CHAPTER 3

# STORMWATER MANAGEMENT

# 3.1 INTRODUCTION

## 3.1.1 GENERAL INFORMATION

### A. Purpose

These policy statements are standards and interpretations made to assist in the implementation of the requirements of the ordinances. These policies are to be followed unless adequate documentation is submitted to and approved by the City Engineer that demonstrates that the intent and requirements of the ordinances will still be met.

## 3.1.2 DEFINITIONS

### A. Adjacent Grade

The elevation of the ground, sidewalk, patio, deck support, or basement entryway immediately next to the structure.

### B. The 100-Year Flood

A flood with a 1% chance of being equaled or exceeded in any given year. Throughout the United States, the standard for floodplain management is protection from flooding up to and including the 100-year flood event.

### C. First Flush

The first half-inch of rainfall runoff (Q=iA), where Q is the runoff flow in cfs, i is the average rainfall intensity in inches per hour, and A is the drainage area.

# 3.2 GRADING AND DRAINAGE

## 3.2.1 DESIGN

### A. General

1. Drainage easements should be identified as early as possible in the planning of any development project, preferably as part of the master plan process. The City will check for and avoid discontinuous drainage easements. Unless otherwise agreed to in writing by the City, maintenance of drainage facilities is the responsibility of the Individual, POA or the HOA that owns the property within which the drainage facilities are located. The Grading and Drainage Plan and Recorded Plat should specify who has maintenance responsibility.
2. All developments are required to have on-site retention sufficient to hold 100% of the 100-year 6-hour storm. A stormwater retention waiver may be submitted if the conditions in Section 3.3.5.I apply.
3. Stormwater runoff volumes will be calculated using the methods, charts, tables and isopluvials found in the Drainage Design Manual for Maricopa County, Volume I, Hydrology.

4. Grades
   a. Grades adjacent to and within 10 feet of sidewalks or roadways shall not exceed a slope of 6:1.
   b. All other grades shall not exceed a slope of 4:1 without prior permission from the City Engineering Department.

B. Structures

1. Structures must be designed such that they do not flood during any storm up to the 100-year 6-hour event.
2. Habitable structures located in an area designated as a Special Flood Hazard Zone by the FEMA Flood Insurance Rate Maps (FIRM) shall be designed to meet the City requirements as identified in the Flood Damage Prevention Ordinance.
3. Finished Floor elevations shall be a minimum of 18 inches above the low lot outfall and a minimum of 12 inches above the high water elevation.

C. Subdivisions

1. Lots shall drain to the street.
2. Lots shall have a minimum slope of 1%.
3. On-Lot retention will not be allowed on lots that are less than one acre in size.
4. Retaining walls will be required when the elevation difference between two adjacent lots is greater than 1foot.
5. Avoid design of common drainage facilities that require maintenance by Individual property owners. Drainage facilities should be located in a common tract that is to be owned and maintained by a POA or HOA.

D. Retaining Walls

1. Retaining walls that retain greater than 1foot of material will be reviewed and approved by the Building Safety Department.
2. Retaining walls should be shown on the Grading Plans for informational purposes only.
3. Retaining walls shall have a maximum retained height of 6 feet.

### 3.2.2 DRAINAGE REPORT PREPARATION

The Drainage Report must be prepared in accordance with the EDS&PM, and Development Regulation regarding the construction of drainage and retention infrastructure.

This section outlines the City's requirements and provides guidance for preparing drainage reports to submit to the City of Goodyear.

This section is based on procedures, data, and basic assumptions, including but not limited to: publications of the FCDMC, regulatory requirements, and the EDS&PM. When methods or data not included in the EDS&PM are used, the Drainage Report must include sufficient information to enable the City staff to fully evaluate the applicability of the methods and data.

A. Purpose of a Drainage Report

The purpose a Drainage Report is to document that stormwater runoff has been considered in the planning of each project, that the runoff will be properly managed by the project, and that the public and its property will be protected from damage by runoff flows and flooding. The requirement applies to those who will own and/or use a proposed project and to those who own or occupy property adjacent to or near the proposed project.

B. Types of Drainage Reports

There are Drainage Memorandums, Master Drainage Reports, Preliminary Drainage Reports, and Final Drainage Reports. The section below describes the four report types.

1. Drainage Memorandum

A Drainage Memorandum shall be provided for all GPA, Rezone, and PAD applications that are not part of a phased construction. The following information, at a minimum, shall be provided:

a. Describe and show the locations and sizes of all existing and/or proposed floodplains, natural and artificial channels, storm drains, storage basins, and any other drainage structures or improvements within, adjacent to, and downstream of the site.

b. Describe how both flows generated on-site and flows impacting the development from off-site are to be managed.

2. Master Drainage Report

A Master Drainage Report provides a governing design plan by which all Preliminary and Final Drainage Reports will be based for each phased portion of development. The Master Drainage Report shall be provided when the project is to be designed and constructed in phased succession. A Preliminary and Final Drainage Report may be submitted following the approval of a Master Drainage Report when a preliminary plat or site plan and civil construction drawings are submitted.

3. Preliminary Drainage Report

A Preliminary Drainage report may be proceeded by a Master Drainage Report if the project is part of a phased construction.

When a Master Drainage Report has previously been approved by the City for an overall development, the Preliminary Drainage Report shall match the Master Report in respect to the portion of the overall development being designed. However, the Preliminary Drainage Report is not a conceptual view of drainage on the property, but rather a draft version of the Final Drainage Report.

A Final Drainage Report shall follow the Preliminary Drainage Report when right-of-way improvement, construction, or grading plans are required.

4. Final Drainage Report

A Final Drainage Report may be proceeded by a Preliminary Drainage Report when a Preliminary Plat or Site Plan have previously been approved for the project.

The Final Drainage Report shall closely follow the Approved Master Drainage Report and Preliminary Drainage Report (if applicable).

See the summary table below for guidance on when the various drainage reports are due to the City and the corresponding requisites. All master, preliminary and final drainage reports must be signed and sealed by a registered professional engineer.

### Table 3.2.2 Drainage Report Guidance

| Types of Drainage Report | Activities Requiring a Drainage Report | Drainage Report Due | Pre-requisite Drainage Reports | Post-requisite Drainage Reports |
|---|---|---|---|---|
| Drainage Memorandum | • GPA, Rezone or PAD that are not part of a phased construction | Submit with GPA, Rezone, or PAD application | N/A | N/A |
| Master Drainage Report | • Phased construction with Rezone or PAD | Submit with Rezone, or PAD application | N/A | Preliminary and Final Drainage Report* |
| Preliminary Drainage Report | • Site Plan<br>• Preliminary Plat | Submit with the Site Plan or Preliminary Plat application | Master Drainage Report* | Final Drainage Report |
| Final Drainage Report | • Permit to construct right-of-way improvements<br>• Permit to construct any structure<br>• Grading Permit | Submit with the construction plans | Preliminary Drainage Report | N/A |

*If part of a phased construction

C. Elements of a Drainage Report

Each Drainage Report shall include a discussion and provide all relevant maps, tables, and calculations necessary to describe and justify how off-site and on-site stormwater will be managed in conjunction with site improvements. For specific items to be included (as applicable) in all drainage report types see the Drainage Report Outline, at the end of Chapter 3.

There will be cases when one or more of these elements would not be applicable, and there could be special projects requiring additional analyses or information not covered in these elements. The elements are described in the following subparagraphs:

1. Introduction

   The introduction shall include the following items:

   a. Project name
   b. Project location – including a vicinity map exhibit
   c. Type of Drainage Report (Master, Preliminary, or Final)
   d. Project description – including the size of the project in acres and scope of project
   e. Include any pertinent existing drainage studies. The existing studies should be described and the information that is being referenced should be summarized. Pertinent excerpts from these studies should be included in the Appendix of the drainage report.
   f. Purpose and Objectives of project

2. On-site Drainage Conditions

   This section shall include a narrative of the on-site drainage network, patterns, and watershed and floodplain boundaries. This section of the report should include the following information about the project, as applicable.

   a. Narrative description of existing drainage network, drainage patterns, watershed boundaries, floodplain boundaries, natural and artificial channels, storm drains, storage basins, and any other drainage structures or improvements that are within the project site. Include location and sizes of all drainage ways and drainage systems within the project limits.
   b. Topographic map depicting the existing conditions including all the aforementioned items, plus the 100-year floodplain for all washes with a capacity of 100 cfs or greater.
   c. Site specific photographs and aerial photographs that describe the location and condition of the property to be developed.
   d. Description of the existing ground cover conditions and the identification of the hydrologic soil group(s) found on the property.
   e. Description of any existing development located on the property and how it affects drainage.
   f. Description of any existing and/or proposed developments on adjacent properties and how it affects drainage on the project area.

g. Justification for the selection of parameters used in analysis of on-site conditions.

3. Off-site Watershed Conditions

This section shall include a narrative of the off-site watershed conditions and the drainage network entering and existing the project. This description will correspond to the watersheds delineated on the topographic map. This section of the report should include the following basic information, as applicable:

a. Narrative description of existing upstream and downstream drainage patterns, watershed boundaries, floodplain boundaries, natural and artificial channels, storm drains, storage basins, and any other drainage structures or improvements that are adjacent to or downstream of the project site. Include location and sizes of drainage ways and drainage systems that are adjacent to and downstream of the project.

b. Topographic map delineating watersheds from which stormwater enters or affects the project's property. These maps shall be prepared at a scale that clearly shows the drainage areas so that the watershed boundaries can be drawn with accuracy. Contour lines should be shall be shown on the maps at an interval appropriate for the slope and complexity of the terrain. The map shall show the locations and flow rates for the off-site flows impacting the property.

c. Site specific photographs and aerial photographs that describe the upstream watersheds and downstream conditions and/or constraints that affect the property.

d. A description of the groundcover conditions and the hydrologic soil group(s) found in the off-site watersheds.

e. A description of existing development in the watersheds and how this affects drainage.

f. A description of any proposed projects or developments, which have approved designs and that will affect this property.

g. Describe any other condition which would significantly affect the runoff from the watershed.

h. Justification of the selection parameters used in analysis of off-site conditions

4. Floodplain Designation

A description of the floodplain designation of the development shall be provided. The description shall identify the flood zone(s) for which the project is located as identified by the current FEMA Flood Map. This section shall also identify the risks of that zone(s). An

excerpt of the current FEMA floodplain map with the location of the property shown shall be provided as an exhibit in the report.

5. Proposed Drainage Plan

The proposed drainage plan shall describe how the proposed project will manage stormwater runoff, including how the project will affect stormwater runoff.

a. Basis of Design for Drainage and Flood Control Facilities

(1). Summarize the design criteria used, and include a brief description of the design approach and methods used. Include exhibits, data, and calculations that support the selection of materials, locations, and design of facilities. Include if the project will be retaining the 100-yr 6-hr volume or a first flush approach will be taken. See Section 3.2 for design criteria and policy guidance, and Section 3.3, Stormwater Management, for design guidance of the specific drainage facility. If the drainage report will be using information from existing drainage studies, these studies should be described and the information that is being referenced should be summarized. Pertinent excerpts from these studies should be included in the appendix.

(2). The peak flows, times of concentration, and other pertinent hydrologic data, for each off-project drainage area tributary to the project shall be computed and submitted in summary form. For the time of concentration include the equation used and minimum time of concentration allowed.

(3). State the peak flow rate calculated and describe the flow capacity requirements and inflow-outflow relationships (as applicable) for the following items:

i. Retention/detention basins - For retention basins specify the design criteria used and explain how the basin will be dewatered

ii. Up and/or downstream ends of culverts;

iii. Intake points for storm drains (i.e. inlets, catch basins, scuppers, etc.);

iv. Points immediately upstream and downstream of channel junctions and/or street intersections;

v. Other items as may be necessary to give a complete hydrologic picture and allow a thorough hydraulic evaluation and/or design of the drainage system.

(4). If approval of a development will require that a wash be retained in its natural state, then supporting hydrologic and hydraulic calculations must be submitted in sufficient detail with the Drainage Report to demonstrate that the easement or tract set aside for drainage will be of sufficient width to convey the peak 100-year storm drainage flow, without endangering life or property which is outside the easement or tract, and to accommodate usual maintenance equipment.

b. Pre- and Post-Project Topography

(1). Prior to development, existing topographic conditions influence the flows of stormwater runoff from off-site watersheds as well as runoff originating on the property. Topographic changes resulting from development will impact these drainage characteristics, including the time of concentration. The drainage report shall include sufficient pre- and post-project topographic information to demonstrate the effects of the project. This information shall be depicted on contour maps that show adjacent properties, including off-site watersheds, in addition to the property being developed, to provide context for the potential impact of development. Information about adjacent property, such as significant differences in elevation, walls, drainage structures, buildings (including lowest floor elevations) shall be included.

c. Pre- and Post-Project Stormwater Runoff of Off-site Flows

(1). Compare and analyze the stormwater runoff exiting the project both prior to and after construction, for the 5-year, 10-year, 50-year, and 100-year storm events. Include the “C” value used to calculate stormwater runoff for the project and when applicable, include calculations to show how a weighted “C” value was developed.

(2). Describe the proposed facilities for collection, routing, and discharging off-site flows.

(3). If, as a result of the project, drainage flows will be reduced by facilities such as retention or detention basins, the effect of these facilities on flows exiting the property shall be described and depicted on appropriate maps. Construction of roads, parking areas, roofs, channels and other development features results in the increase of runoff volumes, peak discharge rate, and reduces times of concentration.

(4). Verify that on-site and off-site flows will not combine.

d. Basis for Selection of Lowest Floor Elevation

For all development projects the lowest floor elevation(s) shall be provided. The lowest floor elevations must provide protection from flooding. The basis for the selection of a floor elevation or the design of protection for the interior of the building, must be clearly presented. See Sections 3.2.1 for design criteria. Supporting documentation should be included in an appendix.

e. Description of the Provisions for Project Phasing:

(1). Describe the phasing of parcels and the timing of the installation of drainage facilities. Any project, particularly a large one, may have interim stormwater runoff, flooding, and erosion problems that would not exist after project completion. The report shall explain how the phasing will occur, what interim drainage problems are anticipated, and what interim measures will be taken to protect against the interim problems.

6. Special Conditions

In this section include project stipulations, 401 and 404 permits, and AZPDES.

7. Data Analysis Methods

Include the hydrologic, hydraulic, and stormwater methods and assumptions utilized in the drainage report.

8. Conclusions

a. Overall Project

(1). Provide a summary of findings and recommendations outlined within the report based on the completion of the project in its entirety. For projects that are constructed in phases, provide conclusions based upon the completion of all phases within the project.

D. Additional Documentation Required with Drainage Reports

1. A construction schedule shall be included in table format for all drainage-related construction required on the development, per signed zoning or other agreements.
2. If construction activity will disturb an acre or more, then a SWPPP and a copy of the NOI must be submitted to the City, by the owner, to obtain a grading permit. For developments that meet the qualification of a “Small Site”, the SWPPP may be included as a separate sheet in the Grading Plans. A copy of the SWPPP and NOI

must also be submitted to ADEQ as required by law. The SWPPP shall include all requirements of Maricopa County Rule 310[1].

a. Effective February 7, 2000, the NPDES Stormwater Program was expanded to address stormwater discharges from small Municipal Separate Storm Sewer Systems (MS4s) and construction sites that disturb one or more acres. The NPDES program requires owners/operators of construction projects disturbing one or more acres to prepare a SWPPP and to file a NOI.

E. Additional Information

Refer to the Drainage Report Checklist, as found on the Engineering Department website, for specific items that are to be included within a Drainage Report.

### 3.2.3 SITE PLANS AND PRELIMINARY PLATS

A. Submittal

1. All Site Plans and Preliminary Plats shall provide a full size (24" x 36") drainage exhibit with the following information provided:

a. All existing stormwater management features, storm drain lines (with line sizes and line material types listed), retention basins, and drainage channels (with flow direction and CFS listed).

b. Existing information shall be shown in dashed screened back line types.

c. All proposed improvements shall be shown in dark lines.

d. Clearly show and define, on the preliminary grading and drainage drawing, each sub-area of the property that will contribute runoff to each retention basin or interconnected retention basin system.

e. Show, label, and quantify (cfs) all stormwater runoff generated offsite which will be impacted by construction of the development.

f. Show the areas to be used for storm drainage retention or detention. These areas shall be tracts to be maintained by the Individual, HOA or POA that owns the area within which the stormwater retention or detention will be located. Sufficient dimensions, contours, side slopes, volumes, top, bottom and high water elevations, and other relevant information shall be provided.

g. Indicate (by arrows) the location, direction, and amount of flow (cfs) of all natural washes or man-made drainage channels which exist or are planned, and which flow through, are adjacent to, or begin within the proposed development.

[1] Copies of all requirements, forms, and guidance are available in the "Drainage Design Manual for Maricopa County Volume III, Erosion Control" available at the Flood Control District, 2801 West Durango, Phoenix, Arizona 85009. Phone No. 602-506-1501.

h. Easements for surface drainage shall be wide enough to provide a channel which meets the City engineering design requirements.

(1). Surface drainage easements may be split so that 1/2 lies on one lot and 1/2 lies on the adjacent lot.

(2). If a development is to have an HOA or POA, the land area set aside for surface drainage should be on a tract which will be owned and maintained by the HOA or POA and not on an easement where maintenance responsibility would be split among several property owners.

i. Show the street drainage pattern by arrows and indicate those points at which it is intended to add concentrated flow to the street drainage and to remove drainage from the street.

### 3.2.4 CONSTRUCTION PLAN REQUIREMENTS

A. Review

1. All improvement plans which include work within the City shall be submitted for review and approval by City Staff. Plan review submittals are made to the Engineering Department.

2. Grading & Drainage improvement plans shall provide sufficient topography and/or point elevations to clearly show that the grading and drainage related improvements have been designed to meet the requirements of this chapter.

B. Review Guidelines

No permits for public storm drain installation will be issued until the Owner/Developer has provided the necessary easements and rights-of-way. The instruments of dedication must be approved by the City and recorded at the Maricopa County Recorder's Office. The following paragraphs highlight construction plan requirements pertaining to the preparation of Grading & Drainage Improvement Plans which are to be submitted to the City for approval:

1. Plans shall be prepared and submitted per the information provided in Chapter 2 of this manual.

2. General Construction Notes and Grading & Drainage Construction Notes which apply to grading a site and the construction of drainage facilities on a site are required on each set of construction plans which include work on the City's storm drain system or a storm drain system which is to be dedicated to the City. These notes are provided in Chapter 1 of this manual.

3. If a storm drain line is to be connected to an existing system, the following note shall be placed on the plans: "Contractor shall verify

the location of the existing storm drain line before proceeding with trenching."

4. Where storm drain lines or culverts cross water lines, sewer lines, reclaimed water lines, or drainage culverts, the relationship shall be shown in both plan and profile and actual separations shall be called out.
5. For permitting purposes, quantities for all items of work within public rights-of-way and public easements shall be included on the cover sheet of the plans unless otherwise approved by the City Engineer.
6. Plans and profiles of storm drain lines shall show size, invert and grade elevations, materials of construction, utility location, and any other details which define the construction requirements.
7. Easements of record shall be noted and shown in plan view. Annotations should include the docket and page number and / or the Maricopa County Recorder's number.
8. The checklist for developing a grading and drainage plan can be located on the City's engineering website. The checklist also provides detailed information regarding the information required for a grading and drainage plan.

C. Mass Grading

A mass grading plan may be submitted to Engineering for permitting. The purpose of a mass grading plan is to balance large scale cut and fill on the site, prior to final grading. The criteria for submitting and permitting of a mass grading plan are as follows:

1. The subject project is part of a current, approved site plan or preliminary plat.
2. The plan should include topographic contours at one (1) foot maximum intervals.
3. No street grading or structures shall be included on the plans. All proposed grading shall be within the project boundary and shall not negatively impact any adjacent property.
4. Retention basins with ponding no more than one (1) foot deep are to be used for the interim condition drainage mitigation.
5. Grading is prohibited in existing City right-of-way or FEMA flood plain (Special Flood Hazard Areas).
6. The submittal shall include a mass grading drainage report (final design report) or mass grading section in the final drainage report for the project, if included in an overall improvement plan package.
7. A SWPPP site plan and narrative shall be submitted.
8. Financial assurances are not required for mass grading permits.

9. For proposed subdivisions, a recorded Final Plat is not required prior to the issuance of a mass grading permit.

D. "At-Risk" Permit

1. An At-Risk Grading and Drainage plan may be approved as a convenience to the developer. The City is not obligated to approve an At-Risk Grading plan. If an At-Risk Grading plan is accepted to be submitted it must follow the below listed requirements:

a. The subject project is part of a current, approved site plan or preliminary plat.

b. The City must complete first review of the Final Grading and Drainage plans for the proposed development and find that the plans are substantially acceptable. The Final Drainage Report must also be substantially acceptable.

c. The City must review and approve the SWPPP.

d. Developer/Contractor must provide a copy of the signed NPDES NOI and construction schedule prior to issuance of At-Risk Grading permit.

e. Contractor to provide to City one copy of the Maricopa County Rule 310 (Dust Control Permit).

f. Contractor shall obtain a Haul Route permit if more than 5,000 cubic yards of material is to be imported to the site or exported from the site, or at the discretion of the Engineering Inspector.

g. Contractor to obtain a "At Risk Grading" permit at a cost of 150% of the actual grading and drainage permit cost, which has a one time "life" of 60-calander days. The total fee (for the "At Risk Grading" permit) will be collected at the time of "At Risk Grading permit application.

h. Developer/Contractor shall obtain an actual Grading and Drainage permit, within 60-calendar days of the issuance of the At-Risk Grading permit and following approval of the Grading and Drainage plans. The Contractor shall cease construction activities at the site if the grading plans and/or the Final Grading permit is not issued within 60-calander days.

i. Grading is prohibited in existing City right-of-way or FEMA flood plain (Special Flood Hazard Areas).

j. The permit is restricted to earth moving operations only – no structures, storm drain or underground storage may be constructed under an "At-Risk Grading" Permit.

(1). The City will issue an "At Risk Grading" permit which is effective for 60-calender days provided that the developer/owner/contractor agree to complete the items listed below. **No other permits such as building, water, sewer,**

**concrete, dry utilities or paving will be issued until such time as:**

i. All civil drawings are approved by the City; and

ii. The final grading and drainage permit is obtained; and

iii. All fees associated with plan review have been paid to the City; and

iv. The financial guarantee for construction of the project has been posted with the City

2. If the above mentioned items are not submitted and accepted by the City within the 60-calander days (unless otherwise extended by the City Engineer,) the "At Risk Grading" permit will be withdrawn and the contractor will be required to return the property to its original condition.

3.2.5 AS-BUILT DRAWINGS

A City-approved set of As-Built Drawings are required for all grading and drainage improvements constructed in the City, prior to acceptance of the system and start of the 5-year warranty period. The 5-year warranty period applies to the stormwater disposal system. As-built plans shall be signed and sealed by a qualified professional registrant registered in the State of Arizona. See Chapter 10 of this manual for applicable as-built standards.

## 3.3 STORMWATER MANAGEMENT

3.3.1 INTRODUCTION

A. Design

The design of drainage and flood control facilities in the City of Goodyear shall follow the latest edition of the Drainage Design Manuals of the FCDMC that pertain to Hydrology, Hydraulics, and Erosion, as supplemented by this manual. This manual contains clarifications or modifications applicable to the design of facilities within the City of Goodyear.

B. Hydrology

Table 3.3-1 outlines the minimum drainage design criteria for stormwater management and drainage facilities within the City of Goodyear.

C. General Information

1. All developments within the City shall provide such storm drainage facilities as are necessary to ensure that all structures and properties- including those within, upstream of, and downstream of the development- shall be protected from the adverse impact of

stormwaters due to the proposed development. All development projects disturbing one acre or more will implement strategies that include a combination of structural and/or non-structural BMP's designed to reduce pollutants in post-construction runoff to the City's municipal separate storm sewer system.

2. All on-site drainage channels and other structures handling stormwater runoff shall be designed and constructed in accordance with these standards, including single family residential lots. Any proposed structural changes which may accelerate, retard, convey, or redirect surface water runoff in any way must be approved by the City Engineer.
3. Any culverts installed for stormwater conveyance shall be 18 inches minimum inside diameter, constructed of approved materials.
4. All culverts shall be installed with both upstream and downstream end sections or headwalls.
5. Where driveways cross existing stormwater channels, the finished elevation of the driveway at the point of crossing the channel shall be at or below the lowest top of curb elevation at the intersection of the driveway and the public street. Where the flow line of the channel is less than 2 feet below the lowest intersected curb elevation, a drop inlet type headwall shall be required if a culvert is used.
6. All scuppers, storm drain inlets and culvert headwalls shall be constructed with a "NO DUMPING" inlet marker per the City Standards Details.

## TABLE 3.3-1 Hydrology Design Criteria

| Peak Frequencies (Six-Hour Storm Evenet) | | | | |
|---|---|---|---|---|
| Drainage Feature | 5-Year | 10-Year | 50-Year | 100-Year |
| Street with Curb & Gutter | Runoff (the flow of water) on collector and local streets shall be contained within the street curbs | Runoff (the flow of water) on arterial streets shall be contained within street curbs.<br>For major collector and all arterial streets, one 12-foot dry lane must be maintained in each direction. | Runoff to be confined to road right–of-way or to drainage easements. | Runoff to be confined to road right-of-way or to drainage easements.<br>Maximum depth for water (dmax) dmax = 8 inches above the low spot in the street. |
| Street with Storm Drain System | Storm Drain Pipes and Inlets shall be added if the 5-year runoff exceeds street capacity as addressed above. | Storm Drain Pipes and Inlets or roadway channels shall be are added if the 10-year runoff exceeds street capacity as addressed above. | N/A | Storm drain systems are used to maintain runoff within the road right-of-way or drainage easements.<br>Storm drain systems: catch basins, scuppers, etc. to be provided to remove water so as not to exceed dmax = 8 inches (12 inches in weir conditions) |
| Cross Road Culvert or Bridges for Arterial and Major Collector Streets | N/A | N/A | Runoff to be conveyed by culvert or bridge under road with no flow overtopping the road. | Culverts shall be used to maintain a maximum 6-inch flow depth over the roadway while maintaining at least one dry lane in each direction |
| Cross Road Culvert or Bridges for Local and Minor Collector Streets | N/A | Runoff to be conveyed by culvert or bridge under road with no flow overtopping the road. | The 25-year frequency storm runoff shall be conveyed by culvert or bridge while maintaining a maximum 6 -inch flow depth over the road. | Maximum flow depth over roadway crown is 12 inches. |
| Any street crossing a water course which provides access to residential areas | N/A | N/A | N/A | May be used as a secondary access road only if an all-weather access road is available to every lot or parcel. Depth of flow shall be no greater than one foot over the road during the 100-year runoff event. |
| FEMA Floodplain Channel | N/A | N/A | N/A | 100-year peak discharge. |
| Channel to Convey Offsite Flow Through Development | N/A | N/A | N/A | 100-year peak discharge |
| Stormwater Storage | N/A | N/A | N/A | 100-year 6-hour runoff for determining on-site storage volume. |

### 3.3.2 COLLECTION SYSTEM

This portion of the system is intended to collect runoff and convey it to retention/detention facilities and/or outfall points. No structure of any kind shall be constructed, nor any vegetation be planted nor be allowed to grow within, on, or over any drainage easement, if it would obstruct or divert the flow of stormwater. The City may, if it so desires, construct or maintain drainage facilities on or under the land of the drainage easement. Stormwater retained in retention basins or conveyed through drainage channels during the 100-year 6-hour event shall not be located above any City utility line including, but not limited to, water, sewer, reclaimed water, and storm drain. In general, the collection system shall consist of the following:

A. Surface Drainage Facilities

1. Streets
2. Open channels

B. Sub-surface Drainage Facilities

Sub-surface drainage facilities are required whenever the capacity of the surface system is exceeded. It is comprised of the following:

1. RGRCP, Polypropylene, and HDPE Pipes
2. Manholes/junction boxes
3. Catch basins and scuppers

C. Retention/Detention Facilities

Retention/Detention Facilities are intended to retain/detain sufficient volumes of runoff to minimize the adverse impact of the new developments on downstream areas.

1. All developments must provide retention/detention facilities.
2. Single family development, when the lots are less than one acre in area, shall provide a common retention tract that is to be owned and maintained by the HOA or POA.

### 3.3.3 DRAINAGE

A. Street Drainage

1. Underground storm drains or open channels are required when the street capacity is exceeded.
2. Dip crossings of open channels shall only be accepted when an alternative all-weather access is available to every property. When

dip crossings are used, the depth of water over a roadway shall be no greater than what is permitted in Table 3.3.1 of this chapter.

3. Theoretical Capacity

   A Manning's "n" value of 0.020 shall be used for residential streets and parking lots, and 0.016 shall be used for non-residential street flow. If special conditions exist, they must be clearly documented in the Drainage Design Report.

4. Longitudinal Street Grades

   The desirable minimum longitudinal street grade is 0.4% to ensure good gutter drainage. Wherever possible, longitudinal street grades greater than or equal to the desirable minimum grade shall be provided. All grades less than 0.4% must be approved by the City Engineering Department.

5. Valley Gutters

   a. Valley gutters shall be used to transport runoff across local streets when a storm drain system is not required. The minimum width of a valley gutter is 4 feet.

   b. Mid-block valley gutters are not allowed. Storm drains or culverts shall be constructed where mid-block stormwater crossings are required.

6. Design Criteria for Roadside Ditches

   Geometry shall be designed to allow maximum conveyance of flows and minimal maintenance.

7. Catch Basins

   a. Catch Basins shall be constructed as shown in the City Standard Details.

   b. For scuppers, MAG Standard Detail 206 shall be used as the basis of design.

B. Drainage Between Lots

1. No subsurface routing of drainage ways between lots or buildings shall be permitted in an easement unless the Engineering Department has approved, in writing, the placement of the drainage way in an easement, and the property owner has granted the necessary easement.

2. If approved, the channel shall be designed to convey the 100-year flow without flooding adjacent properties.

3. If approved, the channel shall be constructed in a dedicated drainage easement leading to a positive outfall point. The minimum width of the easement shall be the top width of the channel plus eight feet for a maintenance roadway. The ends of the easement shall be treated in such a manner as to prevent non-maintenance vehicular access without diminishing the hydraulic capacity of the channel. For design purposes, a minimum of 25% of the upstream opening shall be assumed to be clogged with debris.

C. Underground Storm Drains

1. Underground storm drains shall be provided whenever the capacity of a street is exceeded.
2. Pipes shall be sized using "Manning's Formula". Values of Manning's "n" shall be per appropriate technical literature and shall be referenced.
3. Velocities shall range between 3 fps and 9 fps.
4. The minimum pipe size of a lateral collector and a main shall be 18" ID. In situations where debris is expected, the City's Engineering staff should be consulted for applicable clogging design criteria.
5. The hydraulic grade line for a 10-year storm event may be above the pipe, provided that it remains at least one foot below the ground elevation at all manholes, catch basins, inlets, etc.
6. When the pipe changes direction more than 30 degrees, there shall be a drop, between match points, of at least 0.1 feet. In no case shall the deflection angle be greater than 90 degrees.

D. Separation of storm drain from water and sewer lines

1. Horizontal separation of storm drains to water, sewer, or reclaimed water lines shall be a minimum of 6 feet.
2. Vertical separation of storm drains to a lower sewer should be 2 feet, unless the sewer line is manufactured from epoxy coated ductile iron with mechanical joints or equal.
3. Vertical separation of storm drain to a lower water or reclaimed water line shall be 2 feet.
4. Separation is measured from the outside edges of the two pipes.

E. Bubble-Up Structures

1. Bubble up structures shall not be used to discharge on-site or off-site stormwater.

### 3.3.4 DRAINAGE MATERIALS

A. Pipes

Standard material for storm drain pipes in the public rights-of-way shall be RGRCP per ASTM C76, Polypropylene Pipe per ASTM F2881, or HDPE per ASTM F894. HDPE may only be used up to a maximum diameter of 48 inches. Generally, the minimum rating shall be Class III; when the cover is less than two feet, the minimum rating shall be Class IV. Concrete backfill used to protect pipe shall be subject to City approval.

For additional Polypropylene Pipe information see the City Standard Details.

B. Manholes/Junction Boxes

1. Materials: All manholes shall be per MAG Uniform Standard Specifications and Details.
2. Locations: Manholes and/or junction boxes are required at all of the following:

   a. Junctions of two or more pipes
   b. Changes in grade
   c. Changes in alignment
   d. Changes in pipe sizes (pipe crowns are to match)

3. Spacing: The maximum spacing for manholes shall be:

   a. 400 feet on lines 18 inches to 36 inches diameter
   b. 660 feet on lines 36 inches in diameter and larger

C. Open Channels

1. Natural Channels: Whenever possible and appropriate, existing natural drainage channels shall be left in a natural state. A drainage easement or right-of-way shall be dedicated over the 100-year floodplain of the natural drainage way.
2. Man-made Channels: When man-made channels are required, the emphasis should be placed on creating a "natural" appearance. Grass lining with side slopes 6:1 or flatter are preferred.
3. Maximum Velocities/Erosion Protection: In general, the maximum velocity shall not exceed the scouring velocity of the soil (with natural cover). When the scour velocity is exceeded, additional erosion protection shall be provided. The protection may consist of one or more of the following:

   a. Concrete/gunite lining (reinforced with 4 x 4-inch WWF - 12GA).

b. Natural stone rip-rap, grouted in place, comprised of 4-inch to 12-inch diameter stones with from 1/4 to 1/2 diameter exposed.

c. Check dams, at maximum 3-foot elevation intervals.

4. Maintenance

a. Access: Open channels to be properly maintained should provide reasonable access for maintenance. Minimum width of accessways should be 8 feet. Spacing between vehicular access points should be a maximum of 1/2-mile. A minimum of one access point per subdivision is required. Non-vehicular access points shall be provided every 660-foot maximum. If the facility is to be City-maintained, the above minimum requirements are mandatory.

b. Responsible Party: General maintenance of drainage conveyance facilities within the City of Goodyear is the responsibility of the Individual, POA or HOA that owns the property within which the drainage conveyance facilities are located. For new drainage conveyance facilities, the Developer shall be responsible to repair any deficient material or workmanship for the first 5 years of the facility. The Developer's name, address, phone number, and specific repair and maintenance responsibilities shall be shown on the Recorded Plat and the Grading and Drainage Plan.

### 3.3.5 DETENTION OR RETENTION FACILITIES

A. Sizing

1. Basis of Design

a. All retention/detention facilities shall be sized to retain 100% of the 100-year 6-hour storm falling over the entire project, measured in gross area and including streets. For purposes of determining the volume required, the project shall be considered to extend to the centerline of all existing and/or future streets on the exterior boundaries, and to include all interior streets and other rights-of-way within the project. A stormwater retention waiver may be submitted if the conditions in Section 3.3.6.I apply.

b. Freeboard

(2). There shall be a minimum of eighteen inches of freeboard from the basin high water surface elevation to the lowest building elevation and a minimum of one foot of freeboard from the basin high water surface elevation to the gutter of the upstream streets.

(3). There shall be a minimum 6 inches freeboard from the water surface outfall to the lowest top of bank. An outlet weir may be set at the design high water surface.

2. Volume

Required volumes shall be determined using the methods, charts, tables, and isopluvial maps described in the Drainage Design Manual for Maricopa County, Volume I.

3. Retention/detention basins shall be located such that they can intercept the flows from the entire site.

If the basin is located other than at the lowest point of the project, the Design Engineers shall denote on the Master Drainage Map the actual or effective drainage area. If portions of the project cannot drain to the primary basin, additional basins shall be added to retain runoff from these areas. Credit will not be given for providing volume in excess of that needed to retain the 100-year 6-hour storm from a basin's effective drainage area.

B. Volume Certification

The property owner will provide the City with certified as-built dimensions of the basins and the actual volume of storage provided. This must be based on "As-Built" topographic surveys made by either a Civil Engineer or Land Surveyor who is registered to practice in the State of Arizona. These as-built volumes must reflect permanent conditions, with finished landscaping in place. The volumes shall be certified by the Design Engineer that the volumes provided meet or exceed the required design volumes per City Ordinance and the approved Drainage Plan. The volume of storage provided must equal or exceed the approved design volumes before the City will issue Letters of Acceptance for maintenance of any public facilities.

C. Grading

1. Depths

a. Retention shall not be within the right-of-way or any public non-drainage easement. Temporary shallow (12-inch depth) retention basins may be approved in special, wide rights-of-way where street improvements will not commence within 12 months.

b. The Zoning Ordinance restricts retention to 50% of the street frontage. The percentage may be increased for a shallower basin on a case-by-case basis by the City Planning & Zoning Division during the Site Plan/Preliminary Plat process.

c. The basins shall not exceed 1.5 feet of water depth within 10 feet of the right-of-way unless there is a fence or other similar protection to restrict access to the area.

d. The overall average retained high water depth shall not exceed 3 feet. If special allowances are granted by the City Engineering

Department to retain greater than 3 feet, the basin must be fenced to prohibit access; alternatively, a side slope of 8:1 may be provided for a minimum distance of 25 feet as measured from the 100-year high water elevation.

e. While it is the City's intent that the "average" depth is not to exceed three feet, it is also the City's intent that the basins be contoured to present an aesthetically pleasing appearance. Therefore, up to 25% of the bottom area may be up to 4 feet deep as long as the average depth does not exceed three feet.

f. In no case shall the depth exceed one foot, or the total volume exceed 1,000 cubic yards (27,000 cubic feet), without a positive means of disposing accumulated runoff.

2. Slopes - Side and Bottom

a. Bottom - The bottom of all basins shall be sloped towards the discharge points. The minimum bottom slope shall be 0.5%.

b. Side Slopes

(1). Side slopes adjacent to public rights-of-way, or when there is pedestrian-type access to that portion of the basin, shall have a side slope of 6:1or flatter.

(2). Side slopes adjacent to walls, fences, hedges, or other similar areas with no or limited pedestrian-type access, may have side slopes up to 4:1.

(3). Retaining walls may be used in areas adjacent to permanent walls, fences, or other areas where pedestrian access is not encouraged.

3. Grading/Landscaping/Joint Use as Parks

a. The contours of basin bottoms and side slopes shall be varied to enhance the basin appearance.

The Developer and Designer shall work with representatives of the City's Community Development Department to determine the need/desirability and feasibility of joint usage of the basin as a park site. If appropriate, the design shall provide for appropriate open areas for recreational facilities.

b. It is not the intent of these guidelines to dictate the specific details of the configuration to the designers; however, the following concepts will be used as the basis of reviewing the plans:

(1). Curvilinear sides should be used in lieu of long stretches of straight lines.

(2). Side slopes should be varied (i.e., start with 6:1 then change to 7-8:1 or more). With appropriate use of landscaping, side

slopes can be reduced to 4:1 subject to approval by the City Planning & Zoning and Engineering departments.

(3). Bottom areas should contour to varying depths in lieu of uniform depth/slope.

c. The tops and bottoms of side slopes shall be rounded off - generally over a distance of 5 feet each way of the "PI".

d. Landscaping - Section 7 of this manual defines the basic landscaping requirements for retention/detention basins. As with the grading, the Landscape Plans shall be reviewed in regard to the aesthetic effects of the proposed design.

4. Retention/Detention in Parking Lots.

a. Retention/detention in parking lots of multi-family developments is not permitted. All retention/detention of such developments shall be in landscaped areas.

b. Retention/detention of runoff in parking lots of industrial/commercial developments is permitted subject to the following guidelines:

(1). No more than 50% of the required storage volume may be retained / detained in parking areas. The balance shall be provided in landscaped areas. The tributary areas to each "basin" shall be noted on the Master Drainage Map.

(2). No more than 50% of the required parking spaces shall be covered by stormwater retention/detention.

(3). Storage systems shall be designed to store the first 30% of the required runoff volume off of paved areas, in order to avoid nuisance water constantly ponding on the pavement.

(4). Depth of water shall not exceed six inches within the parking area, nor shall it exceed 0.15 feet at the midpoint of any parking space.

(5). Interference with pedestrian traffic will be minimized in the design of the storage facility.

(6). A continuous fire access lane shall be provided throughout the development, and it shall be free of ponded water from the retention areas.

(7). All parking spaces shall be accessible during periods when the basins are filled to capacity, without pedestrians having to cross ponded water deeper than 0.15 feet.

c. Before final plan approval, an approved Drainage Report must show the calculated stormwater storage volume based on runoff from the 100-year 6-hour storm.

5. Overflow/Outfall

   a. Outfalls: Each project shall be designed such that the "ultimate" outfall for all drainage in excess of the 100-year 6-hour storm is routed to a public street, storm drain, drainage channel, or natural watercourse. The outfall shall be accessible without draining over private property.

   b. If such an outfall does not exist, the project must provide an outfall.

6. Overflow/Conveyance

   a. Off-project flows which historically flowed through the project shall be routed through or around, or retained within the development. Off-site flows routed through a development shall not combine with on-site flows retained within the development.

   b. Off-site runoff volumes shall not be allowed to cross over or encroach upon private lots, streets, or public/private access ways.

   c. On-site runoff volumes in excess of those required to be retained / detained (currently the 100-year 6-hour storm) may be routed directly through the outfall, although they must be routed via the retention/detention facilities.

7. Location/Conflicts with Existing Utilities

   a. Retention/detention facilities shall not encroach into existing easements for private utilities without written approval of the encroachment from all utility companies which are in or may use the easement.

   b. Retention/detention facilities and swales shall not encroach into public rights-of-way or into public easements. If necessary, the Developer shall relocate conflicting utilities into a new dedicated easement.

   c. The top of the retention/detention facilities (i.e., freeboard elevation) shall be at least 4 horizontal feet from any building or public roadway.

   d. Retention/detention facilities shall not be located within 20 feet of an active septic system, nor within 100 feet of an active water well.

   e. A minimum three feet of cover (from the bottom of the basin to the top of the pipe) shall be maintained over water, sewer, and reclaimed water service lines.

8. Disposal/Discharge

   a. All retention/detention facilities shall have a positive method to dispose of retained/detained runoff waters. All stormwater so retained/detained shall be disposed of within a 36-hour time frame.

Public streets are not considered an acceptable outlet for disposal of retained/detained runoff; however, they are considered an acceptable outlet for overflow. Only under special circumstances with prior City staff approval should pump disposal methods be used.

b. The minimum allowable pipe size for primary outlet structures is 18 inches.

c. Methods of disposal of accumulated stormwater runoff shall meet the following requirements prior to issuance of a Grading and Drainage Permit(s):

(1). Developments within 1/4-mile of a positive gravity outlet shall provide a connection between all retention areas greater than one foot in depth, or having more than 1,000 cubic yards of storage volume to the positive gravity outlet. Positive gravity outlets shall be identified as follows:

i. An existing City storm drain (Note: a maximum discharge of 1 cfs will be permitted).

ii. A natural drainage channel of sufficient capacity to convey the anticipated flows from the tributary drainage area.

iii. A man-made drainage channel that connects into a natural drainage channel, each of which is of sufficient capacity to convey the anticipated flows from the tributary drainage area.

(2). Developments not within the specified distance of a positive gravity outlet, which use a one-foot deep or less than 1,000 cubic yards' volume retention basin, shall provide information verifying that surface percolation is sufficient to dispose of retained stormwater within 36 hours of the end of a storm event.

(3). Developments not capable of meeting the above requirements (1 and 2) shall provide information indicating an alternative method to be used for the disposal of retained stormwater within 36 hours of the end of a storm event. The following options may be approved by the City Engineering Department:

i. Drywells, in accordance with this chapter.

ii. Other alternatives as approved by the City Engineering Department.

(4). Stormwater shall not be discharged onto a City street, gutter, or alley.

D. Basin Floors

1. The basin floor to infiltrate properly must be an “engineered basin floor”. They are generally landscaped and maintained for aesthetics only.
2. Drain time: All storage facilities should be designed such that the stored runoff shall be discharged completely from the facility within 36 hours following the end of a storm event. This is a City ordinance requirement related to County Health Department Standards.

   Percolation tests and results shall accompany all drainage reports.
3. Nuisance Water: Each basin, particularly when used as a park, shall be graded such that there are one or more "sump" areas wherein runoff from the more frequent storms, as well as nuisance runoff, may be retained/detained without flooding the balance of the basin. The preference here is surface percolation.

E. Embankment Design Criteria

1. Detention or retention facilities should be constructed below the natural ground surface.
2. The use of embankments to impound stormwater runoff requires prior approval by the City Engineering Department. Embankments become small dams that could potentially present serious downstream flood hazards.
3. If approval is obtained, all of the design requirements contained in the FCDMC Manual Section 9.3.3 must be completely and thoroughly followed.
4. The Owner/Developer must provide to the City an as-built certification by a Registered Geotechnical or Civil Engineer, experienced in dam technology. This information should confirm that the embankment was designed and constructed properly, is stable, and will safely impound the design volumes of water.

F. Operation and Maintenance

Maintenance of detention or retention facilities within the City of Goodyear is usually the responsibility of the subdivision’s HOA or POA.

G. Drainage Corrective Measures

Developers of new projects shall provide financial assurance in a form and amount acceptable to the City Engineer and City Attorney to cover the costs to correct any stormwater erosion and disposal problems that may arise during the first 5 years following the completion of the initial project construction. During the 5-year period, if disposal methods in use are found to be insufficient to dispose retained stormwater within a 36-hour period following the end of a rain event, and/or drainage improvements

fail to operate as designed creating erosion, the Developer's Engineer shall submit a corrective action plan to the City for review and approval. The submitted information shall demonstrate measures that will be implemented to correct deficiencies in the system. The plan shall conform to the requirements of this chapter.

H. Underground Stormwater Storage Facilities (USF)

USF's may be used as a part of a private stormwater management system under the following conditions:

1. USFs shall maintain a positive means to bleed off the retained stormwater. This includes the use of drywells or a connection to a City storm drain line, open channel, or natural drainage channel.
2. Stormwater entering into a USF shall first pass through a cleaning mechanism (such as a retention basin) capable of retaining the first flush event, or a sand & debris separation mechanism capable of treating the first flush peak flow prior to discharging stormwater into the USF.
    a. Sand & debris separation devices shall be designed to remove sands and debris from the first flush peak flows. Flows greater than the first flush peak flows may bypass this device. The manufacturer and model of a proposed sand & debris separation device shall be provided in the Preliminary Drainage Report.
3. Where drywells are selected to bleed off a USF, a drywell with a pre-treatment component shall be required. See the Drywell section of this chapter and the City Standard Details for additional information.
4. Several types of USF materials and systems are permitted within the City. Manufacturers' specifications shall indicate that the USF material shall have a minimum 75-year life span.

I. Drywell Implementation Criteria and Guidelines

1. Drywells may be permitted to be installed in the City for the use of stormwater disposal in retention areas as identified in this chapter.
2. Drywells shall not be used for projects that would require a Drywell Aquifer Protection Permit from ADEQ; this includes but is not limited to the use, storage, loading, or treatment of hazardous or toxic materials.
3. Drywell usage shall comply with all prevailing City, State, and Federal requirements including but not limited to the following ADEQ documents:
    a. "Guidance for Design, Installation, Operation, Maintenance and Inspection of Drywells"

b. "Annual Drywells Inspection Checklist"

c. "Drywell Registration Form"

4. Design and Construction

a. See the City Standard Details for drywell construction requirements.

(1). Standard drywell(s) with a pre-treatment component shall be required in the following circumstances:

i. In industrial and commercial development retention basins that drain parking lots.

ii. In retention basins where the drywell is located closer than the following distances to the outfall location of an opening conveying stormwater from a paved surface:

(a). 20' – Turf-lined basin

(b). 50' – Decomposed Gravel-lined basin

iii. As the primary drywell for a basin that requires more than three drywells. "Primary" signifies the drywell that is located at a lower elevation than the other drywells in the basin.

iv. As the bleed-off for USF's.

v. In retention basins that will accept greater-than-normal levels of debris, sediments, or oils as a result of the proposed use of contributing drainage areas.

(2). A stand-alone standard drywell may be used in situations where the pre-treatment component is not required.

b. Construction shall be performed by a contractor qualified in the construction of drywells.

c. All drywells located in retention basin bottoms are to be equipped with a secured grate to prevent unauthorized removal.

d. Drywell grates shall be elevated 0.5 feet above basin bottoms.

e. Drywells in all other areas except a basin bottom shall have watertight covers. In landscaped areas, drywell covers shall be elevated 0.2 feet above the finished ground elevation.

f. Pipes or facilities conveying stormwater from any surface other than a turf or decomposed granite-lined first flush basin shall not be allowed to enter a standard drywell.

g. Standard drywells shall be located a minimum distance from the outfall location of an opening conveying stormwater from a paved area:

(1). 20’ – Turf-lined basin

(2). 50’ – Decomposed Gravel-lined basin

h. Drywells shall not be installed within City rights-of-way.

i. The number of drywells required to drain a site shall be calculated by using a maximum 0.25 cfs discharge, unless a lower cfs value is recommended by the manufacturer.

j. Drywells that cease to drain a basin or USF within 36 hours of the end of a storm event shall be replaced or refurbished by the Owner with a new one(s) where positive gravity outlet methods of disposal are still not available. Such a requirement shall be written in the Covenants, Conditions and Restrictions (CC&R) for all subdivisions where drywells are used to drain stormwater storage facilities.

k. The excavation for the drywell shall penetrate a minimum of 10 continuous feet into sand, gravel, or other suitable permeable layer approved by the City or when the depth of 75 feet has been reached, unless otherwise approved by the City Engineer.

l. For drywells that do not penetrate into a continuous 10-foot permeable layer, a percolation test shall be performed on the drywell to verify that design percolation rates have been achieved. The test shall consist of injecting the finished drywell system with clean (potable) water until the rates of inflow and percolation have stabilized for one hour. A copy of the report shall be submitted to the City prior to final approval of the grading and drainage for the project.

m. Where possible, drywells shall be located near basin side slopes and away from low areas within the basin but shall not be elevated more than 6-inches above the bottom of the basin.

5. Drywell Maintenance Plan

a. A Drywell Maintenance Plan shall be submitted to the City for review and approval prior to issuance of a drywell installation permit. The plan shall require the following:

(1). Settling chambers and interceptors to be inspected annually.

(2). Removal of deposited sediments and debris is to be performed along with an annual inspection or when:

i. Sediment /debris levels fill more than 10% - 25% of the chamber capacity,

ii. Drywell ownership or maintenance responsibility changes,

iii. Material not resulting from stormwater or urban surface runoff enters the drainage system interceptor or the settling chamber.

b. The plan shall require that a copy of the ADEQ Drywell Registration be submitted to the City Engineering Department.

c. The plan shall require drywell information including but not limited to: Location, depth, type, installing contractor, date of installation, Owner, maintenance contractor, and emergency contact to be provided to the Engineering Department. This information shall also be included on each annual inspection report.

d. Copies of inspection reports and maintenance reports shall be submitted to the Engineering Department within 10 days of inspection or maintenance.

J. Stormwater Retention Waiver

1. Under the current City of Goodyear policy, stormwater storage is required for 100% of the 100-year 6-hour storm. Stormwater retention requirements may be waived to only retain the first flush (the first ½ inch of rainfall runoff volume) if specific criteria are met and if approved by the City Engineer. If not, the development must store the runoff volume necessary to maintain the integrity of the drainage system. Specific criteria for considering a stormwater retention waiver are:

a. The runoff for the project has been included in a storage facility at another location. The applicant must demonstrate that the stormwater storage facility was specifically designed to accommodate runoff from the subject property and that the runoff will be conveyed to this location through an adequately designed conveyance facility.

b. The subject property is adjacent to, and drains directly into, a regional drainage system that an engineering analysis shows has been designed and constructed to handle the additional runoff without increasing the potential for flood damage to the subject property or to any other property.

c. If neither criteria in “a” or “b” can be satisfied, the subject property shall detain sufficient runoff volume to attenuate post-development flows to or below pre-development levels for the 2-, 10-, and 100-year, 6-hour storm events.

2. In no case shall the development of a property increase runoff or change drainage characteristics to the detriment of any other property owner. The Developer/Owner is not relieved of liability if the development causes increased drainage problems or flooding on any other property.

3. If a first flush waiver is granted, Article 16-7 of the Goodyear City Code requires controls to reduce pollutants for the 100-year 6-hour storm, or any amount leaving the property.

### 3.3.6 MISCELLANEOUS DESIGN GUIDELINES

The following guidelines are based on recurring drainage and flooding problems observed in Goodyear, as related to specific design or construction practices:

A. Subdivisions

1. A subdivision should always have an approved subdivision-wide drainage plan. Calculating drainage based on individual lots, and submitting separate grading plans as each lot is developed, should be avoided.
2. Avoid design of a common drainage facility that requires maintenance by individual property owners. Unless not feasible, drainage facilities shall be located in a common tract that is to be owned and maintained by the HOA or POA.

B. Storm Drains

1. If at all possible, avoid the interception of an offsite natural wash with the intent of collecting the water and putting it into a pipe or an underground storm sewer system.
2. If there is no alternative to the routing of an open channel into a piped system, water should be first routed into a sediment or debris basin. Periodic maintenance of the debris basin should be undertaken by the Individual, HOA or POA that owns the property within which the basin is to be located.

C. Culverts

1. Culverts should not be placed more than 0.5 feet below the natural wash invert, or the capacity must be reduced by the cross-sectional area below this depth.
2. Culverts or small free span bridges for private driveways or walkways over washes or drainage channels whose source originates off-site or off-lot should be designed by a Professional Civil Engineer.
3. For small private driveways or walkways, dip crossings or free span bridges that won’t constrict the flow capacity of the channel are recommended.

D. Open Channels

1. Diversions of natural washes or changes in the channel's profile should be avoided whenever possible.
2. Do not permit encroachment into a drainage easement, channel, or its floodway.
3. If channel lining or landscaping material is used, it must be inlaid or located below the design invert (bottom) of the channel. Do not place it on top of the designed finished grade of the channel cross section. The channel surface material (and roughness coefficient) or cross-sectional area shall not be changed without a plan revision, and re-approval by the City.
4. If only the channel banks are being lined, the lining material must extend down below the channel invert to below the anticipated scour depth.
5. Avoid designing turns in open channel conveyance systems sharper than 45 degrees, whenever possible. If curves or bends can't be avoided, the run-up on the outside of curves must be calculated and incorporated into the channel design.
6. Lot lines should not extend out to where they overlay or cross a drainage easement or wash. The wash area or drainage channel should be dedicated in a separate drainage easement tract whenever possible. This will avoid "backyard" drainage channels, which can result in serious flooding problems.

### 3.3.7 STORMWATER MAINTENANCE AGREEMENT

Stormwater management facilities shall have an enforceable operation and maintenance agreement to ensure the system functions as designed. This agreement will include any and all maintenance easements required to access and inspect the stormwater management facility, and to perform routine maintenance as necessary to ensure proper functioning of the stormwater management facility. In addition, a binding covenant specifying the party/parties responsible for the proper maintenance of all stormwater management facilities shall be secured prior to approval of final subdivision plat and issuance of any permits for land disturbance activities. The use of non-structural stormwater treatment practices is encouraged in order to minimize the reliance on structural practices.

## 3.4 STORMWATER POLLUTION PREVENTION FOR CONSTRUCTION SITES

### 3.4.1 PURPOSE

Outline minimum requirements for compliance with the City's Stormwater Management Plan, MS4 Permit, and associated City ordinances adopted as

a result of changes in stormwater pollution regulations. Although specific regulations are referenced, this is not a comprehensive recitation or interpretation of minimum requirements that may apply to construction activity by agencies such as ADEQ or the Environmental Protection Agency (EPA).

### 3.4.2 HISTORY

The EPA issued regulations in 1990 authorizing the creation of a phased NPDES permitting system for stormwater discharges. In 1999, the EPA published rules that implemented Phase II of the stormwater program. In December 2002, the EPA designated ADEQ as the regulating authority, and the AZPDES program was developed.

In March of 2003, the Phase II program expanded to small municipalities which included the City of Goodyear. Over a five-year period, operators of small municipalities were required to develop, implement, and enforce a program to prevent or reduce, to the maximum extent practicable, discharges of pollutants to the City's MS4 and Waters of the United States.

In compliance with Phase II regulations, the City of Goodyear developed both a Stormwater Management Plan and a Stormwater Pollution Ordinance, and obtained permit coverage through ADEQ. The Stormwater Management Plan outlines six distinct programs in which the Engineering Department participates through plan review and compliance inspection processes relating to construction site stormwater runoff control.

### 3.4.3 SITE CLASSIFICATIONS

The City has two classifications for all construction sites that result in a land disturbance. There are distinct plan preparation, construction, and permit termination requirements for each classification. Documents have been prepared to assist applicants with developing plans and are available on the City's website. Projects are classified as either Small Sites or Large Sites as follow:

A. Small Sites and Large Sites

1. Small Sites must meet all of the following criteria:

   a. Area of land disturbance is less than 1 acre, and

   b. not part of a Larger Common Plan of Development or Sale, and

   c. located farther than ¼ mile from impaired or unique waters. *

2. Large Sites must meet any of the following criteria:

   a. Construction that results in land disturbance of 1 acre or greater, or

   b. part of a Larger Common Plan of Development or Sale, or

c. project is located within ¼ mile of unique or impaired waters *

* The City of Goodyear identifies a project to be within ¼ mile of impaired or unique waters if any portion of the project is closer than ¼ mile to the water's floodway boundary as delineated in FEMA FIRM.

### 3.4.4 PLAN REQUIREMENTS AND REVIEWS

All projects shall incorporate methods to control erosion and minimize pollutants from leaving the site associated with any storm event. As a City minimum, erosion and sediment controls shall be designed to manage peak discharges from the 2-year, 24-hour event as determined by utilizing the Drainage Design Manual for Maricopa County, Hydrology. BMPs shall be selected, installed and maintained per the Drainage Design Manual for Maricopa County, Erosion Control. Unless specific approval is granted, the use of straw bales as BMPs is not permitted in the City of Goodyear. Plans shall be developed so as to not cause flooding, negatively affect drainage, or impact adjacent property. Sites adjacent to or having a potential to discharge stormwater into another municipality shall obtain consent of proposed construction from that municipality prior to final plan approval by the City of Goodyear. Submittal to the City of Goodyear and approval of any document by the City does not negate or replace requirements for compliance with any ADEQ or EPA regulation. The Owner and/or Operator is to submit any information to ADEQ or the EPA and must obtain permits as required.

A. Small Site Requirements

A "BMP Exhibit" shall be included as a separate sheet in the Grading and Drainage Plan set and shall demonstrate placement of controls (BMPs) to prevent runoff of pollutants into any stormwater system or adjacent property. If a project does not require grading plans, then either a separate BMP exhibit shall be included in the plans, or BMPs shall be clearly identified on the plan sheets. The exhibit shall include any perimeter control, drainage inlet protection devices, and wash protection devices necessary to control erosion and to prevent sediments and pollutants from leaving the site. Exhibits shall also identify the person responsible for implementation and maintenance of BMPs. Exhibits are considered to be living documents that are subject to change until the project is complete. SWPPP preparation as described in Section 3.4.5 does not apply to small sites. A Small Site Checklist is available to aid applicants with preparing the exhibit for review, and a completed copy shall accompany the plans submitted for review.

B. Large Site Requirements

A SWPPP shall be prepared and shall accompany the grading and drainage documents submitted for review. Reviews follow the normal plan

review process unless the SWPPP is required to be submitted to ADEQ for review and approval. ADEQ currently reviews and approves only those projects located within 1/4 mile of unique or impaired waters. For these projects, the SWPPP shall be submitted to the City for review and found to be in general compliance with the City's requirements prior to submitting to ADEQ; the City will not issue a CSP until the City receives a copy of ADEQ's approval to proceed. Plans submitted to ADEQ prior to City review may require correction and/or resubmittal to ADEQ. A Large Site Checklist is available to aid applicants with preparing documents for plan review, and a completed copy shall accompany the plans submitted for review.

### 3.4.5 SWPPP PREPARATION (LARGE SITES ONLY)

A SWPPP is a two-part living document consisting of a Narrative and a Site Map. Documents shall conform to ADEQ's General Permit AZG2008-001 and the City's Engineering Standards.

A. Narrative

An EPA template is available from the City's website and can be used as a guide for basic formatting and basic information to include when developing narratives. The narrative shall be a separate document including enough topographical information to demonstrate pre- and post-stormwater flows and impacts to adjacent property. Narratives shall indicate any existing or proposed construction adjacent to or within the site and how SWPPP efforts will be coordinated between the sites. Narratives shall also identify any sensitive and protected areas and indicate how these areas will be preserved. Construction staging shall be described including the sequence of activities applicable to that stage.

B. Site Map

The Site Maps shall be prepared as a separate and individual plan set including a cover sheet and additional sheets as necessary to identify changes in drainage during different stages of construction. The site shall be divided into the following three stages of construction: Initial, Interim, and Final. Each stage shall be shown on a separate sheet and shall include BMPs applicable to that stage. If the project is phased, then each project phase shall be broken down into construction stages. Refer to the Plan Review Checklist for minimum information shown on every sheet.

C. Staging

1. Initial Stage

This plan sheet shall provide grading, erosion, and sediment controls for the initial clearing, grubbing and grading of the site. These BMPs shall be installed at the outset of construction, prior to any land-disturbing activities. Initial controls are to be placed on existing

grades, but shall be based in part on proposed grading operations. In addition to minimum required information, this sheet shall include:

a. Contours appropriate to the site to demonstrate existing topography, extending a minimum of 100 feet beyond the property line.

2. Interim Stage

These BMPs shall be based on proposed grades and drainage features and are installed after initial stage. For some BMPs, such as inlet protection, interim controls are installed after the construction of site infrastructure. In addition to minimum required information, this sheet shall include:

a. Location of all interim erosion and sediment controls, designed in conjunction with the proposed site topography. This should also consider the controls designed in the Initial phase sheet.

b. Location of all buildings, drainage features and facilities, paved areas, retaining walls, water quality facilities, or other permanent features to be constructed in connection with, or as a part of, the proposed work, per approved plans.

c. Flow arrows and volumes with proposed contours or major dimensions, locations, and slopes of proposed grading.

3. Final Stage

BMPs shown in the Final phase sheet shall be installed as one of the last steps in the construction process, such as final seeding and mulching and granite placement. This plan sheet shows controls for final completion of the site. In addition to minimum required information this sheet shall:

a. Include any Initial or Interim BMPs that are to be removed, and any resulting disturbed area to be stabilized.

b. Include location of all final erosion and sediment control BMPs, permanent landscaping, and measures necessary to minimize the movement of sediment off site until permanent vegetation can be established.

c. Show area of buildings, pavement, sod, and permanent landscaping (define types) per approved improvement plans.

d. Show BMPs to be removed at the end of construction; for example:

(1). construction pond dewatering

(2). stabilized staging areas

(3). street inlet protection

(4). vehicle tracking controls

(5). construction fencing

### 3.4.6 CITY-ISSUED CONSTRUCTION STORMWATER PERMITS (CSP)

The City will issue a separate CSP for all projects requiring a Grading Permit and all "Large Sites". The CSP shall be obtained prior to performing any land disturbance activities. A CSP Fee Schedule is required for issuance of the permit. The Permittee and/or Owner/Operator shall be ultimately responsible for compliance with City permit conditions and City-issued violations and fines. This permit is not an authorization to discharge, but a permit relating to ATC within the City of Goodyear boundaries, and is in addition to any permit required by other agencies such as ADEQ or the EPA. The permit shall be renewed until such a time that the City has determined the site stabilized and improvements acceptable.

There are Federal, State, and City permits that may be required prior to the start of construction of a project. It is not the City's responsibility to ensure that the plans for a proposed project satisfy State and Federal permit requirements or that all permits have been obtained (e.g., Section 404 permitting, U.S. Fish and Wildlife Service Threatened and Endangered Species Clearance, Archeological, etc.).

A. Terminating Coverage under the CSP

1. Small Sites

Site stabilization, final inspection, and approval of improvements are required to terminate coverage under the CSP.

2. Large Sites

After all construction activities have been completed and the City determines that the site has met final stabilization requirements with temporary BMPs removed, the authorized site representative may file a NOT with ADEQ, with a copy submitted to the City Inspector. The authorized site representative shall also submit a copy of the NOT Acknowledgement Letter issued by ADEQ to the City, which will effectively terminate coverage under the CSP.

### 3.4.7 CONSTRUCTION SITE REQUIREMENTS

A. Pre-construction Meeting

An on-site pre-construction meeting shall be arranged with the City Inspector after obtaining a CSP and prior to any construction activity or placement of BMPs. In attendance shall be the Operator, the Owner or

Owner's Representative, the General Contractor, and any person delegated to carry out Stormwater Pollution Prevention provisions.

B. BMP Placement and Maintenance

BMPs shall be installed and in operation prior to any grading or land clearing activities. Controls shall be placed in such a manner as to ensure that sediment-laden water does not enter drainage systems, adjacent properties, or violate any water standard. Regular inspection and maintenance shall be provided to ensure BMPs are in an operable condition at all times. Damaged controls shall be repaired within 72 hours, and prior to the next rain event. BMPs shall not be removed until the site has been stabilized and the potential for erosion has passed.

C. SWPPP Inspection and Management (Large Sites Only)

It is the Operator's responsibility to ensure the project is in compliance with all federal, state, and local requirements, to include implementation, construction, inspection, maintenance, replacement, upgrading of facilities, and record management of the SWPPP. Any violations and fines are the responsibility of the Owner/Operator and/or site Contractor. All SWPPP documents shall be on site and available for review upon notice by ADEQ, EPA, or City of Goodyear representatives.

The Operator shall perform, at a minimum, a visual inspection of the construction site once every seven calendar days or once every 14 calendar days and within 24 hours of a rain event equal to or greater than half an inch (1/2 inch). If within ¼ mile of an impaired water, inspections shall be performed at a minimum of once every seven calendar days. This should include visual observation of stormwater discharges at all discharge locations within one business day after each rain event of half an inch (1/2 inch) or greater. The Operator shall prepare a report documenting their findings on the conditions of the SWPPP controls and note any erosion problem areas. The report is to be maintained on site by the Operator.

D. Dewatering Activities

Dewatering devices must discharge in a manner that will not affect streams, wetlands, drainage systems, or off-site property. Discharged waters shall be free of any sediment and pollutants. Dissipation and filtering devices shall be placed at the discharge end of any hoses to contain sediments and to prevent any erosion.

### 3.4.8 POST-CONSTRUCTION SEDIMENT CONTROL

The Developer/Owner is responsible for the cleanup of any sediment and the repair or correction of any deficient item relating to the design and construction methods used for stormwater management through the project warranty period. Facilities found to have accumulated sediments

shall be immediately cleaned and measures shall be taken to prevent sediment from entering any adjacent property or storm sewer system. The cleanup should be completed within 72 hours and prior to the next rain event. Sediments shall be removed from the project and properly disposed.

Facilities found deficient in minimizing sediment and erosion from stormwater events shall be immediately reported to the City Engineering Department. These facilities shall be repaired, replaced, or re-designed to correct the deficiency to the City's satisfaction. Additional plan review and permitting may be required prior to correcting the deficiency.

### 3.4.9 ENFORCEMENT

The City may at any time perform a compliance inspection of the construction site and/or SWPPP. Violation of any ordinance or non-compliance with any conditional or correction notice may lead to legal and enforcement action and/or fines. Non-compliance notices issued by the Engineering Department are independent of enforcement actions that may be implemented by other departments within the City of Goodyear or any county, state, and federal agency.

The Engineering Department has two levels of enforcement action for non-compliance. Enforcement action varies for each category, depending on the severity of the violation. Non-compliance may also result in the violation being reported to other City departments or agencies. Levels of Actions:

A. Level I

Level I Actions may result in an immediate issuance of a Stop Work Order. Examples of Level I Actions include the following, among others:

1. Clearing, grubbing, grading, or placement of BMPs without a required CSP and/or grading permit
2. Failure to restrict construction to limits of disturbance
3. Failure to protect sensitive/protected areas
4. Failure to place BMPs prior to construction activity
5. Failure to correct Level II violations as directed

B. Level II

Remediation for Level II Actions may result in a Notice to Comply being issued. Examples of Level II Actions include the following, among others:

1. Failure to clean up tracking of material onto roadways or sediment leaving the site
2. Failure to maintain SWPPP and CSP requirements
3. Failure to schedule a pre-construction meeting

C. Stop Work Orders

If a project is issued a Stop Work Order, all work on site shall cease, excluding any work required to bring the site to a safe condition (e.g., backfilling of holes and trenches). The above corrective actions may be completed, but the Permittee(s) shall inform the Inspector of such activities.

3.4.10 DEFINITIONS

**BMPs** or Best Management Practices – Methods, measures, or practices used to prevent or reduce the introduction of pollutants into receiving waters. In addition, the term shall include erosion and sediment control BMP devices, stormwater conveyance, stormwater diversion and treatment structures, and any procedure or facility used to minimize the exposure of pollutants to stormwater or to remove pollutants from stormwater.

**Construction Activity** – Includes clearing, grading, excavating, stockpiling of fill material, and other similar activities resulting in a land disturbance.

**CSP**- a Construction Stormwater Permit issued by the City of Goodyear Engineering Department.

**Day** - a calendar day or any consecutive 24-hour period that reasonably represents the calendar day.

**Discharge** - any addition of any pollutant to Waters of the United States or to an MS4 from any point source.

**Ephemeral** - a surface water which has a channel that is at all times above the water table, and that flows only in direct response to precipitation.

**Impaired Water** - Waters that have been assessed by ADEQ, under the Clean Water Act, Section 303(d), as not attaining a water quality standard for at least one designated use, and are listed in Arizona's 2004 303(d) List and Other Impaired Waters.

**Larger Common Plan of Development or Sale** - A contiguous area where multiple separate and distinct construction activities are occurring under one plan (e.g., the Operator is building on three half-acre lots in a 6-acre development). The plan in a common plan of development or sale is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.), or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that construction activities may occur on a specific plot.

**MS4** (Municipal Separate Storm Sewer System) - A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) which is: (i) Owned or operated by a state, city, town, borough, county,

district, association, or other public body (created by or pursuant to State law), including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or a designated and approved management agency under section 208 of the Clean Water Act, that discharges into Waters of the United States. (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

**NOI** (Notice of Intent) - the application to operate under the ADEQ general permit.

**NOT** (Notice of Termination) - the application to terminate coverage under the ADEQ general permit.

**Non-stormwater Discharge** – any discharge to City right-of-way or a stormwater collection system that is not composed entirely of stormwater.

**Pollutant** - sediments, fluids, contaminants, toxic wastes, toxic pollutants, dredged spoil, solid wastes, substances and chemicals, pesticides, herbicides, fertilizers and other agricultural chemicals, incinerator residue, sewage, garbage, sewage sludge, munitions, petroleum products, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt (e.g., overburden material), and mining, industrial, municipal and agricultural wastes or any other liquid, solid, gaseous or hazardous substances. See ARS § 49-201(29).

**Rain Event** - is defined as when rain drops reach the ground surface of the construction site, ultimately resulting in 0.5 inch accumulation as recorded by the closest FCDMC rain gage. Separate rain events are distinguished by a 24-hour period of no rain reaching the ground surface of the construction site.

**Receiving Water** - includes Waters of the U.S. and conveyances thereto, including MS4s.

**Significant Materials or Sediment** - any solid, liquid, or gaseous substance other than stormwater that causes or may cause or contribute to the violation of a water quality standard pursuant to Article 2, Title 49, Arizona Revised Statutes.

**Site Operator** - any person associated with a construction project that meets one or both of the following two criteria: a) The person has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications, or b) The person has day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

**Stabilization** - covering or maintaining an existing cover over soil that reduces and minimizes erosion

**Stormwater** - runoff, surface flows, and drainage that is comprised solely of any form of precipitation.

**Stormwater Collection System** - all or any part of any publicly or privately owned system or structure designed or utilized to receive, collect, detain, retain, or convey stormwater, and any direct connection to such system or structure. Such a system may include, but is not limited to, swales, curbs, gutters, ditches, channels, parks, pipes, watercourses, drywells, culverts, storm drains, catch basins, retention or detention areas, spillways, scuppers, pump stations, and common areas.

**SWPPP** (Stormwater Pollution Prevention Plan) - a plan which includes narrative information and a site map describing how requirements in ADEQ's AZG 2008-001 Permit are met, an identification of construction/ contractor activities that could cause pollutants in the stormwater, and a description of measures or practices to control these pollutants.

**Unique Water** - a surface water that has been designated by ADEQ as an outstanding state resource under AAC R18-11-112.

**Waters of the United States** –

1. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide.
2. All interstate waters, including interstate wetlands.
3. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds - the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters: a) Which are or could be used by interstate or foreign travelers for recreational or other purposes; b) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or c) Which are used or could be used for industrial purposes by industries in interstate commerce.
4. All impoundments of waters otherwise defined as waters of the United States under this definition.
5. Tributaries of waters identified in paragraphs 1 - 4 of this definition.
6. The territorial sea, and
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs 1 through 6 of this definition.

**Drainage Report Outline**

Detailed Explanations of Each Element are in Section 3.2.2 (C)

**Title Page:** Project Name; Location; Type of Drainage Report (Preliminary, Master Plan, Final, etc.); and Engineer's Seal, Signature, and Date.

**Table of Contents:** Engineer's Seal, Signature, and Date

**1. Introduction**

- Project Name
- Project Location
- Type of Report (Master, Preliminary, or Final)
- Project Description
- Summarize referenced existing drainage studies
- Purpose and Objectives

**2. On-Site Drainage Conditions**

- Drainage network, watershed, and floodplain boundaries within the project site and corresponding topographic map
- Site specific photographs and aerial photographs to support parameter selection.
- Ground cover conditions
- Existing and proposed developments

**3. Off-Site Watershed Conditions**

- Watershed conditions and the drainage network entering and existing the project site and corresponding topographic map
- Site specific photographs and aerial photographs to support parameter selection
- Ground cover conditions
- Context relative to adjacent projects and improvements

**4. Floodplain Designation**

- Description of floodplain, flood zones, and FEMA Floodplain map

**5. Proposed Drainage Plan**

- General description of proposed drainage system and components; including conveyance of off-site flows;
- Future conditions; including development of adjacent properties;
- Stormwater storage requirements: Volume required, volume provided, and basin locations.
- Proposed drainage structures or special drainage facilities: Include design criteria and probable effect on the existing upstream and downstream drainage system.
- Pre- and post- runoff characteristics at concentration points exiting the property;
- Lowest Floor Elevation
- Project Phasing: Improvements to be constructed with each phase, impact of phased construction, and required interim improvements. Development requirements must be met independently for each phase.

**6. Special Conditions**

- Project Stipulations, 401 and 404 Permits, and AZPDES

**7. Data Analysis Methods**

- Hydrologic procedures, parameter selection and assumptions.
- Hydraulic procedures, methods, parameter selection and assumptions.
- Stormwater storage calculation methods and assumptions.

**8. Conclusions**

- Overall Project
- Project Phasing

**References**

- List all references cited in the report

**Appendices**

- Data and Calculations (as applicable)
- Peak flow calculations (Rational Method, HEC-1 printouts, etc.)
- Channel design calculations including toe-down protection and drop structure design.
- Culvert design calculations
- Floodplain calculations (Manning's HEC-RAS printouts)
- Storage volume calculations
- Retention/detention basin inflow outflow analysis and design calculations

- Street Capacity Calculations *(Final Reports Only)*
- Curb Opening, Catch Basin Calculations *(Final Reports Only)*
- Storm Drain Calculations
- Sediment and Scour Calculations
- Rip-Rap Sizing *(Final Reports Only)*
- Erosion/ Sediment Control Plan
- Soils and or Geologic Analyses
- Rainfall calculations
- Basis for setting finished floor elevations:
    - In relation to designated floodplains or adjacent washes
    - In relation to natural or adjacent ground elevation if in a Special Flood Hazard Zone or not in floodplain
- Pertinent excerpts from studies that are being referenced

**Exhibits**

- Vicinity Map
- Floodplain Map
- Off-site Map: Topography, watershed boundaries, floodplains, and flows impacting the project
- On-Site Map with current 1-foot (minimum) contour mapping based on a current topographic survey: project location, topography, drainage ways with flows labeled (including natural and artificial channels), watershed boundaries, concentration points, floodplain for washes with a flow of 100 cfs or greater, flow entering the project, and flow existing the project
- Current aerial photo, 800 scale or larger, showing site in context.
- Proposed On-site Drainage Plan

Electronic Input Files - HEC-1, HEC-HMS, and HEC-2 or HEC-RAS files, and a working copy of nonstandard software should be included. A PDF file of the drainage report must also be provided that includes all exhibits, plates, figures, etc.