rock sock (see detail RS). Shall be below top of curb.

**SECTION A**

Flow

Pavement

Runoff

Sediment Control
Log See Detail SCL

Tubular marker must be secured to the end of the rock sock and wire–tied with rebar tie wire or a town approved equivalent.
CURB INLET PROTECTION INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF CURB INLET PROTECTION.

2. CRUSHED ROCK SHALL BE 2.0”–3.0” IN SIZE WITH A FRACTURED FACE (ALL SIDES).

3. ROCK SOCK SHALL BE ONE CONTINUOUS PIECE OR SHALL BE CONSTRUCTED USING WIRE WRAPPED JOINTS (SEE DETAIL RS).

4. ROCK SOCK SHALL BE CONSTRUCTED USING CHICKEN WIRE OR OTHER APPROVED MATERIAL Sized TO KEEP ROCK FROM SPILLING OUT.

5. ROCK SOCK SHALL EXTEND 3.0' ALONG THE CURB BEYOND LOCATIONS WHERE IT RETURNS TO CONTACT CURB FACE.

6. TUBULAR TRAFFIC MARKERS SHALL BE A MINIMUM OF 36” IN HEIGHT WITH REFLECTIVE BANDS AND OCTAGON SHAPED BASES.

7. THE CURB INLET PROTECTION SHOWN ON CBMP PLAN SHALL BE INSTALLED ON EXISTING INLETS PRIOR TO ANY LAND DISTURBING ACTIVITIES OR IMMEDIATELY AFTER THE INSTALLATION OF THE FIRST LIFT OF ASPHALT ON ROADWAYS DRAINING TO THE CURB INLET. CMU BLOCKS OR THE ROCK SOCK SHALL BE USED AS INTERIM PROTECTION UNTIL THE FIRST LIFT OF ASPHALT IS INSTALLED.

CURB INLET PROTECTION INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE CURB INLET PROTECTION.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED AS SOON AS POSSIBLE, IMMEDIATELY IN MOST CASES.

3. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED OR DAMAGED.

4. CURB INLET PROTECTION SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.
EROSION CONTROL BLANKET FOR LOT PROTECTION INSTALLATION NOTES

1. ALL EROSION CONTROL BLANKETS FOR LOT PROTECTION INSTALLED IN THE TOWN SHALL MEET THE FOLLOWING MINIMUM REQUIREMENTS:

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<td>S150 BN</td>
</tr>
<tr>
<td>APPROVED EQUAL</td>
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2. ALL EROSION CONTROL BLANKETS FOR LOT PROTECTION SHALL BE INSTALLED ACCORDING TO THE DETAIL DRAWINGS, WITH THE FOLLOWING ALLOWANCES AND ADDITIONS:

- THE TOWN WILL ALLOW THE USE OF BIODEGRADABLE, EROSION CONTROL BLANKET–SPECIFIC STAPLES, IN LIEU OF TRADITIONAL METAL STAPLES.

- ALL EROSION CONTROL BLANKET EDGES (SIDES AND ENDS) MUST OVERLAP THE ADJACENT BLANKET BY A MINIMUM OF 6-INCHES WITH THE UP–GRADIENT EDGES BEING PLACED ON TOP OF THE DOWN–GRADIENT EDGE OF THE ADJACENT BLANKET.

- THE EDGES (SIDES AND ENDS) OF THE EROSION CONTROL BLANKETS DO NOT NEED TO BE TRENCHED INTO THE GROUND ASSUMING THE SITE CONDITIONS WILL NOT CAUSE EROSION BENEATH THE BLANKETS. THESE ASSUMPTIONS WILL BE THE RESPONSIBILITY OF THE EROSION CONTROL SUPERVISOR. ON OCCASION, THE TOWN’S INSPECTOR MAY REQUEST TRENCHING BASED UPON SITE CONDITIONS.

- TOPSOIL PLACEMENT, SEEDING, AND MULCHING WILL NOT BE REQUIRED ON THE LOTS PRIOR TO THE INSTALLATION OF THE EROSION CONTROL BLANKET.

3. ANY DAMAGED OR EXCESS STAPLES SHALL BE REMOVED FROM THE SITE FOLLOWING INSTALLATION.

4. THE EROSION CONTROL BLANKETING REQUIRED AS PART OF THE LOT PROTECTION (LP) REQUIREMENT MUST BE INSTALLED OVER ALL UN–LANDSCAPED AREAS WITHIN EACH RESIDENTIAL, MULTI–FAMILY, AND COMMERCIAL LOT PRIOR TO THE ISSUANCE OF A CERTIFICATE OF OCCUPANCY / TEMPORARY CERTIFICATE OF OCCUPANCY.

EROSION CONTROL BLANKET FOR LOT PROTECTION MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE EROSION CONTROL BLANKET FOR LOT PROTECTION.

2. EROSION CONTROL BLANKETS FOR LOT PROTECTION ARE INTENDED TO REMAIN IN PLACE AND MAINTAINED UNTIL LANDSCAPING IS INSTALLED.
MASONRY WORK PROTECTION INSTALLATION NOTES

1. Masonry work protection may need to be installed when masonry work and mixing is occurring.

2. A rock sock shall be installed in a crescent shape on the downhill side of the masonry work and mixer.

3. Crushed rock shall be 2.0”–3.0” in size with a fractured face (all sides).

4. Rock sock shall be one continuous piece or shall be constructed using wire wrapped joints (see detail RS).

5. Rock sock shall be constructed using chicken wire or other approved material, sized to keep rock from spilling out.

MASONRY WORK PROTECTION INSPECTION AND MAINTENANCE NOTES

1. The erosion control supervisor shall regularly inspect the masonry work protection.

2. All concrete waste shall be regularly cleaned and placed in the concrete wash out area.

3. Rock socks shall be replaced if they become heavily soiled or damaged.
CONTRACTOR SHALL ANCHOR PORTABLE TOILET TO THE GROUND, AT A MINIMUM OF TWO OPPOSING CORNERS (ON A DIAGONAL) USING U-SHAPED REBAR STAKES.
PORTABLE TOILET PROTECTION INSTALLATION NOTES

1. PORTABLE TOILETS SHALL BE PLACED A MINIMUM OF 10.0’ BEHIND ALL CURBS, SIDEWALKS, AND OTHER IMPERVIOUS AREAS.

2. ALL PORTABLE TOILETS MUST BE GROUPED TOGETHER.

3. PORTABLE TOILETS SHALL BE SECURELY ANCHORED TO THE GROUND USING U-SHAPED REBAR STAKES.

4. U-SHAPED REBAR STAKES SHALL BE POSITIONED ON AT LEAST 2 OPPOSING (DIGITAL) CORNERS.

PORTABLE TOILET PROTECTION INSPECTION AND MAINTENANCE NOTES

2. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE PORTABLE TOILET PROTECTION.

3. PORTABLE TOILETS SHALL BE SERVICED AT THE NECESSARY INTERVALS TO ELIMINATE THE POSSIBILITY OF OVERFLOW.

4. WHEN THE PORTABLE TOILETS ARE REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE TOILETS MAY NEED TO BE LANDSCAPED OR ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).

5. PORTABLE TOILETS THAT ARE NOT CONSISTENTLY MAINTAINED IN ACCORDANCE WITH THESE REQUIREMENTS MAY NEED TO BE CLUSTERED TOGETHER, IN ONE CENTRALIZED LOCATION IN ORDER TO INCREASE COMPLIANCE AND REDUCE THE CHANCE OF A SPILL.
PLAN VIEW

NOTE:
Depending upon the phase of construction, curb and gutter may or may not be present.

SECTION A

ROUGH CUT STREET CONTROL

CBMP
CONSTRUCTION BEST MANAGEMENT PRACTICES
ROUGH CUT STREET CONTROL INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF ROUGH CUT STREET CONTROL.

2. THE SPACING OF THE ROUGH CUT STREET CONTROL MAY BE DETERMINED BY THE DESIGN ENGINEER AND SHOWN ON THE CBMP PLAN.

ROUGH CUT STREET CONTROL INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE ROUGH CUT STREET CONTROL.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS 1/2 THE HEIGHT OF THE ROCK SOCK.

3. ROUGH CUT STREET CONTROL SHALL BE REPAIRED IMMEDIATELY FOLLOWING ANY SIGN OF WEAR OR ALTERATION OF THE ORIGINAL SHAPE AND DIMENSIONS.

4. ROUGH CUT STREET CONTROL SHALL BE KEPT IN PLACE AND MAINTAINED UNTIL SUB-GRADE PREPARATION BEGINS FOR PAVING. AT THAT POINT, THE RCSC SHOULD BE REMOVED IN INCREMENTS BASED ON SUBGRADE PREPARATION.
CROSS SECTION

CHICKEN WIRE OR OTHER APPROVED MATERIAL SIZED TO KEEP ROCK FROM SPILLING OUT.

WIRE TIE ENDS OR SECURE IN ANOTHER SUITABLE FASHION

VARIES

2.0”–3.0” CRUSHED GRANITE

COMPLETED ROCK SOCK

ADDITIONAL WIRE MESH

ROCK SOCK

ADDITIONAL 2.0”–3.0” CRUSHED ROCK

DOUBLE WRAP AT ROCK SOCK JOINTS

12”

ANY GAP AT JOINT SHALL BE FILLED WITH AN ADEQUATE AMOUNT OF 2.0”–3.0” CRUSHED ROCK AND DOUBLE WRAPPED WITH ADDITIONAL CHICKEN WIRE (OR APPROVED EQUAL) SECURED TO ENDS OF ROCK REINFORCED SOCK.

JOINT PLAN VIEW

JOINT ELEVATION

RS

ROCK SOCK

CBMP
CONSTRUCTION BEST MANAGEMENT PRACTICES

1 OF 2
Oct. 2013
ROCK SOCK INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF ROCK SOCK.

2. CRUSHED ROCK SHALL BE APPROXIMATELY 2.0”–3.0” GRANITE IN SIZE WITH A FRACTURED FACE (ALL SIDES).

3. ROCK SOCK SHALL BE APPROXIMATELY ONE CONTINUOUS PIECE OR SHALL BE CONSTRUCTED USING WIRE WRAPPED JOINTS (SEE DETAIL RS).

4. ROCK SOCK SHALL BE CONSTRUCTED USING CHICKEN WIRE OR OTHER APPROVED MATERIAL SIZED TO KEEP ROCK FROM SPILLING OUT.

5. MINIMUM ROCK SOCK DIAMETER SHALL VARY BASED ON APPLICATION (7” MIN).

6. TUBULAR MARKERS MAY NEED TO BE USED IN CONJUNCTION WITH ROCKS SOCKS ANYTIME THE ROCK SOCK IS PLACED ON A ROADWAY, SIDEWALK, PARKING LOT OR OTHER LOCATION SUSCEPTIBLE TO VEHICLE OR PEDESTRIAN TRAFFIC. TUBULAR MARKERS SHALL CONFORM TO THE TUBULAR MARKER DETAIL.

ROCK SOCK INSPECTION AND MAINTENANCE NOTES

1. THE Erosion CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE ROCK SOCKS.

2. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED OR DAMAGED.

3. ROCK SOCKS SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.
WIRE AND ROCK NOT SHOWN FOR CLARITY

SWALE ELEVATION

12" MIN.
ROCK SOCK

FLOW

EMBEDDED ROCK SOCK
APPROXIMATELY 2" IN SOIL

EMBEDDED ROCK SOCK
APPROXIMATELY 2" IN SOIL

L = THE DISTANCE SUCH THAT POINT A AND B ARE OF EQUAL ELEVATION.

SWALE SPACING

ROCK SOCK IN SWALE
TRENCH EXCAVATION

STRAW BALE INSTALLATION

SECTION

STRAW BALE
STRAW BALE INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF STRAW BALES.

2. TYPICAL STRAW BALES SHALL BE APPROXIMATELY 36”X18”X18”.

3. TWO (2) WOODEN STAKES SHALL BE USED TO HOLD EACH BALE IN PLACE. WOODEN STAKES SHALL BE A MINIMUM OF 1”X1”X24”.

4. WOODEN STAKES SHALL BE PLACED APPROXIMATELY 6” INTO THE GROUND.

5. STRAW BALES SHALL BE SPACED AND POSITIONED ACCORDING TO DETAILS.

STRAW BALE INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE STRAW BALES.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE THE SEDIMENT HAS REACHED A DEPTH EQUAL TO 1/2 THE HEIGHT OF THE STRAW BALE.

3. STRAW BALES MAY NEED TO BE REPLACED IF THEY BECOME HEAVILY SOILED, ROTTEN, OR OTHERWISE DAMAGED.

4. STRAW BALES SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN INSPECTOR.

5. WHEN THE STRAW BALES ARE REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE STRAW BALES MAY NEED TO BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).
SEDIMENT CONTROL LOG
AT BACK OF CURB

CENTER STAKE IN SEDIMENT CONTROL LOG
9" DIAMETER (MIN.) SEDIMENT CONTROL LOG
PLACE LOG AGAINST BACK OF CURB

FLOW

COMPACTED EXCAVATED TRENCH SOIL 6" MIN

SEDIMENT CONTROL LOG
AT SIDEWALK WITH TREE LAWN

CENTER STAKE IN SEDIMENT CONTROL LOG
9" DIAMETER (MIN.) SEDIMENT CONTROL LOG
SIDEWALK (TYPICAL)

FLOW

PLACE CONTROL LOG AGAINST SIDEWALK
TREE LAWN (TYPICAL)
CURB

SEDIMENT CONTROL LOG JOINTS

12" OVERLAP (MIN)

1"x1"x18" (MIN.) WOODEN STAKE

4.0' MAX

9" DIAMETER (MIN) SEDIMENT CONTROL LOG

SEDIMENT CONTROL LOG

CBMP
CONSTRUCTION BEST MANAGEMENT PRACTICES

Town of Parker, Colorado

SCL

Oct. 2013
SEDIMENT CONTROL LOG INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF SEDIMENT CONTROL LOGS.

2. ALL SEDIMENT CONTROL LOGS SHALL BE INSTALLED FREE OF DEFECTS INCLUDING RIPS, HOLES AND OBIVIOUS WEAR.

3. SEDIMENT CONTROL LOGS SHALL BE INSTALLED IMMEDIATELY ADJACENT TO AN IMPERVIOUS SURFACE SUCH AS A CURB HEAD, SIDEWALK, INLET LID, ETC. NO GAPS SHALL EXIST BETWEEN THE SEDIMENT CONTROL LOG AND THE IMPERVIOUS SURFACE.

4. A UNIFORM 3” DEEP ANCHOR TRENCH (APPROX.) IN THE SHAPE OF A HALF-SPHERE SHALL BE EXCAVATED USING A TRENCHER, SPADE-SHAPED SHOVEL, OR PICK. THE ANCHOR TRENCH SHALL BE SIZED TO ALLOW FOR THE SEDIMENT CONTROL LOG TO SEAT TIGHTLY AGAINST THE ANCHOR TRENCH.

5. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF THE ANCHOR TRENCH AND PROPERLY COMPACTED.

6. ANCHOR TRENCH SHALL BE RELATIVELY FREE OF ROCKS OR OTHER DEBRIS PRIOR TO THE PLACEMENT.

7. ALL SEDIMENT CONTROL LOGS SHALL BE PLACED 3” (APPROX.) BELOW THE GROUND AND PULLED TIGHT ON BOTH ENDS TO REMOVE ANY CURVES OR SNAGS.

8. THE UPHILL SIDE OF THE SEDIMENT CONTROL LOG SHALL BE BACKFILLED WITH SOIL THAT IS RELATIVELY FREE OF ROCKS AND DEBRIS. THE SOIL SHALL BE TIGHTLY COMPACTED AGAINST THE GROUND AND SEDIMENT CONTROL LOG USING A SHOVEL, OR SIMILAR DEVICE.

9. SEDIMENT CONTROL LOG STAKES SHALL BE MADE OF WOOD AND SECURELY ANCHOR THE SCL IN PLACE.

10. STAKES SHALL BE PLACED ON 4.0’ CENTERS AND EMBEDDED APPROXIMATELY 6” INTO THE GROUND. STAKES THAT ARE BROKEN PRIOR TO OR DURING INSTALLATION SHALL BE REPLACED.

11. SEDIMENT CONTROL LOGS SHALL OVERLAP A MINIMUM OF 12”. THE OVERLAPPING SHALL OCCUR ON THE UP-GRADIENT SIDE OF THE LOGS.

12. SEDIMENT CONTROL LOGS SHALL BE STAKED WITHIN 6” FROM EACH END.

13. SEDIMENT CONTROL LOGS THAT ARE INSTALLED BEHIND CURBS AND SIDEWALKS MUST BE DONE SO THAT NO MORE THAN A 2” GAP EXISTS BETWEEN THE CONCRETE AND THE LOG. EROSION CONTROL BLANKETING (ECB) BETWEEN THE GAP MAY BE REQUIRED IN INSTANCES WHERE THIS DOES NOT OCCUR.

SEDIMENT CONTROL LOG INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE SEDIMENT CONTROL LOGS.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED ONCE THE SEDIMENT HAS REACHED A DEPTH EQUAL TO 1/2 THE HEIGHT OF EXPOSED LOG.

3. SEDIMENT CONTROL LOGS SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.

4. SEDIMENT CONTROL LOGS SHALL BE REPLACED WHEN THERE ARE ANY SIGNS OF WEAR OR DAMAGE THAT WOULD PREVENT THE SCL FROM FUNCTIONING AS DESIGNED.

5. WHEN THE SEDIMENT CONTROL LOGS ARE REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE SEDIMENT CONTROL LOGS MAY NEED TO BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).
A min. of 1"x1"x48" wooden stakes shall be placed on the downhill side of the silt fence fabric. A 1-1/2" X 1/4" stake or lath shall be stapled or nailed to the 48" stake on the uphill side of the fabric such that it is flush against the fabric and stake. Length of stake is dependent upon height of fence. Also see alternative installation - 360° twist detail.
ATTACH 1-1/2" X 1/4" STAKE OR LATH ON UPHILL SIDE OF SILT FENCE FABRIC OR USE 360° TWIST ALTERNATIVE INSTALLATION

SILO FENCE FABRIC

FLOW

COMPACTED BACKFILL

BURY SILT FENCE 10" STRAIGHT DOWN

1"x1"x48" WOODEN STAKE ON DOWNHILL SIDE OF SILT FENCE FABRIC.

UNDISTURBED VEGETATION ON DOWNHILL SIDE

10" MIN 12" MIN

JOIN FIRST

ROTATE SECOND

POSTS SHALL BE JOINED AS SHOWN, THEN ROTATED 180 DEG. IN DIRECTION SHOWN AND DRIVEN INTO THE GROUND.

POSTS SHALL OVERLAP AT JOINTS SO THAT NO GAPS EXIST IN SILT FENCE

NOTE: THICKNESS OF GEOTEXTILE HAS BEEN EXAGGERATED FOR CLARITY.

STEP 1

STAPLE FABRIC TO WOODEN STAKE

SILT FENCE FABRIC

AFTER FABRIC IS STAPLED TO STAKE, ROTATE STAKE 360°

STEP 2

1"x1"x48" WOODEN STAKE

SILT FENCE FABRIC

ALTERNATIVE INSTALLATION - 360° TWIST

SILT FENCE

X X

SF

CBMP

CONSTRUCTION BEST MANAGEMENT PRACTICES

SF

2 OF 4
Oct. 2013
SILT FENCE INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF SILT FENCE.

2. ALL SILT FENCE SHALL BE INSTALLED IN GOOD CONDITION AND FREE OF ANY DEFECTS INCLUDING RIPS, HOLES AND OBVIOUS WEAR.

3. A UNIFORM 10” DEEP ANCHOR TRENCH SHALL BE EXCAVATED USING A TRENCHER.

4. A 10” DEEP ANCHOR SLIT SHALL BE FORMED IF USING A STATIC SLICING METHOD.

5. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF THE ANCHOR TRENCH.

6. ANCHOR TRENCH SHALL BE GENERALLY FREE OF ROCKS OR OTHER DEBRIS PRIOR TO THE PLACEMENT OF THE SILT FENCE.

7. THE ANCHOR TRENCH SHALL BE THOROUGHLY BACKFILLED WITH SOIL THAT IS GENERALLY FREE OF ROCKS AND DEBRIS.

8. ALL EXCAVATED MATERIAL SHALL BE PLACED ON THE UP-GRADIENT SIDE OF THE SILT FENCE.

9. STAKES SHALL BE POSITIONED ON THE DOWNHILL SIDE OF THE SILT FENCE FABRIC AND PLACED ON 10.0’ CENTERS OR LESS. STAKES SHALL BE EMBEDDED A MINIMUM OF 12” INTO THE GROUND. A WOODEN LATH SHALL BE ATTACHED TO THE OPPOSING (UPHILL) SIDE OF THE STAKE FOR ADDED STRENGTH AND SUPPORT. THE LATH SHALL HAVE THE FOLLOWING DIMENSIONS: 1”x¼”x24”.

10. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD NOT BE SIGNIFICANT SAGGING ALONG ANY PORTION OF THE SILT FENCE AFTER IT HAS BEEN ANCHORED TO THE STAKES.

11. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES AND LATHS USING STAPLES OR NAILS OF AN APPROXIMATE LENGTH. ENOUGH STAPLES AND NAILS SHOULD BE PLACED ALONG THE LATH TO ENSURE PROPER ATTACHMENT.

12. SILT FENCE FABRIC SHALL MEET THE FOLLOWING MANDATORY REQUIREMENTS:

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>TEST METHOD</th>
<th>MANDATORY REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAB TENSION STRENGTH</td>
<td>ASTM D 4632</td>
<td>≥ 124 LBS</td>
</tr>
<tr>
<td>MULLEN BURST STRENGTH</td>
<td>ASTM D 3786</td>
<td>≥ 300 PSI</td>
</tr>
<tr>
<td>PUNCTURE STRENGTH</td>
<td>ASTM D 4633</td>
<td>≥ 60 LBS</td>
</tr>
<tr>
<td>TRAPEZOID TEAR STRENGTH</td>
<td>ASTM D 4533</td>
<td>≥ 65 LBS</td>
</tr>
<tr>
<td>UV RESISTANCE</td>
<td>ASTM D 4355</td>
<td>&gt; 80% AT 500 HOURS OF UV EXPOSURE</td>
</tr>
<tr>
<td>FLOW RATE</td>
<td>ASTM D 4491</td>
<td>≥ 10 CAL/MIN/FT²</td>
</tr>
</tbody>
</table>

13. AN ORIGINAL PRODUCT SPECIFICATION SHEET FROM THE SILT FENCE MANUFACTURER SHALL BE MADE AVAILABLE AT THE REQUEST OF THE TOWN’S INSPECTOR. THE PRODUCT SPECIFICATION SHEET SHALL PROVIDE THE RESULTS FOR THE TEST METHODS ABOVE.

14. SILT FENCE JOINTS SHALL BE CONNECTED ACCORDING TO THE ATTACHED DRAWING.

15. SILT FENCE THAT IS INSTALLED BEHIND CURBS AND SIDEWALKS MUST BE DONE SO THAT NO MORE THAN A 2” GAP EXISTS BETWEEN CONCRETE AND THE SILT FENCE. EROSION CONTROL BLANKETING (ECB) BETWEEN THE GAP MAY BE REQUIRED IN INSTANCES WHERE THIS DOES NOT OCCUR.
SILT FENCE INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE SILT FENCE.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED REGULARLY.

3. SILT FENCE SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.

4. SILT FENCE SHALL BE REPLACED WHEN THERE ARE ANY SIGNS OF WEAR AND/OR DAMAGE.

5. WHEN THE SILT FENCE IS REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE SILT FENCE MAY NEED TO BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).
SEEDING AND MULCHING SHALL BE PERFORMED ACCORDING TO THE ACCOMPANYING DETAIL(S) AND TEXT. NO EXCEPTIONS SHALL BE MADE

1. SEE PLAN VIEW FOR:
   • LOCATION(S) OF SEEDING AND MULCHING
   • TYPE OF SEED MIX

2. SEED MIXES MAY CONFORM TO THE TABLE PROVIDED WITH THE SMC NOTES OR ALTERNATIVES MAY BE ALLOWED WITH PRIOR PERMISSION BY THE TOWN’S INSPECTOR.

3. SEEDING MAY BE PERFORMED YEAR ROUND ASSUMING THE SOIL IS NOT FROZEN. SEEDING DURING TIMES OF EXTREME TEMPERATURES SHOULD BE AVOIDED IF POSSIBLE.

4. AT THE BEGINNING OF THE LAND DISTURBANCE ACTIVITIES, IT IS HIGHLY RECOMMENDED THAT AN APPROPRIATE AMOUNT OF NATIVE TOPSOIL BE STRIPPED FROM THE SITE AND STOCKPILED. ALL AREAS, PRIOR TO PERMANENT SEEDING AND MULCHING, WILL LIKELY NEED TO BE COVERED WITH AN APPROPRIATE LAYER OF TOPSOIL. THIS REQUIREMENT APPLIES TO ALL AREAS WHERE NATIVE SEEDING IS SPECIFIED ON THE CBMP PLAN AND/OR LANDSCAPING PLANS.

5. IT IS STRONGLY RECOMMENDED THAT SAMPLES FROM THE STRIPPED TOPSOIL BE PROPERLY COLLECTED AND TESTED BY A QUALIFIED LABORATORY TO ENSURE ADEQUATE NUTRIENT CONTENT PRIOR TO SEEDING AND MULCHING. IF IT IS DISCOVERED THAT THE TOPSOIL IS VOID OF THE NUTRIENTS NECESSARY TO SUCCESSFULLY ESTABLISH THE REQUIRED VEGETATION, THEN THE APPROPRIATE AMENDMENTS SHALL BE ADDED.

6. ALL AREAS TO BE SEEDED AND MULCHED SHALL BE SURFACE ROUGHENED ACCORDING TO THE SURFACE ROUGHENING DETAILS AND NOTES. SURFACE ROUGHENING SHALL OCCUR AFTER PLACEMENT OF THE TOPSOIL.

7. WHEN INSTALLED WITH A DRILL SEEDER, SEED SHALL BE PLACED AT A DEPTH OF ¼ – ½ INCH. ROW SPACING SHALL BE NO MORE THAN 6-INCHES.

8. ALL AREAS INCAPABLE OF BEING DRILL SEEDED SHALL BE SURFACE ROUGHENED ACCORDING TO THE SURFACE ROUGHENING NOTES OR EFFECTIVELY ROUGHENED USING A HARRIOW OR OTHER SUCH IMPLEMENT. ALL AREAS SHALL BE UNIFORMLY HAND BROADCASTED WITH THE PROPER SEED MIX APPLIED AT TWO TIMES THE DRILL SEEDED RATE. BROADCASTED AREAS SHALL THEN BE RE-HARRIowed OR RE-RAKED USING A HARD-TIPPED RAKE TO ENSURE THAT SEEDS ARE BURIED TO AN APPROXIMATE DEPTH OF ¼ – ½ INCH.

9. AFTER SEEDING HAS BEEN COMPLETED, MULCH SHALL BE UNIFORMLY APPLIED AT A RATE OF 2 TONS/ACRE (4,000 LBS/ACRE). MULCH SHALL BE MECHANICALLY CRIMPED TO A DEPTH OF 2 INCHES USING A CRIMPER. MULCH SHALL BE HAND CRIMPED AND COVERED WITH A TACKIFIER IN AREAS WHERE MECHANICAL CRIMPING IS NOT POSSIBLE. WHEN SOILS PERMIT, ALL MULCH SHALL BE CRIMPED SUCH THAT THE INDIVIDUAL PIECES OF STRAW OR HAY FORM EXAGGERATED V-SHAPES PROTRUDING OUT OF THE GROUND SEVERAL INCHES.

10. IN CERTAIN INSTANCES, IT MAY BE NECESSARY TO APPLY A TACKIFIER IN ORDER TO HELP WITH STRAW DISPLACEMENT. TACKIFIER SHALL BE APPLIED ACCORDING TO THE MANUFACTURER’S SPECIFICATIONS.
SEEDING AND MULCHING MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE SEEDING AND MULCHING.

2. ANY SEEDED AND MULCHED AREAS THAT BECOME DAMAGED SHALL BE REPAIRED WITHIN THE TIME FRAME SPECIFIED BY THE TOWN’S INSPECTOR.

WEED MANAGEMENT

1. ALL HERBICIDES SHALL BE APPLIED BY COMMERCIAL PESTICIDE APPLICATORS LICENSED BY THE COLORADO DEPARTMENT OF AGRICULTURE AS QUALIFIED APPLICATORS. THE CONTRACTOR SHALL FURNISH DOCUMENTATION OF SUCH LICENSING PRIOR TO HERBICIDE APPLICATION.

2. HERBICIDE APPLICATION METHOD SHALL BE SUCH THAT PLANT GROWTH OUTSIDE THE DESIGNATED TREATMENT AREAS WILL NOT BE DAMAGED. ALL DAMAGE CAUSED BY IMPROPER HERBICIDE APPLICATION SHALL BE REPAIRED AT THE CONTRACTOR’S EXPENSE.

3. HERBICIDES SHALL BE APPLIED DURING THE APPROPRIATE SEASONS, WHEN TARGET PLANTS ARE ACTIVELY GROWING.

4. AFTER THE GRASS SEED IS ESTABLISHED, APPROPRIATE HERBICIDES SHALL BE APPLIED TO CONTROL THE REMAINING WEEDS TO ENSURE A TIMELY RETURN OF THE FINANCIAL SECURITY. PROPER TIMING OF HERBICIDE APPLICATIONS ARE NECESSARY TO ACHIEVE THE SUPPRESSION OF WEED SEED PRODUCTION AND DEPLETION OF WEED ROOT MASS. ULTIMATELY, THE HERBICIDES USED SHALL BE BASED UPON THE TARGET WEEDS.

5. HERBICIDE TREATMENTS SHALL CONTINUE AT AN APPROPRIATE RATE UNTIL IT IS EVIDENT THAT WEED GROWTH PRESENCE AND GROWTH IS MINIMAL AND MAY BE CONTROLLED THROUGH MOWING AND/OR ANNUAL HERBICIDE TREATMENT.
TOWN OF PARKER, SEED MIX 1
20% CANADA WILDRYE
15% CRESTED WHEATGRASS
15% SLENDER WHEATGRASS
10% ANNUAL RYEGRASS
10% SHEEP FESCUE
10% BIG BLUESTEM
10% SIDEOATS GRAMA
 5% CANADA BLUEGRASS
 5% BLUE GRAMA

SEEDING RATE:
DRILLED: 25 LBS/acre
BROADCAST: 50 LBS/acre

TOWN OF PARKER, SEED MIX 2
22% SLENDER WHEATGRASS
18% SODAR STREAMBANK WHEATGRASS
13% ARIZONA FESCUE
13% BLUE GRAMA
12% BUFFALOGRASS
12% BARLEY OR OATS
 5% SPIKE MUHLY
 5% INDIAN RICEGRASS

SEEDING RATE:
DRILLED: 25 LBS/acre
BROADCAST: 50 LBS/acre

TOWN OF PARKER, SEED MIX 3 (LOW-GROWTH MIX)
25% EPHRAIM CRESTED WHEATGRASS
23% SHEEP FESCUE
18% PERENNIAL RYEGRASS
13% CANADA BLUEGRASS
12% BARLEY OR OATS
 9% BLUE FESCUE

SEEDING RATE:
DRILLED: 25 LBS/acre
BROADCAST: 50 LBS/acre

SEED MIX 4:
OTHER SEED MIXES APPROVED BY THE TOWN OF PARKER
FURROWS APPROX. 2" TO 4" DEEP ON APPROX. 6"
CENTERS WITH 6" MAXIMUM SPACING PARALLEL
TO CONTOURS OF SLOPE

STEEP SLOPES (4:1 OR STEEPER)
(SLOPES STEEPER THEN 4:1 MAY BE SURFACE ROUGHENED
IF THE CONTRACTOR FEELS THAT IT IS SAFE TO DO SO)

ROUGHENED ROWS SHALL BE A MINIMUM OF 6 INCHES
DEEP ON A MAXIMUM OF 12-INCH CENTERS.
SURFACE ROUGHENING IS REQUIRED ON ALL DISTURBED SOIL
THAT HAS BEEN EXPOSED AND WHERE LEGITIMATE CONSTRUCTION
ACTIVITIES HAVE NOT OCCURRED FOR 15 DAYS OR MORE.

LESSER SLOPES (4:1 OR LESS)

SURFACE ROUGHING
SURFACE ROUGHENING INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF SURFACE ROUGHENING.

2. DISTURBED AREAS THAT REMAIN INACTIVE FOR 15 DAYS OR MORE MUST RECEIVE SURFACE ROUGHENING OR ANOTHER APPROVED BMP FROM THE SDECM. DETERMINATION OF JOB SITE INACTIVITY IS AT THE DISCRETION OF THE TOWN’S INSPECTOR.

3. FOR STEEP SLOPES (3:1 OR STEEPER), IT IS ACCEPTABLE TO "TRACK" THE SLOPES, ACCORDING TO THE CBMP DETAILS.

4. SCHEDULES FOR REQUIRING STABILIZATION MAY BE MODIFIED BY THE PERMITTEE TO ALLOW FOR SPECIAL CONSIDERATIONS SUCH AS STABILIZING ACCESS AREAS AND AREAS IN CLOSE PROXIMITY TO CONTINUING CONSTRUCTION.

SURFACE ROUGHENING INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL PROACTIVELY INSPECT THE SURFACE ROUGHENING.
STABILIZED STAGING AREA INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION OF STAGING AREA. CONTRACTOR MAY MODIFY LOCATION AND SIZE OF STABILIZED STAGING AREA WITH TOWN APPROVAL.

2. STABILIZED STAGING AREA SHALL BE LARGE ENOUGH TO FULLY CONTAIN PARKING, STORAGE, AND LOADING OPERATIONS.

3. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM OF 3” DIAMETER OF ANGULAR ROCK (GRANITE OR RECYCLED CONCRETE).

4. SSA FOR SMALLER SITES MAY NOT BE PRACTICAL. IN THESE AND SIMILAR SITUATIONS, VARIANCES MAY BE PERMITTED BY THE TOWN.

STABILIZED STAGING AREA INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE STAGING AREA.

2. STABILIZED STAGING AREA SHALL BE ENLARGED AS NECESSARY TO CONTAIN PARKING, STORAGE, LOADING, AND UNLOADING.
WHEN APPLICABLE, INSTALL MUTCD APPROVED SIGN TO INDICATE THAT THE SIDEWALK IS CLOSED.

10' MIN (TYP.)

SILO FENCE (TYP.)
SEE DETAIL SF

10.0' MIN
SEE DETAIL RS

ROCK SOCK (TYP.)
CONSTRUCTION FENCE (TYP.)
SEE DETAIL CF

 WHEN APPLICABLE, INSTALL MUTCD APPROVED SIGN TO INDICATE THAT THE SIDEWALK IS CLOSED.

NOTE:
SEDIMENT CONTROL LOCS (SCL) MAY BE USED IN LIEU OF SILO FENCE (SF) WITH PRIOR APPROVAL FROM TOWN.

SIDEWALK TRANSITION PROTECTION (AT INTERSECTION)
SIDEWALK TRANSITION PROTECTION  
(ALONG STRAIGHT ROADWAY)

NOTE: SEDIMENT CONTROL LOGS (SCL) MAY BE USED IN LIEU OF SILT FENCE (SF) WITH PRIOR APPROVAL FROM TOWN.

CONSTRUCTION BEST MANAGEMENT PRACTICES
SIDEWALK TRANSITION PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION(S) OF SIDEWALK TRANSITION PROTECTION.

2. ROCK SOCK SHALL BE CONSTRUCTED ACCORDING TO THE DETAIL (SEE DETAIL RS).

3. SILT FENCE SHALL BE CONSTRUCTED ACCORDING TO THE DETAIL (SEE DETAIL SF).

4. CONSTRUCTION FENCE SHALL BE CONSTRUCTED ACCORDING TO THE DETAIL (SEE DETAIL CF).

5. SEDIMENT CONTROL LOGS MAY BE USED IS LIEU OF SILT FENCE WITH PRIOR APPROVAL FROM THE TOWN.

SIDEWALK TRANSITION PROTECTION INSPECTION & MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE SIDEWALK TRANSITION INSPECTION.
INFLOWS TO SEDIMENT BASIN SHALL ENTER VIA RIPRAP LINED CHANNEL

RELATIVE ELEVATION, TYP.

CHECK DAM SEE DETAIL CD

BOTTOM LENGTH IS 2 TIMES WIDTH

ECB AND SMC MAY NEED TO BE INSTALLED ON ALL SLOPES THAT ARE 4:1 OR STEEPER

SIZING OF TSB SHALL BE IN ACCORDANCE WITH UDFCD VOLUME 3, AS AMENDED.

PLAN VIEW

TEMPORARY SEDIMENT BASIN
DIMENSIONS FOR SPILLWAY WIDTH AND RISER PIPE HOLES SHALL BE IN ACCORDANCE WITH UDFCD VOLUME 3, AS AMENDED.

SECTION A

SECTION C

SECTION B

TEMPORARY SEDIMENT BASIN
TEMPORARY SEDIMENT BASIN INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF SEDIMENT BASIN(S).

2. THE TEMPORARY SEDIMENT BASIN(S) SHALL BE INSTALLED AND FUNCTIONING PRIOR TO ANY OTHER GRADING ACTIVITIES.

3. THE EXACT DIMENSIONS AND DETAILS OF THE TEMPORARY SEDIMENT BASIN SHALL BE DETERMINED BY THE DESIGN ENGINEER, IN ACCORDANCE WITH UDFCD VOLUME 3, AS AMENDED.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3” AND SHALL HAVE A MINIMUM OF 15% BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO A MINIMUM OF 95% DENSITY, AND WITHIN +/- 2% OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698.

6. AN APPROPRIATELY SIZED DEWATERING BAG SHALL BE SECURED TO THE END OF THE DISCHARGE PIPE. THE DEWATERING BAG SHALL BE REPLACED ONCE SEDIMENT ACCUMULATION REACHES 50%.

TEMPORARY SEDIMENT BASIN INSPECTION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE TEMPORARY SEDIMENT BASIN.

2. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN THE SEDIMENT REACHES A DEPTH OF 2.0’, OR WITHIN 2.0’ OF THE SPILLWAY CREST, OR AS OTHERWISE DIRECTED BY THE TOWN’S INSPECTOR.

3. SEDIMENT BASINS SHALL REMAIN IN PLACE AND PROPERLY MAINTAINED UNTIL UPSTREAM VEGETATIVE COVER HAS REACHED A CONSISTENT DENSITY OF AT LEAST 70% OF FULL VEGETATIVE COVER AND EROSION AND SEDIMENTATION IS NO LONGER A POSSIBILITY AS DETERMINED BY THE TOWN’S INSPECTOR.
ON SITES LESS THAN 10 ACRES AND WHERE SIGNIFICANT
SOIL IMPORTING/EXPORTING IS NOT OCCURRING,
CONSTRUCTION FENCE (CF) OR SILT FENCE (SF) MAY
BE USED IN LIEU OF THE TYPE 4 JERSEY BARRIERS
WITH PRIOR APPROVAL FROM THE TOWN’S INSPECTOR.

3”-6” CRUSHED GRANITE
INSTALLED OVER
1. TENSAR®BX1100 GEOPRINT®
2. MIRAFI®BASGRID II®
3. APPROVED OTHER

TYPE 4 JERSEY BARRIERS
OR EQUIVALENT (TYPICAL)

CONSTRUCTION OR SILT
FENCE SEE DETAIL CF
OR SF REFER TO
CBMP PLANS

STREET

EDGE OF
GUTTER/ROADWAY

CURB FACE

60.0’
MIN

VTC

VEHICLE TRACKING CONTROL

CBMP

CONSTRUCTION BEST MANAGEMENT PRACTICES

Town of Parker, Colorado

1 of 3
Oct. 2013
SECTION A

VTC PAD TO MATCH TOP BACK OF CURB
9" MIN

3"-6" CRUSHED GRANITE

6" MIN

1. TENSAR® BX1100 GEOGRID®
2. MIRAFI® BASXGRID II®
3. APPROVED OTHER

SECTION B

VTC SHALL EXTEND TO BARRIERS OR SILT FENCE/CONSTRUCTION FENCE

TYPE 4 JERSEY BARRIER OR EQUIVALENT (TYPICAL)

3"-6" CRUSHED GRANITE

1. TENSAR® BX1100 GEOGRID®
2. MIRAFI® BASXGRID II®
3. APPROVED OTHER

VEHICLE TRACKING CONTROL
VEHICLE TRACKING CONTROL PAD INSTALLATION NOTES

1. SEE CBMP PLAN FOR LOCATION(S) OF VEHICLE TRACKING CONTROL PAD(S).

2. ALL CONSTRUCTION TRAFFIC MUST ENTER AND EXIT THE SITE THROUGH THE APPROVED ACCESS POINT(S). A VEHICLE TRACKING CONTROL PAD IS REQUIRED AT ALL APPROVED ACCESS POINTS TO THE SITE. EXCEPTIONS MAY BE CONSIDERED FOR CONSTRUCTION ACTIVITY OCCURRING IMMEDIATELY ADJACENT TO PAVED AREAS AND WHERE ALTERNATIVE BMP’S ARE IMPLEMENTED. SUCH ACTIVITY MAY INCLUDE, BUT NOT BE LIMITED TO RESIDENTIAL CONSTRUCTION, UTILITY CONSTRUCTION, ETC.

3. THE VEHICLE TRACKING CONTROL PAD(S) INDICATED ON CBMP PLAN SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

4. VEHICLE TRACKING CONTROL PADS SHALL BE A MINIMUM OF 50–FEET LONG AND 10–FEET WIDE, UNLESS A VARIANCE HAS BEEN GRANTED BY THE TOWN’S INSPECTOR.


6. CRUSHED ROCK SHALL BE A MINIMUM OF 3–6” GRANITE WITH A FRACTURED FACE (ALL SIDES).

VEHICLE TRACKING CONTROL PAD INSTALLATION AND MAINTENANCE NOTES

1. THE EROSION CONTROL SUPERVISOR SHALL REGULARLY INSPECT THE VEHICLE TRACKING CONTROL PAD.

2. WHEN THE VEHICLE TRACKING CONTROL PAD IS REMOVED, ANY DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE VEHICLE TRACKING CONTROL PAD SHALL BE ROUGHENED, SEEDED, MULCHED, AND CRIMPED PER THE TOWN’S SPECIFICATIONS (SEE DETAIL SMC).

3. THE VEHICLE TRACKING CONTROL PAD SHALL BE MAINTAINED SUCH THAT THE ROCK REMAINS RELATIVELY LOOSE AND ACCUMULATED MUD AND OTHER DEBRIS IS REGULARLY REMOVED.
APPENDIX D

CBMP PLAN CHECKLIST
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROVIDED (Engineer)</th>
<th>N/A</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
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<tr>
<td>Title Block (Along Right Edge of Each Sheet)</td>
<td>□</td>
<td>□</td>
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</tr>
<tr>
<td>- Project Name (Legal Name: Subdivision, Filing, Block, Lot, etc.)</td>
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<tr>
<td>- Engineer Seal &amp; Signature</td>
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<tr>
<td>- Engineering Company (Name, Address, Phone)</td>
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<tr>
<td>- Date (Include Revision Dates For Resubmittals Until Mylar)</td>
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<tr>
<td>- Sheet Description &amp; Number</td>
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<tr>
<td>North Arrow</td>
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<tr>
<td>Scale</td>
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<tr>
<td>Town of Parker Review Block</td>
<td>□</td>
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<tr>
<td>Key Map</td>
<td>□</td>
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<tr>
<td>Legend of Symbols (To correspond to Town all 27 CBMP Notes &amp; Details)</td>
<td>□</td>
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<tr>
<td>Existing Contours</td>
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<tr>
<td>Grading Contours (Shadowed)</td>
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<tr>
<td>Omit all existing and proposed utilities except for those relating to stormwater</td>
<td>□</td>
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<tr>
<td>Include the notes and details associated with all 27 CBMPs in the plan set</td>
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<tr>
<td>Do not add any additional notes to the plan set unless they are from the Town</td>
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<tr>
<td>Use arrows to indicate the direction of flow</td>
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<tr>
<td>Show the ratio of all slopes that are 4:1 or greater (Ex. 4:1, 3.5:1, 3:1)</td>
<td>□</td>
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<tr>
<td>Add a note on all land adjacent to the project stating that no work shall occur in these areas</td>
<td>□</td>
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<tr>
<td>Label wetland and habitat protection areas, jurisdictional status and other &quot;Waters of the U.S.&quot;</td>
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<tr>
<td>Add the following note to each plan sheet: To reduce the potential for clogging of debris grates, no straw mulch shall be used within the Excess Urban Runoff Volume of a detention basin. Instead, erosion control blanket shall be installed for a width of at least 6-feet on both sides of the concrete low flow channels or up to a depth of 1-foot in soil riprap or benched low flow channels. Additionally, hydraulically-applied wood fiber mulch, stabilized fiber matrix, bonded fiber matrix, or flexible growth medium shall be used in all other areas within the Excess Urban Runoff Volume of the detention basin. The blanket and hydraulically-applied mulch shall comply with the materials and installation requirements for erosion control blankets as required by the Town’s CBMP program, and where applicable, the product manufacturer. “</td>
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<tr>
<td>DESCRIPTION</td>
<td>PROVIDED (Engineer)</td>
<td>N/A</td>
<td>COMMENTS</td>
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<tr>
<td>Check Dam (CD)</td>
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<tr>
<td>- Medium to high flow drainageways</td>
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<tr>
<td>- Spaced in accordance with the detail</td>
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<tr>
<td>Construction Fence (CF)</td>
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<tr>
<td>- May be used in lieu of silt fence when up-gradient of all disturbed soil</td>
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<tr>
<td>Culvert Protection (CP)</td>
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<tr>
<td>- In front of all culvert inlets</td>
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<tr>
<td>- Not to be used on the down-gradient side of any culverts</td>
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<tr>
<td>Concrete Washout Area (CWA)</td>
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<tr>
<td>- A minimum of 1 CWA is needed on each site</td>
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<tr>
<td>- A VTC pad shall be shown with the CWA if immediately adjacent to an impervious areas</td>
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<tr>
<td>- Add a note stating that the VTC pad for a CWA does not need to the formal VTC detail</td>
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<tr>
<td>- Add a note stating that the true location of the CWA may be determined by the Town and ECS</td>
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<tr>
<td>Debris and Trash Control (DTC)</td>
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<tr>
<td>- Show on proposed and existing streets, roadways, parking lots, drive aisles, etc.</td>
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<tr>
<td>Diversion Ditch (DD)</td>
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<tr>
<td>- Show on all sites 5 acres or larger or where steep topography exists on sites &lt; 5 acres</td>
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<tr>
<td>- Show adjacent to site disturbance limits and connecting to TSBs.</td>
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<tr>
<td>- Show on the inside of the perimeter silt fence</td>
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<tr>
<td>Detention Pond Protection (DP)</td>
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<tr>
<td>- Show on all applicable detention ponds directly impacted by the project</td>
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<tr>
<td>Erosion Control Blankets (ECB)</td>
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<tr>
<td>- Show on all permanent slopes steeper than 4:1.</td>
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<tr>
<td>- Show on both sides of all trickle channels in detention ponds</td>
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<tr>
<td>Inlet Protection for Area Inlets in Pavement (IPAP)</td>
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<tr>
<td>- Show on all proposed and existing area inlets surrounded by an impervious surface</td>
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<tr>
<td>Inlet Protection for Area Inlets Not in Pavement (IPAN)</td>
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<tr>
<td>- Show on all proposed and existing area inlets within landscaped and native areas</td>
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<tr>
<td>Inlet Protection, Curb On-Grade, Type R Inlet (PCOG)</td>
<td></td>
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</tbody>
</table>

Town of Parker  CBMP Plan Checklist  Revised October 2013  Page 2 of 5
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROVIDED</th>
<th>N/A</th>
<th>COMMENTS</th>
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</thead>
<tbody>
<tr>
<td>- Show 5-feet up-gradient of all applicable type R inlets that are on a gradient</td>
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<tr>
<td>- Do not use the IPCOS illustration for IPCOG as this may confuse the installer</td>
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<tr>
<td>- Use IPCOG for Type R inlets in a sump on all roads above a residential-local</td>
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<tr>
<td>- When used on inlets in a sump, show the rock sock on both sides of the inlet</td>
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<tr>
<td>- Do not show IPCOG or sock socks (RS) anywhere else on site unless directed by the Town</td>
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<tr>
<td><strong>Inlet Protection, Curb On-Sump, Type R Inlet (IPCOS)</strong></td>
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<tr>
<td>- Show only on type R inlets that are in a true sump (the lowest point of the roadway)</td>
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<tr>
<td>- Show only on a maximum of residential-local streets (nothing larger, see IPCOG)</td>
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<tr>
<td><strong>Lot Protection (LP)</strong></td>
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<tr>
<td>- Add a note stating that LP is required on all residential lots prior to issuance of a certificate of occupancy.</td>
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<tr>
<td>- Add a note stating that LP is required on commercial lots when landscaping is not possible</td>
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<tr>
<td><strong>Masonry Work Protection (MWP)</strong></td>
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<tr>
<td>- Show MWP in a minimum of 2 locations on the plan</td>
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<tr>
<td><strong>Portable Toilet Protection (PTP)</strong></td>
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<tr>
<td>- Show several PTPs in one centralized location on the plan, such as at the SSA</td>
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<tr>
<td>- Show PTP a minimum of 10-feet from any impervious area (street, sidewalk, etc.)</td>
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<tr>
<td>- Add a note stating that the true location of the PTP may be determined by the Town and ECS</td>
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<tr>
<td><strong>Rough Cut Street Control (RCSC)</strong></td>
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<tr>
<td>- Show on roadways where topography and length could cause erosion issues during const.</td>
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<tr>
<td><strong>Sediment Control Logs (SCL)</strong></td>
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<tr>
<td>- Show in lieu of silt fence where desired</td>
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<tr>
<td>- Show immediately behind the back of curb or sidewalk depending on sidewalk layout</td>
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<tr>
<td>- Use only down-gradient of small disturbance areas</td>
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<tr>
<td>- Show the SCL diameter that is being proposed. A min. of 12-inches will be likely</td>
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<tr>
<td>- Show immediately behind the back of curb on tree lawns slated for formal landscaping</td>
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<tr>
<td>- Show around the perimeter of all proposed landscape islands and other similar areas</td>
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<tr>
<td><strong>Silt Fence (SF)</strong></td>
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<tr>
<td>- Show around the entire perimeter of the project, except for where CF is feasible</td>
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<tr>
<td>- Show around subdivision blocks; immediately behind the back of curb and tie into VTCs</td>
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<tr>
<td>DESCRIPTION</td>
<td>PROVIDED (Engineer)</td>
<td>N/A</td>
<td>COMMENTS</td>
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<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>- Add note, &quot;If SF is not installed on the back of curb, ECB may be necessary in the gap.&quot;</td>
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<tr>
<td>- Connect SF and CF around the project limits to completely contain the site</td>
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<tr>
<td>- Include off-site utility connections in the site containment</td>
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<tr>
<td>- May not be necessary where adjacent grades slope steeply inwards</td>
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<tr>
<td>- Do not show any soil disturbance outside of the SF area unless other BMPs are shown</td>
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<tr>
<td>- Show staking at 5-foot intervals in areas of steeper terrain and larger up-gradient basins</td>
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<tr>
<td>- On residential plans, show on lots that drain into ponds, swales, open tracts, etc.</td>
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<tr>
<td>Seeding, Mulching, and Crimping (SMC)</td>
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<tr>
<td>- Show on all proposed subdivision blocks, detention ponds, drainageways, parks, etc.</td>
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<tr>
<td>Surface Roughening (SR)</td>
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<tr>
<td>- Show in various pervious areas of the site, including slopes</td>
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<tr>
<td>- On residential plans, show on each subdivision block</td>
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<tr>
<td>Stabilized Staging Area (SSA)</td>
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<tr>
<td>- Show at minimum of 1 SSA on site and connected to a main VTC pad when feasible</td>
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<tr>
<td>Sidewalk Transition Protection (STP)</td>
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<tr>
<td>- Show the SF and RS placement at each ADA ramp that is within the disturbance area</td>
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<tr>
<td>Temporary Irrigation (TI)</td>
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<tr>
<td>- Show in all areas of permanent native vegetation (detention ponds, swales, tracts, etc.)</td>
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<tr>
<td>- Coordinate with the landscape architect to ensure that TI is also shown on landscape plan</td>
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<tr>
<td>Temporary Sediment Basin (TSB)</td>
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<tr>
<td>- Required on sites that are 5 acres or larger</td>
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<tr>
<td>- Sized in accordance to UDFCD Vol. 3 as amended</td>
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<tr>
<td>- Shown at the collective low-point(s) of the site</td>
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<tr>
<td>- Multiple TSBs may be necessary on large sites with varied topography</td>
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<tr>
<td>- Connected to Diversion Ditches (See DD)</td>
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<tr>
<td>- Shown with a dewatering bag at the discharge point of the drain pipe</td>
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<tr>
<td>- Clearly show the proper sizing of the riser pipe on the plan sheet</td>
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<tr>
<td>Vehicle Tracking Control (VTC) pad</td>
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<tr>
<td>- Required at desired access points into/out of the site</td>
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</tr>
<tr>
<td>DESCRIPTION</td>
<td>PROVIDED (Engineer)</td>
<td>N/A</td>
<td>COMMENTS</td>
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<tr>
<td>Jersey barriers or an equivalent must be shown at all other access points</td>
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<tr>
<td>Required inside of the site where access will occur from pervious to impervious areas</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>On residential plans, show a min. of 1 VTC on each subdivision block</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Show the VTC width to encompass the entire opening of the access point</td>
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APPENDIX E

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APPENDIX F

STORM DRAINAGE INFRASTRUCTURE NOTES
STORM DRAINAGE INFRASTRUCTURE NOTES

1. All storm drainage improvements are subject to compliance with the Colorado Department of Transportation (CDOT) current edition of the Standard Specifications for Road and Bridge Construction, M & S Standards, and all standard special provisions currently used by CDOT, with the modifications set forth in the Town of Parker’s Storm Drainage and Environmental Criteria Manual (SDECM), as amended.

2. The contractor shall comply with the “Colorado Water Quality Control Act” (Title 25, Article 8 CRS), the “Protection of Fishing Streams” Title 33, Article 5, CRS), the “Clean Water Act” (33 USC 1344), Cherry Creek Reservoir Control Regulation No. 72” (5 CCR 1002-72), the regulation promulgated, certification or permits issues, and the requirements presented in the SDECM Revision to Section 107 and the Construction BMP Plan. In the event of conflicts between these requirements and water quality control laws, rules, or regulations of other Federal, or State agencies, the more restrictive laws, rules, or regulations shall apply.

3. Inspections: Construction shall not begin until a grading permit has been issued for the project. The contractor shall notify the Town of Parker Engineering Department (Public Works) to schedule inspections a minimum of 48 hours prior the construction of all drainage infrastructure (storm sewers, inlets, manholes, energy dissipaters, riprap, grouted boulders, detention pond outlet structures, forebays, trickle channels, etc). Failure to notify the engineering department for inspections may result in non-acceptance of the infrastructure by the Town. Urban Drainage and Flood Control District must also be notified in a similar manner for all maintenance eligible drainage infrastructures (consult with Stormwater Engineering Division).

4. Structural backfill (CDOT Class 1) shall be compacted to conform to CDOT Standard Specification 203.03. Structural backfill (CDOT Class 2) shall conform to CDOT Standard Specification 203.07. At the contractor’s option, Structural Backfill (Squeegee) meeting the gradation requirements contained in Revision of Section 206 of the CDOT Standard Specifications as presented in the SDECM, may be substituted for Structure backfill (Class 1 or Class 2) for backfilling of culvert pipes, storm sewer pipes, manholes and inlet structures; however, the top 2 feet below subgrade elevation shall be the required embankment material.

5. All excavations shall meet OSHA requirements.

6. Testing: Probationary acceptance of storm drainage improvements will be contingent upon satisfactory testing results. In all cases where tests indicate compaction less than that required by Town specifications, additional compaction and tests will be required until the specifications are met. Frequency of testing will be as follows:

   - 1 test for subgrade and 1 test for backfill at every above ground appurtenance (manholes, inlets, etc)
   - 1 test every 200 LF of mainline trench every 1 foot of backfill lift and within 1 foot from all structures.

7. Allowable storm sewer conduit material within the Town of Parker shall be limited to Reinforced Concrete Pipe (RCP) conforming to CDOT Standard Specification 706.02.

8. All RCP joints shall be manufactured in accordance with ASTM C443. Rubber gaskets shall be used on all pipe joints conforming to ASTM C443. All RCP sections shall be joined in such a
manner that the ends are fully entered and the inner surfaces are reasonable flush. Average joint gap that exceeds \( \frac{1}{2} \) inch shall be filled with an approved flexible plastic sealant.


11. CDOT Class D concrete shall be used for all concrete drainage structures.

12. Pre-cast inlets and manhole bases shall not be used within the Town of Parker Right-of-way, with the exception of CDOT Type C and D inlets.

13. Two- (2) manhole access points are required on all Type "R" curb inlets greater than or equal to ten (10) feet in length as presented in CDOT M&S Standard Plan No. M-604-12.

14. All grouting (boulders, riprap) shall be in accordance with the Revision of Section 506 of the CDOT Standard Specifications as presented in the SDECM.

15. All boulders and riprap shall be selected and placed in accordance with the Revision of Section 506 of the CDOT Standard Specifications as presented in the SDECM.

16. Contractor shall refer to the Town of Parker’s Construction Best Management Practices details and notes for all requirements relating to re-vegetation, sediment and erosion control requirements for construction activities.

17. Pipe bells shall not be cast into manhole bases or inlets.
APPENDIX G

SAMPLE OPERATION AND MAINTENANCE (O&M) PLANS, CHECKLISTS AND STANDARD OPERATING PROCEDURES (SOP’s) FOR PERMANENT BEST MANAGEMENT PRACTICES (PBMP’s)
Overall Facilities Map

- O&M Site Plan, Stormwater Facilities Map, Checklist (1 page)
- Sample Stormwater Facilities Map for Commercial Site (1 page)
- Sample Stormwater Facilities Map for Residential Site (1 page)
OPERATION AND MAINTENANCE SITE PLANS
STORMWATER FACILITIES MAP
CHECKLIST FOR REQUIRED ITEMS

Stormwater facilities map shall include:

☐ Labels for all streets (includes linework for edge of street and street name)
☐ Linework for right-of-way lines, lot lines, and tracts
☐ Linework and labels for all major drainageways
☐ Label roadways, developments, etc adjacent to project site
☐ Labels for all BMPs being constructed on project site including a summary table when multiple BMPs are present
☐ Legend for identifying features/linetypes on drawing (optional)
SUMMARY OF BMP'S ON SITE:
EXTENDED DETENTION BASIN A
POROUS LANDSCAPE DETENTION
GRASS BUFFERS
GRASS SWALES
SUMMARY OF BMP'S ON SITE:
- Extended Detention Basin A
- Extended Detention Basin B
- Extended Detention Basin C
- Extended Detention Basin D
- Open Space Swale
- Roadside Swale
Extended Detention Basin (EDB)

- O&M Site Plans, EDB, Checklist (2 pages)
- Sample EDB O&M Plan (Plan and Profile) (1 page)
- Sample EDB O&M Plan (Details) (1 page)
- SOP’s for EDB Inspection and Maintenance (18 pages)
OPERATION AND MAINTENANCE SITE PLANS
EXTENDED DETENTION BASIN (EDB)
CHECKLIST FOR REQUIRED ITEMS

PLAN AND PROFILE SHEET
Plan view shall include:

☐ Location and labels for all major features of EDB (inflow structure(s), forebay, micropool, trickle channel, access road, outlet work(s), spillway, maintenance access ramps, embankment, etc.)
☐ Contours
☐ Other utilities in vicinity of EDB
☐ Cross-reference to EDB Operation and Maintenance Details sheet
☐ Linework for right-of-way lines, lot lines, easements, and tracts
☐ Hatch indicating permanent water elevation in micropool.

Profile view shall include:

☐ Location and labels for all major features of EDB (inflow structure(s), forebay, micropool, trickle channel, access road, outlet work(s), spillway, maintenance access ramps, embankment, etc.)
☐ Invert elevations at major features of EDB (inflow structure(s), forebay, micropool, outlet work(s))
☐ Permanent pool elevation of micropool
☐ Water quality water surface elevation
☐ Water surface elevation of all applicable storm events
☐ Label for upper and bottom stages for EDB

DETAIL SHEET
Detail sheet shall include:

☐ Volume provided by the EDB forebay and micropool, including the WQCV
☐ WQCV drain time
☐ Seed mix
☐ Total mow area including approximate mow boundaries on each side of EDB
☐ Duplicate the following tables from the “Standard Operation Procedure for Extended Detention Basin Inspection and Maintenance” document:
  ☐ Inspection and Maintenance Requirements at Specific EDB Features
  ☐ Summary of Routine Maintenance Activities for an EDB
  ☐ Summary of Minor Maintenance Activities for an EDB
  ☐ Summary of Major Maintenance Activities for an EDB
- Water quality outlet works detail
- Water quality plate detail
- Maintenance access road detail
- Trickle channel typical section
- Forebay edge detail (or cross section) which includes maximum allowed sediment depth in forebay
- Forebay release structure detail
- Spillway detail(s), including cutoff wall
5715

Existing Wetlands (Typ.)

POND SPILLWAY

SPILLWAY CUTOFF WALL

NATIVE GRASS SURFACE TREATMENT.

MAINTENANCE ACCESS ROAD

TRICKLE CHANNEL

WATER QUALITY OUTLET WORKS

FOREBAY CUTOFF WALL/RELEASE STRUCTURE

MAINTENANCE RAMPS/PADS

INFLOW STRUCTURE

CONCRETE FOREBAY

POND EMBANKMENT

MICROPOOL

ENERGY DISSIPATOR

WATER QUALITY OUTLET WORKS

FOREBAY EMBANKMENT

24" RCP @ 1.0%

LOWER STAGE

STAGE 11+00

UPPER STAGE

10+00 11+00 12+00 13+00 14+00 15+00 16+00

90" RCP

100-YEAR WATER QUALITY POND

WSE = 5711.80

BOTTOM OF TRICKLE CHANNEL

IC = 5709.00

10-YEAR WATER QUALITY POND

WSE = 5717.00

66" RCP @ 1.0%

POND EMBANKMENT

MICROPOOL

PERMANENT WATER SURFACE

ENERGY DISSIPATOR

WATER QUALITY POND

WSE = 5715.95

16'

Existing Sanitary Sewer

100-YEAR WATER QUALITY POND

WSE = 5719.00

10-YEAR WATER QUALITY POND

WSE = 5717.00

POND EMBANKMENT

66" RCP

POND EMBANKMENT

24" RCP

POND EMBANKMENT

66" RCP

SEE THE EXTENDED DETENTION BASIN OPERATION AND MAINTENANCE DETAILS FOR MORE INFORMATION.
Standard Operation Procedures (SOP) For
Extended Detention Basin (EDB)
Inspection and Maintenance

March 2012
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# ACRONYMS

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<td>Clean Water Act</td>
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<td>Extended Detention Basin</td>
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EDB-1 BACKGROUND
Extended Detention Basins (EDBs) are one of the most common types of Stormwater Management Facilities utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to "extend" the runoff detention time, but to drain completely dry sometime after stormwater runoff ends. The EDB’s drain time for the water quality portion of the facility is typically 40 hours. The basins are considered to be “dry” because the majority of the basin is designed not to have a significant permanent pool of water remaining between runoff events.

EDBs are an adaptation of a detention basin used for flood control, with the primary difference being the addition of forebays, micropools, and a slow release outlet design. Forebays are shallow concrete “pans” located at the inflow point to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. These forebays collect and briefly hold stormwater runoff resulting in a process called sedimentation, dropping sediment out of the stormwater. The stormwater is then routed from the forebay into the concrete trickle channel and upper basin, the large grassy portion of the basin. The EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. An EDB should have a small micropool just upstream of the outlet. This micropool is designed to hold a small amount of water to keep sediment and floatables from blocking the outlet orifices.

EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)
EDB-2.1 ACCESS AND EASEMENTS
Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the location(s) of the access points and maintenance easements of the EDB(s) within this development.

EDB-2.2 STORMWATER MANAGEMENT FACILITIES LOCATIONS
Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the location(s) of the EDB(s) within this development.

EDB-2.3 EXTENDED DETENTION BASIN (EDB) FEATURES
EDBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. For example, if a forebay is not properly maintained, it could negatively affect the performance of a feature downstream (trickle channel, micropool, etc.). Therefore, it is critical that each feature of the EDB is properly inspected and maintained to ensure that the overall facility functions as it was intended. Below is a list and description of the most common features within an EDB and the corresponding maintenance inspection items that can be anticipated:
TABLE EDB-1  
TYPICAL INSPECTION & MAINTENANCE REQUIREMENTS MATRIX

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<th>Mowing/Weed control</th>
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<th>Erosion</th>
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</tr>
<tr>
<td>Upper Stage</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EDB-2.3.1 Inflow Points**

Inflow Points or Outfalls into EDBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the EDB. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

An energy dissipater (riprap or hard armor protection) is typically immediately downstream of the discharge point into the EDB to protect from erosion. In some cases, the storm sewer outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

The typical maintenance items that are found with inflow points are as follows:

a) *Riprap Displaced.* Many times, because the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b) *Erosion Present/Outfall Undercut.* In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

c) *Sediment Accumulation.* Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in
hydraulic performance of the upstream infrastructure, sediment that accumulates in this area must be removed in a timely manner.

d) **Structural Damage.** Structural damage can occur at any time during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

e) **Woody Growth/Weeds Present.** Undesirable vegetation can grow in and around the inflow area to an EDB that can significantly affect the performance of the drainage facilities discharging into the facility. This type of vegetation includes trees (typically cottonwoods) and dense areas of shrubs (willows). If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the discharge. Also, tree roots can cause damage to the structural components of the inflow. Routine maintenance is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree). In addition, noxious weeds growing in the facility can result in the loss of desirable native vegetation and impact adjacent open spaces/land.

**EDB-2.3.2 Forebay**

A forebay is a solid surface (pad), typically constructed of concrete, immediately downstream of the inflow point. The forebay is designed to capture larger particles and trash to prevent them from entering the main portion of the EDB. The solid surface is designed to facilitate mechanical sediment removal (skid steer). The forebay typically includes a small diameter discharge pipe or v-notch weir on the downstream end and designed to drain the forebay in a specified period of time to promote sedimentation. The forebays vary in size and depth depending on the design and site constraints.

The typical maintenance items that are found with forebays are as follows:

a) **Sediment/Debris Accumulation.** Because this feature of the EDB is designed to provide the initial sedimentation, debris and sediment frequently accumulate in this area. If the sediment and debris is not removed from the forebay on a regular basis, it can significantly affect the function of other features within the EDB. Routine sediment removal from the forebay can significantly reduce the need for dredging of the main portion of the EDB using specialized equipment (long reach excavators). Routine removal of sediment from the forebay can substantially decrease the long-term sediment removal costs of an EDB.

b) **Concrete Cracking/Failing.** The forebay is primarily constructed of concrete, which cracks, spalls, and settles. Damage to the forebay can result in deceased performance and impact maintenance efforts.

c) **Drain Pipe/Weir Clogged.** Many times the drainpipe or weir can be clogged with debris, and prevent the forebay from draining properly. If standing water is present in the forebay (and there is not a base flow), the forebay is most likely not draining properly. This can result in a decrease in performance and create potential nuisances with stagnant water (mosquitoes).
Weir/Drain Pipe Damaged. Routine maintenance activities, vandalism, or age may cause the weir or drain pipe in the forebay to become damaged. Weirs are typically constructed of concrete, which cracks and spalls. The drainpipe is typically smaller in diameter and constructed with plastic, which can fracture.

**EDB-2.3.3  Trickle Channel (Low-Flow)**

The trickle channel conveys stormwater from the forebay to the micro-pool of the EDB. The trickle channel is typically made of concrete. However, grass lined (riprap sides protected) is also common and can provide for an additional means of water quality within the EDB. The trickle channel is typically 6-9 inches in depth and can vary in width.

The typical maintenance items that are found with trickle channels are as follows:

a) **Sediment/Debris Accumulation.** Trickle channels are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Also, if a trickle channel is grass lined it can accumulate sediment and debris at a much quicker rate. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the trickle channel and affecting the dry storage portion of the pond.

b) **Concrete/Riprap Damage.** Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel. Riprap can also shift over time and must be replaced/repaired as necessary.

c) **Woody Growth/Weeds Present.** Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows) can become a problem. Trees and dense shrub type vegetation can affect the capacity of the trickle channel and can allow flows to circumvent the feature.

d) **Erosion Outside of Channel.** In larger precipitation events, the trickle channel capacity will likely be exceeded. This can result in erosion immediately adjacent to the trickle channel and must be repaired to prevent further damage to the structural components of the EDB.

**EDB-2.3.4  Bottom Stage**

The bottom stage is at least 1.0 to 2.0 feet deeper than the upper stage and is located in front of the outlet works structure. The bottom stage is designed to store the smaller runoff events, assists in keeping the majority of the basin bottom dry resulting in easier maintenance operations, and enhances the facilities pollutant removal capabilities. This area of the EDB may develop wetland vegetation.

The typical maintenance items that are found with the bottom stage are as follows:

a) **Sediment/Debris Accumulation.** The micro-pool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.
b) **Woody Growth/Weeds Present.** Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

c) **Bank Erosion.** The micro-pool is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the micro-pool if adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other EDB feature damage.

d) **Mosquitoes/Algae Treatment.** Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micro-pool may be necessary to reduce these impacts to adjacent homeowners.

e) **Petroleum/Chemical Sheen.** Many indicators of illicit discharges into the storm sewer systems will be present in the micro-pool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

**EDB-2.3.5 Micropool**

The micro-pool is a concrete or grouted boulder walled structure directly in front of the outlet works. At a minimum, the micropool is 2.5 feet deep and is designed to hold water. The micro-pool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micro-pool and prevents these sediments from being deposited in front of the outlet works causing clogging of the outlet structure, which results in marshy areas within the top and bottom stages.

The typical maintenance items that are found with micro-pools are as follows:

a) **Sediment/Debris Accumulation.** The micro-pool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

b) **Woody Growth/Weeds Present.** Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).
c) *Mosquitoes/Algae Treatment.* Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micro-pool may be necessary to reduce these impacts to adjacent homeowners.

d) *Petroleum/Chemical Sheen.* Many indicators of illicit discharges into the storm sewer systems will be present in the micro-pool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

**EDB-2.3.6 Outlet Works**

The outlet works is the feature that drains the EDB in specified quantities and periods of time. The outlet works is typically constructed of reinforced concrete into the embankment of the EDB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings (flood control) on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate (smaller diameter holes) will typically have a well screen covering it to prevent smaller materials from clogging it. The outlet structure is the single most important feature in the EDB operation. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the EDB.

The typical maintenance items that are found with the outlet works are as follows:

a) *Trash Rack/Well Screen Clogged.* Floatable material that enters the EDB will most likely make its way to the outlet structure. This material is trapped against the trash racks and well screens on the outlet structure (which is why they are there). This material must be removed on a routine basis to ensure the outlet structure drains in the specified design period.

b) *Structural Damage.* The outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel trash racks and well screens are also susceptible to damage.

c) *Orifice Plate Missing/Not Secure.* Many times residents, property owners, or maintenance personnel will remove or loosen orifice plates if they believe the pond is not draining properly. Any modification to the orifice plate(s) will significantly affect the designed discharge rates for water quality and/or flood control. Modification of the orifice plates is not allowed without approval from the Town of Parker.

d) *Manhole Access.* Access to the outlet structure is necessary to properly inspect and maintain the facility. If access is difficult or not available to inspect the structure, chances are it will be difficult to maintain as well.

e) *Woody Growth/Weeds Present.* Because of the constant moisture in the soil surrounding the outlet works, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate around the outlet works, which can cause problems with other EDB features.
Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

**EDB-2.3.7 Emergency Spillway**

An emergency spillway is typical of all EDBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor) and is sometimes buried with soil. The emergency spillway is typically a weir (notch) in the pond embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

The typical maintenance items that are found with emergency spillways are as follows:

a) **Riprap Displaced.** As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an EDB, the riprap may shift or dislodge due to flow.

b) **Erosion Present.** Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

c) **Woody Growth/Weeds Present.** Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capacity of the spillway.

d) **Obstruction Debris.** The spillway must be cleared of any obstruction (manmade or natural) to ensure the proper design capacity.

**EDB-2.3.8 Upper Stage (Dry Storage)**

The upper stage of the EDB provides the majority of the water quality flood detention volume. This area of the EDB is higher than the micro-pool and typically stays dry, except during storm events. The upper stage is the largest feature/area of the basin. Sometimes, the upper stage can be utilized for park space and other uses in larger EDBs. With proper maintenance of the micro-pool and forebay(s), the upper stage should not experience much sedimentation; however, bottom elevations should be monitored to ensure adequate volume.

The typical maintenance items that are found with upper stages are as follows:

a) **Vegetation Sparse.** The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.

b) **Woody Growth/Undesirable Vegetation.** Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary.
Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.

c) **Standing Water/Boggy Areas.** Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.

d) **Sediment Accumulation.** Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:
1. Ground adjacent to the trickle channel appears to be several inches higher than concrete/riprap
2. Standing water or boggy areas in upper stage
3. Uneven grades or mounds
4. Micropool or Forebay has excessive amounts of sediment

e) **Erosion (banks and bottom).** The bottom grades of the dry storage are typically flat enough that erosion should not occur. However, inadequate vegetative cover may result in erosion of the upper stage. Erosion that occurs in the upper stage can result in increased dredging/maintenance of the micro-pool.

f) **Trash/Debris.** Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can accumulate and clog the EDB outlet works.

g) **Maintenance Access.** Most EDBs typically have a gravel/concrete maintenance access path to either the upper stage or forebay. This access path should be inspected to ensure the surface is still drivable. Some of the smaller EDBs may not have maintenance access paths; however, the inspector should verify that access is available from adjacent properties.

**EDB-2.3.9 Miscellaneous**

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the EDB. This category on the inspection form is for maintenance items that are commonly found in the EDB, but may not be attributed to an individual feature.

a) **Encroachment in Easement Area.** Private lots/property can sometimes be located very close to the EDBs, even though they are required to be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.
b) **Graffiti/Vandalism.** Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the Town of Parker Police Department.

c) **Public Hazards.** Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately!**

d) **Burrowing Animals/Pests.** Prairie dogs and other burrowing rodents may cause damage to the EDB features and negatively affect the vegetation within the EDB.

e) **Other.** Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

**EDB-2.4 INSPECTION FORMS**

EDB Inspection forms are located in the Appendix. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. Copies of these inspections forms shall be kept indefinitely by the property owner or manager and made available to the Town of Parker upon request.

**EDB-3 MAINTAINING EXTENDED DETENTION BASINS (EDBS)**

**EDB-3.1 MAINTENANCE PERSONNEL**

Maintenance personnel must be qualified to properly maintain EDBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

**EDB-3.2 EQUIPMENT**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on an EDB:

1. Loppers/Tree Trimming Tools
2. Mowing Tractors
3. Trimmers (extra string)
4. Shovels
5. Rakes
6. All Surface Vehicle (ASVs)
7. Skid Steer
8. Back Hoe
9. Track Hoe/Long Reach Excavator
10. Dump Truck
11. Jet-Vac Machine
12. Engineers Level (laser)
13. Riprap (Minimum - Type M)
14. Filter Fabric
15. Erosion Control Blanket(s)
16. Seed Mix (Native - Foothills)
17. Illicit Discharge Cleanup Kits
18. Trash Bags
19. Tools (wrenches, screw drivers, hammers, etc)
20. Chain Saw
21. Confined Space Entry Equipment
22. Approved Stormwater Facility Operation and Maintenance Manual

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

EDB-3.3 SAFETY
Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the EDB that is greater than 48” in height, make the appropriate note/comment on the maintenance inspection form.

EDB-3.4 MAINTENANCE FORMS
The EDB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The EBD Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. The EDB Maintenance form is located in the Appendix.

EDB-3.5 MAINTENANCE CATEGORIES AND ACTIVITIES
A typical EDB Maintenance Program will consist of three broad categories of work. Within each category of work, a variety of maintenance activities can be performed on an EDB. A maintenance activity can be specific to each feature within the EDB, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for an EDB.

A variety of maintenance activities are typical of EDBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. Below is a description of each maintenance activity, the objectives, and frequency of actions:

EDB-3.6 ROUTINE MAINTENANCE ACTIVITIES
The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal
of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as includes weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the Town, however, completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance activity.

The Maintenance Activities are summarized below, and further described in the following sections.

### TABLE EDB-2
SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look For:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>Mow grass to a height of 4” to 6”</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash &amp; debris in EDB</td>
<td>Remove and dispose of trash and debris</td>
</tr>
<tr>
<td>Outlet Works Cleaning</td>
<td>As needed – after significant rain events – twice annually min.</td>
<td>Clogged outlet structure; ponding water</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Weed control</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/ herbicide or hand pull; Consult the local weed specialist</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed</td>
<td>Standing water/mosquito habitat</td>
<td>Treat w/ EPA approved chemicals</td>
</tr>
<tr>
<td>Algae Treatment</td>
<td>As needed</td>
<td>Standing water/ Algae growth/green color</td>
<td>Treat w/ EPA approved chemicals</td>
</tr>
</tbody>
</table>

**EDB-3.6.1 Mowing**
Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the EDB. Native vegetation should be mowed to a height of 4-to-6 inches tall. Grass clippings should be collected and disposed of properly.

*Frequency:* Routine - Minimum of twice annually or depending on aesthetics.

**EDB-3.6.2 Trash/Debris Removal**
Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency:* Routine – Prior to mowing operations and minimum of twice annually.

**EDB-3.6.3 Outlet Works Cleaning**
Debris and other materials can clog the outlet work’s well screen, orifice plate(s) and trash rack. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.
Frequency: Routine – After significant rainfall event or concurrently with other maintenance activities.

**EDB-3.6.4 Weed Control**

Noxious weeds and other unwanted vegetation must be treated as needed throughout the EDB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the local Weed Inspector is highly recommended prior to the use of herbicide.

Frequency: Routine – As needed based on inspections.

**EDB-3.6.5 Mosquito/Algae Treatment**

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.

Frequency: As needed.

**EDB- 3.7 MINOR MAINTENANCE ACTIVITIES**

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items require prior approval from the Town of Parker. Completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look For:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>As needed; typically every 1 – 2 years</td>
<td>Sediment build-up; decrease in pond volume</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies forming on side slopes, trickle channel, other areas</td>
<td>Repair eroded areas Revegetate; address source of erosion</td>
</tr>
<tr>
<td>Vegetation Removal/ Tree Thinning</td>
<td>As needed, based upon inspection</td>
<td>Large trees/wood vegetation in lower chamber of pond</td>
<td>Remove vegetation; restore grade and surface</td>
</tr>
<tr>
<td>Drain Cleaning/ Jet Vac</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up / non draining system</td>
<td>Clean drains; Jet Vac if needed</td>
</tr>
</tbody>
</table>

**EDB-3.7.1 Sediment Removal**

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in
the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer’s level, and consultation with the Town of Parker Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from EDBs do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

*Frequency:* Nonroutine – As necessary based upon inspections. Sediment removal in the forebay and trickle channel may be necessary as frequently as every 1-2 years.

**EDB-3.7.2  Erosion Repair**

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Town of Parker Staff.

*Frequency:* Nonroutine – As necessary based upon inspections.

**EDB-3.7.3  Vegetation Removal/Tree Thinning**

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an EDB. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the EDB will most likely have to be removed when sediment/dredging operations occur. A small tree is easier to remove than a large tree, therefore, regular removal/thinning is imperative. All trees and woody vegetation that is growing in the bottom of the EDB or near structures (inflows, trickle channels, outlet works, emergency spillways, etc) should be removed. Any trees or woody vegetation in the EDB should be limited to the upper portions of the pond banks.

*Frequency:* Nonroutine – As necessary based upon inspections.

**EDB-3.7.4  Clearing Drains/Jet-Vac**

An EDB contains many structures, openings, and pipes that can be frequently clogged with debris. These blockages can result in a decrease of hydraulic capacity and create standing water in areas outside of the micro-pool. Many times the blockage to this infrastructure can be difficult to access and/or
clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

_Frequency:_ Nonroutine – As necessary based upon inspections.

**EDB-3.8 MAJOR MAINTENANCE ACTIVITIES**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the Town of Parker to ensure the proper maintenance is performed. This work requires that the Town Staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look For:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment; reduced pond capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
</tbody>
</table>

**EDB-3.8.1 Major Sediment Removal**

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

_Frequency:_ Nonroutine – Repair as needed based upon inspections.

**EDB-3.8.2 Major Erosion Repair**

Major erosion repair consist of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

_Frequency:_ Nonroutine – Repair as needed based upon inspections.
**EDB-3.8.3 Structural Repair**

An EDB includes a variety of structures that can deteriorate or be damaged during the course of routine maintenance. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. These structures include items like outlet works, trickle channels, forebays, inflows and other features. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Town of Parker Staff should take place prior to all structural repairs.

*Frequency*: Nonroutine – Repair as needed based upon inspections.

**Reference:**
Porous Landscape Detention (PLD)

- O&M Site Plans, PLD, Checklist (1 page)
- Sample PLD O&M Plan (Plan) (1 page)
- Sample PLD O&M Plan (Details) (1 page)
- SOP’s for PLD Inspection and Maintenance (16 pages)
OPERATION AND MAINTENANCE SITE PLANS
POROUS LANDSCAPE DETENTION (PLD)
CHECKLIST FOR REQUIRED ITEMS

PLAN SHEET
Plan view shall include:

☐ Location and labels for all major features of PLD (inlet pipe, overflow outlet structure, outlet pipe, etc.)
☐ Linework for underdrains
☐ Linework for right-of-way lines, lot lines, easements, and tracts
☐ Contours
☐ Other utilities in vicinity of PLD
☐ Cross reference to Porous Landscape Detention Operation and Maintenance Details sheet

DETAIL SHEET

☐ WQCV provided by the PLD
☐ WQCV drain time
☐ Duplicate the following tables from the “Standard Operation Procedure for Porous Landscape Detention Inspection and Maintenance” document:
   ○ Inspection and Maintenance Requirements at Specific PLD Features
   ○ Summary of Routine Maintenance Activities for a PLD
   ○ Summary of Minor Maintenance Activities for a PLD
   ○ Summary of Major Maintenance Activities for a PLD
☐ Overflow outlet box detail/typical cross section
☐ Typical PLD cross section (include label for depth of WQCV)
☐ Underdrain detail including labels for the depth and type of fill materials and diameter of perforated pipe
☐ Rundown cross section and details (if applicable).
SEE THE POROUS LANDSCAPE DETENTION OPERATION AND MAINTENANCE DETAILS FOR MORE INFORMATION.
**SUMMARY OF INSPECTION AND MAINTENANCE REQUIREMENTS**

**INSPECTION AND MAINTENANCE REQUIREMENTS AT SPECIFIC PLD FEATURES**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Sediment Removal</th>
<th>Inflow Points</th>
<th>Erosion</th>
<th>Overflow</th>
<th>Vegetation</th>
<th>Structure Repairs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES FOR A PLD**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>twice annually</td>
<td>excessive grasses</td>
<td>cut and remove</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>twice annually</td>
<td>retain and dispose in PLD</td>
<td></td>
</tr>
<tr>
<td>Overflow Outlet Works</td>
<td>as needed, after</td>
<td>plugged outlet structure</td>
<td>replace and</td>
</tr>
<tr>
<td>Cleaning</td>
<td>significant rain events</td>
<td>ponding water above</td>
<td>repair or</td>
</tr>
<tr>
<td>Weed Control</td>
<td>minimum twice annually</td>
<td>noninvasive weeds</td>
<td>consult with Town</td>
</tr>
</tbody>
</table>

**SUMMARY OF MINOR MAINTENANCE ACTIVITIES FOR A PLD**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>as needed, based on</td>
<td>sediment buildup</td>
<td>remove and dispose</td>
</tr>
<tr>
<td></td>
<td>infiltration test</td>
<td>decrease in infiltration rate</td>
<td>of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>as needed, based upon inspection</td>
<td>rills/gulleys on embankments</td>
<td>repair eroded areas and revegetate; address cause</td>
</tr>
<tr>
<td>Jet-Vac/Cleaning Underdrain System</td>
<td>as needed, based upon inspection</td>
<td>sediment build-up; non-draining system</td>
<td>clean drains; Jet-Vac if needed</td>
</tr>
</tbody>
</table>

**SUMMARY OF MAJOR MAINTENANCE ACTIVITIES FOR A PLD**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>as needed, based upon schedule inspection</td>
<td>large quantities of sediment; reduced pond capacity</td>
<td>remove and dispose of sediment; repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>as needed, based upon schedule inspection</td>
<td>severe erosion (including gullies, excessive soil displacement, areas of settlement, holes)</td>
<td>repair erosion; find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>as needed, based upon schedule inspection</td>
<td>settlement and/or damage to structural features of PLD (e.g., concrete, damaged pipes, damaged outlet works)</td>
<td>structural repair to restore structure to its original design</td>
</tr>
<tr>
<td>PLD Repair</td>
<td>as needed, due to complete failure of PLD</td>
<td>structural failure of PLD and underdrain system</td>
<td>Contact the Town</td>
</tr>
</tbody>
</table>

**SUMMARY OF INSPECTION AND MAINTENANCE REQUIREMENTS PROVIDED:**

- **WQCV DRAIN TIME IS 12 HOURS**
- **SUMMARY OF PLD VOLUME PROVIDED:**
  - WQCV 0.10 AF
  - WQCV DRAIN TIME IS 12 HOURS

---

**COBBLE RUNDOWN TYPICAL CROSS SECTION**

- 2" COBBLE
- 1" FILTER FABRIC

**COBBLE BASIN TYPICAL CROSS SECTION**

- 4" - 6" COBBLE
- 6" FILTER FABRIC

---

**Porous Landscape Detention TYPICAL SECTION**

- 18" GROWING MEDIUM (15% COMPOST AND 85% ASTM C-33 SAND)
- 8" FILTER LAYER (CDOT CLASS C FILTER MATERIAL)
- CDOT CLASS B GEOTEXTILE SEPARATOR
- 4" DIA SLOTTED PIPE UNDERDRAIN @ 1% MIN. SLOPE

---

**SUMMARY OF INSPECTION AND MAINTENANCE REQUIREMENTS FOR KOOL VALLEY OUTLET BOX TYPICAL SECTION**

- INFLOW
- OUTLET BOX
- 7.5' CAP PIPE
- 15" RCP

---

**KENNEDY RETAIL CENTER**

**Porous Landscape Detention OPERATION AND MAINTENANCE PLAN (DETAILS)**

**NAME:** P:\11-009.01 Parker Stormwater Criteria Update\O&M Sample Plans\11009-PLDPlanDetails.dwg

**DATE:** APR 03, 2012  TIME: 11:32 AM

**SUMMARY OF ROUTINE MAINTENANCE REQUIREMENTS FOR A PLD**

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<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
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</thead>
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<td>Sediment Removal</td>
<td>twice annually</td>
<td>sediment buildup</td>
<td>remove and dispose</td>
</tr>
<tr>
<td>Inflow Points</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overflow</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td>X</td>
<td></td>
<td></td>
</tr>
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**SUMMARY OF MINOR MAINTENANCE REQUIREMENTS FOR A PLD**

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<tr>
<td>Erosion Repair</td>
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<td>repair eroded areas and revegetate; address cause</td>
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<td>as needed, due to complete failure of PLD</td>
<td>structural failure of PLD and underdrain system</td>
<td>Contact the Town</td>
</tr>
</tbody>
</table>

**NOT TO SCALE**

**DESIGNER:** DRAINAGE SPECIALTY
**DRAWN:** DRAINAGE SPECIALTY
**CHECKED:** DRAINAGE SPECIALTY
**REVISED:** DRAINAGE SPECIALTY

**DRAINAGE SPECIALTY**
**123 MAIN ST**
**SOMEPLACE, CO 81234**
**(123) 456-7890**

---

**NOT TO SCALE**

**DRAINAGE SPECIALTY**
**123 MAIN ST**
**SOMEPLACE, CO 81234**
**(123) 456-7890**

---

**KENNEDY RETAIL CENTER**

**Porous Landscape Detention OPERATION AND MAINTENANCE PLAN (DETAILS)**

**DATE:** APR 03, 2012  TIME: 11:32 AM

**SUMMARY OF ROUTINE MAINTENANCE REQUIREMENTS FOR A PLD**

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<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>twice annually</td>
<td>sediment buildup</td>
<td>remove and dispose</td>
</tr>
<tr>
<td>Inflow Points</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overflow</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td>X</td>
<td></td>
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</tr>
</tbody>
</table>

**SUMMARY OF MINOR MAINTENANCE REQUIREMENTS FOR A PLD**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>as needed, based on infiltration test</td>
<td>sediment buildup decrease in infiltration rate</td>
<td>remove and dispose of sediment</td>
</tr>
</tbody>
</table>
Standard Operating Procedures (SOP) For Porous Landscape Detention (PLD) Inspection and Maintenance

March 2012
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### ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CDPHE</td>
<td>Colorado Department of Public Health and Environment</td>
</tr>
<tr>
<td>CDPS</td>
<td>Colorado Discharge Permit System</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>EDB</td>
<td>Extended Detention Basin</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GS</td>
<td>Grass Swale</td>
</tr>
<tr>
<td>MS4</td>
<td>Municipal Separate Storm Sewer System</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>PBMP</td>
<td>Permanent Best Management Practice</td>
</tr>
<tr>
<td>PLD</td>
<td>Porous Landscape Detention</td>
</tr>
<tr>
<td>SDECM</td>
<td>Storm Drainage and Environmental Criteria Manual</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>WQCD</td>
<td>Water Quality Control Division of the CDPHE</td>
</tr>
<tr>
<td>WQCV</td>
<td>Water Quality Capture Volume</td>
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</table>
PLD-1 BACKGROUND

Porous Landscape Detention (PLD) is one of the most common types of Stormwater Management Facilities utilized within the Front Range of Colorado. PLDs consist of a low-lying vegetated area underlain by a sand bed with an underdrain pipe. A shallow surcharge zone exists above the PLD for temporary storage of the Water Quality Capture Volume (WQCV). During a storm, accumulated runoff ponds in the vegetated zone and gradually infiltrates into the underlying sand bed, filling the void spaces of the sand. The underdrain gradually dewater the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. The PLD provides for filtering, adsorption, and biological uptake of constituents in stormwater\(^1\). The popularity of PLDs has increased because they allow the WQCV to be provided on a site that has little open area available for stormwater management.

PLD-2 INSPECTING POROUS LANDSCAPE DETENTION

PLD-2.1 ACCESS AND EASEMENTS

Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the access points and maintenance easements of the PLDs within this development.

PLD-2.2 STORMWATER MANAGEMENT FACILITIES LOCATIONS

Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the PLDs within this development.

PLD-2.3 POROUS LANDSCAPE DETENTION (PLD) FEATURES

PLDs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. It is important for maintenance personnel to understand the function of each of these features to prevent damage to any feature during maintenance operations:

\(^1\) Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996
Table PLD-1
Typical Inspection & Maintenance Requirements Matrix

<table>
<thead>
<tr>
<th></th>
<th>Sediment Removal</th>
<th>Mowing Weed control</th>
<th>Trash &amp; Debris Removal</th>
<th>Erosion</th>
<th>Overgrown Vegetation Removal</th>
<th>Removal/Replacement</th>
<th>Structure Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Points</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Landscaping</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Media</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Underdrain System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Overflow Outlet Works</td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
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<td>Embankment</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PLD-2.3.1 Inflow Points

Inflow points or outfalls into PLDs are the point of stormwater discharge into the facility. An inflow point is commonly a curb cut with a concrete or riprap rundown. In limited cases a storm sewer pipe outfall with a flared end section may be the inflow point into the PLD.

An energy dissipater (riprap or concrete wall) is typically immediately downstream of the discharge point into the PLD to protect the PLD from erosion. In some cases, the storm sewer outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

The typical maintenance items that are required at inflow points are as follows:

a) **Riprap Displaced.** Many times, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b) **Erosion Present/Outfall Undercut.** In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility. It is imperative that material utilized to correct erosion problems within the filter media meets the requirements for filter media as shown on the approved construction drawings.

c) **Sediment Accumulation.** Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance of the upstream infrastructure, sediment that accumulates in this area must be removed on a timely basis.
d) **Structural Damage.** Structural damage can occur at anytime during the life of the facility. Typically for an inflow, the structural damage occurs to the concrete or riprap rundown or pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

**PLD-2.3.2 Landscaping**

The landscaped area consists of specific plant materials and associated landscaping mulch in the bottom of the PLD. These plantings provide several functions for the PLD. Planting not only provides an aesthetic value for the PLD, but in many cases assists with biological uptake or removal of pollutants.

The plants are carefully selected for use in the PLDs. Plants utilized in PLDs must be able to grow in dry sandy soils but also be able to withstand frequent inundation by stormwater runoff. These plants also must be able to withstand a variety of pollutants commonly found in stormwater runoff. In addition, plants utilized in PLDs cannot have a deep extensive root system that may cause maintenance difficulty or damage to the facility.

The typical maintenance activities that are required within the landscape areas are as follows:

a) **Woody Growth/Weeds Present.** Undesirable vegetation can grow in and around the landscaped area in the PLD that can significantly impact the performance of the facility. This type of vegetation includes dense areas of shrubs (willows), grasses and noxious weeds. If undesired vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the filter media. Also, shrub, grass and weed roots can cause damage to the filter media and underdrain system. Routine management is essential to prevent more extensive and costly future maintenance.

b) **General Landscape Care.** The landscape elements of the PLD are the same as any other landscape area and need to be provided with regular care. Landscape mulch will need to be removed and replaced to ensure the aesthetics of the PLD.

**PLD-2.3.3 Filter Media**

The filter media is the main pollutant removal component of the PLD. The filter media consists of 18-inches of a mixture of coarse sand and compost/shredded paper mixture. The filter media removes pollutants through several different processes, including sedimentation, filtration, adsorption, infiltration and microbial uptake.

Sedimentation is accomplished by the slow release of stormwater runoff through the filter media. This slow release allows for sediment particles to be deposited on the top layer of the filter media where they are easily removed through routine maintenance. Other pollutants are also removed through this process because many pollutants utilize sediment as a transport mechanism.

Filtration is the main pollutant removal mechanism of PLDs. When the stormwater runoff migrates down through the filter media many of the particulate pollutants are physically strained
out as they pass through the filter bed of sand and are trapped on the surface or among the pores of the filter media. ²

The shredded paper in the filter media captures nutrients from the compost and slowly releases them as the paper decomposes. Paper also temporarily slows the infiltration rate of the media and retains moisture, providing additional time for a young root system to benefit from moisture in the growing medium. PLDs that are not lined with an impervious liner allow for infiltration into the native soils. This process also allows for additional pollutant removal.

Microbes that naturally occur in the filter media can assist with pollutant removal by breaking down organic pollutants.

The typical maintenance activities that are required within the filter media areas are as follows:

a) **Infiltration Rate Check.** The infiltration rate of the PLD needs to be checked in order to ensure proper functioning of the PLD. Generally, a PLD should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time than maintenance of the filter media shall be required.

b) **Sediment Removal.** Although PLDs should not be utilized in areas where large concentrations of sediment may enter the PLD, it is inevitable that some sediment will enter the PLD.

c) **Filter Replacement.** The top layers of the filter media are the most susceptible to pollutant loading and therefore may need to be removed and disposed of properly on a semi-regular basis when infiltration rates slow.

**PLD-2.3.4 Underdrain System**

The underdrain system consists of a 6-inch thick layer of CDOT Class C filter material and slotted PVC pipes.

With proper maintenance of the landscape areas and filter media there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning.

**PLD-2.3.5 Overflow Outlet Works**

Generally, the initial runoff (“first flush”) or WQCV during the storm event contains the majority of the pollutants. PLDs are designed to treat only the WQCV and any amount over the WQCV is allowed to go to a detention facility without water quality treatment. The overflow outlet works allows runoff amounts over the WQCV to exit the PLD to the detention facility. The outlet works is typically constructed of a reinforced concrete box in the embankment of the PLD. The concrete structure typically has a steel grate to trap litter and other debris from entering the storm sewer.

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² Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996
system. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the PLD.

The most typical maintenance items that are found with inflow points are as follows:

a) **Structural Damage.** The overflow outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel grate on the overflow outlet structure is also susceptible to damage.

b) **Woody Growth/Weeds Present.** The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can clog the overflow outlet works during a larger storm event, causing flooding damage to adjacent areas. This plant material also may indicate a clogging of the filter media than may require additional investigation.

c) **Trash Debris.** Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can clog the PLD outlet works.

**PLD-2.3.6 Embankments**

Some PLDs utilize irrigated turf grass embankment to store the WQCV.

The typical maintenance activities that are required with the embankments areas are as follows:

a) **Vegetation Sparse.** The embankments are one of the most visible parts of the PLD, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance of the PLD. Vegetation can reduce the potential for erosion and subsequent sediment transport to the filter media, thereby reducing the need for more costly maintenance.

b) **Erosion.** Inadequate vegetative cover may result in erosion of the embankments. Erosion that occurs on the embankments can cause clogging of the filter media.

**PLD-2.3.7 Miscellaneous**

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the PLD. This category on the inspection form is for maintenance items that are commonly found in the PLD, but may not be attributed to an individual feature.

a) **Encroachment in Easement Area.** Private lots/property can sometimes be located very close to the PLDs, even though the County requires that PLDs be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may impact maintenance or the operation of the facility.

b) **Graffiti/Vandalism.** Vandals can cause damage to the PLD infrastructure. If criminal mischief is evident, the inspector should forward this information to the Town of Parker Police Department.
c) **Public Hazards.** Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately.**

d) **Other.** Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

**PLD-2.4 COMPLETED INSPECTION FORMS**

PLD inspection forms are located in the Appendix. The person(s) conducting the inspection activities shall complete inspection reports. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. Copies of these inspections forms shall be kept indefinitely by the property owner or manager and made available to the Town of Parker upon request.

**PLD-3 MAINTAINING POROUS LANDSCAPE DETENTIONS**

**PLD-3.1 MAINTENANCE PERSONNEL**

Maintenance personnel must be experienced to properly maintain PLDs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

**PLD-3.2 EQUIPMENT**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a PLD:

1. Mowing Tractors
2. Trimmers (extra string)
3. Shovels
4. Rakes
5. All Surface Vehicle (ASVs)
6. Skid Steer
7. Back Hoe
8. Track Hoe/Long Reach Excavator
9. Dump Truck
10. Jet-Vac Machine
11. Engineers Level (laser)
12. Riprap (Minimum - Type M)
13. Geotextile Fabric
14. Erosion Control Blanket(s)
15. Sod
16. Illicit Discharge Cleanup Kits
17. Trash Bags
18. Tools (wrenches, screw drivers, hammers, etc)
19. Confined Space Entry Equipment
21. ASTM C-33 Sand
22. Peat
23. Wood Landscaping Mulch

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

PLD-3.3 PLD MAINTENANCE FORMS
The PLD Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The PLD Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. The PLD Maintenance form is located in the Appendix.

PLD-3.4 COMPLETED MAINTENANCE FORMS
A variety of maintenance activities, separated into categories, are identified on the form. All maintenance activities performed during the operation must be identified on the form. These maintenance activities are described in more detail later in this Manual. Maintenance forms shall be completed by the contractor performing the required maintenance items. The form shall then be reviewed by an authorized agent of the property owner and submitted to the Town of Parker.

PLD-3.5 PLD MAINTENANCE CATEGORIES AND ACTIVITIES
A typical PLD Maintenance Program will consist of three broad categories of work: Routine, Minor and Major. Within each category of work, a variety of maintenance activities can be performed on a PLD. A maintenance activity can be specific to each feature within the PLD, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a PLD.

The maintenance activities necessary for a PLD range in magnitude from routine trash pickup to the reconstruction of the PLD filter media or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

PLD-3.6 ROUTINE MAINTENANCE ACTIVITIES
The majority of this work consists of scheduled mowings, trash and debris pickups and landscape care for the PLD during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items typically do not require any prior correspondence with the Town, however, completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period.

The Routine Maintenance Activities are summarized below, and further described in the following sections.
### TABLE PLD-2  
**SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash &amp; debris in PLD</td>
<td>Remove and dispose of trash and debris</td>
</tr>
<tr>
<td>Overflow Outlet Works Cleaning</td>
<td>As needed - after significant rain events – twice annually minimum</td>
<td>Clogged outlet structure; ponding water above outlet elevation</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Weed Control</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull; consult Town of Parker</td>
</tr>
</tbody>
</table>

---

**PLD-3.6.1   Mowing**  
Routine mowing of the turf grass embankments is necessary to improve the overall appearance of the PLD. Turf grass should be mowed to a height of 2 to 4- inches and shall be bagged to prevent potential contamination of the filter media.

*Frequency: Routine - Minimum of twice annually or depending on aesthetics.*

**PLD-3.6.2   Trash/Debris Removal**  
Trash and debris must be removed from the entire PLD area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency: Routine – Prior to mowing operations and minimum of twice annually.*

**PLD-3.6.3   Overflow Outlet Works Cleaning**  
Debris and other materials can clog the overflow outlet work’s grate. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

*Frequency: Routine – After significant rainfall event or concurrently with other maintenance activities.*

**PLD-3.6.4   Weed Control**  
Noxious weeds and other unwanted vegetation must be treated as needed throughout the PLD. This activity can be performed either through mechanical means (mowing/pulling) or with
herbicide. Consultation with the Douglas County Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

Frequency: Routine – As needed based on inspections.

PLD-3.7 MINOR MAINTENANCE ACTIVITIES

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items require prior approval from the Town of Parker. Completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period. In the event that the PLD needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. All dewatering activities shall be coordinated with the Town.

TABLE PLD-3
SUMMARY OF MINOR MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>As needed; Based on infiltration test</td>
<td>Sediment build-up; decrease in infiltration rate</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies on embankments</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Jet Vac/Cleaning underdrain system</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up /non draining system</td>
<td>Clean drains; Jet-Vac if needed</td>
</tr>
</tbody>
</table>

PLD-3.7.1 Sediment/Pollutant Removal

Sediment/Pollutant removal is necessary to ensure proper function of the filter media. The infiltration rate of the PLD needs to be checked in order to ensure proper functioning of the PLD. Generally, a PLD should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time than maintenance of the filter media shall be required.

Generally the top 3-inches of filter media should be removed at each removal period. Additional amounts of filter media may need to be removed if deeper sections of the filter media are contaminated. New filter media will need to replace the removed filter media. It is critical that only sand that meets the CDOT Class C Filter Material gradation in additional to Class 1 Compost be utilized in the replacement of the filter media.
Gradation Specifications for CDOT Class C Filter Material:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Mass Percent Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.0 mm (3/4 inch)</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
<td>60-100</td>
</tr>
<tr>
<td>300μm (No. 50)</td>
<td>10-30</td>
</tr>
<tr>
<td>150μm (No. 100)</td>
<td>0-10</td>
</tr>
<tr>
<td>75μm (No. 200)</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Class 1 Compost:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Stability Indicator (Respirometry)</td>
<td>Stable to Very Stable</td>
</tr>
<tr>
<td>Maturity Indicator Expressed as Ammonia N / Nitrate N Ratio</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Maturity Indicator Expressed as Carbon to Nitrogen Ratio</td>
<td>&lt;12</td>
</tr>
<tr>
<td>Maturity Indicator Expressed as Percentage of Germination/Vigor</td>
<td>80+ / 80+</td>
</tr>
<tr>
<td>pH – Acceptable Range</td>
<td>6.0-8.4</td>
</tr>
<tr>
<td>Soluble Salts – Acceptable Range (1:5 by weight)</td>
<td>0-5 mhos/cm</td>
</tr>
<tr>
<td>Testing and Test Report Submittal Requirement</td>
<td>Seal of Testing Assurance (STA)/Test Methods for the Examination of Composting and Compost (TMECC)</td>
</tr>
<tr>
<td>Chemical Contaminants</td>
<td>Equal or better than US EPA Class A Standard, 40 CFR 503.13, Tables 1 &amp; 3 levels</td>
</tr>
<tr>
<td>Pathogens</td>
<td>Meet or exceed US EPA Class A Standard, 40 CFR 503.32(a) levels</td>
</tr>
</tbody>
</table>

Other types of sand or soil material may lead to clogging of the PLD. The minor sediment removal activities can typically be addressed with shovels and rakes and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. Extreme care should be
taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The major sediment removal activities will also require surveying with an engineer’s level, and consultation with the Town of Parker Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from PLDs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.

*Frequency:* Non-routine – As necessary, based upon inspections and infiltration tests. Sediment removal in the forebay and trickle channel may be necessary as frequently as every 1-2 years.

**PLD-3.7.2 Erosion Repair**

The repair of eroded areas is necessary to ensure the proper functioning of the PLD, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to filter media and embankments, to rills and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Town of Parker Staff.

*Frequency:* Non-routine – As necessary, based upon inspections.

**PLD-3.7.3 Jet-Vac/Clearing Drains**

A PLD contains an underdrain system that allows treated stormwater runoff to exit the facility. These underdrain systems can develop blockages that can result in a decrease of hydraulic capacity and also create standing water. Many times the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

*Frequency:* Non-routine – As necessary, based upon inspections.

**PLD-3.8 MAJOR MAINTENANCE ACTIVITIES**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the Town of Parker to ensure the proper maintenance is performed. This work requires that the Town Staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.
TABLE PLD-4
SUMMARY OF MAJOR MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment; reduced pond capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes &amp; outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>PLD Rebuild</td>
<td>As needed – due to complete failure of PLD</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact the Town of Parker</td>
</tr>
</tbody>
</table>

PLD-3.8.1 Major Sediment/Pollutant Removal

Major sediment removal consists of removal of large quantities of pollutants/sediment/filter media/landscaping material. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Some PLDs also contain an impermeable liner that can be easily damage if care is not taken when removing the filter media. Stormwater sediments removed from PLDs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

Frequency: Non-routine – Repair as needed, based upon inspections.

PLD-3.8.2 Major Erosion Repair

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur.

Frequency: Non-routine – Repair as needed, based upon inspections.
PLD-3.8.3 Structural Repair
A PLD generally includes a concrete overflow outlet structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Town of Parker Staff shall take place prior to all structural repairs.

Frequency: Non-routine – Repair as needed, based upon inspections.

PLD-3.8.4 PLD Rebuild
In very rare cases a PLD may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the PLD. Consultation with the Town of Parker shall take place prior to any rebuild project.

Frequency: Non-routine – As needed, based upon inspections.

Reference:
This Manual is adapted from the Douglas County, Colorado, Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance, July 2005
Sand Filter Basin (SFB)

- O&M Site Plans, SFB, Checklist (1 page)
- Sample SFB O&M Plan (Plan) (1 page)
- Sample SFB O&M Plan (Details) (1 page)
- SOP’s for SFB Inspection and Maintenance (16 pages)
OPERATION AND MAINTENANCE SITE PLANS
SAND FILTER BASIN (SFB)
CHECKLIST FOR REQUIRED ITEMS

PLAN SHEET
Plan sheet shall include:
- Location and labels for all major features of SFB (inlet pipe, energy dissipation structures, maintenance access road, overflow outlet structure, outlet pipe, spillway, etc.)
- Linework for undrains
- Linework for right-of-way lines, lot lines, easements, and tracts
- Contours
- Other utilities in vicinity of SFB
- Cross reference to Sand Filter Basin Operation and Maintenance Details sheet

DETAIL SHEET
Detail sheet shall include:
- WQCV provided by the SFB
- WQCV drain time
- Duplicate the following tables from the “Standard Operation Procedure for Sand Filter Basin Inspection and Maintenance” document:
  - Inspection and Maintenance Requirements at Specific SFB Features
  - Summary of Routine Maintenance Activities for a SFB
  - Summary of Minor Maintenance Activities for a SFB
  - Summary of Major Maintenance Activities for a SFB
- Overflow outlet box detail/typical section
- Typical SFB cross section (include label for depth of WQCV)
- Underdrain detail including labels for the depth and type of fill materials and diameter of perforated pipe
## Summary of Inspection and Maintenance Requirements

### Summary of SFB Volume Provided:

- WQCV: 0.18 AF
- WQCV Drain Time is 40 Hours

### Inspection and Maintenance Requirements at Specific SFB Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Sediment Removal</th>
<th>Mowing</th>
<th>Weed Control</th>
<th>Trash/Odor Removal</th>
<th>Inflow Energy Dissipator</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Trapping Chamber</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>optics</td>
</tr>
<tr>
<td>Inflow Energy Dissipator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>optics</td>
</tr>
</tbody>
</table>

### Summary of Routine Maintenance Activities for a SFB

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>twice annually</td>
<td></td>
<td>2&quot;-4&quot; grass height</td>
</tr>
<tr>
<td>Trash/Odor Removal</td>
<td>twice annually</td>
<td></td>
<td>trash and debris in SFB</td>
</tr>
<tr>
<td>Splitter Box/Overflow Outlet Works Cleaning</td>
<td>as needed</td>
<td></td>
<td>trash and debris in outlet structure; ponding water</td>
</tr>
<tr>
<td>Woody Growth Control</td>
<td>minimum twice annually</td>
<td></td>
<td>treat with herbicide or hand pull, consult with Town</td>
</tr>
</tbody>
</table>

### Summary of Minor Maintenance Activities for a SFB

These activities require prior consultation with the Town.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>as needed, based upon inspection</td>
<td></td>
<td>remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>as needed, based upon inspection</td>
<td></td>
<td>repair erosion; find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Jet-Vac/Cleaning Underdrain</td>
<td>as needed, based upon inspection</td>
<td></td>
<td>clean drain; Jet-Vac if needed</td>
</tr>
</tbody>
</table>

### Summary of Major Maintenance Activities for a SFB

These activities require prior consultation with the Town.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>as needed, based upon scheduled inspection</td>
<td>large quantities of sediment in or on embankments or SFB</td>
<td>remove and dispose of sediment</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>as needed, based upon scheduled inspection</td>
<td>severe erosion, including gullying, excessive soil displacement, areas of settlement, holes</td>
<td>repair erosion; find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>as needed, based upon scheduled inspection</td>
<td>structural damage to structural components (i.e., broken concrete, damaged pipes, damaged outlet works)</td>
<td>structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>SFB Rebuild</td>
<td>as needed, due to complete failure of SFB</td>
<td>removal of filter media and underdrain system</td>
<td>contact the Town of Parker</td>
</tr>
</tbody>
</table>

## Summary of Maintenance Requirements for a SFB

### Maintenance Activity

<table>
<thead>
<tr>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>twice annually</td>
<td></td>
<td>2&quot;-4&quot; grass height</td>
</tr>
<tr>
<td>twice annually</td>
<td></td>
<td>trash and debris in SFB</td>
</tr>
<tr>
<td>as needed</td>
<td></td>
<td>trash and debris in outlet structure; ponding water</td>
</tr>
<tr>
<td>minimum twice annually</td>
<td></td>
<td>treat with herbicide or hand pull, consult with Town</td>
</tr>
<tr>
<td>as needed, based upon inspection</td>
<td></td>
<td>remove and dispose of sediment</td>
</tr>
<tr>
<td>as needed, based upon inspection</td>
<td></td>
<td>repair erosion; find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>as needed, based upon inspection</td>
<td></td>
<td>clean drain; Jet-Vac if needed</td>
</tr>
<tr>
<td>as needed, based upon scheduled inspection</td>
<td>large quantities of sediment in or on embankments or SFB</td>
<td>remove and dispose of sediment</td>
</tr>
<tr>
<td>as needed, based upon scheduled inspection</td>
<td>severe erosion, including gullying, excessive soil displacement, areas of settlement, holes</td>
<td>repair erosion; find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>as needed, based upon scheduled inspection</td>
<td>structural damage to structural components (i.e., broken concrete, damaged pipes, damaged outlet works)</td>
<td>structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>as needed, due to complete failure of SFB</td>
<td>removal of filter media and underdrain system</td>
<td>contact the Town of Parker</td>
</tr>
</tbody>
</table>

## Summary of SFB Volume Provided:

- WQCV 0.18 AF
- WQCV Drain Time is 40 Hours

## Summary of SFB Volume Provided:

- WQCV 0.18 AF
- WQCV Drain Time is 40 Hours
Standard Operating Procedures (SOP) For Sand Filter Basin (SFB) Inspection and Maintenance

March 2012
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<td>Major Sediment/Pollutant Removal ................................................................................</td>
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<td>SFB-3.9.2</td>
<td>Major Erosion Repair ..................................................................................................</td>
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<td>SFB-3.9.3</td>
<td>Structural Repair .........................................................................................................</td>
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<td>16</td>
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</table>
**ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
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<tr>
<td>CDPHE</td>
<td>Colorado Department of Public Health and Environment</td>
</tr>
<tr>
<td>CDPS</td>
<td>Colorado Discharge Permit System</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>EDB</td>
<td>Extended Detention Basin</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GS</td>
<td>Grass Swale</td>
</tr>
<tr>
<td>MS4</td>
<td>Municipal Separate Storm Sewer System</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>PBMP</td>
<td>Permanent Best Management Practice</td>
</tr>
<tr>
<td>PLD</td>
<td>Porous Landscape Detention</td>
</tr>
<tr>
<td>SDECM</td>
<td>Storm Drainage and Environmental Criteria Manual</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>WQCD</td>
<td>Water Quality Control Division of the CDPHE</td>
</tr>
<tr>
<td>WQCV</td>
<td>Water Quality Capture Volume</td>
</tr>
</tbody>
</table>
SFB-1 BACKGROUND

Sand Filter Basins (SFBs) are a common type of Stormwater Management Facility utilized within the Front Range of Colorado. SFB consists of a sedimentation chamber, flat grass area, a filtration chamber, and a flat sand filter bed with an underdrain system. A surcharge zone exists within the sedimentation and filtration chambers for temporary storage of the Water Quality Capture Volume (WQCV). During a storm, runoff enters the sedimentation chamber, where the majority of sediments are deposited. The runoff then enters the filtration chamber where it ponds above the sand bed and gradually infiltrates into the underlying sand filter, filling the void spaces of the sand. The underdrain gradually dewatered the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. SFBs provide for filtering and absorption of pollutants in the stormwater. The popularity of SFBs has grown because they allow the WQCV to be provided on a site that has little open area available for stormwater management. However there are limitations on their use due to potential clogging from large amounts of sediment.

SFB-2 INSPECTING SAND FILTER BASINS (SFBS)

SFB-2.1 ACCESS AND EASEMENTS

Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the access points and maintenance easements of the SFBs within this development.

SFB-2.2 STORMWATER MANAGEMENT FACILITIES LOCATIONS

Inspection or maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the SFBs within this development.

SFB-2.3 SAND FILTER EXTENDED DETENTION BASIN (SFB) FEATURES

SFBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. It is important for maintenance personnel to understand the function of each of these features to prevent damage to any feature during maintenance operations:

---

1 Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996
### TABLE SFB-1
TYPICAL INSPECTION & MAINTENANCE REQUIREMENTS MATRIX

<table>
<thead>
<tr>
<th></th>
<th>Sediment Removal</th>
<th>Mowing Weed control</th>
<th>Trash &amp; Debris Removal</th>
<th>Erosion</th>
<th>Overgrown Vegetation Removal</th>
<th>Removal/Replacement</th>
<th>Structure Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Points/ Splitter Box</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sedimentation Chamber</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Filter Media</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Underdrain System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Overflow Outlet Works</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Embankment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

#### SFB-2.3.1 Inflow Points/Splitter Box

Inflow points or outfalls into SFBs are the point of stormwater discharge into the facility. An inflow point is commonly a curb cut with a concrete or riprap rundown or a storm sewer pipe outfall with a flared end section.

SFBs are designed to treat only the WQCV. The WQCV is a volume of water that runs off a site during an 80th percentile event. Any amount over the WQCV is allowed to go to a detention facility without water quality treatment. The splitter box is generally constructed of reinforced concrete. The splitter box typically has a lower wall that has a height that will trap the required WQCV. Volumes over the WQCV are allowed to spill over the wall and enter a storm sewer system that conveys the runoff to a detention facility. Proper inspection and maintenance of the splitter box is essential in ensuring the long-term operation of the SFB.

An energy dissipater is typically immediately downstream of the splitter box, at the discharge point into the SFB, to protect the sedimentation and filtration chambers from erosion. In some cases, the splitter box outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

The typical maintenance activities that are required at inflow points are as follows:

a) *Riprap Displaced.* Many times, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b) *Sediment Accumulation.* Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance of the upstream infrastructure, sediment that accumulates in this area must be removed on a timely basis.
c) **Structural Damage.** Structural damage can occur at anytime during the life of the facility. Typically for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

**SFB-2.3.2 Sedimentation Chamber**

The sedimentation chamber is located adjacent to the splitter box and generally consists of a flat irrigated turf grass area followed by a water trapping device that allows water to be briefly held in the sedimentation chamber before being released into the filtration chamber. This slowing of the runoff allows sediments to be deposited in the sedimentation chamber and not the filtration chamber where they can cause clogging of the filter media.

The typical maintenance activities that are required within the sedimentation chamber are as follows:

a) **Mowing/weed/woody growth control.** Routine mowing of the turf grass within the sediment chamber is necessary to improve the overall appearance and to ensure proper function of the SFB. Turf grass should be mowed to a height of 2 to 4 inches and shall be bagged to prevent potential contamination of the filter media.

**SFB-2.3.3 Filter Media**

The filter media is the main pollutant removal component of the SFB. The filter media consists of 18-inches of CDOT Class C Filter Material. The filter media removes pollutants through several different processes, including sedimentation, filtration, infiltration and microbial uptake.

Sedimentation is accomplished by the slow release of stormwater runoff through the filter media. This slow release allows for sediment particles that were not deposited in the sedimentation chamber to be deposited on the top layer of the filter media where they are easily removed through routine maintenance. Other pollutants are also removed through this process because they are attached to sediment.

Filtration is the main pollutant removal mechanism of SFBs. When the stormwater runoff migrates down through the filter media many of the particulate pollutants are physically strained out as they pass through the filter bed of sand and are trapped on the surface or among the pores of the filter media.

SFBs that are not lined with an impervious liner allow for infiltration into the native soils. This process also allows for additional pollutant removal.

Microbes that naturally occur in the filter media can assist with pollutant removal by breaking down organic pollutants.

The typical maintenance activities that are required within the filter media areas are as follows:
a) **Mowing/weed/woody growth control.** Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the Town of Parker is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

b) **Sediment/Pollutant Removal.** Although SFBs should not be utilized in areas where large concentrations of sediment and other pollutants will enter the SFB, it is inevitable that some sediment and other pollutants will enter the SFB. Most sediment will be deposited in the sedimentation chamber, however finer suspended particles will migrate to the filter media. These sediments need to be removed to ensure proper infiltration rates of the stormwater runoff.

c) **Filter Replacement.** The top layers of the filter media are the most susceptible to pollutant loading and therefore may need to be removed and disposed of properly on a semi-regular basis when infiltration rates slow.

d) **Infiltration Rate Test.** An infiltration test may be necessary to ensure proper functioning of the filter media. The infiltration test can be conducted by filling the sand filter with water to the elevation of the overflow wall in the splitter box. The sand filter needs to drain completely within 24-hours of the filling. If the drain time for the basin is longer than 24-hours, the filter is in need of maintenance.

**SFB-2.3.4 Underdrain System**

The underdrain system consists of additional CDOT Class C Filter Material and slotted PVC pipes. The undrain system should be placed within a 5-inch thick section of CDOT Class C filter material, below the 18-inch filter layer.

With proper maintenance of the landscape areas and filter media there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning.

**SFB-2.3.5 Overflow Outlet Works**

Some SFBs include an overflow outlet works in place of the splitter box. The overflow outlet works allows runoff amounts that exceed the WQCV to exit the SFB to the detention facility. The outlet works is typically constructed of reinforced concrete into the embankment of the SFB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings (flood control) on the outlet structure typically have trash racks over them to prevent clogging. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the SFB.

The most typical maintenance activities that are required for the overflow outlet works are as follows:
a) **Structural Damage.** The overflow outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel grate on the overflow outlet structure is also susceptible to damage.

b) **Mowing/weed/woody growth control.** The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can clog the overflow outlet works during a larger storm event, causing flooding damage to adjacent areas. This plant material also may indicate a clogging of the filter media than may require additional investigation.

### SFB-2.3.6 Embankments

Some SFBs utilize irrigated turf grass embankments to store the WQCV.

The typical maintenance activities that are required for the embankments areas are as follows:

a) **Vegetation Sparse.** The embankments are one of the most visible parts of the SFB and, therefore, aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance of the SFB. Also, vegetation can reduce the potential for erosion and subsequent sediment transport to the filter media, thereby reducing the need for more costly maintenance.

b) **Erosion.** Inadequate vegetative cover may result in erosion of the embankments. Erosion that occurs on the embankments can cause clogging of the filter media.

c) **Trash Debris.** Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can clog the SFB filter media and outlet works.

d) **Mowing/weed/woody growth control.** The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can result in difficulty in performing maintenance activities. These trees and shrubs may also damage the underdrain system of the SFB. This plant material may also indicate a clogging of the filter media than may require additional investigation.

### SFB-2.3.7 Emergency Overflow

An emergency spillway is typical of all SFBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor), and is sometimes buried with soil or may be a concrete wall or other structure. The emergency spillway is typically a weir (notch) in the basin embankment. Proper function of the emergency spillway is essential to ensure flooding does not impact adjacent properties.

a) **Riprap Displaced.** As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an SFB, the riprap may shift or become dislodged due to flow.
b)  *Erosion Present.* Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

c)  *Mowing/weed/woody growth control.* Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the SFB and reduce the capacity of the spillway. These trees and shrubs may also damage the underdrain system of the SFB.

d)  *Obstruction Debris.* The spillway must be cleared of any obstruction (man made or natural) to ensure the proper design capacity.

### SFB-2.3.8 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the SFB. This category on the inspection form is for maintenance items that are commonly found in the SFB, but may not be attributed to an individual feature.

a)  *Encroachment in Easement Area.* Private lots/property can sometimes be located very close to the SFBs, even though the Town requires that they be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may impact maintenance or the operation of the facility.

b)  *Graffiti/Vandalism.* Vandals can cause damage to the SFB infrastructure. If criminal mischief is evident, the inspector should forward this information to the Town of Parker Police Department.

c)  *Public Hazards.* Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately.**

d)  *Other.* Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

### SFB-2.4 INSPECTION FORMS

SFB Inspection forms are located in the Appendix. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. A copy of these inspections forms shall be kept indefinitely by the property owner or property manager and made available to The Town of Parker upon request.
SFB-3 MAINTAINING SAND FILTER BASINS (SFBS)

SFB-3.1 MAINTENANCE PERSONNEL
Maintenance personnel must be qualified to properly maintain SFBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

SFB-3.2 EQUIPMENT
It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a SFB:

1. Mowing Tractors
2. Trimmers (extra string)
3. Shovels
4. Rakes
5. All Surface Vehicle (ASVs)
6. Skid Steer
7. Back Hoe
8. Track Hoe/Long Reach Excavator
9. Dump Truck
10. Jet-Vac Machine
11. Engineers Level (laser)
12. Riprap (Minimum - Type M)
13. Geotextile Fabric
14. Erosion Control Blanket(s)
15. Sod
16. Illicit Discharge Cleanup Kits
17. Trash Bags
18. Tools (wrenches, screw drivers, hammers, etc)
19. Confined Space Entry Equipment
21. ASTM C-33 Sand

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

SFB-3.3 SAFETY
Vertical drops may be encountered in areas located within and around the SFB. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the pond that is greater than 48-inches in height, make the appropriate note/comment on the maintenance inspection form.
SFB-3.4  SFB MAINTENANCE FORMS
The SFB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The SFB Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. The SFB Maintenance form is located in the Appendix.

SFB-3.5  COMPLETED MAINTENANCE FORMS
A variety of maintenance activities, separated into categories, are identified on the form. All maintenance activities performed during the operation must be identified on the form. These maintenance activities are described in more detail later in this Manual. Maintenance forms shall be completed by the contractor performing the required maintenance items. The form shall then be reviewed by an authorized agent of the property owner and submitted to the Town of Parker.

SFB-3.6  SFB MAINTENANCE CATEGORIES AND ACTIVITIES
A typical SFB Maintenance Program will consist of three broad categories of work: Routine, Minor and Major. Within each category of work, a variety of maintenance activities can be performed on a SFB. A maintenance activity can be specific to each feature within the SFB, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a SFB.

The maintenance activities necessary for a SFB range in magnitude from routine trash pickup to the reconstruction of the SFB filter media or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

SFB-3.7  ROUTINE MAINTENANCE ACTIVITIES
The majority of this work consists of scheduled mowings, trash and debris pickups for the SFB during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items typically do not require any prior correspondence with the Town, however, completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period.

The Routine Maintenance Activities are summarized below, and further described in the following sections.
### TABLE SFB-2
#### SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash &amp; debris in SFB</td>
<td>Remove and dispose of trash and debris</td>
</tr>
<tr>
<td>Splitter Box/Overflow Outlet Works Cleaning</td>
<td>As needed - after significant rain events – twice annually minimum</td>
<td>Clogged outlet structure; ponding water</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Woody Growth Control/Weed Removal</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull, consult Town of Parker</td>
</tr>
</tbody>
</table>

**SFB-3.7.1 Mowing**

Routine mowing of the turf grass embankments and turf grass located in the sedimentation chamber is necessary to improve the overall appearance of the SFB and ensure proper performance of the sediment chamber. Turf grass should be mowed to a height of 2 to 4-inches and shall be bagged to prevent potential contamination of the filter media.

*Frequency:* Routine - Minimum of twice annually or depending on aesthetics.

**SFB-3.7.2 Trash/Debris Removal**

Trash and debris must be removed from the entire SFB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency:* Routine – Prior to mowing operations and minimum of twice annually.

**SFB-3.7.3 Splitter Box/Overflow Outlet Works Cleaning**

Debris and other materials can clog the splitter box/overflow outlet work’s grate. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

*Frequency:* Routine – After significant rainfall event or concurrently with other maintenance activities.

**SFB-3.7.4 Woody Growth Control/Weed Removal**

Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. This activity can be performed either through mechanical means (mowing/pulling) or with
herbicide. Consultation with the Town of Parker is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

**Frequency:** Routine – As needed based on inspections.

### SFB-3.8 MINOR MAINTENANCE ACTIVITIES

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items require prior approval from the Town of Parker. Completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period. In the event that the SFB needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. All dewatering activities shall be coordinated with the Town.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>As needed; typically every 1–2 years</td>
<td>Sediment build-up in sedimentation chamber and filter media; decrease in infiltration rate</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies on embankments or sedimentation forebay</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Jet-Vac/Cleaning Underdrains</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up /non-draining system</td>
<td>Clean drains; Jet-Vac if needed</td>
</tr>
</tbody>
</table>

### SFB-3.8.1 Sediment/Pollutant Removal

Sediment removal is necessary to ensure proper function of the filter media. The infiltration rate of the SFB needs to be checked in order to ensure proper functioning of the SFB. Generally, a SFB should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time than maintenance of the filter media shall be required.

At a minimum, the top 2-inches of filter media should be removed at each removal period. This may be required every 2 to 5 years depending upon the observed drain times. After this has been done two or three times, the top of the filter should be replenished with CDOT Class C filter material back to the original elevation. A minimum depth of 12 inches of filter media must be maintained at all times.
Gradation Specifications for CDOT Class C Filter Material:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Mass Percent Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.0 mm (3/4 inch)</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
<td>60-100</td>
</tr>
<tr>
<td>300μm (No. 50)</td>
<td>10-30</td>
</tr>
<tr>
<td>150μm (No. 100)</td>
<td>0-10</td>
</tr>
<tr>
<td>75μm (No. 200)</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Other types of sand and soil material may lead to clogging of the SFB. The minor sediment removal activities can typically be addressed with shovels, rakes and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The major sediment removal activities will also require surveying with an engineer’s level, and consultation with the Town of Parker Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from SFBs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.

*Frequency*: Non-routine – As necessary, based upon inspections. Sediment removal in the sedimentation chamber may be necessary as frequently as every 1-2 years.

**SFB-3.8.2 Erosion Repair**

The repair of eroded areas is necessary to ensure the proper functioning of the SFB, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to filter media and embankments, to rills, and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Town of Parker Staff.
**SFB-3.9 MAJOR MAINTENANCE ACTIVITIES**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires approval from the Town of Parker to ensure the proper maintenance is performed. This work requires that Town Staff review the original design and construction drawings to assess the situation and assign the necessary maintenance activities. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants. In the event that the basin needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. Consultation with the Town is required prior to any dewatering activity.

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment in the sedimentation chamber and/or filter media; reduced infiltration rate / capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes &amp; outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>SFB Rebuild</td>
<td>As needed – due to complete failure of SFB</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact Douglas County Engineering</td>
</tr>
</tbody>
</table>

**SFB-3.9.1 Major Sediment/Pollutant Removal**

In very rare cases the filter media of the SFB may be contaminated so badly that the entire 18-inches of the filter media may need to be removed.
Major sediment/pollutant removal consists of removal of large quantities of sediment/filter media. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The sediment/filter media needs to be carefully removed, transported and properly disposed. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

Frequency: Non-routine – Repair as needed, based upon inspections.

**SFB-3.9.2 Major Erosion Repair**

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur.

Frequency: Non-routine – Repair as needed, based upon inspections.

**SFB-3.9.3 Structural Repair**

A SFB generally includes a splitter box or concrete overflow outlet structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Town of Parker Staff shall take place prior to all structural repairs.

Frequency: Non-routine – Repair as needed, based upon inspections.

**SFB-3.9.4 SFB Rebuild**

In very rare cases a SFB may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the SFB. Consultation with the Town of Parker shall take place prior to any rebuild project.

Frequency: Non-routine – As needed, based upon inspections.

Reference:

This Manual is adapted from the Douglas County, Colorado, Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance, July 2005
Grass Buffer/Grass Swale (GB/GS)

- O&M Site Plans, GB/GS, Checklist (1 page)
- Sample GB/GS O&M Plan (Plan) (1 page)
- Sample GB/GS O&M Plan (Details) (1 page)
- SOP’s for GB/GS Inspection and Maintenance (16 pages)
OPERATION AND MAINTENANCE SITE PLANS
GRASS SWALES/GRASS BUFFERS (GS/GB)
CHECKLIST FOR REQUIRED ITEMS

PLAN SHEET
Plan view shall include:

☐ Location of grass swale(s) and/or buffer(s)
☐ Contours
☐ Linework for right-of-way lines, lot lines, easements, and tracts
☐ Labels for streets adjacent to grass swale(s)/buffer(s)
☐ Linework for all storm sewer structures
☐ Cross-reference to Grass Swale/Buffer Operation and Maintenance Details sheet

DETAIL SHEET
Detail sheet shall include:

☐ Duplicate the following tables from the “Standard Operation Procedure for Grass Swales/Grass Buffers Inspection and Maintenance” document:
   ○ Typical Inspection and Maintenance Requirements Matrix
   ○ Summary of Routine Maintenance Activities
   ○ Summary of Minor Maintenance Activities
   ○ Summary of Major Maintenance Activities

☐ Typical grass swale and/or buffer section including typical horizontal and vertical dimensions, sideslopes, subgrade material, and underdrain (if applicable).

☐ Underdrain details (if applicable) including trench dimensions, perforated PVC dimensions, and trench fill material.
See the roadside and open space swales operation and maintenance details for more information.
**SUMMARY OF INSPECTION AND MAINTENANCE REQUIREMENTS FOR GRASS SWALES AND GRASS BUFFERS**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic/Deliberate Removal</td>
<td>Biennially</td>
<td>NBC streets</td>
<td>Remove and properly dispose of trash and debris from the sidewalk.</td>
</tr>
<tr>
<td>Mowing</td>
<td>Routine, as needed</td>
<td>Healthy grass present</td>
<td>Mow for height/appearance.</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>Three times annually</td>
<td>Evidence of insufficient or excessive watering; broken or missing parts</td>
<td>SPRING: start up systems; repair for even coverage and correct timer settings. SUMMER: repair for even coverage and correct timer settings. FAUL: drain and winterize system (follow watering regulations).</td>
</tr>
<tr>
<td>Irrigation (Non-Automatic)</td>
<td>As needed to maintain healthy grass</td>
<td>Evidence of insufficient or excessive watering</td>
<td>Water as needed to maintain healthy grass (follow watering regulations).</td>
</tr>
<tr>
<td>Nuisance Control</td>
<td>As needed, based upon inspections</td>
<td>Evidence of weeds, unwanted vegetation</td>
<td>Treat with herbicide or hand pull; consult with weed specialist.</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Treat with EPA approved chemicals; perform minor maintenance to remove standing water.</td>
</tr>
<tr>
<td>Level Spreader (GB only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow; erosion or obstructions</td>
<td>Level spreader is needed to improve drainage.</td>
</tr>
</tbody>
</table>

- **SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES FOR ROADSIDE AND OPEN SPACE SWALES**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic/Deliberate Removal</td>
<td>Biennially</td>
<td>NBC streets</td>
<td>Remove and properly dispose of trash and debris from the sidewalk.</td>
</tr>
<tr>
<td>Mowing</td>
<td>Routine, as needed</td>
<td>Healthy grass present</td>
<td>Mow for height/appearance.</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>Three times annually</td>
<td>Evidence of insufficient or excessive watering; broken or missing parts</td>
<td>SPRING: start up systems; repair for even coverage and correct timer settings. SUMMER: repair for even coverage and correct timer settings. FAUL: drain and winterize system (follow watering regulations).</td>
</tr>
<tr>
<td>Irrigation (Non-Automatic)</td>
<td>As needed to maintain healthy grass</td>
<td>Evidence of insufficient or excessive watering</td>
<td>Water as needed to maintain healthy grass (follow watering regulations).</td>
</tr>
<tr>
<td>Nuisance Control</td>
<td>As needed, based upon inspections</td>
<td>Evidence of weeds, unwanted vegetation</td>
<td>Treat with herbicide or hand pull; consult with weed specialist.</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Treat with EPA approved chemicals; perform minor maintenance to remove standing water.</td>
</tr>
<tr>
<td>Level Spreader (GB only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow; erosion or obstructions</td>
<td>Level spreader is needed to improve drainage.</td>
</tr>
<tr>
<td>Roadside Damage</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Replace parts and test system.</td>
</tr>
</tbody>
</table>

**SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES FOR ROADSIDE AND OPEN SPACE SWALES**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic/Deliberate Removal</td>
<td>Biennially</td>
<td>NBC streets</td>
<td>Remove and properly dispose of trash and debris from the sidewalk.</td>
</tr>
<tr>
<td>Mowing</td>
<td>Routine, as needed</td>
<td>Healthy grass present</td>
<td>Mow for height/appearance.</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>Three times annually</td>
<td>Evidence of insufficient or excessive watering; broken or missing parts</td>
<td>SPRING: start up systems; repair for even coverage and correct timer settings. SUMMER: repair for even coverage and correct timer settings. FAUL: drain and winterize system (follow watering regulations).</td>
</tr>
<tr>
<td>Irrigation (Non-Automatic)</td>
<td>As needed to maintain healthy grass</td>
<td>Evidence of insufficient or excessive watering</td>
<td>Water as needed to maintain healthy grass (follow watering regulations).</td>
</tr>
<tr>
<td>Nuisance Control</td>
<td>As needed, based upon inspections</td>
<td>Evidence of weeds, unwanted vegetation</td>
<td>Treat with herbicide or hand pull; consult with weed specialist.</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Treat with EPA approved chemicals; perform minor maintenance to remove standing water.</td>
</tr>
<tr>
<td>Level Spreader (GB only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow; erosion or obstructions</td>
<td>Level spreader is needed to improve drainage.</td>
</tr>
<tr>
<td>Roadside Damage</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Replace parts and test system.</td>
</tr>
</tbody>
</table>

- **SUMMARY OF MINOR MAINTENANCE ACTIVITIES FOR ROADSIDE AND OPEN SPACE SWALES**

  THESE ACTIVITIES REQUIRE PRIOR CONSULTATION WITH THE TOWN

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>As needed</td>
<td>Bankfull height</td>
<td>Remove and dispose of sediment.</td>
</tr>
<tr>
<td>Erosion/Ponding</td>
<td>As needed, based upon inspections</td>
<td>Severe evidence of ponding</td>
<td>Repair and fill depressions, sod or seed damaged area.</td>
</tr>
<tr>
<td>Vegetation Removal</td>
<td>As needed, based upon inspections</td>
<td>Evidence of weeds, shrubs or excessive vegetation</td>
<td>Dry vegetation, restore grades and surface.</td>
</tr>
<tr>
<td>Revegetation</td>
<td>As needed, based upon inspections</td>
<td>Areas without vegetation</td>
<td>Replace grass by sodding or reseeding.</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of broken or missing parts</td>
<td>Replace parts and test system.</td>
</tr>
<tr>
<td>Level Spreader (GB only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow; erosion or obstructions</td>
<td>Repair sections of level spreader and address issue.</td>
</tr>
<tr>
<td>Fertilization or Soil Amendments</td>
<td>As needed, minimum fertilization</td>
<td>Areas with pale color, areas with poor grass growth not due to irrigation problems</td>
<td>Contact the Town for guidance.</td>
</tr>
<tr>
<td>Vehicle Tracks (if crossing roadway)</td>
<td>As needed, based upon inspections</td>
<td>Depression from vehicle tracks, vegetation damage</td>
<td>Repair and fill depressions, sod or seed damaged area.</td>
</tr>
</tbody>
</table>

**SUMMARY OF MAJOR MAINTENANCE ACTIVITIES FOR ROADSIDE AND OPEN SPACE SWALES**

THESE ACTIVITIES REQUIRE PRIOR CONSULTATION WITH THE TOWN

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed, based upon scheduled inspections</td>
<td>Large operation of sediments</td>
<td>Remove and dispose of sediment.</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed, based upon scheduled inspections</td>
<td>Severe erosion including gullying, excessive soil displacement, areas of settlement, holes</td>
<td>Remove and dispose of sediment.</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed, based upon scheduled inspections</td>
<td>Large operation of sediments</td>
<td>Repair structural defects due to causes of problem.</td>
</tr>
<tr>
<td>Grass Swale/Buffer Residue</td>
<td>As needed, due to complete failure</td>
<td>Removal of filter media and understory system</td>
<td>Contact the Town.</td>
</tr>
</tbody>
</table>

**ROADSIDE SWALE - TYPICAL SECTION (WITH UNDERDRAIN)**

- **ROUTESIDE SWALE TYPICAL SECTION (WITH UNDERDRAIN)**

  - **OPEN SPACE SWALE TYPICAL SECTION (WITH UNDERDRAIN)**

  - **ROUTESIDE SWALE TYPICAL SECTION (WITH UNDERDRAIN)**

- **ROADSIDE SWALE - TYPICAL SECTION (WITH UNDERDRAIN)**

  - **OPEN SPACE SWALE TYPICAL SECTION (WITH UNDERDRAIN)**

  - **ROUTESIDE SWALE TYPICAL SECTION (WITH UNDERDRAIN)**

  - **ROADSIDE SWALE - TYPICAL SECTION (WITH UNDERDRAIN)**
Standard Operation Procedures (SOP)
For
Grass Buffers and Grass Swales (GB/GS)
Inspection and Maintenance

March 2012
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## ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDPHE</td>
<td>Colorado Department of Public Health and Environment</td>
</tr>
<tr>
<td>CDPS</td>
<td>Colorado Discharge Permit System</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>EDB</td>
<td>Extended Detention Basin</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GS</td>
<td>Grass Swale</td>
</tr>
<tr>
<td>MS4</td>
<td>Municipal Separate Storm Sewer System</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>PBMP</td>
<td>Permanent Best Management Practice</td>
</tr>
<tr>
<td>PLD</td>
<td>Porous Landscape Detention</td>
</tr>
<tr>
<td>SDECM</td>
<td>Storm Drainage and Environmental Criteria Manual</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>WQCD</td>
<td>Water Quality Control Division of the CDPHE</td>
</tr>
<tr>
<td>WQCV</td>
<td>Water Quality Capture Volume</td>
</tr>
</tbody>
</table>
**GB/GS-1 BACKGROUND**

Grass Buffers and Grass Swales are common types of Stormwater Management Facilities utilized within the Front Range of Colorado. Grass Buffers and Grass Swales promote filtration, infiltration, and settling to reduce runoff volume.

**Grass Buffers** are uniformly graded and densely vegetated areas of turf grass. They are designed to accommodate sheet flow rather than concentrated or channelized flow. They are typically located adjacent to impervious areas such as parking lots or along highways and roads. Grass Buffers are designed to evenly distribute runoff across the width of the buffer to achieve uniform sheet-flow conditions. A flow spreader may be incorporated for this purpose. In some cases, grass buffers may have underdrain systems.

**Grass Swales** are densely vegetated drainageways with low-pitched side slopes that collect and convey runoff. Design of their longitudinal slope and cross section forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion. Berms or check dams may be installed perpendicular to the flow to decrease the slope and slow down the flow. Grass swales are used in open space and landscaped areas to collect and convey overland flows, and can be used as an alternative to curb and gutter to collect and convey street flows. Some grass swales are designed with underdrain systems.

**GB/GS-2 INSPECTING GRASS BUFFERS AND SWALES**

**GB/GS-2.1 ACCESS AND EASEMENTS**

Inspection and maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the access points and maintenance easements of the GB/GSs within this development.

**GB/GS-2.2 STORMWATER MANAGEMENT FACILITIES LOCATIONS**

Inspection and maintenance personnel may utilize the stormwater facility map located in the Appendix containing the locations of the GB/GSs within this development.

**GB/GS-2.3 GRASS BUFFER - GRASS SWALE (GB/GS) FEATURES**

GB/GSs are unique stormwater quality facilities, in that they are typically viewed as landscaping or ground cover, and are often overlooked as water quality treatment facilities. GB/GSs have a number of features that are designed to serve a particular function. It is important for maintenance personnel to understand the function of each of these features. Below is a list of the common features of a Grass Swale or Grass Buffer and the corresponding maintenance inspection items that can be anticipated:
### GB/GS-2.3.1 Grass Swale Bottom and Side Slopes; Grass Buffer Strips

Grass Swales and Grass Buffers require general maintenance of the turf grass and repair of any rill or gully development. The bottom and side slopes of grass swales and the area of grass buffer strips should be maintained with dense vegetative cover, and should not be eroded or bare. Inspection over the first few years will help to determine if any problems are developing.

The typical maintenance items that are required at the side slopes and bottoms of grass swales and within grass buffer areas are as follows:

- **Sediment Accumulation.** The purpose of the grass swale or buffer is to slow down flow and allow sedimentation to occur. To prevent a loss in performance of the swale or buffer, sediment that accumulates must be removed on a timely basis.

- **Vegetation Sparse.** Grass Swales and Buffers rely on a healthy, dense cover of grass to decrease the flow velocities and promote sedimentation and infiltration. Grasses that are diseased, dying or otherwise damaged should be replaced. All bare areas should be reseeded or patched. Causes which contribute to the damaged grass cover, including lack of adequate irrigation, traces of pedestrian or vehicular traffic, uncontrolled weeds etc., should be identified and remedied.

- **Erosion Present.** Lack of adequate vegetative cover or excessive flow velocities may result in rill or gully development, and erosion of the swale or buffer strip. Erosion will require maintenance to prevent further damage to the area and to prevent sediment transport.

- **Standing Water/Boggy Areas.** Grass swales and buffers are generally intended to drain and be dry in between rain events. If areas of standing water are present, the swale or buffer may need to be evaluated for proper grade to ensure drainage. In some cases, where
underdrains are used, the underdrains should be inspected to ensure that they are not clogged.

**GB/GS-2.3.2 Inflow Points**

Inflow points are the points of stormwater discharge into the swale or buffer. Inflow points are typically pipe outfalls, other grass swales or buffers, or curb cuts from upstream impervious areas, such as parking lots. Some form of energy dissipation is typically provided immediately downstream of the inflow point into the grass swale or buffer. Energy dissipation devices may include riprap aprons, or flow spreader devices.

The typical maintenance items that are required at inflow points are as follows:

a) *Riprap Displaced/Rundown Damaged.* Often, because of, the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, if soil is present between the riprap, or if the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b) *Erosion Present/Outfall Undercut.* In some situations, an energy dissipater may have not been provided, or may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

c) *Sediment Accumulation.* Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance, sediment that accumulates in this area must be removed on a timely basis.

**GB/GS-2.3.3 Underdrain System**

Some grass swales and buffers that have a flatter slope or soils which do not allow adequate percolation or are in areas with a continuous base flow may have been installed with an underdrain system. Underdrains typically consist of an aggregate layer and slotted PVC pipe. The aggregate layer allows for storage of treated stormwater runoff prior to the discharge of the runoff through the slotted PVC pipe.

With proper maintenance of the grassed areas, there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning in the event that it becomes clogged.

**GB/GS-2.3.4 Grade Control Level Spreader**

Grass swales that are installed in areas with steep longitudinal slopes often necessitate the use of grade control checks or drop structures. Grade control structures are typically either concrete walls or riprap structures that serve to provide a reinforced drop at specific locations in the channel, reducing the longitudinal slope between the control structures.
Level Spreaders are installed on the upstream of grass buffers to evenly distribute flows along the design length. Level spreaders may consist of slotted curbing, modular block porous pavement, level walls or other spreader devices.

The typical maintenance activities that are required for grade control structures and level spreaders are as follows:

a) **Erosion present.** Grade control structures and level spreaders are provided to reduce the potential for erosion of the grassed swale or buffer areas. Erosion within the vicinity of the control structure or level spreader indicates that the structure is not functioning as intended and requires maintenance to prevent future erosion and damage.

b) **Structural damage.** Structural damage can occur at anytime along the life of the facility. Typically, structural damage occurs with the deterioration of concrete, including cracking, spalling or settling and the erosion and deterioration of the riprap structures. Level spreaders may settle unevenly creating low areas, which concentrate the flows.

**GB/GS-2.3.5 Irrigation**

Grass Buffers and Grass Swales depend on healthy, dense turf grass to function, and therefore require an irrigation system, to provide a consistent water supply. Typically, the condition of the grass cover will provide evidence of the effectiveness and maintenance needs of the irrigation system.

The typical maintenance activities that are required for irrigation systems are as follows:

Irrigation systems will generally require routine periodic maintenance and adjustment to ensure that proper amounts of water are being applied given the weather conditions, and that they are providing coverage to all areas of the grass to eliminate bare spots.

**GB/GS-2.3.6 Miscellaneous**

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the GB/GS. This category on the inspection form is for maintenance items that are commonly found in the GB/GS, but may not be attributed to an individual feature.

a) **Encroachment in Easement Area.** The Town of Parker requires that GB/GS be located in tracts or drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.

b) **Public Hazards.** Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately.
c) **Burrowing Animals/Pests.** Prairie dogs and other burrowing rodents may cause damage to the GB/GS features and negatively affect the vegetation within the GB/GS.

d) **Other.** Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

**GB/GS-2.4 INSPECTION FORMS**

GB/GS Inspection forms are located in the Appendix. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. Copies of these inspections forms shall be kept indefinitely by the property owner or manager and made available to the Town of Parker upon request.

**GB/GS-3 MAINTAINING GRASS BUFFERS & GRASS SWALES**

**GB/GS-3.1 MAINTENANCE PERSONNEL**

Maintenance personnel must be experienced to properly maintain GB/GSs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

**GB/GS-3.2 EQUIPMENT**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a GB/GS:

1. Mowing Tractors
2. Trimmers (extra string)
3. Shovels
4. Rakes
5. All Surface Vehicle (ASVs)
6. Engineers Level (laser)
7. Erosion Control Blanket(s)
8. Mulch
9. Sod or Seed
10. Illicit Discharge Cleanup Kits
11. Trash Bags

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.
GB/GS-3.3  MAINTENANCE FORMS
The GB/GS Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The GB/GS Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Parker per the requirements of the Operations and Maintenance Manual. The GB/GS Maintenance form is located in the Appendix.

GB/GS-3.4  MAINTENANCE CATEGORIES AND ACTIVITIES
A typical GB/GS Maintenance Program will consist of three broad categories of work: Routine, Minor and Major. Within each category of work, a variety of maintenance activities can be performed on a GB/GS. A maintenance activity can be specific to each feature within the GB/GS, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a GB/GS.

A variety of maintenance activities are typical of GB/GSs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the GB/GS or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

GB/GS-3.5  ROUTINE MAINTENANCE ACTIVITIES
The majority of this work consists of scheduled mowing, trash and debris pickups and landscape care for the GB/GS during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items typically do not require any prior correspondence with the Town, however, completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period.

The Routine Maintenance Activities are summarized below, and further described in the following sections.
<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annual and before mowing</td>
<td>Trash &amp; debris in GB/GS</td>
<td>Remove and properly dispose of trash and debris</td>
</tr>
<tr>
<td>Mowing</td>
<td>Routine – as necessary to maintain 2” – 4” grass height</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height for turf grass; 4” to 6” for native grass</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>Three times annually</td>
<td>Areas of insufficient or excess watering; broken or missing parts</td>
<td>SPRING: start up system; test for even coverage and correct timer settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SUMMER: test for even coverage and correct timer settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FALL: drain and winterized system (follow watering regulations)</td>
</tr>
<tr>
<td>Irrigation (Not Automatic)</td>
<td>As needed to maintain healthy grass</td>
<td>Areas of insufficient or excess watering</td>
<td>Water as needed to maintain healthy grass; (follow watering regulations)</td>
</tr>
<tr>
<td>Weed Control</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull; consult a local Weed Inspector</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed, based upon inspections</td>
<td>Standing water/ mosquito habitat</td>
<td>Perform maintenance to eliminate standing water; Treat w/ EPA approved chemicals</td>
</tr>
<tr>
<td>Level Spreader (Grass Buffer only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow/localized erosion</td>
<td>Look for cause; repair, fill or revegetate areas of erosion</td>
</tr>
<tr>
<td>Rodent Damage</td>
<td>As needed, based upon inspections</td>
<td>Holes, small piles of dirt, raised burrows</td>
<td>Evaluate damage; contact the Town for guidance</td>
</tr>
</tbody>
</table>

**GB/GS-3.5.1 Trash/Debris Removal**

Trash and debris must be removed from the GB/GS area to allow for proper functioning and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency:* Routine – Prior to mowing operations and a minimum of twice annually.

**GB/GS-3.5.2 Mowing**

Routine mowing of the turf grass embankments is necessary to maintain an appropriate grass height and to improve the overall appearance of the GB/GS. Turf grass should be mowed to a height of 2 to 4- inches (4 – 6- inches for native grass) and shall be bagged to prevent potential contamination of the filter media.

*Frequency:* Routine – as necessary to maintain grass height.
**GB/GS-3.5.3  Irrigation**

Irrigation systems should be maintained in proper working order to provide an adequate water supply to support the grass cover. When automatic irrigation systems are not available, alternate methods for providing a water supply during times of drought must be provided.

Automatic irrigation systems should be maintained routinely throughout the growing season to ensure that they are providing the appropriate amounts of water, and are providing complete coverage of the area. Sprinkler heads should be adjusted as necessary, and checked for broken or missing parts.

*Frequency:* Routine as needed throughout the growing season, plus the following:
- **SPRING:** Start up the system and test for even coverage and correct timer settings.
- **SUMMER:** Test for even coverage and correct timer settings.
- **FALL:** Drain and winterize the system.

**GB/GS-3.5.4  Weed Control**

Noxious weeds and other unwanted vegetation must be treated as needed throughout the GB/GS. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the Town is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

*Frequency:* Routine – As needed based upon inspections.

**GB/GS-3.5.5  Mosquito Treatment**

GB/GS facilities are intended to drain, and should not have areas of standing water which creates mosquito habitat. Causes of the standing water or boggy conditions should be investigated and remediated as necessary to eliminate the standing water. Only EPA approved chemicals should be applied in accordance with the recommendations of the manufacturer.

*Frequency:* As needed based upon inspections.

**GB/GS-3.5.6  Level Spreader (Grass Buffer only)**

Evidence of uneven flow and localized erosion downstream of the level spreader indicate that the flow is not evenly distributed along the length of the spreader. Areas of erosion should be repaired, filled and revegetated. Causes for the erosion should be investigated and repaired.

*Frequency:* As needed based upon inspections.

**GB/GS-3.5.7  Rodent Damage**

Small holes, piles of dirt, and raised burrows are evidence of rodent damage. Damaged areas should be repaired and revegetated. Consultation with an animal control specialist or the Division of Wildlife may be required for persistent problems.
**GB/GS-3.6 MINOR MAINTENANCE ACTIVITIES**

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items require prior approval from the Town of Parker. Completed inspection and maintenance forms shall be submitted to the Town for each inspection and maintenance period.

**TABLE GB/GS-3**

**SUMMARY OF MINOR MAINTENANCE ACTIVITIES**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>As needed.</td>
<td>Sediment build-up.</td>
<td>Remove and properly dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills and gullies forming on slopes and other areas</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Vegetation Removal</td>
<td>As needed, based upon inspection</td>
<td>Trees, willows, shrubs impeding flow</td>
<td>Remove vegetation; restore correct grade and surface</td>
</tr>
<tr>
<td>Revegetation</td>
<td>As needed, based upon inspection</td>
<td>Areas without grass</td>
<td>Replace grass by sodding or seeding</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>As needed, based upon inspection</td>
<td>Evidence of broken or missing parts</td>
<td>Replace parts and test system</td>
</tr>
<tr>
<td>Level Spreader (Grass Buffer Only)</td>
<td>As needed, based upon inspection</td>
<td>Evidence of uneven flow; erosion; or rills/gullies</td>
<td>Repair sections of level spreader and address cause</td>
</tr>
<tr>
<td>Fertilization or Soil Amendment</td>
<td>As needed, minimize fertilization</td>
<td>Grass with pale color; areas with poor grass growth not due to irrigation problems</td>
<td>Consult with turf specialist; Test soil</td>
</tr>
<tr>
<td>Vehicle Tracks (Along Roadways)</td>
<td>As needed, based upon inspection</td>
<td>Depressions from vehicle tracks; vegetation damage</td>
<td>Repair and fill depressions; sod or seed damaged areas</td>
</tr>
</tbody>
</table>

**GB/GS-3.6.1 Sediment Removal**

Sediment removal is necessary to ensure proper function of the grass swale or buffer. Care should be taken when removing sediment to prevent damage to the turf grass and surrounding areas. Excessive amounts of sediment are an indication of upstream erosion or lack of adequate BMPs during construction activities. Causes for contributions of excess sediment should be investigated and addressed.

*Frequency: As needed based upon inspections.*
GB/GS-3.6.2  Erosion Repair

The repair of eroded areas is necessary to ensure the proper functioning of the GB/GS, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to vegetation and embankments, to rills and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion in a GS/GB is generally the result of excessive velocities caused by steep slopes. It may be necessary to make design improvements to the swale or buffer when erosion becomes a major maintenance item.

*Frequency:* As necessary, based upon inspections.

GB/GS-3.6.3  Vegetation Removal

Weeds, Shrubs, Willows and other unwanted vegetation that develops in the grass swale or buffer area may impede the flow and cause standing water or back flow problems. It is necessary to remove unwanted vegetation as soon as it appears. Remove the unwanted vegetation, and restore the correct grade. Revegetate with seed or sod.

*Frequency:* As necessary, based upon inspections.

GB/GS-3.6.4  Revegetation

Bare areas should be repaired as soon as possible. Repair bare areas with grass or sod. Causes of the problem, such as inadequate water supply or diseased grasses, should be investigated and resolved.

*Frequency:* As necessary, based upon inspections.

GB/GS-3.6.5  Irrigation (Automatic)

Irrigation systems require routine maintenance in accordance with the manufacturer’s recommendations (valves, timer, etc.), and maintenance of the pipe and heads to ensure that even coverage is being applied, and that there are no missing or broken parts. Timing systems should be checked to verify that the correct amount of water is being applied to the grassed areas for the seasonal conditions.

*Frequency:* As necessary, based upon inspections.

GB/GS-3.6.6  Level Spreader

Level Spreaders that are no longer level, or have developed damaged areas of cracking or spalling, allow flows to concentrate in these depressed areas instead of being distributed over the length of the structure. Also, build up of grasses along the edge of the spreader may create an uneven flow distribution. Rills, gullies and other erosion that develops downstream of level spreaders should be repaired and reseeded or sodded. Causes of the erosion should be investigated and addressed.
Frequency: As necessary, based upon inspections.

GB/GS-3.6.7  Fertilization/Soil Amendment
Grass Buffers and Swales rely on healthy, dense turf in order to function properly. Grasses that appear to be diseased, dying or unhealthy may require amendments. Fertilizers should be applied in the minimum amounts recommended by the manufacturer.

Frequency: As necessary, based upon inspections.

GB/GS-3.6.8  Vehicle Tracks
GB/GSs that are adjacent to roadway sections may be damaged by vehicle tracks. Rutted areas should be filled in and revegetated as soon as possible. Frequent problems associated with vehicle traffic (such as around corners) may require a barrier or sign to avoid vehicular traffic within the grassed areas.

Frequency: As necessary, based upon inspections.

GB/GS-3.7 MAJOR MAINTENANCE ACTIVITIES
This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the Town of Parker to ensure the proper maintenance is performed. This work requires that the Town Staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.
<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – level spreader, grade control structures, irrigation components, and ponding water.</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>GB/GS Rebuild</td>
<td>As needed – due to complete failure of GB/GS</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact the Town of Parker</td>
</tr>
</tbody>
</table>

**GB/GS-3.7.1 Major Sediment/Pollutant Removal**

Major sediment removal consists of removal of large quantities of pollutants/sediment /landscaping material. Stormwater sediments removed from GB/GSs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

*Frequency: Non-routine – Repair as needed, based upon inspections.*

**GB/GS-3.7.2 Major Erosion Repair**

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

*Frequency: Non-routine – Repair as needed, based upon inspections.*
GB/GS-3.7.3 Structural Repair
A GB/GS generally includes level spreader and grade control structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Town of Parker shall take place prior to all structural repairs.

*Frequency:* Non-routine – Repair as needed, based upon inspections.

GB/GS-3.7.4 GB/GS Rebuild
In very rare cases, a GB/GS may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the GB/GS. Consultation with the Town of Parker shall take place prior to any rebuild project.

*Frequency:* Non-routine – As needed based upon inspections.

Reference:
This Manual is adapted from the Douglas County, Colorado, Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance, July 2005