CITY COUNCIL WORKSHOP AGENDA

Notice is hereby given that the Rockport City Council will hold a workshop meeting on Tuesday, November 17, 2015, at 1:30 p.m. The meeting will be held at Rockport City Hall, 622 E. Market, Rockport, Texas. The matters to be discussed and acted upon are as follows:

Opening Agenda

1. Call meeting to order.

Regular Agenda

2. Hear and deliberate on a presentation from Lockwood Andrews and Newman, Inc. Engineering to assist the City of Rockport with floodplain management initiatives and the National Flood Insurance Program's Community Rating System.

3. Hear and deliberate on a presentation from Urban Engineering on the draft Master Drainage Plan Modeling Report.

4. Hear and deliberate on a proposed utility easement for the Cape Velero loop waterline project.

5. Adjournment.

Special Accommodations

This facility is wheelchair accessible and accessible parking spaces are available. Requests for accommodations or interpretive services must be made 48 hours prior to this meeting. Please contact the City Secretary's office at (361) 729-2213, ext. 225 or FAX (361) 790-5966 or email citysec@cityofrockport.com for further information. Braille is not available. The City of Rockport reserves the right to convene into executive session under Government Code 551.071-551.074 and 551.086.

Certification

I certify that the above notice of meeting was posted on the bulletin board at City Hall, 622 E. Market Street, Rockport, Texas on Friday, November 13, 2015, by 5:00 p.m. and on the City's website at www.cityofrockport.com. I further certify that the following News Media were properly notified of this meeting as stated above: *The Rockport Pilot*, *Coastal Bend Herald*, and *Corpus Christi Caller Times*.

Teresa Valdez

Teresa Valdez, City Secretary

CITY COUNCIL WORKSHOP AGENDA
Tuesday, November 17, 2015

AGENDA ITEM: 2

Hear and deliberate on a presentation from Lockwood Andrews and Newman, Inc. Engineering to assist the City of Rockport with floodplain management initiatives and the National Flood Insurance Program's Community Rating System.

SUBMITTED BY: Public Works Director Mike Donoho

APPROVED FOR AGENDA: PKC

BACKGROUND: On February 17, 2016, the new FEMA Flood Insurance Rate Maps will go into effect and an updated Flood Ordinance will have to be adopted by then.

In preparation for these required changes, on October 2, 2015, Lockwood Andrews and Newman, Inc. (LAN) Engineering provided an informational training session to community stakeholders regarding the benefits of setting higher floodplain development standards and participating in the Community Rating System (CRS). In addition to CRS participation resulting in lower flood insurance premiums for local policy holders, CRS floodplain management activities provide enhanced public safety, reduced damage to property and public infrastructure, and avoidance of economic disruption and loss. LAN Engineering will provide assistance to City staff regarding the CRS application process, community outreach and information initiatives, floodplain management and flood hazard mitigation efforts, elevation certificate documentation, FEMA Community Assistance Visit, as well as recertification.

Please see the accompanying PowerPoint presentation, scope of work, fee breakdown, and CRS guide for more detailed information.

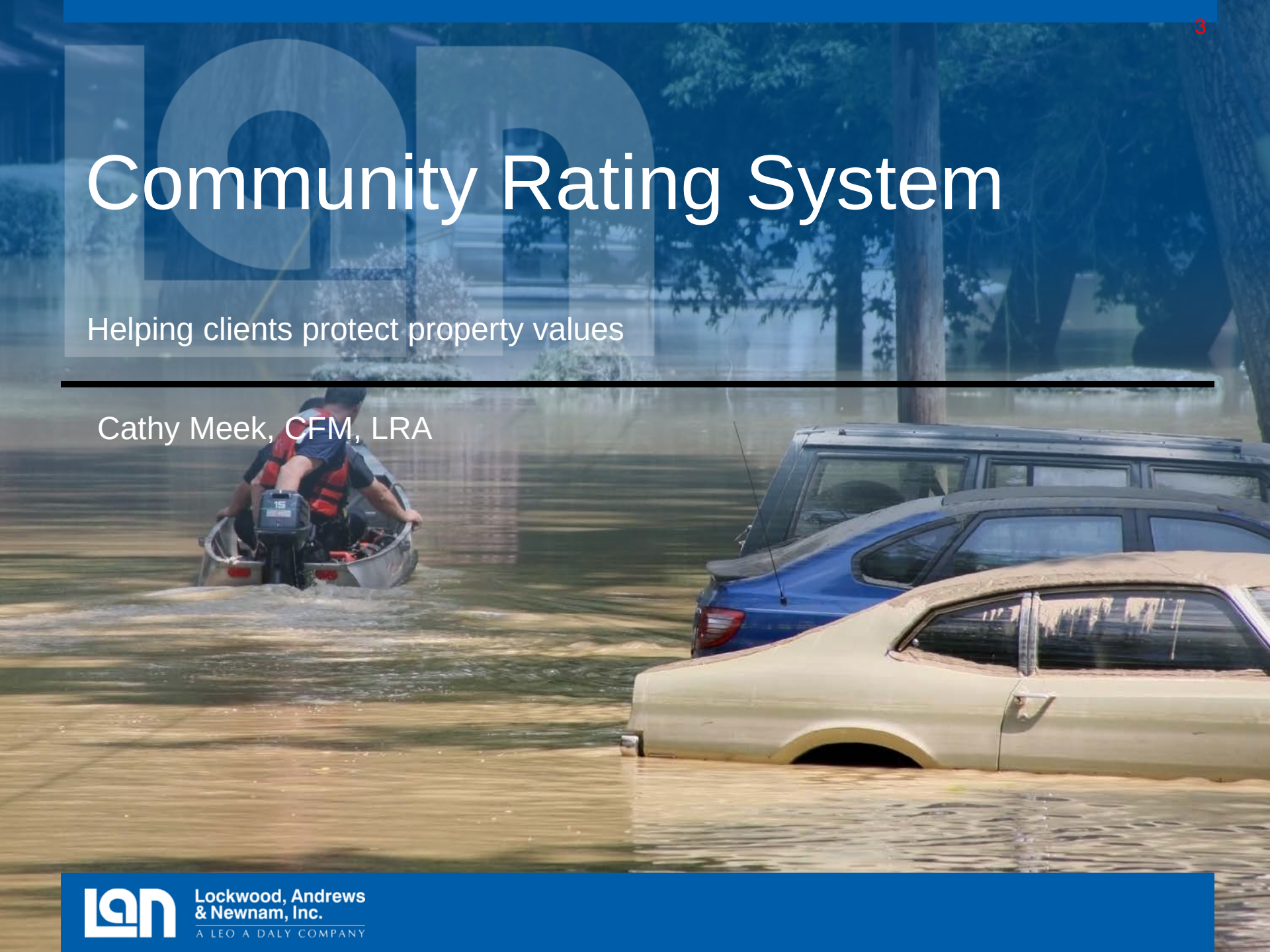
FISCAL ANALYSIS: The estimated contract cost for services is $51,655.00. Funds for this request are available in the Professional Services line item, to be taken from both Public Works and Building and Development Departments. A CRS rating of Class 7 should yield an estimated annual premium savings of $64,673 (15 percent) for those currently paying for NFIP coverage. The total annual savings will increase as additional policies are written.

RECOMMENDATION: Not an action item.

Community Rating System

Helping clients protect property values

Cathy Meek, CFM, LRA



Community Rating System (CRS)

- Available for National Flood Insurance Program (NFIP) communities in good standing
  - Incentive-based program to reduce flood damage
- Strengthens local NFIP program
  - Adopt higher NFIP regulatory standards for development and to mitigate flood risk
- **Provides resident policyholders with discounted flood insurance premiums**
  - Incremental CRS credits earn greater discounts

The NFIP and Biggert-Waters Reform Act

- National Flood Insurance Program (NFIP) is $24 billion in debt
- Designed to allow premiums to reflect the true risk of living in high-flood areas
- Actuarial rate increase for secondary or vacation homes; up to a 10-fold increase in premiums
- CRS requires higher regulatory standards for development that results in a more flood-resilient community and lower premiums

Insurance Discounts & Participation

(Rating Class improves for each 500 credits in 5% increments)

Class	Credits	Discount
10	0-499	0%
9	500-999	5%
8	1,000-1,499	10%
7	1,500-1,999	15%
6	2,000-2,499	20%
5	2,500-2,999	25%
4	3,000-3,499	30%
3	3,500-3,999	35%
2	4,000-4,499	40%
1	4,500+	45%

Community	Class	Discount
Arlington	7	15%
Austin	6	20%
Bryan	6	20%
Conroe	7	15%
Corpus Christi	7	15%
Dallas	5	25%
Fort Worth	8	10%
Galveston	7	15%
Houston	5	25%
Lubbock	7	15%
New Braunfels	6	20%
Pflugerville	7	15%

Insurance Savings for Rockport at Class 7 Rating (15% discount)

	Special Flood Hazard Area	Flood Zone X/AR/A99	Total
Policies in Force	519	1,582	2,101
Annual Premiums	$360,880	$783,387	$1,144,267
ANNUAL SAVINGS	**$104 Per Policy (avg.)**	**$42 Per Policy (avg.)**	**$64,673****

***** Greater savings will be reflected as additional properties are included in the SFHA on updated FEMA Flood maps***

Credit-Earning Activities

Public Information	Mapping & Regulations	Flood Damage Reduction	Flood Preparedness
• Elevation certificates • Map information • Outreach projects • Hazard disclosure • Flood protection information • Flood protection assistance	• Additional flood data • Open space preservation • Higher regulatory standards • Flood data maintenance • Stormwater management	• Floodplain management planning • Acquisition & relocation • Flood protection • Drainage system maintenance	• Flood warning program • Levee safety • Dam safety

Note: Most Texas Communities will classify as a 7 for ongoing/existing activities

Community Benefits of CRS

- Reduce flood damage to property through higher standards
- Strengthen the local National Flood Insurance program (NFIP)
- CRS outreach will increase flood policy count community-wide
- Recover from flood disasters more efficiently and more quickly
- Direct monetary benefit to citizens

Integrating Other Planning Mechanisms into CRS

Hazard Mitigation Action Plan (HMAP)

- Disaster Mitigation Act of 2000 requires communities to mitigate risk to natural hazards that affect the community such as flood, hurricane, tornado, wildfire, through development of an HMAP. Communities qualify for funding to develop and implement pre- and post-disaster activities or projects in the HMAP. Rockport is part of Coastal Bend Council of Governments (CBCOG) HMAP, expiring in 2017.
- Some of the flood mitigation actions in the HMAP may be identified in the CRS program for CRS credit, and funded under FEMA grants.

Integrating Other Planning Mechanisms into CRS

- The CRS program entails review of ongoing measures to address the flood hazard, maximize CRS points, prioritize flood projects, and apply for FEMA grant funding.

Plan review includes:

- Drainage Master Plan, Stormwater Plan, Capital Improvement Projects (CIP) addressing development requirements and Stormwater and drainage criteria
- Open space preservation
- Drainage system maintenance
- Floodplain ordinance, permitting, and Elevation Certificate record-keeping, and recommendations for improvement
- Emergency Operations plan (preparedness, response, and warnings)
- Development of a public outreach program and optional ***'Program for Public Information' (PPI), and 'Floodplain Management Plan' (FMP)***

Other CRS Programs

Floodplain Management Plan (FMP)

- This CRS activity is development of a stand-alone, in-depth analysis of programs, projects, and measures that will reduce the adverse impact of the flood hazard on the community. It incorporates all other related planning mechanisms such as drainage and stormwater plans, and Emergency Operations Plan, and those previously cited.
- An FMP is required as part of CRS if the community has at least 10 repetitive loss properties (RL). An FMP follows a 10-step planning process similar to the HMAP. An HMAP may be used as a basis for development of the FMP with a maximum credit is 50 points.

Note: Since the City of Rockport's HMAP will be expiring in 2017, it may be advantageous to develop the FMP when the HMAP is updated.

Maximum Credit for this activity is 382 points

Other CRS Programs

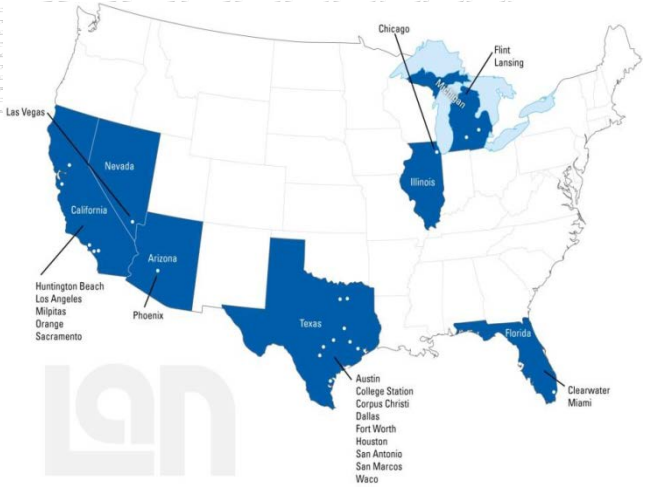
Program for Public Information (PPI)

- Public information and outreach is a critical component of a CRS program. CRS credits local activities that advise people about the flood hazard, flood insurance, and flood protection measures. The activities may be community-wide, and target specific groups such as residents in the floodplain. A PPI can help design an entire public information program, not just outreach projects. A PPI may include public information endeavors such as updating the community website, developing a community newsletter, or brochure. One activity, maintaining Elevation Certificates, is a mandatory element of the CRS program.

A primary advantage to developing a PPI is that this element is a 40% multiplier for each Outreach Project identified in the CRS program

About LAN

- Founded in 1935
- Full-service engineering, planning, and program management firm
- 21 offices nationwide
- Over 50 years' combined staff experience in NFIP/FEMA program management, CRS, and hazard mitigation planning



Questions?

Lockwood, Andrews & Newnam, Inc.

A LEO A DALY COMPANY

Thank You

Contact:

Scott Harris, P.E.
Regional Manager
361-876-6395
smharris@LAN-inc.com

Cathy Meek. CFM, LRA
CRS / Floodplain Mitigation Manager
512-338-2732
CLMeek@lan-inc.com

Janine Ellington, CFM
CRS Program Manager
830-660-1209
JEEllington@lan-inc.com

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Community Rating System (CRS) Program Application Support

The following scope details the tasks performed to support the City of Rockport, or the *City*, in their application to join the Community Rating System (CRS) program. CRS is a FEMA established program designed to promote reduced flood risk through community activities such as the adoption of higher development standards with regard to flood protection and community education and outreach. Communities are eligible to receive discounted flood insurance premiums for participation in the CRS program.

There are five phases to the CRS Application Process:

1. Completion of the CRS Application and submittal to Insurance Services Office (ISO);
2. The Application triggers a Community Assistance Visit (CAV) from FEMA;
3. Community generates the required documentation while waiting for CAV completion;
4. ISO Visit with the City after the CAV is complete to submit activity documentation;
5. Post ISO visit follow-up to finalize documentation.

Services to be provided by LAN

Lockwood Andrews and Newman, Inc. (LAN), known as *Consultant,* provides support with all five phases of the process. A detail of each phase and the approximate timeframe for each phase is outlined below.

1. **CRS Application Preparation, Overall Plan Development, Coordination and General Project Management (10% to 15% of Project)**
    a. General Project Management and Administration: General project management and administration will be ongoing through the period of the contract and include items such as developing and updating the project schedule, preparing contract correspondence, transmitting deliverables, documenting the quality control process, and other project oversight activities.
    b. Project Plan: The Consultant will develop a project plan tailored to the City's application and consisting of a chronological list of activities and action items. The project plan will clearly define key steps and schedule of activities necessary to achieve project success. The plan will also clearly define the rolls and responsibilities of both the City and the Consultant for each activity.
    c. CRS Application and Submittal: The Consultant will assist the City in preparing the application and required documentation and submit the application to ISO and FEMA Region VI.

2. **CAV Assistance (5%)**
    a. CAV Assistance: Consultant will provide support to the City, as needed, throughout the CAV process. This generally consists of participating in the CAV process as the City's support representative.

3. CRS Activity Documentation Preparation (60% to 70% of Project)

CRS Activity Documentation Preparation**:** CRS activities are organized into different categories according to the 2013 CRS Coordinators Manual. These categories are referred to as Series.

a. **300 Series: Public Information**: the Consultant will provide
   1) Elevation Certificate Review;
   2) Outreach Project Creation;
   3) Public Protection Information Plan creation;
   4) Map Information Summary;
   5) Flood Protection Assistance Summary; and
   6) Create website content for flood information.

b. **400 Series - Mapping and Regulations:** the Consultant will provide
   1) Assistance in documenting Mapping Credit;
   2) Assistance in documenting Open Space Credit;
   3) Review of the City's Higher Standards Regulations Credit
   4) Review of the City's Stormwater Regulations.

c. **500 Series - Flood Damage Reduction Activities**: the Consultant will provide
   1) Assistance in creating the required Repetitive Loss Area Maps and outreach letter.
   2) The consultant will review current Hazard Mitigation Action Plan for credit and if needed and can provide assistance in creating a new Floodplain Management Plan.
   3) Assistance in creating drainage component maps and SOP for Drainage System Maintenance

d. **600 Series - Warning and Response:** the Consultant will provide
   1) Review and Submittal of the City/County Flood Warning Response Plan.
   2) Review and submittal of Dam Safety Credit

4. ISO Visit Support (5%)

a. LAN will assist the City in scheduling the ISO visit and will support the City as their representative through the actual ISO visit.

5. Post ISO Visit Revisions: (10%)

a. Review and Revise Based on Comments: After Verification Visit with ISO, the consultant will review comments given to the city and implement any changes or corrections to the activities that received comments.
b. CRS Submittal: the consultant will compile all documentation for each activity making a copy for submittal to ISO, a copy to the city and a copy for consultant.

c. Develop Recertification Packet: the Consultant will create a recertification packet, with directions, for the city to use for their annual recertification, based on the new submittal.

Services to be provided by The City

To complete the CRS application and acceptance process requires action and activity from both the Consultant and the City. The following items outline the role of the City in the CRS application process.

1. If possible, the City should complete the Community Self Assessment at www.CRSResouces.org under Activity 240. This assessment will assist with expediting the application process.
2. Providing documents such as permit records, regulations, maps, etc., in order to demonstrate proof that the City is conducting each activity specified.
3. Should the City decides to undertake a Public Protection Information (PPI) Plan under Activity 330, the City will be required to create a PPI Committee dedicated to instituting viable floodplain information outreach projects for the residents of the City.
4. The City is required to coordinate and respond to FEMA or State NFIP requirements and requests throughout the CAV process.

CITY OF ROCKPORT CRS APPLICATION FEE ESTIMATE

TASK #	DESCRIPTION OF WORK TASKS	PROJECT MANAGER	CRS SPECIALIST	PROJECT ENGINEER	ADMIN	TOTAL HOURS	LABOR COSTS
1	**Overall Plan Development, Coordination and General Project Management**						
a	General Project Management and Administration	6			3	9	$ 1,665.00
b	CRS Application		16			16	$ 2,400.00
c	CAV Assistance		5			5	$ 750.00
d	Project Plan	16	8			24	$ 5,040.00
	Total	**22**	**29**	**0**	**3**	**54**	**$ 9,855.00**
2	**CRS Submittal Preparation****						
a	300 Services: Public Information Activities		60			60	$ 9,000.00
b	400 Services: Mapping and Regulations	4	60	3		67	$ 10,320.00
c	500 Services: Flood Damage Reduction Activities		65			65	$ 9,750.00
d	600 Services: Warning and Response		20			20	$ 3,000.00
	Total	**4**	**205**	**3**	**0**	**212**	**$ 32,070.00**
3	**Post ISO Revisions**						
a	Review and Revise Based on Comments		24			24	$ 3,600.00
b	CRS Submittal		2			2	$ 300.00
c	Develop Recertification Packet		16			16	$ 2,400.00
	Total	**0**	**42**	**0**	**0**	**42**	**$ 6,300.00**
	TOTAL HOURS	**26**	**276**	**3**	**3**	**308**	
	Contract Labor Rate	$240.00	$150.00	$120.00	$75.00		
	TOTAL LABOR COSTS	**$6,240.00**	**$41,400.00**	**$360.00**	**$225.00**		**$48,225.00**

	DIRECT COSTS	QUANTITY	UNIT	COST	TOTAL
1	PRINTING AND REPRODUCTION	1.00	LS	500.00	$500.00
2	DELIVERIES	1.00	LS	60.00	$60.00
	Travel Cost for In house work with the city	1.00	LS	500.00	$2,000.00
3	MILEAGE (3 trips)	1,500.00	MILE	0.58	$870.00
	SUB-TOTAL				**$3,430.00**

TOTAL CONTRACT AMOUNT **$51,655.00**

**** Estimated hours may increase depending on the actual activities the City chooses to incoporate to achieve at least a Class 7.**

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

300 Series: Program for Public Information (PPI)

A PPI can help design an entire public information program, not just outreach projects. A PPI that covers other types of public information endeavors, such as website, newsletter, outreach brochure, etc., can result in increased credit under other activities.

Note: A primary advantage to developing a PPI is that this element is a 40% multiplier that increases the points for each Outreach Project (OP) identified in the CRS program.

500 Series: Floodplain Management Plan (FMP)

The objective of this activity is to credit the production of an overall strategy of programs, projects, and measures that will reduce the adverse impact of the flood hazard on the community. A FMP is required as part of CRS if the community has at least 10 repetitive loss properties (RL). The FMP follows a 10-step planning process similar to a community's FEMA Hazard Mitigation Action Plan (HMAP). The community's HMAP may be used in place of an FMP. However, the HMAP will provide a maximum of 50 points activity credit. A stand-alone FMP maximum credit is 382 points.

CITY OF ROCKPORT CRS APPLICATION FEE ESTIMATE OPTIONAL ADDITIONAL SERVICES

TASK #	DESCRIPTION OF WORK TASKS	PROJECT MANAGER	CRS SPECIALIST	PROJECT ENGINEER	ADMIN	TOTAL HOURS	LABOR COSTS
1	**300 Series PPI Plan**						
a	Review HMAP and other Plan Review and recommended Outreach Projects		20			20	$ 2,500.00
b	Work With PPI Committee to final ize projects		40			40	$ 5,000.00
c	Draft PPI Plan		80			80	$ 10,000.00
d	Analyze Outreach options		30			30	$ 3,750.00
e	Submit Plan for ISO/FEMA for Review		4			4	$ 500.00
f	Create Flood Response Plan		12			12	$ 1,500.00
	Total	**0**	**186**	**0**	**0**	**186**	**$ 23,250.00**
2	**500 Series: Floodplain Management Plan**						
a	Organize the Planning Process; review HMAP and Other Plans to Integrate		10			10	$ 1,250.00
b	Work with FMP Committee to Develop Projects		40			40	$ 5,000.00
c	Create an Outreach Process for public involvement		15			15	$ 1,875.00
d	Incorporate Existing Planning Mechanisms		10			10	$ 1,250.00
e	Assess the Flood Hazard		15			15	$ 1,875.00
f	Assess the Community's Flood Problem areas		20			20	$ 2,500.00
g	Set Goals		25			25	$ 3,125.00
h	Review Possible Activities		25			25	$ 3,125.00
i	Draft Community Actions		25			25	$ 3,125.00
j	Provide sample Resolution for community adoption of Plan		3			3	$ 375.00
k	Advisement on implementation and updating newly adopted Plan		3			3	$ 375.00
Total	**0**	**0**	**191**	**0**	**0**	**191**	**$ 23,875.00**
	Total Hours	**0**	**377**	**0**	**0**	**377**	
	Contract Labor Rate	$240.00	$125.00	$120.00	$75.00		
	TOTAL LABOR COSTS	**$0.00**	**$47,125.00**	**$0.00**	**$0.00**	**$0.00**	**$47,125.00**

**** Estimated hours may increase depending on the actual activities the City chooses to incoporate to achieve at least a Class 7.**

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

National Flood Insurance Program

Community Rating System

A Local Official's Guide to

Saving Lives

Preventing Property Damage

Reducing the Cost of Flood Insurance

FEMA B-573 / May 2015

FEMA

How the Community Rating System Works

Every year, flooding causes hundreds of millions of dollars' worth of damage to homes and businesses around the country. Standard homeowners and commercial property policies do not cover flood losses. So, to meet the need for this vital coverage, the Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP).

The NFIP offers reasonably priced flood insurance in communities that comply with minimum standards for floodplain management.

The NFIP's Community Rating System (CRS) recognizes community efforts beyond those minimum standards by reducing flood insurance premiums for the community's property owners. The CRS is similar to — but separate from — the private insurance industry's programs that grade communities on the effectiveness of their fire suppression and building code enforcement.

CRS discounts on flood insurance premiums range from 5% up to 45%. Those discounts provide an incentive for new flood protection activities that can help save lives and property in the event of a flood.

To participate in the CRS, your community can choose to undertake some or all of the 19 public information and floodplain management activities described in the *CRS Coordinator's Manual*.

You're probably already doing many of these activities. To get credit, community officials will need to prepare an application documenting the efforts.

The CRS assigns credit points for each activity. Table 2 lists the activities and the possible number of credit points for each one. The table also shows the average number of credit points communities earn for each activity. These averages may give a better indication than the maximums of what your community can expect.

To be eligible for a CRS discount, your community must do Activity 310, Elevation Certificates. If you're a designated repetitive loss community, you must also do Activity 510,

Floodplain Management Planning. All other activities are optional.

Based on the total number of points your community earns, the CRS assigns you to one of ten classes. Your discount on flood insurance premiums is based on your class.

For example, if your community earns 4,500 points or more, it qualifies for Class 1, and property owners in the floodplain get a 45% discount. If your community earns as little as 500 points, it's in Class 9, and property owners in the floodplain get a 5% discount. If a community does not apply or fails to receive at least 500 points, it's in Class 10, and property owners get no discount.

Table 1, below, shows the number of points required for each class and the corresponding discount.

Table 1:

How much discount property owners in your community can get

Rate Class	Discount SFHA*	Discount Non-SFHA**	Credit Points Required
1	45%	10%	4,500 +
2	40%	10%	4,000 – 4,499
3	35%	10%	3,500 – 3,999
4	30%	10%	3,000 – 3,499
5	25%	10%	2,500 – 2,999
6	20%	10%	2,000 – 2,499
7	15%	5%	1,500 – 1,999
8	10%	5%	1,000 – 1,499
9	5%	5%	500 – 999
10	0%	0%	0 – 499

* Special Flood Hazard Area

** Preferred Risk Policies are available only in B,C, and X Zones for properties that are shown to have a minimal risk of flood damage. The Preferred Risk Policy does not receive premium rate credits under the CRS because it already has a lower premium than other policies. Although they are in SFHAs, Zones AR and A99 are limited to a 5% discount. Premium reductions are subject to change.

Table 2:

What You Can Do to Get Credit

The CRS grants credit for 19 different activities that fall into four series:

Series 300	Public Information	Maximum Points*	Average Points*
	This series credits programs that advise people about the flood hazard, flood insurance, and ways to reduce flood damage. The activities also provide data that insurance agents need for accurate flood insurance rating.		
310	**Elevation Certificates** • Maintain FEMA elevation certificates for new construction in the floodplain. (At a minimum, a community must maintain certificates for buildings built after the date of its CRS application.)	116	46
320	**Map Information Service** • Provide Flood Insurance Rate Map (FIRM) information to people who inquire, and publicize this service.	90	63
330	**Outreach Projects** • Send information about the flood hazard, flood insurance, flood protection measures, and/or the natural and beneficial functions of floodplains to flood-prone residents or all residents of a community.	350	63
340	**Hazard Disclosure** • Real estate agents advise potential purchasers of flood-prone property about the flood hazard. • Regulations require notice of the hazard.	80	14
350	**Flood Protection Information** • The public library and/or community's website maintains references on flood insurance and flood protection.	125	33
360	**Flood Protection Assistance** • Give inquiring property owners technical advice on how to protect their buildings from flooding, and publicize this service.	110	49
370	**Flood Insurance Promotion**	110	0
	Series 300 Total	981	268

*Maximum and average points are subject to change. See the current *CRS Coordinator's Manual* for the latest information.

Series 400	Mapping and Regulations	Maximum Points*	Average Points*
	This series credits programs that provide increased protection to new development.		
410	**Floodplain Mapping** • Develop new flood elevations, floodway delineations, wave heights, or other regulatory flood hazard data for an area not mapped in detail by the flood insurance study. • Have a more restrictive mapping standard.	802	65
420	**Open Space Preservation** • Guarantee that currently vacant floodplain parcels will be kept free from development.	2,020	474
430	**Higher Regulatory Standards** • Require freeboard. • Require soil tests or engineered foundations. • Require compensatory storage. • Zone the floodplain for minimum lot sizes of 1 acre or larger. • Require coastal construction standards in AE Zones. • Have regulations tailored to protect critical facilities or areas subject to special flood hazards (for example, alluvial fans, ice jams, subsidence, or coastal erosion).	2,042	214
440	**Flood Data Maintenance** • Keep flood and property data on computer records. • Use better base maps. • Maintain elevation reference marks.	222	54
450	**Stormwater Management** • Regulate new development throughout the watershed to ensure that post-development runoff is no worse than pre-development runoff. • Regulate new construction to minimize soil erosion and protect or improve water quality.	755	119
	Series 400 Total	**5,841**	**926**

Series 500	Flood Damage Reduction	Maximum Points*	Average Points*
	This series credits programs that reduce the flood risk to existing development.		
510	**Floodplain Management Planning** • Prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan using a standard planning process. (This is a minimum requirement for all repetitive loss communities.)	622	123
520	**Acquisition and Relocation** • Acquire and/or relocate flood-prone buildings so that they are out of the floodplain.	1,900	136
530	**Flood Protection** (Protection of existing floodplain development by floodproofing, elevation, or minor structural projects.)	1,600	136
540	**Drainage System Maintenance** • Conduct periodic inspections of all channels and retention basins, and remove debris as needed.	570	214
Series 500	Total	4,692	609

Series 600	Flood Preparedness	Maximum Points*	Average Points*
	This series credits flood warning, levee safety, and dam safety projects.		
610	**Flood Warning and Response** • Provide early flood warnings to the public, and have a detailed flood response plan keyed to flood crest predictions.	395	144
620	**Levee Safety** • Maintain existing levees not otherwise credited in the flood insurance rating system that provide some flood protection.	235	0
630	**Dam Safety** (Communities in a state with an approved dam safety program that have at least one building subject to inundation from the failure of a high-hazard-potential dam receive some credit.)	160	0
Series 600	**Total**	**790**	**144**
All Series	**Total**	**12,304**	**1,947**

Extra Credit

Your community can get extra credit for regulating development outside the SFHA to the same standards as development inside the SFHA. Also, if your community faces growth pressures, the mapping and regulation activities in Series 400 receive extra credit. See the *CRS Coordinator's Manual* for full details.

Many communities can qualify for what the CRS calls "uniform minimum credit," based on the activities a state or regional agency implements on behalf of its communities. For example, some states have disclosure laws eligible for credit under Activity 340, Hazard Disclosure. Any community in those states can receive the uniform minimum credit.

Your community may want to consider floodplain management activities not listed in the *CRS Coordinator's Manual*. You should evaluate these activities for their ability to increase public safety, reduce property damage, avoid economic disruption and loss, and protect the environment. In addition, you can request a review of these activities to determine whether they should be eligible for CRS credit. FEMA welcomes innovative ways to prevent or reduce flood damage.

How to Apply

Participation in the CRS is voluntary. If your community is in full compliance with the rules and regulations of the NFIP, you may apply. There's no application fee, and all CRS publications are free.

Your community's chief executive officer (that is, your mayor, city manager, or other top official) must appoint a CRS coordinator to handle the application work and serve as the liaison between the community and FEMA. The coordinator should know the operations of all departments that deal with floodplain management and public information. And the coordinator should be able to speak for the community's chief executive officer.

The first step in the application process is to get a copy of the CRS Application, which contains all the instructions and procedures you need for preparing and submitting your community's initial application for a CRS classification. The CRS Application includes easy-to-follow worksheets that provide credits for applicable activities. The CRS Application also identifies the documentation you must submit to support the credits you are requesting.

You may also want to order a copy of the *CRS Coordinator's Manual*, which describes the program in full and provides specific information, including eligible activities, required documentation, and resources for assistance.

Your designated CRS coordinator should fill out and submit your application. Help is also available through the contact information below. The CRS will verify the information and arrange for flood insurance premium discounts.

To order CRS publications at no charge, fax the order form on the following page to 201-748-1936, or mail to the address below. You can also e-mail your request to **nfipcrs@iso.com.** Both the CRS Application and the *CRS Coordinator's Manual* are also available at FEMA's CRS Resource Center website — **www.training.fema.gov/emiweb/crs.**

For more info, write, phone, or fax:

NFIP/CRS
P.O. Box 501016
Indianapolis, IN 46250-1016
Telephone: 317-848-2898
Fax: 201-748-1936
E-mail: nfipcrs@iso.com

Order Form

Fax to: 201-748-1936

Please send me these CRS publications:

No. of Copies	Document
_____	*CRS Coordinator's Manual*
_____	CRS Application

_____

Name _____ Phone _____

Title _____

Street _____

City _____ State _____ ZIP _____

Community Name _____ NFIP Number _____
(if applicable) (if applicable)

CITY COUNCIL WORKSHOP AGENDA
Tuesday, November 17, 2015

AGENDA ITEM: 3

Hear and deliberate on a presentation from Urban Engineering on the draft Master Drainage Plan Modeling Report.

SUBMITTED BY: Public Works Director Mike Donoho, Jr.

APPROVED FOR AGENDA: PKC

BACKGROUND: The City contracted with Urban Engineering in 2013 to prepare a master drainage plan. Urban Engineering will present the draft Drainage Master Plan.

The University of Texas Center for Research in Water Resources Coastal Storm Water Best Management Practices Program has agreed to review the final draft of the plan after Council accepts it from the engineer.

Please see the accompanying draft of the plan for more detailed information.

FISCAL ANALYSIS:

RECOMMENDATION: Not an action item.

City of Rockport
Master Drainage Plan
Modeling Report

Prepared by:

TX Firm 145
2725 Swantner Dr
Corpus Christi, TX 78404

URS Corporation
TX Firm 3162
9400 Amberglen Blvd
Austin, TX 78729

November 2015

Table of Contents

1.0 Introduction 1

2.0 Model Development 1
2.1 Software 1
2.2 Study Area 1
2.3 Hydrology 2
2.3.1 Infiltration 2
2.3.2 Rainfall 3
2.4 Hydraulics 3
2.4.1 Overland flows 3
2.4.2 Stormwater Infrastructure 5
2.5 Model Validation 6

3.0 Flood Hazard Assessment modeling 7
3.1 Criteria 7
3.2 Preliminary Flood Hazard Assessment 7
3.3 Final Risk Areas 7

4.0 Modeling of Capital Improvements 10
4.1 Proposed Infrastructure 10
4.2 Flood Hazard Mitigation 10
4.3 Capital Improvements Projects 10
4.3.1 Project 1 – SH 35 Business at Traylor Avenue and Tule Park Drive 11
4.3.2 Project 2 – SH 35 Business at Enterprise and Maple 12
4.3.3 Project 3 – Market Street (FM 1069) at SH 35 Bypass, Hickory, and Steart 13
4.3.4 Project 4 – Market Street (FM 1069) at SH 35 Business 14
4.3.5 Project 5 – Market Street (FM 1069) at Burton and Kossuth 15
4.3.6 Project 6 – Enterprise from Pearl Street (FM 2165) to Omohondro and Live Oak at Maple 16
4.3.7 Project 7 – Market Street (FM 1069) at Church Street (Loop 70) 17
4.3.8 Project 8 – Pearl Street (FM 2165) at Orleans and Laurel 18
4.4 Mapping 19

5.0 References 20

Appendix A – Additional Information

List of Tables

Table 1. Model Areas 1
Table 2. Horton Parameters by Soil/Use Type (Innovyze, 2014) 2
Table 3. Rainfall Event Total Rainfall 3
Table 4. Overland Roughness Parameters by Land Cover Type 4
Table 5. Inlet Modeling Assumptions 5
Table 6. Manning's n Roughness Values 6
Table 7. Historic Storm Validation Data 7

Table A-1. Construction Plans and As-Built Drawings 22
Table A-2. May 2004 Storm Rainfall Distribution 24
Table A-3. July 2007 Storm Rainfall Distribution 25
Table A-4. Existing and Future Infiltration Parameters 26
Table A-5. Existing and Proposed Risk Areas 39

1.0 INTRODUCTION

The purpose of this report is to document the actions performed by URS as a sub-consultant to Urban Engineering for The City of Rockport Master Drainage Plan. URS tasks included the model development and validation of an existing conditions model, extracting and processing model results for the flood hazard assessment, the modeling of infrastructure improvement for the capital improvement plan, extracting and processing the model results for the capital improvement plan, and the production of the Master Drainage Plan Sheets. For depictions of data discussed in this report, refer to The Master Drainage Plan Sheets.

2.0 MODEL DEVELOPMENT

2.1 Software

InfoWorks® ICM, Version 5.0 (Innovyze, 2014) was selected to simulate the hydrology and hydraulics within the area included in this study. InfoWorks ICM is a fully integrated one-dimensional (1D) / two-dimensional (2D) model, which enables the hydrology and the hydraulics of natural terrain and constructed infrastructure to be simulated in a single model. This particular model was selected because the relatively flat terrain in the study area requires consideration of 2D flows that occur, in addition to 1D flows that are typically modeled in hydraulic modeling software. Rather than modeling hydrology in one software and then importing the results into a hydraulic model, InfoWorks ICM allows the user to simulate rainfall directly onto a 2D mesh surface. Runoff from the mesh surface can travel in multiple directions and is routed through infrastructure before returning to the mesh surface or leaving the system.

2.2 Study Area

The area included in this study was selected based on the watersheds delineated in the Storm Drainage Design Manual for the City of Rockport (Urban Engineering, 2000). Watersheds from the previous study that are within the City of Rockport Half Mile ETJ boundary and areas contributing to the Half Mile ETJ were included in this study, for a study area totaling over 21 square miles. To more efficiently model this area using InfoWorks ICM the total area was subdivided into five smaller models. These models were separated along major watershed breaks to facilitate accurate modeling of drainage patterns. The five models and their areas are shown in Table 1.

Table 1. Model Areas

Model Name	Area (ac)
Copano Heights and Griffith St.	2,457
Machelle Street	1,776
Rockport Country Club & FM 1069	3,132
Ruby Allan	2,941
West 3036	3,678
Total	**13,984**

2.3 Hydrology

2.3.1 Infiltration

The Horton Infiltration Method was selected to simulate infiltration in this study, based on the methods available within InfoWorks ICM and the data that were available for this study. This method models infiltration as a decay function, using the following equation:

$$f = f_c + (f_0 - f_c)\, e^{(-kt)}$$

Where:

f_0 is the initial infiltration rate;
f_c is the limiting infiltration rate; and
k is the coefficient of the exponential term.

While the parameters for the Horton Infiltration Method would ideally be estimated through field analysis for each study area, estimates based on hydrologic soil group are provided in the InfoWorks ICM technical documentation (Innovyze, 2014). These estimates are included in Table 2.

Table 2. Horton Parameters by Soil/Use Type (Innovyze, 2014)

Soil/Use Type	f_0 (in/hr)	f_c (in/hr)	k (hr)	Recovery
A	9.84	1.00	2	0.020833
C	4.92	0.13	2	0.020833
D	2.99	0.10	2	0.020833

These values have been converted from mm/hr to in/hr.

Once estimated, the Horton Infiltration Parameters are applied to Infiltration Zones that must be defined within the InfoWorks ICM model. The Infiltration Zones can be defined as the boundaries within the soil layer used (highest resolution), or can be aggregated and applied to larger boundary areas (less resolution). It was decided that utilizing the Storm Drainage Design Manual for the City of Rockport (Urban Engineering, 2000) watershed boundaries as the Infiltration Zones and aggregating the infiltration data by these boundaries would provide a sufficient level of detail for this study.

Existing Condition

Impervious cover data were developed by URS using 2006 Texas Natural Resources Information System (TNRIS) LiDAR and 2012 National Agriculture Imager Program (NAIP) 2012 aerial imagery to identify developed areas within the study area. Developed areas were assigned an initial infiltration rate of 0.001 in/hr and limiting infiltration rate of 0.0001 in/hr, as they were the lowest limits allowable by the InfoWorks ICM model. The Horton Infiltration Parameters shown in Table 2 were assigned to the remaining undeveloped areas using Natural Resources Conservation Service (NRCS) Soil Survey Geographic database (SSURGO) hydrologic soil type

data. The Zonal Statistics tool in ArcGIS was used to produce aggregate parameters for each watershed. The aggregate existing condition parameters are included in Appendix A, Table A-4.

Future Condition

Urban Engineering estimated the number of homes that would be added to each of the watersheds in the future condition, assuming an ultimate build-out for each basin. A comparison was made between the growth percentages established by the Texas Water Development Board and the growth projected in the City of Rockport's Water and Wastewater Master Plan (2014). Ultimately, the decision was made to use the growth percentages from the Master Plan and adding 6728 homes to the area by year 2030. In 2006, the City of Rockport issued 172 building permits, which would be equivalent to 207 residential living unit equivalent structures added that year. The additional impervious cover impact for each residence was estimated at 4400 SF, which includes a home footprint, driveway, and portion of the street. URS used this information to estimate the increase in impervious cover percentage for each watershed and to develop estimates of aggregate future condition infiltration parameters for each of the Infiltration Zones based on these estimated increases. The aggregate future condition parameters are included in Table A-4.

2.3.2 Rainfall

The 5-year and 100-year, 24-hour duration frequency storm events were selected for simulation in this analysis. Total rainfall depths for the frequency storms were obtained from the 2004 USGS Atlas (USGS, 2004). Total rainfall depths are in Table 3.

Table 3. Rainfall Event Total Rainfall

Event	Depth (in)
5 yr, 24-hr	6.5
100 yr, 24-hr	13.5

The City of Rockport is located in Region III of the TR-55 rainfall distribution map (NRCS, 1986), so a Type III rainfall distribution was applied for this study.

2.4 Hydraulics

2.4.1 Overland flows

Ground Elevation Data

LiDAR data were obtained for the study area from TNRIS. The LiDAR were collected in 2006, have an average point spacing of 1.5 meters, and are in vertical datum NAVD 88, GEOID03. The data were processed into a 5-foot by 5-foot, bare earth ASCII formatted raster for use in the modeling. The raster was input directly into InfoWorks ICM and used to build the ground mesh. During the modeling process it was discovered that elevation discrepancies exist between the LiDAR data, construction as-built, and survey data. A further discussion of this issue is included

in the Tule Creek Watershed Project Report (2010). TNRIS staff were informed of the potential issue and possible explanations for the discrepancies were discussed. TNRIS staff informed URS that despite known issues with the LiDAR data, that they had passed an independent test for vertical accuracy. After discussions with Urban Engineering and TNRIS staff a determination was made that the LiDAR were the best available and were suitable for watershed level assessment. All elevations should be verified by a licensed surveyor before proceeding to final design.

Development of Roughness

Roughness Zones required for the InfoWorks ICM model were created based on 2006 National Land Cover Dataset (NCLD) (Fry et al., 2011) spatial files. Manning's n values were assigned to each land cover type based on the definition provided for the land cover type. In the case of composite land cover types, an area weighted approach was used to estimate the Manning's n for the land cover type. The estimated roughness values shown in Table 4 were assigned to the Roughness Zone shapefile.

Table 4. Overland Roughness Parameters by Land Cover Type

Land Cover	Description	Manning's n
21	Developed, open space	0.0404
22	Developed, low intensity	0.0678
23	Developed, medium intensity	0.0678
24	Developed, high intensity	0.0404
31	Barren land	0.0113
41	Deciduous forest	0.36
42	Evergreen forest	0.32
43	Mixed forest	0.4
52	Shrub/scrub	0.4
71	Grassland/herbaceous	0.368
81	Pasture/Hay	0.325
95	Emergent herbaceous wetlands	0.1825

Development of Mesh

InfoWorks ICM uses a 2D triangular mesh surface generated from the LiDAR, roughness, and infiltration parameters to model overland flows. Sensitivity testing was performed using various minimum and maximum triangle sizes to determine a mesh density that was detailed enough to model complex overland flows, but not so detailed as to cause inefficient run times. A maximum triangle area of 100 square feet and a minimum triangle area of 10 square feet were used for this study.

2.4.2 Stormwater Infrastructure

Data Sources

The stormwater infrastructure included in the InfoWorks ICM model includes an extensive storm sewer system, culverts, and open channels. Data were obtained from the Storm Drainage Design Manual for the City of Rockport (Urban Engineering, 2000), construction plans, and as-built drawings, which are listed in detail in Table A-1. All elevation data used from construction plans or as-built drawings prior to 1988 were adjusted to the vertical datum NAVD 88, GEOID03. Where gaps still existed in the data and where feasible, survey was performed by Urban Engineering. Where data sources had conflicting information, the more current source was assumed to be most accurate.

Storm Sewer

The models included an extensive storm sewer network of inlets, conduits, manholes, and outlets. Storm sewer conduits were assigned normal headlosses based on InfoWorks ICM's built-in headloss curve.

Inlets were modeled as 2D inlet nodes, allowing flows to enter and exit the 1D storm sewer system from the 2D mesh through the inlet. Due to a lack of dimensional data from many inlets, global assumptions were made for curb and grate inlets. These are listed in Table 5.

Table 5. Inlet Modeling Assumptions

Parameter	Value
Cross Slope (ft/ft)	0.02
Grate Width (ft)	2
Grate Length (ft)	2
Curb Opening Length (ft)	5
Curb Opening Height (ft)	0.5
Weir Behavior Depth (ft)	0.7
Grate Clear Opening Area (sq ft)	2

Culverts

Culverts were modeled in accordance with the InfoWorks ICM User's Manual (Innovyze, 2014). Culvert inlet links with a headloss coefficient of 0.7 were used. Inlet nodes were placed at the low point nearest to each culvert on the 2D mesh. This allows for a more accurate modeling of the culverts' headwater conditions. All circular culverts were assumed to have a square-edged headwall, and all rectangular culverts were assumed to have square-edged headwalls with 90º wingwalls. The project study area contains many small driveway culverts, which were not modeled and for which no data were available.

Channels

Channels within the model were modeled in accordance with the InfoWorks ICM User's Manual. Major existing and proposed channels were modeled as 1D elements with 2D bank connections, allowing flows to enter and exit the channel onto the 2D surface. Minor channels and roadside ditches were modeled in the 2D mesh based on LiDAR data.

Manning's n roughness values for all storm sewer infrastructure were assigned based on material type, as shown in Table 6.

Table 6. Manning's n Roughness Values

Material	Manning's n
PVC/HDPE	0.012
Concrete	0.013
Iron	0.024
Earthen	0.03

Outfalls

All infrastructure outfalls within the 2D mesh were modeled as 2D outfall nodes, allowing flows to enter and exit the 1D storm sewer system from the 2D mesh through the outfall. Outfalls leaving the system were modeled as loss outfall nodes and given a tailwater condition.

2.5 Model Validation

Two historical storm events were run in the model to validate its accuracy. The historical storms' rainfall distributions were obtained from Tule Creek Watershed Project Report (2010). and are shown in Tables A-2 and A-3. The model results were analyzed at eight locations where high water marks had been recorded and surveyed after the storm events. All validation points were within the Rockport Country Club & FM 1069 modeling area. Infrastructure constructed prior to the storms was removed from the calibration model. The greatest difference between the storms' surveyed maximum water surface elevation and the model's maximum water surface elevation was 0.31 foot, as shown in Table 7.

Table 7. Historic Storm Validation Data

Location	Storm Date	Surveyed Max WSEL (ft)	Modeled Max WSEL (ft)	Difference (ft)
Colonial and Olympic Dr.	7/5/07	14.46	14.58	-0.12
Colonial and Olympic Dr.	7/5/07	14.66	14.59	0.07
306 Colonial Dr.	7/5/07	14.84	14.62	0.22
Colonial and Olympic Dr.	7/5/07	14.90	14.72	0.18
Colonial Dr. Looking North towards Marion	7/5/07	14.44	14.31	0.13
108 Cedar Ridge Dr.	5/8/04	12.60	12.91	-0.31
112 Peachtree Dr.	5/8/04	12.36	12.53	-0.17
Broadway and SH-35	5/9/04	10.14	10.36	-0.22

3.0 FLOOD HAZARD ASSESSMENT MODELING

3.1 Criteria

The flood hazard criteria for the study were developed by Urban Engineering. All roads in the study area were prioritized by Urban Engineering, using classifications of major, collector, or local. All structures at risk were also assigned a structure type of critical (CRIT), single-family residence (SFR), multi-family residence (MFR), commercial (COM), or garage/barn/shed (G).

Top priority was given to hazards threatening loss of life. This includes the flooding of emergency facilities and structures, and loss of access for police, fire, EMS, and other emergency personnel. A water depth at the crest of the road of greater than 1 foot in the 100-year storm event and greater than 0.5 foot in the 5-year storm event on major or collector roads is considered unacceptable. The next priority was hazards threatening the loss of or damage to property, with highest priority given to single-family and multi-family residences.

3.2 Preliminary Flood Hazard Assessment

The preliminary flood hazard assessment was conducted by URS and Urban Engineering. Preliminary flood depths were mapped over aerial imagery, and areas that appeared to not meet the flood hazard criteria were identified. These areas underwent a more detailed assessment and were narrowed down into final risk areas.

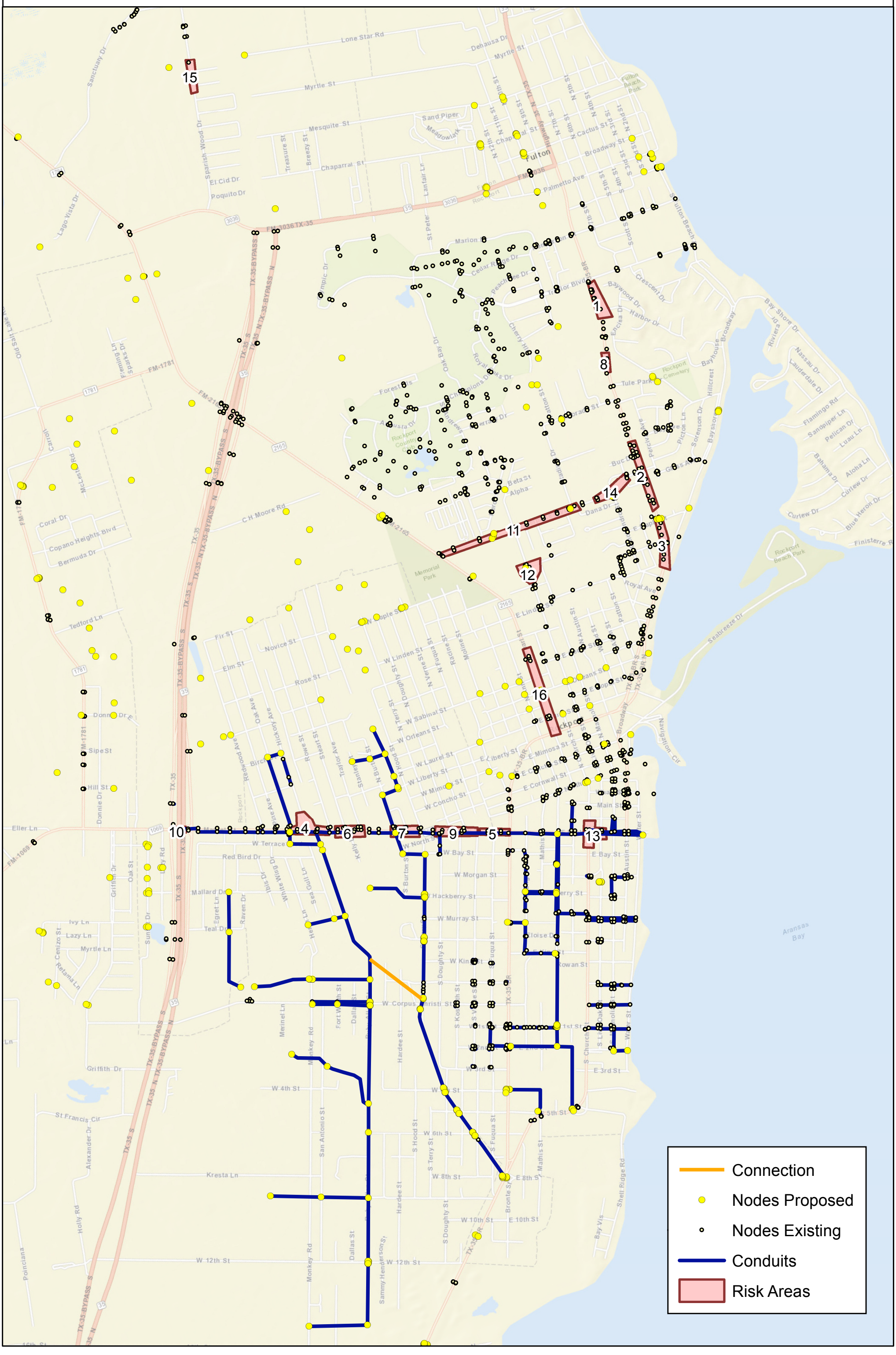
3.3 Final Risk Areas

The preliminary risk areas were refined to final risk areas. Roadways that appeared to be flooded were further analyzed. The maximum flooding depth and inundation length along the crest of any major or collector roadway were obtained from the model results for the existing 5- and 100-year storms.

Buildings that appeared to be flooded were also further analyzed. Building finished floor heights above the bare earth were estimated from LiDAR data and aerial imagery. The building was estimated to be at risk for flooding if the flood depth at the building location was greater than the estimated building finished floor height. For each risk area, buildings at risk of flooding were recorded. At some locations, isolated buildings appeared to be at risk for flooding not due to issues with drainage infrastructure, but solely due to being located in a depression. These areas were not further studied or included in the capital improvement plan. No critical buildings were estimated to be at risk of flooding in the existing 5- or 100-year storms. Final risk area results are shown in Table A-5.

Exhibit 1 below illustrates the locations and extent of the risk area flooding resulting from the modeling.

EXHIBIT 1 - RISK AREA FLOODING



4.0 MODELING OF CAPITAL IMPROVEMENTS

4.1 Proposed Infrastructure

Proposed infrastructure was modeled for the capital improvement plan. Initially, all infrastructure improvements in the Storm Drainage Design Manual for the City of Rockport (Urban Engineering, 2000) that are not currently constructed were modeled. If the desired flood hazard mitigation was not achieved with these improvements, or if there was a conflict with existing infrastructure, adjustments were made as directed by Urban Engineering.

4.2 Flood Hazard Mitigation

The model results with the proposed infrastructure improvements were assessed again to analyze the flood hazard mitigation at the final risk areas. The maximum flooding depth and inundation length along the crest of any major or collector roadway, as well as building flooding information was obtained from the model results for the existing 5- and 100-year storms. The proposed infrastructure is estimated to lower all maximum flood depths for the existing 100-year storm to 1 foot or lower on all major and collector streets, and to remove all buildings in the identified risk areas from risk of flooding. Final risk area results with proposed infrastructure improvements are shown in Table A-5.

4.3 Capital Improvements Projects

The eight projects listed below were selected using improvements proposed in the 2000 Master Plan and prioritized according to the flood risk criteria previously discussed. Project 1 has the highest priority for funding with Project 8 being the lowest priority. For instance, eliminating water from SH 35 Business and Market Street is a higher priority than eliminating flooding on Pearl Street or Enterprise Boulevard.

4.3.1 Project 1 – SH 35 Business at Traylor Avenue and Tule Park Drive

This project involves upgrading the lower Tule ditch system from SH 35 Business down Encina to the Little Bay outfall by improving the ditch and installing additional box culvert capacity. This will eliminate the Risk Area 1 and 8 flooding on the highway south of Traylor.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	9'X5' Precast Concrete Box Culvert	923	969	LF	$600.00	$581,400.00
2	Dewatering	923	969	LF	$35.00	$33,915.00
3	OSHA Trench Protection	923	969	LF	$2.00	$1,938.00
4	Junction Box	1	1	EA	$10,000.00	$10,000.00
5	Grate Inlets on Box Culvert	8	8	EA	$3,000.00	$24,000.00
6	Ditch Improvements (B=14')	2,322	2,438	LF	$20.00	$48,760.00
7	Concrete Headwalls	4	4	EA	$15,000.00	$60,000.00
8	Demolition and Haul Off	1	1	LS	$2,500.00	$2,500.00
9	Pavement and Driveway Repair	244	244	SY	$65.00	$15,860.00
10	Misc. Utility Adjustments	1	1	LS	$20,000.00	$20,000.00
11	Flexterra / Hydromulch	2,580	2,709	SY	$2.50	$6,772.50
12	Maintenance / Watering	1	1	LS	$10,000.00	$10,000.00
13	Pollution Prevention	1	1	LS	$15,000.00	$15,000.00
					PROJECT 1 SUBTOTAL:	$830,145.50
					Engineering & Contingencies (20%)	$166,029.10
					PROJECT 1 TOTAL:	**$996,174.60**

4.3.2 Project 2 – SH 35 Business at Enterprise and Maple

This project involves installing a new box culvert outfall on Maple Street from SH 35 Business to Little Bay, intercepting water currently flowing south down SH 35 to Cherry. These improvements will free up capacity of the downstream system while eliminating the flooding in Risk Areas 2 and 3.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	6'x3' Reinforced Concrete Box Culvert	700	735	LF	$350.00	$257,250.00
2	Dewatering	700	735	LF	$35.00	$25,725.00
3	OSHA Trench Protection	700	735	LF	$2.00	$1,470.00
4	Junction Box	2	2	EA	$10,000.00	$20,000.00
5	Grate Inlets on Box Culvert	4	4	EA	$3,000.00	$12,000.00
6	Outfall Structure w/Headwalls	1	1	LS	$25,000.00	$25,000.00
7	Demolition and Haul Off	1	1	LS	$3,000.00	$3,000.00
8	Pavement and Driveway Repair	750	788	SY	$65.00	$51,220.00
9	Misc Utility Adjustments	1	1	LS	$35,000.00	$35,000.00
10	Pollution Prevention	1	1	LS	$15,000.00	$15,000.00
11	Regrade Existing Road Swales	1	1	LS	$5,000.00	$5,000.00
					PROJECT 2 SUBTOTAL:	$450,665.00
					Engineering & Contingencies (20%)	$90,133.00
					PROJECT 2 TOTAL:	**$540,798.00**

4.3.3 Project 3 – Market Street (FM 1069) at SH 35 Bypass, Hickory, and Steart

This project requires improving the upper Ruby Allen ditch system to carry water that currently surcharges the storm sewer system in Market Street. Improvements include installing a 54" RCP from Market Street to the open ditch, then widening the ditch south to Corpus Christi Street, diverting drainage to combine flows with the downstream Traylor Avenue ditch. The Master Plan from 2000 recommended a concrete-lined ditch in this section; however, the ditch can be designed and constructed to carry the water without concrete lining, using those funds for additional system improvements. This project is the first step to reducing the flooding from Risk Areas 4, 6, and 10; however, the downstream improvements will be completed in Project 5 detailed below.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	54" RCP	1,100	1,155	LF	$200.00	$231,000.00
2	7'x4' Precast Concrete Box Culvert	150	158	LF	$400.00	$63,200.00
3	Two 7'x4' Precast Concrete Box Culverts	200	210	LF	$775.00	$162,750.00
4	Two 8'x4' Precast Concrete Box Culverts	100	105	LF	$925.00	$97,125.00
5	OSHA Trench Protection	1,550	1,628	LF	$2.00	$3,256.00
6	Dewatering (As Required)	1,550	1,628	LF	$35.00	$56,980.00
7	Junction Box / Inlets	4	4	EA	$3,500.00	$14,000.00
8	Ditch Improvements (B=5')	4,450	4,673	LF	$30.00	$140,190.00
9	Ditch Improvements (B=0')	900	945	LF	$15.00	$14,175.00
10	Concrete Headwalls	5	5	EA	$10,000.00	$50,000.00
11	Demolition and Haul Off	1	1	LS	$5,000.00	$5,000.00
12	Misc Utility Adjustments	1	1	LS	$25,000.00	$25,000.00
13	Driveway / Access Crossings	3	3	EA	$50,000.00	$150,000.00
14	Pavement and Driveway Repair	450	473	SY	$65.00	$30,745.00
15	TXDOT Pavement Repair	350	368	SY	$85.00	$31,280.00
16	Regrade Existing Road Swales	1	1	LS	$10,000.00	$10,000.00
17	Flexterra / Hydromulch	12,000	12,600	SY	$2.50	$31,500.00
18	Maintenance / Watering	1	1	LS	$30,000.00	$30,000.00
19	Pollution Prevention	1	1	LS	$30,000.00	$30,000.00
					PROJECT 3 SUBTOTAL:	$1,176,201.00
					Engineering & Contingencies (20%)	$235,240.20
					PROJECT 3 TOTAL:	**$1,411,441.20**

4.3.4 Project 4 – Market Street (FM 1069) at SH 35 Business

This project is proposed to alleviate the flooding on Market Street, just west of SH 35 Business. The recommended improvements include upgrading the storm sewer system down Ann Street from Market Street to the Murray Street outfall. This drainage upgrade will eliminate the flooding of Risk Area 5.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	24" RCP	1,471	1,545	LF	$80.00	$123,600.00
2	42" RCP	1,127	1,183	LF	$160.00	$189,280.00
3	OSHA Trench Protection	2,598	2,728	LF	$2.00	$5,456.00
4	Dewatering (As Required)	2,598	2,728	LF	$25.00	$68,200.00
5	Post Inlets / Grate Inlets	17	17	EA	$3,000.00	$51,000.00
6	6' Diameter Manhole over Ex. 48" RCP	1	1	EA	$6,000.00	$6,000.00
7	Junction Box	2	2	EA	$10,000.00	$20,000.00
8	Demolition and Haul Off	1	1	LS	$5,000.00	$5,000.00
9	Pavement and Driveway Repair	1,732	1,819	SY	$65.00	$118,235.00
10	Regrade Existing Road Swales	1	1	LS	$3,000.00	$3,000.00
11	Misc Utility Adjustments	1	1	LS	$30,000.00	$30,000.00
12	Pollution Prevention	1	1	LS	$20,000.00	$20,000.00
13	Sodding / Hydromulch	1	1	LS	$20,000.00	$20,000.00
					PROJECT 4 SUBTOTAL:	$659,771.00
					Engineering & Contingencies (20%)	$131,954.20
					PROJECT 4 SUBTOTAL:	**$791,725.20**

4.3.5 Project 5 – Market Street (FM 1069) at Burton and Kossuth

This project includes improving the upper Traylor ditch system (on Terry Street) from Market to Corpus Christi, then upgrading the Traylor ditch from Corpus Christi to handle the combined flow from this basin as well as the Ruby Allen water across SH 35 to the outfall. This ditch system is much shorter than the Ruby Allen ditch; therefore, the recommendation is to dedicate funds to upgrading this system rather than both major outfalls separately. The proposed improvements will eliminate flooding of Risk Areas 7 and 9.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	6'x4' Precast Concrete Box Culvert	1,100	1,155	LF	$375.00	$433,125.00
2	Two 7'x4' Precast Concrete Box Culverts	450	473	LF	$775.00	$366,575.00
3	Three 8'x4' Precast Concrete Box Culver	300	315	LF	$1,200.00	$378,000.00
4	Four 7'x3' Precast Concrete Box Culverts	170	179	LF	$1,400.00	$250,600.00
5	OSHA Trench Protection	2,020	2,121	LF	$2.00	$4,242.00
6	Dewatering (As Required)	2,020	2,121	LF	$35.00	$74,235.00
7	Concrete Headwalls	15	15	EA	$10,000.00	$150,000.00
8	Driveway Box Culvert Crossings	8	8	EA	$50,000.00	$400,000.00
9	Junction Box / Inlets	2	2	EA	$3,500.00	$7,000.00
10	Grate Inlets on top of box culvert	5	5	EA	$3,000.00	$15,000.00
11	Ditch Improvements (B=5')	1,800	1,890	LF	$30.00	$56,700.00
12	Ditch Improvements (B=7')	1,300	1,365	LF	$40.00	$54,600.00
13	Ditch Improvements (B=8')	4,100	4,305	LF	$45.00	$193,725.00
14	Demolition and Haul Off	1	1	LS	$15,000.00	$15,000.00
15	Pavement and Driveway Repair	300	315	SY	$65.00	$20,475.00
16	TXDOT Pavement Repair	178	187	SY	$85.00	$15,895.00
17	Misc Utility Adjustments	1	1	LS	$40,000.00	$40,000.00
18	Flexterra / Hydromulch	14,500	15,225	SY	$2.50	$38,062.50
19	Maintenance / Watering	1	1	LS	$50,000.00	$50,000.00
20	Pollution Prevention	1	1	LS	$50,000.00	$50,000.00
					PROJECT 5 SUBTOTAL:	$2,613,234.50
					Engineering & Contingencies (20%)	$522,646.90
					PROJECT 5 TOTAL:	**$3,135,881.40**

4.3.6 Project 6 – Enterprise from Pearl Street (FM 2165) to Omohondro and Live Oak at Maple

The improvements proposed in this project are to upgrade the storm sewer system on Enterprise from Stadium to Omohondro, then on Omohondro to Maple and Cherry, with a new storm sewer pipe installed down Maple. These upgrades will eliminate the flooding that occurs around the high school designated as Risk Areas 11 and 14 and the flooding on Live Oak in Risk Area 12.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	30" RCP	1,035	1,087	LF	$120.00	$130,440.00
2	42" RCP	870	914	LF	$160.00	$146,240.00
3	54" RCP	1,300	1,365	LF	$200.00	$273,000.00
4	Dewatering	3,205	3,365	LF	$25.00	$84,125.00
5	OSHA Trench Protection	3,205	3,365	LF	$2.00	$6,730.00
6	Post Inlets	11	11	EA	$3,000.00	$33,000.00
7	Manholes	2	2	EA	$5,000.00	$10,000.00
8	Junction Box	4	4	EA	$10,000.00	$40,000.00
9	Regrade Existing Road Swales	1	1	LS	$3,000.00	$3,000.00
10	Misc Utility Adjustments	1	1	LS	$65,000.00	$65,000.00
11	Demolition and Haul Off	1	1	LS	$6,000.00	$6,000.00
12	Pavement and Driveway Repair	2,360	2,478	SY	$35.00	$86,730.00
13	Pollution Prevention	1	1	LS	$15,000.00	$15,000.00
					PROJECT 6 SUBTOTAL:	$899,265.00
					Engineering & Contingencies (20%)	$179,853.00
					PROJECT 6 TOTAL:	**$1,079,118.00**

4.3.7 Project 7 – Market Street (FM 1069) at Church Street (Loop 70)

A new storm sewer pipe is required in Market Street from Church Street to the bay, which would eliminate the flooding at Risk Area 13. The existing storm sewer would remain in place, with the new pipe adding additional capacity.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	24" RCP	80	84	LF	$80.00	$6,720.00
2	30" RCP	1,200	1,260	LF	$120.00	$151,200.00
3	OSHA Trench Protection	1,280	1,344	LF	$2.00	$2,688.00
4	Dewatering (As Required)	1,280	1,344	LF	$25.00	$33,600.00
5	Post Inlets / Grate Inlets	6	6	EA	$3,000.00	$18,000.00
6	Outfall Structure	1	1	LS	$5,000.00	$5,000.00
7	Demolition and Haul Off	1	1	LS	$3,500.00	$3,500.00
8	Pavement and Driveway Repair	135	142	SY	$35.00	$4,970.00
9	Regrade Existing Roadway Swale	1	1	LS	$5,500.00	$5,500.00
10	Misc Utility Adjustments	1	1	LS	$30,000.00	$30,000.00
11	Pollution Prevention	1	1	LS	$20,000.00	$20,000.00
12	Sodding/ Hydromulch	1	1	LS	$10,000.00	$10,000.00
					PROJECT 7 SUBTOTAL:	$291,178.00
					Engineering & Contingencies (20%)	$58,235.60
					PROJECT 7 SUBTOTAL:	**$349,413.60**

4.3.8 Project 8 – Pearl Street (FM 2165) at Orleans and Laurel

This project involves installing a new box culvert outfall down Orleans from Ann Street to Little Bay, with major crossings of Pearl Street and SH 35 Business. This new storm sewer system would extend down Sabinal on the west side of Pearl to pick up drainage from that basin that currently surcharges the Pearl system. Additional capacity would also be added on Laurel from Pearl to the existing outfall in Nopal. All of these improvements will eliminate the flooding in Risk Area 16.

Item	Description	Quan	Quan (+5%)	Unit	Unit Price	Total Cost
1	18" RCP	350	368	LF	$60.00	$22,080.00
2	30" RCP	1,403	1,473	LF	$120.00	$176,760.00
3	42" RCP	1,001	1,051	LF	$160.00	$168,160.00
4	48" RCP	335	352	LF	$180.00	$63,360.00
5	6'x4' Reinforced Concrete Box Culvert	2,966	3,114	LF	$375.00	$1,167,750.00
6	OSHA Trench Protection	6,055	6,358	LF	$2.00	$12,716.00
7	Dewatering (As Required)	6,055	6,358	LF	$35.00	$222,530.00
8	Post Inlets / Grate Inlets	50	50	EA	$3,000.00	$150,000.00
9	Manholes	8	8	EA	$5,000.00	$40,000.00
10	Outfall Structure	1	1	LS	$15,000.00	$15,000.00
11	Demolition and Haul Off	1	1	LS	$10,000.00	$10,000.00
12	Pavement and Driveway Repair	4,000	4,200	SY	$35.00	$147,000.00
13	Misc Utility Adjustments	1	1	LS	$100,000.00	$100,000.00
14	Pollution Prevention	1	1	LS	$20,000.00	$20,000.00
15	Sodding / Hydromulch	1	1	LS	$25,000.00	$25,000.00
16	Regrade Existing Road Swales	1	1	LS	$4,500.00	$4,500.00
					PROJECT 8 SUBTOTAL:	$2,344,856.00
					Engineering & Contingencies (20%)	$468,971.20
					PROJECT 8 TOTAL:	**$2,813,827.20**

The improvements to correct the flooding designated as Risk Area 15 on Spanish Woods Drive is already completed; therefore, it is not discussed any further in this report.

4.4 Mapping

After the Capital Improvement Plan and flood hazard mitigation study were completed, master drainage plan map sheets were developed. The intention of these sheets is to show the existing and proposed infrastructure with other relevant information, including flows and hydraulic grade lines for the 100-year and 5-year flood results.

Existing storm sewer infrastructure is shown in dashed blue lines with italicized call-out boxes. Proposed storm sewer infrastructure is shown in solid red lines with non-italicized call-out boxes. All flows are in cubic feet per second (cfs) and hydraulic grade lines in feet. These results shown are with proposed infrastructure modeled as being constructed.

Some features from the Storm Drainage Design Manual for the City of Rockport (Urban Engineering, 2000) are included in the master drainage plan map sheets, but were not updated for this study. These features include: existing flow directions, spot elevations, building footprints, and drainage basin boundaries.

5.0 REFERENCES

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, *PE&RS*, Vol. 77(9):858-864.

Innovyze. InfoWorks® ICM, Version 5.0. www.innovyze.com, Monrovia, CA, 2014.

Natural Resources Conservation Service (NRCS). Soil Survey Staff, United States Department of Agriculture (USDA). SSURGO Database, Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/.

NRCS, USDA. Urban Hydrology for Small Watersheds. Technical Release 55 (TR-55). http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf. Revised June 1986.

Tule Watershed Project Team (Naismith Engineering, Inc.; Lippke, Cartwright, and Roberts; and LDP Consultants, Inc.). Tule Creek Watershed Project Report – Hydrologic, Hydraulic, Water Quality and Ecological Assessment and Analysis with Project Recommendations. *Aransas County Stormwater Management Plan*. June 2010.

U.S. Geological Survey (USGS) – Asquith, W.H. and Roussel, M.C. Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas. SIR 2004-5041 (TxDOT Implementation Report 5-1301-01-1). http://pubs.usgs.gov/sir/2004/5041/pdf/sir2004-5041.pdf. Austin, TX, June 2004.

Urban Engineering. Storm Drainage Design Manual for the City of Rockport. Job No. 1560.A0.01, Corpus Christi, TX, December 2000.

Appendix A

Additional Information

Table A-1. Construction Plans and As-Built Drawings

From	Number	Name	Engineer	Sealed Date	As-Built Date	Adjustment
UE	1560	Storm Sewer Layout	UE	11/1/1969	5/17/1971	Yes
UE	18930.1	RCC Estates	Quilio	4/22/1982		Yes
UE	18930.11	RCC Unit 1A	UE	5/2/1985	4/9/1985	Yes
UE	18930.2	Golf Course Lake and Drainage Improvement RCC Estates Unit 2	UE	1/5/1984		Yes
UE	18930.3	RCC Estates Unit 3	UE	2/21/1985	8/19/1985	Yes
UE	01560.A2.07	2002 Drainage Improvements	UE	10/30/2002		
UE	01560.A2.09	Henderson and Traylor Paving Improvements	UE	4/17/2003		
UE	01560.A3.06	Live Oak St. Paving and Drainage Improvements	UE	10/25/2006		
TXDOT	0180-04-098	SH35 STP98 (317)RM	TXDOT	4/30/1998		
TXDOT	0180-4-062	SH35 F 69 (5), ETC	TXDOT	9/16/1991		
TXDOT	0180-4-085	SH35B	TXDOT	9/14/1993		
TXDOT	0180-4-086	SH35B	TXDOT	10/26/1994		
TXDOT	0180-4-096	SH35 H1479 (1)	TXDOT	5/10/2001		
TXDOT	0180-4-108	SH35 STP2002(714)	TXDOT	3/5/2003		
TXDOT	0507-04-025	FM1069 DBUSTP95(209)UM	TXDOT	3/7/1995		
TXDOT	0507-04-031	FM1069 MC507-4-31, ETC.	TXDOT	4/12/1992		
TXDOT	1549-01-049	FM1781 SFT1549-1-49, ETC	TXDOT	5/17/2006		
UE	1560.99.01	COR 1999 Paving & Drainage Improvements	UE	5/19/2009	1/14/2002	
UE	1560.A1.03	2001 Drainage Improvements	UE	10/17/2001		
UE	1560.A1.08	RCC Drainage Improvements	UE	8/13/2001		
UE	1560.A3.08	Cherry Street Drainage Improvements	UE	5/28/2004		
UE	1560.A4.03	Tule Ditch System Drainage Improvements	UE	10/4/2005		
UE	1560.A6.10	2007 Downtown Drainage Improvements	UE	3/8/2007	8/18/2008	
UE	1560.A8.02	Master Plan Drainage Crossings	UE	8/1/2009		
UE	1560.A8.10	RCC Drainage Improvements Hole 6	UE	1/20/2009	10/6/2009	
UE	1560.B0.11	Lady Claire Drainage Improvements	UE	3/2/2011		
UE	1560.B1.02	South Rockport Drainage Improvements	UE	2/1/2013		
UE	18930.2A	Lots 1,2 &3, Block I RCC Estates Unit 2A	UE	8/30/1984	4/9/1985	Yes
UE	18930.95.01	St. Andrews Place	UE	6/2/1995	9/19/1995	
TXDOT	2023-01-010	FM2165 STP2004(242)	TXDOT	11/19/2003		

From	Number	Name	Engineer	Sealed Date	As-Built Date	Adjustment
TXDOT	3116-01-003	FM3036 STP941(57)RM	TXDOT	2/9/2004		
UE	39723.B2.00	Aransas County ISD Live Oak Learning Center	UE	6/15/2012		
Aransas County		Mesquite Bypass	Lippke	8/30/2012		
UE	1560.A8.06	Austin Street Paving Improvement Phase Two	UE	10/1/2008		
UE	1560.B3.00	Southside Drainage Improvements Phase 2	UE	4/15/2013		
UE	37806.A2.01	Whistler's Cove Unit 1	UE	8/19/2002		
UE	E13897.00	Whistler's Cove Unit 2	UE	6/10/2005		
UE	E14331.00	Whistler's Cove Unit 3	UE	5/17/2005		

Table A-2. May 2004 Storm Rainfall Distribution

Date	Time	Rainfall (in)	Cumulative Rainfall (in)
5/8/2004	12:00 AM	0	0
	1:00 AM	0	0
	2:00 AM	0	0
	3:00 AM	0.03	0.03
	4:00 AM	0.01	0.04
	5:00 AM	0	0.04
	6:00 AM	0.01	0.05
	7:00 AM	0.25	0.3
	8:00 AM	0.1	0.4
	9:00 AM	2.19	2.59
	10:00 AM	1.97	4.56
	11:00 AM	1.68	6.24
	12:00 PM	0.42	6.66
	1:00 PM	0.02	6.68
	2:00 PM	0.33	7.01
	3:00 PM	0.19	7.2
	4:00 PM	0.09	7.29
	5:00 PM	0	7.29

Table A-3. July 2007 Storm Rainfall Distribution

Date	Time	Rainfall (in)	Cumulative Rainfall (in)
7/4/2007	1:00 AM	0	0
	2:00 AM	0.01	0.01
	3:00 AM	0.01	0.02
	4:00 AM	0.1	0.12
	5:00 AM	0.02	0.14
	6:00 AM	1.03	1.17
	7:00 AM	0.12	1.29
	8:00 AM	0.85	2.14
	9:00 AM	0.68	2.82
	10:00 AM	0.6	3.42
	11:00 AM	0.38	3.8
	12:00 PM	0	3.8
	1:00 PM	0	3.8
	2:00 PM	0	3.8
	3:00 PM	0	3.8
	4:00 PM	0	3.8
	5:00 PM	0	3.8
	6:00 PM	0	3.8
	7:00 PM	0	3.8
	8:00 PM	0	3.8
	9:00 PM	0	3.8
	10:00 PM	0	3.8
	11:00 PM	0.13	3.93
	12:00 AM	0.22	4.15
7/5/2007	1:00 AM	0	4.15
	2:00 AM	0	4.15
	3:00 AM	0	4.15
	4:00 AM	0.07	4.22
	5:00 AM	0.47	4.69
	6:00 AM	0.02	4.71
	7:00 AM	0.24	4.95
	8:00 AM	0.69	5.64
	9:00 AM	0.03	5.67
	10:00 AM	0	5.67

Table A-4. Existing and Future Infiltration Parameters

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-14-B	5.1	14.6%	0.74	4.32	0.31	14.6%	0	4.32	0.31
DB-14-C	15.4	13.0%	2.00	4.42	0.31	13.0%	0	4.42	0.31
DB-14-D	45.3	2.8%	1.28	3.99	0.18	7.0%	1.9046	3.82	0.17
DB-32-B	78.9	2.8%	2.17	3.38	0.13	7.0%	3.3331	3.23	0.13
DB-33-A	7.0	19.9%	1.38	2.52	0.09	26.7%	0.4762	2.30	0.08
DB-33-B	9.5	17.6%	1.67	3.17	0.14	39.7%	2.0951	2.32	0.10
DB-33-C	14.7	8.7%	1.28	3.89	0.18	17.1%	1.2380	3.53	0.16
DB-37-A	83.3	4.9%	4.07	3.96	0.18	9.5%	3.8093	3.77	0.17
DB-38-A	58.8	4.4%	2.56	4.05	0.19	7.6%	1.9046	3.91	0.18
DB-39-A	29.2	19.4%	5.66	3.38	0.15	29.2%	2.8570	2.97	0.14
DB-39-B	21.2	0.7%	0.14	4.10	0.19	2.9%	0.4762	4.01	0.18
DB-39-C	4.9	7.8%	0.38	4.54	0.23	17.6%	0.4762	4.06	0.20
DB-39-D	67.5	9.2%	6.22	4.47	0.23	12.0%	1.9046	4.33	0.22
DB-39-E	19.5	18.4%	3.60	3.48	0.16	20.9%	0.4762	3.38	0.16
DB-39-G	23.1	1.8%	0.41	3.67	0.15	3.9%	0.4762	3.59	0.15
DB-36	15.9	13.8%	2.19	3.24	0.14	22.8%	1.4285	2.90	0.12
DB-37-B	34.2	4.0%	1.37	4.72	0.24	11.0%	2.3808	4.38	0.22
DB-37-C	34.2	13.9%	4.76	3.76	0.18	19.5%	1.9046	3.51	0.16
DB-37-D	16.3	5.8%	0.95	4.02	0.19	11.7%	0.9523	3.77	0.17
DB-37-E	49.6	4.7%	2.32	4.63	0.23	10.4%	2.8570	4.35	0.22
DB-39-F	73.2	8.3%	6.06	3.49	0.15	10.9%	1.9046	3.40	0.14
DB-51- A	12.4	5.3%	0.66	4.65	0.23	16.8%	1.4285	4.09	0.21
DB-51-B	37.4	1.8%	0.66	4.67	0.23	12.0%	3.8093	4.18	0.21
DB-51-C	37.9	4.9%	1.87	4.09	0.19	12.4%	2.8570	3.77	0.18
DB-51-D	32.1	7.1%	2.29	3.76	0.17	14.5%	2.3808	3.46	0.15

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-52-A	33.8	1.8%	0.60	4.42	0.21	4.6%	0.9523	4.30	0.21
DB-52-B	82.7	1.2%	1.01	3.99	0.18	3.0%	1.4285	3.92	0.17
DB-52-C	21.7	0.9%	0.20	4.88	0.25	5.3%	0.9523	4.66	0.23
DB-52-D	26.1	9.6%	2.51	4.13	0.20	16.9%	1.9046	3.80	0.18
DB-52-E	80.6	5.6%	4.49	4.29	0.21	9.1%	2.8570	4.13	0.20
DB-52-F	35.6	8.0%	2.86	4.32	0.21	12.1%	1.4285	4.14	0.20
DB-52-G	14.9	17.6%	2.63	3.05	0.13	20.8%	0.4762	2.93	0.12
DB-52-I	30.0	0.9%	0.27	3.59	0.15	7.2%	1.9046	3.36	0.14
DB-52-J	31.6	1.6%	0.51	4.42	0.27	7.6%	1.9046	4.15	0.25
DB-54-F	6.1	5.8%	0.35	4.29	0.21	13.6%	0.4762	3.93	0.19
DB-53	13.1	5.1%	0.66	4.65	0.23	8.7%	0.4762	4.47	0.22
DB-54-A	37.5	5.7%	2.14	4.51	0.22	8.2%	0.9523	4.39	0.22
DB-54-B	12.3	8.5%	1.05	4.40	0.22	12.4%	0.4762	4.21	0.21
DB-54-C	87.5	7.7%	6.74	4.37	0.22	9.3%	1.4285	4.29	0.21
DB-54-D	66.1	4.9%	3.26	4.68	0.24	6.4%	0.9523	4.61	0.23
DB-54-E	62.9	16.0%	10.07	3.78	0.18	16.8%	0.4762	3.75	0.18
DB-54-G	13.3	17.4%	2.31	3.82	0.19	31.7%	1.9046	3.15	0.15
DB-54-H	41.6	4.4%	1.81	4.34	0.21	13.5%	3.8093	3.93	0.19
DB-54-I	34.9	2.4%	0.83	3.86	0.17	6.5%	1.4285	3.70	0.16
DB-54-J	65.9	2.3%	1.54	3.23	0.14	7.4%	3.3331	3.06	0.13
DB-54-M	34.7	10.4%	3.61	5.00	0.35	21.4%	3.8093	4.39	0.31
DB-54-P	29.3	9.0%	2.63	2.72	0.09	21.9%	3.8093	2.34	0.08
DB-54-Q	25.0	12.0%	3.01	7.03	0.67	23.4%	2.8570	6.12	0.58
DB-54-S	7.8	0.7%	0.06	2.97	0.10	6.8%	0.4762	2.79	0.09
DB-54-T	28.3	7.8%	2.22	6.29	0.56	11.2%	0.9523	6.06	0.54
DB-55-A1	15.7	27.9%	4.37	5.37	0.49	34.0%	0.9523	4.92	0.45
DB-55-A2	45.8	17.4%	7.98	4.34	0.33	24.7%	3.3331	3.96	0.30

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-55-D	48.2	8.5%	4.11	6.69	0.61	10.5%	0.9523	6.54	0.60
DB-55-E	43.6	28.5%	12.44	5.94	0.57	35.1%	2.8570	5.40	0.52
DB-55-C	23.0	13.6%	3.14	5.60	0.48	15.7%	0.4762	5.47	0.47
DB-55-J	66.9	16.8%	11.26	8.19	0.83	19.7%	1.9046	7.91	0.80
DB-69-A	97.0	18.9%	18.32	7.98	0.81	21.3%	2.3808	7.74	0.79
DB-2-A	4.9	11.2%	0.55	6.81	0.63	17.0%	0.2857	6.37	0.59
DB-2-B	64.1	25.0%	16.04	6.07	0.58	26.5%	0.9523	5.95	0.57
DB-3-A	4.2	30.6%	1.29	4.70	0.41	30.6%	0	4.70	0.41
DB-3-B	21.5	8.8%	1.89	5.73	0.48	13.2%	0.95232	5.45	0.46
DB-4-A	6.9	11.6%	0.81	4.09	0.28	18.5%	0.47616	3.78	0.26
DB-4-B	150.3	20.5%	30.74	4.78	0.39	21.4%	1.42848	4.72	0.39
DB-5-A	2.9	8.9%	0.25	2.73	0.09	25.6%	0.47616	2.23	0.07
DB-5-B	52.7	16.4%	8.63	4.33	0.32	16.4%	0	4.33	0.32
DB-6-A	87.2	21.2%	18.48	6.13	0.57	22.3%	0.95232	6.04	0.57
DB-6-D	8.1	27.0%	2.18	6.24	0.61	32.9%	0.47616	5.74	0.56
DB-14-A	5.7	21.4%	1.22	4.47	0.36	21.4%	0	4.47	0.36
DB-14-F	54.3	7.7%	4.18	6.33	0.56	9.5%	0.95232	6.21	0.55
DB-14-J	148.8	8.8%	13.02	6.94	0.64	10.0%	1.90465	6.85	0.64
DB-14-K	14.6	15.1%	2.20	4.11	0.29	18.4%	0.47616	3.95	0.28
DB-14-L	38.7	27.5%	10.63	5.38	0.49	30.0%	0.95232	5.19	0.48
DB-8-A	109.3	21.4%	23.37	5.33	0.47	21.8%	0.47616	5.30	0.47
DB-8-B	52.9	6.2%	3.30	6.74	0.61	7.1%	0.47616	6.67	0.60
DB-8-C	41.4	7.0%	2.90	4.42	0.31	9.3%	0.95232	4.31	0.30
DB-8-D	64.6	12.9%	8.33	7.33	0.71	14.4%	0.95232	7.21	0.70
DB-8-E	58.5	11.8%	6.89	7.15	0.68	13.4%	0.95232	7.01	0.67
DB-14-E	352.6	5.9%	20.97	5.81	0.47	7.9%	6.76149	5.69	0.46
DB-14-G	15.0	23.3%	3.50	6.10	0.58	29.7%	0.95232	5.60	0.53

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-14-H	23.8	22.1%	5.25	7.65	0.78	28.1%	1.42848	7.06	0.72
DB-14-I	38.2	17.0%	6.50	7.63	0.76	24.5%	2.85697	6.94	0.69
DB-14-M	69.0	11.1%	7.63	6.39	0.58	14.5%	2.38081	6.14	0.56
DB-14-N	9.2	0.5%	0.05	9.79	0.99	0.5%	0	9.79	0.99
DB-14-O	41.3	23.1%	9.53	7.57	0.77	27.7%	1.90465	7.12	0.72
DB-14-P	71.2	16.0%	11.39	8.27	0.84	21.3%	3.80929	7.74	0.79
DB-15-C	36.9	12.7%	4.70	5.23	0.43	15.3%	0.95232	5.08	0.42
DB-15-L	26.1	26.4%	6.90	3.60	0.26	33.7%	1.90465	3.24	0.23
DB-15-P	25.5	42.6%	10.87	2.98	0.22	46.4%	0.95232	2.78	0.21
DB-15-Q	14.0	38.4%	5.40	4.22	0.37	45.2%	0.95232	3.75	0.33
DB-15-R	17.8	38.4%	6.84	5.95	0.60	43.7%	0.95232	5.43	0.55
DB-15-T	27.0	7.0%	1.88	6.52	0.58	17.6%	2.85697	5.78	0.52
DB-15-U	157.4	19.4%	30.49	6.61	0.63	23.6%	6.66626	6.26	0.60
DB-20-A	4.6	64.1%	2.95	3.03	0.29	74.4%	0.47616	2.16	0.21
DB-33-D	185.3	7.9%	14.57	4.86	0.34	8.1%	0.47616	4.84	0.33
DB-33-E	28.0	10.5%	2.94	6.62	0.61	12.2%	0.47616	6.49	0.60
DB-33-F	3.2	28.7%	0.91	7.02	0.71	28.7%	0	7.02	0.71
DB-33-G	20.6	19.1%	3.92	7.96	0.81	33.0%	2.85697	6.60	0.67
DB-33-H	7.0	9.0%	0.63	8.96	0.91	14.4%	0.38093	8.42	0.86
DB-33-I	10.6	25.7%	2.72	7.31	0.74	34.7%	0.95232	6.43	0.65
DB-39-H	61.4	4.9%	3.00	4.02	0.25	10.3%	3.33313	3.79	0.23
DB-38-B	37.5	10.0%	3.76	4.20	0.21	16.4%	2.38081	3.91	0.20
DB-39-I	100.8	5.5%	5.54	5.95	0.50	12.1%	6.66626	5.53	0.47
DB-39-J	82.2	8.4%	6.94	7.57	0.73	17.7%	7.61859	6.80	0.65
DB-39-K	53.3	13.5%	7.22	8.37	0.85	18.9%	2.85697	7.85	0.79
DB-39-L	74.9	1.4%	1.07	9.20	0.92	6.5%	3.80929	8.72	0.87
DB-39-M	58.1	3.2%	1.85	9.39	0.95	8.1%	2.85697	8.91	0.90

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-39-N	13.6	20.4%	2.77	7.84	0.80	34.4%	1.90465	6.45	0.66
DB-40-A	172.3	11.1%	19.19	6.51	0.59	14.7%	6.19010	6.24	0.57
DB-40-D	216.3	14.7%	31.85	7.20	0.70	20.0%	11.42788	6.75	0.65
DB-40-E	23.2	35.4%	8.21	4.52	0.40	41.5%	1.42848	4.09	0.37
DB-40-F	27.4	22.5%	6.17	4.71	0.39	22.5%	0	4.71	0.39
DB-40-G	3.4	12.5%	0.43	8.61	0.88	26.3%	0.47616	7.25	0.74
DB-40-J	110.2	25.4%	27.98	5.85	0.55	31.4%	6.66626	5.37	0.50
DB-40-K	16.0	36.4%	5.82	5.00	0.47	39.3%	0.47616	4.76	0.45
DB-40-L	14.5	16.2%	2.35	4.60	0.36	35.9%	2.85697	3.52	0.27
DB-40-M	39.0	19.3%	7.52	6.37	0.60	24.2%	1.90465	5.99	0.56
DB-40-N	19.2	15.2%	2.92	6.77	0.64	17.7%	0.47616	6.57	0.62
DB-40-O	26.5	15.2%	4.02	7.90	0.79	22.3%	1.90465	7.23	0.72
DB-40-P	56.9	5.1%	2.93	8.54	0.84	15.2%	5.71394	7.64	0.75
DB-40-Q	17.5	10.5%	1.85	6.30	0.57	16.0%	0.95232	5.92	0.53
DB-40-R	40.8	3.2%	1.31	7.97	0.76	10.2%	2.85697	7.39	0.71
DB-40-S	37.1	2.4%	0.87	9.59	0.97	7.5%	1.90465	9.09	0.92
DB-40-T	8.5	2.4%	0.21	9.08	0.91	13.6%	0.95232	8.04	0.80
DB-40-U	39.8	3.2%	1.26	7.78	0.74	5.6%	0.95232	7.59	0.72
DB-40-X	8.3	13.0%	1.07	6.74	0.63	24.5%	0.95232	5.85	0.55
DB-52-H	23.4	8.3%	1.94	7.73	0.75	20.5%	2.85697	6.70	0.65
DB-52-K	45.8	6.7%	3.08	5.35	0.42	10.9%	1.90465	5.11	0.40
DB-52-L	68.4	2.1%	1.46	9.38	0.94	9.1%	4.76162	8.71	0.88
DB-52-M	19.1	0.4%	0.07	9.47	0.95	2.9%	0.47616	9.24	0.93
DB-52-N	73.0	2.7%	2.00	9.57	0.97	13.2%	7.61859	8.55	0.87
DB-52-O	77.1	15.0%	11.58	8.37	0.85	29.8%	11.42788	6.91	0.70
DB-52-P	10.6	25.2%	2.67	7.36	0.75	38.7%	1.42848	6.04	0.61
DB-54-K	22.2	11.0%	2.44	4.45	0.32	19.6%	1.90465	4.02	0.29

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-54-L	44.6	5.7%	2.52	7.12	0.64	14.2%	3.80929	6.48	0.58
DB-54-N	66.2	4.2%	2.81	6.49	0.57	15.8%	7.61859	5.71	0.50
DB-40-AA	33.9	16.7%	5.68	6.36	0.59	28.0%	3.80929	5.51	0.51
DB-40-V	40.6	9.0%	3.68	7.34	0.70	18.4%	3.80929	6.58	0.63
DB-40-W	21.5	2.5%	0.54	6.74	0.60	13.6%	2.38081	5.97	0.53
DB-40-Y	18.8	4.4%	0.83	6.50	0.57	12.0%	1.42848	5.98	0.53
DB-40-Z	39.2	10.8%	4.23	7.91	0.78	20.5%	3.80929	7.05	0.69
DB-43-A	68.6	18.6%	12.74	6.51	0.62	32.4%	9.52323	5.40	0.51
DB-44-A	50.6	16.5%	8.34	6.46	0.60	22.2%	2.85697	6.02	0.56
DB-44-B	43.0	16.1%	6.93	3.84	0.26	22.8%	2.85697	3.54	0.24
DB-46-A	63.2	15.3%	9.67	6.72	0.63	24.3%	5.71394	6.01	0.57
DB-46-B	34.8	39.9%	13.86	3.14	0.24	50.8%	3.80929	2.57	0.19
DB-46-C	38.3	19.3%	7.37	5.04	0.42	29.2%	3.80929	4.42	0.37
DB-46-D	3.4	59.3%	2.03	1.34	0.06	87.2%	0.95232	0.42	0.02
DB-54-AA	51.5	16.5%	8.52	8.21	0.83	22.1%	2.85697	7.67	0.78
DB-54-BB	20.1	5.0%	1.00	9.35	0.95	16.8%	2.38081	8.19	0.83
DB-54-CC	33.2	18.3%	6.08	8.04	0.82	24.0%	1.90465	7.48	0.76
DB-54-O	31.2	6.7%	2.09	7.03	0.63	12.8%	1.90465	6.57	0.59
DB-54-R	51.7	13.5%	6.97	8.49	0.86	28.2%	7.61859	7.04	0.71
DB-54-U	50.2	11.6%	5.83	8.29	0.83	23.0%	5.71394	7.22	0.72
DB-54-V	18.7	19.3%	3.61	7.94	0.81	39.7%	3.80929	5.94	0.60
DB-54-W	37.1	35.6%	13.22	6.34	0.64	38.2%	0.95232	6.08	0.62
DB-54-X	24.7	15.0%	3.69	8.37	0.85	18.8%	0.95232	7.99	0.81
DB-54-Y	47.1	9.3%	4.39	8.92	0.91	17.4%	3.80929	8.13	0.83
DB-54-Z	5.3	14.5%	0.77	8.41	0.85	32.6%	0.95232	6.63	0.67
DB-55-H	6.6	20.5%	1.35	7.83	0.80	27.7%	0.47616	7.12	0.72
DB-55-I	6.3	25.3%	1.60	7.35	0.75	32.8%	0.47616	6.61	0.67

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-56-A	79.0	24.1%	19.02	7.46	0.76	27.7%	2.85697	7.10	0.72
DB-56-B	43.1	18.5%	7.98	6.77	0.65	36.2%	7.61859	5.30	0.51
DB-56-D	13.5	37.3%	5.05	4.99	0.47	51.4%	1.90465	3.87	0.37
DB-56-E	11.8	24.5%	2.88	6.58	0.64	40.6%	1.90465	5.17	0.51
DB-56-F	12.6	18.8%	2.37	7.05	0.69	37.8%	2.38081	5.40	0.53
DB-56-G	6.5	14.4%	0.94	2.56	0.08	29.1%	0.95232	2.12	0.07
DB-56-H	4.6	54.5%	2.49	1.36	0.04	65.0%	0.47616	1.05	0.03
DB-56-I	19.8	17.0%	3.36	7.50	0.74	31.4%	2.85697	6.20	0.61
DB-56-L	18.0	16.9%	3.05	7.04	0.68	27.4%	1.90465	6.14	0.59
DB-56-M	9.1	10.2%	0.93	8.55	0.86	20.7%	0.95232	7.56	0.76
DB-57-A	19.1	10.6%	2.02	7.03	0.66	20.5%	1.90465	6.25	0.59
DB-57-B	18.7	8.3%	1.55	6.05	0.53	18.5%	1.90465	5.37	0.47
DB-57-C	9.5	7.6%	0.72	4.39	0.31	17.6%	0.95232	3.92	0.27
DB-57-D	14.8	8.8%	1.29	6.43	0.58	18.4%	1.42848	5.75	0.52
DB-57-E	20.3	16.9%	3.43	3.46	0.21	28.6%	2.38081	2.98	0.18
DB-57-F	15.2	13.2%	2.01	3.92	0.26	22.6%	1.42848	3.50	0.23
DB-57-G	5.0	19.2%	0.97	7.95	0.81	28.7%	0.47616	7.02	0.71
DB-57-H	3.6	14.7%	0.53	8.25	0.83	27.9%	0.47616	6.98	0.71
DB-57-I	3.9	33.9%	1.33	4.02	0.33	58.2%	0.95232	2.54	0.21
DB-57-J	7.5	29.7%	2.23	5.95	0.58	42.4%	0.95232	4.87	0.47
DB-57-K	20.7	3.2%	0.66	9.53	0.97	30.8%	5.71394	6.81	0.69
DB-57-L	41.3	3.5%	1.43	9.49	0.96	17.3%	5.71394	8.13	0.83
DB-57-M	9.8	15.5%	1.51	7.18	0.69	25.2%	0.95232	6.35	0.61
DB-57-N	24.8	11.4%	2.83	6.52	0.60	22.9%	2.85697	5.67	0.52
DB-55-F	48.5	15.7%	7.61	8.30	0.84	21.6%	2.85697	7.72	0.78
DB-55-G	98.3	20.4%	20.00	7.84	0.80	23.3%	2.85697	7.55	0.77
DB-55-K	56.6	12.2%	6.92	8.64	0.88	16.4%	2.38081	8.23	0.84

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-56-AA	52.7	11.4%	6.00	8.72	0.89	15.9%	2.38081	8.28	0.84
DB-56-BB	13.4	3.0%	0.40	9.55	0.97	6.5%	0.47616	9.20	0.93
DB-56-CC	48.8	7.9%	3.85	9.07	0.92	11.8%	1.90465	8.68	0.88
DB-56-DD	93.3	10.6%	9.87	8.58	0.87	13.6%	2.85697	8.29	0.84
DB-56-J	72.4	16.5%	11.96	8.22	0.83	21.1%	3.33313	7.77	0.79
DB-56-K	48.6	12.7%	6.18	8.59	0.87	20.5%	3.80929	7.82	0.79
DB-56-M1	15.5	14.2%	2.20	8.44	0.86	17.3%	0.47616	8.14	0.83
DB-56-M2	35.7	14.2%	5.06	7.37	0.72	20.9%	2.38081	6.80	0.66
DB-56-M4	37.7	6.9%	2.59	9.17	0.93	10.7%	1.42848	8.79	0.89
DB-56-N	38.8	28.8%	11.16	7.01	0.71	31.2%	0.95232	6.77	0.69
DB-56-O	40.1	10.2%	4.09	8.84	0.90	16.1%	2.38081	8.25	0.84
DB-56-P	14.9	17.4%	2.59	8.13	0.83	23.8%	0.95232	7.50	0.76
DB-56-Q	56.0	11.3%	6.31	7.88	0.77	14.7%	1.90465	7.58	0.75
DB-56-R	24.5	9.5%	2.34	8.90	0.90	17.3%	1.90465	8.14	0.83
DB-56-S	24.2	9.7%	2.36	7.29	0.69	15.6%	1.42848	6.82	0.65
DB-56-T	6.1	22.0%	1.34	4.43	0.35	26.7%	0.28570	4.17	0.33
DB-56-U	6.1	19.7%	1.21	7.63	0.77	27.5%	0.47616	6.89	0.69
DB-56-V	8.8	13.2%	1.16	7.25	0.70	24.0%	0.95232	6.35	0.61
DB-56-W	49.1	13.3%	6.55	8.23	0.83	16.3%	1.42848	7.96	0.80
DB-56-X	40.5	5.0%	2.01	9.35	0.95	8.5%	1.42848	9.01	0.92
DB-56-Y	30.2	14.4%	4.36	8.42	0.86	17.6%	0.95232	8.11	0.82
DB-56-Z	150.6	7.4%	11.17	8.59	0.86	10.6%	4.76162	8.29	0.83
DB-57-O	24.6	11.9%	2.92	8.67	0.88	17.7%	1.42848	8.10	0.82
DB-57-P	6.6	19.0%	1.25	7.97	0.81	33.4%	0.95232	6.55	0.67
DB-57-Q	8.3	15.6%	1.30	5.77	0.51	32.8%	1.42848	4.60	0.41
DB-57-R	23.5	22.6%	5.30	7.62	0.77	28.7%	1.42848	7.02	0.71
DB-57-S	61.8	14.4%	8.90	7.61	0.75	18.2%	2.38081	7.27	0.72

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-57-T	18.0	14.2%	2.57	8.44	0.86	19.5%	0.95232	7.92	0.80
DB-57-U	6.8	11.0%	0.75	8.76	0.89	18.0%	0.47616	8.07	0.82
DB-57-V	49.0	13.7%	6.70	6.79	0.64	19.5%	2.85697	6.33	0.60
DB-57-W	3.2	9.2%	0.30	8.10	0.80	23.9%	0.47616	6.79	0.67
DB-57-X	10.5	11.0%	1.15	5.03	0.40	15.5%	0.47616	4.77	0.38
DB-64-A	83.4	17.0%	14.19	6.21	0.57	28.4%	9.52323	5.36	0.49
DB-64-D	37.1	29.7%	11.02	4.99	0.45	36.1%	2.38081	4.53	0.41
DB-64-E	26.4	25.4%	6.70	6.18	0.59	32.6%	1.90465	5.58	0.54
DB-64-F	36.8	13.2%	4.86	6.38	0.58	21.0%	2.85697	5.81	0.53
DB-65-A	23.3	13.0%	3.03	6.96	0.66	19.1%	1.42848	6.47	0.61
DB-56-EE	172.6	8.2%	14.13	8.13	0.80	10.9%	4.76162	7.89	0.77
DB-56-FF	76.8	7.1%	5.44	8.62	0.86	10.8%	2.85697	8.28	0.83
DB-56-GG	30.8	6.2%	1.91	4.96	0.38	10.8%	1.42848	4.71	0.36
DB-56-HH	77.3	5.5%	4.22	8.62	0.85	7.3%	1.42848	8.45	0.84
DB-56-II	22.3	7.0%	1.57	7.23	0.68	11.3%	0.95232	6.90	0.65
DB-56-JJ	22.6	5.1%	1.15	3.44	0.17	9.3%	0.95232	3.29	0.16
DB-56-KK	128.1	9.9%	12.70	8.72	0.88	15.9%	7.61859	8.14	0.82
DB-56-LL	71.3	9.6%	6.87	2.74	0.09	11.0%	0.95232	2.70	0.09
DB-57-Y	25.0	29.3%	7.32	2.76	0.15	33.1%	0.95232	2.61	0.15
DB-66	56.5	13.7%	7.72	2.81	0.12	17.9%	2.38081	2.67	0.11
DB-67	17.6	18.4%	3.23	2.44	0.08	21.1%	0.47616	2.36	0.08
DB-68-A	44.8	8.9%	4.01	8.20	0.81	12.1%	1.42848	7.91	0.78
DB-68-B	237.1	8.8%	20.92	8.57	0.86	11.2%	5.71394	8.34	0.84
DB-68-C	189.7	7.0%	13.19	4.48	0.31	9.0%	3.80929	4.38	0.31
DB-69-B	71.9	12.8%	9.19	8.53	0.86	15.4%	1.90465	8.27	0.84
DB-69-C	81.6	3.9%	3.17	8.91	0.89	7.4%	2.85697	8.59	0.86
DB-69-D	109.1	8.6%	9.43	7.22	0.68	12.1%	3.80929	6.94	0.65

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-69-E	85.9	12.6%	10.82	6.08	0.54	15.9%	2.85697	5.85	0.52
DB-70-A	16.7	4.3%	0.72	9.42	0.96	7.2%	0.47616	9.14	0.93
DB-70-B	53.8	9.7%	5.23	8.89	0.90	12.4%	1.42848	8.63	0.88
DB-70-C	53.9	5.7%	3.07	8.38	0.82	10.1%	2.38081	7.98	0.79
DB-70-D	10.0	21.2%	2.12	2.36	0.08	30.7%	0.95232	2.07	0.07
DB-71-A	133.1	8.4%	11.20	8.68	0.87	10.6%	2.85697	8.48	0.85
DB-71-B	31.9	14.7%	4.71	7.16	0.69	19.2%	1.42848	6.78	0.65
DB-71-C	37.4	3.1%	1.16	6.00	0.50	8.2%	1.90465	5.68	0.48
DB-71-D	14.5	12.7%	1.85	2.73	0.10	52.2%	5.71394	1.50	0.06
DB-72	15.4	13.5%	2.09	3.72	0.23	19.7%	0.95232	3.46	0.22
DB-73	30.2	15.7%	4.74	3.47	0.21	20.4%	1.42848	3.27	0.20
DB-74-A	72.6	13.7%	9.96	8.49	0.86	15.0%	0.95232	8.36	0.85
DB-74-B	73.4	16.3%	11.94	8.22	0.84	18.9%	1.90465	7.97	0.81
DB-74-C	64.5	6.1%	3.96	9.24	0.94	12.0%	3.80929	8.66	0.88
DB-74-D	37.2	8.2%	3.06	9.03	0.92	12.1%	1.42848	8.66	0.88
DB-74-E	10.3	3.8%	0.39	9.47	0.96	8.4%	0.47616	9.01	0.92
DB-74-F	20.1	22.2%	4.45	3.59	0.24	26.9%	0.95232	3.38	0.23
DB-76-B	15.4	21.0%	3.24	4.23	0.32	24.0%	0.47616	4.07	0.31
DB-76-C	38.2	8.3%	3.18	5.38	0.44	14.6%	2.38081	5.01	0.41
DB-15-BB	33.4	24.5%	8.18	4.81	0.41	27.3%	0.95232	4.63	0.39
DB-15-V	23.6	37.6%	8.86	4.36	0.39	43.6%	1.42848	3.93	0.35
DB-15-W	16.6	24.9%	4.14	7.28	0.74	27.8%	0.47616	7.00	0.71
DB-15-X	15.3	45.7%	7.01	3.95	0.36	45.7%	0	3.95	0.36
DB-15-Y	27.5	18.7%	5.15	5.66	0.51	22.2%	0.95232	5.42	0.48
DB-15-Z	8.3	56.9%	4.75	3.87	0.38	74.0%	1.42848	2.34	0.23
DB-18	38.9	34.3%	13.31	3.30	0.24	44.1%	3.80929	2.81	0.20
DB-19	31.2	18.8%	5.87	7.10	0.69	24.9%	1.90465	6.57	0.64

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-20-B	31.4	48.4%	15.21	3.73	0.34	54.4%	1.90465	3.30	0.30
DB-20-C	10.1	15.8%	1.59	4.58	0.35	44.0%	2.85697	3.04	0.24
DB-20-D	25.2	48.9%	12.33	2.76	0.21	52.7%	0.95232	2.56	0.20
DB-21-A	16.5	7.7%	1.28	5.83	0.49	13.5%	0.95232	5.47	0.46
DB-21-B	11.0	13.3%	1.47	8.04	0.80	22.0%	0.95232	7.24	0.72
DB-22	3.4	38.7%	1.30	6.04	0.61	52.8%	0.47616	4.65	0.47
DB-40-B	17.0	17.2%	2.93	7.28	0.71	22.8%	0.95232	6.79	0.67
DB-40-C	11.5	5.5%	0.63	7.50	0.71	13.8%	0.95232	6.84	0.65
DB-15-AA	18.1	72.1%	13.08	2.71	0.27	74.7%	0.47616	2.45	0.25
DB-15-CC	26.8	21.5%	5.75	4.81	0.40	28.6%	1.90465	4.37	0.36
DB-15-DD	25.0	30.1%	7.51	6.37	0.63	37.7%	1.90465	5.68	0.56
DB-15-EE	10.6	21.6%	2.30	4.39	0.35	30.6%	0.95232	3.89	0.31
DB-15-FF	7.9	34.5%	2.73	1.98	0.07	40.5%	0.47616	1.80	0.06
DB-40-H	15.4	5.8%	0.89	9.19	0.93	24.3%	2.85697	7.38	0.75
DB-40-I	55.9	42.7%	23.84	4.17	0.38	46.1%	1.90465	3.92	0.36
DB-41-A	68.1	25.7%	17.49	4.90	0.43	27.8%	1.42848	4.76	0.41
DB-41-B	46.4	49.2%	22.83	4.04	0.38	52.3%	1.42848	3.80	0.36
DB-41-C	32.0	36.0%	11.51	4.84	0.45	40.4%	1.42848	4.50	0.42
DB-41-D	9.9	75.3%	7.47	2.10	0.20	84.9%	0.95232	1.29	0.12
DB-41-E	15.0	39.7%	5.94	5.42	0.54	52.4%	1.90465	4.28	0.42
DB-42-A	84.5	20.8%	17.62	4.85	0.41	24.2%	2.85697	4.65	0.39
DB-42-B	19.7	30.5%	6.00	4.91	0.44	32.9%	0.47616	4.74	0.43
DB-42-C	46.5	16.7%	7.79	3.56	0.22	24.9%	3.80929	3.21	0.20
DB-42-D	8.8	76.4%	6.69	1.35	0.11	81.8%	0.47616	1.04	0.08
DB-43-D	4.1	16.5%	0.68	8.22	0.84	39.5%	0.95232	5.96	0.61
DB-43-E	13.7	13.0%	1.78	8.39	0.85	26.9%	1.90465	7.05	0.71
DB-43-F	12.2	16.1%	1.96	8.19	0.83	31.6%	1.90465	6.67	0.68

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-43-G	6.2	18.0%	1.12	7.99	0.81	40.8%	1.42848	5.76	0.58
DB-43-H	13.7	34.0%	4.67	3.53	0.27	44.4%	1.42848	2.97	0.23
DB-80	7.6	67.2%	5.08	0.98	0.03	79.8%	0.95232	0.60	0.02
DB-81	21.1	23.2%	4.89	6.37	0.61	30.0%	1.42848	5.81	0.56
DB-43-B	23.7	18.5%	4.37	5.62	0.50	24.5%	1.42848	5.20	0.46
DB-43-C	3.0	22.4%	0.68	7.64	0.78	38.2%	0.47616	6.08	0.62
DB-44-C	13.0	23.3%	3.04	2.76	0.14	34.2%	1.42848	2.37	0.12
DB-44-D	12.6	20.5%	2.59	7.81	0.79	24.3%	0.47616	7.44	0.76
DB-44-E	9.8	24.0%	2.35	5.68	0.52	33.7%	0.95232	4.95	0.46
DB-44-F	6.1	31.1%	1.90	2.75	0.16	46.7%	0.95232	2.13	0.12
DB-45-A	25.4	36.9%	9.38	4.77	0.44	48.1%	2.85697	3.92	0.36
DB-45-B	15.8	45.2%	7.14	5.08	0.51	48.3%	0.47616	4.80	0.48
DB-45-C	8.8	23.1%	2.03	6.07	0.57	33.9%	0.95232	5.21	0.49
DB-45-D	16.6	62.6%	10.42	1.30	0.06	68.3%	0.95232	1.10	0.05
DB-46-E	17.4	49.9%	8.69	3.77	0.35	52.6%	0.47616	3.56	0.33
DB-46-F	12.7	74.4%	9.46	0.77	0.03	78.1%	0.47616	0.65	0.02
DB-46-G	15.3	66.9%	10.23	0.99	0.03	73.1%	0.95232	0.80	0.03
DB-47-A	22.8	55.9%	12.74	2.59	0.21	62.1%	1.42848	2.22	0.18
DB-47-B	33.1	58.5%	19.35	1.45	0.07	64.3%	1.90465	1.25	0.06
DB-47-C	12.2	56.6%	6.91	1.80	0.11	68.3%	1.42848	1.31	0.08
DB-48	26.5	45.1%	11.98	2.35	0.15	54.1%	2.38081	1.97	0.12
DB-58-A	52.6	43.1%	22.66	4.16	0.38	64.8%	11.42788	2.57	0.23
DB-58-B	34.8	31.4%	10.93	5.51	0.52	47.8%	5.71394	4.19	0.40
DB-58-C	15.3	18.9%	2.88	7.76	0.78	25.1%	0.95232	7.17	0.72
DB-59-A	12.2	24.4%	2.98	4.29	0.34	32.2%	0.95232	3.85	0.31
DB-59-B	7.5	37.5%	2.80	2.10	0.09	43.8%	0.47616	1.89	0.08
DB-59-C	10.7	36.4%	3.91	2.22	0.10	40.8%	0.47616	2.07	0.10

Watershed Name	Area (acres)	Existing				Future			
		Impervious Cover	Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)	Impervious Cover	Added Impervious Area (acres)	F0 (in/hr)	Fc (in/hr)
DB-59-D	8.1	40.8%	3.32	3.69	0.31	52.5%	0.95232	2.96	0.25
DB-58-D	39.3	24.7%	9.70	2.62	0.12	29.6%	1.90465	2.45	0.11
DB-58-E	11.0	37.4%	4.12	1.87	0.06	41.7%	0.47616	1.74	0.06
DB-58-F	6.7	35.8%	2.40	1.92	0.06	42.9%	0.47616	1.71	0.06
DB-58-G	11.9	48.0%	5.72	4.34	0.42	52.0%	0.47616	4.00	0.39
DB-60	25.3	30.6%	7.76	2.90	0.18	36.3%	1.42848	2.67	0.16
DB-61-A	11.8	9.8%	1.16	8.88	0.90	17.9%	0.95232	8.09	0.82
DB-61-B	10.5	33.2%	3.49	3.45	0.26	42.2%	0.95232	2.98	0.22
DB-62	14.7	27.8%	4.08	4.17	0.33	37.5%	1.42848	3.61	0.29
DB-63	24.0	39.1%	9.37	1.82	0.06	47.0%	1.90465	1.58	0.05
DB-64-B	51.6	18.5%	9.52	6.85	0.66	23.1%	2.38081	6.46	0.62
DB-64-C	3.4	31.2%	1.06	6.58	0.66	45.1%	0.47616	5.25	0.53
DB-64-G	67.2	14.8%	9.92	6.07	0.55	20.4%	3.80929	5.66	0.51
DB-64-H	7.6	28.8%	2.19	2.13	0.07	41.3%	0.95232	1.76	0.06
DB-65-B	29.8	11.3%	3.36	5.63	0.48	16.1%	1.42848	5.33	0.45

Table A-5. Existing and Proposed Risk Areas

Risk Area	Location	Road Type	100-Year Ex Road Flooding		5-Year Ex Road Flooding		Flooded Structures, Existing	100 yr Prop Road Flooding		5 yr Prop Road Flooding		Flooded Structures, Proposed
			Crest Max Depth (ft)	Crest Length (ft)	Crest Max Depth (ft)	Crest Length (ft)		Crest Max Depth (ft)	Crest Length (ft)	Crest Max Depth (ft)	Crest Length (ft)	
1	35 Business at Traylor Blvd	Major	2.30	600	-	-	None	0.50	500	-	-	None
2	35 Business at Enterprise Blvd.	Major	2.30	1,200	1.30	100	None	1.00	1,000	0.80	50	None
3	35 Business at E. Maple St.	Major	2.20	1,000	1.60	400	None	1.00	500	0.80	200	None
4	FM 1069 at Hickory St.	Major	1.80	800	-	-	None	-	-	-	-	None
5	FM 1069 at 35 Business	Major	1.60	620	-	-	None	0.90	450	-	-	None
6	FM 1069 at Steart St.	Major	1.50	500	-	-	None	-	-	-	-	None
7	FM 1069 at Burton St.	Major	1.45	320	-	-	None	0.55	225	-	-	None
8	35 Business at Tule Park Dr.	Major	1.40	250	1.20	25	None	0.55	160	-	-	None
9	FM 1069 at N. Kossuth St.	Major	1.20	700	-	-	None	0.60	600	-	-	None
10	FM 1069 at 35	Major	1.00	210	0.66	120	None	0.70	126	-	-	None
11	Enterprise Blvd at N Live Oak St.	Collector	2.50	3,000	0.90	200	None	0.70	1,500	0.40	100	None
12	N Live Oak St. at E Maple St.	Collector	2.20	1,000	-	-	3 SFR	0.80	500	-	-	None
13	FM 1069 at Loop 70	Collector	1.90	200	1.20	140	4 SFR, 2 COM	0.40	160	-	-	None
14	Enterprise Blvd at Omohundro St.	Collector	1.80	700	0.75	50	None	0.60	650	-	-	None
15	Spanish Woods Dr. at Paso Madera Dr.	Collector	1.55	590	-	-	None	0.50	120	-	-	None
16	FM 2165 at E Orleans St	Collector	1.50	2,000	0.50	20	4 SFR, 2 COM	0.80	1,000	-	-	None

CITY COUNCIL AGENDA
Workshop Meeting: Tuesday, November 17, 2015

AGENDA ITEM: 4

Hear and deliberate on a proposed utility easement for the Cape Velero loop waterline project.

SUBMITTED BY: Public Works Director, Michael S. Donoho, Jr.

APPROVED FOR AGENDA: PKC

BACKGROUND: Currently Cape Velero is served by a single 12" water line approximately 2.5 miles in length, feeding an 8" distribution system serving approximately 45 customers.

The detention time in this dead end line affects water quality to the point that we must flush 37,000 gallons per day to maintain chlorine residuals at the end of the system. With the current water rate paid to San Patricio Municipal Water District, the annual cost to maintain this flushing program is approximately $50,000. We have studied chlorine feeding equipment which could induce chlorine into the line; however, the water still has to be moved to the end of the system daily via flushing

On Rattlesnake Point Road, the City currently has a dead end 8" water line serving approximately 300 Copano Water Company customers. Staff and Urban Engineering ran a hydraulic study on this line in approximately 2010 when a developer, Troy Parnell, wanted to supply a new subdivision. It was determined at that time that the line was near maximum capacity and since that time, 50 plus customers have been added.

Staff investigated both issues and determined the solution would be to directionally drill an 8" HDPE water line under Pete's Bend Road and connect the two systems.

Mr. Parnell agreed to participate in the cost of the project to allow for the improvements to his property. He provided a letter of commitment agreeing to contribute $89,950 to the project for his improvements.

FISCAL ANALYSIS: The projected is funded through the 2009 certificate of obligation under account 6572080 for $400,000, of which the entire $400,000 is available.

RECOMMENDATION: Not an action item.