

**PUBLIC  
WORKS  
STANDARDS**

FOR  
YUMA COUNTY  
VOLUME III  
STORM DRAINAGE FACILITIES



**YUMA COUNTY  
DEPARTMENT OF DEVELOPMENT SERVICES**  
As amended and adopted  
August 21, 2006

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## YUMA COUNTY BOARD OF SUPERVISORS

### RESOLUTION NO. 06 -50

A RESOLUTION BY THE YUMA COUNTY BOARD OF SUPERVISORS ADOPTING AMENDMENTS AND REVISIONS TO THE PUBLIC WORKS STANDARDS FOR YUMA COUNTY, VOLUME III – STORM DRAINAGE FACILITIES.

**WHEREAS**, Yuma County pursuant to Arizona Revised Statutes 11-251.36, may adopt and enforce standards for excavation, landfill and grading to prevent unnecessary loss from erosion, flooding and landslides; and

**WHEREAS**, there exists a need to revise the adopted Public Works Standards for Yuma County, Volume III – Storm Drainage Facilities for orderly development and growth, and public safety and welfare; and

**WHEREAS**, it appears to the Yuma County Board of Supervisors that the revision of the said Public Works Standards, Volume III is necessary in the orderly development of Yuma County and in providing public safety and welfare; and

**WHEREAS**, the notice and hearing requirements addressed in A.R.S. § 11-251.05 have been met,

**NOW, THEREFORE BE IT RESOLVED**, that the amendments and revisions to the Public Works Standards for Yuma County, Volume III – Storm Drainage Facilities as described in Exhibit "A", attached hereto and incorporated herein, are hereby adopted for use in Yuma County; and

**BE IT FURTHER RESOLVED**, that the effective date of this resolution shall be  
September 25, 2006.

**APPROVED AND ADOPTED**, by the Yuma County Board of Supervisors this  
21st day of August, 2006.

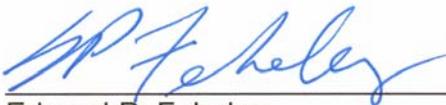
  
\_\_\_\_\_  
Casey Prochaska, Chairman

ATTEST:

  
\_\_\_\_\_  
Sue Stallworth, Clerk of the Board

The undersigned has determined that this Resolution is in proper form and is within the powers and authority granted under the laws of the State of Arizona to Yuma County.

Jon Smith  
Yuma County Attorney

  
\_\_\_\_\_  
Edward P. Feheley  
Deputy County Attorney

**STANDARDS**  
**FOR**  
**YUMA COUNTY**  
**VOLUME III**  
**STANDARDS**  
**FOR**  
**STORM**  
**DRAINAGE FACILITIES**

**Originally Adopted: APRIL 1996**

**As Amended and Adopted**  
**August 21, 2006**

**YUMA COUNTY DEPARTMENT OF DEVELOPMENT SERVICES**

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## **PREFACE**

**Public Works Standards for Yuma County, Volume III**, are intended to provide a consistent policy for the orderly development and protection of storm drainage facilities and improvements within Yuma County.

This volume contains the following sections:

1. General Provisions,
2. Storm Drainage Development and Permit Requirements,
3. Grading and Storm Drainage Facilities Standards, and
4. Standards for Preparing Drainage Report and Improvement Plans.

Companion documents to this volume are:

Volume I, which contains Public Works Construction Standards and

Volume II, which contains Public Works Construction Specifications.

These Standards are prepared to fulfill the need for uniform rules governing construction performed in unincorporated Yuma County and incorporated cities and towns who use these standards.

Copies of the Standards are available from the Yuma County Department of Development Services.

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# TABLE OF CONTENTS

## PREFACE

### 1.0 GENERAL PROVISIONS

1.1	Introduction.....	1-1
1.2	Purpose.....	1-1
1.3	Glossary .....	1-2
1.4	Acronyms.....	1-8

### 2.0 STORM DRAINAGE DEVELOPMENT AND PERMIT REQUIREMENTS

2.1	Area of Jurisdiction.....	2-1
2.2	Requirements and Conformance.....	2-1
2.3	Submittals .....	2-2
2.4	Submittal Procedure.....	2-3
2.5	Review & Revision Procedures .....	2-3
2.6	Terms of Grading Applications and Permits .....	2-4
2.7	Construction in Accordance with Approved Plans.....	2-4
2.8	Completion and Approval of Work .....	2-5
2.9	Compliance .....	2-5
2.10	Connections to Yuma County Flood Control District Facilities.....	2-6

### 3.0 GRADING & STORM DRAINAGE FACILITY STANDARDS

3.1	General Standards .....	3-1
3.2	Basis of Calculations.....	3-1
3.3	Off-Site Drainage Standards.....	3-4
3.4	On-Site Drainage Standards.....	3-4
3.5	Retention and Detention Facilities General Standards .....	3-5
3.6	Retention and Detention Facilities Design Standards.....	3-6
3.7	Individual Parcel Retention Standards.....	3-7
3.8	Open Channels Standards .....	3-8
3.9	Storm Drains Standards .....	3-9
3.10	Culverts Standards .....	3-10
3.11	Streets Drainage Standards .....	3-10
3.12	Erosion Control System Standards .....	3-11

### 4.0 STANDARDS FOR PREPARING DRAINAGE REPORT & IMPROVEMENT PLANS

4.1	General Standards .....	4-1
4.2	Project Description.....	4-1
4.3	Off-site Drainage .....	4-2

4.4	On-site Drainage .....	4-3
4.5	Retention/Detention .....	4-5
4.6	Supporting Technical Data .....	4-6
4.7	Improvement Plan Standards .....	4-6

## **APPENDICES**

- A. Rainfall Intensity - Duration – Frequency Relationship for Yuma, Arizona
- B. Non-Dimensional Storm Rainfall Distribution
- C. Runoff Curve Numbers by Soil Type and Zoning Classification
- D. Rational Method Hydrologic Design Data Sheet
- E. Rational Method Retention and Detention Basin Volume Design Data Sheet
- F. Nomograph for Flow in Triangular Channels
- G. Nomograph for Flowing Full Pipe Capacities
- H. Individual Parcel Retention Basin Design Data Sheet

## **1.0 GENERAL PROVISIONS**

### **1.1 INTRODUCTION**

Grading, excavation, fill, and other development alter the natural contours of the ground, often causing erosion, siltation, landslides, unstable soil conditions, flooding, soil and vegetation loss, diversion, obstruction and altering of drainage patterns. Development of land often results in an increase of impervious surface area of a water shed, causing an increase in the volume of storm water runoff. Proper measures for grading and excavating land are necessary to address these problems and to avoid unnecessary future problems.

### **1.2 PURPOSE**

The purpose of this volume of the Public Works Standards is to promote the public health, safety and general welfare, and to minimize public and private losses due to unnecessary loss from erosion, flooding and inundation by provisions designed to:

- 1.2.1 Provide the minimum design and technical standards for the analysis and design of storm drainage facilities;
- 1.2.2 Match or blend all grading, excavations, cut, fill and other undulations of the land with the natural contours;
- 1.2.3 Protect existing, developed real property immediately adjacent to the earth work operation;
- 1.2.4 Stabilize cuts and fills, reduce erosion, siltation, and inundation and stabilize soil condition problems;
- 1.2.5 Provide sufficient storage to retain the total runoff from the design storm falling on that parcel, lot, or plot of land;
- 1.2.6 Minimize damage to public facilities and utilities, such as water and gas mains, electric and telephone lines, streets, and bridges, located in areas adjacent to proposed earth work;
- 1.2.7 Provide uniform minimum storm water drainage development requirements;
- 1.2.8 Establish responsibility and provide mechanisms to enforce and implement management of grading and drainage with respect to construction and development;
- 1.2.9 Preserve the storm water carrying capacity of natural drainage ways and constructed flood control and drainage facilities;

1.2.10 Protect natural drainage ways from grading and filling; and

1.2.11 Provide standards for the preparation of grading plans and drainage reports so that manpower requirements are reduced in developing and reviewing grading plan submittals.

### 1.3 GLOSSARY

**Agricultural Purposes** means grazing or general agricultural purposes on a tract of five or more contiguous commercial acres.

**Approval** shall mean a written notice by the County Engineer approving the design, progress and completion of the work.

**Approved Plans** shall mean the most current grading and improvements plans and specifications which bear the authorized stamp of approval of the County Engineer.

**Area of Jurisdiction** means the unincorporated areas of Yuma County, including public lands, and those incorporated areas of cities or towns which have elected to adopt these standards.

**Arizona Construction General Permit (CGP)** means the AZPDES General Permit for Discharge from Construction Activities to Waters of the United States which provides authorization to discharge under the AZPDES program, in compliance with the provisions of ARS Title 49, Chapter 2, Article 3.1, the Arizona Administrative Code, Title 18, Chapter 9, Articles 9 and 10, and the Clean Water Act as amended (33 U.S.C. 1251 et seq.)

**Arizona Municipal General Permit (MGP)** means the AZPDES General Permit for Discharge from Small MS4s to waters of the United States. In compliance with the provisions of the AZPDES program, (ARS Title 49, Chapter 2, Article 3.1 and Arizona Administrative Code, Title 18, Chapter 9, Article 9 and 10), this general permit authorizes discharges certified under this general permit from those locations specified throughout the state of Arizona to waters of the United States.

**Arizona Pollutant Discharge Elimination System (AZPDES)** means the State of Arizona program to regulate the discharges of pollutants from any point source into waters of the United States as adopted under §402(b) of the CWA. The AZPDES rules are contained in Arizona Administrative Code Title 18 Chapter 9, Article 9.

**AZPDES Authorization Letter** means a letter from ADEQ authorizing coverage under an AZPDES general permit.

**AZPDES Individual Permit** means an AZPDES permit for a single point source, a single facility, or a municipal separate storm sewer system.

**AZPDES Permit** means either a general or individual permit issued by ADEQ under the AZPDES and NPDES programs.

**Best Management Practices (BMP)** shall mean those methods, measures or practices to prevent or reduce pollution or sediment discharges and includes structural and nonstructural controls and operation and maintenance procedures accepted as standard procedures by the environmental science or engineering professions. Best management practices may be applied before, during, and/or after discharges to reduce or eliminate the introduction of pollutants into receiving waters.

**Borrow** is earth material acquired from an off-site location for use in grading a site.

**Channel** means a natural or man-made water course with defined banks.

**Channelization** is the artificial restriction of a river, wash, or other water way into a defined channel.

**Civil Engineer** shall mean a Professional Engineer registered in the State of Arizona to practice Civil Engineering.

**Clean Water Act (CWA)** means the Federal Water Pollution Control Act, 33 U.S.C. Section 1251 et seq. and all appurtenant federal and state regulations.

**Clearing, Brushing, and Grubbing** shall mean soil disturbance and/or the removal of vegetation (grass, brush, trees, and similar plant types) by mechanical or manual means.

**Contiguous Development** means any phased or otherwise connected development that when complete is intended to function as a whole.

**Contributing Area** means part or all of a watershed, drainage area, or drainage basin or other area that contributes runoff to a point, channel, stream, wash, drainage facility, retention or detention basin, or other project.

**County** means Yuma County, Arizona.

**County Engineer** is the County Engineer appointed by the Yuma County Board of Supervisors or his duly authorized representative.

**Critical Point** is any location of a water flow which is at the narrowest sections, highest volume, greatest slope, highest velocity, and geometric and hydraulic transition points, etc.

**Deficiency** means a submittal or document does not meet one or more standards, regulations, or conditions.

**Detention Basin** is an area designated for temporary storage of storm water where bleeding or pumping drains the basin over a specified and limited period of time.

**Development** is any man made change to improved or unimproved real estate including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, surfacing, excavation or drilling operations.

**Director** means the Director of the Yuma County Department of Development Services or his duly authorized representative.

**Disturbed Area** means that the area has been altered from its pre-existing condition due to development.

**Drainage** means the collection and flow of storm water within natural or man made channels, drainage ways, structural, across a surface and/or non-structural methods.

**Drainage Facility** means a structure used primarily for the collection, conveyance, and disposal of storm water.

**Drainage Report** is generally an engineered report analyzing the drainage requirements for a site or project including pre- and post-development runoff, drainage facility sizes, retention requirements, flow rates and velocities, and other hydraulic data.

**Earth Material** is any rock, natural soil or fill, and/or any combination thereof.

**Effective Date** means the date that the latest revision of this regulation is adopted by the Board of Supervisors.

**Erosion** is the wearing away of the ground surface from natural forces such as wind and water.

**Erosion Control System** is any combination of sediment traps, erosion protection (including lining and riprap) and effective planting used to reduce or eliminate erosion.

**Excavation** is the artificial removal of earth material.

**Filling** is the deposition of earth material by artificial means.

**Finished Grade (FG)** is the final grade of the site which conforms to the approved plan.

**Flood Insurance Rate Map (FIRM)** means the official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the County.

**Floodplain** means the area adjoining and within the channel of a watercourse, or areas where drainage is or may be restricted by man made structures which have been or may be covered partially or wholly by floodwater from the 100-year flood.

**Floodplain Regulations for Yuma County** is an official document of Yuma County Flood Control District regulating the use of land and construction within the floodplain areas of Yuma County.

**Floodplain Use Permit** is an official document of Yuma County Flood Control District which authorizes specific activity within a defined area of the floodplain.

**Grade (noun)** is the vertical location of the ground surface.

**Grade (verb), Grading** is any excavating or filling, or combination thereof including the initial clearing, brushing and grubbing.

**Grading Permit** is an official document issued by the County Engineer, authorizing grading activity as specified by approved plans and specifications.

**Grading Plans** are generally engineered plans outlining the extent and quantity of cut and fill, the existing and finish grades, contour lines, detention and/or retention facilities. This may also include, but not be limited to soils or geotechnical reports, phasing or scheduling plans, and plans for stabilization or other structural measures or improvements.

**Impaired/Unique Waterway** means any body of water listed as impaired or unique by a state, territory, or authorized tribe under Section 303(d) of the Clean Water Act.

**Impaired Water (ARS §49-231)** means navigable water for which credible scientific data exists that satisfies the requirements of ARS §49-232 and that demonstrates that the water would be identified pursuant to 33 United States Code Section 1313(d).

**Impervious Surface Area** is the area of a site that has been surfaced or covered with material restricting natural percolation into the soil.

**Improvement Plans** are plans showing all of the planned improvements to a parcel and surrounding rights-of-way.

**Individual Residential Lot or Parcel** is a lot or parcel zoned and used for a single family dwelling as defined by the Yuma County Zoning Ordinance.

**Inspector** is an individual duly authorized by the County Engineer to perform inspection of grading and excavation work for compliance with a grading permit and these regulations.

**Lot or Parcel** is any real property recorded by a deed with the Yuma County Recorder's Office.

**Major Waterway** is the Colorado River, Gila River, Fortuna Wash or any other waterway shown to have 100-year flowrates exceeding 3,000 cfs at any point.

**National Pollutant Discharge Elimination System (NPDES)** means the national program for issuing, modifying, revoking, reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment and biosolids requirements under sections 307 (33 U.S.C. 1317), 318 (33 U.S.C. 1328), 402 (33 U.S.C. 1342), and 405 (33 U.S.C. 1345) of the Clean Water Act.

**Natural Grade** shall mean the ground surface unaltered by artificial means.

**Notice of Intent (NOI)** means an official document required by Arizona Department of Environmental Quality to apply for use of State of Arizona NPDES permit identifying the intended activity for which permitted coverage is requested.

**Notice of Termination (NOT)** means an official document required by Arizona Department of Environmental Quality demonstrating that the permitted coverage under AZPDES General Permit is terminated.

**Off-site Drainage** means drainage required to control and direct off-site runoff.

**Off-site Runoff** means storm water runoff originating outside the parcel or project boundaries.

**On-site Drainage** means drainage required to control and direct on-site runoff.

**On-site Runoff** means storm water runoff originating within the parcel or project boundaries.

**One Hundred Year Storm** means a storm with a one percent (1%) probability of occurrence annually.

**Owner or Person** is an individual, agent, firm, partnership, association, corporation or this State or any agency or political subdivision having a legal or equitable interest in given real property.

**Preliminary Drainage Report** means an engineered report providing existing site conditions, preliminary drainage calculations, and a description of the conceptual design.

**Retention** is the prevention of runoff from entering a stream, storm disposal or sewer system by storing it in some type of storage basin.

**Retention Basin** is the area designated and constructed for total storage of storm water from the drainage area without bleeding or pumping of storm water to another facility.

**Revetment** may be a retaining wall for facing of rock, concrete blocks, mattresses, etc., with structural integrity that is placed along an embankment to minimize erosion and to prevent sliding or slippage of earth.

**Site** is any land under the same ownership or unified control, where the proposed grading is to be performed or permitted.

**Slope** is an inclined ground surface, the inclination of which is expressed as the ratio of horizontal distance or vertical distance.

**Stabilization, Final** means 70% of the project area has been stabilized in accordance with the Arizona Construction General Permit SWPPP and improvement plans.

**Storage** means the holding or impoundment of storm water either by detention or retention.

**Storm** means a precipitation event. Storms are defined by a statistical frequency and duration. The frequency is defined as the inverse of the probability of annual occurrence. The duration is the length of time the storm occurred. Design standards storms are written as X, Y storm with X equaling the frequency and Y equaling the duration (i.e., 100-year, 2 hour storm). The duration of a design storm is equal to the time of concentration (10 minute minimum) unless given otherwise.

**Storm, One Hundred Year** means a storm with a one percent (1%) probability of occurrence annually.

**Storm Water** means storm water runoff, snow melt runoff, and surface runoff and drainage.

**Storm Water Peak** means the highest runoff flow rate, in cfs, produced from a storm.

**Storm Water Volume** means the total volume of runoff produced from a storm.

**Storm Water Pollution Prevention Plan (SWPPP)** means a plan that includes site map(s), an identification of construction/contractor activities that could cause pollutants in the storm water, and a description of measures or practices to control these pollutants. The plan also includes measures to minimize erosion and sediment formation to the maximum extent practicable.

**Structure** is anything constructed or erected for use which requires a location on the ground or attachment to something having a location on the ground but not including walls and fences less than 4 ½ feet in height when located in front yards, or less than 6 feet in height when located in side or rear yards. Structure shall also include streets, alleys, roadways, water lines and sewer lines; however, setback line requirements shall not apply to streets, alleys, roadways, water or sewer lines and their appurtenant features.

**Time of Concentration (Tc)** means the time required for runoff at the most distant point of a drainage area to reach the discharge point. Calculations shall use a Tc greater than or equal to 10 minutes unless otherwise noted.

**Unique Water** (AAC R18-9-A901) means any water with unique physical, biological or chemical properties.

**Waiver, ADEQ** means an official document from ADEQ releasing an operator from permitting requirements.

**Waiver** means a written document from the County Engineer releasing an applicant from one or more specific standards.

#### 1.4 ACRONYMS

**AAC** - Arizona Administrative Code  
**ADEQ** – Arizona Department of Environmental Quality  
**ARS** – Arizona Revised Statutes  
**AZPDES** – Arizona Pollution Discharge Elimination System  
**BMP** – Best Management Practices  
**CFR** – Code of Federal Regulations  
**CFS** – Cubic Feet per Second  
**CGP** – Arizona Construction General Permit  
**CWA** – Clean Water Act  
**DDS** – Yuma County Department of Development Services  
**FG** – Final Grade  
**FPS** – Feet per Second  
**FPU** – Floodplain Use Permit  
**MGP** – Arizona Municipal General Permit  
**MS4** – Municipal Separate Storm Sewer System  
**MSL** – Mean Sea Level  
**NOAA** – National Oceanic & Atmospheric Administration  
**NOI** – Notice of Intent  
**NOT** – Notice of Termination  
**NPDES** – National Pollution Discharge Elimination System  
**SCS** – Soil Conservation Service  
**SWPPP** – Storm Water Pollution Prevention Plan

## **2.0 STORM DRAINAGE DEVELOPMENT & PERMIT REQUIREMENTS**

### **2.1 AREA OF JURISDICTION**

These standards apply to all land within the unincorporated area of Yuma County and to those incorporated areas of Yuma County whose governing bodies adopt these standards and requirements.

### **2.2 REQUIREMENTS AND CONFORMANCE**

2.2.1 Before any development takes place on any land within the area of jurisdiction, a completed grading permit application form with a grading plan, a drainage report, and required fees shall be submitted to the County Engineer for review and approval and a grading permit obtained.

2.2.2 Before any development disturbing one or more acres takes place, the following additional items shall be submitted as part of the grading permit application and become part of the grading permit requirements:

- A. Arizona Department of Environmental Quality Notice of Intent (NOI);
- B. Storm Water Pollution Prevention Plan (SWPPP); and
- C. AZPDES Authorization Letter; or
- D. Waiver issued by the Arizona Department of Environmental Quality (ADEQ).

2.2.3 These standards apply when any of the following activities are proposed or exist:

- A. The impervious surface area of any parcel is increased by more than 400 square feet for any addition or improvement including building construction or surfacing on the natural ground; or
- B. The existing grade is altered more than twelve (12) inches across an area larger than 400 square feet; or
- C. Runoff peak flowrate or volume will increase as a result of development; or
- D. Drainage facilities, channels, or drainage ways are altered, diverted, blocked, obstructed, or otherwise impacted.

2.2.4 Exceptions to the requirements are as follows:

- A. Cemetery grave excavation;
- B. Refuse disposal sites operated by a public agency under an AZPDES Permit or controlled by federal or state regulations;

- C. Excavations for water well and utility line trenching;
- D. An individual residential lot or parcel; when:
  - 1. Existing slopes are less than 10% measured across the entire site at maximum gradient, and
  - 2. Where applicable, individual parcel retention complies with the retention requirements shown on the subdivision plat, grading plan or drainage report.
- E. Grading done exclusively for agricultural purposes;
- F. Exploratory excavations under the directions of an Arizona registered engineer or geologist provided all excavations are properly backfilled;
- G. Grading and maintenance of existing streets and roads under an AZPDES permit;
- H. Excavations below finished grade for a cesspool, septic tank, swimming pool, storage tanks for oil, gas or water or foundations and footing for buildings, manufactured homes, retaining walls or other structures authorized by a valid building permit (This does not exempt any fill made with the material from the excavation nor exempt any excavation having an unsupported height greater than 5 feet after completion of such structures.); and
- I. Statutory exemptions as provided by the Arizona Revised Statutes and federal codes.

## **2.3 SUBMITTALS**

- 2.3.1 Grading permit applications shall include the following submittals to the County Engineer for approval:
  - A. Completed Application for Grading Permit Form including applicant's name, address, and phone number, owner's name and address, site address or location, and assessor's parcel number;
  - B. Four copies of the Drainage Report with Grading Plans with appropriate details prepared by an Arizona Registered Engineer or Arizona Registered Architect prepared in accordance with Sections 3 and 4 of this volume;
  - C. Where applicable, offsite improvement plans for improvements in existing and proposed public rights-of way prepared by an Arizona Registered Engineer in accordance with Public Works Volumes I, II, and III;

- D. When proposed development is within a floodplain, a Floodplain Use Permit Application with required plans and certifications prepared by an Arizona Registered Engineer in accordance with the Floodplain Regulations for Yuma County;
  - E. If the disturbed area is one or more acres, one (1) copy of applicable NOI, SWPPP, and ADEQ Authorization Letter or ADEQ issued waiver; and
  - F. Required Fees – Application and review fees shown on the current Fee Schedule available at Department of Development Services.
- 2.3.2 Subdivision tentative plans are to be submitted with four copies of the preliminary drainage report, grading plans, and a flood protection fee.
- 2.3.3 Final subdivision improvement plans are to be submitted with a completed grading permit application with four copies of grading plans, drainage report, applicable SWPPP, NOI, and ADEQ Authorization Letter or waiver, and required fees.
- 2.3.4 Upon completion of final stabilization, as required by the general or individual AZPDES permit, a NOT must be submitted to the County Engineer indicating termination of coverage under the general or individual permit.

## **2.4 SUBMITTAL PROCEDURE**

- 2.4.1 Applicants requesting a grading permit and AZPDES review should submit completed application form with required submittals and fees to Yuma County Department of Development Services.
- 2.4.2 If the site is within ¼ mile of a unique or impaired waterway, a copy of the NOI and SWPPP with selected BMP's shall be submitted by the applicant to ADEQ for review.
- 2.4.3 If the site is further than ¼ mile from a unique or impaired waterway, Yuma County may request ADEQ to review the SWPPP to determine whether the selected BMP's are sufficient to protect water quality.

## **2.5 REVIEW & REVISION PROCEDURE**

- 2.5.1 Approval of the drainage report, grading and improvement plans will only be granted and a grading permit issued after all review comments have been satisfactorily addressed by revision to the County Engineer.
- 2.5.2 Four copies of the final drainage report, grading plan, improvement plans, SWPPP, NOI, and ADEQ Authorization Letter or waiver are to be provided for approval.

2.5.3 An approved copy of the grading plans and any other submitted plans along with a grading permit will be forwarded to the owner.

## **2.6 TERMS OF GRADING APPLICATIONS AND PERMITS**

2.6.1 A grading permit application will become void if the permit is not issued within two years from date of application.

2.6.2 A grading permit and plan approval will be void after one year from the date of approval if construction has not begun, and is void after two years from date of approval. To reinstate a permit, a new application with the required fees will be required.

2.6.3 The County Engineer may revoke a Grading Permit if any of the following conditions are met:

A. Hazardous conditions exist; or

B. The conditions of the permit, these standards, federal, state, or county regulations, the SWPPP, NOI, or ADEQ Authorization Letter are violated; or

C. Substantial work has not been accomplished such that the construction cannot be completed by the expiration date.

## **2.7 CONSTRUCTION IN ACCORDANCE WITH APPROVED PLANS**

2.7.1 Unless otherwise noted on the project plans, drainage and flood control work is to be constructed in accordance with the Yuma County Public Works Standards Volumes I, II, & III.

2.7.2 All construction and work shall be in accordance with and conform to the approved plans and specifications.

2.7.3 Minor revisions to on-site improvements, not affecting total retention capacities and drainage routing to detention areas, will be permitted during construction without re-approval of plans, provided the revisions are submitted, in document form, to County Engineer before final approval.

2.7.4 All revisions to approved plans for work on the off-site areas shall be first approved by the County Engineer.

## **2.8 COMPLETION AND APPROVAL OF WORK**

- 2.8.1 Every project requiring a grading permit is to have a final inspection. The County Engineer shall be notified when the project is ready for a final inspection.
- 2.8.2 The final inspection is to determine if the work has been completed and constructed to approved plans and specifications.
- 2.8.3 Any modification of the approved plans shall be documented and approved by County Engineer. Approval of storm water facility construction will be given after all deviations from the plan have been corrected to comply with the approved plan.
- 2.8.4 Approval of equipment will not be given until after any necessary operation and maintenance manuals have been received and approved by the County Engineer.
- 2.8.5 The Notice of Termination (NOT) to ADEQ and DDS shall be submitted within 30 days after any of the following conditions have been met:
  - A. Final stabilization requirements of the AZPDES permit have been met on all portions of the site for which the operator is responsible; or
  - B. Another operator has assumed control over all areas that have not been finally stabilized; or
  - C. For residential construction only, temporary stabilization has been completed and the residence has been transferred to the homeowner.

## **2.9 COMPLIANCE**

- 2.9.1 No grading, excavation or filling on any land shall hereafter take place without full compliance with the terms of this standard.
- 2.9.2 Mechanical, electrical, plumbing, building and manufactured home placement permits are not to be issued without full compliance with the terms of this standard.
- 2.9.3 Grading permits shall not be issued when an existing violation to federal, state, or Yuma County laws, ordinances, codes, regulations, or standards unless a grading permit is required to correct the violation.
- 2.9.4 Final approval of construction and certificate of occupancy shall not be issued until the grading permit has been finalized.

## **2.10 CONNECTIONS TO YUMA COUNTY FLOOD CONTROL DISTRICT FACILITIES**

When a storm sewer, outlet of a detention basin, or other storm sewer pipeline connection is proposed into a facility owned, operated or managed by the Yuma County Flood Control District, a separate approval from the District is to be obtained. Before approval is obtained, an Intergovernmental Agreement for operation and maintenance with the jurisdiction involved is required, along with any applicable connection fees.

### **3.0 GRADING & STORM DRAINAGE FACILITY STANDARDS**

#### **3.1 GENERAL STANDARDS**

Grading, drainage facilities, channels, and other improvements to control storm water are to be designed and constructed in accordance with the standards and criteria contained in this section. These standards include standards for basis of calculations, off-site drainage, on-site drainage, retention and detention facilities, individual parcel retention, open channels, storm drains, culverts, and streets.

3.1.1 Grading, drainage facilities, channels, and other improvements to control storm water shall be designed to:

- A. Dispose of water in, as nearly as possible, the same manner as before the planned development;
- B. Limit post-development peak discharges from a project and in affected streams and channels at pre-development peak discharge rates;
- C. Minimize erosion by providing erosion control systems which may include channelization, flumes, lining, and rip-rapping as required to prevent erosion and scour;
- D. Be compatible with existing improvements and drainage;
- E. Be compatible with the latest adopted Master Drainage Plans; and
- F. If in public or county right-of-way or proposed to be in a public right-of-way, conform to the Public Works Standards for Yuma County, Volume I and II, latest edition.

3.1.2 The County Engineer, at his discretion, may require additional information, design, analysis, or the use of specific design and construction methods. The County Engineer may waive specific standards, at his discretion, if technical data is submitted to support the waiver.

#### **3.2 BASIS OF CALCULATIONS**

3.2.1 Drainage facilities and grading shall be designed based on a storm having a one percent (1%) probability of annual occurrence (100-year storm) with a duration equal to the time of concentration (10 minutes minimum) unless otherwise specified in these regulations.

- 3.2.2 The acceptable methods for performing hydrologic calculations used in determination of peak storm water flow rates and run-off volumes are:
- A. Army Corps of Engineers HEC-HMS or HEC-1 computer models in accordance with Highway Drainage Design Manual – Hydrology, Arizona Department of Transportation, FHWA-AZ93-281, latest edition;
  - B. Soil Conservation Service (SCS) Unit Hydrography Method; and
  - C. Rational Method.
- 3.2.3 **Army Corps of Engineers HEC-HMS or HEC-1** – The Highway Drainage Design Manual – Hydrology presents methods for HEC-HMS calculations for rainfall, rainfall losses, unit hydrographs, channel routing, storage routing, and transmission losses acceptable to Yuma County. Other methods for HEC-HMS or HEC-1 calculations shall be approved by County Engineer prior to use.
- 3.2.4 **Soil Conservation Service Unit Hydrography Method** – The SCS Unit Hydrography Method may be applied by use of the SCS TR-20, U.S. Army Corps of Engineers HEC-1 or HEC-HMS computer programs. The minimum watershed area analyzed must have a time of concentration greater than 10 minutes.

The following are the limits and sources allowed for input parameters:

- A. Time of Concentration—Use the procedures set forth in the SCS Publication Technical Release 55 (TR-55);
- B. Precipitation—Use the Rainfall Intensity-Duration-Frequency Relationship for Yuma shown in Appendix A to determine intensity and use the Rainfall Depth-Duration-Frequency statistics in NOAA Atlas 2, Volume VIII, Arizona (1973) to determine precipitation depths with the duration equal to the time of concentration (10 minute minimum);
- C. Rainfall Distribution—Use the non-dimensional hydrograph given in Appendix B or other applicable unit hydrographs;
- D. Soil Classification—Use the SCS Publication Soil Survey of Yuma-Wellton Area, Parts of Yuma County, Arizona and Imperial County, California to classify the soils present on the watershed by SCS Soil Type A through D; and
- E. Runoff Curve Numbers—Assign curve numbers according to SCS soil type and land use per Appendix C or by the methods set forth in TR-55 using soil antecedent moisture condition II.

### 3.2.5 Rational Method

- A. The equation,  $Q=CIA$ , may be used to compute peak runoff from urbanized areas up to 10 acres or non-urbanized areas up to 80 acres, post-development, where:

$Q$  = Peak runoff (cfs);

$C$  = Runoff coefficient representing the characteristics of the drainage area (See Appendix D: Rational Method Design Data Sheet);

$I$  = Average intensity of rainfall in inches per hour for a duration equal to the time of concentration,  $T_c$ , for a selected rainfall frequency (Utilize the intensity-frequency graph in Appendix A);

$A$  = Size of drainage area in acres; and

- B. Time of concentration from impervious areas should be computed using average gutter velocities from the modified Manning's formula for triangular flow, if applicable, and/or average pipe velocities utilizing Manning's formula (See Appendices F & G).

### 3.2.6 Retention and Detention Basins

- A. The basis of calculations for retention and detention basins, which receive runoff from more than one parcel, shall be the total runoff volume from the 100-year storm using an approved method in Section 3.2.1.
- B. The Rational Method may be used for basins with a contributing drainage area of less than 10 acres. Design data sheets are given in Appendix E. If the rational method is used, the 100-year, 2-hour storm or 2.44 inches of total rainfall shall be used.

### 3.2.7 Individual Parcel Retention Basins

The basis of calculations for on-site retention basins shall be the total volume of storm precipitation falling on the individual parcel, lot, space or block with no consideration given to rainfall absorbed by the ground. Appendix H contains a design data sheet for individual parcel retention. The following design storms are to be used for sizing individual parcel retention basins:

- A. Commercial/Industrial—100-year, 1-hour storm or 2.25 inches of total rainfall;
- B. Residential with drained streets—100-year, 1-hour storm or 2.25 inches of total rainfall;

- C. Residential with streets drained onto lot—100-year, 6-hour storm or 3.05 inches of total rainfall;
- D. RV Parks—100-year, 1-hour storm or 2.25 inches of total rainfall;
- E. Mobile Home park with streets drained to a retention area—100-year, 1-hour storm or 2.25 inches of total rainfall. With streets drained onto mobile home spaces—100-year, 6-hour storm or 3.05 inches of total rainfall; and
- F. Other—100-year, 1-hour storm or 2.25 inches of total rainfall.

### **3.3 OFF-SITE DRAINAGE STANDARDS**

Drainage facilities, channels, grading and other improvements including underground pipe, inlets, catch basins, open drainage, ditches and washes, channels, pumps, lining, channelization, rip-rapping, basins, and erosion control systems for storm water from off-site areas which drain through or adjacent to the project shall:

- 3.3.1 Be sized adequately for the 100-year, peak flowrates and volumes from the entire contributing area;
- 3.3.2 Be contained within recorded tracts, rights-of-way, easements, or drainage ways;
- 3.3.3 If receiving runoff from public land, facilities or right-of-way, be contained within a public drainage easement;
- 3.3.4 Have a means for perpetual maintenance such as dedication and acceptance by the public, homeowners association or special improvement district;
- 3.3.5 Result in post-development peak discharges being equal to or less than pre-development peak discharges;
- 3.3.6 Result in post-development water surface elevations above and below being equal to or less than pre-development water surface elevations; and
- 3.3.7 Use no streets to carry offsite drainage.

### **3.4 ON-SITE DRAINAGE STANDARDS**

Drainage facilities, channels, grading and other improvements including underground pipe, inlets, catch basins, open drainage, ditches and washes, channels, pumps, lining, channelization, rip-rapping, basins, and erosion control systems for on-site drainage shall:

- 3.4.1 Be sized adequately to store, route, and dispose of storm water from the 100-year storm from the entire site;

- 3.4.2 Have the resulting damage potential to real property and hazard potential to human life assessed;
- 3.4.3 Be contained within recorded tracts, rights-of-way, easements, or drainage ways;
- 3.4.4 If receiving runoff from public land, facilities or right-of-way, be contained within a public drainage easement;
- 3.4.5 Have a means for perpetual maintenance such as dedication to the public, homeowners association or special improvement district; and
- 3.4.6 Result in post-development peak discharges being equal to or less than pre-development peak discharges.

### **3.5 RETENTION AND DETENTION FACILITY GENERAL STANDARDS**

In general, retention and detention facilities shall:

- 3.5.1 Limit peak discharges at the lower boundary of the proposed development to pre-development peak discharges;
- 3.5.2 Provide adequate storage for post-development discharges exceeding pre-development peak discharges of on-site runoff;
- 3.5.3 Have the contributing area and routing for each facility delineated;
- 3.5.4 Retain all the runoff contributing directly to it;
- 3.5.5 Have the runoff contributing to each facility calculated separately;
- 3.5.6 Consist of the following and may include other approved methods and areas:
  - A. Depressed areas or ponds,
  - B. Landscaped areas,
  - C. Yards and playgrounds,
  - D. Parks, golf courses and other open areas,
  - E. Vehicle parking areas,
  - F. Individual lots and parcels, and
  - G. Off-site retention basins, where a recordable easement for drainage purposes has been obtained;

- 3.5.7 Dispose of stored storm water runoff within 5 days which may be accomplished by the following or other approved methods:
  - A. Authorized pumping or controlled bleeding of the stored runoff into water courses, storm conduits or drainage ways in a judicious manner, after peak flows in those water courses have passed, or
  - B. In areas where depth to groundwater is greater than 10 feet and soils are classified by SCS Soil Survey as Soil Group A, percolation or infiltration directly into the ground or into dry wells for infiltration into sub-surface zones.
- 3.5.8 Be dedicated for drainage and public use if the basin receives storm water runoff from public right-of-way;
- 3.5.9 Be constructed at a minimum of one basin per 40 acres;
- 3.5.10 Have a positive method to drain the basin in the event the storage capacity of the basin is exceeded or the drainage system plugged such as standby pumps; and
- 3.5.11 Have clearly established maintenance provisions for the basin which are acceptable to the county engineer.

### **3.6 RETENTION AND DETENTION FACILITY DESIGN STANDARDS**

Retention and detention facilities shall be designed to have:

- 3.6.1 25% additional basin capacity over and above the design retention volume with no allowance for evaporation or percolation;
- 3.6.2 A minimum of 1 foot freeboard, above design capacity within the retention area;
- 3.6.3 In the case of an underground storm sewer there is to be a 1 foot minimum free board between the grate and the high water elevation;
- 3.6.4 Maximum side slope of 3:1 with a minimum bottom slope of 0.5% for grassed areas and 0.3% bottom slope for non-grassed areas draining to the sump or dry well;
- 3.6.5 Minimum bottom width is 10 feet;
- 3.6.6 An access ramp with a minimum width of 10 feet and a slope not to exceed 12% for vehicle access to the bottom;

- 3.6.7 Concrete flumes to transport water from the street into the basin are to be provided so the integrity of the banks and floors of the basin are preserved;
- 3.6.8 When deeper than four feet measured from the lowest finished adjacent grade, six foot high fencing or masonry wall with locked 16 foot wide gate;
- 3.6.9 In residential areas when the basin is not fenced, an irrigation sprinkler system and landscaping;
- 3.6.10 Where not located in areas with SCS Group A soils or depth to groundwater is less than 10 feet, controlled bleeding or pumping of the basin, using adequate permanent facilities, into an approved disposal facility unless approved by the County Engineer; and
- 3.6.11 A drywell and sump constructed in all retention basins with bleeding or pumping facilities.

### **3.7 INDIVIDUAL PARCEL RETENTION STANDARDS**

- 3.7.1 Projects using individual parcel retention shall meet the retention and detention facilities standards in Sections 3.5, & 3.6 as modified by the following standards:
  - A. One foot freeboard, additional 25% capacity above design retention volume, and minimum bottom width requirements may be omitted;
  - B. Percolation or infiltration directly into the ground or into dry wells for infiltration into sub-surface zones may be used to dispose of stored storm water runoff regardless of soil type and where depth to groundwater exceeds five (5) feet provided percolation test results are provided demonstrating that the retention area will drain within five (5) days;
  - C. The 100-year high water elevation of the retention area shall be lower than the lowest existing grade adjacent to the retention area unless a concrete or asphalt barrier is constructed around the retention area to prevent overland flow;
  - D. Individual parcels shall slope inward with adequate protection to retain storm water on the site;
  - E. Earthen berms shall only be used as a secondary method to reduce overland flow;
  - F. Parking lots and recreational vehicle placement areas within retention areas shall be paved or have a minimum of 3 inches of aggregate base material surfacing with the depth of retention of retention not exceeding 6 inches; and

- G. Dry wells are permitted to provide additional storage and to drain parking and asphalt areas.
- 3.7.2 Subdivision and park developments with individual parcel retention shall meet the retention and detention facilities standards in Sections 3.5, 3.6, & 3.7.1 and:
- A. In areas with soil Group A, as defined by the Soil Conservation Service, provide a minimum lot size of 14,500 square feet;
  - B. In areas with soils other than Group A, as defined by the Soil conservation Service, provide a minimum lot size of one acre;
  - C. When streets are drained to another location, minimum lot size can be reduced proportionately with the approval of the County Engineer;
  - D. Be located on existing ground slope less than two percent (2%) measured across the entire parcel at the maximum gradient;
  - E. Prohibit alteration of the final site ground elevations with retention depth and area requirements specified on the subdivision plat;
  - F. Position the retention at the front of each lot within a drainage easement (15-foot minimum) dedicated to the public to maintain capacity for street runoff retention;
  - G. Permit street runoff onto the drainage easement by maintaining clear openings through fences within the drainage easement (6 inch opening at 20 foot spacing minimum);
  - H. Limit the maximum design depth of storm water storage to nine (9) inches below top of curb or edge of pavement where no curbs exist;
  - I. Elevate finished floor elevations at least nine (9) inches above the centerline of the adjacent street at its lowest adjacent point;
  - J. Limit the retention area to the percentage of lot cover remaining after deducting the maximum lot or space coverage as defined in the Yuma County Zoning Ordinance; and

### **3.8 OPEN CHANNEL STANDARDS**

Open channels shall:

- 3.8.1 Convey the 100-year storm peak runoff within the banks;

- 3.8.2 Have erosion control if:
  - A. the velocity exceeds 5 fps, or
  - B. in sandy soil, the side slopes are greater than 3:1, or
  - C. there are rapid changes in channel geometry, or
  - D. the Froude number is greater than 0.80;
- 3.8.3 Utilize riprap or concrete channel drop structures to control the longitudinal slope of a drainage channel;
- 3.8.4 Utilize energy dissipating devices when the average velocity exceeds 10 fps;
- 3.8.5 Be designed to prevent silt deposition due to low velocities; and
- 3.8.6 When requested, provide an access and maintenance road dedicated to the public.
- 3.8.7 Be contained within recorded tracts, rights-of-way, easements, or drainage ways;

### **3.9 STORM DRAIN STANDARDS**

Storm drains systems shall:

- 3.9.1 Convey the 10-year runoff, minimum, at a maximum flow velocity of 15 fps;
- 3.9.2 Be at least 18 inches in diameter if for public use;
- 3.9.3 Be at least 12 inches in diameter if acting as bleed-off lines from a detention basin;
- 3.9.4 Be at least 6 inches in diameter if a pressurized main;
- 3.9.5 Utilize catch basins designed for 10 year runoff, minimum, in accordance with Drainage of Highway Pavements, Hydraulic Engineering Circular No. 12, U.S. Department of Transportation, Federal Highway Administration, latest revision;
- 3.9.6 Be contained in an easement if not in a public right-of-way;
- 3.9.7 Be designed with a minimum full flow velocity of 2 fps to prevent excessive silt deposition; and
- 3.9.8 Have inlet and outlet protection including:
  - A. Head and wing walls or a flare end section, and

- B. Riprap or concrete apron with energy dissipaters at all outlets designed for the flowrate and velocity.

### **3.10 CULVERT STANDARDS**

#### 3.10.1 Culverts shall:

- A. Convey the 50-year runoff, minimum, with a maximum ponding elevation two (2) feet below the finished centerline of the structure crossing the channel;
- B. At all-weather crossing, convey the 100-year runoff, minimum, with a maximum ponding elevation one (1) foot below the finished centerline of the structure crossing the channel;
- C. Be an 18 inches diameter round or a 22" X 13" arch or 23" X 14" elliptical culvert, minimum;
- D. Have dedicated easements for the culvert and resulting ponding;
- E. Not divert ponded water into another drainage area;
- F. If the outlets are not submerged, have riprapping with energy dissipaters, headwalls and other improvements as required to provide an erosion control system;
- G. If 60 inches or larger diameter; require concrete headwalls; and
- H. Not be permitted on major waterways.

3.10.2 Pond or dip crossings will only be permitted on local roads where an alternate, all-weather route into the area exists and after approval of the concept by the County Engineer. If such a crossing is permitted, roadway embankment slopes are to be protected with concrete armoring toed into the embankment and channel below the scour depth.

### **3.11 STREETS DRAINAGE STANDARDS**

Utilization of streets to collect and conveyance of drainage shall conform to the following standards.

- 3.11.1 The use of streets and roads for collection and movement of storm runoff water is a secondary function of the street and therefore is limited at the discretion of the County Engineer.
- 3.11.2 Arterial and collector streets are not to have more than ½ of through traffic lanes in either direction flooded during a ten year storm.

- 3.11.3 Minimum street grades for water transport with concrete gutters are to be a minimum of 0.20% and with asphalt surfacing a minimum of 0.30%.
- 3.11.4 The use of inverted streets will only be permitted if approved by the County Engineer. A six (6) foot wide concrete valley gutter will be required.
- 3.11.5 Concrete cross and valley gutters are to have a minimum of 0.20% grade.
- 3.11.6 The maximum velocity of flow of the deepest water in a street or parking lot should not exceed 10 fps.
- 3.11.7 Valley gutters are not allowed on arterial intersections unless approved by the County Engineer.
- 3.11.8 Roadside ditches are to have adequate capacity for the peak 10 year storm runoff. Where runoff exceeds the capacity of the ditch, a storm drain system is required.
- 3.11.9 When the secondary use of a street to transport drainage water collected on other streets is permitted, the 10 year design discharge is to be contained between the top of curbs. The following conditions also apply:
  - A. Adjacent lots are to be a minimum of 6 inches above top of curb and or right-of-way;
  - B. Flow is equally divided across the road cross section, not more than 6 inches deep with maximum allowable velocity of 5 fps;
  - C. 100-year discharge is contained between property lines without erosion;
  - D. Vertical curbs are used.

### **3.12 EROSION CONTROL SYSTEM STANDARDS**

Erosion control systems shall:

- 3.12.1 Consist of erosion easements and setbacks, channelization, flumes, lining, gabions, rip-rapping and concrete, energy dissipating devices, and other approved methods as required to prevent erosion and scour;
- 3.12.2 Extend below the scour depth and above the energy gradient line of the channel;
- 3.12.3 Prevent migration and subsidence of soil and erosion control materials with compaction, cutoff walls, filter fabric or other measures; and

3.12.4 Be designed in accordance with State Standard 7-98: State Standard for Watercourse Bank Stabilization and State Standard 5-96: State Standard for Watercourse System Sediment Balance.

3.12.5 Be reviewed individually and approved by County Engineer.

## **4.0 DRAINAGE REPORT & IMPROVEMENT PLANS STANDARDS**

### **4.1 GENERAL STANDARDS**

The preparation of drainage reports and grading improvement plans shall be prepared by an Arizona registered civil engineer or architect following the procedures given in this section. Work within public right-of-way shall be prepared by an Arizona registered civil engineer.

4.1.1 Drainage reports and grading plans are to include hydrologic and hydraulic calculations delineating the watershed and showing how storm and flood water will be controlled in accordance with Section 3 of these regulations.

4.1.2 At a minimum, drainage reports and grading improvement plans shall include the following sections:

- A. Project Description,
- B. Off-site Drainage,
- C. On-site Drainage,
- D. Retention/Detention, and
- E. Supporting Technical Data.

4.1.3 The drainage report is to be accompanied with a grading plan and improvement plans, showing proposed improvements for handling the storm and flood water as outlined in Section 4.7. The drainage report may be presented on the grading plans.

4.1.4 Drainage report and grading plans shall conform to these Public Works Standards and all applicable federal, state and county laws, ordinances, codes, regulations, and standards.

### **4.2 PROJECT DESCRIPTION**

4.2.1 Drainage reports are required to include a project description and overview section.

4.2.2 The following information shall be provided on the grading plans or in the project description section:

- A. Owner's Name, Address, and Phone Number;
- B. Engineer's Name, Address, and Phone Number;

- C. Parcel Location and Vicinity Map – Describe location by Assessor’s Parcel Identification Number and/or township, range, section and quarter section and a vicinity map showing local streets, channels and washes within and adjacent to the project and name surrounding developments;
- D. Existing Site Description – Describe the existing site conditions including the general description, total area, dimensions, drainage pattern & terrain type, existing structures, existing drainage facilities, floodplain zone pursuant to FEMA, and soil type with percolation rate; and
- E. Project Description – Provide general description of the proposed development and method used to control the runoff and erosion including total drainage area, dimensions, proposed drainage pattern & terrain, proposed structures and drainage facilities, and proposed modifications to the floodplain.

**4.3 OFF-SITE DRAINAGE**

- 4.3.1 Drainage reports are required to include an off-site drainage section whenever off-site drainage enters the site, the site is traversed by or is adjacent to a channel or wash, or the project alters off-site drainage.
- 4.3.2 The following information and calculations shall be provided on the grading plans or in the off-site drainage section:
  - A. Identify which methods are used for hydrologic and hydraulic computations and identify the design frequency;
  - B. If computer models are used for hydrologic and hydraulic computations, identify the name of the software, version, and provide an electronic copy of the input and output files;
  - C. Describe and map to scale the off-site contributing drainage areas for each wash or drainage way affected by the project at pre- and post-development status;
  - D. Provide topographic contours on the grading plans with maximum contour intervals as follows:

<b>SLOPE</b>	<b>INTERVAL</b>
0-2%	2 feet
3-9%	5 feet
10% and greater	10 feet;

- E. Locate and show on the grading plans all natural and man-made drainage ways and patterns;
  - F. Show how the values were determined for all variables and factors used in the various calculations;
  - G. Indicate how all assumptions were determined;
  - H. Show cross-sections of washes and drainage ways including hydraulic computations to show velocity, quantity and water surface elevations at the narrowest sections, transition points, and outflows of the project and at other critical points;
  - I. Indicate the path chosen for computation of time of concentration; and
  - J. Tabulate pertinent data and state conclusions.
- 4.3.3 When all storm drainage water is to be retained on-site, no off-site drainage water enters the site, and the site does not contain or adjoin a channel or wash, the drainage report and plans may demonstrate and state:
- A. There is no off-site drainage entering the site and
  - B. All storm water generated from the site will be retained on the site.

In this case, the off-site drainage section may be omitted.

#### **4.4 ON-SITE DRAINAGE**

- 4.4.1 Drainage reports are required to include an on-site drainage section.
- 4.4.2 The following information and calculations shall be provided on the grading plans or in the on-site drainage section:
  - A. Identify which methods are used for hydrologic and hydraulic computations and identify the design frequency in accordance with Sections 3.2, 3.4, & 3.5;
  - B. If computer models and/or software are used, identify the name of the software, version, and provide an electronic copy of the model input and output files;
  - C. Describe the pre- and post-development contributing drainage areas including dimensions, routing, flow direction and determine total runoff volume, flowrate, velocity, and depth from each drainage area;

- D. Determine the 100-year high-water elevation for the drainage area as:
1. At least the regulatory flood elevation, if applicable,
  2. At least the water surface elevation of new permanent retention facilities, if applicable, and
  3. The lowest of either the centerline of the adjacent road and the elevation of the adjacent property;

E. Provide topographic contours on the grading plans with maximum contour intervals as follows:

<b>SLOPE</b>	<b>INTERVAL</b>
0-2%	2 feet
3-9%	5 feet
10% and greater	10 feet;

- F. Provided hydraulic calculations and cross-sections of gutters, streets, drainage ways and other water transport facilities at critical and other point as necessary and as directed by the County Engineer;
- G. If all storm drainage water is to be retained on the site, a statement to this effect must be included in the report;
- H. Indicate how any assumptions were determined;
- I. Indicate the path used for computation of time of concentration;
- J. Show catch basin, inlet and underground pipe calculations;
- K. Explain the effects of drainage upon streets including proposed high-water elevations related to top of curb and flow within right-of-way;
- L. Show how values were determined for all variables and factors;
- M. Explain the effects of drainage upon proposed building finished floor elevations;
- N. Tabulate pertinent data and state conclusions; and
- O. Tabulate the velocity and flow rate in drainage ways for the post development condition, and the difference from the pre-development condition.

- 4.4.3 If on-site runoff is discharged directly into a storm drain facility, drainage channel, wash, or other drainage facility or onto another parcel of land, the following shall be provided:
- A. A copy of a recorded agreement or easement from the owner authorizing use the facility or parcel of land for drainage;
  - B. Adequate capacity shall be demonstrated; and
  - C. Post-development peak flows within drainage channels and washes shall not exceed pre-development peak flows (Detention facilities are required if pre-development peak flows are exceeded).
- 4.4.4 When all storm drainage water is to be retained on-site, no off-site drainage water enters the site, and the site is not traversed or adjoined by a channel or wash, the drainage report and grading plans may demonstration and state:
- A. There is no off-site drainage entering the site, and
  - B. All storm water generated from the site will be retained on the site.

In this case, calculations for pre-development on-site drainage may be omitted.

## **4.5 RETENTION/DETENTION**

- 4.5.1 Drainage reports are required to include a retention/detention section when detention and/or retention basins are included in the design.
- 4.5.2 The following calculations and information shall be provided on the grading plans or in the retention/detention section:
- A. Describe the proposed detention and/or retention concept including a description of the location with volumes, depths, and dimensions;
  - B. Determine the rate of inflow into the basin and the maximum permitted release rate from the facility;
  - C. Determine the storage volume required;
  - D. Show the proposed basin capacity, depth, and elevations including free board or additional basin capacity;
  - E. Describe the method of controlled bleeding or pumping the basin, including discharge rates;

- F. Show how the values were determined for all variables and factors used in calculations.
- G. Indicate how any assumptions were determined; and
- H. Tabulate pertinent data and state conclusions.

#### **4.6 SUPPORTING TECHNICAL DATA**

- 4.6.1 Drainage reports are required to include supporting technical data.
- 4.6.2 Supporting technical data shall provide all documentations, data, assumptions, calculations, analyses, and results necessary to support and reproduce the findings of the drainage report.

#### **4.7 IMPROVEMENT PLAN STANDARDS**

- 4.7.1 Plans shall conform to Public Works Standards No. 1-010 and No. 1-030.
- 4.7.2 Plans and details shall show:
  - A. Existing site conditions and proposed development including buildings, finished floors, sidewalks, curbs, gutters, drainage patterns, grades, surfacing, parking areas, streets, landscaping, ditches, channels, basins, inlets, outlets, grates, grade breaks, inverts, erosion control, and other improvements affecting the drainage;
  - B. Slopes on streets, curbs, gutters, channels, ditches, and other improvements conveying runoff;
  - C. All dimensions;
  - D. Routing of water to retention areas;
  - E. The new 100-year water surface elevations;
  - F. All construction details; and
  - G. Property lines, lot numbers, survey ties to the closest record monument, and basis for grade elevations;
- 4.7.3 Unless otherwise noted on the project plans, drainage and flood control work is to be constructed in accordance with the Yuma County Public Works Construction Standards.

# **APPENDICES**

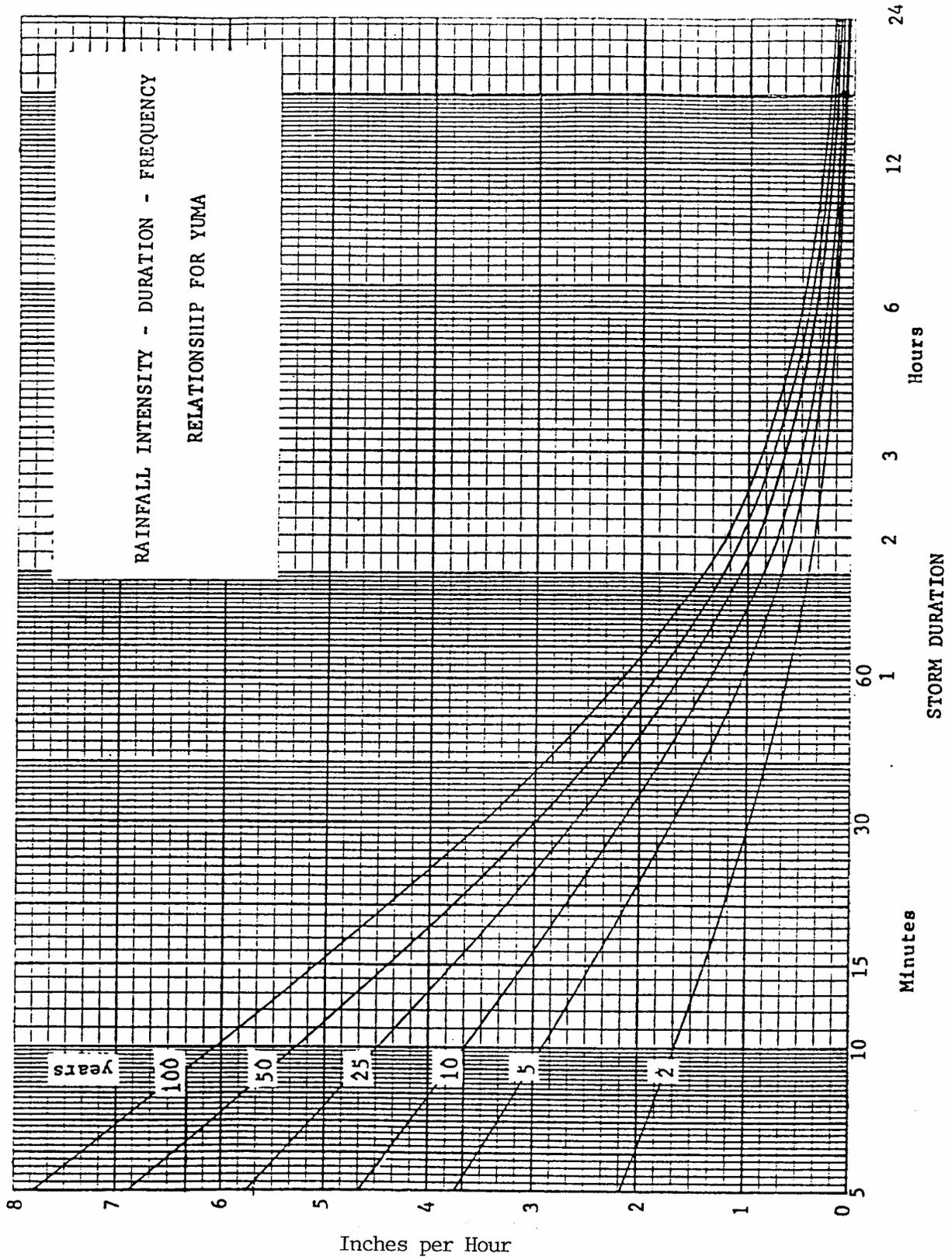
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# **APPENDIX A**

## **Rainfall Intensity-Duration-Frequency Relationship for Yuma, Arizona**

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# RAINFALL INTENSITY



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# APPENDIX B

## Non-Dimensional Storm Rainfall Distribution

Ratio of Time to Storm Duration	Ratio of Accumulated Precipitation to Total Storm Precipitation	Ratio of Time to Storm Duration	Ratio of Accumulated Precipitation to Total Storm Precipitation
0.0000	0.0000	0.5167	0.7351
0.0167	0.0042	0.5333	0.7647
0.0333	0.0086	0.5500	0.7830
0.0500	0.0130	0.5667	0.8031
0.0667	0.0176	0.5833	0.8197
0.0833	0.0223	0.6000	0.8343
0.1000	0.0272	0.6167	0.8475
0.1167	0.0322	0.6333	0.8593
0.1333	0.0374	0.6500	0.8701
0.1500	0.0428	0.6667	0.8801
0.1667	0.0483	0.6833	0.8891
0.1833	0.0541	0.7000	0.8977
0.2000	0.0601	0.7167	0.9057
0.2167	0.0664	0.7333	0.9133
0.2333	0.0729	0.7500	0.9206
0.2500	0.0797	0.7667	0.9274
0.2667	0.0869	0.7833	0.9339
0.2833	0.0945	0.8000	0.9401
0.3000	0.1026	0.8167	0.9461
0.3167	0.1112	0.8333	0.9519
0.3333	0.1203	0.8500	0.9574
0.3500	0.1303	0.8667	0.9627
0.3667	0.1411	0.8833	0.9679
0.3833	0.1530	0.9000	0.9729
0.4000	0.1662	0.9167	0.9777
0.4167	0.1808	0.9333	0.9824
0.4333	0.1995	0.9500	0.9870
0.4500	0.2227	0.9667	0.9914
0.4667	0.2544	0.9833	0.9958
0.4833	0.3593	1.0000	1.0000
0.5000	0.6632		

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# APPENDIX C

## Runoff Curve Numbers by Soil Type & Zoning Classification

Zoning Classification/Land Use			SCS Soil Classification			
Yuma County	City of Yuma	City of Somerton	A	B	C	D
HI, LI, II	H-I, L-I	M	91	93	95	96
C-1, C-2, RC	B-2	C	91	93	95	96
R-2, R-3	TR, B-1	R-3	86	88	90	92
RVP	MH	TR	82	89	91	93
RVS	MH	TR	82	88	90	92
MHP	MH	TR	84	88	90	92
MHS 4.5, MHS 6	MH	TR	84	87	90	92
R-1-6	R-MH	R-1	81	87	90	92
R-1-8, MHS 8	R-A	R-1	79	85	89	92
R-1-12, MHS 10, MHS 12	RE-12	R-1	77	85	88	92
R-1-20, MHS 15, MHS 20	RE-18	R-1	75	84	87	91
R-1-40	RE-35	R-1	73	81	86	89
SSB & SR	SR	RA	72	81	85	88
1, 2, 3, 4, 5, 10, 20	AG	A	71	80	85	88
RA 5, 10, 20, 40	Desert	Desert	70	81	88	90
Desert	Desert	Desert	70	81	88	90
Parks	Parks	Parks	60	75	83	87

Yuma County Zoning Abbreviation	Zoning District Title	Minimum Lot Size
HI	Heavy Industrial	8,000 sq. ft.
LI	Light Industrial	8,000 sq. ft.
II	Intensive Industrial	40,000 sq. ft.
C-2	Commercial (General)	8,000 sq. ft.
C-1	Commercial (Local)	8,000 sq. ft.
RC	Residential Commercial	8,000 sq. ft.
R-3	High Density Residential	2,000 sq. ft.
R-2	Intermediate Density Residential	4,000 sq. ft.
RVP	Recreation Vehicle Park	1,200 sq. ft.
RVS	Recreational Vehicle Subdivision	2,400 sq. ft.
MHP	Mobile Home Park	3,200 sq. ft.
MHS-4.5	Mobile Home Subdivision	4,500 sq. ft.
MHS-6	Mobile Home Subdivision	6,000 sq. ft.
MHS-8	Mobile Home Subdivision	8,000 sq. ft.
MHS-10	Mobile Home Subdivision	10,000 sq. ft.
MHS-12	Mobile Home Subdivision	12,000 sq. ft.
MHS-15	Mobile Home Subdivision	15,000 sq. ft.
MHS-20	Mobile Home Subdivision	20,000 sq. ft.
R-1-6	Low Density Residential	6,000 sq. ft.
R-1-8	Low Density Residential	8,000 sq. ft.
R-1-12	Low Density Residential	12,000 sq. ft.
R-1-20	Low Density Residential	20,000 sq. ft.
R-1-40	Low Density Residential	40,000 sq. ft.

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<b>Yuma County Zoning Abbreviation</b>	<b>Zoning District Title</b>	<b>Minimum Lot Size</b>
SR-1	Suburban Ranch	1 acre
SR-2	Suburban Ranch	2 acres
SR-3	Suburban Ranch	3 acres
SR-4	Suburban Ranch	4 acres
RA-5	Rural Area	5 acres
RA-10	Rural Area	10 acres
RA-20	Rural Area	20 acres
RA-40	Rural Area	40 acres
SSB-1	Suburban Site Built	1 acre
SSB-2	Suburban Site Built	2 acres
SSB-3	Suburban Site Built	3 acres
SSB-4	Suburban Site Built	4 acres
SSB-5	Suburban Site Built	5 acres
SSB-10	Suburban Site Built	10 acres
SSB-20	Suburban Site Built	20 acres

# APPENDIX D

## Rational Method Hydrologic Design Data Sheet

**DRAINAGE AREA:** \_\_\_\_\_

### AREA CHARACTERISTICS

Land Use	“C” Factor	Area (Acres)	C x A
Low Density Residential (1 to 4 Dwellings per acre)	.39		
Medium Density Residential (4+ Dwellings per acre)	.43		
High Density Residential (Apartments)	.51		
Mobile Home Parks	.51		
Parks	.20		
Agricultural	.12		
Streets	.90		
Commercial & Industrial	.80		
<b>Total</b>	---		

Weighted “C” =  $\frac{\sum C \times A}{\sum A}$  = \_\_\_\_\_ = \_\_\_\_\_

### FLOW PATH & TIME OF CONCENTRATION

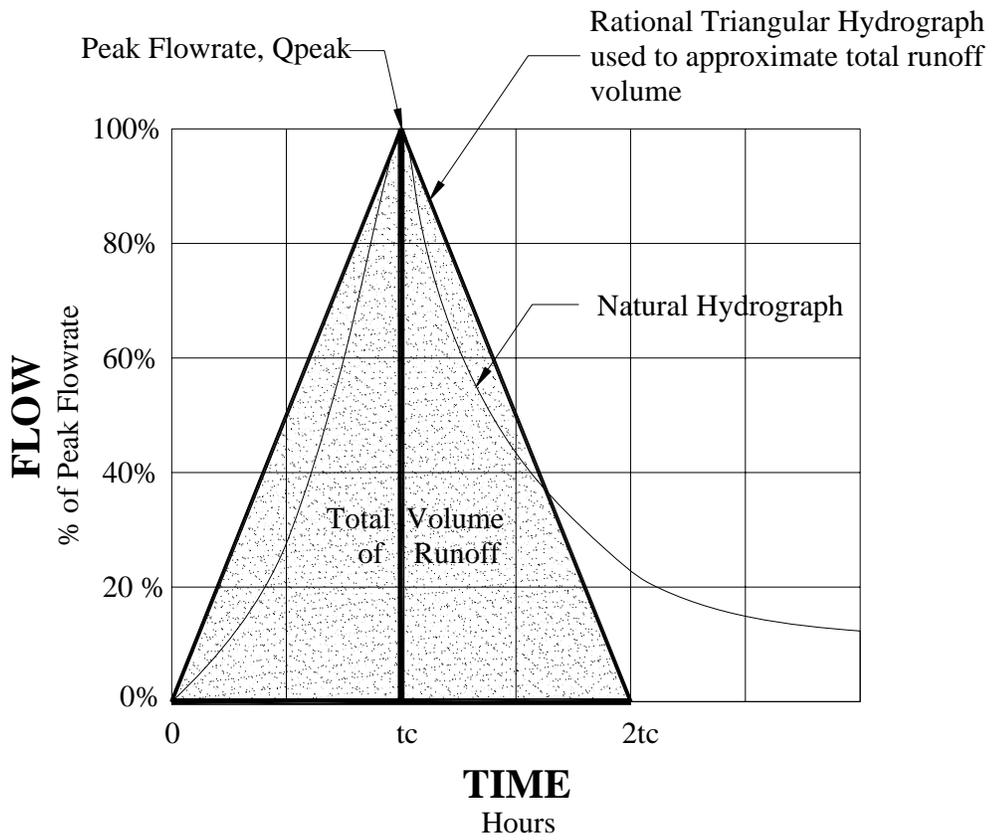
Reach	Length (ft)	Upper Elevation	Lower Elevation	Mean Slope	Channel Type	Velocity (ft/min)	Time of concentration (min.)
<b>Total</b>							

### RAINFALL AND RUNOFF

<b>Recurrence Interval (Years)</b>			<b>10</b>			<b>100</b>
<b>Intensity, I, (in/hr)</b>						
<b>Peak Flowrate Q<sub>peak</sub> = CIA (cfs)</b>						
<b>Q (cfs) provided by structure</b>						

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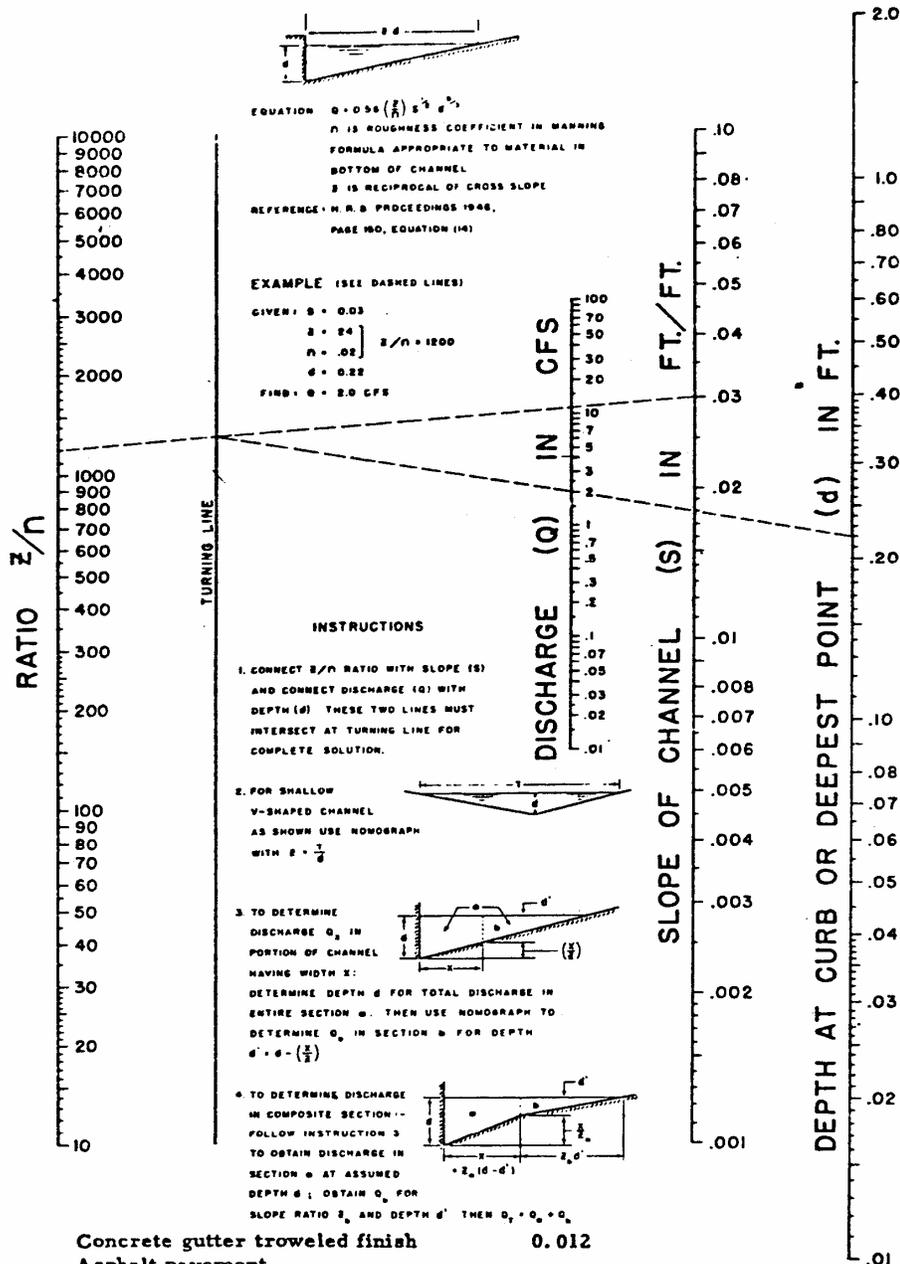




# **APPENDIX F**

## **Nomograph for Flow in Triangular Channels**

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Concrete gutter troweled finish	0.012
Asphalt pavement	
(1) Smooth texture	0.013
(2) Rough texture	0.016
Concrete gutter with asphalt pavement	
(1) Smooth	0.013
(2) Rough	0.015
Concrete pavement	
(1) Float finish	0.014
(2) Broom finish	0.016
	0.016

For gutters with small slope where sediment may accumulate, increase all above values of "n" by 0.002.

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

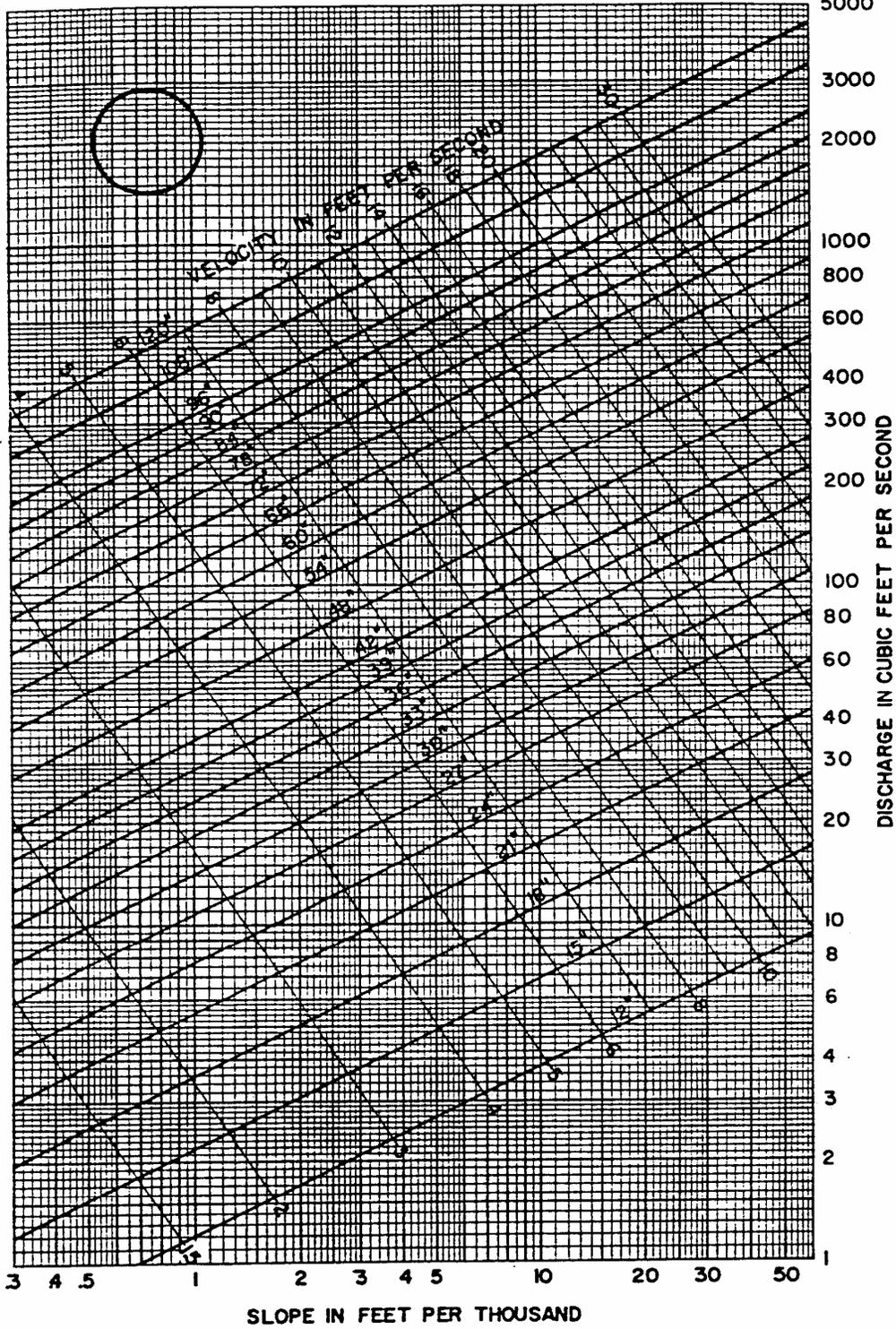
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# **APPENDIX G**

## **Nomograph for Flowing Full Pipe Capacities**

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COMPUTED FROM MANNING'S FORMULA  
 $n=0.012$



SLOPE IN FEET PER THOUSAND

PIPE CAPACITIES  
FLOWING FULL

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# APPENDIX H

## Individual Parcel Retention Basin Design Data Sheet

This design data sheet may be used to calculate the total volume required for individual parcel retention basins.

### Design Storm

Duration: \_\_\_\_\_ hour  
Total Rainfall: \_\_\_\_\_ inches

Drainage Area # \_\_\_\_\_

Area of Drainage: \_\_\_\_\_ ft<sup>2</sup>

### Required Retention Volume

The required retention for individual parcels is the total volume of storm precipitation falling on the entire parcel. The volume can be calculated using:

$$\begin{aligned} \text{Required Volume (ft}^3\text{)} &= \text{Total Rainfall (inches)} \times \text{Total Area (sq. ft.)} \times (1 \text{ ft} / 12 \text{ inches}) \\ &= \text{_____} \times \text{_____} \times 1/12 \\ &= \text{_____} \text{ ft}^3 \end{aligned}$$

Note: The 1.25 safety factor and one (1) foot freeboard requirement is not required for individual parcel retention.

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