

# **RULES, REGULATIONS, & GUIDELINES**



## **BRAZORIA DRAINAGE DISTRICT NO. 4**

Approved and adopted at a regular DISTRICT meeting on November 4, 2025  
Effective date: December 1, 2025.



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# **PREFACE**

BRAZORIA DRAINAGE DISTRICT NO. 4 is a political subdivision of the State of Texas. Its mission is to control and distribute the storm and floodwaters within its jurisdiction pursuant to Article III, Section 52 of the Texas Constitution, Chapters 49 and 56 of the Texas Water Code and all special legislation pertaining to the DISTRICT.

To achieve its mission, the Board of Commissioners has directed that the DISTRICT:

1. Develop sound fiscal procedures to protect taxpayer monies, including implementation of an appropriate tax rate that does not place an undue burden on taxpayers.
2. Design near-term and long-term goals and objectives.
3. Establish guidelines for land development that has the potential to impact the distribution of storm and floodwaters.
4. Schedule labor force and equipment to meet maximum efficiencies and use thereof.
5. Report plans and program progress to the public through appropriate entities.
6. Execute projects to mitigate flooding within the DISTRICT.



# STATEMENT OF AUTHORIZATION

WHEREAS BRAZORIA DRAINAGE DISTRICT NO. 4, (the "DISTRICT") is lawfully and duly constituted, operates under applicable articles of the Texas Constitution, State Statutes, including but not limited to the Texas Water Code, special legislation, and rules and regulations duly adopted by the DISTRICT's Board of Commissioners; and

WHEREAS a decided need exists for adoption, promulgation, application, and enforcement of uniform standards, Rules, Regulations & Guidelines affecting development within the boundaries of the DISTRICT; and

WHEREAS the aforementioned Rules, Regulations & Guidelines have been duly considered and adopted by the Board of Commissioners of the DISTRICT; and

WHEREAS said duly adopted Rules, Regulations & Guidelines are available at the DISTRICT's offices at 4813 W. Broadway, Pearland, Texas 77581, and are entitled, BRAZORIA DRAINAGE DISTRICT NO. 4 Rules, Regulations & Guidelines; and

WHEREAS said Rules, Regulations & Guidelines are readily available to the public and all persons who may be affected by the same; and

WHEREAS said Rules, Regulations & Guidelines are reasonably related to the provision of adequate drainage and flood control for the citizens of and property within the DISTRICT; and

WHEREAS said Rules, Regulations & Guidelines regulate the impact of man-made drainage from any private property into the DISTRICT's facilities to ensure that the DISTRICT's facilities are capable of handling said artificial runoff and to avoid harm to the DISTRICT's facilities and pre-existing property and/or persons; and

WHEREAS said Rules, Regulations & Guidelines use generally accepted engineering criteria; and

WHEREAS the DISTRICT seeks compliance with applicable statutes, articles, and rules of the State of Texas, and its agencies requiring notice, publication, and administrative compliance prior to certain enforcement of its Rules, Regulations & Guidelines; and

WHEREAS the DISTRICT hereby finds and determines that the adoption of the Rules, Regulations, & Guidelines is exempted from the requirements of the Private Real Property Rights Preservation Act, Tex. Gov't. Code Ann. Gov't. Code Ann. §2007.001, et. seq. (the "Act") by virtue of the exceptions set out in section §2007.003 (b) of the Act and/or by virtue of the exceptions set out in Tex. Water Code Ann. §49.212 and/or that there is no private real property impact or taking which will result from any of said actions and therefore, no takings impact assessment will be required; and

WHEREAS, the DISTRICT held a public hearing on November 4, 2025, at which time said Rules, Regulations, & Guidelines were presented to the public for review and comment; now therefore,

BE IT RESOLVED that the facts and matters set forth in the preamble hereof are true and correct.

BE IT FURTHER RESOLVED that the DISTRICT, by and through its duly elected Board of Commissioners, having considered all of the facts attendant to adoption and enforcement of its Rules, Regulations & Guidelines, hereby adopts these Rules, Regulations & Guidelines as authorized by Section 49.211 of the Texas Water Code.

BE IT FURTHER RESOLVED that these Rules, Regulations & Guidelines and its appendices shall constitute a component part of the DISTRICT's Master Drainage Plan, entitled Flood Protection Plan for BRAZORIA DRAINAGE DISTRICT NO. 4, as authorized by Section 49.211(c) of the Texas Water Code, and shall become effective and enforceable within the DISTRICT's boundaries on the December 1, 2025.

BE IT FURTHER RESOLVED that a certified copy of this STATEMENT OF AUTHORIZATION shall be filed in the official Public Records of Brazoria County, Texas.

PASSED, APPROVED and ADOPTED on this 4th day of November, 2025.

BRAZORIA DRAINAGE DISTRICT NO. 4

\_\_\_\_\_  
JEFFREY H. BRENNAN  
CHAIRMAN

\_\_\_\_\_  
SCOTT FEULESS  
SECRETARY

\_\_\_\_\_  
ADRIAN HERNANDEZ

COMMISSIONER

Attest:

\_\_\_\_\_  
JOHN GENARO  
SUPERINTENDENT

# INTRODUCTION

The DISTRICT and its surrounding areas are drained by seven (7) major drainage arteries which run through the DISTRICT: CLEAR CREEK, HICKORY SLOUGH, MARY'S CREEK, COWARD (aka COWART) CREEK, CHIGGER CREEK, MUSTANG BAYOU, and CHOCOLATE BAYOU. Land located in the vicinity of, but not directly located on one of these major drainage arteries, is generally drained by man improved or man-made ditches and / or storm sewers, which convey the rainfall runoff to a major drainage artery.

Responsibility for provision and maintenance of drainage facilities is uniquely divided between the incorporated cities within the DISTRICT, Brazoria County, and the DISTRICT in the following manner:

Incorporated cities are generally responsible for underground storm sewers, open roadside ditches, and all roadside ditches that have been covered with the construction of various size pipes set at the roadside ditch grade, and regional detention facilities constructed and accepted by the City all within the boundaries of the city.

Brazoria County is generally responsible for underground storm sewers, open roadside ditches, and all roadside ditches that have been covered with the construction of various size pipes set at the roadside ditch grade, all outside the boundaries of a city.

The DISTRICT is generally responsible for the seven major drainage arteries listed above, all DISTRICT maintained tributary drainage ditches, and all regional, sub-regional, facilities as cited in inter-local agreements, and other detention reservoirs constructed in accordance with these criteria and accepted by the DISTRICT for maintenance, all within the boundaries of the DISTRICT.

The DISTRICT was created and organized to manage these drainage arteries within its boundaries. The DISTRICT's Board of Commissioners is charged with the responsibility of developing policies and enacting resolutions to facilitate the intent as well as implement the laws of the State of Texas and the DISTRICT's Master Drainage Plan, entitled Flood Protection Plan for BRAZORIA DRAINAGE DISTRICT NO. 4, ("Flood Protection Plan") as authorized by Section 49.211(c) of the Texas Water Code.

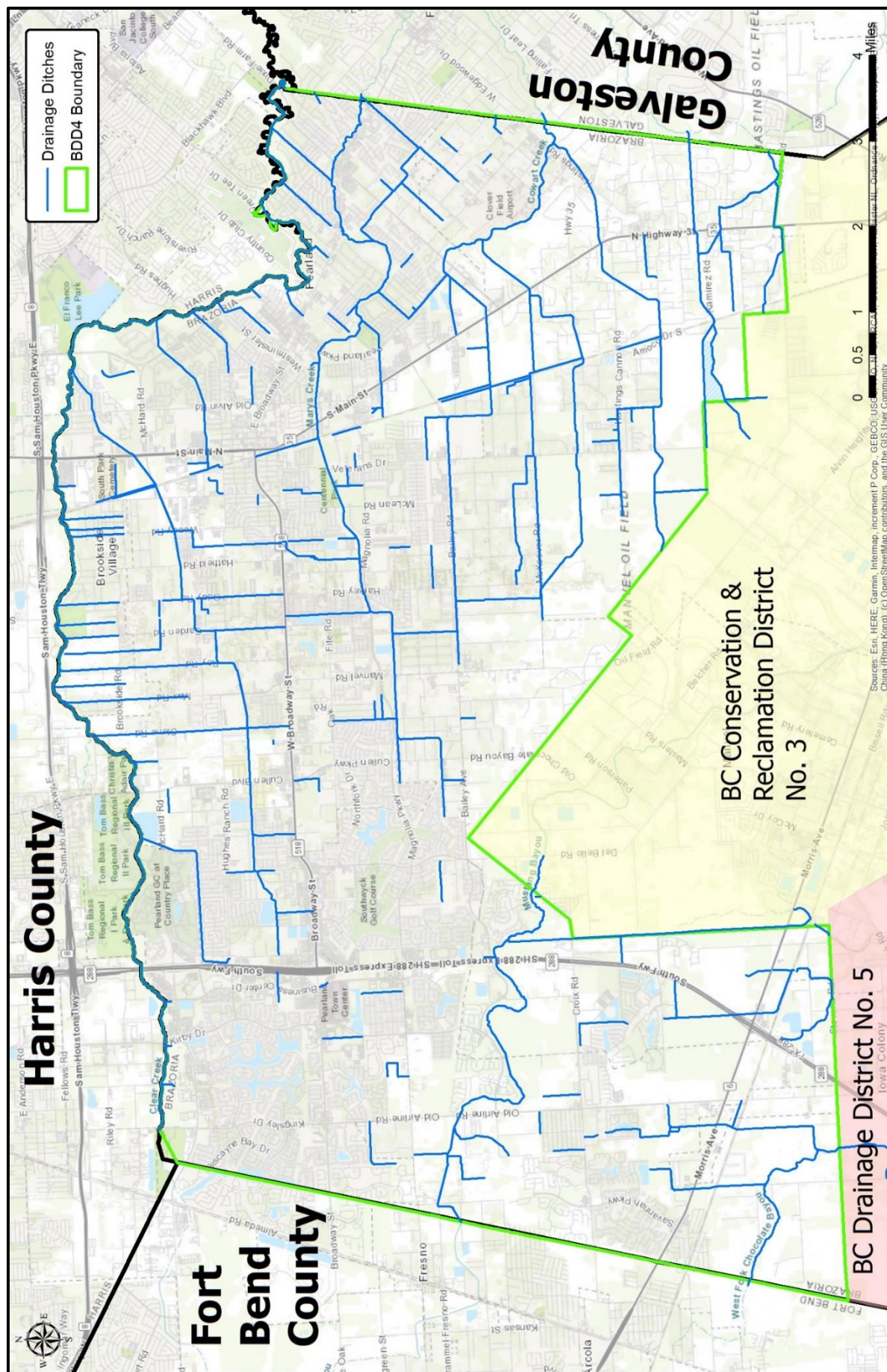
The DISTRICT's Flood Protection Plan for the area within its jurisdiction identifies easements and/or fee strips needed along its creeks, bayous, streams, gullies, and ditches, as well as channel design and size for the major drainage arteries and tributary drainage ditches as they are improved.

The following Rules, Regulations & Guidelines and its appendices shall constitute a component part of the DISTRICT's Flood Protection Plan and the DISTRICT's Flood Protection Plan shall constitute a component part of the DISTRICT's Rules, Regulations & Guidelines. The following Rules, Regulations & Guidelines apply within the jurisdictional boundaries of the DISTRICT and address, among other subjects, the preparation of drainage plans for the development of land within the DISTRICT's jurisdiction, taking into consideration waters flowing from the property as a result of said development and the impact these waters have on the DISTRICT's drainage facilities beyond what was experienced in the property's pre-development state.

The purpose of these Rules, Regulations & Guidelines is to a) provide for the efficient, consistent and orderly development and maintenance of drainage facilities within the DISTRICT's jurisdiction by applying generally accepted engineering criteria, and b) establish factual and scientific data required for

planning and designing future drainage facilities, in order to achieve adequate retention, detention, and conveyance of storm and flood waters through the DISTRICT's jurisdiction.

These Rules, Regulations & Guidelines, followed in conjunction with the rules, regulations, guidelines, ordinances, and criteria manuals concerning development of governmental entities which share concurrent jurisdiction with the DISTRICT, provide information and instruction necessary for creating drainage plans that will promote the orderly development of land within the District while protecting the health and safety of citizens and property within the DISTRICT's jurisdiction. In instances where the requirements contained herein conflict with the requirements of other agencies with authority, the most stringent requirement shall apply.



## DISTRICT WEBSITE

The DISTRICT has a website [www.bdd4.org](http://www.bdd4.org) for the purposes of providing information which would typically include the following:

- Rules, Regulations, and Guidelines
- Standard DISTRICT notes and details
- DISTRICT meeting dates and submittal deadlines
- DISTRICT meeting agendas
- DISTRICT meeting minutes
- Standard DISTRICT forms
- Fee Schedules
- Other pertinent policies

Additionally, the current procedures for obtaining plan and plat approval are contained on the website.

# **SECTION 1 – GENERAL REQUIREMENTS AND OVERVIEW**

## **A. POLICY STATEMENT**

The DISTRICT, by these Rules, Regulations & Guidelines, assumes and exercises its authority as provided by law and does not in any way infringe upon the express or implied rights or obligations of any other governmental entity which shares concurrent jurisdiction with the DISTRICT. It is not the DISTRICT's intent to usurp the powers or authority of any other governmental entity by exercising its own authority.

## **B. DRAINAGE PLAN**

It is the expressed intent of the DISTRICT to control flooding and detain excess runoff from land within its boundaries. To that end, these Rules, Regulations & Guidelines serve to provide the means of zero downstream impact (ZDI) after development. The terms "develop" and "development" herein include (i) the subdivision of land for purposes of laying out streets, lots, alleys, or public works, (ii) the construction of permanent improvements and all appurtenances thereto, including, but not limited to, any and all impervious cover constructed to support such improvements, and (iii) the redevelopment of land.

An owner of property within the District shall prepare and submit to the DISTRICT a Final Drainage Plan prior to development of the property. A Final Drainage Plan must be filed and approved by the District prior to commencement of construction. The DISTRICT also requires the following:

1. The Preliminary Drainage Plan (if needed) and Final Drainage Plans shall define the method of moving rainfall runoff from the development to the appropriate drainage artery and comply with the requirements and specifications as contained in these Rules, Regulations, & Guidelines.
2. No property may be developed within the jurisdiction of this DISTRICT unless the property owner has obtained the DISTRICT's approval of a Final Drainage Plan as provided in Section 7 of these Rules, Regulations, & Guidelines.
3. All drainage systems and detention facilities shall be constructed in strict compliance with the approved Final Drainage Plan for the property, regardless as to whether that plan was originally approved by the District, the City of Manvel, the City of Pearland, or other authorized overlapping jurisdiction. Property that has been developed without approval of a Final Drainage Plan or not in accordance with an approved Final Drainage Plan shall be considered to be non-compliant with these Rules, Regulations, & Guidelines. An owner of non-compliant property shall be responsible for constructing and maintaining any and all necessary drainage facilities to bring the property into compliance with a Final Drainage Plan and these Rules, Regulations, & Guidelines. The DISTRICT may exercise its enforcement procedures hereunder against the owner of non-compliant property, regardless of whether the current owner engaged in the original development or any redevelopment of the property.
4. The DISTRICT may conduct periodic inspections of all projects being constructed within the DISTRICT. See Section 27.



5. Within thirty (30) days of the earlier of completion of the project that is subject to the Final Drainage Plan or the completion of all drainage structures included in the Final Drainage Plan, the property owner shall submit to the DISTRICT a certification signed by a Texas Registered Professional Engineer that the project has been constructed in accordance with the approved Final Drainage Plan along with a digital copy of the 'As-Built' drawings. A property owner must also submit an as-built survey signed and sealed by a State of Texas Registered Professional Land Surveyor, a point file, and a DWG file for any detention ponds.
6. Upon notification by the property owner, the DISTRICT shall conduct a final construction inspection and notify the owner (or designee) in writing of any deficiencies. The owner (or designee) shall notify the DISTRICT when all deficiencies have been corrected and a subsequent inspection will be conducted. If all deficiencies have been corrected, a Certificate of Compliance will be issued.

## **C. DATUM**

The DISTRICT shall use its Flood Protection Plan or Master Drainage Plan, as amended, to determine which creeks, bayous, streams, gullies, and ditches are governed by the DISTRICT, and to determine the easements or fee strips required along such creeks, bayous, streams, gullies, and ditches for the DISTRICT's access and maintenance of its drainage facilities. All drainage plan elevations utilized in connection with submittals to the District shall correspond with and be the datum used on the latest FEMA Floodplain Maps, as currently amended.

## **D. REVIEW AND APPROVAL**

Review and approval by the DISTRICT for the following items are required as described below:

### **1. DRAINAGE IMPACT ANALYSIS**

A Drainage Impact Analysis typically includes a written report, exhibits, output data, hydrologic models, and / or hydraulic models for the purpose of ensuring compliance with the DISTRICT's Zero Downstream Impact (ZDI) policy.

Drainage Impact Analyses require Board approval. Once a Drainage Impact Analysis has been approved, all Plats and Drainage Plans for development within the service area for that study must be in accordance with the approved Drainage Impact Analysis on file at the DISTRICT office. Deviation will only be allowed once the Board has approved a revised Drainage Impact Analysis.

See Section 4 for the Drainage Impact Analysis submittal requirements.

### **2. MASTER DEVELOPMENT PLAN**

A Master Development Plan presents the applicant's proposed layout for a phased development on larger tracts of land. For the purposes of the DISTRICT, the Master Development Plan will ensure continuity of the completed detention and drainage system, and includes the incorporation of DISTRICT facilities into the development. This plan will also show proposed drainage easements and access easements required for DISTRICT drainage facilities.

Phased development on tracts that are 50 acres or larger require Board approval of a Master Development Plan as a pre-requisite to receiving approval for plats or plans for the individual phases of development. See Section 5 for the Master Development Plan submittal requirements.



### 3. PRELIMINARY DRAINAGE PLAN

In some instances, the review and approval processes of other agencies may require that the Engineer show evidence of Preliminary Drainage Plan approval from this DISTRICT. Preliminary Drainage Plan review and approval (when needed) will be completed by the DISTRICT Engineer and Staff and does not require Board approval.

The Preliminary Drainage Plan shall present the applicant's overall approach to moving storm water runoff from the development to the appropriate drainage artery without an adverse impact occurring downstream. In particular, the Preliminary Drainage Plan must show the detention system (where applicable) and the proposed outfall for discharging the runoff downstream. The Preliminary Drainage Plan shall include the approximate detention volume, the sizing of the restrictor, and downstream outfall. Additionally, the Preliminary Drainage Plan shall show the ultimate drainage easement and access point locations for any DISTRICT owned and / or maintained drainage ditches and channels.

The primary purpose of the Preliminary Drainage Plan review and approval is to ensure that the overall conceptual drainage plan will generally comply with the DISTRICT's criteria and will not cause an adverse impact downstream. See Section 6 for the Preliminary Drainage Plan submittal requirements.

### 4. FINAL DRAINAGE PLAN

The Final Drainage Plan shall contain the detailed designs for the construction of all drainage improvements in accordance with these Rules, Regulations, and Guidelines. This Final Drainage Plan must be signed and sealed by a Professional Engineer registered in the State of Texas. The Final Drainage Plan review will be completed by the DISTRICT Engineer and Staff. Approval of the Final Drainage Plan will be granted or denied by the Board. See Section 7 for the Final Drainage Plan submittal requirements.

### 5. SINGLE-FAMILY HOME CRITERIA

In some situations where one single family property is to be developed, a property owner may be relieved of the requirement to obtain a Board approved Drainage Plan. See Section 8 for the single-family home criteria. The final determination for a project's eligibility for a Section 8 exemption will be made by the District Engineer.

### 6. PRELIMINARY PLAT

The primary purpose of this Preliminary Plat review and approval is to ensure that land is being properly subdivided particularly as it relates to detention and drainage. The secondary purpose of this Preliminary Plat review and approval is to allow the applicant to move forward in City review and approval processes as applicable. Preliminary Plat review and approval (when needed) will be completed by the DISTRICT Engineer and Staff upon written request and does not require Board approval. See Section 9 for the Preliminary Plat submittal requirements.

## 7. FINAL PLAT

The primary purpose of this Final Plat review and approval is to ensure that land is being properly subdivided particularly as it relates to detention and drainage. The Final Plat review will be completed by the DISTRICT Engineer and Staff. Approval of the Final Plat will be granted or denied by the Board. See Section 10 for the Final Plat submittal requirements.

## 8. REQUEST FOR VARIANCE

Only submittals meeting all of the requirements in the DISTRICT's Rules, Regulations, and Guidelines will be placed on an upcoming agenda for consideration and possible action by the Board.

In situations where the property owner or applicant finds the DISTRICT's Rules, Regulations, and Guidelines impose an undue hardship, the property owner may submit a Request for Variance. Any Request for Variance must be approved at a separate, prior Board meeting from the meeting where the Board will consider a Plan, Plat, or other item which requires the Board approved Request for Variance.

Only the Board may approve a Request for Variance. See Section 11 for Request for Variance submittal requirements.

## 9. REVISIONS

See Section 13 for the review and approval process for any revisions made to Final Plats and Final Drainage Plans after DISTRICT approval.

## **SECTION 2 – DISTRICT MEETINGS**

### **A. SUBMITTAL**

The DISTRICT's Board of Commissioners holds regular and special DISTRICT meetings as deemed necessary for the proper conduct of the DISTRICT's business and orderly development within the DISTRICT. Drainage Plans, Plats, Drainage Impact Analysis reports, requests for Variance, and all other items requiring Board approval shall be submitted to the DISTRICT prior to the posted agenda deadline. No item will be placed on the DISTRICT agenda until the DISTRICT has determined that the submittal is in conformance with the DISTRICT's Rules, Regulations, and Guidelines.

DISTRICT meetings will typically occur once per month. DISTRICT meeting dates and submittal deadlines are available on the DISTRICT website or at the DISTRICT office. The DISTRICT will require up to **30 business days** to review Drainage Impact Analysis reports and up to **10 business days** for all other submittals. It is the applicant's responsibility to stay informed about upcoming DISTRICT meeting dates and the submittal deadlines.

The DISTRICT may change the procedures for making a submittal. For this reason, applicants are encouraged to obtain a current list of all submittal requirements on the DISTRICT website or from the DISTRICT office.

### **B. PROCEDURE**

During the meeting of the Board of Commissioners of the DISTRICT, the DISTRICT's Engineer will present Drainage Plans, Plats, Drainage Impact Analyses, and requests for Variances for discussion, consideration, and possible action. The DISTRICT Engineer and staff will answer any questions prior to the Board's approval or denial of each item. The applicant or their designee may participate in the discussion and offer any additional information that the applicant deems pertinent to assist the Board of Commissioners in making its decision. If an applicant or their designee wishes to address the Board, they should follow the requisite procedure for notifying staff and / or the Board prior to the start of the meeting.

### **C. APPROVAL**

An affirmative majority vote of two or more Commissioners is required in order to approve any Drainage Plan, Plat, Drainage Impact Analysis, or Request for Variance submitted to the DISTRICT for approval.

## SECTION 3 – FEE SCHEDULE

Fees must be paid and received by the DISTRICT office prior to the initiation of the review of Drainage Impact Analysis reports, Drainage Plans, and Plats. Other items requiring review and approval by DISTRICT and / or Board may include fee requirements. A current Fee Schedule can be found on the DISTRICT's website or obtained in person at the DISTRICT office.

The approved methods of payment will be shown on the DISTRICT website or provided on request by the DISTRICT office.

*Submittals will be deemed incomplete and review will not commence if the required fees have not been received at the DISTRICT office.*

## **SECTION 4 – DRAINAGE IMPACT ANALYSIS**

### **A. INTRODUCTION**

A Drainage Impact Analysis will be required for certain types of projects to ensure compliance with the DISTRICT's Zero Downstream Impact (ZDI) policy. A Drainage Impact Analysis will typically include hydrologic and hydraulic models, written reports, exhibits, and output data to demonstrate that the improvements proposed by any project will not cause an adverse impact downstream.

Subsequent development for a tract with a Board approved Drainage Impact Analysis proposed by a Drainage Plan or Plat must be in conformance with that report and modeling. Deviation will only be allowed after the applicant revises the models and report, submits the revised Drainage Impact Analysis to the DISTRICT, and receives Board approval for the revised report.

### **B. APPLICABILITY**

No Drainage Plan or Plat will be approved by the DISTRICT for the following types of projects until the applicant has prepared a Drainage Impact Analysis and received Board approval for that report:

1. Any project for which the Floodplain Administrator deems it necessary.
2. Phased or master planned developments totaling 100 or more acres.
3. Projects proposing to utilize offsite or regional detention.
4. Projects proposing "inline" detention.
5. Projects proposing a bridge or culvert crossing within a DISTRICT facility for a proposed public road. A Drainage Impact Analysis will not be required for a private driveway.
6. Projects proposing to replace a DISTRICT channel with conduit.
7. Any project which proposes to re-align, widen, or restrict a DISTRICT facility and is deemed to be significant by the DISTRICT Engineer and / or DISTRICT staff.

### **C. REQUIREMENTS**

The Drainage Impact Analysis for projects within the DISTRICT must meet the following minimum requirements:

1. Identify the property owner or developer on the report. Include the company or entity name, individual contact person, address, email, and phone number for the property owner or developer. Put this information on the cover sheet of the report.
2. Identify the engineer for the report. Include the company name, firm registration number, address, email, phone number, and name of the engineer. Put this information on the cover sheet of the report.

3. Identify the Municipal Utility District (MUD) or other special purpose district, if any. Include the company name, address, phone number, and name of an individual point of contact. Put this information on the cover sheet of the report.
4. Show the submittal date and the date of all revisions on the report including the month, day, and year. Update this information for each resubmittal or revision.
5. Provide a location or vicinity map in the report drawn to scale. Clearly define the project limits in relation to nearby streets and DISTRICT facilities.
6. For a Drainage Impact Analysis involving a determination of detention or floodplain mitigation, provide a detention summary. Differentiate between detention and floodplain mitigation as applicable. For each mitigation basin, list the proposed detention and floodplain mitigation volumes. For each phase of development, show the approximate acreage and the detention required. Include the overall detention rate provided (exclusive of floodplain mitigation) in this summary.
7. Include a discussion of existing on-site utilities in the text of the report. Cite any anticipated utility conflicts or crossings and the requirements for obtaining approvals, Letters of No Objection (LONOs), or crossing agreements from the applicable utility or pipeline owners.
8. On exhibits, show and label existing DISTRICT facilities in a general manner and their respective ultimate easements as per the DISTRICT's current Master Drainage Plan or Flood Protection Plan. Additional access points from public road rights-of-way to DISTRICT facilities may also be required and should be shown on the exhibit(s). Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access points for any DISTRICT facilities within or adjacent to the subject tract.
9. Include a floodplain exhibit. Show and label the 100-year floodplain and floodway based upon a scaling of the current effective FIRM. Alternatively, add a statement in the report that the entire development is outside of the 100-year floodplain.
10. Include a statement regarding the anticipated phasing of the overall development. Demonstrate / state that detention mitigation will precede construction of proposed impervious cover. Ensure / state that no phase of development will cause an interim adverse impact downstream.
11. Include the output data from the modeling software used for the analysis in the appendix of the report. This output data shall substantiate that Zero Downstream Impact (ZDI) will occur as a result of the proposed development. Minimal downstream impacts are not allowed.
12. Where applicable, include consideration of downstream siphons within downstream channels based upon a pro-rata allocation of any downstream siphon.
13. Include a statement regarding any anticipated Requests for Variance and the proposed deviations from the DISTRICT's Rules, Regulations, and Guidelines.
14. Include the DISTRICT signature block behind or on the cover sheet of the written report. Include the name of the report, DISTRICT reference ID#, or other identifying information on the page with the

DISTRICT signature block. This sheet is intended to be stand-alone evidence of approval in the event that it gets separated from the report.

#### **D. APPROVAL**

The DISTRICT will approve the Drainage Impact Analysis if one of the following criteria is satisfied:

1. The Drainage Impact Analysis shows that the development will cause no proposed increase in the 2-year, 10-year, and 100-year peak discharge from the subject tract and no increase in the 2-year, 10-year, and 100-year peak water surface elevation in the affected drainage artery;
2. The Drainage Impact Analysis shows that the development will detain the proposed peak discharge to eliminate any increases in the 2-year, 10-year, and 100-year peak runoff leaving the site through the use of proposed detention and a restrictor on the subject tract; or
3. The Drainage Impact Analysis shows that the development will address offsite drainage deficiencies in the downstream channel or drainage structure, which will carry the additional load resulting from development of the subject tract to a regional detention facility.

Drainage Impact Analyses require Board approval. Within three business days of approval by the Board at a DISTRICT meeting, the DISTRICT will provide a copy of the stamped and signed report to the applicant as evidence of approval.

The approval of a Drainage Impact Analysis is not approval to begin construction or development activities on site. The property owner or designee must still submit Drainage Plans and / or Plats to the DISTRICT for review and Board approval.

The approval of a Drainage Impact Analysis is not a promise of future Drainage Plan or Plat approval. This is particularly true for projects including requests for Variance or otherwise proposing to deviate from DISTRICT criteria in any way.

DISTRICT approval of a Drainage Impact Analysis does not relieve the property owner of the responsibility for obtaining the approval of other agencies or third parties.

See Section 12 – Expiration of Approvals.

#### **E. DENIAL**

In the event that the DISTRICT denies approval of the Drainage Impact Analysis, the DISTRICT shall provide the applicant with a written letter and / or report markup within three business days identifying the parts of the projects that are not in compliance with the DISTRICT's Flood Protection Plan and / or Rules, Regulations, and Guidelines.

## SECTION 5 – MASTER DEVELOPMENT PLAN

### A. INTRODUCTION

The Master Development Plan presents the applicant's proposed layout for a phased development on larger tracts of land. For the purposes of the DISTRICT, the Master Development Plan will ensure continuity of the completed detention and drainage system and may also include the incorporation of DISTRICT facilities into the development. This plan will also show proposed drainage easements and access points for DISTRICT owned or maintained drainage facilities.

### B. APPLICABILITY

Phased development on tracts that are 50 acres or larger require a Board approved Master Development Plan as a pre-requisite to receiving approval for Plats or Plans for the individual phases of development.

### C. REQUIREMENTS

The current process for obtaining Master Development Plan review and approval will be shown on the DISTRICT website or provided on request by the DISTRICT office.

The Master Development Plan for phased projects within the DISTRICT must meet the following minimum requirements:

1. Use standard engineering scales. Identify the drawing scale and include a scale bar on each plan sheet. The plan must be clear and legible. Decrease the plan scale and use match lines as needed to ensure compliance with this requirement.
2. Identify the property owner or developer on the plan. Include the company or entity name, individual contact person, address, and phone number for the owner or developer.
3. Identify the engineer or planner on the plan. Include the company name, firm registration number (if applicable), address, phone number, and name of the engineer or planner.
4. Show the submittal date and the date of all revisions on the plan including the month, day, and year. Update this information with each resubmittal or revision.
5. Provide a location or vicinity map on the plan drawn to scale. Clearly show the project limits in relation to nearby streets and DISTRICT facilities.
6. Provide the DISTRICT signature block.
7. Put the following note directly beneath the DISTRICT signature block:

“Approval of this Master Development Plan is not approval to begin construction or development activities on site. The property owner or designee must still submit Drainage Plans and / or Plats to the DISTRICT for review and approval. The approval signatures on this Master Development Plan are not a promise of future Drainage Plan or Plat approval.”



8. Show the proposed development plan in a general manner. Identify each reserve and its intended use. Identify the anticipated phases of development. Additionally, show proposed residential areas and roadways. For each detention reserve, provide the approximate acreage, approximate detention volume proposed, and approximate floodplain volume proposed.
9. Provide a preliminary detention summary. For each phase of development, show the approximate acreage, detention volume required, and floodplain volume required. Include the overall detention rate provided (exclusive of floodplain mitigation) in this summary.
10. Show and label existing on-site utilities, pipelines, etc. in a general manner and their respective easements and / or fee strips.
11. Show and label existing DISTRICT facilities in a general manner and their respective ultimate easements as per the DISTRICT's current Master Drainage Plan or Flood Protection Plan. Additional access points from public road rights-of-way to DISTRICT facilities may also be required and should be shown on the Master Development Plan. Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access points (if any) for DISTRICT facilities within or adjacent to the subject tract.
12. Show and label the 100-year floodplain and floodway in an approximate manner on the plan. Alternatively, add a statement on the plan that the entire development is outside of the 100-year floodplain.
13. Identify adjacent, offsite areas. Show the direction of existing runoff for those adjacent areas and show the proposed plan for routing those flows through or around the proposed development to ensure no adverse impact will occur to those adjacent sites.

#### **D. APPROVAL**

The DISTRICT will give approval to the Master Development Plan if:

- (i) The requisite ultimate drainage easements and access easements are properly shown on the Master Development Plan, and
- (ii) One of the following criteria is satisfied:
  - (a) There is reasonable assurance that the Master Development Plan as shown in a general manner will cause no proposed increase in the 2-year, 10-year, and 100-year peak discharge from the subject tract and no increase in the 2-year, 10-year, and 100-year water surface elevation in the affected drainage artery;
  - (b) There is reasonable assurance that the Master Development Plan as shown in a general manner will detain the proposed peak discharge to eliminate any increases in the 2-year, 10-year, and 100-year peak runoff leaving the site through the use of proposed detention and a restrictor on the subject tract; or
  - (c) There is reasonable assurance that the Master Development Plan as shown in a general manner, will address offsite drainage deficiencies in the downstream channel or drainage structure, which

will carry the additional load resulting from development of the subject tract to a regional detention facility; and  
Master Development Plans require Board approval. Within a short time of approval by the Board at a DISTRICT meeting, the DISTRICT will provide a copy of the Master Development Plan with an approval stamp.

The approval of a Master Development Plan is not approval to begin construction or development activities on site. The property owner must still submit Drainage Plans and / or Plats to the DISTRICT for review and approval.

The approval of a Master Development Plan is not a promise of future Drainage Plan or Plat approval. This is particularly true for projects including requests for Variance or otherwise proposing to deviate from DISTRICT criteria in any way.

DISTRICT approval of a Master Development Plan does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties.

See Section 12 – Expiration of Approvals.

## **E. DENIAL**

In the event that the DISTRICT denies approval of the Master Development Plan, the DISTRICT shall provide the applicant with a written letter and / or plan markup identifying the parts of the project which are not in compliance with the DISTRICT's Flood Protection Plan and / or Rules, Regulations, and Guidelines.

## SECTION 6 – PRELIMINARY DRAINAGE PLAN

### A. INTRODUCTION

In some instances, the review and approval processes of other agencies may require that the Engineer show evidence of Preliminary Drainage Plan approval from the DISTRICT. Preliminary Drainage Plan review and approval (provided upon written request) will be completed by the DISTRICT Engineer and staff and does not require Board approval.

The Preliminary Drainage Plan shall present the applicant's overall approach to moving storm water runoff from the development to the appropriate drainage artery without an adverse impact occurring downstream. In particular, the Preliminary Drainage Plan must show the detention system (where applicable) and the proposed outfall for discharging the runoff downstream. The Preliminary Drainage Plan shall include the approximate detention volume, the sizing of the restrictor, and downstream outfall. Additionally, the Preliminary Drainage Plan shall show the ultimate drainage easement and access point locations for any DISTRICT owned and / or maintained drainage ditches and channels.

The DISTRICT Engineer and staff will have up to **10 business days** to review a Preliminary Drainage Plan submittal.

### B. REQUIREMENTS

The current process for obtaining Preliminary Drainage Plan review and approval will be shown on the DISTRICT website or provided on request by the DISTRICT office.

The Preliminary Drainage Plan for construction or development within the DISTRICT must meet the following minimum requirements:

1. Construction plan sheets must be 22" x 34". Contact the DISTRICT office to discuss any requirements of other agencies with jurisdiction *prior to* preparing engineering plans with alternate sheet sizes.
2. Each set of construction plans shall include a sheet which is labeled "Drainage Plan".
3. Use standard engineering scales. Identify the drawing scale and include a scale bar on each plan sheet. The plans must be clear and legible. Decrease the plan scale and use match lines as needed to ensure compliance with this requirement.
4. Identify the property owner or developer on the cover sheet. Include the company or entity name, individual contact person, address, email, and phone number for the owner or developer.
5. Identify the engineer on the cover sheet. Include the company name, firm registration number, address, email, phone number, and name of the engineer.
6. Show the submittal date and the date of all revisions on the plans including the month, day, and year. Update this information with each resubmittal and revision.
7. Provide a location or vicinity map on the cover sheet drawn to scale.

8. Identify privately held easements and / or fee strips, existing utilities and / pipelines, potential conflicts, and proposed work requiring approval of those easement holders or property owners.
9. Provide existing topographic contour lines based upon current elevation data. The use of 0.5' contour intervals is preferred. The contour lines must clearly illustrate the topography of the existing elevations on site. A minimum of two contour lines are required. Show existing grade contour lines and existing elevations on the Proposed Grading Plan. Additionally, provide separate and legible Topographic Survey sheet(s) in the Drainage Plan set.
10. Identify adjacent, offsite areas. Show the direction of existing runoff for those adjacent areas and show the proposed plan for routing offsite flow through or around the proposed development to ensure no adverse impact will occur to those adjacent sites.
11. Provide representative cross sections of proposed detention ponds and ditches. Ensure that an adequate amount of space on site has been set aside for these facilities.
12. Identify drainage area divides including off-site areas which drain toward the project limits. Provide adequate assurance that off-site areas will not be adversely impacted by development. Show conceptually how off-site flow will be routed through or around the proposed development.
13. Identify any required drainage easements and access easements for DISTRICT. Contact the DISTRICT Engineer to verify what easements will be required.
14. Show the detention calculations in accordance DISTRICT requirements including the detention pond service area, the detention amount required, and the detention amount provided. For phased projects, provide a detention service area map sheet including the detention required and detention provided ledgers from the Board approved Drainage Impact Analysis.
15. Identify the proposed outfall and restrictor. Include dimensions.
16. Provide a statement on the plans that the downstream pipe, ditch, or system, which will receive runoff, will not be adversely impacted.
17. Identify existing and proposed improvements on the plans.
18. Show and label all proposed drainage improvements within the subject tract, including general sizing information.
19. A professional engineer registered in the State of Texas must put their interim review stamp, and the date on all plan sheets.

### **C. APPROVAL**

The DISTRICT will give approval to the Preliminary Drainage Plan if one of the following criteria is satisfied:

1. There is adequate assurance that there will be no proposed increase in the 2-year, 10-year, and 100-year peak discharge from the subject tract and no increase in the 2-year, 10-year, and 100-year peak discharge or water surface elevation in the affected drainage artery;
2. Adequate provisions are shown to detain the proposed peak discharge which would eliminate any increases in the 2-year, 10-year, and 100-year peak runoff leaving the site through the use of proposed detention and a restrictor on the subject tract; or
3. There is adequate assurance that offsite drainage deficiencies in the downstream channel or drainage structure will be corrected or improved (at the Developer's expense) to carry the project additional load resulting from the subject tract to a regional detention facility.

Preliminary Drainage Plans do not require Board approval. Written notification of Preliminary Drainage Plan approval will be provided to the applicant upon written request. In some instances, another agency with overlapping jurisdiction may require that the applicant furnish evidence of Preliminary Drainage Plan approval from the DISTRICT as a pre-requisite for continuing through that agency's review and approval process.

The approval of a Preliminary Drainage Plan is not approval to begin construction or development activities on site. The property owner or designee must still submit a Final Drainage Plan to the DISTRICT for review and approval.

The approval of a Preliminary Drainage Plan is not a promise of future Final Drainage Plan approval. This is particularly true for projects including requests for Variance or otherwise proposing to deviate from DISTRICT criteria in any way.

If for any reason the applicant does not request written approval of the Preliminary Drainage Plan, the Reviewer will assume they intend to bypass the Preliminary Drainage Plan approval step and proceed directly to Final Drainage Plan review and approval.

DISTRICT approval of a Preliminary Drainage Plan does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties.

See Section 12 – Expiration of Approvals.

#### **D. DENIAL**

In the event that the DISTRICT denies approval of the Preliminary Drainage Plan, the DISTRICT shall provide the applicant with a written letter and / or plan markup within 10 business days identifying the parts of the projects which are not in compliance with the DISTRICT's Flood Protection Plan and / or Rules, Regulations, and Guidelines.

# SECTION 7 – FINAL DRAINAGE PLAN

## A. INTRODUCTION

A Property Owner (or authorized agent) shall prepare a Final Drainage Plan for each development, which outlines the method proposed for moving stormwater runoff from the developed area to a drainage artery. This plan shall be submitted to the DISTRICT for review and approval to ensure that no adverse drainage or flooding conditions will be created along any drainage artery or on adjacent property as a result of the proposed development.

## B. REQUIREMENTS

The current process for obtaining Final Drainage Plan review and approval will be shown on the DISTRICT website or provided upon request by the DISTRICT office.

The Final Drainage Plan for construction or development within the DISTRICT must meet the following minimum requirements:

1. Construction plan sheets must be 22" x 34". Contact the DISTRICT office to discuss any requirements of other agencies with jurisdiction *prior to* preparing engineering plans with alternate sheet sizes.
2. Each set of construction plans shall include a sheet which is labeled "Drainage Plan".
3. Use standard engineering scales. Identify the drawing scale and include a scale bar on each plan sheet. The plans must be clear and legible. Decrease the plan scale and use match lines as needed to ensure compliance with this requirement.
4. Identify the property owner or developer on the cover sheet. Include the company or entity name, contact person, address, email, and phone number for the owner or developer.
5. Identify the engineer on the cover sheet. Include the company name, firm registration number, address, email, phone number, and name of the engineer.
6. Show the submittal date and the date of all revisions on the plans including the month, day, and year. Update this information with each resubmittal or revision.
7. Provide a location or vicinity map on the cover sheet drawn to scale. Clearly identify the limits of the property in relation to nearby streets and / or DISTRICT facilities.
8. Provide a benchmark and reference benchmark which includes the datum and year of adjustment. All projects must be tied vertically to a DISTRICT or City benchmark. Provide an adjustment from the project datum to the datum of the current effective FIRM panel when the two datums are different.
9. Show the DISTRICT notes on the construction plans. The DISTRICT notes can be found on the DISTRICT website or obtained in person at the DISTRICT office.
10. Show the DISTRICT signature block on the plan. Include the DISTRICT REF ID# in the space provided.

11. Provide existing topographic contour lines based upon current elevation data. The use of 0.5' contour intervals is preferred. The contour lines must clearly illustrate the topography of the existing elevations on and immediately adjacent to the site. A minimum of two contour lines are required. Show existing grade contour lines and existing elevations on the Proposed Grading Plan. Additionally, provide separate and legible Topographic Survey sheet(s) in the Drainage Plan set.
12. Provide a Geotechnical soil report with a minimum of two 20-foot boreholes for Final Drainage Plans that include a detention basin with a depth of 6-feet or greater. The boreholes must lie within the detention basin's footprint.
13. Identify adjacent, offsite areas. Show the direction of existing runoff for those adjacent areas and show the proposed plan for routing those flow through or around the proposed development to ensure no adverse impact will occur to those adjacent sites. Include runoff and capacity calculations for each proposed structure. If no such condition exists, add a statement on the plans that "No offsite areas will be adversely affected by this proposed development".
14. Provide a cross section of all existing and proposed swales and ditches on site. Show the minimum depth, bottom width, side slopes, and design water surface. Include actual runoff amounts and capacity calculations for each ditch or swale on site to demonstrate sufficient capacity.
15. Provide a cross section for each detention pond. Show and label the top of bank, freeboard, design water surface elevation, static water elevation (if any), bottom elevation, bottom slopes, and side slopes. Dimension maintenance berms. Include detailed calculations for the volume provided.
16. Provide drainage area divides for all project areas including off-site areas which drain toward the project limits. Provide the developed runoff amount for each drainage area, inlet, pipe, swale, or drainage structure. Account for any accumulation of drainage areas in the calculations. Provide the runoff and capacity calculations on the plans to demonstrate that each inlet, pipe, swale, or drainage structure is properly sized.
17. Show and dimension all existing and proposed drainage, storm sewer, and access easements. Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access easements for any DISTRICT facilities within or adjacent to the subject tract.
18. Locate and show all drainage facilities adjacent to or within the subject tract as determined by actual, recent, on the ground survey. For DISTRICT facilities, show the high banks, toe of slopes, flowline, and static water level. Survey shall have been completed within the past year and start 200 feet upstream of and end 200 feet downstream of the subject tract. For any culvert proposed in a ditch, show the first pipe culvert upstream and downstream of the subject tract including the flowline elevation and diameter.
19. Show the detention calculations in accordance with DISTRICT requirements including the detention pond service area, the detention amount required, and the detention amount provided. Show floodplain volumes separately from detention volumes. Show the proposed detention rate (exclusive of any floodplain mitigation). For ponds serving multiple projects, include a detention service area map and a ledger showing each allocation of detention mitigation and floodplain mitigation for each section or phase of development.

20. Add a note to the plans referring to the approved Drainage Impact Analysis for the development including the title of the report and the date of Board approval (as applicable). For projects requiring a Drainage Impact Analysis, the Board will not approve the Final Drainage Plan until the Drainage Impact Analysis has received Board approval. This Drainage Impact Analysis must be approved at a separate, prior meeting.
21. Show the existing, allowable runoff rate, the restrictor sizing analysis, and the proposed runoff rate.
22. Provide the drainage area map for the downstream pipe, ditch, or system which will receive runoff from the subject tract. Include calculations to substantiate available capacity in the receiving system downstream.
23. Show and label all existing and proposed buildings, structures, paving, impervious cover, or other permanent improvements within the subject tract.
24. Show and label all proposed drainage improvements within the subject tract which will convey the proposed runoff to the receiving drainage system. Label the diameter, material type, slope, and flowlines for all proposed pipes. Label the minimum slopes, side slopes, and flowlines for all ditches and swales.
25. Show and label all proposed structures, utilities, drainage facilities, and permanent improvements where they will cross pipelines, utilities, and ditches. Provide sufficient information for the DISTRICT Engineer to ensure that no crossing conflicts are proposed. Include the size, depth, and location of all underground facilities.
26. For projects requiring variances, add a note regarding each approved Request for Variance and the date of Board approval. Put this note on the cover page and the appropriate plan sheets.
27. Include all of the current DISTRICT details in the plan set whether they apply or not. Do not “x” out any details. Callout the relevant and required standard DISTRICT details by detail number in plan and profile views on the plan sheets.
28. A Professional Engineer registered in the State of Texas must put their seal, signature, and the date on all plan sheets.
29. Provide an AutoCAD (DWG) file for the Final Drainage Plan to the DISTRICT. Provide the base map only and not individual plan sheets. See the DISTRICT website or contact the DISTRICT office for the current requirements and submittal process.

## **C. APPROVAL**

The Board will give approval to the Final Drainage Plan if one of the following criteria is satisfied:

1. There is no proposed increase in the 2-year, 10-year, and 100-year peak discharge from the subject tract and no increase in the 2-year, 10-year, and 100-year peak discharge or water surface elevation in the affected drainage artery;



2. Adequate provisions are made to detain the proposed peak discharge to eliminate any increases in the 2-year, 10-year, and 100-year peak runoff leaving the site through the use of proposed detention and a restrictor on the subject tract; or
3. Offsite drainage deficiencies in the downstream channel or drainage structure are corrected or improved (at the Developer's expense) to carry the project additional load resulting from the subject tract to a regional detention facility.

Final Drainage Plan approval may only be granted by the Board at a DISTRICT meeting. Within three business days of approval by the Board at a DISTRICT meeting, the DISTRICT will provide a copy of the Final Drainage Plan with approval stamps and signatures.

See Section 13 for the review and approval process for any revisions made to a Final Drainage Plan after DISTRICT approval.

**DISTRICT approval of a Final Drainage Plan does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties.**

See Section 12 – Expiration of Approvals.

#### **D. DENIAL**

In the event that the DISTRICT denies approval of the Final Drainage Plan, the DISTRICT shall provide the applicant with a written letter and / or plan markup within three business days identifying the parts of the projects which are not in compliance with the DISTRICT's Flood Protection Plan and / or Rules, Regulations, and Guidelines.

## SECTION 8 – SINGLE FAMILY HOME CRITERIA

### A. INTRODUCTION

In some situations where one single family property is to be developed, the property owner may be relieved of the requirements to obtain a Board approved Final Drainage Plan.

### B. ELIGIBILITY

A single-family home site is exempt from the requirement to obtain a Board approved Final Drainage Plan in the following specific situation:

1. Property NOT adjacent to a DISTRICT maintained facility
  - a. A single-family residential structure which is 5,000 square feet or smaller does not require a Board approved Final Drainage Plan.
  - b. For a single-family home site within a mapped 100-year floodplain, the property owner is allowed to import fill material for the house pad without a Board approved Final Drainage Plan. Fill material may not extend more than 10 feet beyond the slab. No fill may be placed within 10 feet of a property line. Any additional fill beyond a house pad will require a Board approved Drainage Plan.
  - c. For a single-family home site outside the mapped 100-year floodplain, the property owner is allowed to import fill material for the house pad without a Board approved Final Drainage Plan. Fill material may not extend more than 10 feet beyond the slab. No fill may be placed within 10 feet of a property line. Additional fill material may be placed without a Board approved Final Drainage Plan only if all the following apply:
    - i. No more than 20 additional loads (250 cubic yards) of fill are placed per acre (beyond the house pad).
    - ii. The fill material is spread equally and evenly on site.
    - iii. No fill is placed within 10 feet of a property line.

For all other developments, including a single-family home which has frontage on a DISTRICT maintained facility or which discharges directly into a DISTRICT maintained facility, submit a Final Drainage Plan in accordance with Section 7 of these Rules, Regulations, and Guidelines to the DISTRICT for review and Board approval.

The final determination of eligibility for projects under Section 8 of these Rules, Regulations, and Guidelines shall be made by the DISTRICT Engineer.

NOTE – The requirements contained in Section 8 of these Rules, Regulations, and Guidelines do not in any way relieve the property owner of the requirement to follow all applicable County and City regulations and to obtain any necessary permits.

**In any instance where conflicting requirements exist, the more stringent of the two requirements shall apply.**

### **C. DISQUALIFIED**

Specific developments which are NOT eligible for exemption under Section 8 of these Rules, Regulations, and Guidelines include but are not limited to:

1. Any property which is not “residential” as defined herein.
2. Any property illegally divided from a parent tract without obtaining the requisite approvals.
3. Property which will be rented or leased for commercial use.
4. Homes used for business purposes to house or care for the elderly (group homes).
5. Non-traditional residential uses such as a garage, metal building, or airplane hangar that does not meet IRC and Texas minimum requirements for a residential dwelling, and uses less than 25% of the overall square footage of the structure for residential living space.

### **D. REQUIREMENTS**

In instances where a Board approved Final Drainage Plan is required in this section of the Rules, Regulations, and Guidelines refer to Section 7 for the Final Drainage Plan submittal requirements and other pertinent information.

See Section 12 – Expiration of Approvals.

## SECTION 9 – PRELIMINARY PLAT

### A. INTRODUCTION

Certain governmental entities within the jurisdiction of the DISTRICT require Preliminary Plat approval from the DISTRICT. In these instances, a Preliminary Plat must be submitted to the DISTRICT. If the plat is being required by any agency due to proposed development on site, a Preliminary Drainage Plan shall accompany the Preliminary Plat submittal. If no other agency requires Preliminary Plat approval by the DISTRICT, the applicant may proceed directly to Final Plat review and approval. Preliminary Plat review and approval will only be provided upon written request.

### B. REQUIREMENTS

The current process for obtaining Preliminary Plat review and approval will be shown on the DISTRICT website or provided on request by the DISTRICT office.

The Preliminary Plat must meet the following minimum requirements:

1. Title the submittal as “Preliminary Plat”.
2. Use standard engineering scales. Identify the drawing scale and include a scale bar on each sheet. The plat must be clear and legible. Decrease the plat scale and use match lines as needed to ensure compliance with this requirement.
3. Identify the property owner or developer on the plat. Include the company or entity name, individual contact person, address, email, and phone number for the property owner or developer.
4. Identify the surveyor on the cover sheet. Include the company name, address, email, phone number, and name of the surveyor.
5. Show the submittal date and the date of all revisions on the plans including the month, day, and year.
6. Provide a location or vicinity map on the cover sheet drawn to scale. Clearly show the limits of the tract in relation to nearby streets and DISTRICT facilities.
7. Locate and show all drainage facilities adjacent to or within the subject tract as determined by actual, recent, on the ground survey. For DISTRICT facilities, show the high banks, toe of slopes, centerline, flowline, and static water level. Survey shall have been completed within the past year and start 200 feet upstream of and end 200 feet downstream of the subject tract. For roadside ditches, show the first box or pipe culvert upstream and downstream of the subject tract including the flowline elevation and diameter. *This item is required for the first submittal only for the purpose of determining where proposed drainage or storm sewer easements are needed.*
8. Under separate cover, submit a Preliminary Drainage Plan prepared by a registered professional engineer for review and approval by the DISTRICT. See Section 6 and Section 7 for additional requirements. DISTRICT approval of the Final Drainage Plan will be a prerequisite for receiving DISTRICT approval of the Final Plat. With this in mind, the DISTRICT recommends submitting the Drainage Plan at the earliest opportunity.

9. Show and dimension all existing and proposed drainage, storm sewer, and access easements. When subdividing land, account for the different ownership of lots and reserves. Show drainage and / or storm sewer easements allowing each lot or reserve to drain to the detention pond or outfall in perpetuity. Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access easements for any DISTRICT facilities within or adjacent to the subject tract.
10. Provide a flood statement on the face of the plat. Include the current effective FIRM panel number and the effective date. Show and label the limits of the floodway and the 100-year floodplain (if any) as scaled from the current FIRM. If none exists, add a note stating that the subject tract lies entirely outside the 100-year floodplain.
11. Provide data relating to adjoining property including the names of adjacent property owners. Alternatively, show section, lot, and block numbers in adjacent residential subdivisions.
12. Provide a table requiring specific minimum finish floor heights for each reserve or single-family residential lot. List specific minimum elevations for each residential lot and not general criteria. The finish floor elevations shall be on the same datum as the effective FEMA floodplain map for the tract.
13. Show a detention reserve and 20' wide unobstructed access path to a public road right-of-way in accordance with DISTRICT requirements for any proposed detention pond which will serve two or more properties now or in the future.
14. All plat submittals must conform to the Texas Board of Professional Land Surveying rule 663.18.

## **C. APPROVAL**

DISTRICT Staff will give Preliminary Plat approval if the submittal is found to be in general conformance with the DISTRICT's Rules, Regulations, & Guidelines, Flood Protection Plan, and Master Drainage Plan (if applicable).

The approval of a Preliminary Plat is not approval to begin the recordation process. The property owner or designee must still submit a Final Plat to the DISTRICT for review and approval.

The approval of a Preliminary Plat is not a promise of future Final Plat approval. This is particularly true for projects including requests for Variance or otherwise proposing to deviate from DISTRICT criteria in any way.

DISTRICT approval of a Preliminary Plat does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties. See Section 12 – Expiration of Approvals.

## **D. DENIAL**

In the event that the DISTRICT denies approval of the Preliminary Plat, the DISTRICT shall provide the applicant with a written letter and / or plat markup within three business days identifying the parts of the submittal which are not in compliance with the DISTRICT's Rules, Regulations, and Guidelines, Flood Protection Plan, or Master Drainage Plan.

# SECTION 10 – FINAL PLAT

## A. INTRODUCTION

Certain governmental entities within the jurisdiction of the DISTRICT require Final Plat approval from the DISTRICT. In these instances, a Final Plat must be submitted to the DISTRICT. Requirements may be further outlined in the applicable interlocal agreements with those agencies who have overlapping jurisdiction. A Drainage Plan must be provided with any Plat unless the DISTRICT Engineer deems it unnecessary. Board approval of the Final Drainage Plan will otherwise be a prerequisite to Board approval of the Final Plat.

## B. REQUIREMENTS

The current process for obtaining Final Plat review and approval will be shown on the DISTRICT website or provided upon request by the DISTRICT office.

The Final Plat must meet the following minimum requirements:

1. Title the submittal as “Final Plat”.
2. Use standard engineering scales. Identify the drawing scale and include a scale bar on each sheet. The plat must be clear and legible. Decrease the plat scale and use match lines as needed to ensure compliance with this requirement.
3. Identify the property owner or developer on the plat. Include the company or entity name, individual contact person, address, email, and phone number for the owner or developer.
4. Identify the surveyor on the cover sheet. Include the company name, address, email, phone number, and name of the surveyor.
5. Show the submittal date and the date of all revisions on the plans including the month, day, and year. Update this information with each resubmittal and revision.
6. Provide a location or vicinity map on the cover sheet drawn to scale. Clearly show the limits of the property in relations to nearby streets and DISTRICT facilities.
7. Provide a benchmark and reference benchmark which includes the datum and year of adjustment. All projects must be tied vertically to a DISTRICT or City benchmark. Provide an adjustment from the project datum to the datum of the current effective FIRM panel when the two datums are different.
8. Show the standard DISTRICT notes on the plat. Show the additional DISTRICT notes as required when dedicating drainage easements by plat. The DISTRICT notes can be found on the DISTRICT website or obtained in person at the DISTRICT office.
9. Show the DISTRICT signature block on the plat. Include the DISTRICT REF ID# in the space provided.

10. Locate and show all drainage facilities adjacent to or within the subject tract as determined by actual, recent, on the ground survey. For DISTRICT facilities, show the high banks, toe of slopes, flowline, centerline, Ditch ID #, and static water level. Survey shall have been completed within the past year and start 200 feet upstream of and end 200 feet downstream of the subject tract. For roadside ditches, show the first box or pipe culvert upstream and downstream of the subject tract including the flowline elevation and diameter. *This item is required for the first submittal only for the purpose of determining where proposed drainage or storm sewer easements are needed.*
11. Under separate cover, submit a Final Drainage Plan prepared by a registered professional engineer for review and approval by the DISTRICT for review and approval. See Section 6 and Section 7 for additional requirements. DISTRICT approval of the Final Drainage Plan will be a prerequisite for receiving DISTRICT approval of the Final Plat.  
  
Note - For a plat of one single family lot which does not propose to subdivide a larger tract into three or more lots, the applicant will not be required to submit a Drainage Plan with the Plat unless the property has frontage on a District maintained facility.
12. Show and dimension all existing and proposed drainage, storm sewer, and access easements. When subdividing land, account for the different ownership of lots and reserves. Show drainage and / or storm sewer easements allowing each lot or reserve to drain to the detention pond or outfall in perpetuity. Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access easements for any DISTRICT facilities within or adjacent to the subject tract.
13. Provide a flood statement on the face of the plat. Include the current effective FIRM panel number and the effective date. Show and label the limits of the floodway and the 100-year floodplain (if any) as scaled from the current FIRM. If none exists, add a note stating that the subject tract lies entirely outside the 100-year floodplain.
14. Provide data regarding adjoining property including the names of adjacent property owners. Alternatively, show section, lot, and block numbers in adjacent residential subdivisions.
15. Provide a table requiring specific minimum finish floor heights for each reserve or single-family residential lot. List specific minimum elevations and not general criteria. The finish floor elevations provided shall be on the same datum as the effective FEMA floodplain map.
16. When subdividing land, account for the different ownership of lots and reserves. Show drainage and / or storm sewer easements allowing each lot or reserve to drain to the detention pond or outfall in perpetuity. Contact the DISTRICT Engineer to determine the ultimate drainage easement width and the need for access easements for any DISTRICT facilities within or adjacent to the subject tract.
17. Show a detention reserve and 20' wide unobstructed access path in accordance with DISTRICT requirements for any proposed detention pond which will serve two or more properties now or in the future.
18. Add a note on the plat for each approved Request for Variance and the date of Board approval.
19. All plat submittals must conform to the Texas Board of Professional Land Surveying rule 663.18.

20. Provide an AutoCAD (DWG) file for the plat to the DISTRICT. See the DISTRICT website or contact the DISTRICT office for the current requirements and submittal process.

### **C. APPROVAL**

Final Plat approval may be granted by the Board at a DISTRICT meeting if the submittal is found to be in conformance with the DISTRICT's Rules, Regulations, & Guidelines, Flood Protection Plan, and Master Drainage Plan (as applicable).

In instances where the property to be platted does not have frontage on a District facility as confirmed by the District Engineer, the Final Plat may be issued by District Staff.

See Section 13 for the review and approval process for any revisions made to a Final Plat after DISTRICT approval.

DISTRICT approval of a Final Plat does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties.

See Section 12 – Expiration of Approvals.

### **D. DENIAL**

In the event that the DISTRICT denies approval of the Final Plat, the DISTRICT shall provide the applicant with a written letter and / or plat markup within three business days identifying the parts of the submittal which are not in compliance with the DISTRICT's Rules, Regulations, and Guidelines, Flood Protection Plan, or Master Drainage Plan.

### **E. SIGNATURES ON MYLAR**

The applicant is encouraged to bring the original mylar of the plat to the DISTRICT meeting on the day of Board approval. If the original mylar is not ready for signatures on the day of the DISTRICT meeting, the applicant may drop off the original mylar and the DISTRICT Signature Request Form at the DISTRICT office. The Applicant will be notified when the mylar is signed and ready for pickup. The Signature Request Form can be obtained on the DISTRICT website or in person at the DISTRICT office.



## SECTION 11 - REQUEST FOR VARIANCE

The DISTRICT may approve a Request for Variance to these Rules, Regulations, & Guidelines. The Request for Variance must be prepared by the property owner or applicant and submitted along with any engineering reports, drawings, etc. to the DISTRICT for consideration. The Request for Variance will be presented to the Board at a DISTRICT meeting and must show substantial and credible evidence that:

1. There is no available alternative or option that would allow compliance with the Rules, Regulations, & Guidelines in lieu of an approved Request for Variance; and
2. There are special circumstances or conditions affecting the applicant's land involved such that strict application of the provisions of the Rules, Regulations, & Guidelines would deprive the applicant of all reasonable use of their land; and
3. The Request for Variance is necessary for the preservation and enjoyment of a substantial property right of the applicant; and
4. The approval of a Request for Variance will not be detrimental to the public health, safety, or welfare, or injurious to other property in the area; and
5. The approval of the Request for Variance will not result in an increase the 100-year base flood elevations on property upstream or downstream of the applicant's property; and
6. The approval of the Request for Variance will not have the effect of preventing the orderly development of other land in the vicinity in accordance with the provisions of these Rules, Regulations, & Guidelines.

The DISTRICT may approve a Request for Variance to the Rules, Regulations, & Guidelines if it determines, based upon the evidence presented to the Board that an undue hardship may result from strict compliance with said Rules, Regulations, & Guidelines. Pecuniary (financial) hardship to the property owner or developer, standing alone, shall not be deemed to constitute undue hardship.

Approval of a Request for Variance may be granted so that substantial justice is done and the public interest secured, provided that such Request for Variance shall not have the effect of nullifying the intent and purpose of these Rules, Regulations, & Guidelines.

Each Variance approved by the Board of Commissioners shall be entered into the minutes of the meeting. Within three business days of the meeting, DISTRICT staff will issue a written notice of approval (or denial) and any special conditions attached to the approval of the request.

For requests for Variance associated with a Plan or a Plat, the request must be approved by the Board at a separate meeting prior to the meeting where a Plat, Plan, or other submittal requiring that approved Request for Variance will be considered by the Board.

DISTRICT approval of a Request for Variance does not relieve the applicant of the responsibility for obtaining the approval of other agencies or third parties.

## **SECTION 12 - EXPIRATION OF APPROVALS**

All approvals of the DISTRICT shall be valid for a period of time not to exceed those listed below. Failure to obtain a DISTRICT permit and to commence construction of the detention and / or drainage for an approved project or to make full use of approvals granted within the time frames listed below shall make such approvals null and void. In those instances, all fees shall be forfeited and will not be returned to the Applicant.

A Drainage Impact Analysis or Master Development Plan is typically required for larger developments which are usually proposed and constructed in phases of development. With this in mind, a Drainage Impact Analysis and / or Master Development Plan shall remain intact for two years. The two-year period shall be measured from the date of the most recent Plat submittal, Plan submittal, or Board approval of a Plan or Plat for any phase of construction within the overall development described in the approved Drainage Impact Analysis or Master Development Plan. If a master planned or phased development goes dormant for two years or longer, then the approval of the Drainage Impact Analysis and / or Master Development Plan is expired.

Preliminary Drainage Plan and Preliminary Plat approvals (if any) shall remain intact for twelve months from the date of DISTRICT approval. Failure on the part of the applicant to secure Final Drainage Plan or Final Plat approval from the Board within the twelve-month time period will result in a requirement to restart the Preliminary Drainage Plan or Preliminary Plat approval review and approval process. A written notice of preliminary approval of a Drainage Plan or Plat will be issued by DISTRICT staff within three business days of approval and shall include an expiration date.

Final Drainage Plan approval shall remain intact for one year from the date of Board approval. If the property owner or their contractor does not obtain a DISTRICT permit and begin construction of the detention and / or drainage improvements within one year of Board approval, the Plan approval will be deemed expired. Final Drainage Plan approval will expire if construction of the project is not completed and approved by the DISTRICT Inspector within 18 months of the issuance of a permit under Section 24. At the discretion of the District engineer, a single 6-month extension may be granted by the District for good cause provided the request for extension is received in writing prior to expiration of the District issued permit.

Final Plat approval shall remain intact for two years from the date of Board approval. If the applicant does not record the Plat within two years of Board approval of the Final Plat, it will be deemed expired.

The approval for requests for Variance shall remain intact for one year from the date of Board approval. The one-year period shall be measured from the date of the most recent Plat submittal, Plan submittal, or Board approval of any Plan or Plat submission which is dependent upon the previously approved Request for Variance.

## **SECTION 13 - REVISIONS TO PREVIOUSLY APPROVED ITEMS**

The DISTRICT acknowledges that changes may need to be made to a Plan, Plat, or other submittal which was previously approved by the DISTRICT. These changes or revisions may occur for a variety of reasons.

Only the Board approved version of the Final Plat may be recorded. Similarly, construction of a project must be in strict conformance with the Board approved Final Drainage Plan. The DISTRICT Inspector will not give final approval to any construction project that was not built per the Board approved Final Drainage Plan.

Any proposed changes to a Board approved Final Plat, Drainage Impact Analysis, or Final Drainage Plan which DISTRICT Staff or the DISTRICT Engineer deem significant will require formal Board approval. Submit the Revised Final Plat, Revised Drainage Impact Analysis, or Revised Final Drainage Plan in accordance with the current DISTRICT procedure as specified on the DISTRICT website or obtained in person at the DISTRICT office. After all review comments have been addressed, the submittal will be presented to the Board for approval at a future District meeting.

In other instances where the DISTRICT Staff and DISTRICT Engineer deem the revisions to be trivial or insignificant in terms of drainage, the Revised Final Plat or Revised Final Drainage Plan, or Revised Drainage Impact Analysis can be signed and dated again by DISTRICT Superintendent and DISTRICT Engineer without the need for Board approval.

## **SECTION 14 - DETENTION PONDS**

### **A. INTRODUCTION**

In situations where proposed development will result in the increase in storm water runoff leaving a site, detention facilities will typically be necessary to mitigate any potential adverse impacts. This section of Rules, Regulations, and Guidelines presents background information on storm water storage techniques and the specific DISTRICT criteria and guidelines for the design of those facilities.

See Section 32 – Criteria and Methodology for instructions on how to size the detention facility which include the mention of the requirement for a de-facto minimum detention rate of 0.65-acre feet / acre.

### **B. DETENTION POND REQUIREMENTS**

The following requirements will apply to all detention facilities within the DISTRICT:

1. Drainage Plans for proposed detention facilities shall include detention service area, required detention volume, required detention rate, detention pond, detention reserve, etc.
2. All public detention ponds (serving more than one property now or in the future) must be placed in a detention reserve. Additionally, identify the individual, company, HOA, MUD, or authority responsible for maintenance of that detention facility in a statement on the Plan or Plat.
3. All detention facilities serving more than one property shall have a 20-foot minimum width unobstructed access path from the detention facility to a public right-of-way. In situations where this access route crosses privately held property, an additional recorded access easement may be required.
4. Backslope swales and interceptor structures shall be required wherever property adjacent to a proposed detention pond drains toward the basin. Backslope swales and interceptors are required on all sides of any detention pond which will be dedicated to the DISTRICT.
5. Side slopes of detention ponds shall be 4:1 or flatter. 3:1 may be permitted with a slope stability analysis signed and sealed by a Geotechnical Engineer.
6. Ponds must include 1 foot of Freeboard. In cases where a pond discharges to a shallow outfall point, the DISTRICT Engineer may allow a reduction of the required Freeboard provided that:
  - a. The Freeboard volume shall never be less than 25% of the total detention storage volume.
  - b. The Freeboard shall never be less than 6 inches.
7. Freeboard shall be measured from the 100-yr design water surface elevation (DWSE) or overflow weir flowline (whichever is higher) to the minimum top of bank elevation.
8. Appropriate cover on the slopes, bottom, and maintenance berm shall be established prior to approval of the construction by the DISTRICT. At least 95% germination of the grass must be established prior to approval of construction by the DISTRICT.

9. All detention ponds shall have maintenance berms as follows:

**Table 15-1**

<b>Pond Depth (ft)</b>	<b>Berm Width</b>
0 - 2'	10'
>2' - 5'	15'
>5' - 10'	20'
>10'	30'

The depth to be used in the Table 15-1 above is the total depth and not the detention storage depth.

All detention pond maintenance berms fronting on street rights-of-way or DISTRICT maintained channels shall be a minimum of 30 feet in width independent of pond depth. A detention pond and DISTRICT maintained ditch may share a 30-foot maintenance berm however an easement or agreement may be required depending on the specific situation.

In no case shall the maintenance berm width be less than 25 feet if the detention pond is to be dedicated to the DISTRICT.

10. Existing and proposed detention ponds and maintenance berms shall not be encumbered with easements, rights-of-way, or permanent improvements including but not limited to landscaping, shrubs, and trees as deemed adverse to maintenance operations by the DISTRICT Engineer. Add a clear statement about additional improvements on a previously approved detention pond site.
11. Detention ponds shall not be encumbered with overlapping improvements such as benches, sports fields, etc. without specific prior authorization by way of a Board approved Request for Variance. A consultation with the District Engineer is required prior to the design of detention ponds intended to be utilized for recreational uses. See Section 17.D.
12. Concrete slope paving shall be provided at the upstream and downstream end of the boxes or pipes entering and leaving the detention pond as per the standard DISTRICT details. Put a callout specifying the specific DISTRICT detail at each proposed location on the plan sheets.
13. The DISTRICT's personnel shall have the right to enter upon property during construction or as may be warranted to ensure the detention facility and drainage system are being constructed and / or operating properly. Place a note to this effect on the Drainage Plan or Plat.
14. The Property Owner must provide the DISTRICT with a Maintenance Declaration and Maintenance Plan for the upkeep of the detention pond, outfall, drainage system, and pump station (if any) in accordance with the regulations and policies in effect at the time that Drainage Plan approval is requested. The Maintenance Plan and any other required documentation will be a prerequisite for Drainage Plan approval. The Maintenance Declaration and Maintenance Plan shall be prepared and executed in the form provided by the District. Copies of such forms are available upon request.

The property owner is further advised to review Section 19 regarding the maintenance of detention facilities prior to beginning design and construction.

## **C. GEOTECHNICAL REQUIREMENTS**

Before initiating the final design of detention ponds over six (6) feet deep, a detailed soils investigation by a Geotechnical Engineer shall be undertaken. A minimum of two 20' bore holes that lie within the detention pond footprint must be taken. The geotechnical investigation, analysis, and report at a minimum shall address:

1. The groundwater conditions at the proposed detention pond site.
2. The type of material to be excavated from the pond site and its suitability for fill material.
3. If a dam or levee is to be constructed, this geotechnical assessment shall include adequate investigation of potential seepage problems, the availability of suitable embankment material, and stability requirements. The DISTRICT will not be responsible for any dams or accept that type of facility for maintenance.
4. Stability analysis for the proposed pond side slopes.

## **D. MANICURED POND BOTTOMS**

The bottom of a manicured detention pond must be designed such that it will remain dry and aesthetically manicured in order to ensure good long-term maintenance. In order to meet the DISTRICT criteria for a manicured detention pond, the pond must meet the following additional minimum criteria:

1. Provide a concrete pilot channel as per the current DISTRICT details.
2. The concrete pilot channel shall be sloped at 0.1% toward the outfall pipe.
3. The remainder of the pond bottom shall be sloped toward the pilot channel at 1%.

## **E. NATURALIZED POND BOTTOMS**

A naturalized detention pond is meant to support natural vegetation but a proper design must consider the long-term maintenance of the facility. In order to meet the DISTRICT criteria for a naturalized detention pond, the pond must meet the following additional minimum criteria:

1. The low point (valley) in the pond shall be sloped at 0.2% toward the outfall pipe.
2. The remainder of the pond bottom shall be sloped toward the valley at 1%.

Plans proposing a naturalized pond shall also include notes and requirements addressing the long-term maintenance of the detention pond including the removal of trash, debris, siltation, and undesirable vegetation.

The DISTRICT may require additional volume be provided to offset anticipated siltation which is common in a naturalized detention pond.

## **F. WET DETENTION PONDS**

Any detention pond which is designed to hold any water for any reason shall be considered a wet detention pond and will be subject to the following additional requirements:

1. It will be the responsibility of the property owner, developer, Municipal Utility District, Homeowners Association, or other applicable entity to maintain any wet detention facility. The Drainage Plan (and plat if any) shall identify the person or entity responsible for maintenance with a statement on the Plan or Plat.
2. The applicant is encouraged to evaluate the potential for wetland vegetation within a wet detention pond. The required minimum wet depth is 4 feet.
3. The applicant is encouraged to evaluate the potential for erosion of the detention pond side slopes at the water's edge which is generally caused by wind and wave action. A hard edge is recommended.

## **G. PUMPED DETENTION PONDS**

A stormwater detention facility requiring a mechanical pumping system may be allowed under the following conditions and with the following stipulations:

1. A combination of pump and gravity drainage must be used.
2. The required detention rate required for pumped detention ponds shall be no less than 0.70 ac-ft / ac independent of what the analysis and modeling shows.
3. No more than 75% of the required detention volume shall be pumped.
4. The discharge delivery system for any combination of pumps running shall not have a peak discharge and / or peak stages that exceed the pre-developed 2-year, 10-year, and 100-year design storm events.
5. Two pumps including a low flow “jockey” pump and a main pump shall be required with the combined pumps capable of providing the design discharge rate. Project proposing less than 5 ac-ft of detention and a pumping rate less than 500 gpm will be allowed to use a single pump design.
6. Include an analysis showing the time required to drain the detention pond. This analysis shall include consideration of “pumps off override” requirement # 13 (below). Ponds are ideally drained within 48 – 72 hours but the 2-year pre-developed runoff may not be exceeded.
7. Pumping from a detention pond into an existing storm sewer is prohibited unless the pre-developed land already drains into that system and that system is designed to provide capacity for those undeveloped flows.
8. For pumped detention basins within the DISTRICT's jurisdiction the DISTRICT must receive adequate assurance that the pump system will be maintained in working condition. This assurance will come in the form of a Maintenance Declaration, or other requirements in place at the time of plan review and approval.

9. Fencing of the control panel must be provided to prevent unauthorized operation and vandalism pursuant to the Texas Commission on Environmental Quality (TCEQ) standards. The DISTRICT must have access to the equipment for periodic inspections by way of a shared key lock box (or similar) on site.
10. Adequate assurance must be provided to ensure that flooding would not occur due to loss of power during a storm or rain event.
11. The pump system shall include a water level detection system which will cause the system to cease pumping when the water level in the receiving ditch is at 75% of its capacity. This level switch shall be placed away from the force main discharge to avoid misreads due to turbulence and wave action. Show a ditch cross section, elevations, and calculations to demonstrate compliance.
12. The pump system shall use a one-way valve or other means of ensuring that the water pumped out of the detention pond will not readily return back to the detention pond by way of the gravity outfall pipe. The one-way valve shall be placed at the appropriate end of the pipe to facilitate inspection and cleaning.
13. The pump system shall include an hour meter to show the total hours of pump operation. The design on the plans shall demonstrate that the pump system has this data collection capability.
14. The DISTRICT shall have the right to enter the property and inspect the pump for any reason. Include a statement to this effect on the Plan or Plat.
15. Failure to maintain the pump system in working order is a violation of these Rules, Regulation, and Guidelines and will subject the owner to civil penalties as defined in Section 29 – Penalties of these regulations. Penalties may include charges for repairs conducted by the DISTRICT, or other penalties prescribed by the current policy of the DISTRICT at the time of violation.

## **H. VERTICAL WALL DETENTION PONDS**

A vertical wall in lieu of the required 4:1 grass lined slopes will be permitted in a detention pond if all of the following requirements are met:

1. The applicant shall submit the detailed design and construction plans for the retaining wall signed and sealed by a structural engineer registered in the State of Texas. Design details on the plans shall include paving thickness, rebar size, and rebar spacing. No interior bracing will be allowed within the detention pond.
2. The design of the pond must include a 12-foot-wide concrete lined ramp on an 8:1 slope so that maintenance and mowing equipment can access the bottom of the pond. Access ramps shall be on grade. Additionally, concrete landings shall be placed at the bottom and top of the ramp and shall be a minimum of 12 feet in width and length. Account for the loss of detention volume created by the access ramp.
3. The floor of the detention pond must have a concrete pilot channel to ensure quick and adequate drying of the bottom of the pond.



4. Adequate measures must be incorporated into the design and constructed to prevent pedestrians and vehicles from falling into the detention facility.
5. When a vertical wall in a detention pond has frontage on a DISTRICT facility, the structural engineer's design shall account for the heavy equipment that the DISTRICT uses to access or maintain DISTRICT facilities. Contact the DISTRICT office to verify the current loads to be used in these calculations.
6. No vertical wall within a detention pond shall be placed within 30 feet of a DISTRICT drainage easement, DISTRICT fee strip, or road right-of-way. In other locations where a vertical wall is not adjacent to a road or DISTRICT facility, a 3-foot safety setback is required in lieu of a maintenance berm. Permanent improvements within this 3-foot safety setback shall be limited to guardrails, fencing, and other safety measures.

## SECTION 15 - OUTFALL REQUIREMENTS

Any proposed, altered, or repaired outfall into a DISTRICT facility must be constructed in strict conformance with this section of the DISTRICT's Rules, Regulations, and Guidelines.

All outfalls to a storm sewer, ditch, or channel that is not owned or maintained by the DISTRICT must be designed and constructed in accordance with that maintenance authority's requirements. Demonstrate / show compliance and include that maintenance authority's required detail sheets within the plan set.

### A. DRAINAGE OUTFALLS

The following requirements will apply to all drainage outfalls into a DISTRICT maintained facility:

1. All storm sewer conduits for outfalls shall be reinforced concrete pipe (RCP), reinforced concrete box (RCB), aluminized steel pipe, high performance polypropylene pipe (HP), or high-density polyethylene (HDPE).
2. No outfall box or pipe less than 12 inches in diameter or less than 1 square foot of opening will be allowed.
3. A restrictor is to be used at the upstream end of the outfall as required to ensure that the opening remains free of debris and to ensure that no increase in runoff will occur during the 2-year, 10-year, and 100-year storm events.
4. The backfill for outfall conduits shall be properly placed and compacted as recommended by a geotechnical analysis. The use of cement stabilized sand or pressure grouting shall be used where soil conditions prevent satisfactory compaction or in the absence of analysis and recommendations by a geotechnical engineer. Pressure grouting should also be used when headwater depths could cause backfill to wash out around the conduit. Seepage cutoff collars are not allowed.
5. Adequate steel grating shall be provided as required to prevent displaced vegetation from clogging the conduit.
6. The outfall conduit shall be pointed at a 30-degree downstream angle as prescribed by the standard DISTRICT details. Put callouts on the plan sheets citing the specific DISTRICT detail number.
7. The outfall system shall include a manhole in a location 5 feet outside of the DISTRICT easement or fee strips as shown on the standard DISTRICT details. Put callouts on the plan sheets citing the specific DISTRICT detail number.
8. The downstream end of the outfall conduit shall be mitered per the standard DISTRICT details. Put callouts on the plan sheets citing the specific DISTRICT detail number.
9. The downstream end of the outfall conduit shall have concrete slope paving and toe walls as per the standard DISTRICT details. Put callouts on the plan sheets citing the specific DISTRICT detail number.

10. The downstream flowline of the outfall conduit shall be 6 inches above the receiving ditch flowline and static water surface elevation in the receiving ditch as per the standard DISTRICT details. Show the static water surface elevation based upon recent survey on the construction plans. If the receiving ditch was dry at the time of survey, put a statement to this effect on the plan sheet. Any proposed demucking or dredging of any downstream ditch will only be allowed if the DISTRICT confirms that the proposed flowline will be dry and maintainable. Put callouts on the plan sheets citing the specific DISTRICT detail number.
11. Outfalls into a detention pond shall be aligned in the same direction with any proposed pilot channel to minimize washout and erosion.
12. See the current DISTRICT detail sheets for additional requirements.

## **B. WASTEWATER TREATMENT PLANT OUTFALLS**

The following additional requirements will apply to all wastewater treatment plant outfalls into a DISTRICT maintained facility:

1. Provide a copy of the TCEQ / TPDES Permit.
2. Demonstrate / show that the drainage analysis accounts for the routine and regular discharge of treated effluent from the proposed wastewater treatment plant in addition to stormwater flows.

## **C. RESTRICTOR**

The following requirements for restrictors will apply to all developments within the DISTRICT:

1. Restrictors shall be placed at the upstream end of a pipe to facilitate inspection and cleaning.
2. Provide a detail for the proposed restrictor on the plans. Provide a callout on the plans identifying the location of the restrictor and the construction detail. No restrictor smaller than 6 inches in diameter is allowed. Non-circular restrictors may be no less than 6 inches in any direction across the opening.
3. Provide restrictor calculations. Use the orifice equation. Assume 2 feet of head unless better tailwater data is available. Compare the actual release to the maximum allowable release.

Use the following orifice equation for this analysis:

$$Q = C \times A (2 \times g \times H)^{\frac{1}{2}}$$

Where:

Q = The actual release rate (cfs)

C = The pipe coefficient (typically 0.8)

A = The restrictor cross-section area (sf)

g = Acceleration due to gravity (32.2 ft/s<sup>2</sup>)

H = The water surface elevation difference across the opening (ft)

4. If a subdivision (or development) is constructed in phases, in accordance with an approved Final Drainage Plan (and Final Plat if required), the outlet or metering pipe or device shall be designed so that the allowable peak discharge from the first phase is the control factor for sizing the metering device. As

additional phases are constructed, replacement restrictors or additional openings may be put in the outlet system. Alternatively, the existing device may be altered to allow the peak discharge to be metered for both phases. All subsequent phases must follow this requirement.

## **SECTION 16 - EXTREME EVENT OVERFLOW REQUIREMENTS**

An extreme event shall be defined as a storm event equal to or in excess of a 100-year storm. The Applicant must provide an extreme event analysis which will convey the runoff from the development area to the detention pond and ultimately to the point of discharge from the site.

Projects with multiple ponds must additionally show how the extreme event will be conveyed from pond to pond in an extreme event overflow swale or underground pipe or box. An extreme event overflow swale shall be provided where the extreme event enters and exists all detention ponds.

All extreme event overflow swales into a DISTRICT owned or maintained facility shall meet the following requirements:

1. Construct the overflow swale with reinforced concrete slope paving as per the District's details. Articulated interlocking block and rubble stone rip-rap will not be allowed.
2. The cross section of the lined overflow swale shall have slopes no greater than 6:1 such that DISTRICT maintenance equipment can navigate across the opening.
3. The lined overflow swale shall have a minimum bottom width of 6 feet. The applicant's engineer shall provide calculations on the plans demonstrating that the weir is adequately sized. A broad crested weir calculation shall be used for this analysis.
4. See the current DISTRICT details for additional requirements.

All other extreme event swales which will discharge into a County, City, MUD, or otherwise publicly maintained facility shall be constructed in accordance with the applicable agencies. Include a reference to the specific requirements of the agency(s) and any required details.

## **SECTION 17 – OTHER APPROACHES TO DETENTION**

### **A. UNDERGROUND DETENTION SYSTEMS**

In some instances, special constraints on site may make it desirable to utilize underground detention storage to maximize the use of the available land on site. The following requirements shall apply to all underground detention systems within the DISTRICT:

1. For underground detention systems using circular pipes, a minimum diameter of 48 inches shall be required.
2. For underground systems using rubble backfill, the void space in between the stones shall not be counted as detention volume.
3. A storm water pump station may be used in combination with an underground detention system.
4. All underground detention systems shall be designed such that the bottom of the underground system can be viewed from the ground surface without the need for confined space entry. This can be achieved with surface grate inlets, manhole covers, or inspection ports. The District shall have the right to inspect or enter an underground detention system for any reason.
5. Provide information, specifications, and / or calculations on the construction drawings to demonstrate that the system is properly designed for the anticipated vehicle loading.
6. No underground detention system will be accepted by the DISTRICT for maintenance. Identify the individual or entity responsible for maintenance on the plan.
7. The Owner shall provide inspection reports, photos, and / or videos acceptable to the DISTRICT Inspector for the purposes of confirming that the system is working properly and that detention volume has not been reduced as a result of the accumulation of sediment. This information shall be provided to the DISTRICT a minimum of once per year.

### **B. REGIONAL DETENTION FACILITIES**

The DISTRICT along with other governmental entities have constructed numerous regional detention facilities throughout the DISTRICT. Additionally, the DISTRICT has a preference for development to utilize larger, shared regional detention facilities especially when they have the potential to reduce or eliminate the number of small, shallow ponds throughout the DISTRICT. In addition to a reduction of maintenance related issues, these larger deeper detention facilities offer the added benefit to the property owner of less land being utilized for detention.

Applicants making a claim for detention credits within a regional facility must submit paperwork including the Board approved Drainage Plan and / or Report, authorization to use any surplus credits from the facility owner, and an updated ledger of all previous commitments of the regional detention system to other projects. Failure to provide adequate documentation will result in denial of the request.

Regional facilities may be utilized in lieu of on-site detention provided there is sufficient conveyance across privately held property to the detention facility and / or DISTRICT channel without an impact

occurring between the increased runoff caused by development upstream and the detention mitigation provided downstream. See Section 4.B.3.

A meeting with the DISTRICT to discuss the possibility of master planned detention is highly recommended prior to proceeding with design and plan production. In other cases where the Applicant proposes to mitigate for new development in existing regional detention facilities, a meeting with the DISTRICT is required prior to beginning design.

In cases where the proposed development is separated from the detention mitigation by a public storm sewer or DISTRICT facility, the Applicant is required to have a Board approved Drainage Impact Analysis showing zero downstream impact prior to receiving Drainage Plan approval from the Board.

### **C. IN-LINE DETENTION**

In-line detention proposed by benching drainage ditches and channels will be handled in a similar manner to regional detention. In-line detention will always require a Board approved Drainage Impact Analysis showing zero downstream impact prior to the Board approving the Drainage Plan for proposed development. The engineer for the project is encouraged to consult with the Floodplain Administrator regarding any other pertinent requirements in advance of beginning analysis and design.

### **D. DETENTION USED AS RECREATIONAL SPACE**

A detention facility generally requires the commitment of a substantial land area. The DISTRICT recognizes that such a facility could potentially be used for other purposes which are compatible with the primary intended purpose of mitigating developed runoff and providing flood control.

Detention facilities could potentially be used as parks, ball fields, or other recreational facilities. Detention ponds which will serve a secondary use such as those listed above require approval of the DISTRICT Engineer in advance of commencing with design and the preparation of construction plans. A Board approved Request for Variance is required for permanent improvements within a detention pond. See Section 14.B.11.

## **SECTION 18 - OTHER MEANS OF MITIGATING DEVELOPED FLOWS**

### **A. PARKING LOT STORAGE**

Parking lot detention storage may be used to mitigate developed flows subject to meeting all of the following requirements:

1. The depth of storage cannot exceed 9 inches at any point on site.
2. The depth of storage cannot exceed 3 inches in any areas designated for vehicle parking. Show / dimension parking stalls in the required cross sections. See Section 18.A.6.
3. The property owner or designee's engineer must prove that storm water will rise to the design elevations intended by providing a hydraulic analysis or by other means.
4. The perimeter paving or curb elevations must be capable of containing the water to the design elevation intended.
5. The applicant's engineer must provide an extreme event analysis demonstrating that the extreme event will drain toward the pond and / or outfall point as intended.
6. The applicant's engineer must provide detailed cross sections and calculations giving an accurate accounting of the volume provided based upon actual, attainable water surface elevations and depths. Typical cross sections, average depths and other simplified means determining the volume will not be accepted.
7. The DISTRICT will not be liable for any damage or flooding which occurs as a result of parking lot detention storage. Place a note to this effect on the plans.

### **B. PIPE AND INLET STORAGE**

Storm sewer pipe and inlet boxes may be counted as detention storage used to mitigate developed flows subject to meeting all of the following requirements:

1. The storm sewer pipe counted in this analysis cannot be anything more than the typical pipe needed to drain the site. Oversized or redundant pipes are to be constructed as Underground Detention Storage. See Section 17.A for those requirements.
2. The applicant's engineer shall provide a detailed accounting of the pipe storage provided on the plan sheets.
3. The applicant's engineer shall prove that the pipes and inlets will fill during a storm event based upon hydraulic or other analysis.



## **C. DITCH AND SWALE STORAGE**

The volume within ditches and swales cannot be counted as detention storage for a property to be used for subdivision developments, multi-family projects, commercial purposes, or industry unless it complies with all of the minimum requirements for a traditional detention pond listed in these Rules, Regulation, and Guidelines.

## **D. PERMEABLE PAVING SYSTEMS**

The DISTRICT will allow the use of permeable pavement systems to be treated as pervious cover (no detention required) subject to meeting all of the following requirements:

1. The property owner or designee's engineer shall provide technical data on the plans which supports the applicant's claim for the paving system being permeable.
2. The design of the permeable pavement system shall include detailed, site specific specifications and requirements for excavation, preparation, backfill, and a slotted drain pipe which will allow the design flows to permeate into the area beneath the driving surface.
3. The applicant's engineer shall provide adequate technical data and specifications to ensure that the system will have capacity for the anticipated vehicle loads.
4. The applicant's engineer shall provide adequate assurance that the permeable paving system will be adequately maintained and continue to perform as intended. This assurance will come in the form of Maintenance Declaration, or other requirements in place at the time of plan review and approval.
5. Failure to maintain the permeable paving system in working order is a violation of these Rules, Regulation, and Guidelines and will subject the property owner to civil penalties pursuant to Section 29 – Penalties of these regulations. Penalties may include charges for repairs conducted by the DISTRICT, or other penalties prescribed by the current policy of the DISTRICT at the time of violation.

## **SECTION 19 - MAINTENANCE OF DETENTION FACILITIES**

Unless otherwise provided by written agreement consented to by the DISTRICT, all drainage and detention facilities constructed to serve land within the DISTRICT shall be maintained by the current owner of the property where the facilities are located, regardless as to whether the current owner developed the property. The responsible maintenance party at the time of development must be noted on the Drainage Plan and in any applicable Maintenance Declaration.

The maintenance of detention and drainage facilities is critical for ensuring that these facilities will work as intended during rainfall events. The current property owner shall ensure that the drainage facilities are functioning as designed and being maintained in accordance with the approved final plans for the property. Any person or entity who fails to properly construct or maintain all drainage and / or detention systems in strict compliance with (i) the Maintenance Declaration for the property, as applicable; or (ii) the approved plans, shall be subject to the enforcement and civil penalty provisions contained herein. This provision applies regardless of whether (a) that plan was originally approved by the District, the City of Manvel, the City of Pearland, or other authorized overlapping jurisdiction, or (b) the current owner developed the property.

The DISTRICT will not be responsible for the maintenance of any detention pond within the DISTRICT unless specific criteria have been met and the DISTRICT has formally accepted the facility for maintenance.

### **A. MAINTENANCE OF NON-DISTRICT DETENTION FACILITIES**

The owner(s) of property served by non-DISTRICT detention facilities shall ensure that those facilities are properly maintained in accordance with the approved Final Drainage Plan and meet the following minimum standards:

1. Routine mowing and the removal of invasive plants.
2. Restoration of grass cover.
3. Removal of trash and debris from inlet and outlet pipes.
4. Repair of erosion, rills, and washouts.
5. Removal of excessive silt, debris, and vegetation from pilot channels, pond bottoms, wet wells, underground storage tanks, permeable paving systems, inlets, interceptors, and drainage pipes.
6. Other repairs and maintenance as needed to restore positive drainage and allow the pond to drain as intended.
7. Stormwater pump stations (if any) are functioning automatically as designed and per the Board approved Final Drainage Plan.

## **B. GENERAL REQUIREMENTS FOR ALL DETENTION FACILITIES TO BE MAINTAINED BY THE DISTRICT**

The DISTRICT, at its option, may accept for maintenance a detention facility provided that the following minimum criteria are met:

1. The developer / property owner conveys the land area of the detention facility to the DISTRICT by General Warranty Deed, in a form acceptable to the DISTRICT. This transfer of land shall include a minimum 20-foot-wide unobstructed access way to the nearest public road right-of-way.
2. No detention pond under two (2) acres will be accepted by the DISTRICT for maintenance.
3. Detention facilities must be located adjacent to an existing DISTRICT facility or public road right-of-way.
4. Side slopes in the detention pond must be 4:1 or flatter.
5. The pond shall have maintenance berms no less than 25 feet in width in accordance with Section 14.B.9.
6. A note in the acceptance agreement will state that mowing will only be performed on the normal DISTRICT mowing schedule (typically a few times per year).
7. Hand maintenance must be minimal and the extent of hand maintenance must be clearly identified in the agreement.
8. A maintenance fee must be paid as per the DISTRICT's current Fee Schedule.
9. Any variance granted to the detention facility must be considered as part of the acceptance criteria.
10. The DISTRICT will not accept any pumped detention systems for maintenance.

## **C. DISTRICT MAINTENANCE OF NEWLY CONSTRUCTED DETENTION FACILITIES**

The DISTRICT, at its option, may accept for maintenance a newly constructed detention facility provided that the following minimum criteria are met:

1. The developer / property owner conveys the land area of the detention facility to the DISTRICT by General Warranty Deed, in a form acceptable to the DISTRICT. This transfer of land shall include a minimum 20-foot-wide unobstructed access way to the nearest public road right-of-way.
2. The detention facility is constructed in accordance with the Final Drainage Plan which was approved by the DISTRICT.
3. The DISTRICT is furnished an "As-Built" survey signed and sealed by a Surveyor registered in the State of Texas.
4. The detention facility has a concrete pilot channel.

5. In most cases an amenity or wet detention pond will not be accepted.
6. The detention facility is not used for recreational purposes such as sports fields.
7. The detention pond shall have been constructed with adequate backslope drains and swales that were constructed to DISTRICT standards and requirements.
8. The detention facility, maintenance berms, and access points meet DISTRICT requirements and are not obstructed or encumbered by permanent improvements including landscaping or any other easements or rights-of-way.
9. The developer or property owner has paid to the DISTRICT the appropriate maintenance fee as reflected in the DISTRICT's current Fee Schedule.
10. The developer or property owner has provided the DISTRICT (in form and content acceptable to the DISTRICT):
  - a. An owner's title policy for the property conveyed based upon the fair market value as determined by an appraisal, including a tax search.
  - b. An Indemnification and Hold Harmless Agreement for any and all claims, actions and demands, including costs and attorney's fees, the cause of which originated prior to conveyance of ownership.

#### **D. DISTRICT MAINTENANCE OF PREVIOUSLY CONSTRUCTED DETENTION FACILITIES**

The DISTRICT, at its option, may accept for maintenance a previously constructed detention facility provided that:

1. The facilities are returned to the standards of the DISTRICT that were in force at the time the DISTRICT approved the Final Drainage Plan.
2. The DISTRICT is provided access to inspect the facility and to provide the developer / property owner / Homeowner's Association with a list of items that must be corrected. The DISTRICT shall be allowed to inspect the facility after corrective measure are complete to ensure compliance.
3. A concrete pilot channel is constructed as needed and at no cost to the DISTRICT and then inspected by the DISTRICT.
4. Upon request, the DISTRICT will provide the developer, property owner, or Homeowners' Association with an estimated cost to correct the deficiencies and to retrofit a concrete pilot channel. Upon agreement by all parties, the DISTRICT will provide the necessary construction in exchange for a fee based upon the estimated costs of repairs and upgrades as determined by the DISTRICT.
5. The detention facility, maintenance berms, and access points are not obstructed or encumbered by any permanent improvements, landscaping, easements, or rights-of-way.
6. In most cases an amenity or wet detention pond will not be accepted.

7. The detention facility is not used for recreational purposes such as sports fields.
8. The developer / property owner conveys the land area of the detention facility to the DISTRICT by General Warranty Deed, in a form acceptable to the DISTRICT. This transfer of land shall include a minimum 20-foot-wide unobstructed access way to the nearest public road right-of-way.
9. The developer or property owner has paid to the DISTRICT the appropriate maintenance fee as reflected in the DISTRICT's current Fee Schedule. This fee will only be waived in instances where it is deemed advantageous to the DISTRICT.
10. The developer or property owner has provided the DISTRICT (in form and content acceptable to the DISTRICT):
  - a. An owner's title policy for the property conveyed based upon the fair market value as determined by an appraisal, including a tax search.
  - b. A warranty regarding the quality and performance of the facility includes but not limited to engineering, design, construction, and operation.
  - c. An Indemnification and Hold Harmless Agreement for any and all claims, actions and demands, including costs and attorney's fees, the cause of which originated prior to conveyance of ownership.

## **SECTION 20 - DITCHES, SWALES, AND CHANNELS**

### **A. GENERAL REQUIREMENTS**

All ditches and channels in the DISTRICT which will be owned and maintained by the County or a City must conform to that agency's requirements. Identify the City or County as the party responsible for maintenance on the plans.

All other ditches and channels within the DISTRICT shall comply with the following requirements:

1. Side slopes shall not exceed 4:1 unless specifically approved by the DISTRICT. For channels six (6) feet or greater in depth, a geotechnical investigation including a slope stability analysis shall be used to validate the adequacy of 4:1 slopes or in other instances substantiate the viability of steeper side slopes.
2. All swales, ditches, and channels shall have a minimum bottom width of 2 feet. Only swales and ditches less than one foot deep and with side slopes 6:1 or flatter may have a "v" bottom configuration. See Section 21 for the specific requirements for backslope swales.
3. Turf shall be established on side slopes and the bottom of all ditches and channels to prevent erosion during periods of high-water velocity. Germination must cover 95% of the gross disturbed area prior to the time of final inspection and approval by the DISTRICT.
4. All ditches and channels which intersect with a second, downstream ditch must align at a 30-degree downstream angle to minimize water turbulence and reduce erosion. Alternatively, an interceptor structure, conduit, or drop structure meeting all of the requirements of the DISTRICT may be used.
5. The Applicant must demonstrate that the proposed ditch or channel is maintainable. This includes providing maintenance berms and access points for mowers, excavators, and other necessary maintenance equipment. See Section 20.G – Maintenance Berms and Section 22 – Access Points of these Rules, Regulations, and Guidelines for additional requirements.
6. Ditches which will serve both as conveyance and as detention mitigation will be further be subject to the requirements for detention ponds within the DISTRICT.

### **B. LOCATION AND ALIGNMENT**

The first step in design or improving an open channel drainage system is to specify its location and alignment. Incorporate good engineering judgement to ensure that the proposed channel location provides maximum service to an area while minimizing construction and maintenance costs.

General factors and the DISTRICT criteria to take into account in locating improved channels are as follows:

1. Follow existing channels, ditches, swales or other low areas in undeveloped watersheds. This will minimize the cost of the channel itself and the underground storm sewer system, and will allow for overland flow to follow its natural drainage pattern.

2. For safety reasons, avoid locating channels and road adjacent to one another. Should such a situation be unavoidable, coordinate the design with the DISTRICT Engineer.

### **C. EROSION AND VELOCITY CONSIDERATIONS**

For ditches, swales, and channels within the DISTRICT, the calculations provided for each of these structures must include the maximum velocity during the appropriate design storm event. The maximum velocity shall not exceed 5 feet per second.

The minimum slope of ditches and swales in the direction of flow shall be 0.1%. The maximum slope will further be controlled based upon the previously mentioned maximum velocity.

In situations where the design velocity will exceed 5 feet per second, a scour analysis shall be provided. Alternatively, concrete channel section meeting all DISTRICT criteria may be used.

### **D. BENDS**

Channel bends or curves should be as gradual as possible to reduce erosion and deposition tendencies. For channel bends with a radius of curvature measure from the channel centerline which is less than three (3) times the top width, concrete slope paving meeting DISTRICT criteria is required. This concrete slope paving shall be extended no less than twenty (20) feet downstream of the end of the curve. The velocity analysis may result in additional concrete slope paving upstream or downstream based upon the 5 feet per second criteria mentioned above.

### **E. CONFLUENCES**

The angle of intersection between a main channel and a tributary channel shall be thirty (30) degrees as shown in the current DISTRICT details. An angle less than this amount will be allowed only when deemed appropriate by the DISTRICT Engineer.

The full intersection of the confluence shall have concrete slope paving including concrete upstream and downstream of the confluence as shown in the current DISTRICT details.

### **F. TRANSITIONS**

Transitions generally occur at bridges, culverts, and where the cross section of the ditch or channel section changes. For these situations, additional analysis to determine velocities is required. Based upon the velocity, concrete slope paving will be required as described in Section 20.C.

### **G. SPECIAL STRUCTURES**

Based upon the relatively flat terrain throughout the DISTRICT, special structures such as straight drop spillways, baffle chutes, and sloped drop structures should rarely be required. Prior to initiating the design of any of the special structures, the Applicant shall meet with the DISTRICT Engineer to discuss the unique requirements for the development and the special structures proposed.

The DISTRICT shall have the right to require additional information, analysis or design which may include soil analysis, slope stability analysis, scour analysis, geotechnical engineering, and structural engineering.

## **H. MAINTENANCE BERMS**

All DISTRICT and privately maintained ditches and channels shall meet the following minimum maintenance berm criteria:

**Table 21-1**

<b>Channel Depth (ft) *</b>	<b>Berm Width</b>
0' - 1.5'	10'
>1.5' - 3'	15'
>3' - 5'	20'
>5'	30'

\* - Total excavated depth on the deepest side

For all other ditches and channels, identify the public agency, private entity or Owner responsible for maintenance and cite the maintenance berm width requirements on the plans.

## **I. CONCRETE LINED CHANNEL SECTIONS**

In some instances, flow velocities, erosion consideration, or easement constraints may make a fully or partially concrete lined channel section necessary. The degree of structural analysis required varies significantly depending on the intended purpose and the steepness of the slope on which paving is proposed. Any proposed design for slope paving steeper than 3:1 must be accompanied by geotechnical analysis and a structural design by an Engineer.

Independent of that analysis and design, the following minimum requirements shall apply to concrete lined channel sections:

1. All slope paving shall meet or exceed the requirements for paving thickness, rebar size and spacing, and toe walls as reflected in the current DISTRICT details for outfalls into a DISTRICT facility.
2. Poured in place reinforced concrete slope paving shall not be steeper than 1.5:1. Concrete lined rectangular (vertical wall) channel cross sections are not allowed without prior approval by the DISTRICT.
3. For fully lined channel sections, no backslope swales or interceptor structures are required. Partially lined channel sections must be in compliance with Section 20 of these Rules, Regulations, and Guidelines.
4. All concrete lined channels shall include weep holes which shall be constructed to relieve hydrostatic head behind the channel lining in accordance with the current DISTRICT details. Include callouts on the plan sheets referring to the specific standard DISTRICT details which must be followed.



5. Where construction of concrete slope paving is to occur in mud or standing water, a seal slab shall be placed prior to the placement of slope paving or toe walls. Alternatively, a plan for dewatering shall be provided.
6. For channel bottom widths twenty (20) feet or greater, transverse grade beams shall be installed at a separation distance no greater than twenty (20) feet center to center. Grade beams shall be no less than one (1) foot wide and no less than eighteen (18) inches deep and run the width of the channel bottom.

## SECTION 21 - BACKSLOPE SWALES AND INTERCEPTORS

The use of backslope drains and swales is required wherever the property adjacent flows overland toward and down the slopes of a detention pond, ditch, or channel. These backslope swales collect the overland flow from the overbanks and other areas. Their purpose is to prevent excessive overland flow from eroding grass-lined channel side slopes as it enters the detention pond, ditch, or channel.

The general requirements for backslope swales and interceptor structures are as follows:

1. Backslope drain pipe shall be aluminized steel, reinforced concrete pipe (RCP), High Performance Polypropylene (HP), or High-Density Polyethylene pipe (HDPE). Pipe type and diameter shall be labeled on the Drainage Plan.
2. The backslope interceptor pipe shall be no smaller than 18 inches in diameter.
3. The maximum backslope interceptor structure spacing shall be five hundred (500) feet as measured from the high point in the backslope swale to the low point at the interceptor structure.
4. The interceptor structure and swale shall be placed five (5) feet inside of the detention pond reserve, drainage easement, or fee strip, toward the outside edge of the maintenance berm. Provide dimensions on the plan to demonstrate compliance. The maintenance berm shall be graded to drain toward the backslope swale as per the DISTRICT details.
5. The minimum depth of the backslope swale shall be 6 inches. Show flowlines on the plan.
6. The maximum depth of the backslope swale shall be 18 inches. Show flowlines on the plan.
7. The minimum slope for the backslope swale in the direction of flow shall be 0.1%. Label the slope on the drawing.
8. The backslope swale side slopes shall be no steeper than 3:1. Label the proposed side slopes to demonstrate compliance.
9. The backslope swales, interceptor structures, and required concrete slope paving shall be constructed as per the current DISTRICT details.

Proposed detention ponds with less than 3 feet of excavated depth are exempt from the requirement to provide backslope swales and interceptor structures however the Engineer shall make reasonable efforts to keep sheet flow from running down the slopes of the detention pond.

## SECTION 22 - ACCESS POINTS

Access points from a public right of way to a detention pond, swale, ditch, or channel within the DISTRICT are necessary to ensure that maintenance is possible.

For DISTRICT maintained ditches and channels, the following access requirements will apply:

1. The spacing between access points for a DISTRICT facility shall not exceed two thousand (2,000) feet unless specifically approved by the DISTRICT. Consult with the DISTRICT Engineer early in the design process to confirm the correct access point locations.
2. The proposed access point shall be a minimum of twenty (20) feet wide and shall not be obstructed by permanent improvements including but not limited to landscaping, bushes, and trees.
3. Additional access easements may be required to provide the DISTRICT with ingress / egress from a drainage easement or fee strip to a public road right of way.
4. Gates may be placed at access points if they meet the DISTRICT's requirements and the DISTRICT has the means to open the gate without the assistance of the property owner. A properly executed Encroachment Agreement approved by the DISTRICT is required.

## **SECTION 23 – DISTRICT MAINTAINED FACILITIES, DRAINAGE EASEMENTS & FEE STRIPS**

The DISTRICT requires fee strips or easements in all developments within DISTRICT jurisdiction for the purpose of allowing the DISTRICT access to and maintenance of the DISTRICT's drainage facilities in accordance with the DISTRICT's Flood Protection Plan and Master Drainage Plan. Absent specific authority for the construction or placement of an encroachment, improvements or materials placed within areas owned or maintained by the DISTRICT will be removed by the DISTRICT. Unless otherwise required by law, such property may be removed without notice to the landowner. The landowner shall be responsible for payment of costs incurred by the DISTRICT to remove same.

1. Access easements, drainage easements, and / or fee strips shall be provided for each DISTRICT owned or maintained ditch for access and maintenance by DISTRICT drainage crews from a public road right of way or adjacent drainage facility pursuant to the requirements of the Rules, Regulations, and Guidelines.
2. For all DISTRICT owned and / or maintained facilities, the total ultimate drainage easements shall be as prescribed in the DISTRICT's Flood Protection Plan and Master Drainage Plan as currently amended. Contact the DISTRICT Engineer for specific easement requirements for each DISTRICT facility.
3. Drainage easements and / or fee strips shall be placed such that they are centered on the existing centerline of the ditch or channel.
4. Additional access easements may be required to comply with the Section 22 of these Rules, Regulations, and Guidelines.
5. Buildings, fences, structures, landscaping, and other permanent improvements shall not be placed or erected in drainage easements, fee strips, or access points.
6. Dumping, placing and/or storing landscaping materials or debris, household garbage, general rubbish, illegal discharges and construction of any kind upon a District owned or maintained facility is strictly prohibited.
7. Aerial overhang of a drainage easement, fee strip, or access point shall be prohibited unless specifically approved in writing by the DISTRICT.
8. Drainage easements, fee strips, and access points may be used by any governmental body for the purposes of drainage work provided that the DISTRICT is properly notified.
9. Instruments conveying easements and / or fee strips to the DISTRICT must be acceptable to the DISTRICT in form and content.
10. A District permit and approval are required prior to construction, use, access, or crossing of a District maintained facility, drainage easement, or fee strip.

Drainage easements and access easements require the approval of District Staff and the District Engineer prior to dedication to the DISTRICT.

## SECTION 24 – PERMITS

The DISTRICT controls certain activities within its jurisdictional authority. The DISTRICT requires permits and on-site availability of such permits. Permits granted for activities within the DISTRICT shall list the specific activities for which the permit was issued and the date of expiration. Activities shall be limited to those shown on the issued permit. The Property Owner is responsible for renewing permits prior to the expiration date and will be considered in non-compliance during the period that the permit is expired.

Either the DISTRICT's Superintendent or the DISTRICT's Engineer shall approve or deny permit requests. Payment must be received at the DISTRICT office before the permit will be issued.

There are two types of permit application forms for construction activities within the DISTRICT:

### **A. PERMIT APPLICATION FOR ANY WORK ASSOCIATED WITH THE CONSTRUCTION OF A PROJECT WHICH HAS RECEIVED DRAINAGE PLAN APPROVAL FROM THE DISTRICT**

A permit must be obtained from the DISTRICT prior to the start of construction for work, including but not limited to, the following activities shown on a Board approved Drainage Plan:

1. Construction of dry detention ponds
2. Construction of wet detention ponds
3. Construction of a pump station for a detention facility
4. Construction of an underground detention system
5. Construction of parking lots used for surface detention
6. Construction of permeable paving systems

No permit will be issued until the applicant has obtained a Board approved Drainage Plan. The DISTRICT's current Permit Application for Work on a DISTRICT Board approved Drainage Plan, which form of permit is incorporated herein by reference, contains a complete list of projects requiring a permit, current permit fees, and other permit and construction requirements. This application form is available on the DISTRICT website or in person at the DISTRICT office.

### **B. PERMIT APPLICATION FOR WORK IN A DISTRICT MAINTAINED FACILITY, EASEMENT, OR FEE STRIP**

A permit must be obtained prior to the start of construction for work including, but not limited to, the following activities within a DISTRICT owned or maintained facility, easement, or fee strip:

1. Utility or pipeline crossings – See Section 24.C.
2. Drainage outfalls \*\*
3. Temporary low water crossings
4. Temporary pumping
5. Bridge crossings. See Section 25. \*\*
6. Permanent culvert crossings. See Section 25. \*\*
7. Temporary parking, staging, or access

**\*\* The property owner must obtain a Board approved Drainage Plan as a pre-requisite for obtaining a permit.**

The DISTRICT's current Permit Application for Work in a DISTRICT Facility, which form of permit is incorporated herein by reference, contains a complete list of projects requiring a permit, current permit fees, and other permit and construction requirements. This application form is available on the DISTRICT website or in person at the DISTRICT office.

## **C. UTILITY AND PIPELINE CROSSING REQUIREMENTS**

As a pre-requisite for obtaining a permit to construct utility or pipeline crossings of a DISTRICT owned or maintained facility, the applicant must obtain DISTRICT approval of a Construction Plan. A Construction Plan may be reviewed and approved by DISTRICT staff. No Board approval is required for this type of plan provided that the minimum requirements are met.

Plan and profile drawings must be drawn to scale, signed and sealed by an Engineer, and meet the following minimum DISTRICT requirements:

1. Show the existing DISTRICT ditch in plan and profile views.
2. Show the existing and ultimate cross section of the DISTRICT ditch in the profile view. In the plan and profile views, label the high bank, toe of slope, and the flowline of the ditch. Show and label the existing and ultimate drainage easement. Dimension the maintenance berms. Obtain the ultimate channel and easement configuration from the DISTRICT Engineer.
3. All newly constructed pipelines shall have a minimum ten (10) feet depth of cover as measured from the bottom of the ultimate cross section for the entirety of the ultimate drainage easement or fee strip. Dimension to demonstrate compliance.
4. All other relocated, proposed, or newly constructed utilities shall have a minimum five (5) feet depth of cover as measured from the bottom of the ultimate cross section for the entirety of the ultimate drainage easement or fee strip. Dimension to demonstrate compliance.
5. Manholes (if any) associated with any crossing must be placed outside of the DISTRICT's ultimate drainage easement.
6. Crossings must be clearly marked in the field with a sign on both sides of the DISTRICT facility and shall be placed immediately outside of the DISTRICT's ultimate drainage easement or fee strip. Put a note regarding this requirement on the plan.
7. Any damage to the DISTRICT's facility caused by the Applicant or their agents shall be repaired by the Applicant at no cost to the DISTRICT. Include a note to this effect on the plan sheet.
8. The Contractor shall notify the DISTRICT office a minimum of 48 hours prior to construction at (281) 485-1434. Put a note to this effect on the plans.

9. Temporary low water crossings are not allowed except with specific, prior authorization by the DISTRICT. See Section 24.B.
10. No open cut or excavation will be allowed within a DISTRICT facility without specific prior approval by the DISTRICT.
11. Aerial power, phone, cable, and data crossings shall be a minimum of fifteen (15) feet above the ground for the entirety of the ultimate drainage easement or fee strip.
12. Meet with and obtain approval from the DISTRICT Engineer prior to designing all other aerial crossings over DISTRICT maintained ditches and channels. The DISTRICT Engineer has the discretion to require a Board approved Drainage Plan.

#### **D. SAND PIT PERMIT**

The DISTRICT has adopted a Sand Pit Policy, effective December 1, 2021, which policy is incorporated herein by reference. The Sand Pit Policy requires that the operator of a sand pit obtain a permit prior to beginning any construction or mining related activity. An Engineered Drainage Plan must be submitted to the DISTRICT for approval to obtain this permit. No permit will be issued until the property owner or designee obtains a Board approved Drainage Plan.

Sand Pit Permits expire within 365 days of the issue date. If the permit renewal application is submitted and approved by the District within 90 days of expiration, the permit can be renewed for an annual fee. If the application is not submitted and approved by the District within 90 days of expiration, the development is subject to all current Sand Pit submittal requirements, application fees, and permit fees.

All sites within the jurisdiction of the DISTRICT that are commercially mining sand, fill, aggregate and similar materials will be subject to the policies and procedures contained herein.

These policies and procedures include the minimum requirements for mining and associated groundwater pumping on those sites. Additional requirements may be imposed as deemed necessary based upon the complexity and scale of the operation.

All mining operations are subject to these Rules, Regulations, & Guidelines.

##### **1. PROCEDURES**

- a. A meeting shall be held at the DISTRICT office with the DISTRICT staff or DISTRICT Engineer prior to initiating the design and preparing engineering drawings for the proposed mining operation.
- b. Applicant's engineer initiates design and construction plan preparation.
- c. Applicant initiates required paperwork and approval processes with the TCEQ and other agencies with jurisdictional authority.
- d. Applicant submits the required items to the DISTRICT for review and comment. Applicant makes corrections as required.



- e. Final approval can be issued only by the DISTRICT's Board of Commissioners at a posted DISTRICT meeting which typically occurs only once per month. No approval will be given until all of the requisite TCEQ paperwork and approvals have been provided.
- f. A DISTRICT issued Sand Pumping Permit expires after one year. Property Owner or his/ her designee must request renewal of the Sand Pumping Permit annually. No construction or mining related activity may begin until the project receives Board approval and the Sand Pumping Permit has been issued.

## 2. DESIGN REQUIREMENTS

- a. Design a Storm Water Pollution Prevention Plan (SWPPP) showing the temporary erosion control measures to prevent sediment laden storm water from leaving the site during the initial disturbance and setup of the mining operation. This plan would typically include filter fabric fence, reinforced filter fabric fence, diversion swales, stabilized construction entrance, and concrete truck washout. This plan must include procedures for maintenance of the erosion control measures and requirements for regular record keeping regarding rainfall and maintenance events on site.
- b. Design a Storm Water Quality Management Plan (SWQMP) showing the permanent measures which will be put in place to remove sediment prior to the discharge off site as water is pumped from the excavation area. This plan would typically include settling ditches, sedimentation basins, and other anti-scour erosion control measures. This plan must also include an operations manual for the maintenance and cleaning of permanent storm water control measures on site. Records shall be kept on site for all maintenance and cleaning activities. The manual and records shall be made available to the DISTRICT upon request.
- c. Drainage calculations shall be in conformance with the DISTRICT's Rules, Regulations, and Guidelines. At a minimum, the plans and calculations shall show the existing and proposed 3- year, 10-year, and 100-year runoff. This will include an analysis of offsite flows which drain toward the subject tract. The calculations shall show no adverse impact to neighboring tracts as a result of the proposed mining operation.
- d. Pumping calculations shall show that no net increase in water leaving the site will occur as a result of rainfall and/or pumping operations. Pumping rates shall not exceed the existing/ allowable 3-year runoff rate. Pumping shall discontinue when the receiving ditch is more than ½ full. Pumping shall discontinue during rain events and when rainfall is eminent. Notes to this effect must on the plans.
- e. For projects which propose perimeter levees on site, the applicant must obtain approval or letter of no objection from the Floodplain Administrator. This approval will be required prior to Board approval of the plan and issuance of the pumping permit.
- f. The plans shall include the design of a combination of settling ditches and settling ponds to remove sediment for pumped water prior to the release from the site.
- g. Settling calculations shall be provided on the plans and must meet the following minimum criteria:
- h. Provide the flow velocity across the cross section of each settling ditch and settling pond. Velocities in settling ditches shall not exceed 0.1 fps. Velocities in settling ponds shall not exceed

0.01 fps. The cross section used in these calculations shall account for sediment accumulation prior to cleaning.

- i. Provide the settling time for each settling ditch and settling pond. The minimum treatment time for settling ditches shall be 5 hours. The minimum treatment time for settling ponds shall be 10 hours. The total treatment time prior to release from the site shall be no less than 15 hours.
- j. All transitions between pumps, ditches, ponds, and the outfall point shall be manufactured conduit, reinforced, or concrete lined to prevent erosion and resuspension of sediment.
- k. A minimum 30-foot setback from the property line to the edge of the excavation area is required.
- l. The slope of the excavation area shall be no steeper than 4:1. Construction plans must be in compliance with the DISTRICT's Rules, Regulations, & Guidelines.

### 3. SUBMITTAL REQUIREMENTS

- a. One (1) complete set of construction plans and supporting documentation containing the following items shall be submitted to the DISTRICT office.
- b. Provide a copy of the approved Texas Commission on Environmental Quality (TCEQ) Aggregate Production Operation (APO) Registration form with assigned APO number. <https://www.tceq.texas.gov/permitting/registration/aggregates>
- c. Provide a copy of the approved Texas Commission on Environmental Quality (TCEQ) Storm Water Permit. <https://www.tceq.texas.gov/permitting/stormwater>
- d. Provide a complete set of plans for the proposed mining operation signed and sealed by a professional engineer registered in the State of Texas. The plans shall include at a minimum:
- e. Cover sheet including a vicinity map, and DISTRICT signature block.
- f. General construction notes including the DISTRICT Standard Notes.
- g. Topographic survey prepared by a professional land surveyor registered in the State of Texas and including actual on the ground survey collected within the last year.
- h. Overall layout showing the pit location, pumping facilities, storm water outfall, and other pertinent improvements.
- i. Drainage Plan showing how on-site and off-site runoff will be managed without an adverse impact on site or to neighboring property.
- j. Storm Water Pollution Prevention Plan (SWPPP).
- k. Storm Water Quality Management Plan (SWQMP).
- l. Plan and profile drawing showing the outfall per DISTRICT requirements and details.

- m. Detailed drawings and cross sections for mining areas, settling ditches, sedimentation basins, and perimeter levees.
- n. Drainage, pumping, and settling calculations.
- o. Construction details.
- p. A Geotechnical Report including boring logs and slope stability analysis prepared by a professional engineer registered in the State of Texas.
- q. Technical specifications for the pumping equipment to be used on site including pump curves and other data to substantiate the actual pumping rates.
- r. Additional paperwork and documentation as required by DISTRICT Staff.

## SECTION 25 – BRIDGES AND PERMANENT CULVERTS

The following standards apply to permanent bridge and roadway culvert crossings to be constructed across DISTRICT ditches and channels:

1. Because of the level of effort required for analyzing and designing a bridge or culvert crossing and because of the potential for those proposed improvements to adversely impact DISTRICT operations, it is strongly recommended that the applicant's engineer hold a pre-development meeting with the DISTRICT as early as possible in the design process.
2. Construction and maintenance of bridges and culvert crossings are the responsibility of the property owner.
3. Proposed Construction Plans must designate the contact person, entity name (if applicable), address, and phone number for the responsible party. Do this by adding a statement to this effect on the plan.
4. Bridges and culvert crossings shall not cause an adverse impact upstream or downstream of the proposed crossing. The applicant bears the responsibility for demonstrating compliance. This may trigger the need for a Drainage Impact Analysis. In cases where a Drainage Impact Analysis was submitted and approved by the Board as a pre-requisite for obtaining Drainage Plan approval, the name of the Drainage Impact Analysis, submitting engineering firm, and date of Board approval shall be listed on the construction plans for the bridge or crossing.
5. Construction Plans for all bridges and culvert crossings of DISTRICT facilities shall be submitted to the DISTRICT for review and approval. Board approval is required. Installations of temporary low water crossings or private driveway culvert installations does not require Board approval.
6. Bridge piers may be placed within the cross section of the DISTRICT's facility but shall not be placed within the channel bottom.
7. Guardrails, abutments, and other bridge improvements shall not prevent access to the channel for maintenance. Additional access easements may be required.
8. The bottom of the low chord of any bridge must be set no lower than the 500-year base flood elevation (BFE) per the current Flood Insurance Rate Map (FIRM). The current effective FIRM panel number, effective date, and 500-year base flood elevation (BFE) shall be noted on the construction plans. The applicant bears the responsibility for determining if the Floodplain Administrator has a more stringent requirement.
9. Bridge designs must include cast in place reinforced concrete slope paving per the DISTRICT details under the bridge to prevent scouring, erosion, and structural failure.
10. Bridge designs shall account for any future widening of a DISTRICT facility to the ultimate cross section.
11. In some instances, additional pipe must be installed on each side of the road to provide a 20' wide unobstructed path for maintenance equipment from one bank of the ditch to the other. Pipe ends at culvert crossings on District maintained facilities must be as per the DISTRICT details.

12. Bridge and culvert plans must be accompanied by a scour analysis prepared by an Engineer which addresses erosion and the need for concrete slope paving. No articulated interlocking concrete block or rubble rip rap will be allowed. See also, Section 20.C.

The following additional criteria shall apply to any culvert crossing of a DISTRICT owned or maintained facility:

1. Culvert crossings shall meet or exceed any County, City, or TxDOT requirements. In cases where those other criteria exceed the following DISTRICT criteria, the more stringent County, City, or TxDOT requirements shall be followed.
2. The minimum diameter of any culvert shall be 18-inches.
3. Culvert crossings shall be sized using the following methodology unless the DISTRICT Engineer confirms that an analysis provided by the applicant's engineer shows that compliance with these standards would result in an adverse impact to nearby property.
  - a. Private driveway culverts to be installed in ditches 3 feet or less in depth shall be sized based upon the 5-year flow for the fully developed condition. The analysis must show that no more than 0.2 feet of head loss will occur to the normal water surface profile across the culvert.
  - b. Culvert crossings on public streets and private streets serving two or more properties shall be sized based upon the 25-year flow for the fully developed condition. The analysis must show that the culvert installation will not cause the water surface profile to be higher than the edge of paving along the roadway.
  - c. Any other culvert crossing including any of the crossings in Section (a) and (b) above which drain 100 acres or more shall be sized based upon the 100-year flow for the fully developed condition. The analysis must show that the culvert installation will not cause the water surface profile to be higher than the edge of paving along the roadway

See Section 24.B for additional information regarding the permit required to install a bridge or culvert crossing.

## **SECTION 26 - TEMPORARY CONSTRUCTION MEASURES**

### **A. TEMPORARY PUMPING**

The DISTRICT acknowledges that various construction projects within the DISTRICT may require temporary pumping to remove water from excavation areas. For commercial sand mining operations, See Section 24.D. For any and all other temporary pumping measures into a DISTRICT maintained facility, the following additional requirements will apply to the Board approved Final Drainage Plan for that project:

1. The contractor shall notify the DISTRICT office a minimum of 48 hours prior to the initial pumping on site. Include a statement to this effect on the Final Drainage Plan.
2. No pumping shall occur within 24 hours of a heavy rain or high-water event. The heavy rain or high-water determination shall be made by the DISTRICT. Include a statement to this effect on the Final Drainage Plan.
3. Any damage to a DISTRICT facility as a result of pumping will be repaired promptly by the permit holder at no cost to the DISTRICT. Include a statement to this effect on the Final Drainage Plan.
4. Permittee is responsible for preventing sediment laden stormwater from being released into DISTRICT facilities. Permittee is responsible for channel restoration and sediment renewal. Noncompliance during construction will result in the immediate discontinuation of pumping.

See Section 24.B.4 regarding the Temporary Pumping Permit which will be required prior to the start of any temporary pumping activities within a DISTRICT owned or maintained facility.

### **B. TEMPORARY LOW WATER CROSSING**

The DISTRICT acknowledges that various construction projects within the DISTRICT may require temporary low water crossings for construction purposes. For permanent bridges or roadway crossings, See Section 25. For any temporary low water crossings on a DISTRICT maintained facility, the following additional requirements will apply to the Final Drainage Plan for that project:

1. Provide a drawing of the proposed low water crossing. Show plan and profile views on the Final Drainage Plan.
2. The low water crossing shall be a low-profile design using a combination of smaller diameter conduits and shallow cover.
3. The applicant's engineer shall certify that the low water crossing will not cause an adverse upstream impact. Provide a statement to this effect on the Final Drainage Plan.
4. The Contractor shall be responsible for the removal of any temporary crossing prior to a rain event as the DISTRICT deems it necessary to do so. Include a statement to this effect on the Final Drainage Plan.

5. At the conclusion of construction, the DISTRICT's facility shall be restored to the satisfaction of the DISTRICT Inspector as a pre-requisite for obtaining final project approval. Include a statement to this effect on the Final Drainage Plan.
6. Permeable paving systems will be subject to DISTRICT inspections, confirmation of permeability, and the potential requirement to remove, replace, or clean the system to restore permeability.
7. The Contractor will be responsible for any cleanup or repair of the temporary crossing caused by a rain event. Include a statement to this effect on the Final Drainage Plan.

See Section 24.B.3 regarding the Temporary Low Water Crossing Permit which will be required prior to constructing a temporary low water crossing within a DISTRICT owned or maintained facility.

## **SECTION 27 - INSPECTION AND NOTIFICATION REQUIREMENTS**

### **A. INSPECTIONS THROUGHOUT CONSTRUCTION**

All drainage facilities must be constructed and maintained in strict conformity with the approved Final Drainage Plan for the property. To ensure compliance, the DISTRICT has the right to enter upon property to inspect the installation and maintenance of storm drainage and detention facilities. Upon completion of any inspection, the DISTRICT shall issue a notice of the deficiencies or the approval of the construction in accordance with the approved Final Drainage Plan. All deficiencies shall be corrected by the property owner.

Prior to the start of construction for development for which a Final Drainage Plan is required, the property owner or his or her designee shall notify the DISTRICT Inspector and request a pre-construction meeting. The DISTRICT Inspector will notify the property owner of the required inspections for the project during the pre-construction meeting. It is the property owner's responsibility to obtain all required permits (See Section 24) prior to construction and to receive all required inspections throughout construction. Failure to obtain the required inspections will likely result in the requirement to remove and replace completed work at the property owner's expense.

The DISTRICT's Rules, Regulations, and Guidelines prohibit any development which causes a rise in water surface elevation or increase in flow. This would apply to projects throughout the construction process. With this in mind, the property owner shall not place any new impervious cover until the detention improvements which will mitigate increases in runoff are substantially complete.

Additional requirements for notifying the DISTRICT prior to construction and requesting DISTRICT inspections can be found on the permit application forms, on the DISTRICT website, or in person at the DISTRICT office.

### **B. NOTIFICATION**

It is the responsibility of the property owner or designee to notify the DISTRICT office at the proper times using the correct procedures. It is additionally the responsibility of the property owner or designee to obtain confirmation that the notification was received at the DISTRICT office.

All concrete pours and backfill activities on detention systems or any proposed construction within DISTRICT facilities require a minimum of a twenty-four (24) hour notice to the DISTRICT to secure an inspection appointment. The property owner or designee must pass a DISTRICT required inspection before backfill or the placement of any concrete. Schedule accordingly. Similarly, a minimum of twenty-four (24) hours' notice shall be given to the DISTRICT prior to the start of other construction work within a DISTRICT owned or maintained facility.

Failure to properly coordinate an on-site inspection before concrete placement, backfill, seeding, etc. may cause portions of the construction to be removed and redone at the property owner's expense in order to demonstrate to the DISTRICT that the construction complies with the DISTRICT's Rules, Regulations, & Guidelines.



The DISTRICT does not assume any liability or responsibility for damages occasioned by the exercise of its rights, obligations, and powers stated herein.

The latest inspection procedures including the processes for requesting an inspection are available on DISTRICT permit application forms, the DISTRICT website, or in person at the DISTRICT office.

### **C. FINAL APPROVAL**

An As-Built Certificate shall be submitted prior to approval of any completed work by the DISTRICT. This certificate shall be signed and sealed by the property owner or developer's engineer. Obtain this form on the DISTRICT website or in person at the DISTRICT office.

The DISTRICT also requires an as-built survey prepared and sealed by a professional land surveyor registered in the State of Texas which is necessary to verify elevations and substantiate detention volumes.

All final inspections shall be performed by the DISTRICT Engineer (or designee).

No project will receive final approval until the DISTRICT Inspector and DISTRICT Engineer have determined that all DISTRICT requirements have been satisfied.

All drainage systems must be fully constructed by the property owner in strict conformance with the approved drainage plan and inspected and approved by the District prior to the occupancy of any buildings or commencement of any business operations on the property.

A complete list of the requirements for obtaining final project approval, the as-built certificate, requirements for as-built surveys, and related information can be found on the DISTRICT website or obtained in person at the DISTRICT office.

### **D. ONGOING INSPECTIONS FOLLOWING CONSTRUCTION**

The DISTRICT may enter upon property to inspect all drainage facilities located within the boundaries of the DISTRICT for compliance with the Board approved Drainage Plan for the property, including drainage plans approved by any other overlapping jurisdiction, and take enforcement actions related thereto in accordance with the District's Rules, Regulations, and Guidelines. Upon completion of any inspection, the DISTRICT may issue a Letter of Non-Compliance or a Notice of Observed Deficiencies. Failure to respond to any notice of deficiencies may result in the assessment of civil penalties in accordance with Section 29 of the DISTRICT's Rules, Regulations, and Guidelines.

## SECTION 28 - ENFORCEMENT & COMPLIANCE

An owner or property that fails to strictly comply with these Rules, Regulations, & Guidelines, regardless as to whether the owner engaged in development, is subject to the enforcement and penalty provisions herein.

1. In addition to the inspection set forth in Section 27 of these Rules, Regulations, & Guidelines and pursuant to Section 49.221 of the Texas Water Code, the Commissioners, Engineers, Attorneys, Operators, Agents, and employees of the DISTRICT have the right to enter real property within the jurisdiction of the DISTRICT to inspect, survey, or perform tests upon said property to determine the condition, value, or suitability of the property with reference to the proposed location of flood control works, improvements, plants, facilities, equipment, or appliances.
2. In addition to the inspection set forth in Section 27 of these Rules, Regulations, & Guidelines and pursuant to Section 49.221 of the Texas Water Code, the Commissioners, Engineers, Attorneys, Operators, Agents, or employees of the DISTRICT are entitled to enter any public or private property within the boundaries of the DISTRICT or adjacent to any reservoir or other property owned by the DISTRICT for the purpose of inspecting and investigating conditions relating to the quality of water in the state or the compliance with any rule, regulation, permit, or other order of the DISTRICT.
3. Pursuant to Section 49.221 of the Texas Water Code, the Commissioners, Engineers, Attorneys, Operators, Agents, or employee of this DISTRICT who enter private property shall observe the establishment's rules and regulations concerning safety, internal security and fire protection, and shall notify any occupant or management of their presence and exhibit proper credentials.
4. All requirements contained in these Rules, Regulations, & Guidelines are mandatory unless specifically stated otherwise or unless a variance is granted by the DISTRICT. The use of the term "Guidelines" herein does not affect the mandatory nature of these Rules, Regulations, & Guidelines.
5. Each day that a violation occurs may be considered a separate breach of the DISTRICT's Rules, Regulations, & Guidelines.
6. Upon its determination that property is in violation of these Rules, Regulations, & Guidelines, the DISTRICT may issue written notice to the record owner of the property as indicated by the most recent tax rolls of Brazoria County Appraisal District. Written notice of a violation shall be given by certified mail and as may otherwise be deemed appropriate by the DISTRICT. Except in the case of imminent danger to life or property, a property owner shall have sixty (60) days from the transmittal date of an initial notice to (i) rectify a deficiency and / or violation and demonstrate compliance with these Rules, Regulations, and Guidelines, (ii) request a remediation and maintenance plan, or (iii) request a variance pursuant to the terms outlined in Section 11 herein. Remediation and maintenance plans must be approved by the DISTRICT's Engineer. If a property owner fails to take the corrective action described in (i)-(iii) above within sixty (60) days from the transmittal date of the initial notification or fails to strictly comply with an action plan approved by the DISTRICT, the matter shall be referred to the Board of Commissioners for assessment of civil penalties in accordance with Section 29 herein.
7. For the purposes of calculating any day or period of time under these rules, the period of time begins to run the day written notice is placed in the United States mail or hand delivered to the person to

whom it is addressed. The day that the written notice is deposited in the United States mail or hand delivered to the person against whom penalties are to be assessed shall not be included as a 'day'. The last day of the period so computed is to be included, unless it is a Saturday, Sunday, or legal holiday, in which event the period of time runs until the end of the next day which is not a Saturday, Sunday, or a legal holiday. Saturdays, Sundays, and legal holidays shall be counted when computing this time period.

## **SECTION 29 – PENALTIES**

### **A. CIVIL PENALTIES**

1. Pursuant to Section 49.004 of the Texas Water Code, the DISTRICT may assess reasonable civil penalties for the violation of the DISTRICT's Rules, Regulations, & Guidelines, not to exceed the jurisdiction of a Justice Court.
2. A violation of these Rules, Regulations, and Guidelines for which corrective action has not been taken within sixty days from the transmittal date of the initial notice from the DISTRICT shall be subject to a minimum civil penalty of no less than \$500 and no more than \$20,000 per violation.
3. A penalty under this section is in addition to any other penalty provided by law and may be enforced by filing complaints in an appropriate court having jurisdiction over the matter.
4. The DISTRICT may seek to recover reasonable attorney's fees, reasonable expert witness fees, interest, and other reasonable costs incurred by the DISTRICT in conjunction with the prosecution of said penalties, in addition to the penalty assessed.
5. The DISTRICT may assess a separate penalty for each and every separate violation of its rules.

### **B. HEARINGS ON CIVIL PENALTIES**

Before assessing a civil penalty pursuant to this section, the DISTRICT shall meet the following procedural requirements:

1. Provide written notice to the owner of the land against which penalties are sought, as determined by the most recent tax rolls of Brazoria County Appraisal District, by certified mail, return receipt requested. If the identity of the owner of the property at issue is not known, the DISTRICT may provide written notice by placing such a written notice on the property itself in a manner calculated to attract the attention of the owner of the property.
2. The written notice shall be mailed or delivered to the owner of the property at issue at least fourteen days prior to the open meeting at which the assessment of civil penalties will be considered.
3. The written notice shall advise the landowner of the following:
  - a. The rule or regulation of the DISTRICT that has been violated and a statement of the nature of the violation.
  - b. The date, place, and time of the hearing.
  - c. The minimum and maximum amount of penalties, which may be assessed by the DISTRICT.
  - d. He / she has the right to appear at the hearing before the Board of Commissioners concerning the penalties in question either in person or through a duly authorized agent.

- e. He / she has the right to address the Board of Commissioners on the subject of penalties in question either in person or through a duly authorized agent, and to present relevant data and witnesses.
  - f. He / she has the right to have legal counsel present if he / she so desires.
- 4. All civil penalties assessed by the DISTRICT must be authorized by a majority vote of Commissioners present and voting.
  - 5. In the event that the DISTRICT assesses civil penalties for a violation of these Rules, Regulations, & Guidelines, the DISTRICT shall provide written notice by certified mail, return receipt requested, advising the property owner of the following, as applicable:
    - a. The nature of the violation.
    - b. The amount of the civil penalties assessed, whether a set amount or a daily fine to accrue until correction of the noted violation(s).
    - c. The date by which payment of the civil penalty is due.
    - d. The date by which all corrective action must be completed on the property.
  - 6. Unless otherwise specified by the Board of Commissioners, payment of all civil penalties assessed by the DISTRICT is due and owing thirty (30) days following the transmittal date of the written notice of assessed civil penalties. Penalties that remain unpaid fifteen (15) days after the date set for payment may be referred to the DISTRICT's attorneys for collection. The DISTRICT may also collect any additional attorney's fees incurred in the collection of unpaid assessed penalties.

### **C. SUBSEQUENT PENALTIES**

The DISTRICT may assess additional civil penalties without the need for a notice of violation under Section 28 if the owner of the subject property fails to (i) timely correct a deficiency for which the DISTRICT has assessed civil penalties, or (ii) timely pay an assessed civil penalty.

### **D. CUMULATIVE REMEDIES**

Nothing in this Section shall or shall not be deemed to prevent, prohibit, or limit any other remedy at law or in equity otherwise available to the DISTRICT.

## SECTION 30

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## **SECTION 31 - SAVINGS, REPEALER, SEVERABILITY & EFFECTIVE DATE**

### **A. SAVINGS**

All rights and remedies that have accrued in favor of the DISTRICT under these Rules, Regulations, & Guidelines and amendments thereto shall be and are preserved for the benefit of the DISTRICT.

### **B. REPEALER**

All resolutions, actions, policies, and procedures of the DISTRICT that are inconsistent herewith or in conflict with state laws and regulations are hereby repealed, but only to the extent of such inconsistency or conflict.

### **C. SEVERABILITY**

If any section, subsection, paragraph, sentence, clause, phrase, word, or portion of the Rules, Regulations & Guidelines or amendments thereto, is for any reason, held invalid, unconstitutional, or otherwise unenforceable by any court of competent jurisdiction, such portion shall not affect the validity of the remaining portions thereof, which remaining portions shall continue in full force and effect and be binding upon all parties.

### **D. EFFECTIVE DATE**

These Rules, Regulations, & Guidelines shall become effective on December 1, 2025 and shall continue in force and effect until amended or repealed.

## **SECTION 32 - CRITERIA AND METHODOLOGY**

### **A. INTRODUCTION**

Over the years a number of methods have been used in Brazoria County and adjacent counties for discharge determination in the design and analysis of flood control facilities. The methods included various forms of the Rational Method, U.S. Soils and Conservation Society synthetic unit hydrograph analysis using existing stream gauging records and computer programs developed by the Corps of Engineers, and U.S. Geological Survey generalized regression equations developed for the area.

In the mid-1960's, the Harris County Flood Control District (HCFCD) and the City of Houston commissioned a detailed hydrologic study of Harris County which resulted in the development of discharge versus drainage area relationships and unit graph methodologies used for the design of flood control and drainage facilities.

In the early 1980's, FEMA allowed the Harris County Flood Control District (HCFCD) to complete the first FEMA Flood Insurance Rate Maps for Harris County that the U.S. Army Corps of Engineers (USACE) had started. The HCFCD developed a new hydrologic methodology and revised hydraulic channel models that could be updated as the watersheds developed.

In June of 2001, Tropical Storm Allison came ashore on the Upper Texas Coast and produced record rainfall amounts and pervasive flooding in Harris and surrounding counties, including the Clear Creek Watershed. In October of 2001, through a joint effort between FEMA and HCFCD, Harris County began the Tropical Storm Allison Recovery Project (TSARP) to refine the hydrologic methodology and update the hydraulic models for the channels. Since that time, a variety of updated models and FEMA maps have been released. Some of these models and maps are still preliminary while others have been officially adopted.

It is required that the effective (current) FEMA map shall be used for any project within the DISTRICT. Furthermore, any new or updated analysis within the DISTRICT shall consider the tail water effects based upon potentially higher water surface elevations in the models or effective maps within neighboring counties. If the project involved requires the approval of FEMA, then the requirements of FEMA supersede DISTRICT requirements.

In the case that FEMA approval is not required for the project, use the hydrologic and hydraulic methodologies presented in these Rules, Regulations, & Guidelines to design drainage facilities in the DISTRICT.

### **B. EXISTING IMPERVIOUS COVER – GRAND-FATHERING**

No credit will be given for existing impervious cover unless the Applicant provides a Drainage Plan previously approved by an applicable drainage entity showing that the project was authorized without detention or that detention was provided in the appropriate amount at the time of prior Board approval. For the purposes of new development or redevelopment, any project which does not satisfy that requirement will be given no credit for existing impervious cover and will further be required to provide detention based upon the current detention requirements at the time of permitting.



## **C. DETENTION METHODOLOGY BASED UPON PROJECT SIZE**

### **1. Small Projects 0 to 2 acres**

Small projects are defined as those projects that are two (2) acres or smaller. The detention required for these small projects shall be based upon a detention storage rate of 0.65 ac-ft / ac. The rate shall be applied to the entire acreage independent of the amount of development.

In some cases, a detention pond shown on a Drainage Plan previously approved by the Board may have been over-sized to serve a future small or medium sized project. If that previously approved plan included storm sewer or other drainage improvements capable of conveying the 100-year developed flows from the new development to the detention pond without impacts, no additional on-site detention will be required.

In situations where the proposed development will not drain into a master-planned or regional system as described above, the rational method shall be used in accordance with Section 32.F to determine the pre-development and post development flow rates. The restrictor shall be sized so that no increase in the 2-year, 10-year, or 100-year flow will occur downstream. The 2-year and 10-year detention storage depths shall be determined based upon 39% and 57% of the total detention volume. No small watershed or hydrograph analysis will be required for small projects.

### **2. Medium Projects – More than 2 acres, less than 300 acres**

Medium projects are defined as projects greater than 2 acres and less than 300 acres in size. Medium projects will have their detention mitigation volumes calculated using the Small Watershed Method in accordance with Section 32.G. All calculations shall be provided to the DISTRICT with submittals. Include the calculations and analysis on the Drainage Plan sheets.

The minimum detention rate for medium projects shall be 0.65 ac-ft / ac.

For ponds within medium projects, the outfall structure shall be designed to ensure that the allowable flow is not exceeded during a 2-year, 10-year, and 100-year event. This may be achieved using a combination of openings, pipes, or weirs. The flowline of each opening, pipe, or weir shall be set based upon the 2-year, 10-year, and 100-year water surface elevation in the pond(s).

The restrictor and outfall for medium projects shall be sized as follows:

- a) Determine the storage elevations for the 2-year, 10-year, and 100-year storms.
- b) Determine the water surface elevation in the downstream system (if reasonably able to) for the 2-year, 10-year, and 100-year storms.
- c) Size the restrictor in accordance with Section 15.C.

### **3. Large Projects – 300 acres or greater in size**

For projects 300 acres or larger, HEC-RAS and HEC-HMS modeling shall be performed. The HEC-HMS modeling shall include analysis of existing and developed runoff. This analysis must demonstrate that no increase in runoff will occur for the 2-year, 10-year, and 100-year event storms. Similarly, the HEC-RAS

modeling shall show that no increase in water surface elevation will occur within the receiving system for the 2-year, 10-year, and 100-year event.

The minimum rate of detention for all large projects shall be 0.65 ac-ft / ac.

#### **D. HYDROLOGIC ANALYSIS OVERVIEW**

Use Figure 2-1 to select an appropriate hydrologic methodology for all projects. Contact the appropriate reviewing agencies prior to preparing the analysis and to obtain approval of the selected methodology prior to initiating analysis or modeling. A meeting with the DISTRICT's Engineer is strongly recommended.

The U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) created HEC-HMS, a commonly used rainfall-runoff watershed model for creating FEMA Flood Insurance Rate Maps. The use of the HEC-HMS model is intended only for rainfall runoff analysis where it is required for a FEMA submittal or where a reviewing agency has determined that the design engineer must investigate the downstream impact of the proposed project. For projects requiring FEMA approval, use the most current effective model of the studied stream.

#### **E. APPLICATION OF RUNOFF CALCULATION MODELS**

1. Acceptable methodology for areas up to three hundred (300) acres.

For areas up to three hundred (300) acres served by storm sewer or roadside ditches with no new outfall channel, base peak discharges will be based on the Rational Method. If the modeling is associated with establishing or revising a flood-prone area for the purposes of a FEMA submittal, the models used must be acceptable to that agency.

2. Acceptable methodology for areas greater than three hundred (300) acres.

Apply rainfall runoff modeling to areas greater than three hundred (300) acres in size. Again, if the modeling is associated with establishing or revising a flood-prone area for purposes of a FEMA submittal, the models used must be acceptable that that agency.

3. Rainfall durations for hydrologic modeling

For design using HEC-HMS, use the 24-hour design storm isohyeto-graph for rainfall data for drainage areas larger than three hundred (300) acres.

#### **F. APPLICATION OF THE RATIONAL METHOD**

1. Runoff Equation

The use of the Rational Method for calculating the peak pre-development and post development runoff for a storm drainage system involves applying the following formula to runoff:

$$Q = c * i * A$$

Where Q = peak discharge (cfs)  
 c = runoff coefficient  
 i = rainfall intensity (in / hr)  
 A = area (acres)

## 2. Runoff Coefficients

The runoff coefficient “c” values in the Rational Method formula vary based on land use. Land use types and “c” values are as follows:

**Table 34-1**

<b>Land Use Type</b>	<b>Runoff Coefficient</b>
Paved Areas / Roofs *	1.00
Residential Areas	
Lots more than 1 acre	0.40
Lots 1/4 acre to 1 acre	0.50
Lots 8,000 sf - 1/4 acre	0.55
Lots 5,000 sf - 8,000 sf	0.60
Lots less than 5,000 sf	0.70
Multi-Family / Apartments	0.85
Commercial Developments	0.95
Industrial Developments	0.95
Developed Parks / Open Areas	0.30
Undeveloped land	0.20
Lakes **	1.00
Detention facilities (including dry) **	1.00

\* Includes all paving types and stabilized surfaces

\*\* To be measured from top of slope

Detention ponds with less than two feet of detention storage depth and serving one single-family home site may be treated as pervious for the purposes of determining detention volume required.

Composite “c” values are allowed in mixed drainage areas. The Engineer must show detailed calculations of how the composite “c” value were determined by using the following formula for the weighted “c” value:

$$C = \frac{1 * A1 + C2 * A2 + \dots Cn * An}{(A1 + A2 + \dots An)}$$

Include the calculations and an exhibit of surface types for use of composite “c” values with the detailed calculations on the plans.

The following example calculation is provided for the Engineer’s reference. The Engineer shall show their calculations in a similar manner on the Drainage Plan.

#### Composite "c" Calculation

Type of Cover	"c"	a (acres)	c * a
Building	1.00	0.2296	0.2296
Pavement	1.00	0.8035	0.8035
Park	0.30	0.0861	0.0258
Detention Pond	1.00	0.5969	0.5969
Total		1.7161	1.6558
<b>Composite "c"</b>			<b>0.9649</b>

### 3. Determination of Time of Concentration

Use the following method for determining the time of concentration

$$T_c = \frac{D}{(60 * V)} + T_i$$

Where  $T_c$  = Time of concentration (min)

$T_i$  = Initial time (min)

use 10 min for developed flows

use 15 min for undeveloped flows

$D$  = travel distance on flow path (ft)

$V$  = Velocity (ft / sec)

Time of concentration shall be based upon the actual travel time from the most remote point in the drainage area to the point of discharge or outfall point. Provide a sketch of the travel path including surface types and calculations on the plans.

The following minimum velocities shall be used when determining the time of concentration.

**Table 34-2**

<b>Surface Type</b>	<b>Undeveloped Flows Min V (fps)</b>	<b>Developed Flows Max V (fps)</b>
Storm sewer	3.00	3.00
Ditch / channel	2.00	2.50
Paved area	1.50	1.50
Bare ground	0.50	1.00
Grass	0.35	0.50
Thick Vegetation	0.25	0.35

#### 4. Rainfall Intensity

The rainfall intensity shall be computed as follows:

$$I = \frac{b}{(T_c + d)^e}$$

Where I = Rainfall intensity (in / hr)

T<sub>c</sub> = Time of concentration (min)

b, d, e = Coefficients per Table 34-3 below

**Table 34-3**

<b>Return Period</b>	<b>Region 1</b>		
	<b>e</b>	<b>b</b>	<b>d</b>
<b>2-Year</b>	0.754	57.440	11.511
<b>5-Year</b>	0.712	58.019	9.236
<b>10-Year</b>	0.676	57.515	7.777
<b>25-Year</b>	0.618	52.780	5.022
<b>50-Year</b>	0.574	49.157	3.081
<b>100-Year</b>	0.533	46.316	1.555
<b>500-Year</b>	0.474	47.179	0.322

## G. SMALL WATERSHED METHOD HYDROGRAPH METHODOLOGY

The Small Watershed Hydrograph Method is a technique for hydrograph development which is useful in the design of detention facilities serving relatively small watersheds. The methodology utilizes a pattern hydrograph which peaks at the design flow rate and contains a runoff volume consistent with the design rainfall. The pattern hydrograph is a two-part function approximation to the dimensionless hydrograph proposed by the Bureau of Reclamation and the Soil Conservation Service.

This method shall be used for medium projects as defined in Section 32.C.2.

When using this method, the detention rate required shall never be less than the defacto minimum rate of 0.65 (or 0.70 for pumped ponds) ac-ft / ac.

## 1. Equations

The Small Watershed Hydrograph Method consists of the following equations:

$$T_p = \frac{V}{1.39Q_p}$$

$$Q_i = \frac{Q_p}{2} \left[ 1 - \cos \left( \frac{\pi T_i}{T_p} \right) \right] \quad \text{for } T_i \leq 1.25T_p$$

$$Q_i = 4.34Q_p e^{\left( \frac{-1.30T_i}{T_p} \right)} \quad \text{for } T_i > 1.25T_p$$

Where

$T_p$  is the time in seconds for the peak design flow rate ( $Q_p$ ) to drain the subject area

$Q_p$  is the peak design flow rate in cubic feet per second

$T_i$  is the time in seconds for the inflow flow rate

$Q_i$  is the inflow flow rate in cubic feet per second

NOTE – Calculator must be in radians

## 2. Application

The peak flow rate  $Q_p$  is obtained from the Rational Method Formula. For detention mitigation analyses, the Rational Method should be applied in accordance with Section 32.F of these Rules, Regulations, and. The total volume of runoff (V) is the same as the rainfall excess. Table 34-4 below gives typical values for the rainfall excess based on percent impervious cover. The actual values may be interpolated from the table provided. See Table 34-6 for how to determine the percent impervious cover.

**Table 34-4**

### Typical Rainfall Excess Values For use with Small Watershed Method

Percent Impervious	2-YR, 24-HR Rainfall			5-YR, 24-HR Rainfall			10-YR, 24-HR Rainfall			25-YR, 24-HR Rainfall			100-YR, 24-HR Rainfall		
	Total	Losses	Excess	Total	Losses	Excess	Total	Losses	Excess	Total	Losses	Excess	Total	Losses	Excess
	in	in	in	in	in	in	in	in	in	in	in	in	in	in	in
Region I															
0	5.27	2.06	3.21	7.05	2.29	4.76	8.83	2.43	6.40	11.60	2.58	9.02	17.00	2.70	14.30
20	5.27	1.67	3.60	7.05	1.85	5.20	8.83	1.96	6.87	11.60	2.08	9.52	17.00	2.18	14.82
40	5.27	1.28	3.99	7.05	1.41	5.64	8.83	1.50	7.33	11.60	1.59	10.01	17.00	1.66	15.34
60	5.27	0.89	4.38	7.05	0.98	6.07	8.83	1.03	7.80	11.60	1.09	10.51	17.00	1.14	15.86
80	5.27	0.49	4.78	7.05	0.54	6.51	8.83	0.57	8.26	11.60	0.60	11.00	17.00	0.62	16.38

Use the Small Watershed Hydrograph Method where an impact analysis is not required for the total drainage system which includes the detention facility and outfall. The Small Watershed Hydrograph Method cannot be used in conjunction with the HEC-HMS computer models of watersheds used in the FEMA Flood Insurance Study. The time to peak of the Small Watershed Hydrograph Method is computed strictly to match volumes and has no relationship to the storm durations and rainfall distributions used in the Flood Insurance Study.

## **H. WATERSHED MODELING**

### **1. Introduction**

In June of 2001, Tropical Storm Allison came ashore on the Upper Texas Coast and produced record rainfall amounts and pervasive flooding in Harris and surrounding counties including the Clear Creek Watershed. In October of 2001, through a joint effort between FEMA and HCFCD, Harris County began the Tropical Storm Allison Recovery Project (TSARP). Since that time, a variety of updated models and FEMA maps have been released within the region, including in Brazoria County.

It is required that the effective (current) FEMA model be used for any project within the DISTRICT. Furthermore, for any new or updated analysis within the DISTRICT, consider the tail water effects based upon potentially higher water surface elevations in the models or effective maps within neighboring counties.

If the proposed project requires the approval of FEMA, then the FEMA requirements supersede any DISTRICT requirements. In the case that FEMA approval is not required for the project, design engineers should use the methodology presented in this Appendix to design drainage facilities in the DISTRICT.

### **2. Rainfall Frequency and Duration**

The storm event used to establish regulatory floodplain and floodway limits in the Flood Insurance Study is the 100-year, 24-hour event. For planning purposes and establishing flood insurance rate zones, the 10-year, 50-year, and 500-year events also require analysis. For projects requiring FEMA submittals, the rainfall depths in the most current effective model should be used. For all other project requiring a rainfall runoff analysis, the depths should be based upon Table 34-5 below which includes the maximum value for each depth, duration, and frequency from the Atlas 14 rainfall information for Texas.

**Table 34-5****Point Rainfall Depth (inches) Duration – Frequency Values**

Duration	Depth (in)								
	100% 1-Year	50% 2-Year	20% 5-Year	10% 10-Year	4% 25-Year	2% 50-Year	1% 100-Year	0.2% 500-Year	0.1% 1000-Year
5-min	0.51	0.60	0.74	0.86	1.04	1.17	1.31	1.65	1.80
10-min	0.81	0.95	1.18	1.37	1.65	1.87	2.09	2.59	2.80
15-min	1.03	1.21	1.49	1.73	2.07	2.34	2.61	3.27	3.56
30-min	1.48	1.73	2.13	2.47	2.94	3.30	3.68	4.66	5.11
60-min	1.96	2.31	2.86	3.33	3.99	4.50	5.05	6.56	7.29
2-hr	2.39	2.90	3.63	4.32	5.36	6.24	7.23	9.91	11.20
3-hr	2.62	3.25	4.11	4.97	6.29	7.48	8.84	12.50	14.30
6-hr	3.04	3.88	4.99	6.15	7.97	9.66	11.60	17.00	19.60
12-hr	3.49	4.55	5.98	7.43	9.72	11.80	14.30	21.20	24.80
24-hr	3.96	5.27	7.05	8.83	11.60	14.10	17.00	25.30	29.60
2-day	4.44	6.01	8.18	10.30	13.60	16.60	20.00	29.00	33.40
3-day	4.81	6.53	8.92	11.30	14.90	18.10	21.70	30.90	35.20
4-day	5.15	6.95	9.47	11.90	15.60	19.00	22.70	31.90	36.30

**3. Rainfall Depth-Area Relationship and Temporal Distribution**

HEC-HMS has replaced HEC-1 as the standard software for hydrologic analysis within the DISTRICT. Two important differences between HEC-HMS and HEC-1 have to do with the use of depth-area indices to account for point rainfall depths or large areas and the temporal distribution of rainfall (the rainfall hyetograph).

This section of the Rules, Regulations, and Guidelines is intended to put the Applicant on notice that HEC-1 models will no longer be accepted by the DISTRICT for any reason.

**4. Loss Rates**

Rainfall excess and runoff volume are dependent on factors such as rainfall volume, rainfall intensity, antecedent soil moisture, impervious cover, depression storage, interception, infiltration, and evaporation. The extent of impervious cover and depression storage is actually a measure of development and is discussed in the next section. The other factors are dependent on soil type, land use, vegetative cover, topography, time of year, temperature, etc.

For projects requiring FEMA approval, the loss input in the most current effective model should be used. For all other projects requiring a rainfall runoff analysis, the Green-Ampt loss function can be found USACE documentation. The following parameters should be used to compute the Green-Ampt losses:

Initial Loss	=	0.1 inches
Volume Moisture Deficit	=	0.385
Wetting Front Section	=	12.45 inches
Hydraulic Conductivity	=	0.024 in / hr



Additional development in the watershed is analyzed by increasing the value of the impervious cover parameter in the runoff model. Table 34-6 gives appropriate values of percent impervious based on land use types:

**Table 34-6**

<b>Percent Impervious Cover By Land Use Type</b>	
<b>Land Use</b>	<b>Percent Impervious</b>
High Density (apartment, townhome, condos)	85%
Commercial	90%
Undeveloped / Undisturbed	0%
Developed Green Space	15%
Residential (< 1/4 acre lots)	40%
Residential (>1/4 acre lots)	20%
Rural Residential (>5 acre lots)	5%
Isolated Transportation	90%
Ponds (wet or dry - measure to top of bank)	100%
Paving	100%

\* All others - Use weighted average, provide calculations

## **I. UNIT HYDROGRAPH METHODOLOGY**

The model that the Clear Creek Watershed Flood Insurance Study is based on is the Clark unit hydrograph. In cases where FEMA submittals are required, the design engineer should use the Clark unit hydrograph method. In other cases, where a downstream impact analysis is required, consult the appropriate reviewing agencies on the applicability of the Clark unit hydrograph. In some cases, other unit hydrograph methods may be applicable.

The watershed parameters for the Clark unit hydrograph may be developed using the Harris County methodology. Design engineers should refer to the most current effective model and the most recent version of the HCFCD hydrology manual.

## **J. FLOOD HYDROGRAPH ROUTING**

Flood routing is used to simulate the runoff hydrograph movement through a channel or reservoir system. Flood routing techniques vary greatly between hydrologic computer models and caution should be used in selecting a routing method which adequately represents the channel storage conditions present in areas with extremely flat slopes which are commonly found throughout the DISTRICT.

The HEC-HMS program employs several flood routing methods for characterizing the transfer of the runoff hydrograph through the drainage system of a watershed. The models developed for the Flood Insurance Study for the Clear Creek watershed use the Modified Puls Method of routing. This flood

routing method is based on the continuity equation and a relationship between flow and storage or stage. The routing is modeled on an independent reach basis from upstream to downstream. A detailed discussion of the Modified Puls Method can be found in the user's manual for HEC-HMS.

## **K. STORAGE ROUTING COMPUTATIONS USING HEC-2 OR HEC-RAS**

All of the Flood Insurance Study data submitted for the Clear Creek Watershed have utilized the HEC-2 or HEC-RAS computer program to generate the storage-discharge relationship required for HEC-1 or HEC-HMS to utilize the Modified Puls flood routing. Listed below is a suggested procedure by which the HEC-2 or HEC-RAS program can best be formatted to provide the most effective input and output data necessary for hydrologic studies.

- a) Determine which routing reaches of the subject channel will need to be evaluated. Routing reaches that are defined in the Flood Insurance Study usually represent an area between outfalls of two significant drainage areas.
- b) Review all the available data for the routing reaches of the subject stream.
- c) Run HEC-HMS for the 100-year storm event using preliminary channel routing data or alternate methods (i.e., Muskingum or Lag).
- d) Multiply the preliminary 100-year peak discharges determined above by 0.20, 0.40, 0.60, 0.80, 1.00, and 1.20 to obtain a series of six discharges for each storage routing reach.
- e) The discharges that have been developed are the input to the HEC-RAS program. The discharges should be held constant throughout the subject routing reach. Outflows through a routing reach should not vary.

HEC-RAS has replaced HEC-2 as the standard model for this type of analysis. Furthermore, it is expected that HEC-2 will no longer be supported by the U.S. Army Corps of Engineers. For these reasons, the design engineer must get the DISTRICT Engineer's approval prior to using HEC-2 models. This applies to existing, revised, and proposed models.

The HEC-2 or HEC-RAS model used in the storage-outflow analysis should be reviewed to ensure that the analysis is correctly determining the total storage volume. Make sure that the ineffective flow areas are modeled appropriately. Also, if using HEC-2 make sure that any ET or XS cards are removed from the input prior to running the storage-outflow multiple profile analysis.

## **L. WATERSHED MODELING**

### **1. Introduction**

In June of 2001, Tropical Storm Allison came ashore on the Upper Texas Coast and produced record rainfall amounts and pervasive flooding in Harris and surrounding counties, including the Clear Creek Watershed. In October of 2001, through a joint effort between FEMA and HCFCD, Harris County began the Tropical Storm Allison Recovery Project (TSARP). Since that time, a variety of updated models and FEMA maps have been released. Some of these models and maps may still be preliminary while others have been officially adopted. It is required that the effective (current) FEMA map shall be used for any

project within the DISTRICT. Furthermore, any new or updated analysis within the DISTRICT shall consider the tail water effects based upon potentially higher water surface elevations in the models or effective maps within neighboring counties. If the project involved requires the approval of FEMA, then any more stringent requirements of FEMA shall supersede any DISTRICT requirements.

The DISTRICT is not a Floodplain Administrator. Projects within the jurisdiction of the DISTRICT may also be subject to the requirements of the Floodplain Administrator at an agency with overlapping jurisdiction. In those cases, any more stringent requirements imposed by a Floodplain Administrator will supersede DISTRICT requirements.

## 2. Rainfall Frequency and Duration

The storm event used to establish regulatory floodplain and floodway limits in the Flood Insurance Study is the 100-year, 24-hour event. For planning purposes and establishing flood insurance rate zones, the 10-year, 50-year, and 500-year events also require analysis. For projects requiring FEMA submittals, the rainfall depths in the most current effective model should be used. For all other projects requiring a rainfall runoff analysis, the depths should be based on Table 34-7, which include the maximum values for each depth, duration, and frequency from the TSARP, TP40, and Hydro 35 information.

Point rainfall amounts for various durations and frequencies for use in the DISTRICT are given in Table 34-7.

**Table 34-7**  
**Point Rainfall Depth Duration Frequency Values**

Duration	Depth (in)								
	100% 1-Year	50% 2-Year	20% 5-Year	10% 10-Year	4% 25-Year	2% 50-Year	1% 100-Year	0.2% 500-Year	0.1% 1000-Year
5-min	0.51	0.60	0.74	0.86	1.04	1.17	1.31	1.65	1.80
10-min	0.81	0.95	1.18	1.37	1.65	1.87	2.09	2.59	2.80
15-min	1.03	1.21	1.49	1.73	2.07	2.34	2.61	3.27	3.56
30-min	1.48	1.73	2.13	2.47	2.94	3.30	3.68	4.66	5.11
60-min	1.96	2.31	2.86	3.33	3.99	4.50	5.05	6.56	7.29
2-hr	2.39	2.90	3.63	4.32	5.36	6.24	7.23	9.91	11.20
3-hr	2.62	3.25	4.11	4.97	6.29	7.48	8.84	12.50	14.30
6-hr	3.04	3.88	4.99	6.15	7.97	9.66	11.60	17.00	19.60
12-hr	3.49	4.55	5.98	7.43	9.72	11.80	14.30	21.20	24.80
24-hr	3.96	5.27	7.05	8.83	11.60	14.10	17.00	25.30	29.60
2-day	4.44	6.01	8.18	10.30	13.60	16.60	20.00	29.00	33.40
3-day	4.81	6.53	8.92	11.30	14.90	18.10	21.70	30.90	35.20
4-day	5.15	6.95	9.47	11.90	15.60	19.00	22.70	31.90	36.30

## 3. Rainfall Depth-Area Relationship and Temporal Distribution

In the initial stages of the TSARP, it was necessary to address issues having to do with the use of the new USACE runoff model called HEC-HMS. HEC-HMS replaced HEC-1 as the standard software for hydrologic analysis within the DISTRICT. Two important differences between HEC-HMS and HEC-1 have to do with the use of depth-area indices to account for point rainfall depths on large areas and the temporal distribution of rainfall (the rainfall hyetograph).

For these reasons, the DISTRICT no longer allows the use of HEC-1 models. This applies to existing, revised, and proposed models. For project requiring FEMA approval, the rainfall input of the most current effective model should be used. For projects not requiring FEMA submittals, the 67% duration peaking temporal rainfall distribution should be used.

#### 4. Loss Rates

Rainfall excess and runoff volume are dependent on factors such as rainfall volume, rainfall intensity, antecedent soil moisture, impervious, cover, depression storage, interception, infiltration, and evaporation. The extent of impervious cover and depression storage is actually a measure of development and is discussed in the next section. The other factors are dependent on soil type, land use, vegetative cover, topography, time of year, temperature, etc.

For projects requiring FEMA approval, the loss input in the most current effective model should be used. For all other projects requiring a rainfall runoff analysis, the Green-Ampt loss function available in HEC-HMS shall be used. A detailed description of the Green-Ampt loss function can be found in USACE EM 1110-2-1417. The following parameters should be used to compute the Green-Ampt losses:

Initial Loss	=	0.1 inches
Volume Moisture Deficit	=	0.385
Wetting Front Suction	=	12.45 inches
Hydraulic Conductivity	=	0.024 in / hr

Additional development in the watershed is analyzed by increasing the value of the impervious cover parameter in the runoff model. Table 34-8 gives appropriate values of percent impervious based on land use types:

**Table 34-8**

<b>Land Use</b>	<b>Percent Impervious</b>
Multi-Family / Apartments	85%
Paved Areas	100%
Commercial Developments	95%
Dry Detention Ponds *	100%
Undeveloped Lands	0%
Developed Green Space / Parks	15%
Residential Lots (less than 1/4 acre)	40%
Residential Lots (greater than 1/4 acre)	20%
Roadways / Highways	90%
Lakes / Amenity Ponds *	100%

\* Measured at top of bank

## **M. OPEN CHANNEL DESIGN**

All of the DISTRICT's open channels are to be designed to contain the runoff from the 100-year storm within the drainage easement or fee strip. The existing 100-year flood profile shall not be increased as a result of development.

For new channels or proposed modifications to existing facilities, a hydraulic analysis must be conducted that includes all the factors potentially affecting the water-surface profile or hydraulic grade line of the facility. For open channels, the primary factors are typically friction, constriction, bridges, culverts, confluences, transitions, and bends. The design for the channels shall minimize the energy losses caused by these factors which have the potential to impede or disrupt flow. This design must additionally be in conformance with the DISTRICT's Zero Downstream Impact (ZDI) policy.

Several methods exist which can be used to computer water-surface profiles in open channels. The methodology selected depends on the complexity of the hydraulic design and the level of accuracy desired.

For the design of a proposed channel with flow confined to uniform cross-sections, either a hand calculated normal depth or direct step computation is sufficient. Manning's Equation shall be used for computing normal depth. For designing a non-uniform proposed channel or for designs where flow occurs in the overbanks, the use of HEC-RAS is required.

Exercise good judgement when determining cross-section locations for water surface profile calculations. Cross sections should divide the channel into reaches which approximate uniform flow conditions. For example, solely spaced cross sections are required at an abrupt transition such as a bridge, while relatively uniform channel reaches with no significant physical conveyance changes will require relatively fewer cross sections. As a general guideline, the spacing of channel cross sections should never exceed one thousand (1,000) feet.

Any proposed creation or modification of a DISTRICT channel must be modeled using HEC-RAS and incorporated into the model used in the DISTRICT's Flood Protection Plan. This modeling and analysis shall be provided in a Drainage Impact Analysis submitted to the DISTRICT for review and Board approval.

The design or analysis for channels and overbanks shall be based upon recent on the ground field survey. In some cases, the DISTRICT may have recent survey information which can be utilized. Plans or models from previous channel projects shall only be used for preliminary analysis. Overbanks are best defined by recent on the ground survey but this is not always practical or economically justified. In these instances, the elevations in the floodplain beyond the limits of the channel can be obtained from the best topographic information available for the study reach.

When designing or analyzing channel sections, extend the cross sections beyond the DISTRICT easement or fee strip a reasonable distance. The distance shall be proposed by the design engineer and agree upon by the DISTRICT Engineer on a case-by-case basis. The purpose of including elevations beyond the easement or fee strip is to avoid a design which creates ponding adjacent to the channel. A reasonable distance depends on the adjacent terrain, but in no case shall it be less than twenty (20) feet beyond the limits of the easement or fee strip.

## N. BRIDGE AND CULVERT DESIGN

Roadway bridges and culverts shall be modeled using HEC-RAS. This requirement will apply to new construction and modifications to existing crossings. This modeling and analysis shall be provided in a Drainage Impact Analysis submitted to the DISTRICT for review and Board approval.

For private driveway culvert installations on smaller DISTRICT maintained channels or roadside ditches, the DISTRICT Engineer may permit a simplified analysis which adequately accounts for the quantity of flow and the losses which may occur across the culvert.

## O. OPEN CHANNEL FLOW

### 1. Manning's' Equation

Manning's Equation is an empirical formula used to evaluate the effects of friction and resistance in open channels. For uniform flow conditions where the channel bottom and energy line are essentially parallel, Manning's Equation can be used to compute the normal depth. For gradually varied flow conditions, the slope of the energy line at a given channel section can be computed using the Manning's Equation.

The equation is:

$$Q = \frac{1.49 \times A \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}}{n}$$

Where Q = Total flow (cfs)

n = Coefficient of roughness

A = Cross sectional area of the channel (sf)

R = Hydraulic radius of the channel (ft)

S = Channel flowline slope (ft / ft)

Manning's "n" values shall conform to Table 34-9 below.

**Table 34-9**

<b>Channel Description</b>	<b>Roughness Coefficient or Manning's "n" Value</b>	<b>Average Velocity (fps)</b>	<b>Maximum Velocity (fps)</b>
Unmaintained Grass	0.05	3.0	5.0
Maintained Grass	0.045	3.0	5.0
Clay Lined	0.045	2.0	4.0
Concrete Lined	0.015	6.0	10.0
Articulated Block	0.045	5.0	8.0
Other	**	N/A	N/A

\*\* See Chow, V.T., Open-Channel Hydraulics, McGraw-Hill, 1959

## **P. STORM SEWER AND ON-SITE DITCH DESIGN**

Design and construct storm sewers, and small on-site ditches in accordance with the applicable City Ordinance and / or criteria. In location within the DISTRICT where no City has jurisdiction, Brazoria County storm sewer regulations shall prevail.

The storm sewer and ditch calculations must be on the Drainage Plan. Independent of the requirements of the overlapping jurisdictions above, these calculations shall include:

- a) Area ID number / identifier and the area in acres.
- b) Runoff coefficient for each drainage area.
- c) Rainfall intensity and cumulative flow for each segment.
- d) Diameter, slope, and “n” value for each conduit.
- e) Dimensions, slope, and “n” value for each ditch.
- f) Actual velocity and flow capacity for each segment. A minimum velocity of 3 feet per second is required to prevent the accumulation of sediment in the pipe.
- g) Proposed finished grade or top of paving at each node.

- h) Hydraulic grade line (HGL) at the upstream and downstream end of each segment.
- i) Vertical difference in elevation between the HGL and finish grade at each node.



## GLOSSARY

2 YEAR DISCHARGE	The annual peak discharge that has a 50 percent chance of being met or exceeded in any given year.
10 YEAR DISCHARGE	The annual peak discharge that has a 10 percent chance of being met or exceeded in any given year.
100 YEAR DISCHARGE	The annual peak discharge that has a 1 percent chance of being met or exceeded in any given year.
BACKSLOPE DRAIN	A swale, drain, or interceptor structure that collect overland sheet flow. These facilities are intended to intercept and redirect the sheet flow to the bottom of a detention pond or drainage channel in order to prevent erosion of the side slopes of those channels and ponds.
BENCHMARK	A point of known exact elevation set and used by surveyors as a starting point for gathering additional elevation points. These know elevations on benchmarks are typically tied to “mean sea level”.
BOARD	The Board of Commissioners of Brazoria Drainage District No. 4.
CFS	Cubic feet per second. A unit of measure for flow.
CMP	Corrugated metal pipe.
COEFFICIENT OF ROUGHNESS	A number used to measure and compare the roughness of the interior of a pipe, box pipe, or open channels. Sometimes referred to as the Manning’s “n” value.
COMMERCIAL	Development of real estate for any purpose other than “residential” as defined herein.
CONDUIT	Any open or closed device used to convey flowing water.
CONSTRUCTION	The building of a planned or designed project.
CONTOUR LINE	A line on a map, chart, survey, or plan that follows a known constant elevation.
CULVERT	One or more pipes that carry storm water from one point in a ditch or channel to another point in a ditch or channel. Typically used for driveway or roadway crossings.

GENERAL WARRANTY DEED	An instrument that transfers legal title to real property from one to another in which grantor covenants to warrant and defend the title against all claims and demands.
DESIGN STORM EVENT	The rainfall intensity and / or depth for which a drainage facility will be sized.
DETENTION FACILITY	A reservoir, pond, or other area serving primarily as a temporary storm water holding area. The release of the storm water is typically metered using a restrictor or control structure.
DEVELOPER	A person or entity who engages in development as defined herein.
DEVELOPMENT	The improvement or subdivision of a tract of land exclusive of acreage being used for crops or livestock. Improvements of land includes grading, paving, buildings, structures, or otherwise changing the runoff characteristics of the tract.
DEVELOPER'S ENGINEER	A Registered Profession Engineer licensed in the State of Texas who engaged in consulting or design services for a developer.
DEVELOPER'S SURVEYOR	A Registered Professional Land Surveyor or Surveyor licenses in the State of Texas who is engaged in surveying work for a developer.
DISTRICT	The Board of Commissioners and / or staff of Brazoria Drainage District No. 4.
DISTRICT FACILITY	Any and all drainage arteries, tributaries, channels, creeks, bayous, streams, gullies, ditches, lakes or ponds owned, operated, maintained, or controlled by the DISTRICT.
DISTRICT ENGINEER	A Registered Professional Engineer licensed by the State of Texas who has been appointed by the DISTRICT to review Drainage Plans, Plats, Drainage Impact Analyses, Requests for Variance, or provide other technical support under the direction, supervision, and authority of the DISTRICT.
DRAINAGE AREA MAP	An area map of a watershed or sub-watershed which is divided for the purpose of determining the quantity of storm water runoff as required to size drainage facilities.

DRAINAGE PLAN	An engineering representation of storm water flows onto, within, and through a particular area. The plan typically includes systems used to manage, detain, or control runoff and to provide flood control to mitigate development.
DRAINAGE SYSTEM	A series of swales, storm sewers, ditches, and / or creeks which will collect, manage, and convey storm water runoff within an area.
EASMENT	A land area conveyed for a specific use such as drainage while the underlying fee title remains property of the owner.
FEMA	The Federal Emergency Management Agency which administers the National Flood Insurance Program.
FEE STRIP	A strip of land or real property for which legal title is conveyed to the DISTRICT by General Warranty Deed.
FIRM	A Flood Insurance Rate Map, published by FEMA.
FIS	A Flood Insurance Study prepare by FEMA for the purposes of developing or updating the FIRM.
FLOOD MAP	The current, effective Flood Insurance Rate Map (FIRM).
FLOODPLAIN ADMINISTRATOR	The person identified by a governing municipality or county who is responsible for administering the National Flood Insurance Program for the City of count in accordance with the guidelines established by FEMA. Brazoria County and each of the incorporate cities each have their own designated Floodplain Administrator.
FLOOD PROTECTION PLAN	The DISTRICT's Master Drainage Plan, entitled Flood Protection Plan for Brazoria Drainage District No. 4 as authorized by Section 49.211.c of the Texas Water Code including updates and addendums.
FPS	Feet per second. A unit of measure for velocity.
HDPE	High density polyethylene pipe.
HP	High-performance polypropylene pipe.
HEC-HMS	"Hydrologic Modeling System" computer program written by the U.S. Army Corps of Engineers similar to HEC-1 which it replaced.

HEC-RAS	“River Analysis System” computer program written by the U.S. Army Corps of Engineers similar to HEC-2 which it replaced.
HYDRAULIC ANALYSIS	The study and / or definition of the movement of storm water through a drainage system.
HYDRAULIC GRADE LINE	A line representing the pressure head (or height of water) along any given point within a drainage system.
HYDROLOGIC ANALYSIS	The study and / or definition of the properties, quantity, circulation, or distribution of storm water runoff across land or into the ground.
HYDROMULCHING	The process of spraying grass seeds onto unvegetated areas for seal the surface and seed it for the purpose establishing vegetative cover and to help prevent erosion.
ICPR	Interconnected Channel and Pond Routing computer program developed by Streamline Technologies.
IMPACT	The effect of development on an area further defined by an increase or decrease in runoff quantity or water surface elevation.
IMPACT DATA	Data required to support the Developer Engineer’s claim that a development will not have a negative impact on the runoff quantity or water surface elevation adjacent to or downstream of the developed area.
IMPERVIOUS COVER	Surface cover placed on land which reduces the ability of storm water to penetrate into the underlying soil. Used in hydrologic analyses or the development of a drainage plan to determine increases in storm water runoff.
INLINE DETENTION	Detention mitigation which is not separated from the receiving drainage channel by the typical berm, outfall pipe, or control structure.
MAINTENANCE DECLARATION	A written and signed declaration by a property owner that obligates the owner of the land, and any subsequent owners, to maintain approved drainage and detention facilities in accordance with the approved Final Drainage Plan and Maintenance Plan.
MAINTENANCE PLAN	A written plan of action for the maintenance of approved drainage and detention facilities, including the types and frequency of activities to be performed by the landowner.

MANNINGS EQUATION	An empirical equation that applies to uniform flow in pipe or channels and is a function of velocity, flow area, and slope.
METERING DEVICE	A device utilizing pipes, weirs, orifices, slots or other configurations design to meter or regulate storm water release.
MITIGATE	To reduce or eliminate the impact of storm water runoff caused by development.
MODIFIED RATIONAL FORMULA	A formula for determining storm water runoff based upon impervious cover and rainfall within a developed or undeveloped area.
MSL	Mean sea level.
MYLAR	A polyester film resistant to tear, warp, curl, crack, and peel sometimes used for printing plats and plans.
OUTFALL STRUCTURE	A structure made to contain and release storm water using conduits, weirs, slope paving or other methods to control direction, velocity, and erosion. Typically includes a metering device.
OUTFALL	The necessary conveyance from a development into another downstream drainage system.
OUTFLOW	The total peak discharge from a development into another downstream drainage system.
OVERFLOW	The peak discharge which exceeds the capacity of the outfall structure and typically passes over a weir or other relief structure.
PEAK DISCHARGE	The maximum rate of storm water runoff from a tract within a conduit or channel. Typically determined using the rational formula or similar methods.
PLAT	A map of a piece of land with actual or proposed features which is filed with the appropriate regulatory authority to legally subdivide a parcel.
PROJECT	A drainage improvement, whether one or more, to be modified, repaired, or constructed by an owner of land in accordance with the DISTRICT's Rules, Regulations, & Guidelines.

RAINFALL DATA	Data pertaining to the amount of rainfall in a certain area and occurring over a specified period of time.
RAINFALL FREQUENCY	<p>The probability that a rainfall event of a defined magnitude will be equaled or exceeded in any given year. Information on rainfall frequency is published by the National Weather Service. For the purpose of drainage design, the following frequencies are typically applicable:</p> <p>2-year frequency – A rainfall intensity having a 50% chance of being equaled or exceeded in any given year.</p> <p>3-year frequency – A rainfall intensity having a 33.33% chance of being equaled or exceeded in any given year.</p> <p>5-year frequency – A rainfall intensity having a 20% chance of being equaled or exceeded in any given year.</p> <p>10-year frequency – A rainfall intensity having a 10% chance of being equaled or exceeded in any given year.</p> <p>25-year frequency – A rainfall intensity having a 4% chance of being equaled or exceeded in any given year.</p> <p>50-year frequency – A rainfall intensity having a 2% chance of being equaled or exceeded in any given year.</p> <p>100-year frequency – A rainfall intensity having a 1% chance of being equaled or exceeded in any given year.</p>
RATIONAL FORMULA	A method for calculation peak runoff for a drainage system.
REDEVELOPMENT	Development of land which has been developed before.
RCP	Reinforced concrete pipe.
REGIONAL DETENTION FACILITY	A detention facility which serves or will serve two or more developments or tracts of land.
RESIDENTIAL	Pertaining to detached dwellings where a single family resides. This specifically does not include multi-family townhomes, condominiums, elderly care facilities, group homes, duplexes, or apartments.
RIGHT OF WAY	A strip of land that is set aside and reserved for certain purposes including drainage and maintenance, and possibly the future widening of a drainage channel.

ROADSIDE DITCH	A ditch made alongside a roadway to convey storm water runoff from the road and sometimes additional, adjacent land.
RUNOFF	That portion of rainfall which does not soak into the ground or evaporate and ultimately sheds downstream.
RUNOFF COEFFICIENT	A comparative measure of different ground cover and impervious cover and the relative amount of runoff which will not penetrate the surface and is shed downstream.
SHEET FLOW	Overland storm runoff which is conveyed when it exceeds the capacity of an existing or proposed drainage system.
SITE	An area of land occupied or to be occupied by a building or development.
SPILLWAY	The part of a drainage system which allows and controls any overflow which exceeds the design capacity of the outfall structure.
SUBDIVIDE	To divide a tract of land into lots or reserves.
SUBDIVISION	A tract of land which has been separate from surrounding property into lots or reserves by an approved and recorded plat.
SWALE	A very shallow ditch that usually has mild side slopes and causes water to flow in a controlled manner.
TECHNICAL PAPER NO. 40	A publication of the U.S. Weather Service.
TSARP	Tropical Storm Allison Recovery Project.
UNDERGROUND STORM SEWER	A continuous round or box pipe constructed underground used to collect and convey storm water to a downstream drainage system.
VARIANCE	An exception granted by the Board to allow a developer or property owner in limited instances to depart from the literal requirement of the DISTRICT's Rules, Regulations, and Guidelines.
WATERSHED	An area or region bounded along the perimeter by relatively high elevation which all drains to a particular watercourse or body of water.
WEIR	A notch through which water flows.

# **APPENDIX**

## **A. DISTRICT NOTES – PLATS AND PLANS**

The standard DISTRICT notes must be on all Drainage Plans and Plats. These notes can be found on the DISTRICT website or obtained in person from the DISTRICT office.

## **B. SIGNATURE BLOCK – PLATS AND PLANS**

The standard DISTRICT signature block must be on all Drainage Plans and Plats. This signature block can be found on the DISTRICT website or obtained in person from the DISTRICT office. The BDD 4 REF ID # must be included in the blank provided.



# AMENDMENTS

The DISTRICT’s Rules, Regulations, & Guidelines may be amended by the District's Board of Commissioners from time to time. Please see below for the effective date of any such amendments and the list of sections affected.

	Sections Affected