CHAPTER 2. STORMWATER PLANNING

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1.0 INTRODUCTION

Planning of the urban storm drainage system is an integral part of urban design. A well-planned urban drainage system is critical for the overall effectiveness of flood control and water quality measures. Furthermore, the drainage system is a central component of a plan that best utilizes a property and considers the natural easement created by drainages.

Planning of urban drainage facilities should be based upon integrating natural waterways, artificial channels, storm sewers, and other drainage works into the layout of a desirable, aesthetic, and environmentally-sensitive urban community. It is imperative that runoff and drainage patterns be considered early in the design process for new developments, *before* site layout begins, rather than attempting to superimpose drainage works on a development after it is laid out, as is frequently done with water supply and sanitary sewer facilities. A well-planned major drainage system can reduce or eliminate the need for costly underground storm sewers, and it can provide improved protection from property damage, injury, and loss of life caused by flooding.

In addition to involving drainage engineering, planning for the management of urban runoff requires a comprehensive understanding of city planning and the many social, technical, and environmental issues associated with each watershed. Therefore, the drainage engineer should serve as one member of the urban design team and should be included in the earliest stages of the urban planning process.

1.1 Benefits of Stormwater Planning

If drainage planning is incorporated *after* other decisions have been made related to the layout of a new project, costly drainage and urban space allocation problems may result that are difficult to correct. In contrast, if drainage planning is incorporated into the initial stages of an urban design, the benefits that result from a well-planned storm drainage system are numerous and include the following:

Improved functionality of drainage system:

- Minimized increases in peak flow rates, diversions, improper discharges, and other actions that can potentially harm neighboring properties;
- Minimized constrictions to flow conveyance and storage;
- Improved water quality;
- Protection and enhancement of environmentally sensitive areas; and
- Improved public health, safety and welfare.

Reduced development costs:

- Reduced storm drainage system construction and maintenance cos

- Reduced excavation, fill, and grading costs;
- Reduced street construction and maintenance costs; and
- Reduced costs for open space and parks.

Improved building sites and land use:

- Improved building sites for residential and commercial development;
- Improved aesthetics of overall development and increased opportunities to make the storm drainage system a development amenity; and
- Increased recreational opportunities.

1.2 Master Planning

Watershed plans identify requirements for flood control, detention, and water quality management throughout a watershed. As watershed plans are completed and made available to the public, developments can be designed in accordance with the plans, which provide a basis for the proper location and sizing of inlets, pipes, detention basins, and Best Management Practices (BMPs) that are necessary to effectively control downstream flooding and meet water quality requirements. These factors will have a direct bearing on the layout of a new development.

During the master planning phase, major decisions are made related to drainage that address factors such as design velocities, locations of structures, open space allocation for drainages, and integration of drainage features with recreational uses. Potential alternate uses for stormwater facilities, such as parks or open space, are identified for open channels, detention facilities, and water quality facilities. In addition, the master planning phase involves making decisions whether to use downstream or upstream detention storage.

1.3 Categories of Stormwater Planning

Major Drainage System - The major drainage system frequently consists of open channels, as either stabilized natural waterways, modified natural channels, or artificial channels with grass or other lining, but can include closed conduits such as box culverts or large pipes. When well-planned, the major system can reduce or eliminate the need for underground storm sewers, and can protect an urban area from extensive property damage, injury, and loss of life from flooding.

The major drainage system exists in a community regardless of whether it has been planned and regardless of where development is located. The planning process can best serve the community by

ensuring that natural drainage easements are maintained along major drainage routes. Floodplain delineation and zoning are tools that should be used freely to designate major drainageways. Smaller waterways and valleys lend themselves to floodplain regulations in the same manner as larger creeks.

Minor Drainage System - The minor drainage system, or initial system, consists of grass and paved swales, streets and gutters, storm sewers, and smaller open channels. If properly planned and designed, the minor drainage system can eliminate many "complaint" calls to the city. A well planned and maintained minor drainage system provides convenient drainage, reduces costs of streets and storm sewers, and has a direct effect on the orderliness of an urban area during runoff events.

Planning of urban drainage features should proceed on a well-organized basis with a defined set of drainage policies that have the backing of suitable ordinances. The policies presented in this *Manual* provide a basis upon which additional localized and specific policies can be built.

2.0 STORMWATER DRAINAGE PRINCIPLES

Planning and development of stormwater drainage systems must be guided by a set of underlying principles that are based on sound engineering practice in combination with other community objectives. Key principles that serve as the foundation of the design criteria provided in this manual are described below.

2.1 Stormwater Planning Objectives

The primary objective of stormwater drainage design is the protection of public health, safety, and welfare. Stormwater systems should be designed to minimize the potential for health risks associated with runoff and should minimize the risk of damage to both public and private property, including minimizing the risk of structure inundation. Streets and the minor drainage system should be designed for the safe and efficient movement of traffic to the maximum extent practicable. Consideration should also be given to the public health and welfare benefits that result from the protection of water quality and other environmental characteristics of a watershed.

2.2 Watershed Approach for Stormwater Planning

The water resources of a watershed are affected by all who conduct activities within it and, therefore, all should be a part of the process to care for its water resources. Stormwater drainage is independent of government boundaries and, hence, stormwater system planning and implementation should include coordination with all affected agencies, communities, and neighborhoods within the watershed, regardless of government boundaries. The watershed approach to stormwater drainage and

management has been embraced by the U.S. Environmental Protection Agency (USEPA) and many other agencies and communities across the country.

2.3 Compatibility with Other Planning Objectives

In addition to protecting public health, safety and welfare, the stormwater drainage system must consider other urban planning objectives. Stormwater system planning and design for any new development must be compatible with watershed master plans and objectives and be coordinated with plans for land use, open space, transportation, and other community objectives. Watershed master plans must consistently address both stormwater quantity and quality issues in the context of the local and regional drainage basins.

2.4 Space Allocation for Flood Control

Flood control is primarily an issue of space allocation. The amount of stormwater runoff present at any time in an urban watershed cannot be compressed or diminished. Open and enclosed storm systems serve both conveyance and storage functions. If adequate provision is not made for drainage space requirements, stormwater runoff may conflict with other land uses and result in damage to public and private property and the impairment or disruption of other urban systems. In urban watersheds that have been developed without adequate stormwater planning, there is generally inadequate space available to construct detention storage facilities to reduce peak flows significantly along major waterways. Creation of adequate space to construct such storage facilities frequently requires the removal of valuable existing buildings or other facilities and is often not economically or socially feasible.

2.5 Floodplain Preservation

Floodplains should be preserved wherever feasible and practical to maintain naturally occurring stormwater storage. Floodplains serve as natural outfall areas for urban drainage, riparian corridors, and habitat for diverse ecological systems. Encroachment into floodplains should be avoided and should occur only after careful planning and engineering have been conducted so that the effects are fully recognized and minimized. Preservation of urban floodplains provides value to communities through flood hazard reduction, water quality enhancement, stream protection, preservation of plant and animal habitat, creation of open spaces and linear parks, and provision of recreational opportunities. When determining the width of a floodplain to preserve, consideration should be given to the intended use of the floodplain and the dynamic nature of stream channels. All work within a regulatory floodplain or floodway must comply with the City's Flood Damage Prevention Code.

2.6 Stream and Riparian Corridor Preservation

Streams and riparian corridors should be maintained as they naturally occur to the maximum extent practical and in accordance with the City's Subdivision Code Section 1400.10.B.11. Providing buffers between valuable riparian corridors and urban development promotes filtering of pollutants from urban runoff before it enters a stream. Each site's development plan should include careful consideration to preserve and enhance natural features, including riparian corridors. Consideration should be given to environmentally sensitive stream stabilization in areas where urbanization, altered hydrology, or soil characteristics result in unstable natural channel conditions. In certain cases, urban hydrologic conditions will require structural stabilization of streams to avoid degradation. These improvements should be completed in an aesthetic and environmentally sensitive manner.

2.7 Major and Minor Drainage Systems

Every urban area has a minor and a major drainage system, whether or not they are actually planned or designed. Generally, the minor and major drainage systems have distinctly different design criteria based on public health, safety and welfare, and economic considerations. The minor drainage system is typically designed to accommodate moderate flooding. For minor drainage systems, local street flooding can result from extreme, less frequent rainfall events may be permissible for short periods, provided that public health, safety, and welfare are protected, and structures are protected from inundation. The major system will generally have a higher design standard to minimize the impacts of flooding from more severe, less frequent floods. This approach is used because of the greater potential threat to public health, safety, and welfare that generally exists along major waterways. The specific design requirements for various conveyance methods are found in later chapters.

2.8 BMPs to Mitigate Impacts

Impacts of urbanization should be reduced through the use of Best Management Practices (BMPs). In general, urbanization tends to increase downstream peak flows, runoff volumes, and runoff velocities, which can cause the capacity of inadequately designed downstream systems to be exceeded and can disrupt natural waterways. The impacts of new urbanization must be reduced through the use of structural and non-structural BMPs that typically include stormwater detention to limit peak flow rates to predevelopment rates. Detention facilities may be constructed either on-site or as regional facilities. Regional facilities developed by the City will be constructed and evaluated as the need arises. It will be up to the City to determine the need and location of any regional detention they see as a cost effective and useful tool for controlling stormwater runoff in nuisance/flooding prone areas of the city. Other BMPs include hydraulically disconnecting impervious areas to achieve maximum contact between runoff and vegetation for maximizing infiltration and filtering of pollutants. While it is generally not practical to

maintain predevelopment runoff volumes, accepted stormwater BMPs should be used to the maximum extent practicable to minimize runoff volume. For redevelopment projects, consideration should be given to retrofitting the existing stormwater controls as necessary, given the size of the redevelopment project and its location within the watershed.

2.9 Sustainability and Maintenance

The stormwater drainage system should be designed for sustainability, with careful consideration given to the need for accessibility and maintenance to sustain adequate function, and whether the facilities will be publicly or privately maintained. The major drainage system is more likely to be maintained by a public entity, whereas the minor system is more often maintained by a private entity. Parts of the major system that serve specific functions for private entities should be maintained by those private entities. Failure to provide proper maintenance reduces both the hydraulic capacity and the pollutant removal efficiency of the drainage system. Planning and design of drainage facilities should include consideration of the funding necessary to provide proper maintenance.

2.10 Consideration of Downstream Impacts

A stormwater drainage system should be designed beginning with the point of discharge, with careful consideration given to upstream and downstream impacts and the effects of off-site flows. The location and method of discharge from a development site must be carefully determined to avoid causing harm to properties located adjacent to the site. The engineer should evaluate the conveyance system downstream of each point of discharge from a new development to ensure that it has sufficient capacity for design discharges without adverse backwater or downstream impacts such as flooding, stream bank erosion, and sediment deposition. In addition, great care must also be taken to determine the method of receiving, conveying, and discharging stormwater runoff that originates from off-site.

3.0 MAJOR DRAINAGE PLANNING

Major drainageways can consist of open channels or closed conduits. In general, use of open channels is strongly preferred to closed conduits. Primary Channels, as defined in Chapter 7 – *Open Channel Flow Design* of this *Manual*, will be the foundation of major drainageways. Open channels can include stabilized natural waterways, modified natural channels, or artificial channels with grass or other lining. Closed conduits include structures such as box culverts and large pipes.

In cases where major drainageways already exist in a natural condition, they should generally be preserved, except where any engineered improvements, such as grade control, erosion protection, or restoration, are needed. The practice of lining, straightening, narrowing, and filling major natural

waterways is strongly discouraged, whether the channel is perennial (wet) or ephemeral (dry except for storm runoff). In contrast, the practice of preserving natural waterways is highly encouraged because it generally provides benefits in terms of preserving natural floodplain storage, reduction of channel erosion, water quality enhancement, preservation of habitat, and opportunities for parks, greenway trails, and other recreational uses.

Important planning-level considerations for initial major drainage planning, open channels, and floodplain regulation are discussed in Section 3.1 through Section 3.3, respectively. Detailed design criteria are not provided in this chapter but are provided, where applicable, in other chapters as noted in the text.

3.1 Initial Major Drainage Planning

When planning a new development, a variety of drainage concepts should be evaluated prior to determination of the location of streets and lot layout. Decisions made at this point in the development process have the greatest impact regarding the cost and performance of the drainage facilities.

Developments should be designed around the existing natural drainage patterns and topography to achieve the most efficient drainage system. The designer should begin by determining the location and width of existing waterways and floodplains. A preliminary estimate of the design flow rate is necessary to approximate the capacity and size of a channel or conduit (See Chapter 4 - *Determination of Stormwater Runoff*).

Streets and lots should be laid out in a manner that preserves the existing drainage system to the greatest extent practical. Constructed channels should only be used when it is not practical or feasible to use existing waterways. Proposals to modify major natural waterways should be submitted to the City for approval prior to detailed design. In such cases, it must be shown why it is not feasible to preserve the natural major drainageway.

3.2 Open Channels

The use of open channels for major drainageways can provide significant advantages, compared with closed conduits, in terms of cost, capacity, potential for recreational uses, aesthetics, environmental protection/enhancement, and detention storage. Disadvantages of open channels compared with closed conduits include increased space and right-of-way requirements and additional maintenance needs associated with channel instability.

Open channels in new developments typically fall in one of the following categories:

Existing natural channels

- Existing natural channels that are stable and are expected to remain stable and are being preserved in a natural state.
- Existing natural channels that are unstable or are not expected to remain stable because of changes in the watershed and are being stabilized with bioengineering methods to preserve and maintain the natural character of the channel.

Existing or proposed semi-improved channels

- Existing or proposed semi-improved channels where some modifications are made, such as grading, but the channel appears to be natural and is lined with vegetation such as grass and trees.

Existing or proposed improved channels

- Existing or proposed improved channels with a natural lining, such as a trapezoidal grass channel that is mowed on a regular basis. An improved channel may include a small, concrete low-flow channel to reduce erosion and allow the grade to be maintained.
- Existing or proposed improved channels where a hard lining such as concrete, rock or other hard armor material makes up a significant part of the channel. Examples include rectangular or trapezoidal channels lined with riprap or concrete.

The volume of storm runoff, peak discharge rate, and frequency of bank-full discharges from an urban area are often larger than historic undeveloped conditions, depending on the nature of the development (Leopold 1994; Urbonas 1980; ASCE and WEF 1992; WEF and ASCE 1998). When natural channels begin to carry storm runoff from a newly urbanized area, the changed runoff regime may result in new and increased erosional tendencies.

Careful hydraulic analysis of natural channels must be made to assess and address these potential impacts. Some modification of the channel is frequently required to create a more stabilized condition to withstand changes to surface runoff created by urbanization. Channel modifications should not be undertaken unless they are found to be absolutely necessary. The objective is to avoid excessive and extensive channel disturbance and the subsequent negative impacts on erosion, sediment deposition, and water quality that they can create.

Factors to consider when choosing between using the existing channel or making improvements to the channel include:

- Required channel capacity for flood control compared with the existing channel capacity
- Space availability within the development

- Recent and expected changes in upstream runoff from the contributing watershed
- Physical characteristics of the natural channel such as slope, soil characteristics, and vegetative condition

Measures to stabilize a natural channel frequently include construction of grade controls or drop structures at regular intervals to decrease the longitudinal slope of the thalweg (channel invert), thereby controlling erosion. Bank and bottom stabilization measures may also be necessary.

If site conditions are conducive, channels should be left in a condition that resembles a natural state provided it can be demonstrated that the channel is stable during the 25-year event. It is preferred that natural channels be preserved or stabilized through bioengineering methods. If bioengineering methods are not feasible, improved grass channels are generally preferred to channels with a hard lining, except where armoring is necessary because of the physical or hydrologic characteristics of the site. Benefits of a stabilized natural channel can include:

- Lower flow velocities
- Longer concentration times and lower downstream peak flows
- Channel and adjacent floodplain storage that tends to decrease peak flows
- Protection of riparian and aquatic habitat
- Greenbelt and recreational area that adds significant social benefits

Specific design criteria along major drainageways are provided in Chapter 7 – *Open Channel Flow Design*.

3.3 Floodplain Management and Regulation

Floodplain management and regulation is necessary for a government to exercise its duty to protect the health, safety, and welfare of the public. The concept of the existence of a natural floodway fringe for the storage and passage of floodwaters is fundamental to the assumption of regulatory powers in a definable flood zone. Floodplain regulation must define the boundary of the natural floodway fringe and therefore must delineate easement occupancy that will be consistent with public interests.

3.3.1 Floodplain Management Goals

There are two major goals with respect to floodplain management:

Floodplain Management Goal 1 - Reduce the vulnerability of the residents in the City of Bella Vista to the danger and damage of floods.

Floodplain Management Goal 2 - Preserve and enhance the natural characteristics of the City's floodplains.

These two goals are achievable through appropriate management shared by the agencies involved. A multi-pronged approach to achieve the floodplain management goals described above is summarized below:

- Adopt effective floodplain regulations.
- Appropriately modify local land use practices, programs, and regulations in flood-prone areas.
- Provide a balanced program of measures to reduce losses from flooding.
- Foster the preservation and/or creation of greenbelts, with associated wildlife and other ecological benefits, in urban areas.

Floodplain management practices must be implemented to be of value. Although hydrologic data are critical to the development of a floodplain management program, the program is largely dependent on a series of policy, planning, and design decisions.

3.3.2 National Flood Insurance Program

Flood insurance should be an integral part of a strategy to manage flood losses. The City is a participant in the National Flood Insurance Program (NFIP), which is administered by the Federal Emergency Management Agency (FEMA). As a participant, the City must maintain and enforce regulations meeting minimum requirements of the NFIP including restricting development in designated flood hazard areas shown on FEMA Flood Insurance Rate Maps (FIRMs). Federal requirements mandate that flood insurance be purchased for mortgaged properties within a FEMA flood hazard area. Because the City is an NFIP participant in good standing, all property owners in the City are able to obtain flood insurance for their property with premiums based on the flood hazard zones shown on the FIRM. For additional information related to flood hazard zones, refer to the City's Flood Damage Prevention Code.

3.3.3 Floodplain Filling

While floodplain management includes some utilization of the flood fringe (i.e., areas outside of the formal floodway), city staff in conjunction with the design engineer should proceed cautiously when planning facilities on lands below the expected elevation of the 100-year flood. Flood peaks from urbanized watersheds are high and short-lived, but filling the flood fringe tends to increase downstream peaks.

3.3.4 Floodplain Mapping

Maps can be referenced to identify flood-prone areas in the City of Bella Vista for use in drainage planning. FEMA Flood Insurance Rate Maps (FIRM) are an important tool to assist with good floodplain management. The National Flood Insurance Act of 1968 established the National Flood Insurance Program (NFIP), which included a national floodplain mapping effort. Certain areas in the City of Bella Vista have been designated as floodplains and are regulated as required by the NFIP. While these maps were created to indicate risk factors for determining appropriate flood insurance rate premiums, they are also useful for designating flood prone areas. Anyone considering developing property in the City of Bella Vista should obtain a copy of the relevant FIRM panels and understand the effects any floodplain may have on a proposed development.

4.0 MINOR DRAINAGE PLANNING

In addition to addressing major drainages, effective drainage planning also requires thorough attention to the initial or minor drainage system. The minor drainage system includes features such as street inlets, storm sewers, site drainage, detention and other best management practices (BMPs). This section provides planning-level considerations for the minor drainage system and also provides references to chapters in this *Manual* that have detailed design criteria for specific minor drainage features.

4.1 Site Drainage

The initial collection system within a development may include curbs, gutters, inlets, swales, pipes, flumes, channels, open waterways, detention, and water quality BMPs. The collection system is critical to the protection of adjacent streets and properties from flooding. The objective of the site collection system is to completely collect, control, and convey the required design storm for specific street classifications (see Chapter 5 – *Storm Sewer System Design)* and protect properties adjacent to streets during runoff from storms up to the 100-year design flow.

The combination of drainage improvements and surface grading must convey all runoff to the discharge point serving the area. Discharges from a site must connect directly to the existing drainage system where possible, as opposed to discharging to the street. Provisions must be made to protect streets and sidewalks from flooding. Discharges to public rights-of-way should not exceed the street design criteria while discharges across a sidewalk must protect the sidewalk from inundation up to the 2-year flow.

4.2 Streets, Inlets and Storm Sewers

Street rights-of-way often serve as part of the initial collection system in an overall drainage system. The objective of street drainage design is to reasonably minimize inconvenience to the traveling public, provide for safe passage of emergency vehicles during runoff from storms up to a 100-year event, and prevent the overflow of runoff from streets onto private property during runoff from storms up to a 100-year event. Well-planned street location and preliminary design can greatly reduce street drainage improvement construction costs.

Inlets must be properly selected and designed to minimize the possibility of clogging and to limit spread based on the street classification. Typical inlet types include curb opening inlets, open-side drop inlets and grated inlets. (See Chapter 5 - *Storm Sewer System Design*, for detailed design criteria.) Site storm sewer pipes and box culverts must be designed to convey flow from the design storm frequency associated with site specific infrastructure as described in Chapter 5 – *Storm Sewer System Design* and Chapter 8 – *Culvert and Bridge Hydraulic Design*.

4.3 Site Detention

Any development that increases runoff must address runoff through construction of onsite detention or other compensatory measure approved by the City. Detention for flood control is designed to prevent increases in peak flow from the 1-, 2-, 5-, 10-, 25-, 50- and 100-year storms. Onsite detention should be appropriately located and shall discharge to a public right-of-way or drainage easement.

Detention basins should be planned to match existing topography to minimize cut and fill, land disturbance, and environmental impacts. Aesthetics should also be considered during design so that the facility complements surrounding land uses. In all cases, opportunities should be sought to create amenities with detention basins by utilizing permanent pools, gentle slopes, landscaping, and trees and incorporating multi-purpose uses, such as recreation. Design criteria for detention basins are provided in Chapter 6 - *Detention Design*.

Permanent pool detention basins, also known as wet detention basins, are encouraged because they provide added benefits with respect to water quality, aesthetics and habitat. When designed and constructed properly, permanent pool detention basins can be an amenity to both the development and the community. Detailed design criteria for permanent pool detention areas are provided in Chapter 6 - *Detention Design*.

Detention basins sited on or near the upstream portion of a site to reduce offsite peak runoff may be considered as an option to compensate for increased peak runoff from the site in cases where the low point of the site is not conducive to detention facilities. It must be shown that the total peak runoff rates

for the design storms at locations downstream of the site are no greater than pre-development conditions. Careful attention must be given to the timing of peak runoff. A conservative design may be appropriate to assure that peak flow rates are not increased because of inaccurate modeling of the peak timing.

4.4 On-Site Best Management Practices

Storm water quality and quantity (rate and volume) are closely related and should be planned and designed concurrently. Storm water quality BMPs are encouraged on new developments to reduce adverse impacts on downstream water quality and to meet the requirements of the City's federally-mandated National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer (MS4) permit. Planning for a new development should include determination of the BMPs to be used. These commonly include extended or wet detention basins, disconnecting impervious areas, and utilizing grass buffer strips, swales, and channels.

Designs should both filter runoff and maintain long-term stability, thereby reducing pollutants and sediment. Detailed design criteria for several common water quality BMPs are provided in Chapter 10 - *Water Quality*. Design criteria for open channels that provide stable channel linings and reduce the amount of impervious area are provided in Chapter 7 - *Open Channel Flow Design*.

5.0 TRANSPORTATION PLANNING

Developments near major transportation features and facilities, such as highways and railroads, should include a careful evaluation of the effects caused by any storm water conduits or structures related to the transportation facility. Many flooding problems can be created by bottlenecks of conduits under transportation-related structures, particularly by those that are older or inadequate. For example, culverts at highway or railroad embankments can cause drainage hazards such as excessive flooding upstream of the culvert or, alternatively, can cause excessive flow velocity and erosion downstream of the culvert.

Many storm drainage problems can be avoided through cooperation and coordination between the developer, the transportation, agency and the local governing authority over the drainage system. Drainage conditions at transportation facilities should be investigated early in the planning process to determine what limitations exist or what costs might be required to address the situation. Furthermore, it must be shown that any improvements to an existing drainage system won't create flooding. This situation could occur when replacing historically inadequate crossings with larger crossings, where the original crossing effectively detained upstream runoff and after the improvements the runoff is now allowed to travel downstream more quickly. Proposals for new developments or improvements by transportation agencies should be closely coordinated with the City to identify drainage issues, potential problems, and requirements and incorporation of watershed planning objectives. Similarly, improvements to transportation facilities by the City or private developers should comply with the *Manual*. In the case of

improvements to state or federal highways and interstates, the more restrictive requirements of the *Manual* or those of applicable state or federal guidelines shall be followed.

6.0 OPEN SPACE PLANNING

Floodplains often serve as excellent locations for community or neighborhood open space, particularly since periodic flooding in these areas makes many types of developments unfeasible. While leaving floodplains open reduces the flood risk to a community, it also serves multiple other purposes, such as enhancement of water quality and habitat, and provides space for the creation of greenway trails and other recreational uses.

The area adjacent to floodplains may be appropriate for a broader riparian and buffer corridor, larger scale recreational uses, or parks. The designer of new developments should consider these options for floodplains and consult the City for any watershed plans that address land use along floodplains.

7.0 REQUIRED PERMITS

Planning for any new development must consider the need for city, county, state, and federal permits early in the planning process. This is particularly important when the development will involve construction along a major drainageway. Common permits related to stormwater runoff are listed below:

- Large-Scale Development Plan, Preliminary Plat – A preliminary plan set designed to meet the requirements of the City of Bella Vista development ordinances. An approved Preliminary Plat is required prior to obtaining a grading / erosion control permit (see below).
- Grading / Erosion Control Permit – The City requires any project/site that involves a LSDP approval or a Preliminary Plat to obtain a grading / erosion control permit prior to commencement of earthwork at a project site. A grading / erosion control permit will be issued by the City of Bella Vista only after approval of the LSDP or Preliminary Plat.
- General Permit for stormwater discharges associated with construction activity – The Arkansas Department of Environmental Quality (ADEQ) requires a permit to allow discharges of stormwater from construction sites in cases where those discharges enter surface waters of the State or a municipal separate storm sewer system (MS4) leading to surface waters of the State subject to the conditions set forth in the permit. The designer is encouraged to either contact ADEQ or review the permit requirements on the ADEQ website (http://www.adeq.state.ar.us/). Careful review of the general permit (ARR150000) is necessary to understand which stormwater discharges are allowed under the coverage of the general permit and which are not.
- Section 404 Permit - Section 404 of the Clean Water Act requires approval from the U.S. Army Corps of Engineers (USACE) prior to discharging dredged or fill material into the “Waters of the

U.S." Waters of the U.S. include essentially all surface waters, such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. Any waterway with a permanent flow of water is generally considered a Water of the U.S. Some intermittent waterways also may be considered Waters of the U.S.

Wetlands are areas characterized by growth of wetland vegetation (e.g., bulrushes, cattails, rushes, sedges, willows, etc.) where the soil is saturated during a portion of the growing season or the surface is flooded during part of most years. Wetlands generally include swamps, marshes, bogs, and similar areas.

Typical activities within Waters of the U.S. and adjacent wetlands that require Section 404 permits are:

- Site development fill or excavation for residential, commercial, or recreational construction
- Construction or replacement of in-channel structures
- Placement of riprap
- Construction of roads
- Construction of dams
- Any grading within the channel of Waters of the U.S.

When activities of this type are proposed, the developer should contact the USACE to determine if a Section 404 Permit will be required and to identify major issues involved in obtaining the permit. The City of Bella Vista is located in the Little Rock District of the USACE.

Because Bella Vista is located in Benton County, any work considered to be covered under one of the several Nationwide Permits authorized by the USACE still requires the submittal of an "APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT – 33 CFR 325". Additional requirements needed to complete this permit include, but are not limited to, the following:

- Historic Preservation – evidence must be provided that a project is not going to adversely impact protected historic landmarks. The *Arkansas Historic Preservation Program* shall be contacted in regards to providing guidance and evidence as to whether a proposed project will or will not adversely impact protected historic landmarks.

- Endangered Species Protection – evidence must be provided that a project is not going to adversely impact protected threatened and endangered species. The *US Fish and Wildlife, Arkansas Field Office* shall be contacted in regards to providing guidance and evidence as to whether a proposed project will or will not adversely impact threatened or endangered species.

Floodplain Development Permit (if required) – Development requirements and restrictions in Special Flood Hazard Areas of the City of Bella Vista are described in the Flood Prevention Code for the City. If development is to occur within a FEMA regulatory floodplain, a floodplain development permit must be obtained from the City. In addition, if necessary, additional floodplain requirements, such as a Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR) must be obtained through FEMA or a "No Rise Certification" (for floodways) must be obtained through the City.

8.0 DEVELOPMENT REVIEW PROCESS

8.1 Subdivisions

All Large Scale Development Plans, Subdivision Plans (Preliminary and Final Plats) and any projects that impacts the City of Bella Vista must go through the technical review process with city staff and utility providers. To become familiar with the development approval process in the City of Bella Vista, and to understand the development review schedule, refer to the City of Bella Vista's Planning, Building, and Code Enforcement Department's web page which provides the current development review schedule.

Submittal requirements for subdivision development in the City of Bella Vista are specified in the Subdivision Code of Ordinances for the City. Early planning for a new subdivision should include meeting with the Planning, Building, and Code Enforcement Department develop an acceptable stormwater management plan that will be less likely to experience problems in the review process while resulting in a more efficient and optimum storm water design. Major conceptual storm water issues can be identified to help with development of a design that can maximize flood control and water quality protection while minimizing project costs and future conflicts and construction difficulties.

Major design features that should be identified first are the preservation of major drainageways. These include location and configuration of detention basins and water quality controls, and the location and configuration of streets and lots. Any watershed plans affecting a development should be identified so that compliance approach can be incorporated early in the design process. The developer should obtain a copy of the Preliminary Plat checklist from the Planning, Building, and Code Enforcement Department, to begin preparation of acceptable stormwater drainage plans and plat layout.

Subdivisions within a floodplain or floodway must provide floodplain data certified by an engineer or architect and must meet all FEMA requirements for new construction in floodplains or floodways.

8.2 Large Scale Development Plans

Submittal requirements for a Large Scale Development (LSD) in the City of Bella Vista are specified in the Subdivision Code of Ordinances for the City. Drainage improvements must be indicated on the plans and a drainage report must accompany the plans. An engineer's certified calculations must be provided for all improvements. Improvements must be completed and certified by the engineer of record prior to the issuance of a certificate of occupancy.

Major design features that should be identified first are the preservation of major drainageways. These include location and configuration of detention basins and water quality controls, and the location and configuration of streets, parking lots, and buildings. Any watershed plans affecting the development should be identified so that compliance approach can be incorporated early in the design process. The developer should obtain a copy of the Large Scale Development checklist from the Planning, Building, and Code Enforcement Department, to begin preparation of acceptable stormwater drainage plans and site layout.

Large Scale Developments within a floodplain or floodway must provide floodplain data certified by an engineer or architect and must meet all FEMA requirements for new construction in floodplains or floodways.

9.0 REFERENCES

American Society of Civil Engineers and Water Environment Federation. 1992. *Design and Construction of Urban Stormwater Management Systems.* ASCE Manual and Reports of Engineering Practice No. 77 and WEF Manual of Practice FD-20. Alexandria,VA: Water Environment Federation.

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