

City of El Centro

Stormwater

Detention and Retention Basin

Guidelines



City of El Centro Public Works Department – Engineering Division
City of El Centro Community Development Department
City of El Centro Parks and Recreation Department
City of El Centro Community Enhancement Task Force

1275 W. Main Street
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CITY OF EL CENTRO STORMWATER DETENTION BASIN GUIDELINES

February, 2018

USE OF THIS DOCUMENT

The intent of this document is to provide guidelines for the design and construction of detention/retention basins for recreational use of stormwater detention facilities without disrupting the primary function of these facilities, as well as define the responsibility of the developer in the planning, constructing, and financing of these public improvements; and to establish procedures for review and approval of engineering and landscape plans. All improvements in detention/retention basins, that are required as a condition of approval, shall be the responsibility of the developer.

DEFINITIONS

Detention Basin or Retention Basin? Which One Is It?

Some terms and phrases used in the business of flood damage reduction seem to find their way through the public-at-large either being interchanged with similar terms or referred to altogether incorrectly. DETENTION and RETENTION are two such terms. Both detention basins and retention basins are ways in which flood damage reduction can be accomplished. Although the terms are sometimes used interchangeably, there are differences between them.

Detention Basin

A DETENTION BASIN is an area where excess stormwater is stored or held temporarily and then slowly drains when water levels in the receiving channel recede. In essence, the water in a detention basin is temporarily detained until additional room becomes available in the receiving channel. Detention basins are used extensively in the Imperial County region. Detention basins may drain to an IID drainage channel system following IID encroachment permit requirements, procedures and standards.

Retention Basin

A RETENTION BASIN also stores stormwater, but the storage of the stormwater would be on a more permanent basis. In fact, water often remains in a retention basin indefinitely, with the exception of the volume lost to evaporation and the volume absorbed into the soils. This differs greatly from a detention basin, which typically drains after the peak of the storm flow has passed, sometimes while it is still raining. Retention basins, for the sake of flood damage reduction, are not common in the

Imperial County region; they are popular in parts of the country that have soils more amenable to this type of flood damage reduction measure.

PURPOSE OF DETENTION/RETENTION BASINS

The primary purpose of a detention/retention basin is to reduce the maximum flow rate and load on the stormwater drainage collection system, which is currently operated and maintained by the Imperial Irrigation District. The secondary purpose of a detention/retention basin is to incorporate Post-Construction Best Management Practices (BMPs) where feasible, to help in compliance of the City's MS4 permit. These efforts to design and construct BMPs within the flood basin for the treatment of stormwater result in improvements to the stormwater quality entering IID channels. The tertiary purpose of the basin, should developer elect, is to provide for recreational use of these facilities without disrupting the primary and secondary functions of these facilities.

This system protects the development from flooding during storm events by conveying or storing stormwater flows. Additionally, stormwater detention basins and channels can provide a recreation resource. When not used to store or convey stormwater flows, these facilities may supplement the amount of land within the plan area used for athletic fields, playgrounds, and bicycle and pedestrian trails.

LANDSCAPE AND LIGHTING MAINTENANCE DISTRICT (LLMD)

The developer shall be responsible for the costs associated with establishing a landscape and lighting maintenance district for the maintenance of the detention/retention basin and any other development amenities.

Any necessary stormwater pumps shall be maintained by the Lighting and Landscape District.

DESIGN GUIDELINES

A. ENGINEERING REQUIREMENTS - GENERAL

Engineered plans shall be submitted to the City's Engineering Division following the City's Grading permit procedures. Plans must be in compliance with the City's MS4 regulations, including the Jurisdictional Runoff Management Plan (JRMP).

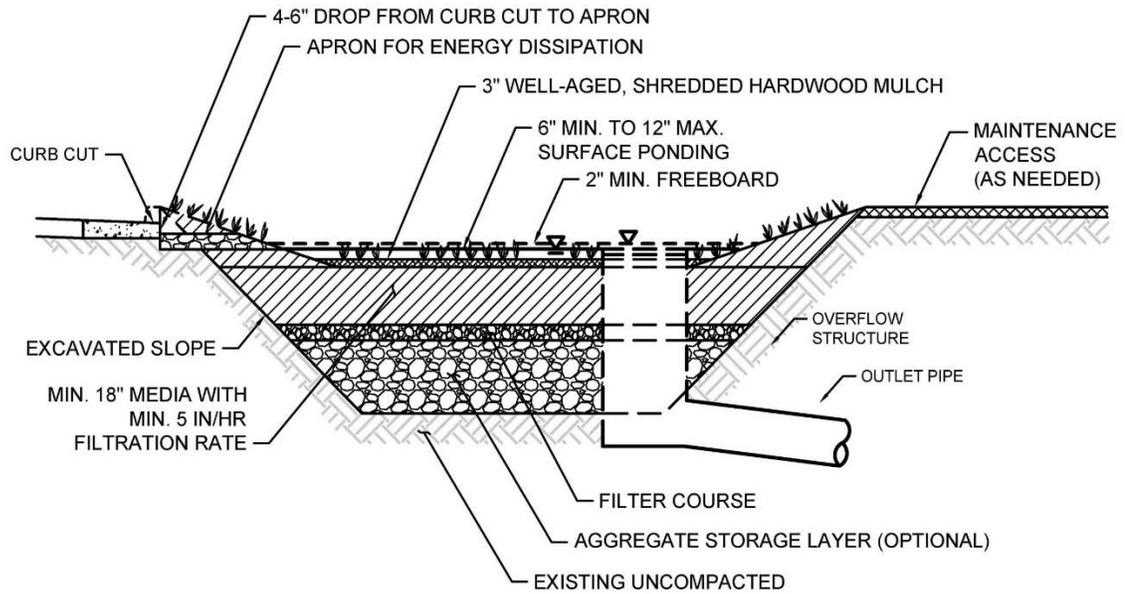
STORMWATER DETENTION AND RETENTION BASIN GUIDELINES

Plans must incorporate any BMP measures as called for in the Water Quality Management Plan (WQMP) for the project.

Refer to Appendix A – “Guidelines for Designing Retention Basins” and the following:

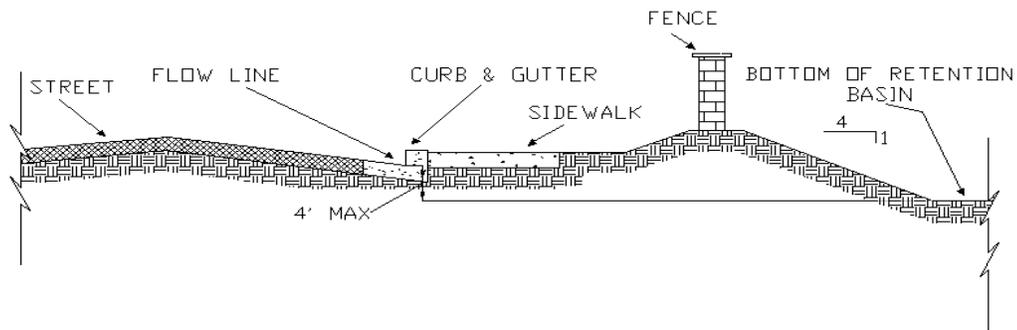
- a. Detention/retention basins shall be limited to five (5) acres or less for flood control basins. Multi-use basins may be larger when coordinated with the Community Development, Public Works and Parks Directors.
- b. Surface standing water in the Detention/Retention Basin must be drained within 72 hours after the Rainfall Event to eliminate and prevent mosquito development. Water storage over 72 hours shall be maintained underground in such a manner that mosquitos cannot enter or exit the water storage area.
- c. Basins may be contoured to provide a natural look. The use of gently curving, variable contouring may be used to establish design grades to meet WQMP BMPs, establish storm volume areas and/or encourage a more aesthetically interesting design.
- d. Where feasible, incorporate bio retention into areas of the detention/retention basin. Consider this feature between inlet and outlet structures of the detention/retention basin. The detail below relies on a deep outlet pipe, which may not always be available. Pumps may be considered for drainage with approval of the Public Works Director.

STORMWATER DETENTION AND RETENTION BASIN GUIDELINES



Source: San Diego Regional Model BMP Design Manual, 2015

- e. Developer may submit an alternative design of drainage system if approved by the City and Imperial Irrigation District (IID).



STREET RETENTION BASIN CROSSSECTION
(NTS)

- f. Generally, the depth of detention/retention basin shall not exceed four feet maximum.
- In cases where the depth of the detention/retention basin exceeds four feet (such as in locations required to treat the one-year storm by use of a bio-swale detail), the depth shall be a minimum of five feet above the water table at its highest point during the preceding year (provide report) or be lined to prevent infiltration to the

STORMWATER DETENTION AND RETENTION BASIN GUIDELINES

ground water table. City Engineer approval is required for depths exceeding four feet.

- Additional requirements apply to multi-use basins.
- g. Depth shall be measured from adjacent street's gutter flow line (used as datum).
 - h. Minimum free board = 1.0 foot from lowest building pad or 0.5' from flowline of curb from closest road, in relation to the 100 year water surface elevation (3-inch storm), whichever is lowest.
 - i. Irrigation water meters shall be installed on all detention/retention basins as per City Code Chapter 28-5.
 - j. Each service connection from the City's water system shall be protected against backflow of the water from the premise into the public water system and meet the requirements of City Code Chapter 28-24, 28-25, 28-26, 28-27, 28-28.
 - k. If basin is open to the public, at least one access shall include an ADA accessible concrete ramp down to the bottom of the detention/retention basic (and to the walking paths, if provided). This ramp shall be integrated with access to an adjacent street sidewalk and have a landing area at the end of the path for wheelchairs. This pathway shall be lighting with a photocell switch.



Sample ADA Ramp and Landing

STORMWATER DETENTION AND RETENTION BASIN GUIDELINES

1. The detention/retention basin shall have a vehicle access concrete paved driveway off an adjacent street down to the bottom of the detention/retention basin. A curb cut and driveway approach shall be provided.



Sample Maintenance Vehicle Access and Driveway with Landing

- m. Perimeter Lighting & Safety- Detention/retention Basin shall have perimeter lighting. Lighting shall be “Directional Lighting” (directed away from homes). It shall be placed at a maximum spacing of 300 feet around the perimeter, except when adjacent to streets that have lighting spaced at 300 feet, on the retention side of the street. The power level of the lighting shall be at least 150W. Solar powered lighting should be considered.
- n. Separation From Yards - Homes that abut the detention/retention basin shall have a block wall separating the yard and detention/retention basin on the property line.



Sample Block Wall Defining Property Line

B. LANDSCAPING – GENERAL REQUIREMENTS – ALL BASINS

Landscaping and Irrigation Plans shall be submitted to the Community Development Department and routed to the Community Services Department and Engineering Department for review and approval. Plans shall comply with the project's WQMP BMPs, if any.

Soil testing and recommendations shall be included with the landscaping submittal. Soil testing report shall explore soil characteristics at the proposed depth of the basin and provide recommendations for the intended plant palette. Proximity of local alkaline water table shall be investigated and mitigated to permit successful plant establishment.

Soil recommendations may include:

1. Top soil importing (for larger developments, in areas where surface top soil is adequate, explore the possibility of moving surface top soil from the surrounding development into the bottom of an over excavated basin as part of rough grading operations).
2. Additives and amendments to ensure proper nutrient/chemical balance throughout the life of the project.
3. Underground leach line system use for drainage shall be explored in the soil recommendation submittal comparable to the systems used by the local agricultural community.

The proposed plant palette shall include landscaping materials as found in Section 29-142 of the El Centro Municipal Code, in addition to hulled highlander bermuda grass. Any proposed materials not found in the recommended list may be included with approval of the Community Development Director.

The developer shall warranty and maintain the landscaping for one year. If, after a year, the landscaping (plants, groundcover, and grass) does not appear to be healthy and growing, the developer shall extend the warranty another year and correct the deficiencies.

C. SINGLE-USE DETENTION BASINS – FLOOD AND WATER QUALITY

1. General

Basins can be used solely for flood and water quality purposes only. Note that any surface area used by this type of basin does not count towards the park area requirement.

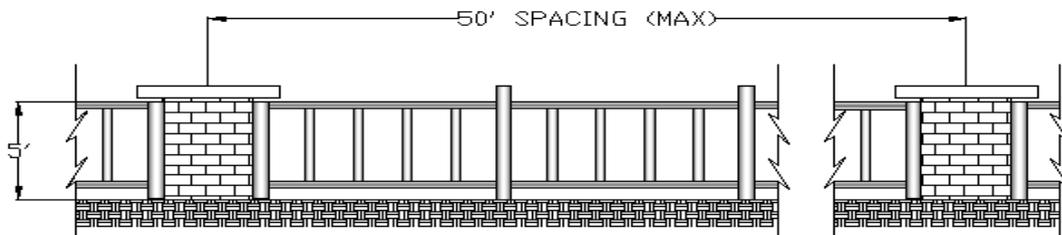
2. Slopes

The slope of the detention/retention basin shall not exceed a 4:1 slope

3. Fencing

Single-use detention/retention basin shall be enclosed with wrought iron fence with pilasters spaced fifty feet maximum on center. The basin fence shall have lockable personnel gates to restrict access during storm events.

An alternative decorative fence may be proposed and submitted to the Director of Public Works/City Engineer for review and approval.



WROUGHT IRON FENCE W/ PILASTERS
(NTS)



Sample Wrought Iron Fence with Pilasters

4. Landscaping – Single Use basins – Residential Areas

The location and visibility of the basin will affect the requirements that may be imposed by the city for the required landscaping treatments. Close coordination with city staff is recommended early in the design process for basin design considerations.

a. High Visibility Basins - Residential

Slopes shall have low maintenance drought tolerant landscaping with drip automatic irrigation system.



Sample Slopes with Drought Tolerant Landscaping

The bottom of the detention/retention basin shall have grass with an automatic sprinkler system. With approval of the Community Development Director and Public Works Director, the City will consider an alternate design in the basin floor such as drought tolerant landscaping with 3" minimum rock treatment. Plants shall be capable of surviving 72-hours under water.



Sample Retention Basin Bottom with Grass

b. Low Visibility Basins - Residential

Coordinate early in the design with City staff for acceptable levels of treatment that may include a combination of drought tolerant landscaping and rock scape. City staff will consider other treatment methods as may be proposed by the developer. Consideration shall be given to low maintenance and aesthetics in relation to its current and proposed surrounding environment, as well as compliance with outside agencies for dust control, etc.

5. Landscaping – Single Use basins – Commercial and Industrial Areas

The location and visibility of the basin will affect the requirements that may be imposed by the city for the required landscaping treatments. Close coordination with City staff is recommended early in the design process for basin design considerations.

Generally, these locations shall mimic the Low Visibility Basins landscape requirements for residential areas at a minimum, except that City staff may require more landscaping based on proximity to priority city corridors or visibility of the basin. The landscaping requirements shall blend with the surrounding and proposed use of the development.

D. MULTI-USE DETENTION BASINS (PARK AND RECREATIONAL USES)

1. General

Online detention facilities, which pass the entire flood through them, are well suited for joint uses such as open space, wetlands and wildlife habitat that can tolerate frequent inundations. Off-line detention facilities, which bypass the frequent flows and allow only the excess flow into the detention area are well suited for intensive recreational uses such as playgrounds and play fields since they are flooded less frequently (DeGroot and Lloyd, 1992, 20). The uses can be combined at the time of development or could be retrofitted, either putting detention into an existing park or putting recreational facilities into an existing detention facility. If done well, the facilities become an asset to the community (DeGroot and Lloyd, 1992, 19)(Shinde, 2002, 23).

The following guidelines direct the recreational use of stormwater basins and channels:

- Informal turf areas and passive vegetation zones may be placed within the average annual storm flood zone (1-yr 85th percentile storm) and up to the 10-year storm.
- Recreational sports fields (e.g. soccer, baseball, softball) shall be placed at or above the 10-year 24-hr storm event elevation.
- Hard court game surfaces and group picnic areas shall be placed at or above the 50-year storm event.
- Habitable structures, swimming pools, skate parks, children's play grounds, and parking lots shall be placed at or above the 100-year storm event.
- Storm basins may be contoured to provide a natural look. The use of gently curving, variable contouring to establish design grades within a dual use detention basin is encouraged to provide for a more aesthetically interesting design.
- Side slopes of storm basins shall be 6:1 or flatter to facilitate the ease of mowing. The use of irregular configuration and gentle side slopes is encouraged.
- Basin bottoms shall have a minimum cross-slope of 2 percent to allow for positive drainage.
- Contouring within the detention facilities is recommended to create internal elevation variations (or tiers) that have differing frequencies and depths of inundation and differing flood risk.

Joint-use detention/park facilities will require site specific designs to be coordinated with the City's planning and engineering departments during conceptual and final design to ensure the facilities meet both water quality/detention and park needs while minimizing maintenance requirements.

2. Soil Treatment

Soil properties and qualities must be investigated by a geologist or a soil quality expert at the depths of proposed vegetation and/or activities (ie. grass). The report shall determine the chemical composition of the soil and identify factors that may prevent vegetation growth, including alkali and drainage potential and

requirements. Report must include permanent soil treatment measures if required to support the proposed use. The report shall also locate the expected maximum water table level. Refer to additional requirements in the Landscaping General section of this guide.

3. Fencing

Fences, though used extensively for safety purposes, are considered unattractive. The use of natural landforms, meandering channels, irregular configuration, gentle side slopes, mosquito control, planting of native trees and shrubs, concealment of inlets and outlets and other landscaping features can transform a detention facility into an attractive amenity for the neighborhood (Stahre and Urbonas, 1990, 32) (Urbonas, Carlson and Tucker, 1993, 17). Fencing of detention basins should be discouraged wherever possible. Fences are expensive to install and maintain, tend to be unsightly, produce “edges”, which increase grounds maintenance needs, exists as a challenge to some of those they are intended to protect, and they impede emergency access in the unlikely event it becomes necessary (Jonathan Jones and Earl Jones, 1982, 325). Although safety should remain a concern, a properly designed detention basin should not be more hazardous than an urban lake, a playground, a hiking trail, or any other recreational or park facility in a city. It is definitely a safer facility than a city street, yet no one fences off the streets (Stahre and Urbonas, 1990, 36). (Shinde, 2002, 37)

4. Slopes

Slopes shall have grass with sprinkle irrigation or low maintenance drought tolerant landscaping with drip automatic irrigation system.



Sample Slopes with Drought Tolerant Landscaping

5. Detention Basin Depth

The 10-year 24-hour storm flood elevation and associated recreational uses shall not occur at a depth over two (2') feet, as measured against the adjacent street flow line or pre-existing ground elevation. Please note that various locations within the city limits exhibit high alkalinity soils.

6. Detention Basin Landscape – at or above the 10-year flood elevation.

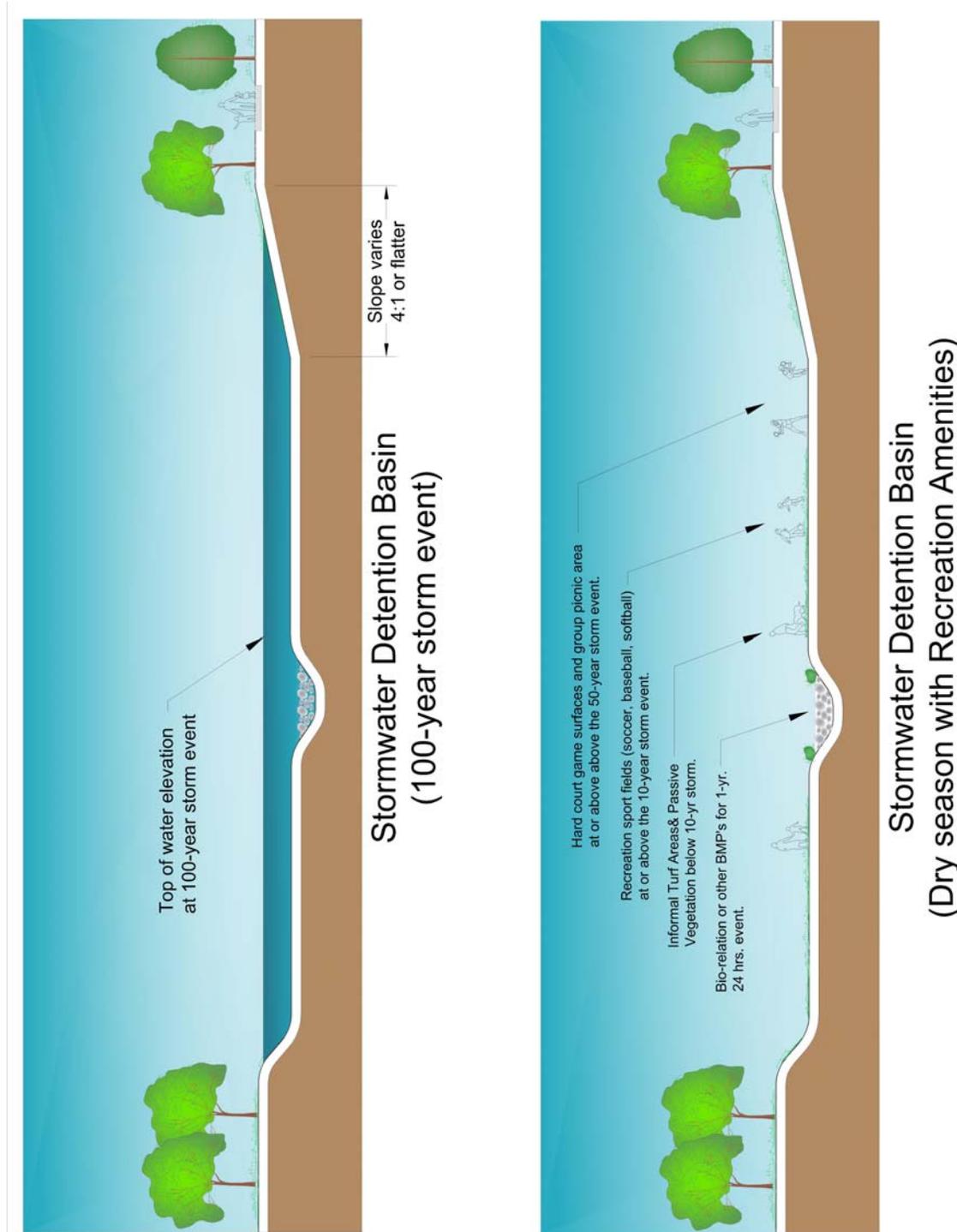
The floor of the detention/retention basin at or above the 10-year flood elevation shall have grass with an automatic sprinkler system, consistent with the proposed recreational use.



Sample Retention Basin Bottom with Grass

7. Detention Basin Landscape – 1-yr to 10-yr flood elevation

The basin shall have grass with an automatic sprinkler system or irrigated drought tolerant landscaping consistent with passive activities and informal turf areas.



E. MULTI-USE BASIN PARK CREDIT

Recreational use of the basins provides developers the ability to leverage the land area and combine parks and basins. Table 1 provides a summary of credits that are available towards satisfying the parkland requirement.

Table 1

	Non-Basin Park Acres ¹	Multi-Use Basin Acres				Total Parkland Credit
		Above 100 Year Flood Levels	10-100 Year Flood Levels	1-10 Year Flood Levels	less than 1 Year Flood Levels	
Parkland Credit Percentage	100%	100%	90%	50%	0%	
TOTAL	A Acres	B Acres	C Acres	D Acres	E Acres	SUM ²

1 Standard park or standard park built at surface elevation over underground storage system.

2 Multiply available acres in each flood zone by available credit, then add categories

See Appendix B for a sample comparison of sizing based on multi-use facility vs. single use facilities.

F. AMENITIES

1. The Developer is to consider installing recreation facilities, such as tennis and basketball courts, in coordination with the City’s Community Services and Community Development Department.
2. Developer may use park (Quimby) fees for improvements, such as tot lots, tennis and basketball courts, restrooms and drinking fountains.
3. Developer shall include a drinking fountain with drain into a small leach line within the detention/retention basin, unless an exception is granted by the Director of Public Works.
4. On detention/retention basins over three acres, developer shall (at City’s discretion) provide restrooms.
5. If a tot lot is installed, it shall be approved by the City’s Parks Department and adhere to the following:
 - a. Have state approved/certified playground equipment.

- b. Have an impact absorbent surface material with perimeter curb to contain the material.



Sample Tot Lot

G. ALTERNATE DESIGN FOR THE BASIN

1. Landscape

An alternative landscaped plan may be proposed and submitted to the Director of Public Works/City Engineer for review and then presented to the Planning Commission and City Council for approval.

2. Storage

Developer may elect to partially or fully contain water underground in mechanical storage systems. If a surface elevation park is built over this storage system, 100% of this area will be eligible for park land credit. Assuming a standard park and landscape is developed; approval of this system shall be obtained from the City Engineer.

REFERENCES

- Shinde, Pallavi Shashank. Multi-use of Stormwater Detention Ponds in Parks and Open Spaces. Athens: U of Georgia, 2002. Print
- DeGroot, William G., and David W. Lloyd, “Detention in Parks and Open Spaces Good, Bad and Ugly”, Flood Hazard News, Urban Drainage and Flood control District, volume 22, number 1, December 1992: 19-21.
- Jones, Jonathan E., and Earl Jones, “Interfacing Considerations in Urban Detention Ponding”, Proceedings of the Conference on Stormwater Detention Facilities: Planning, Design, Operation and Maintenance, American Society of Civil Engineers, New York, 1982: 317
- Shinde, Pallavi Shashank. Multi-use of Stormwater Detention Ponds in Parks and Open Spaces. Athens: U of Georgia, 2002. Print
- Stahre, Peter, and Ben Urbonas, Stormwater Detention for Drainage, Water Quality, and CSO Management, Englewood Cliffs, New Jersey: Prentice Hall, 1990.

Guidelines for Designing Retention Basins

Section E.11.i of the MS4 Permit requires the City to incorporate water quality components into new and rehabilitated flood management projects. Retention basins are commonly used for flood management in El Centro. However, since these retention basins are designed to have outflow, in many situations it will be possible to design flood management basins to also provide stormwater quality benefits, thus addressing Section E.11.i of the Permit. This document provides guidelines for designing flood control basins that also provide stormwater treatment. These guidelines apply to the following situations:

- Creation of new retention basins (typically associated with new development)
- Modification/Retrofit of existing basins associated with redevelopment or other significant activities that the City identifies as feasible opportunities for retrofit (e.g. major maintenance projects)

General Design Concept

Historically, retention basins have been used for flood control purposes only. Whenever feasible, new flood control retention basins should also be designed to provide stormwater quality benefits. There are a few key conceptual design components to these basins that may differ from typical flood control basins implemented in the past. These include:

- Separate inlet and outlet structures located a significant distance away from each other (as opposed to combination inlet/outlet structures)
- Upstream drainage structures designed to route *all* flows through the basin rather than just routing water to the basin during periods of high flow
- Flow control structures at the basin outlets designed to meet performance standards

Performance Standards

Retention basins should be designed to meet the following performance standards:

- The basin shall have a *maximum* drawdown time of 72 hours¹ for a 3-inch storm (flood control design storm).
- The basin shall have a *minimum* drawdown time of 24 hours for 50% of a 0.41-inch storm (water quality design storm).

Projects shall submit documentation of their calculations demonstrating compliance with these performance standards. See the “Recommended Calculation Method” section for additional guidance.

Additionally, if the basin is being used to meet hydromodification management requirements for a Regulated project that creates and/or replaces one acre or more of impervious surface, the post-project runoff shall not exceed estimated pre-project peak flow rate for the 10-year, 24-hour

¹ If the basin is also being used as a grass sports field, the maximum drawdown time shall be less than 72 hours if the vegetation cannot survive 72 hours of submersion. Consult the landscape architect to determine the maximum submersion time of the vegetation, and use this as the maximum drawdown time if it is less than 72 hours.

storm, which is approximately 1.93 inches. (See Post-Construction Stormwater BMP Manual for more information on hydromodification requirements).

Feasibility

The design standards described above should be met wherever feasible. Since the highest priority in designing retention basins is the protection of life and property, a basin should only be designed to meet the water quality performance standards if it will not inhibit the basin's ability to provide an adequate level of flood protection.

Recommended Calculation Method

The basin outlet should be sized to achieve both of the following:

- A. Release the entire volume of runoff generated by a 3-inch storm within a 72-hour period.
- B. Release no more than 50 percent of runoff generated by a 0.41-inch storm within the first 24 hours.

Selecting the appropriate orifice size can be done through the following iterative process.

1. Assume the design storm fills the basin instantaneously and calculate the water surface elevations for the two different design storms (3-inch and 0.41 inch).
2. Select an initial orifice size and use the orifice equation below for calculating discharge.

$$Q = C * A * [2 * g * (H - H_0)]^{0.5}$$

Where:

Q = discharge (ft³ /s)

C = orifice coefficient

A = area of the orifice (ft²)

g = gravitational constant (32.2 ft²/s)

H = water surface elevation (ft)

H₀ = orifice elevation (ft)

Use 0.66 for C unless the material is thicker than the orifice diameter, in which case, use 0.80. To help avoid clogging, use a minimum orifice diameter of 3/8 inch. When using multiple orifices, the discharge from each is summed.

3. Perform stage storage calculation to route each of the two design storms through the basin and determine the drawdown time for the 3-inch storm and for the first 50% of the 0.41 inch storm. Use a time step of 1 hour or shorter. The drawdown time for each stage becomes:

$$\Delta t = V_i / Q$$

Where:

Δt = drawdown time for each stage

V_i = the volume at each stage

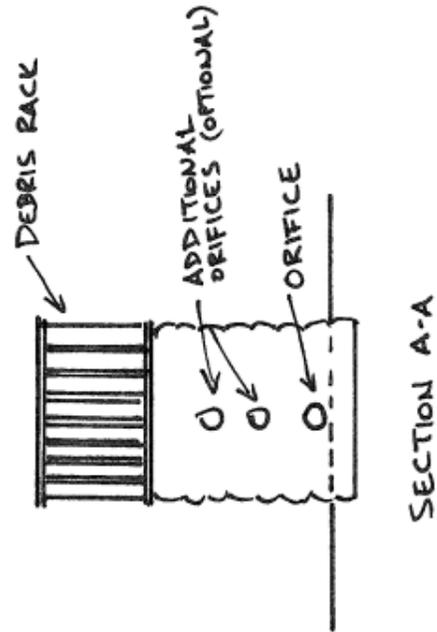
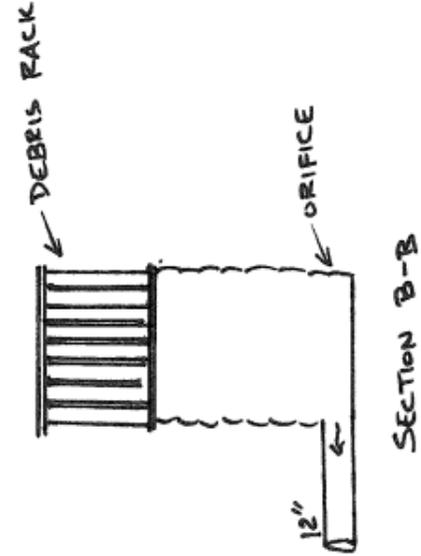
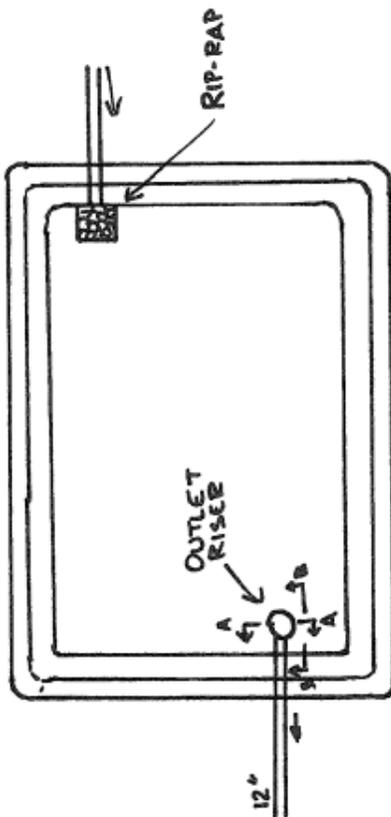
Q = the flow rate corresponding to the headwater elevation at each stage.

For each of the two design storms, determine if both drawdown time requirements A and B listed at the top of the page are met.

4. If both of the drawdown time requirements are not met, adjust the orifice size or configuration and repeat the process starting at Step 2.

Example Conceptual Basin Design

NOTE:
POSITION INLET AND OUTLET
STRUCTURES AT OPPOSITE
SIDES OF THE BASIN WHEN
POSSIBLE TO MAXIMIZE
RESIDENCE TIME



APPENDIX B

Sample Standard vs Multi-Use Project

Assumptions	
Project area	80 acres
Dwellings	200
Persons per dwelling	3.2
Required parkland area standard	5 acres per 1000 residents
Separate Parkland area	3.2 acres
Separate Basin Area (4')	5 acres
Total Park + Basin Area	8.2 acres
Site area	3,484,800 square feet
Max facility open depth	4 ft
100-yr storm (in)	3 inches
10-yr storm (in)	1.93 24hr. 85th percentile
1-yr storm (in)	0.41 24hr. 85th percentile

Required Basin Volumes (without any discharge credit)			
	100-yr Storm	871,200	cubic feet
	10-yr Storm	560,472	cubic feet
	1-yr Storm	119,064	cubic feet

100% Multi-Use facility

Parkland Credit Percentage	Non-Basin Park Area	Multi-Use Basin Acres				Total Parkland Credit
		Above 100 Year Flood Levels	10-100 Year Flood Levels	1-10 Year Flood Levels	less than 1 Year Flood Levels	
Surface parkland area	- SF					
100-yr storm surface area***	282,480 SF					
10 yr Storm required surface area**	152,210 SF		117,243	28,479		
1-yr storm required surface area*	95,251 SF					
TOTAL		-	117,243	28,479	-	145,723 SF
Total Parkland Credit						3.35 Acres
Total multiuse physical area						6.48 Acres

* assume 2.5 foot thickness, 50% void ratio, bioswale. Depth between 4 and 6.5 below curb flowline
 ** assume elevation varies between 1.1 and 4 feet below curb flowline
 *** assume elevation varies between 0 to 1.1 feet below curb flowline

SUMMARY	
Acres required separate basin and park facilities	8.2
Acres required through multi-use facility	6.48
Net project area savings	21%

Multi-Use facility and Non-Basin Area

	Parkland Credit Percentage	Non-Basin Park Area	Multi-Use Basin Acres				Total Parkland Credit
			Above 100 Year Flood Levels	10-100 Year Flood Levels	1-10 Year Flood Levels	less than 1 Year Flood Levels	
		73,000 SF					
		207,152 SF					
10 yr Storm required surface area**		176,563 SF	27,530	40,656			
1-yr storm required surface area*		95,251 SF					
TOTAL			27,530	40,656	-	141,186 SF	3.24 Acres
							6.43 Acres

*assume 2.5 foot thickness, 50% void ratio, bioswale. Depth between 4 and 6.5 below curb flowline

**assume elevation varies between 1.5 and 4 feet below curb flowline

***assume elevation varies between 0 to 1.5 feet below curb flowline

SUMMARY	
Acres required separate basin and park facilities	8.2
Acres required through multi-use facility	6.43
Net project area savings	22%