Chapter 1: Drainage Principles & Policies

Contents

1.0 Principles

The purpose of this Manual is to promote the health, safety, welfare, and property of the City of Fort Collins and citizens through the proper control and treatment of stormwater, whether above or below surface; and, to ensure uniformity in performance with respect to design and construction of all drainage facilities.

Adequate drainage for urban areas is necessary to preserve and promote the general health, welfare and economic well-being of the region. Drainage is a regional feature that affects all governmental jurisdictions and all parcels of property. (UDSCM, 2016)

The UDFCD includes a list of principles for drainage planning in the UDFCD Manual that has served as a guide for formulating its technical criteria for almost 50 years. Many of these principles are included in this Manual because these same philosophies have provided guidance and direction for the City's Master Drainage Plans, policies and design criteria that aim to protect the public and the environment, space planning requirements for new development, encouragement of responsible development as it relates to storm drainage infrastructure design, and Low Impact Development principles. The following UDFCD principles are included herein and adopted by the City:

1) ***Drainage is a regional phenomenon that does not respect the boundaries between government jurisdictions or between properties.*** *This makes it necessary to formulate programs that include both public and private involvement. Overall, the governmental entities most directly involved must provide coordination and master planning, but drainage planning must be integrated on a regional level if optimum results are to be achieved. The manner in which proposed drainage systems fit into existing regional systems must be quantified and discussed in the master plan.*

2) ***A storm drainage system is a subsystem of the total urban water resource system.*** *Stormwater system planning and design for any site must be compatible with comprehensive regional plans and should be coordinated with planning for land use, open space and transportation. Erosion and sediment control, flood control, site grading criteria, and water quality all closely interrelate with urban stormwater management. Any individual master plan or specific site plan should normally address all of these considerations.*

3) ***Every urban area has an initial (i.e., minor) and a major drainage system, whether or not they are actually planned and designed.*** *The initial drainage system, sometimes referred to as the "minor system," is designed to provide public convenience and to accommodate moderate, frequently occurring flows. The major system carries more water and operates when the rate or volume of runoff exceeds the capacity of the minor system. Both systems should be carefully considered.*

4) ***Runoff routing is primarily a space allocation problem.*** *The volume of water present at a given point in time in an urban region cannot be compressed or diminished. Channels and storm drains serve both conveyance and detention functions. If adequate provision is not made for drainage space demands, stormwater runoff will conflict with other land uses, result in damages, and impair or disrupt the functioning of other urban systems.*

5) ***Planning and design of stormwater drainage systems should not be based on the premise that problems can be transferred from one location to another.*** *Urbanization tends to increase downstream peak flow by increasing runoff volumes and velocities. Stormwater runoff can be temporarily captured and slowly released via detention facilities to manage peak flows, thereby reducing the drainage capacity required immediately downstream.*

6) ***An urban storm drainage strategy should be a multi-objective and multi-means effort.*** *The many competing demands placed upon space and resources within an urban region argue for a drainage management strategy that meets a number of objectives, including water quality enhancement, groundwater recharge, recreation, wildlife habitat, wetland creation, protection of landmarks/amenities, control of erosion and sediment deposition, and creation of open spaces.*

7) ***Design of the storm drainage system should consider the features and functions of the existing drainage system.*** *Every site contains natural features that may contribute to the management of stormwater without significant modifications. Existing features such as natural streams, depressions, wetlands, floodplains, permeable soils, and vegetation provide for infiltration, help control the velocity of runoff, extend the time of concentration, filter sediments and other pollutants, and recycle techniques that preserve or protect and enhance the natural features are encouraged. Good designs improve the effectiveness of natural systems rather than negate, replace or ignore them.*

8) ***In conjunction with new development and redevelopment, coordinated efforts should be made to minimize increases in, and reduce where possible, stormwater runoff volumes, flow rates, and pollutant loads to the maximum extent practicable***. *Key practices include:*

a. The perviousness of the site and natural drainage paths should be preserved to the extent feasible. Areas conducive to infiltration of runoff should be preserved and integrated into the overall runoff management strategy for the site.

b. The rate of runoff should be slowed. Preference should be given to stormwater management systems that maximize vegetative and pervious land cover. These systems will promote infiltration, filtering and slowing of the runoff. It should be noted that, due to the principle of mass conservation, it is virtually impossible to prevent increases in post-development runoff volumes for all storm events when an area urbanizes. Peak flows must be controlled to predevelopment levels. Increases in runoff volumes are managed to minimize adverse impacts on stream stability.

c. Pollution control is best accomplished by implementing a series of measures, which can include source controls, minimizing directly connected impervious area, and construction of on-site and regional facilities to control both runoff and pollution. Implementing measures that reduce the volume of runoff produced by frequently occurring events through infiltration and disconnection of impervious areas is one of the most effective means for reducing the pollutant load delivered to receiving waters.

9) ***The stormwater management system should be designed beginning with the outlet or point of outflow from the project, giving full consideration to downstream effects and the effects of offsite flows entering the system.*** *The downstream conveyance system should be evaluated to ensure that it has sufficient capacity to accept design discharges without adverse upstream or downstream impacts such as flooding, stream bank erosion, and sediment deposition. In addition, the design of a drainage system should take into account the runoff from upstream sites, recognizing their future development runoff potential (e.g., imperviousness).*

10) ***The stormwater management system requires regular maintenance.*** *Failure to provide proper maintenance reduces both the hydraulic capacity and pollutant removal efficiency of the system. The key to effective maintenance is clear assignment of responsibilities to an established entity (e.g., private property owner or HOA, local jurisdiction) and a regular schedule of inspections to determine maintenance needs and to ensure that required maintenance is conducted. Maintenance requirements of onsite drainage infrastructure should be a consideration when selecting specific design criteria for a given site or project.*

2.0 Policies

Principles are made operational through a set of policy statements. These include direction on how to implement these criteria, planning for stormwater drainage, and an overview of the technical criteria covered in this Manual.

2.1 Implementation of the Criteria in this Manual

The criteria set forth in this Manual applies to all land disturbing activities defined as Development by the Land Use Code or otherwise regulated by the City, including but not limited to, activities on private land, public rights-of-way, easements dedicated for public use, private roads and to all privately, publicly, and quasi-publicly owned and maintained facilities. All public or private storm drainage facilities regulated by the City must be planned and designed in accordance with the standards and criteria set forth in this Manual.

These criteria, with all future amendments, establish minimum design standards for providing and maintaining stormwater drainage systems. Should a conflict arise between the City Code, the Land Use Code or other City adopted standards and requirements, including but not limited to this Manual, City Code and the Land Use Code will govern.

The Manual may be periodically revised and amended, either by approval of the City Council or by technical revision approved by the Utilities Executive Director in accordance with City Code Section 26-500, as new technology is developed and experience is gained in the use of the Manual.

Adherence to the criteria in this Manual does not remove the Design Engineer or Developer's responsibility to investigate and obtain any other regulatory permits or approvals from local, regional, state and/or federal agencies that may be required for a particular project.

Before commencing design of any project, comprehensive facts and data should be collected and examined for the particular watershed and area under consideration, and the basis for the design should then be agreed upon by the governmental entities affected.

The Design Engineer is responsible for compliance with this Manual as well as other applicable design and construction standards in the preparation of engineering and construction documents for review and acceptance by FCU. The provisions of this Manual are minimum requirements that do not preclude the use of more restrictive or enhanced standards by the Design Engineer. The review and approval of any submitted plans by the City does not imply responsibility by FCU for accuracy or correctness of the plans.

Consequently, pursuant to the procedures of this Manual, when the Utilities Executive Director determines that an applicant has made a sufficient showing that an alternate design, analysis or

procedure would meet the purposes of a specific requirement of this Manual in a manner and to an extent equal to or better than compliance with the specific requirement the Utilities Executive Director may authorize a variance to the standard to allow for the use of the alternative design, analysis or procedure, as applicable. The variance request process is set forth in Chapter 2: Development Submittal Requirements.

2.2 Drainage Planning

Storm drainage is a part of the total urban environmental system. Therefore, storm drainage planning and design must be compatible with comprehensive regional plans. Master plans for storm drainage have been developed for this region and are maintained at FCU offices.

The planning for drainage facilities should be coordinated with planning for open space and transportation. By coordinating these efforts, new opportunities may be identified that can help solve drainage problems. Natural streams should be used to convey storm runoff whenever feasible. Major consideration must be given to the floodplains and open space requirements of the area. (White 1945)

All planned public or private improvements, or any other proposed construction or development activities regulated by the City must include an adequate plan for storm drainage. This plan must be based on an analysis and design in compliance with all the applicable requirements set forth in this Manual.

To provide for orderly urban growth, reduce costs to future generations and avoid loss of life and major property damage, both the initial drainage and the major drainage system must be properly planned, engineered and maintained.

Runoff from small, frequently occurring storms should be managed to reduce runoff peak flows, volumes (where feasible and pursuant to legal requirements) and pollutant loading to streams. Management of these frequently occurring events helps to protect beneficial uses of streams and promotes channel stability.

The detention of runoff can reduce the drainage conveyance capacity requirement immediately downstream. Acquisition of open space adjacent to streams provides areas where storm runoff can spread out for slower delivery downstream.

2.2.1 Planning Process Elements

1) **Major Drainage Planning:** Local and regional planning should consider the major drainage system necessary to manage the 100-year runoff; that is the runoff having a one percent

(1%) probability of occurrence in any given year. Implementation of major drainage plans will reduce loss of life and major damage to the community and its infrastructure.

2) **Outfall System Planning:** Outfall system planning efforts identify detention, water quality and conveyance practices within a watershed that ultimately discharges to a receiving stream. Outfall system plans typically address storm drain improvements, stream crossing improvements, stream enlargement, stabilization, and floodplain preservation.

3) **Initial Drainage System Planning:** All local and regional planning should consider the initial drainage system to transport the runoff from the 2-year storm; this storm has a 50% probability of occurrence in any given year. The planner of an initial system must strive to minimize future drainage problems from these more frequently occurring storms.

4) **Water Quality and Environmental Design:** All planning efforts should address stormwater quality treatment requirements, opportunities for the development to mimic natural hydrology and preserve natural features, enhance habitat, and evaluate impacts of new facilities. When convened early in the planning and design process, a multi-disciplinary design team can help to ensure that the benefits to total urban systems are considered in the drainage planning effort. For large-scale, multi-phase developments, planners and engineers should incorporate space for water quality treatments in the initial, overall design plans and plan ahead for addressing the water quality requirements, whether meeting all the requirements in the first phase or each phase meeting the requirements individually.

5) **Long-term Maintenance and Operation**: Future operation and maintenance by private and public entities needs to be considered.

2.2.2 Master Planning

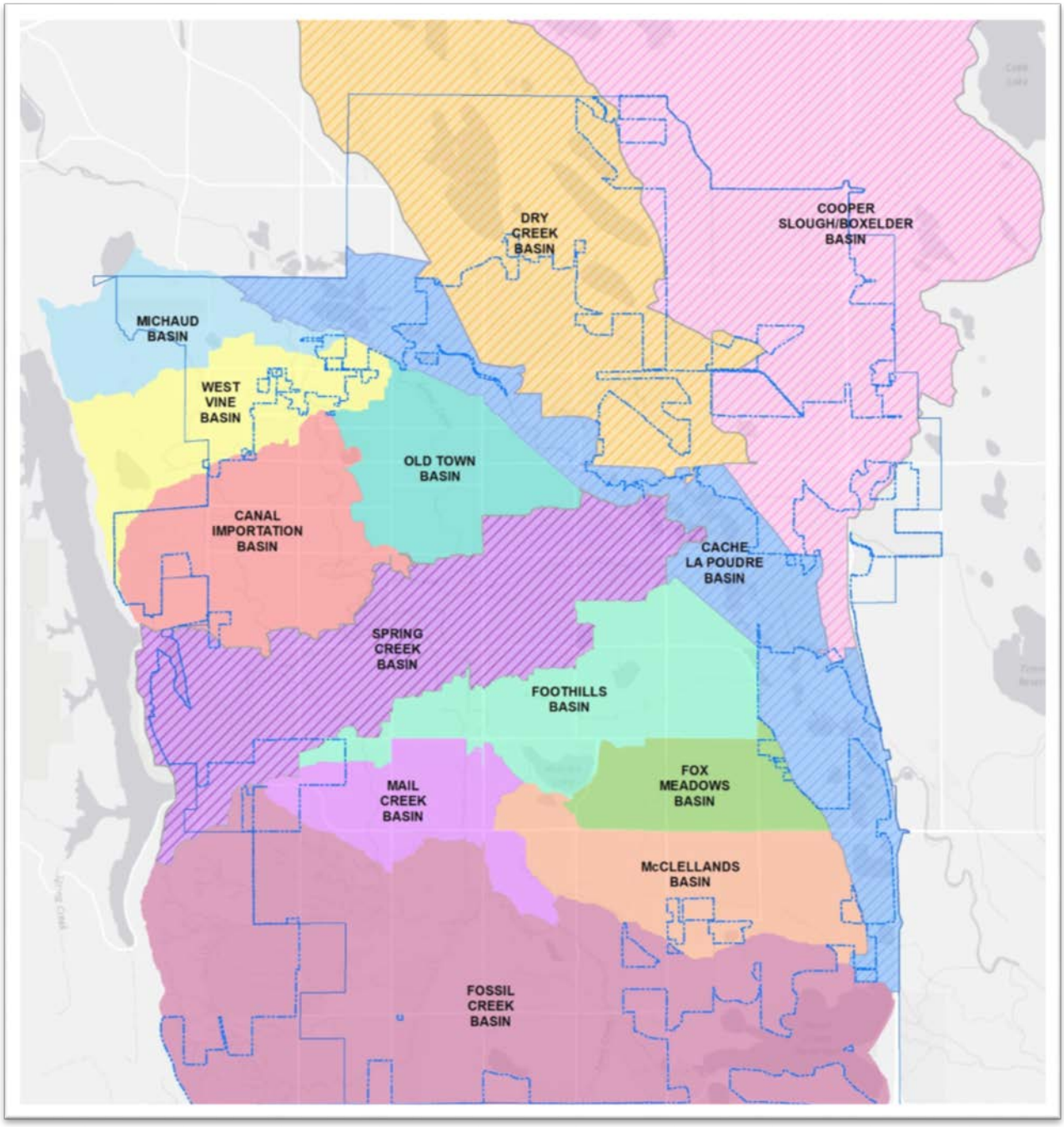
The Fort Collins area is divided into twelve regional and individual drainage basins. These are: **Cache La Poudre, Dry Creek, Cooper Slough/Boxelder, West Vine, Old Town, Canal Importation, Spring Creek, Foothills, Mail Creek, Fox Meadows, McClellands and Fossil Creek**. The City of Fort Collins has developed Master Drainage Plans for each of these individual drainage basins which will guide or dictate site requirements for development sites as well as establish any needed public improvements. Development within individual basins shall be required to meet the specifications of the Master Drainage Plan for the given area.

Proposed drainage systems design and construction must comply with all requirements set forth in the pertinent Master Drainage Plan for the area. The criteria specified in the appropriate Master Drainage Plan will hold precedence over the criteria set forth in this Manual in the event these differ or conflict.

Master Drainage Plans are developed in cooperation with Larimer County, affected ditch and reservoir companies and other affected governmental agencies within the given basin or basins. These plans are

adopted only after they have been reviewed by all affected entities and after soliciting public input. Master Drainage Plans are updated periodically when new information or updating basin conditions warrant it. These updates are also conducted in cooperation with all affected entities.

Figure 2.2.2-1. Master Drainage Basins



Reference: Master Drainage Plans are available at the Fort Collins Utility Services Center.

2.2.3 Drainage and Required Space

The stormwater drainage system is an integral part of the urbanization process; and requires storm drainage planning for all developments to include the allocation of space for drainage facilities' construction and maintenance which may entail the dedication of easements.

Drainage facilities, such as channels, storm pipes and detention facilities serve conveyance, treatment, as well as detention functions for water quantity and quality. When space requirements are considered, the provision for adequate drainage becomes a competing use for space. Therefore, adequate provision must be made in the land use plan for drainage space requirements. This may entail the dedication of adequate easements, in order to minimize potential conflict with other land uses.

These goals have the potential to influence the type of drainage subsystem selected. Planning for drainage facilities should be related to the goals of the urban region, should be looked upon as a subsystem of the total urban system and should not proceed independent of these considerations (Wright 1967).

2.2.4 Development and Site Planning

All land development proposals should receive full site planning and engineering analyses. In this regard, consideration must be given to the criteria outlined in this Manual. A development plan should consider broad goals such as:

- Drainage and flood control problem alleviation
- Economic reasonableness
- Broader regional development context
- Environmental preservation and enhancement, considering water quality, stream stability and natural resource protection (e.g. wetlands)
- Social and recreational objectives
- Long-term maintenance of the drainage systems

Flood control facilities, as planned by the City or Developers, are an integral part of the total drainage system required to preserve and promote the general health, welfare, and economic well-being of the area.

Planning for drainage facilities should be coordinated with planning for open space, recreation and transportation. By coordinating these efforts, new opportunities can be identified which can assist in the solution of drainage problems (Heaney, Pitt and Field 1999).

Regional flood control facilities are those that are operated and maintained by the City to benefit a regional area of a basin and the developments therein. Local flood control facilities are generally designed and constructed as a part of a private development project and are to be maintained and operated by the land owner. Any facility that is privately owned is required to enter into a Development Agreement with the City for maintenance requirements.

The City requires the planning and construction of all private local stormwater control and treatment facilities be performed in a manner that ensures that such facilities are compatible with all regional Master Drainage Plans including the City's Master Drainage Plans and the design requirements set forth in this Manual.

2.2.5 Development and Site Planning for Offsite Flows

Water naturally flows from up-gradient lands to down-gradient lands, without regard for land ownership boundaries. As discussed in this Manual, developments and other projects must plan for and consider water flows entering the subject property from up-gradient lands, and water flows leaving the subject property onto down-gradient lands in conformity with the City's Master Drainage Plans.

Up-gradient properties have been deemed to have legal and natural easements over down-gradient properties for the drainage of waters flowing in their natural course and manner. The owners of down-gradient properties thus generally have the corresponding obligation to accept the drainage of waters from up-gradient properties, provided that the up-gradient property owners have not overstepped their rights. A property owner may also generally re-route water within the property, provided that the property owner continues to abide by the various legal requirements with respect to the property being up-gradient to other properties, and down-gradient of others.

Water also naturally flows into channels, creeks, streams, and other naturally-occurring drainage ways. Whether or not these natural drainage ways are expressly dedicated or otherwise formally recognized for their drainage purposes, they are generally considered to be the best and most appropriate location of stormwater conveyance systems. They are also frequently recognized in the City's Master Drainage Plans.

When an up-gradient property develops (formally though the Development Review Process), specific drainage easements may be required on certain down-gradient properties, such as when the flows entering the down-gradient property are altered in quality or quantity or as to exceed the existing

drainage easements and potentially adversely affect the down-gradient property. Likewise, when a down-gradient property develops and up-gradient flows are draining onto the property, drainage easements may be required to allow for the continued conveyance of flows from the up-gradient site.

When drainage easements are required, the development is required to dedicate said easements to the City. Developments that affect or have an impact upon existing drainage easements must preserve and maintain those easements.

2.2.6 Multiple-Objective Considerations

Planning stormwater facilities should include consideration of multiple objectives, including the following:

1) **Lower Drainage Costs:** Planning drainage projects in conjunction with other urban needs results in more orderly development and lower costs for drainage and other facilities.

2) **Open Space:** Open space provides significant urban social, environmental and economic benefits. Use of stabilized, natural streams is often less costly than constructing artificial channels. Combining the open space needs of a community with the major drainage system is a desirable combination of uses that reduces land costs and promotes riparian zone protection and establishment over time.

3) **Transportation:** Design and construction of new streets and highways should be fully integrated with drainage needs of the urban area for better streets and highways and better drainages and to avoid creation of flooding hazards.

4) **Natural Drainage Ways:** Natural channels, creeks, streams and other naturally occurring drainage ways should be used in lieu of storm drains for stormwater runoff wherever practical. Preservation and protection of natural streams are encouraged; however, significant consideration must be given to minimize erosion as the tributary area urbanizes.

5) **Channelization:** Natural streams within an urbanizing area are often “channelized” (i.e. they could be deepened, straightened, lined, and sometimes put underground). A community loses a natural asset when this happens. Channelizing a natural waterway usually speeds up the flow, causing greater downstream flood peaks and higher drainage costs, and does nothing to enhance the environment. Natural streams within an urbanizing area require stabilization, not channelization.

6) **Channel Capacity:** Streams having “slow flow” characteristics, vegetated bottoms and sides, and wide water surfaces provide significant floodplain capacity. This capacity is beneficial because it reduces downstream runoff peaks and provides an opportunity for groundwater

recharge. Wetland channels, wide natural streams, and adjacent floodplains provide urban open space.

7) **Major Runoff Capacity**: Streams and their residual floodplains should be capable of carrying the 100-year storm runoff, which can be expected to have a one percent chance of occurring in any given year.

8) **Maintenance and Maintenance Access**: Urban streams require both scheduled and unscheduled maintenance activities such as the repair of structures, mowing and the removal of sediment, debris and trash. Assured long term maintenance is essential, and it must be addressed during planning and design.

2.2.7 Avoiding the Transfer of Problems

Planning and design of stormwater drainage systems should not be based on the premise that problems can be transferred from one location to another. Both intra-watershed and inter-watershed transfers should be avoided and appropriate assumptions should be made during site planning to avoid transfer of problems. Key principles include:

1) **Intra-Watershed Transfer**: Channel modifications that create unnecessary problems downstream should be avoided, both for the benefit of the public and to avoid damage to private downstream parties. Problems to avoid include land and channel erosion and downstream sediment deposition, increase of runoff peaks, and debris transport, among others.

2) **Inter-Watershed Transfer:** Diversion of storm runoff from one watershed to another introduces significant legal and social problems and should be avoided unless specific and prudent reasons justify and dictate such a transfer, no measurable damages occur to the natural receiving water or urban systems or to the public and all applicable laws are complied with.

2.2.8 Managing Runoff from Frequently Occurring Storms

Protecting and enhancing the water quality of streams is an important objective of drainage planning. Erosion control, maintaining stream stability, and reducing pollutant loading from stormwater runoff must be considered. Chapter 6: Water Quality, provides criteria for stormwater runoff BMPs that help to reduce runoff volumes for frequently occurring storm events and provide treatment of the water quality capture volume (WQCV), which is based on the 80th percentile runoff-producing event.

The first step in managing runoff from frequently occurring storms is implementing runoff reduction practices, also known as minimizing directly connected impervious area (MDCIA), which reduces the

amount and connectivity of impervious surfaces in a development. This can be accomplished through a variety of techniques such as functional grading, wide and shallow surface flow sections, disconnection of hydrologic flow paths, and the use of Low Impact Development systems. The extent to which MDCIA and runoff reduction can be implemented on a development site is dependent on the site conditions (e.g., soil type, groundwater depth, depth to bedrock) and development type (e.g., new development, redevelopment, ultra-urban and infill).

2.2.9 Watershed Approach to Stormwater Management

The City has initiated a "Watershed Approach" to stormwater management. This program includes three major watershed components and associated objectives:

1) **Land:** The objective of this component is pollution prevention, including public education, regulation, and enforcement. This is accomplished through implementation of the City's Municipal Separate Storm Sewer System (MS4) permit, as described in the "Water Quantity and Quality Integration" Section of this Chapter.

2) **Tributaries:** The objectives of this component are stormwater treatment and pollutant load reduction and include the development of design criteria for "Control Measures".

3) **Receiving Waters:** The objectives of this component are aimed at stream and habitat protection and restoration and include the creation of buffer zones on creeks and natural drainage ways.

The water quality protection regulations as specified in this Manual are primarily directed at the tributaries component of this approach. This includes BMPs for erosion control during construction and post-construction controls for development sites. These BMPs are intended to be located onsite; and therefore, address runoff from development sites or from any public improvements.

Any public or private improvement that has an impact on receiving waters must be constructed in accordance with the criteria specified in this Manual, the City's Master Drainage Plans, City Code, the City Land Use Code and any other applicable State or federal regulations such as the United States Army Corps of Engineers (USACE) 404 permit requirements.

Runoff generated from any public or private improvement and directed into historic and natural drainage ways must be done in a manner that would promote the multi-functional use of these drainage ways, protect and restore their natural functions and enhance their aesthetic value.

Natural drainage ways, including creeks and streams, are considered important community assets that contribute to the aesthetic value and the livability of the urban environment. Their function extends beyond that of conveying floodwater, to their use as trails and open space corridors, for water quality

protection and enhancement, and to preserve natural vegetation and wildlife habitat to the greatest extent possible.

Public or private improvements located in or near receiving waters, must not adversely affect the natural character of the stream or water course. To that effect, the following provisions must be met:

1) Pollutant reduction and treatment facilities must be located upstream of streams and natural drainage ways.

2) Natural drainage ways must remain in as near a natural state as practicable.

3) Any proposed modification, including any erosion mitigating measures, must be designed and constructed in a manner that protects and enhances the natural character of receiving waters. Such modification must be addressed in the Drainage Report and clearly shown on the associated Drainage Plans.

2.3 Technical Criteria

Designing for storm drainage requires detailed examination of the specific requirements of the technical criteria presented in this Manual. The key components of the technical standards presented in this Manual include: determining runoff magnitude, detention basin design, water quality components of stormwater management, the use of streets for stormwater conveyance, inlets, piping and conveyance design, the use of Best Management Practices for permanent erosion control measures, and long-term maintenance of stormwater facilities.

2.3.1 Determining Runoff Magnitude

Runoff magnitude shall be determined by using the Rational Formula or the Stormwater Management Model (SWMM).

Reference: Refer to Chapter 5: Hydrology Standards, for further discussion regarding runoff determination.

2.3.2 Detention Basins

Stormwater runoff can be temporarily detained in detention basins. Such detention, when properly designed, constructed, and maintained with adequate assurances for the long-term, can reduce the peak flow drainage capacity required, thereby reducing the land area and expenditures required downstream.

Onsite detention is required for all new development, as well as when detention is deemed necessary to protect structures or downstream properties when 1000 square feet or more of imperviousness is created with said development. The required minimum detention volume, with minimum and maximum release rate(s) for the developed condition 100-year recurrence interval storm must be determined in accordance with the conditions and regulations established in the appropriate Master Drainage Plan(s) for that development and in accordance with the criteria set forth in this Manual.

All detention facilities constructed after August 5, 2015 must meet the requirements of "stormwater detention and infiltration facilities" under CRS §37-92-602(8) which was enacted through Senate Bill 15-212. Further discussion regarding the design and construction of detention facilities to meet the requirements of this statute is included in Chapter 5: Detention, of this Manual.

Development should also provide detention of storm runoff close to the points of rainfall occurrence to the extent practical. Opportunities for detention include onsite detention basins, parking lots, ball fields, property line swales, parks, road embankments, and borrow pits. Wherever reasonably acceptable from a social standpoint, parks should be used for short-term detention of storm runoff. Such use may help justify park and greenbelt acquisition and expenditures. This "Blue-Green" concept was introduced in the 1960's (Jones 1967) and remains an effective strategy in drainage planning.

Reference: Refer to Chapter 6: Detention Chapter, for further discussion on the requirements for detention.

2.3.3 Retention Ponds

Retention ponds hold a permanent pool of water and typically have very minimal or zero water release by gravity.

Retention ponds are generally not allowed in Fort Collins and typically require a legal right to store water in Colorado. Consultation with the State Engineer's Office is needed in such cases and special permission from the FCU would be required for any retention pond design or installation.

2.3.4 Municipal Separate Storm Sewer System (MS4) Permit

Pursuant to the federal Clean Water Act and the Colorado Water Quality Control Act, owners and operators of Municipal Separate Storm Sewer Systems (MS4s), such as the City, are required to obtain permit coverage for stormwater discharges from their MS4s to surface waters of the state. The City is authorized under Colorado Discharge Permit System (CDPS) General Permit COR090000, certification #COR090050.

All discharges authorized by the MS4 permit shall be in accordance with permit conditions, including pollutant restrictions, prohibitions, and reduction requirements. As the permit holder, the City is required to implement the following programs. Only Construction and Post-Construction Stormwater

Management requirements are covered in the subsequent text and Chapters of this Manual, which include various requirements for Developers.

1) Public Education and Outreach

2) Illicit Discharge Detection and Elimination

3) Construction Sites Stormwater Management

4) Post Construction Stormwater Management in New Development and Redevelopment

5) Pollution Prevention/Good Housekeeping for Municipal Operations

Applicable Development Sites: must prevent or reduce pollutant discharge to the MS4. Although "applicable development sites", "applicable construction activity", "new development" and "redevelopment" sites are specifically defined in the MS4 permit, the City may apply more stringent requirements, as set forth in this Manual. In addition, the MS4 permit outlines specific sites that may be excluded from the requirements of an applicable development site. City policy is that only those exclusions specifically listed in the MS4 permit may be allowed. Exceptions or variances to the requirements of the MS4 permit cannot and will not be granted.

Regulatory Mechanism: Article II, Section 7 of the City Charter, Article 3 of the Land Use Code and Chapter 26 of the City Code provide the City legal authority to implement and enforce the requirements of this Manual.

Control Measures: The design requirements set forth in Chapter 7: Water Quality and Chapter 4: Construction Control Measures address the reduction of pollutant discharges to the MS4 through temporary erosion control measures and permanent BMPs.

Site Plans: Project designs are reviewed through the City's development review process. The drainage report and construction plans submittal requirements set forth in Chapter 2: Development Submittal Requirements adhere to the Site Plan requirements established in the MS4 permit.

Construction Inspection and Acceptance: Acceptance procedures are outlined in Chapter 3: Post-Construction Requirements. Inspection is implemented through the City's MS4 construction and post-construction and enforcement program.

Long-term Operation and Maintenance and Post Acceptance Oversight and Enforcement Response: Requirements are implemented through the City's MS4 post-construction inspection and enforcement program.

Reference: City of Fort Collins MS4 Permit information

2.3.5 Water Quality

Water quality treatment of stormwater runoff is required for parcels that are developing, redeveloping or sites that are required to meet Land Use Code requirements if the development is adding or modifying 1000 square feet of imperviousness or more, or if the development involves land disturbing activities that disturb one (1) acre or more with no added impervious area. Water quality treatment facilities must include a combination of "standard" water quality treatment provisions (e.g. WQCV in extended detention basins) and Low Impact Development (LID) treatment provisions. FCU institutes minimum design requirements for both "standard" water quality and "LID" systems but requires, however, that 100% of development sites are captured for treatment, per the MS4 requirements.

There are regional water quality detention facilities available for use for certain basins in the City. Water quality requirements for a development may be deemed met where FCU determines that an applicant has made a sufficient showing that the existing regional water quality detention facilities are sized with the capacity to accommodate flows from a fully developed basin (including the development site in question) and are publicly owned and maintained, provided that any requirements for cost sharing or reimbursement to the City have been met. The Design Engineer will need to coordinate with FCU staff to determine if the development parcel in question drains to a regional facility.

Reference: Water quality control treatment thresholds can be achieved through the use of an array of methods and devices as described in Chapter 7: Water Quality.

2.3.6 Four Step Process to Minimize Adverse Impacts of Urbanization

UDFCD has long recommended a Four Step Process for receiving water protection that focuses on 1) reducing runoff volumes, 2) treating the water quality capture volume (WQCV), 3) stabilizing streams and 4) implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring events. Implementation of these four steps helps to achieve stormwater permit (e.g. MS4 permit) requirements. Added benefits of implementing the complete process can include improved site aesthetics through functional landscaping features that also provide water quality benefits.

Management of runoff from frequently occurring storm events shall include consideration of the following four steps.

1) **Employing runoff reduction practices:** This is done to reduce runoff peaks, volumes and pollutant loads from urbanizing areas, and by implementing LID strategies including MDCIA.

2) **Implementing best management practices (BMPs) that provide a water quality capture volume with slow release and/or infiltration:** After runoff has been minimized, the remaining runoff should be treated through capture and slow release of the WQCV.

3) **Stabilizing streams:** During and following development, natural streams are often subject to bed and bank erosion due to increases in frequency, duration, rate and volume of runoff. Although steps 1 and 2 help to minimize these effects, some degree of stream stabilization is required, either directly or indirectly.

4) **Implementing site specific and other source control BMPs:** Site specific needs such as material storage or other site operations require consideration of targeted source control BMPs.

Reference: Refer to Chapter 7: Water Quality for more detailed information on the Four Step Process.

2.3.7 Low Impact Development

Low Impact Development (LID) is simply defined as an integrated, sustainable stormwater management program that requires a more distributed, landscaping-based stormwater runoff control that relies mainly on filtration and infiltration to treat and manage stormwater runoff.

LID systems are required to be included as a stormwater quality treatment provision for any developing site that is also required to meet current Land Use Code requirements and if the site development is adding or modifying 1000 square feet of imperviousness or more. LID systems provide a higher degree of stormwater quality treatment than that provided with standard water quality design. Implementation of LID systems requires one of the following two options:

1) 50% of the newly added or modified impervious area must be treated by LID techniques and 25% of new paved areas must be pervious; or

2) 75% of all newly added or modified impervious area must be treated by LID techniques

Reference: Refer to Chapter 7: Water Quality, and Appendix C: LID Implementation Manual for more detailed requirements for incorporating low impact development systems into site designs.

2.3.8 Use of Streets

Streets are a significant component of the urban drainage system, and use of streets for storm runoff should be made within reasonable limits, recognizing that the primary purpose of streets is for traffic. Reasonable limits of the use of streets for conveyance of stormwater should be governed by design criteria provided in this Manual.

The criteria in this Manual are consistent with the intent that streets should not be used as stormwater conveyance for initial storm runoff. Usability of the street during minor storms and reduction of street maintenance costs should be objectives of urban drainage design and that major storm runoff will be removed from public streets at frequent and regular intervals and routed into streams, as well as the recognition that runoff tends to follow streets and roadways; therefore, streets and roadways may be aligned to provide a specific runoff conveyance function.

Initial and major drainage planning should go hand-in-hand. When maximum allowable street encroachment will be exceeded, a storm drain system based on the initial storm should be planned. Development of a major drainage system that can also drain the initial runoff from the streets is encouraged; this enables the storm drain system to commence further downstream. Drainage design objectives for streets should include reducing street repair and maintenance costs, minimizing nuisance to the public, and minimizing frequent disruption of traffic flow.

Reference: Incorporating the use of streets in the use of stormwater conveyance must comply with the design requirements set forth in Chapter 9: Streets, Inlets and Conveyance, and with the Larimer County Urban Area Street Standards (LCUASS).

2.3.9 Open Channels

Developments in or near major runoff channels must be planned and designed to maintain channel stability. Developments in and near major runoff channels must adopt measures to ensure that excessive erosion does not occur under peak flood flow conditions.

Realignment of natural channels in urban areas is not encouraged and may only be permitted if the FCU approves a design that maintains stream stability and aesthetics, enhances or improves the ecological character of the natural channel and prevents failure and erosion under peak flow conditions.

Reference: The design of open channels must comply with all the appropriate provisions set forth in Chapter 9: Streets, Inlets and Conveyance.

2.3.10 Use of Irrigation Ditches and Reservoirs

Irrigation ditches and reservoirs should not be used as outfall points for initial or major drainage systems, unless such use is shown to be without unreasonable hazard, there are no other outfall options and the outfall does not exceed historic runoff (rate and volume) into the ditch or reservoir, as substantiated by thorough hydraulic engineering analysis, and written approval of the ditch or reservoir owner(s) is obtained. In addition, irrigation ditches and reservoirs cannot be relied on to mitigate upstream runoff.

Stormwater facilities and improvements must be designed to avoid discharge of runoff from urban areas into irrigation ditches and reservoirs, except as required by decreed water rights or where such discharge is in conformance with the approved Master Drainage Plan. Where either of these conditions are present, the Developer must submit to the Utilities Executive Director and the affected ditch or reservoir owner(s) or other affected parties documentation of the relevant water rights-related constraint or Master Drainage Plan condition.

The Utilities Executive Director may approve of this discharge into irrigation ditches and reservoirs only upon a determination that sufficient showing has been made that such a discharge is acceptable to the affected ditch or reservoir owner(s), will not result in harm or interfere with the operation of affected stormwater management plans or systems, and that the requirements for a modification have been met (i.e. it is required by decreed water rights or is in conformance with the approved Master Drainage Plan).

In addition, whenever irrigation ditches cross major drainage channels in developing areas, the responsible party must separate stormwater runoff flows from normal ditch flows.

Whenever development occurs where an irrigation ditch or reservoir or other facility is present, the responsible party must provide adequate easements or other interests for ditch and reservoir operations, maintenance and repair, as required by the owner(s) of the ditch or reservoir.

Reference: Refer to Chapter 9: Streets, Inlets and Conveyance for requirements regarding the use of irrigation ditches and reservoirs.

2.3.11 Erosion and Sediment Control

Erosion and sedimentation are natural processes, the intensity of which is increased by Construction Activities. Clearing and stripping of land can cause localized increased erosion rates with subsequent deposition of sediments and damage to adjacent downstream and leeward properties. Erosion can reduce or destroy the aesthetic and practical values of neighboring properties, streams, lakes, wetlands and rivers. The methods and means to disturbing these areas may also bring materials and degrade water quality that if not maintained and handled properly may result in more impactful pollution discharges to these downstream parties and cause irreversible impacts to receiving waters.

The City is committed to the enhancement and protection of existing development, storm water infrastructure, streams, lakes, wetlands and rivers that may be impacted by sediment and pollutant laden runoff resulting from Construction Activities.

Therefore, it is City policy to encourage maintenance of the natural balance between sediment or other such pollutant supply and transport. To accomplish this balance of pollutants associated with construction, the City promotes programmatic implementation of criteria and specifications used to train, educate, and promote knowledge transfer and continually raise awareness of the issues

associated with Construction Activities and the pollutant transport from those activities. Through education and training based on clear guidelines, the City seeks to change behaviors through the design and infield implementation of Control Measures to reduce the quantities of pollutant materials allowed to impact the stormwater infrastructure and thereby ultimately protecting and enhancing receiving waters from the effects of Construction Activities.

With respect to construction control measures, the City's goal is to encourage control of erosion by leaving land undisturbed as long as possible (through project phasing), and once disturbed, to encourage Erosion and Sediment Control Measures be implemented to reduce pollution discharges directly from the exposed land and indirectly from the activities to rework that land. Control Measures, frequently referred to as BMPs, must be implemented until the site has been fully constructed and all vegetation has been re-established.

The City has determined that planning for and creating materials for the use of these Control Measures and practices, involves taking a proactive stance that can reduce the ground erosion, sediment deposition, and pollutant transportation to an acceptable level. Projects (or phases of projects depending on size) shall be designed to adequately anticipate and reduce possible erosion, sedimentation, and pollution discharges associated with Construction Activities.

Reference: Erosion Control documentation must be prepared in accordance with the criteria set forth in Chapter 2: Development Submittal Requirements, and implemented for all development, both public and private as explained in Chapter 3: During and Post-Construction Requirements. Selection of Construction Control Measures can be found in Chapter 4: Construction Control Measures. Other tools and information to facilitate meeting the Erosion Control Criteria can be found in Appendix D: Construction Control Measures Guidance.

2.3.12 Maintenance

Proper design and construction of stormwater facilities is necessary to minimize future maintenance and operating costs and to avoid public nuisances, health hazards, and safety hazards. This is particularly important given the many detention facilities and extents of storm piping in urban areas.

Long-term maintenance provisions must be prescribed for detention and water quality facilities. Maintenance of detention facilities includes the removal of debris, excessive vegetation from the embankment, and sediment. Maintenance requirements for water quality facilities (BMPs) vary, depending on the BMP type. Without maintenance, detention, retention, and water quality facilities will become unsightly social liabilities and eventually become ineffective for their intended functions.

All drainage facilities must be designed to minimize the need for facility maintenance and must provide for ease of maintenance access to all storm drainage facilities in order to ensure the continuous operational function of the system.

Maintenance access for all stormwater control and treatment facilities must be adequate and must be clearly delineated on the Final Development Plans for any development. Maintenance responsibility must be clearly described on the Final Development Plans and in the Standard Operating Procedures (SOPs) that are part of the Development Agreement.

Stormwater control and treatment facilities must be continually maintained to ensure their long term operational effectiveness. Maintenance of storm drainage facilities includes, but is not limited to, the regular performance of the following activities:

1) Mowing for weed control and removal of dead grasses; regularly scheduled during summer months.

2) Sediment and debris removal from channels, storm sewers and stormwater treatment facilities; scheduled periodically and after storm events.

3) Trash racks and street inlets must be cleared of debris; scheduled seasonally and after storm events.

4) Pipe inlets and outlets must be cleaned and cleared of vegetative overgrowth; scheduled regularly.

5) Channel bank erosion or damage to drop structures must be repaired to avoid reduced conveyance and treatment capability, unsightliness, and ultimate failure.

Pursuant to City Code Section 26-547, persons responsible for any private storm drainage facility, whether by law or as a condition of development approval or Development Agreement, shall maintain and operate said facility in accordance with maintenance best management practices.

Specific maintenance procedures are outlined in SOPs that are included as part of the Development Agreement for a project. Should the owner or responsible party fail to adequately maintain said facilities, the City has the right to enter said property for the purpose of maintenance as described in City Code Section 26-22. All such maintenance costs will be assessed to the property owner in accordance with City Code Section 26-28.

2.3.13 Floodplain Regulations

Floodplain rules and regulations for all development activities in and adjacent to the City-regulated floodplains as well as requirements for development within FEMA regulated floodplains is beyond the scope of this Manual.

Reference: Floodplain regulations can be found in Chapter 10 of the City Code.