3.0 Introduction

Stormwater management is an integral component of overall development planning and site design that must be addressed in the earliest planning stages. Initial feasibility studies or preliminary site analyses can not be properly performed without a clear understanding of stormwater management regulatory requirements and criteria, site design practices which lead to more effective management of stormwater, existing site characteristics or features which affect stormwater management concepts, and the fact that stormwater can not be properly managed by allocating minimal space in a portion of a site or development which is convenient or "out of site". Incorporating stormwater management planning in the initial stages and designing stormwater management facilities as site amenities can lead to reduced infrastructure construction and maintenance costs, better long term function of facilities and increased property values. Initiating stormwater management independently, after development planning or site layout has been accomplished, may lead to inadequate space being allocated for stormwater management and other design challenges. Often, this results in an increase in infrastructure costs and difficulty meeting regulatory requirements and criteria. Arapahoe County will not accept designs that compromise long term function and maintainability.

3.1 Planning for Stormwater Management

The following sections provide some general discussion regarding impacts of urbanization and factors to consider when planning for stormwater management in the site design or development layout processes. Additional guidance for planning of the urban storm runoff system is provided in the Planning section of the UDFCD Manual.

3.1.1 Impacts of Development. The increased runoff rates and volumes, associated with urbanization and development, can significantly impact downstream properties, existing infrastructure, and natural drainageways and other resources. Flooding of downstream properties can result if existing drainage facilities are not adequate to handle the increased runoff peak flows. Drainageways are subject to increased peak discharges, runoff volumes, and more frequent runoff events. Channel bank erosion and degradation occur, if channel stabilization measures are not implemented as development occurs.

In addition to challenges presented by increased runoff quantities, changes in stormwater runoff quality, associated with urbanization, can have significant impacts on rivers, streams, and lakes. Some of the urban stormwater pollutants are sediments, nutrients, microbes, organic matter, toxic pollutants, and trash and debris.

3.1.2 Multi-purpose Resource. Although sometimes considered a liability to urbanization, stormwater runoff is an urban resource, having many potential beneficial uses that are compatible with adjacent land uses and Colorado Water Law. When treated as a resource, aesthetic and water quality aspects become increasingly important. The stormwater urban sub-system should be multi-

purpose to satisfy the competing demands for land within the County. For example, stormwater management facilities can be designed to fulfill recreational purposes and open space requirements along with stormwater runoff conveyance or storage. In addition, facilities not intended primarily for stormwater management, may be designed to incorporate water quantity and quality benefits. Stormwater runoff is considered to be an integral part of the surface and groundwater resources and is recognized for its potential for other uses.

3.1.3 Allocation of Space. The stormwater management system is an integral part of the total urban system and therefore, planning of drainage facilities must be included in the urbanization process. Stormwater management facilities, such as channels and storm sewers, may serve conveyance, storage, and water quality functions. When the space requirements are considered, the provision for adequate drainage becomes a competing use for space along with other land uses. If adequate provision is not made in a land use plan for the drainage requirements, storm water runoff will conflict with other land uses and will impair or even disrupt the functioning of other urban systems. The County requires storm drainage planning for all developments to include the allocation of space for drainage facility construction and maintenance, which includes the dedication of right-of-way and/or easements.

3.1.4 Regional and Local Master Planning. In recognition that drainage boundaries are non-jurisdictional, the County, in cooperation with the District and other local jurisdictions, has participated in preparing regional, basin-wide master plans to define the major drainageway stabilization improvements and other stormwater management improvements that are needed to mitigate drainage problems or impacts associated with development. The County will also encourage, and may choose to participate in, preparation of such future master plans. In the absence of regional master plans, the developer will be responsible for providing additional information as necessary, and may be required to participate in master planning efforts to ensure that the proposed development and associated stormwater runoff system will be compatible with the surrounding properties in the drainage basin. The County may choose to undertake preparation of such plans in unplanned basins. In order to cover it's costs, the County assesses a drainage master planning fee with preliminary plats. The County will require that stormwater management facilities be designed in conformance with approved regional flood control or water quality master plans.

3.1.5 Site Design and Layout. Good site planning and development layout is the key to effective stormwater management. Initial planning must identify important natural features or environmentally sensitive areas, such as floodplains or wetlands. Protection of those areas should be incorporated into the site plan or development plan concept. Other existing site characteristics such as topography, geologic features, or soils may also present unique challenges when developing the stormwater management plan for a site or development. Generally, there are significant benefits to implementing practices that reduce runoff volumes, slow runoff velocities, and provide water quality treatment close

to the source. The incorporation of infiltration, detention and stormwater conveyance into landscaped areas furthers the concept of developing stormwater management facilities that are amenities, which are aesthetically pleasing and effective. Attempts to address stormwater management in later stages of development planning will lead to ineffective and costly stormwater management.

3.1.6 Volume Reduction Practices. Runoff volume and peak reduction, through the implementation of the Minimizing Directly Connected Impervious Areas concept should be considered as an important component in effective stormwater management planning. The goals of implementing this practice are to reduce impervious areas or the effective imperviousness of the site and to slow down runoff and promote infiltration. Reduction in size and cost of downstream stormwater management infrastructure is another potential benefit of implementing Minimizing Directly Connected Impervious Area. Reduction of paved or impervious areas and the use of porous pavement, grass buffers, and grass swales are several of the approaches that are part of implementing Minimizing Directly Connected Impervious Area. The New Development Planning chapter of UDFCD Volume 3 and Chapter 14 of these Criteria should be consulted for more detailed discussion regarding the implementation of Minimizing Directly Connected Impervious Areas.

3.1.7 Design of Stormwater Quantity Management Improvements. Detention storage facilities and improvements that convey stormwater runoff must be carefully planned and integrated into the first stages of site planning. Sufficient space must be allocated to allow for designs that meet all technical requirements and that ensure long-term function and maintainability. Conveyance facilities that are aesthetic and promote infiltration of stormwater runoff should be considered where feasible. Inlets, when needed to collect stormwater runoff at points of concentration, shall be located and designed to maximize collection or interception efficiency and with consideration of the proposed use in the vicinity of the inlet locations.

Inlets, when needed to collect stormwater runoff shall be located and designed to maximize collection or interception efficiency and with consideration of the proposed use in the vicinity of the inlet locations. Inlets in vehicular traffic or parking areas are much different than inlets in landscaped or pedestrian traffic areas. Inlet types and grate designs must be chosen with those considerations in mind. Potential inundation depths and limits at inlets must also be acceptable when considering the adjacent property use.

Underground storm sewer systems, required to convey stormwater runoff collected at inlets, must be integrated and located within the site, to facilitate proper function and ease of maintenance. Issues to be considered when developing preliminary storm sewer locations include, but are not limited to, proximity to proposed structures, other utilities, and adjacent properties, depth of cover, traffic loading, proposed surface improvements, and accessibility for future maintenance.

Detention storage facilities have special design considerations and space allocation requirements. These facilities should not be designed based on minimum required volume calculations, by assuming that retaining walls or steep slopes can be used to minimize the land area needed for the improvements. Generally, aesthetics and long-term operation and ease of maintenance are severely compromised when detailed design criteria and maintenance access requirements are not considered in the earliest planning stages. Detention pond designs that incorporate detention storage into the overall landscape plan can lead to detention ponds that are viewed as site amenities.

3.1.8 Water Quality Treatment. Post construction water quality best management practices are required with all new development or redevelopment within the County. The County strongly *recommends* stormwater quality and peak flow reduction practices associated with Minimizing Directly Connected Impervious Area and will require that applicants address opportunities for providing Minimizing Directly Connected Impervious Area in the drainage report for the project. Best management practices that provide water quality capture volume will be required for the excess runoff that remains after the volume reduction practices are accounted for. Best management practices that include water quality capture volume drain slowly which results in sedimentation of particles and removal of pollutants. Common water quality capture volume best management practices are porous pavement detention, porous landscape detention, extended detention basins, sand filter extended detention basins, and constructed wetland basins. Incorporation of these best management practices into a site or development must be addressed in the initial planning stages and requires a well coordinated effort between the land planners, landscape architect, and the engineers responsible for stormwater management design. Issues associated with the long-term maintenance of permanent best management practices must be considered when selecting appropriate best management practices for a site. Implementation of water quality best management practices must be addressed hand in hand with the stormwater conveyance and detention storage facilities. Consult UDFCD Volume 3 and the criteria in this manual for detailed design requirements, considerations, limitations, and information regarding proper implementation.

3.1.9 Channel Stabilization. Drainageways experience more frequent runoff events as watersheds develop. These runoff events increase in rate and volume as the imperviousness in the basin changes. Channel bank erosion and degradation can occur with changes in hydrology, if channel stabilization measures are not implemented with development. There has been a common misconception that providing on-site detention mitigates impacts to downstream drainageways for all storm events. Typical detention facilities often do not provide mitigation for the more frequent runoff volumes or events. Drainageway stabilization within or adjacent to a development must be addressed in the overall stormwater management plan. Many watershed specific Outfall Systems Planning Studies and Master Plans have been developed, through cooperative efforts of the County, UDFCD, and other local governments. These studies provide conceptual or preliminary design information regarding stabilization of many major

drainageways within the County. The overall stormwater management plan for any development must address the recommendations contained within the Outfall Systems Planning Studies or Master Plan.

3.1.10 Maintenance Considerations. Maintenance activities, including routine maintenance, restorative maintenance, and rehabilitation are required to ensure the long-term function and effectiveness of stormwater management facilities and infrastructure. Initial site planning must incorporate provisions for adequate access and space to perform maintenance activities for all stormwater management facilities. Proper design is also critical to the long-term function and can help to reduce required maintenance activities. The County will not approve stormwater management facilities, if adequate space is not allocated or designs are proposed which limit access and proper function. All facility designs will be held to the same standards, regardless of the organization or entity that has accepted responsibility for maintenance. Maintenance responsibilities and access issues are discussed in more detail in Section 3.5 of this chapter.

3.1.11 Drainage Law. The general principles of Colorado drainage law and specific Colorado Revised Statutes guide and affect many aspects of stormwater management, including, but not limited to, private and municipal liability, maintenance and repair of drainage improvements, construction of drainage improvements by local governments, financing of drainage improvements, floodplain management, irrigation ditches, dams and detention facilities, water rights, and water quality. The Drainage Law chapter in UDFCD Volume 1 provides a good outline of many of the general principles of Colorado drainage law and it should be consulted for general reference.

3.1.12 County Permits. The construction of stormwater management facilities within the County may require coordination with several County permits. These include:

1. Public Improvements Construction Permit. All public improvements constructed in the County require an Arapahoe County Public Improvements Construction Permit. More information on the Arapahoe County Public Improvements Construction Permit can be found in the County's Roadway Design and Construction Standards.

2. Floodplain Development Permit. Projects that include work within designated 100-year floodplain limits of major drainageways require a Floodplain Development Permit. Additional information on the floodplain permit can be found in Chapter 5 of this criteria.

3. Street Cut and Right-of-Way Use Permit. Projects that include work within and/or use of the County right-of-way must obtain an Arapahoe County Street Cut/Right-of-Way Use permit. Information on the Arapahoe County Street Cut/Right-of-Way Use permit can be found in the County's Roadway Design and Construction Standards.

4. GESC Permit. Arapahoe County requires that a GESC (Grading, Erosion, and Sedimentation Control) Permit be obtained prior to the start of land disturbing activities within the unincorporated areas of the County. Information on the County's GESC permit requirements can be obtained in the Arapahoe County GESC Manual.

3.1.13 Environmental Permitting. In addition to County permitting processes, the construction of stormwater management facilities must be coordinated through the Colorado Department of Public Health and Environment with regard to the Stormwater Construction permitting requirements, and through the United States Army Corps of Engineers (USACE), relative to Section 404 of the Clean Water Act, and compliance with the requirements of Sections 7 and 9 of the Endangered Species Act of 1973. It is strongly recommended that initial project planning incorporate input from the appropriate agencies to determine permitting process requirements, if applicable, as these processes can be complex and time consuming.

Compliance with state or federal permitting requirements does not obviate the need to fully comply with County regulations, standards, or criteria. If necessary, joint discussions between all regulatory agencies shall be initiated in project planning stages and continued, as needed, through the various project phases, to ensure that the requirements of all regulatory agencies are fully satisfied.

3.2 Special Planning Areas and Districts

There are Special Planning Areas or Districts within the County where additional or unique considerations affect stormwater management planning or design. Special policies or recommendations may implemented for these areas, as discussed in the following sections.

3.2.1 Four Square Mile Area. Roughly bounded by Mississippi, Dayton, Yale, and Quebec streets, this area has been designated as a special planning area. This is an area of the County that may lack adequate outfall systems to support the planned development. Outfall systems planning has been achieved through the "Outfall System Planning – Four Square Mile Area". Some of the outfall systems have been constructed. Drainage basin fees have been established based on the County's cost recovery policy, to help pay for the design and construction of the outfall systems. The basin fees are published in the November 1998 "Four Square Mile Area, Arapahoe County, Colorado, Storm Sewer Summary and Associated Drainage Fees," by ICON Engineering and are subject to future update and revisions. Applicants should consult with the County's Public Works department for information on current drainage basin fees within the Four Square Mile Area.

Not all of the master planned outfall systems have been constructed in the Four Square Mile Area. Because of this, retention may be required as an interim measure, until standard detention can be implemented and eventually connected

to an outfall system. On-site retention will not be approved as a permanent solution.

3.2.2 Cherry Creek Basin Water Quality Authority (CCBWQA). A State Stormwater Quality Control Cherry Creek Reservoir Control Regulation No. 72 is in effect for this watershed. The CCBWQA was formed to protect and enhance the overall quality of the water within Cherry Creek Reservoir, and therefore for all development within the Cherry Creek Basin, including tributaries, the CCBWQA will be a referral. The CCBWQA will review development proposals and land use applications for conformance with the control regulation requirements and will provide comments and recommendations to the County.

3.2.3 Denver Highline Canal. The Highline Canal is a large irrigation ditch that runs throughout various areas of the County, and is owned and operated by the Denver Water Board. Developments which are adjacent or tributary to the Highline Canal must be reviewed and coordinated with the Denver Water Board. Several master planning studies have been or are being completed to address the interaction between stormwater drainage and irrigation flows in the canal and should be consulted prior to planning drainage facilities that may be tributary to the Highline Canal.

3.2.4 Areas with Existing Drainage Problems. General principles regarding the management of stormwater, engineering expertise and methodologies, accepted design practices, local government oversight, and the development of minimum design standards of criteria have evolved over time. There are areas of the County that developed during the earlier stages of this evolution, when there may not have been a thorough understanding of how to properly convey stormwater or mitigate the potential adverse impacts associated with increased peak flow rates and volumes. As a result, some of the areas experience drainage problems and lack adequate infrastructure to properly convey stormwater runoff. In these areas, additional analysis and improvements may be required by the County in order to ensure that the existing problems are not exacerbated by new development or redevelopment.

3.2.5 Local Improvement Districts. The County may consider the formation of area-wide drainage improvement districts for designated special planning areas on a case-by-case basis, where there is a need.

3.3 Special Considerations

3.3.1 Irrigation Ditches. There are many irrigation ditches and reservoirs in the County. The ditches and reservoirs have historically intercepted the storm runoff from rural and agricultural basins. Urbanization of the basins, however, has increased the rate, quantity and frequency of stormwater runoff, and has had negative effects on water quality. Irrigation ditches are designed with flat slopes and have limited carrying capacity, decreasing in the downstream direction. As a general rule, irrigation ditches cannot be used as an outfall point for the storm drainage system because of these physical limitations. In addition, certain

ditches are abandoned after urbanization and, therefore, could not be successfully utilized for storm drainage.

In certain instances, however, irrigation ditches have been successfully utilized as outfall points for the drainage system, but only after a thorough hydrological and hydraulic analysis. Since the owner's liability from ditch failure increases with the acceptance of storm runoff, the responsibility must be clearly defined before a combined system is approved.

Irrigation facilities shall not be utilized indiscriminately as drainage facilities and, therefore, policies have been established to achieve compatibility between urbanization and the irrigation facilities. The primary irrigation ditch within the urbanized area of Arapahoe County is the Highline Canal. Several master planning studies are underway or have been completed for the Highline Canal, and should be referenced for all work near or adjacent to the Highline Canal.

In general, stormwater runoff generated by urbanization or development shall be directed into historic flow paths and drainageways, thus avoiding discharging into irrigation canals or ditches, except as required by water rights. The engineer or developer shall coordinate with the ditch owner when specific site characteristics or circumstances present challenges relative to separation of irrigation and stormwater flow paths or conveyance facilities.

The County will require drainage analysis to verify that an irrigation ditch does not intercept the storm runoff from the upper basin and that the upper basin remains tributary to the basin area downstream of the ditch.

Whenever new development or improvements will alter patterns of the storm drainage into irrigation ditches by increasing flow rate volumes, or changing points of concentration, the written consent from the ditch company shall be submitted with the development application. The discharge of runoff into the irrigation ditch shall be approved only if such discharge is consistent with an adopted master drainage plan.

Whenever irrigation ditches cross major drainageways, appropriate structures to separate storm runoff from ditch flows shall be provided.

3.3.2 Jurisdictional Dams and Reservoirs. Hazards associated with dams are the subject of a National Dam Safety program by the federal government. Jurisdictional dams are classified by the State Engineer as low, moderate, or high hazard structures when, in the event of failure, there is a potential loss of life. Dams presently rated as low or moderate hazard structures may be changed to high hazard rating if development occurs within the potential path of flooding due to a dam breach. In this case, the reservoir owners would be liable for the cost of upgrading the structure to meet the higher hazard classification.

Pursuant to Section 37-87-123, CRS, as amended, the Office of the State Engineer has prepared flood hazard maps that predict potential results of a

failure of the high hazard dams within the state. These reports have been made available to various cities, towns, and counties that may be affected by a dam breach. The following shall apply when development is proposed in the vicinity of dams or reservoirs:

- Development shall be restricted to areas outside of the reservoir's high water line, plus freeboard, created by the design flood for the emergency spillway.
- Development shall be restricted to areas outside of the high water line created by the breach of a dam (excepting high hazard classified dams which have passed inspection by the state engineer's office in accordance with *37-87-105 et seq CRS 1973*). For more information refer to the State Engineer's office.
- Development shall be restricted to areas outside of the existing or potential spillway paths, beginning at the dam and proceeding to the point where the floodwater returns to the natural drainage course.

Due to the potential liabilities and regulatory and administrative requirements, the creation of jurisdictional dams is discouraged. The creation of a jurisdictional dam shall not be allowed, unless upon special approval by the County. Detention pond embankment heights shall be limited, and other elements of pond design shall be considered to avoid the creation of a jurisdictional dam.

3.3.3 Groundwater Investigations. Groundwater can affect the function of stormwater management facilities, and other infrastructure. It is the engineer's responsibility to perform investigations and analyses to quantify potential impacts and to develop designs, which mitigate any potential impacts.

There are also cases where groundwater or sub-surface flows seem to increase with development and urbanization. Foundation drains and sump pumps collect and discharge these flows to the surface. If quantities are excessive, icing and algae nuisances can result, which affect the quality of life of residents. Mitigation of these problems typically requires an additional collection system, which must ultimately discharge into the storm sewer system. The function or capacity of the storm sewer system may be compromised and stormwater runoff can surcharge the subsurface drainage collection system. There are likely many factors, including increased irrigation, introduction of non-native soils during grading operations, varying levels of compaction adjacent to structures, etc. that lead to excessive sub-surface flows being discharged to the surface.

To the extent possible, efforts need to be made during the development process to identify potential problems and provide the appropriate mitigation so that the function of storm sewer facilities and other public and/or private infrastructure is not impacted in the future.

The County currently does not have specific design criteria or standards to address the potential impacts of groundwater. It is anticipated that these will be developed in the future. In the interim, the County will require all developers to

provide an appropriate analysis and discussion of potential groundwater impacts within their development and identify potential solutions to address the impacts. The County may require additional information and analysis based on the information provided by the Developer, and ultimately may require additional improvements to address potential impacts.

3.4 Construction of Improvements and Fees

When Drainage Reports, Drainage Master Plans, UDFCD Outfall Systems Planning Studies, or other applicable reports or studies prepared in conformance with these criteria identify that public improvements are necessary to properly manage stormwater runoff, mechanisms for funding the improvements are required. In accordance with the Regulations, subdividers and developers are required to construct, or guarantee to construct stormwater management improvements. These include improvements that are necessary to serve the subdivision or development, convey off-site flows through the property, convey runoff from the site to the major drainageway, and to stabilize or improve the major drainageway system.

3.4.1 Local Drainage System, Off-Site Conveyance System and the Major Drainageway System. Public improvements typically consist of the Local Drainage System, the Off-site Conveyance System and the Major Drainageway system, further described below.

1. Local Drainage System. The Local Drainage System consists of the drainage facilities within the development or subdivision that are necessary to collect, detain, and provide water quality treatment of the minor and major storm runoff for the development. The Local Drainage System also includes those facilities necessary to convey upstream off-site flows across or through the developing property. The Local Drainage System improvements may include curb and gutter, inlets and storm sewers, culverts, bridges, swales, ditches, channels, detention facilities, and water quality best management practices.

2. Off-site Conveyance System. The Off-site Conveyance System is comprised of the facilities necessary to convey the flow from the Local Drainage System to the Major Drainageway System. It must be analyzed, designed and constructed with all new development and redevelopment. If the Off-site Conveyance System crosses private properties, the developer shall be required to obtain easements and provide improvements as necessary to ensure that the downstream properties are not unreasonably burdened. If the conveyance is provided by an existing drainage system, the engineer must ensure the existing system is adequate to accommodate the intended flows from their development. The developer will be responsible for any necessary improvements to the drainage system to accommodate flows from their site. The County will require that the Off-site Conveyance System provide capacity to convey not only those flows (including upstream off-site flows) leaving the specific development site, but also any existing, future or master-planned flows. To minimize overall capital costs, the County encourages adjacent developments to join in designing and constructing off-site drainage systems.

The Off-site Conveyance System improvements may include inlets and storm sewers, curb and gutter, culverts, swales, ditches, and channels

3. The Major Drainageway System. The Major Drainageway System, as defined by Drainage Master Plans, UDFCD Outfall Systems Planning Studies or other applicable reports or studies consists of the channels, storm sewers, bridges, culverts, regional detention facilities, and water quality best management practices generally serving a tributary area of 130 acres or greater and in many cases, more than one subdivision or development. The Major Drainageway System within or adjacent to the development must be designed and constructed with all new development and redevelopment. Equitable participation in the design and construction of the off-site Major Drainageway System that serves the development may be required. The County may equitably distribute the major drainage basin improvements by establishing and collecting fees imposed on all new development, redevelopment, expansion, or modifications to existing development, to recover costs for existing or future improvements. It is recognized that major drainageways serve all development in the drainage basin, either directly or indirectly.

3.4.2 Master Planning Fees. The policy of the County shall be to charge property developers a fee to cover the cost of drainage master plan development. The fee proceeds shall be used to cover the costs of County initiated master planning for major drainageways, including those that have been previously master planned, and those that will need to be planned in the future.

3.4.3 Storm Sewer Cost Recovery Fees. It shall be the policy of the County to plan for and implement storm sewer systems where it deems necessary, and to recover the cost of the systems from those who benefit directly or indirectly. The County shall require storm sewer cost recovery fees for completed, partially completed, planned, or other systems as necessary. In order to facilitate the recovery of capital costs for storm sewer systems, the County will require that each individual development pay a pro-rata share toward the final cost of the storm sewer system. The pro-rata share will be based on the final system construction cost expended (or estimated to be expended) by the County, (including design, right-of-way, construction and construction management costs), and will be distributed equitably throughout the basin that is served, based on the anticipated impervious acreage for the basin. Storm sewer fees have been determined for some, but not all, of the collector systems within the County. It may be necessary for the County to determine the cost recovery fees with the individual development submittal. When collector storm sewer systems are to be constructed by others, the County may require cost recovery fees to provide a reimbursement and/or participation to the entity that has or will construct the improvements.

3.4.4 Major Drainage Basin Fees. It is recognized that urbanization increases runoff volumes and the frequency of runoff events, and ultimately leads to channel erosion, deterioration of the water quality and the need for improvements. Refer

to Chapter 12 for additional information regarding the impacts of development on drainageway systems. In order to equitably distribute the costs of the major drainageway improvements, the County has developed major drainage basin fees. The major drainage basin fees are calculated based on the known or estimated costs of the major drainageway improvements, and shall be distributed equitably among the properties that are tributary to the major drainage basin. The fee amounts shall be adjusted due to actual costs that are incurred, inflation, or as project estimates are revised. The fee amounts for each of the basins will be made available at the County's pre-application meeting, or upon request to Public Works. It may be necessary for the County to determine the major drainage basin fee with an individual development submittal. When major drainageway improvements are to be constructed by others, the County may apply major drainage basin fees to provide a reimbursement and/or participation to the entity that has or will construct the improvements.

3.4.5 Major Drainageway Stabilization. All projects within a watershed must participate in the stabilization and improvement of major drainageways. The minimum improvements discussed in Chapter 12 regarding stabilization of drainageways shall be constructed with all new development and redevelopment.

3.4.6 Construction of Major Drainageway Improvements. In addition to minimum stabilization improvements, all projects which either contain or are adjacent to a major drainageway may be required to construct major drainageway improvements when it is determined by the County that they are necessary. The major drainageway improvements may be master planned, or may require the preparation of a detailed analysis by the developer's engineer. The Phase III drainage report shall clearly discuss the existing condition of the drainageway within or adjacent to the site and shall identify the need for improvements. It is the responsibility of the design engineer to verify that the site and infrastructure constructed by the development will be protected from minor and major storm flows, flooding, erosion and channel bank degradation.

1. Construction of Improvements. When it is determined that the construction of improvements is necessary to mitigate flooding, stabilize the channel, provide embankment protection or otherwise ensure that the site infrastructure is protected, the County's policy shall be to require that the developer construct the required drainageway improvements. The developer shall be required to guarantee, design and construct the improvements as a condition of the land development approval process.

2. Application of Fees. Where major drainage basin fees or storm sewer cost recovery fees (refer to Sections 3.4.3 and 3.4.4) have been established, the County shall apply the developer's fee contribution to the costs that are incurred by the developer in the design and construction of the required improvements. When the costs of the improvements exceed the developer's fee contribution, the County shall not provide additional reimbursement. Fee contributions shall only be applied to those improvements shown in the master plan (or similar) and in the amount shown in the master plan and

calculated into the fee derivation. Master drainage fees shall not be applied to those improvements that serve the purpose to enhance the property (i.e. floodplain fringe filling, aesthetic or recreational amenities, etc.) Fees shall be applied based on costs established in the master plan, or as otherwise agreed upon by the County, not the developer's incurred costs.

3. Fees in Lieu of Construction. When it is determined that the construction of the master planned improvements is not necessary to support the request for development, the County's policy shall be to require that the developer contribute to future improvements by providing the major drainage basin fee or storm sewer cost recovery fee. In basins where fees have not been developed, the County may develop one, based on estimated future improvement costs in the basin, or may require that the developer agree to participate in future improvements, via a note on the plat or zoning document. The developer will still be required to provide minimum stabilization improvements as discussed in Chapter 12.

3.5 Stormwater Facility Maintenance

Stormwater management facilities must be properly maintained to function as designed. The County will require that all stormwater management facilities be designed to minimize facility maintenance as well as to provide adequate maintenance access. Routine maintenance of facilities may include removal of debris and sediment, trash rack clearing, mowing, noxious weed control, etc. Non-routine restorative maintenance activities include repairs to, or replacement of, structures and other improvements necessary to retain the effectiveness of the system. Such tasks are necessary to preclude the facility from becoming unhealthy and to avoid reduced conveyance capability, unsightliness, and ultimate malfunction.

3.5.1 Maintenance Responsibility. Maintenance responsibility lies with the owner of the land, except as modified by specific agreement. Maintenance responsibility shall be defined on Final Plats and Final Development Plans. The property owner or designee shall be responsible for the maintenance of all drainage facilities including inlets, pipes, culverts, channels, ditches, hydraulic structures, and detention basins located on their land unless modified by specific agreement. Maintenance access for all facilities must be adequate for the anticipated maintenance vehicles and equipment and should be shown on the Final Plats and Final Development Plans. Should the owner fail to adequately maintain said facilities, the County shall seek any remedies available to ensure that the facilities are adequately maintained.

3.5.2 Easements. Drainage easements are required in order to ensure for the proper construction, maintenance, and access to drainage improvements that have the potential to affect the public drainage system and other properties. Drainage easements shall be granted to the County for inspection and maintenance purposes, and shall be shown on the Drainage Plan, Final Plat and Site Improvement Plan, as applicable. The drainage easement shall state that the County has the right of access on the easements for inspection and maintenance

purposes. In general, easements are required for detention or retention ponds, water quality enhancement ponds and best management practices, storm sewers, swales, channels, parking lot areas that convey runoff from adjacent properties (blanket type easements), and major drainageways and floodplains. Easement requirements are specific to the type of stormwater management facility and are discussed in more detail in later chapters.

3.5.3 Operation and Maintenance Manual. An Operation and Maintenance Manual (O&M Manual) shall be required for all permanent stormwater facilities to ensure that they function as designed. The purpose of the O&M Manual is to provide guidance and standard forms for those entities that will be responsible for the long-term inspection and maintenance of the facility. The County's standard template shall be used as the basis for the O&M Manual. For more information refer to Section 4.8.

3.5.4 Easements on Residential Lots. It is recognized that there are certain liabilities and responsibilities associated with the ownership and maintenance of drainage facilities within drainage easements. It is undesirable to assign this responsibility and liability to single family lots with individual ownership. The County's policy shall be to require that in residential subdivisions, areas that convey flows from the subdivision, be designated as tracts that are within a common ownership, such as an HOA, a local District or a similar approved entity. A drainage easement shall be provided on the tract for drainage facilities. An exception shall be provided for the drainage of the individual lot, or a maximum of 3 adjacent lots. Drainage easements are allowed at a width of 10 to 20 feet along residential lot lines for swales placed within these easements that accept a limited amount of drainage from no more than 3 residential lots.

3.5.5 UDFCD Maintenance Assistance. The Urban Drainage and Flood Control District has a Maintenance Program, which, based on a yearly Work Program, provides drainageway and regional stormwater facility routine, restoration, and rehabilitation maintenance services. Routine maintenance generally consists of mowing, trash and debris pickup, weed control and small revegetation projects on major drainageways during the growing season. Restoration maintenance solves small or isolated drainage problems, including addressing local erosion problems, repair of existing erosion protection, detention pond restoration, tree thinning, and removal of sediment from culverts, channels, and detention ponds. Rehabilitation work is applicable where an existing unimproved channel has extensive erosion problems or where existing drainage improvements on a reach of drainageway have deteriorated or failed.

Funds available to be spent through the Work Program are allocated to each of the six counties within the UDFCD in direct proportion to the amount of tax revenue each county generates for the Maintenance Program. The primary purpose of the Maintenance Program is to assist local governments within the UDFCD boundaries in maintaining major drainageways within their jurisdiction. This provides a direct benefit to the entities responsible for maintenance of drainageways or flood control facilities and the citizens of Arapahoe County.

Any major drainageway improvement designed and constructed by, or approved for construction by a local public body, after March 1, 1980, within the UDFCD boundaries, must be reviewed and approved by the UDFCD and must be constructed in substantial conformance with the UDFCD approved design before it can be eligible for UDFCD maintenance assistance. UDFCD maintenance funds cannot be spent on facilities that did not meet these requirements. Arapahoe County requires that all major drainageway and regional stormwater improvements meeting the guidelines of the UDFCD Maintenance Program, be designed and constructed in conformance with Arapahoe County and UDFCD criteria and standards to ensure that those facilities become eligible for UDFCD Maintenance Assistance.

Even though major drainageway improvements may be eligible for UDFCD maintenance assistance, the property owner or other authorized designee is primarily responsible for the maintenance of the improvements. The owner may apply to the County for UDFCD assistance. The County will include the maintenance assistance request with all other requests received and will prioritize them as appropriate. The limited funds received for use in the County do not typically allow for all maintenance assistance requests to be fulfilled.