Stormwater Drainage Planning

The Colonias of the Lower Rio Grande Valley (LRGV)

Located within the Counties of Cameron, Hidalgo, and Willacy

Phase 2 Report

Presented by:

JSW & Associates, Inc.
Hazard Mitigation Consultants

in association with

HALFF

RPS Espey

Brown Leal & Associates
R. Gutierrez Engineering
ERO Architects

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			10% (10-year) Protected Inundated Structures	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio
Cameron Park	Cameron	A1	45	113	$27,243,668	$8,837,211	3.08	113	$27,243,668	$20,616,225	1.32	113	$69,864,466	$21,118,569	3.31
Colonia Iglesia Antigua	Cameron	A1	2	6	$201,783	$1,654,594	0.12	6	$201,783	$86,925	2.32	6	$208,633	$279,820	0.75
Coronado	Cameron	A1	8	7	$2,054,749	$1,853,479	1.11	7	$2,054,749	$951,900	2.16	7	$3,379,482	$855,928	3.95
Dakota Mobile Home Park	Cameron	A1	1	2	$472,005	$614,562	0.77	2	$472,005	$208,350	2.27	2	$492,749	$230,605	2.14
Del Mar Heights	Cameron	A1	1	1	$421,344	$637,715	0.66	1	$421,344	$272,755	1.54	1	$647,859	$145,527	4.45
Eggers	Cameron	A1	3	5	$2,190,148	$709,460	3.09	5	$2,190,148	$778,500	2.81	5	$2,478,363	$640,229	3.87
Glenwood Acres	Cameron	A1	2	3	$448,772	$2,551,371	0.18	3	$448,772	$314,175	1.43	3	$1,482,549	$334,911	4.43
Grande Acres	Cameron	A1	1	2	$211,325	$630,295	0.34	2	$211,325	$169,800	1.24	2	$220,860	$114,539	1.93
Green Valley Farms	Cameron	A1	2	2	$1,425,829	$51,986,870	0.03	2	$1,425,829	$979,425	1.46	2	$3,051,808	$1,301,737	2.34
La Coma	Cameron	A1	2	1	$324,553	$1,084,356	0.30	1	$324,553	$302,475	1.07	1	$724,186	$229,813	3.15
La Feria Gardens	Cameron	A1	0	0	$0	$1,717,418	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Lago	Cameron	A1	1	4	$595,700	$853,798	0.70	4	$595,700	$451,350	1.32	4	$205,485	$389,916	0.53
Las Yescas	Cameron	A1	3	3	$2,196,453	$826,404	2.66	3	$2,196,453	$331,800	6.62	3	$2,206,776	$295,972	7.46
Longoria Townsite	Cameron	A1	4	2	$625,555	$694,021	0.90	2	$625,555	$225,300	2.78	2	$886,836	$237,307	3.74
Lourdes Street	Cameron	A1	8	8	$6,061,333	$1,461,573	4.15	8	$6,061,333	$841,350	7.20	8	$6,267,103	$728,190	8.61
Nogal St.	Cameron	A1	0	1	$409,296	$1,272,999	0.32	1	$409,296	$1,097,712	0.37	1	$1,806,223	$126,033	14.33
Paredes Estates	Cameron	A1	1	2	$592,346	$564,116	1.05	2	$592,346	$269,775	2.20	2	$612,455	$263,662	2.32
Pennsylvania Avenue	Cameron	A1	2	3	$695,205	$394,970	1.76	3	$695,205	$483,525	1.44	3	$1,122,650	$548,271	2.05
Santa Maria	Cameron	A1	6	8	$7,286,759	$2,379,820	3.06	8	$7,286,759	$1,128,975	6.45	8	$7,956,392	$1,005,060	7.92
Santa Rosa #13	Cameron	A1	0	1	$38,201	$24,935	1.53	1	$38,201	$117,000	0.33	1	$247,092	$103,268	2.39
Santa Rosa Annex	Cameron	A1	2	3	$799,756	$641,672	1.25	3	$799,756	$202,200	3.96	3	$1,040,520	$242,359	4.29
Alberta Estates #2	Hidalgo	A1	5	14	$3,116,644	$1,632,506	1.91	14	$3,116,644	$1,509,525	2.06	14	$3,517,582	$1,908,959	1.84
Arriaga Subd.	Hidalgo	A1	0	1	$217,008	$576,030	0.38	1	$217,008	$123,600	1.76	1	$227,413	$90,350	2.52
Basham #12	Hidalgo	A1	2	4	$169,436	$1,688,057	0.10	4	$169,436	$495,975	0.34	4	$855,713	$402,547	2.13
Basham #4	Hidalgo	A1	2	2	$1,797,261	$647,470	2.78	2	$1,797,261	$230,550	7.80	2	$1,858,273	$263,227	7.06
Capisallo Park	Hidalgo	A1	8	9	$4,277,993	$2,967,645	1.44	9	$4,277,993	$903,525	4.73	9	$2,838,531	$697,940	4.07
Chapa #5	Hidalgo	A1	1	1	$58,812	$709,421	0.08	1	$58,812	$21,600	2.72	1	$63,168	$64,412	0.98
Chapa Subdivision	Hidalgo	A1	0	3	$349,695	$289,846	1.21	3	$349,695	$329,100	1.06	3	$610,124	$505,085	1.21
Chula Vista Acres	Hidalgo	A1	11	4	$1,579,133	$1,121,561	1.41	4	$1,579,133	$1,855,050	0.85	4	$5,965,155	$2,153,794	2.77
Cotter Tract	Hidalgo	A1	21	26	$15,103,516	$893,880	16.90	26	$15,103,516	$3,737,400	4.04	26	$15,881,187	$4,200,663	3.78
Cuellar Subd. #1	Hidalgo	A1	0	0	$0	$39,598	0.00	0	$0	$0	N/A	0	$0	$0	N/A
El Gato	Hidalgo	A1	1	2	$871,754	$2,490,649	0.35	2	$871,754	$384,900	2.26	2	$2,543,053	$469,598	5.42
Enrique Bazan Subd.	Hidalgo	A1	3	2	$967,053	$481,950	2.01	2	$967,053	$108,675	8.90	2	$999,882	$121,977	8.20
Hilda Subd.	Hidalgo	A1	2	2	$547,852	$1,743,773	0.31	2	$547,852	$242,700	2.26	2	$571,171	$213,547	2.67
J.R. Subdivision #2	Hidalgo	A1	3	5	$1,045,239	$266,880	3.92	5	$1,045,239	$570,600	1.83	5	$1,335,119	$657,395	2.03
Linda Vista Estates	Hidalgo	A1	25	4	$9,066,983	$3,238,300	2.80	4	$9,066,983	$2,450,775	3.70	4	$11,626,494	$2,782,319	4.18
Los Trevinos Subd. #3	Hidalgo	A1	4	4	$464,727	$1,070,445	0.43	4	$464,727	$474,750	0.98	4	$1,119,270	$441,200	2.54
Los Treviños Subd. #4	Hidalgo	A1	0	0	$0	$931,626	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Los Trevinos Subd. #5	Hidalgo	A1	0	0	$0	$63,765	0.00	0	$0	$0	N/A	0	$0	$0	N/A
North Santa Cruz Subd	Hidalgo	A1	0	0	$0	$156,246	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Olivarez #10	Hidalgo	A1	1	3	$710,559	$482,835	1.47	3	$710,559	$390,600	1.82	3	$914,535	$487,775	1.87
Olivarez #6	Hidalgo	A1	2	5	$1,930,704	$1,093,558	1.77	5	$1,930,704	$1,120,500	1.72	5	$2,020,158	$1,021,260	1.98
Olivarez 17	Hidalgo	A1	2	1	$958,403	$391,333	2.45	1	$958,403	$639,300	1.50	1	$1,220,705	$460,320	2.65
Owassa Rd/Tower Rd	Hidalgo	A1	1	3	$1,175,619	$945,298	1.24	3	$1,175,619	$279,900	4.20	3	$1,224,644	$345,111	3.55
Penitas	Hidalgo	A1	45	56	$31,375,687	$13,836,407	2.27	56	$31,375,687	$13,783,688	2.28	56	$32,708,185	$16,347,611	2.00
Perezville	Hidalgo	A1	9	10	$2,283,341	$2,347,060	0.97	10	$2,283,341	$1,694,700	1.35	10	$5,044,234	$1,346,170	3.75
R.C. Babb Subd #3 and 4	Hidalgo	A1	0	5	$4,099,349	$406,894	10.07	5	$4,099,349	$824,625	4.97	5	$5,095,343	$929,484	5.48
Ramirez Estates	Hidalgo	A1	6	9	$1,465,253	$1,513,405	0.97	9	$1,465,253	$918,150	1.60	9	$2,149,709	$896,906	2.40
Reina Del Sol Mobile Home Esta	Hidalgo	A1	6	10	$4,760,308	$1,035,164	4.60	10	$4,760,308	$1,350,375	3.53	10	$4,970,522	$1,363,874	3.64
River Road Subd.	Hidalgo	A1	2	5	$1,798,275	$1,239,551	1.45	5	$1,798,275	$479,400	3.75	5	$2,119,772	$391,704	5.41
Ruthven #1	Hidalgo	A1	1	2	$384,398	$1,001,319	0.38	2	$384,398	$142,500	2.70	2	$397,448	$119,398	3.33
Salida del Sol Estates Subd.	Hidalgo	A1	2	5	$549,478	$2,384,200	0.23	5	$549,478	$348,150	1.58	5	$568,133	$346,918	1.64

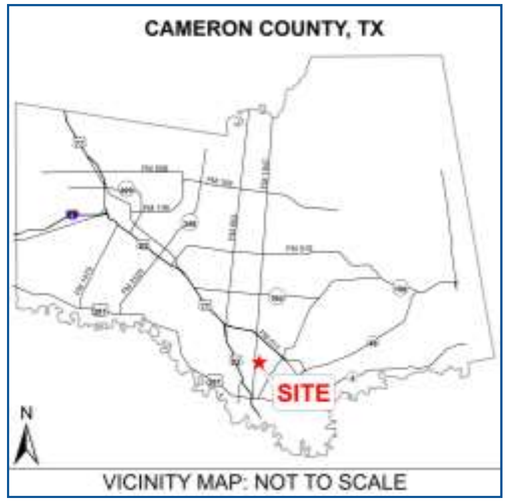
Colonia Name	County	Phase IB Class	Drainage Improvement Project					Elevate Structures Project				Acquisition/Demolition Project			
			10% (10-year) Protected Inundated Structures	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio	1% (100-year) Protected Inundated Structures	Avoided Damages	Cost	Benefit-Cost Ratio
South Fork Subd.	Hidalgo	A1	8	7	$3,454,362	$4,399,927	0.79	7	$3,454,362	$2,445,525	1.41	7	$6,391,368	$2,687,932	2.38
Southside Village	Hidalgo	A1	6	6	$4,444,409	$776,511	5.72	6	$4,444,409	$627,150	7.09	6	$4,595,288	$621,464	7.39
Sun Valley Estates	Hidalgo	A1	0	0	$0	$532,914	0.00	0	$0	$0	N/A	0	$0	$0	N/A
V&C	Hidalgo	A1	0	8	$923,933	$966,798	0.96	8	$923,933	$519,300	1.78	8	$973,526	$546,818	1.78
Val Verde Grove	Hidalgo	A1	0	0	$0	$1,157,133	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Val Verde North Subd.	Hidalgo	A1	0	3	$616,217	$829,221	0.74	3	$616,217	$303,000	2.03	3	$646,250	$377,424	1.71
Victoria Belen	Hidalgo	A1	0	0	$0	$346,636	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Welch Tract	Hidalgo	A1	21	26	$15,103,516	$893,880	16.90	26	$15,103,516	$3,737,400	4.04	26	$15,881,187	$4,200,663	3.78
Lasara	Willacy	A1	15	12	$11,248,574	$3,334,439	3.37	12	$11,248,574	$3,091,200	3.64	12	$13,196,752	$2,557,263	5.16
Bar #3	Hidalgo	B1	10	11	$7,026,109	$1,199,801	5.86	11	$7,026,109	$1,528,125	4.60	11	$7,257,018	$1,231,792	5.89
Bernal Heights #1	Hidalgo	B1	2	3	$509,450	$384,092	1.33	3	$509,450	$211,500	2.41	3	$535,858	$282,771	1.90
Blue Star Enterprises #2	Hidalgo	B1	8	12	$2,307,816	$1,469,068	1.57	12	$2,307,816	$1,599,900	1.44	12	$5,246,751	$1,567,434	3.35
Colonia Tijerina	Hidalgo	B1	3	9	$1,751,576	$1,371,617	1.28	9	$1,751,576	$848,775	2.06	9	$1,838,380	$967,161	1.90
Hoehn Drive Subd.	Hidalgo	B1	39	13	$16,002,965	$2,837,474	5.64	13	$16,002,965	$3,983,550	4.02	13	$16,667,757	$4,004,582	4.16
Imperial Subd.	Hidalgo	B1	2	4	$2,330,882	$440,833	5.29	4	$2,330,882	$544,800	4.28	4	$2,419,125	$410,530	5.89
La Blanca Heights	Hidalgo	B1	1	9	$791,342	$1,523,792	0.52	9	$791,342	$367,875	2.15	9	$827,320	$381,014	2.17
Rankin Subd.	Hidalgo	B1	1	2	$414,285	$755,332	0.55	2	$414,285	$175,950	2.35	2	$434,425	$253,398	1.71
Reina Subd.	Hidalgo	B1	0	0	$0	$323,264	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Ruthven Subd. #2	Hidalgo	B1	4	3	$2,626,735	$805,466	3.26	3	$2,626,735	$438,000	6.00	3	$2,731,096	$528,604	5.17
Southern Breeze Subd.	Hidalgo	B1	13	9	$5,201,847	$1,304,296	3.99	9	$5,201,847	$1,088,475	4.78	9	$5,417,935	$1,279,442	4.23
Umberto Garcia Jr. Subd.	Hidalgo	B1	0	0	$0	$410,801	0.00	0	$0	$0	N/A	0	$0	$0	N/A
Val Verde Acres	Hidalgo	B1	6	8	$1,737,464	$1,206,548	1.44	8	$1,737,464	$1,122,150	1.55	8	$1,823,792	$1,212,922	1.50
Tierra Bella Subd.	Hidalgo	B1	11	11	$7,457,332	$956,301	7.80	11	$7,457,332	$1,316,850	5.66	11	$7,746,950	$1,158,951	6.68
Olmito	Cameron	B1	88	126	$73,676,981	$39,369,330	1.87	126	$73,676,981	$23,469,900	3.14	126	$188,166,286	$27,564,960	6.83
Cuevitas	Hidalgo	B1	7	8	$2,649,523	$1,343,237	1.97	8	$2,649,523	$698,925	3.79	8	$2,763,775	$607,831	4.55
Green Valley Development Subd.	Hidalgo	B1	8	12	$6,422,399	$428,115	15.00	12	$6,422,399	$1,402,725	4.58	12	$6,789,814	$1,452,911	4.67

Colonia: Cameron Park, Cameron County

Basin: Brownsville North Main Drain

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Cameron Park colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 20-acre colonia are generally to the south and west. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Cameron Park experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Cameron Park, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 1,660 linear feet of 18-inch diameter pipe, 9,020 linear feet of 24-inch diameter pipe, 660 linear feet of 30-inch diameter pipe, 10,510 linear feet of 36-inch diameter pipe, 210 linear feet of 42-inch diameter pipe, 3,160 linear feet of 48-inch diameter pipe, 1,380 linear feet of 60-inch diameter pipe, 1,400 linear feet of 72-inch diameter pipe, 75,000linear feet of grassy swale, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 117.9 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed drainage channel improvements, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Cameron Park Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	**1,145,631.11**
2	**DRAINAGE IMPROVEMENTS**	$	**2,657,474.00**
3	**POND EXCAVATION IMPROVEMENTS**	$	**2,994,750.00**
	Sub-Total =	$	**6,797,855.11**
	Engineering (10%)	$	679,785.51
	Contingency (20%)	$	1,359,571.02
	Total =	$	**8,837,211.64**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 11.7 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	54	36	18
20% (5-year)	71	43	28
10% (10-year)	102	57	45
4% (25-year)	159	85	74
1% (100-year)	221	108	113

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$27,243,668	$8,837,211	3.08
Elevate Structures	$27,243,668	$20,616,225	1.32
Acquisition/Supplemental Housing/Demolition	$69,864,466	$21,118,569	3.31

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	54	36	18
Inundated Lots	377	290	87
Inundated Roadway (LF)	4830	3150	1680

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	71	43	28
Inundated Lots	487	301	186
Inundated Roadway (LF)	7830	3350	4480

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	102	57	45
Inundated Lots	554	319	235
Inundated Roadway (LF)	11470	3710	7760

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	159	85	74
Inundated Lots	676	381	295
Inundated Roadway (LF)	14130	5640	8490

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Cameron Park, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

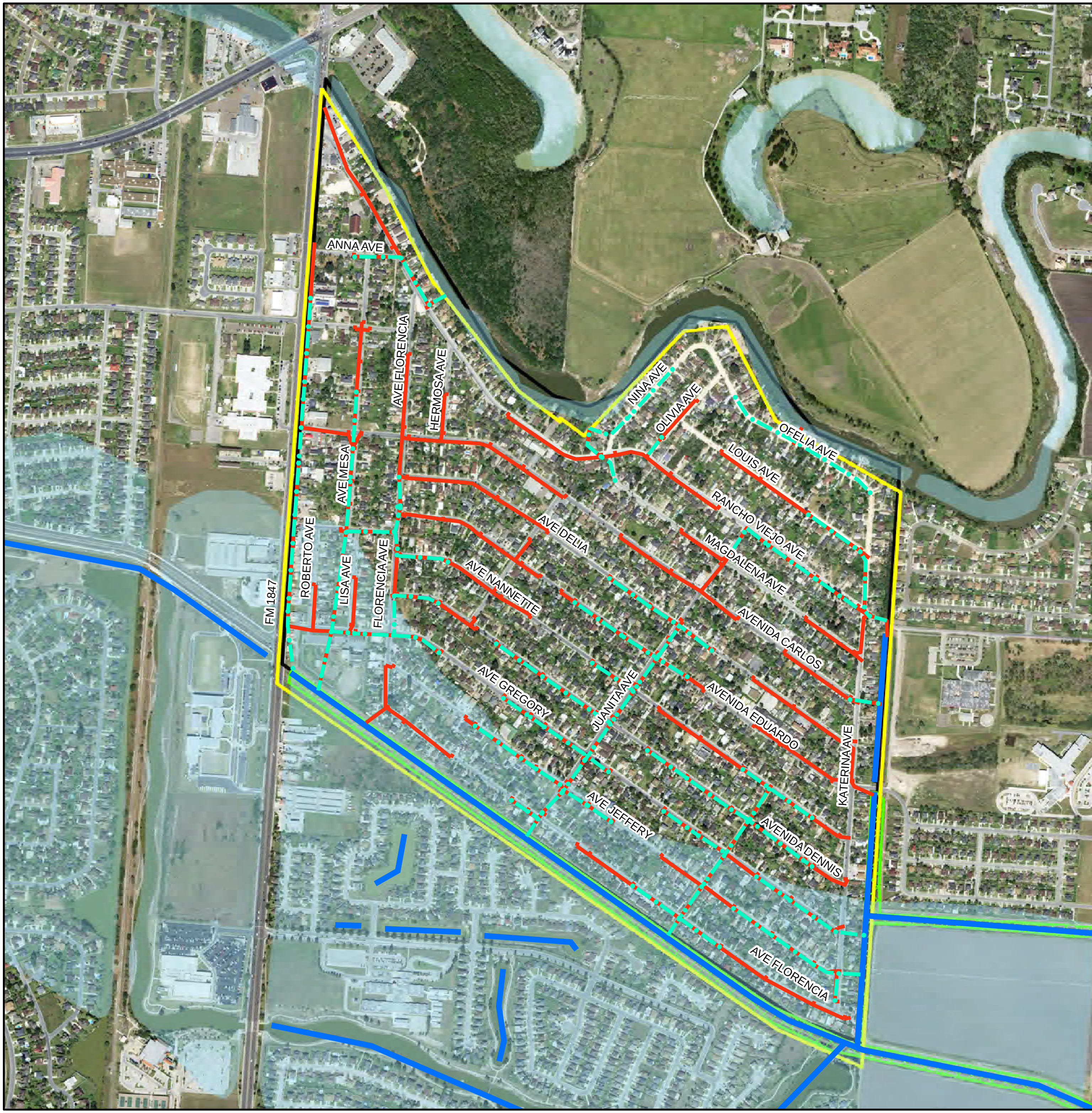
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	221	108	113
Inundated Lots	885	570	315
Inundated Roadway (LF)	20250	13290	6960

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Cameron Park
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Stormwater System
- Proposed Drainage Pattern
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Cameron Park
- Proposed Retention Pond
- Drainage Area

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

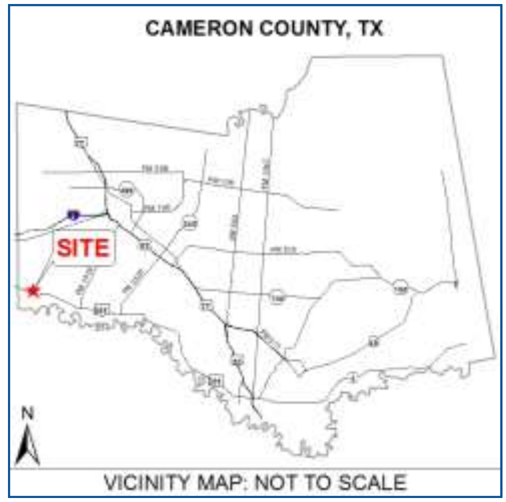
"Filling the Gap"

.Colonia: Iglesia Antigua, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Iglesia Antigua colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 31-acre colonia are generally from the south to the northeast with the southwest portion of the colonia draining towards a drainage ditch to the west. This colonia is located entirely within the FEMA Zone AH 100-year floodplain. The colonia does not have adequate roadside swale conveyance and frequently experiences residential lot and street flooding as well as some structural flooding during significant regional storm events. Model results indicate that high-risk flooding areas exist throughout the very flat terrain of the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Iglesia Antigua, Cameron County

"Filling the Gap"

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install an underground drainage system with a retention pond to eliminate off-site impacts
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes an underground drainage system with a retention facility. The improvements include 740 linear feet of 18-inch diameter pipe, 1,060 linear feet of 24-inch diameter pipe, 1,010 feet of 36-inch diameter pipe, pavement and curb/gutter for 2,600 linear feet of roadway, 12 curb inlets, and four 48-inch manholes. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 18 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Colonia Iglesia Antigua

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	606,694.44
2	**DRAINAGE IMPROVEMENTS**	$	191,750.00
3	**POND EXCAVATION IMPROVEMENTS**	$	474,320.00
	Sub-Total =	**$**	**1,272,764.44**
	Engineering (10%)	$	127,276.44
	Contingency (20%)	$	254,552.89
	Total =	**$**	**1,654,593.78**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	6	0	6

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$201,783	$1,654,594	0.12
Elevate Structures	$201,783	$86,925	2.32
Acquisition/Supplemental Housing/Demolition	$208,633	$279,820	0.75

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

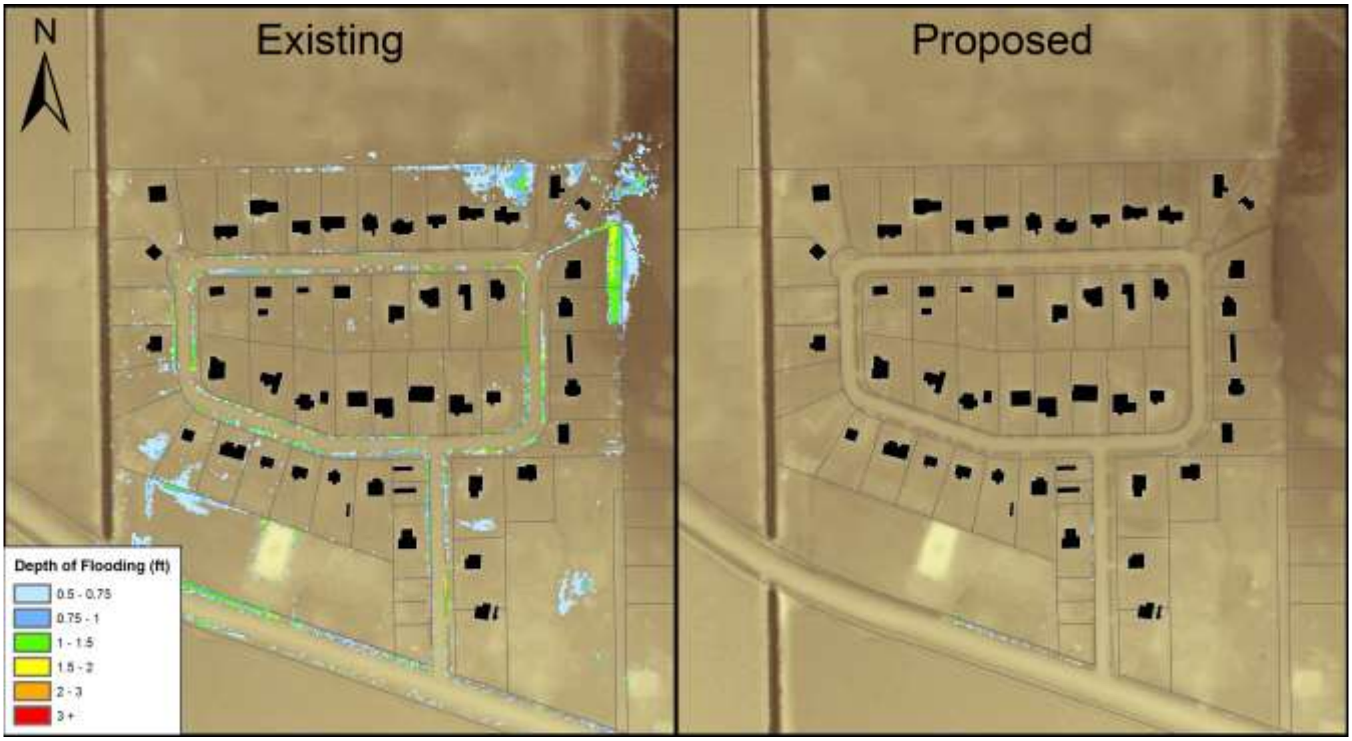


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	6	43
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

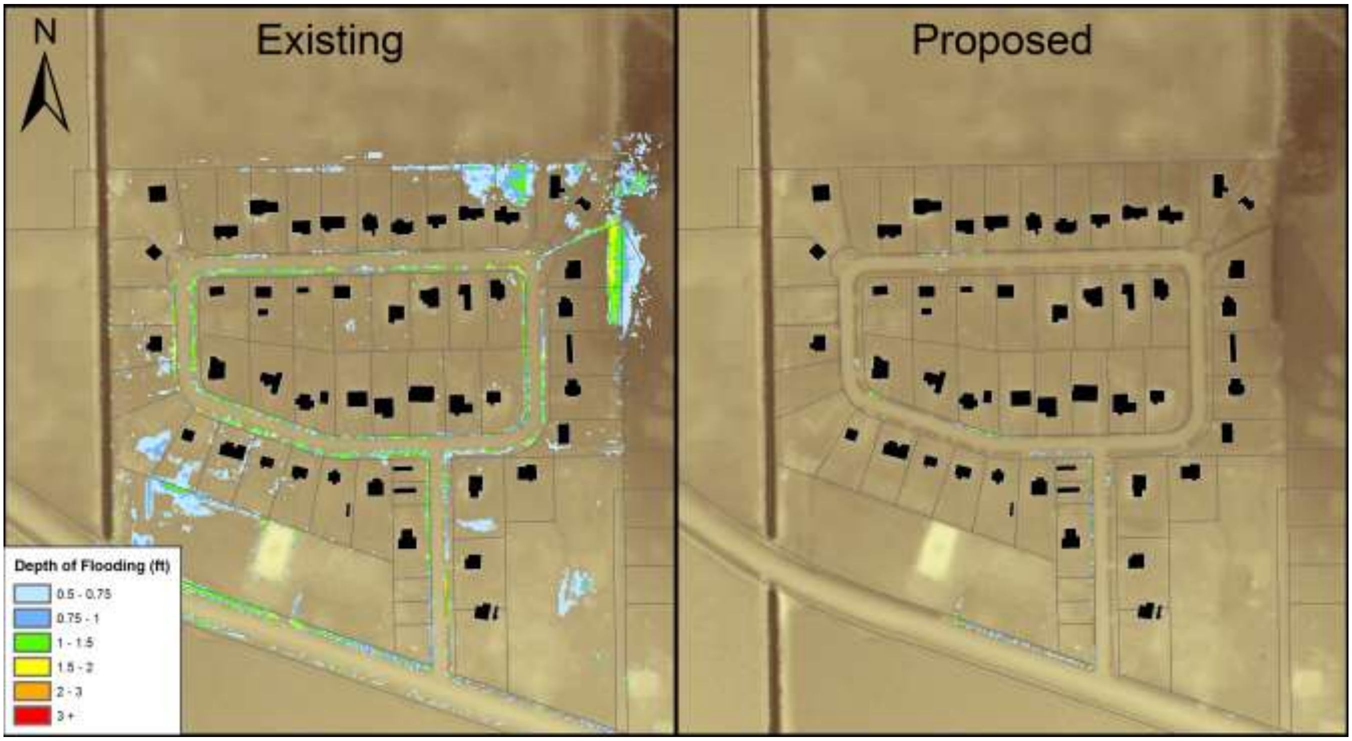


Figure 1: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	52	12	40
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

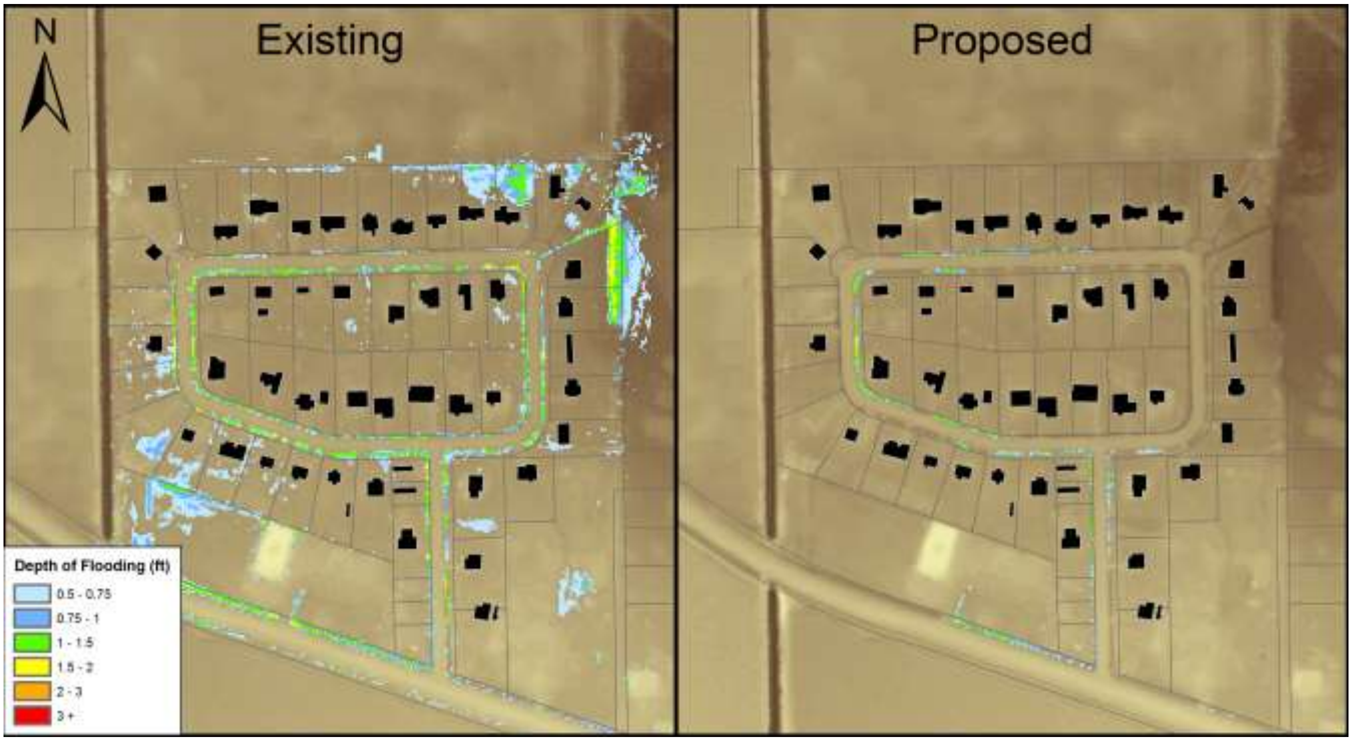


Figure 1: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	18	35
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

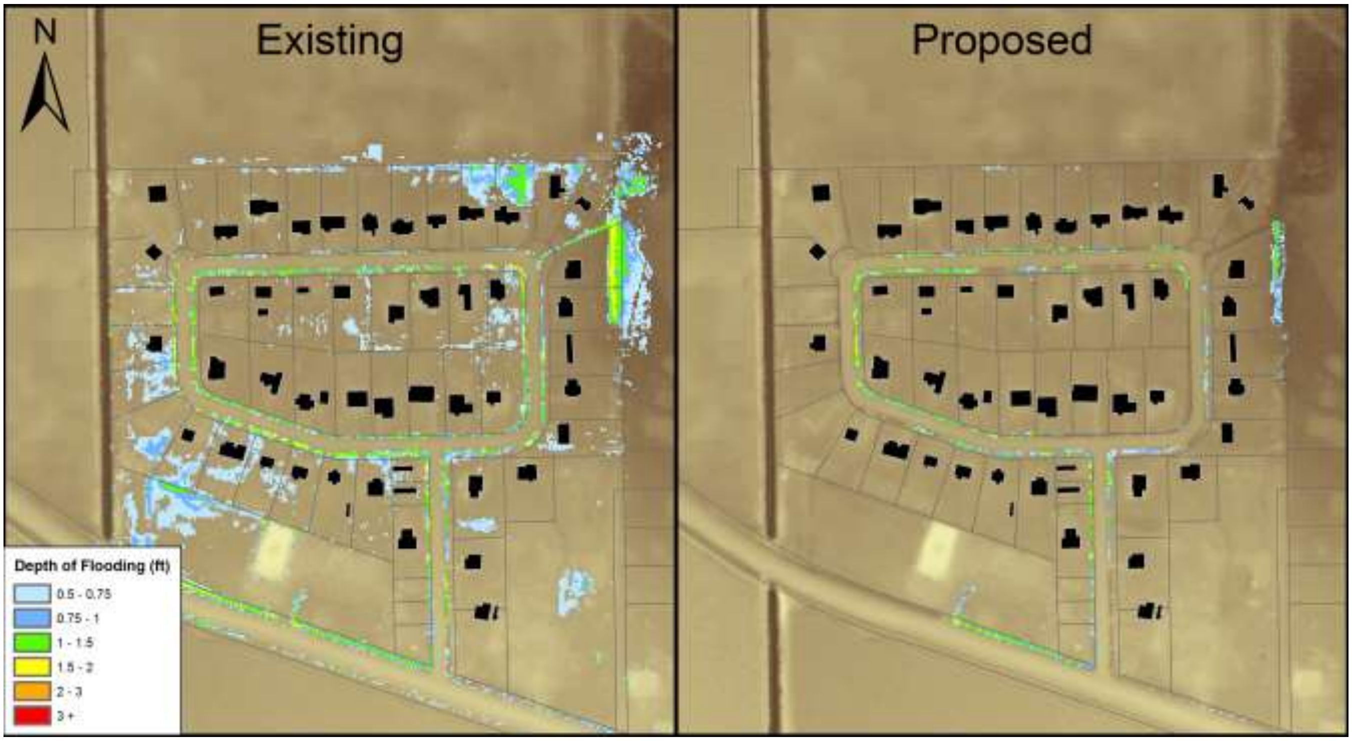


Figure 1: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	54	29	25
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Iglesia Antigua, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

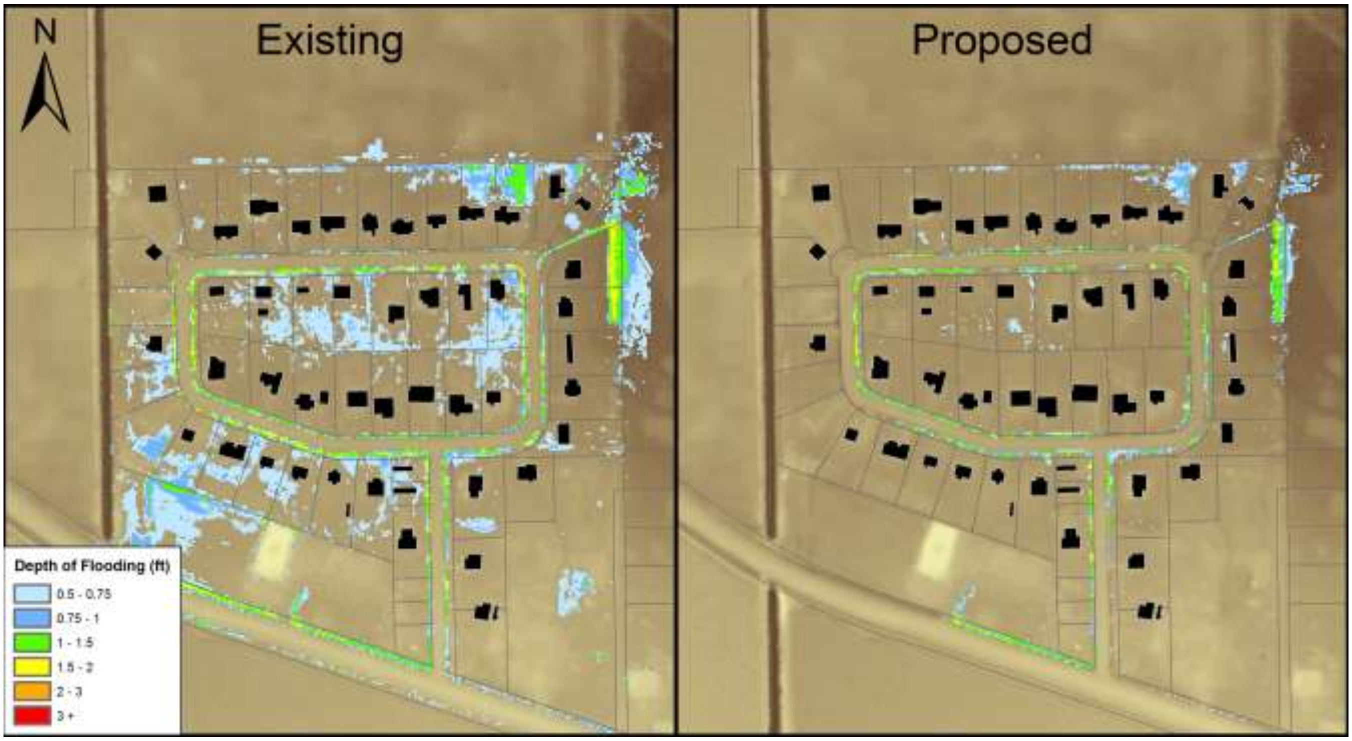
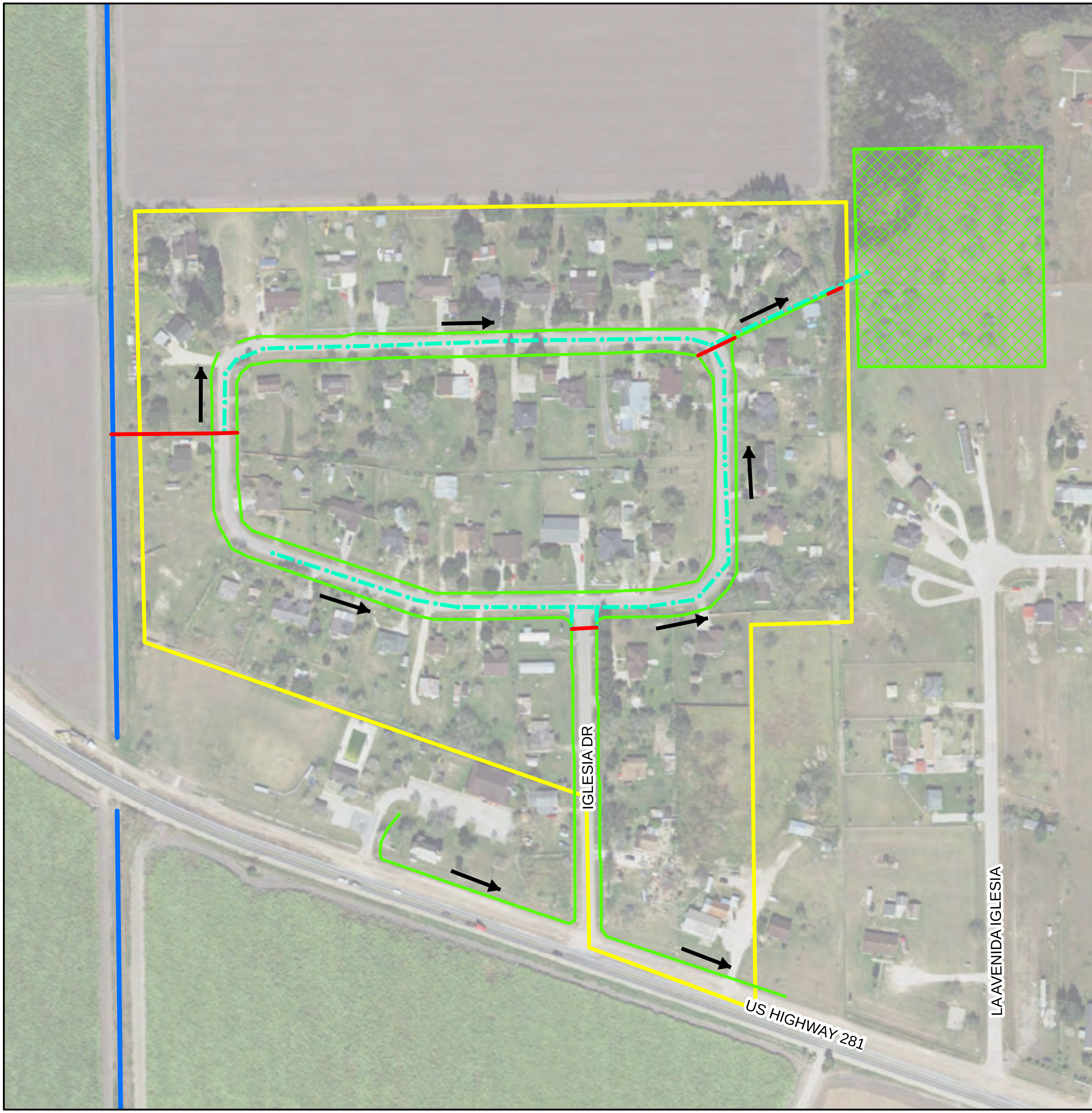


Figure 1: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	54	38	16
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Iglesia Antigua
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Existing Stormwater System
- Existing Drainage Swales
- Existing Drainage Ditches
- Proposed Retention Pond
- Colonia Iglesia Antigua

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

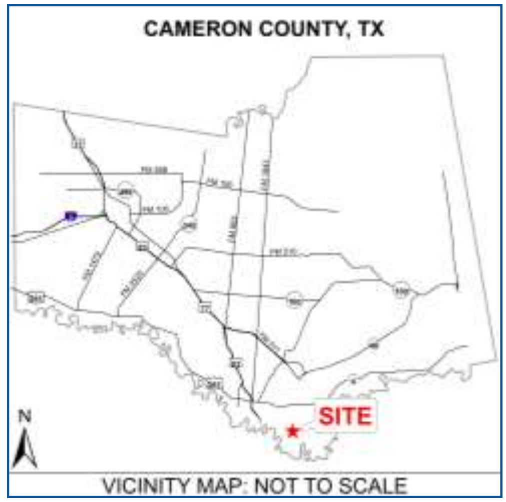
"Filling the Gap"

Colonia: Coronado, Cameron County

Basin: Brownsville North Main Drain

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Coronado colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 47-acre colonia are generally from the west to the northeast towards Maverick Rd and southeast towards a low-lying area on the west side of South Dakota Ave. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. The colonia experiences frequent residential lot and street flooding as well as structure flooding during local events. Areas with a high flooding potential exist throughout the colonia due to the flat terrain. Model results show that homes in the northeast portion of the colonia along Coronado Street have the highest risk of inundation. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Coronado, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install an underground drainage system with a retention pond to eliminate off-site impacts
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes an underground drainage system with a retention facility. The improvements include 590 linear feet of 30-inch diameter pipe, 1,200 linear feet of 36-inch diameter pipe, 320 feet of 48-inch diameter pipe, pavement and curb/gutter for 2,400 linear feet of roadway, 12 curb inlets, and four 60-inch manholes. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 30 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Coronado Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	450,833.33
2	**DRAINAGE IMPROVEMENTS**	$	192,050.00
3	**POND EXCAVATION IMPROVEMENTS**	$	782,870.00
	Sub-Total =	$	1,425,753.33
	Engineering (10%)	$	142,575.33
	Contingency (20%)	$	285,150.67
	Total =	$	1,853,479.33
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4.7 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	5	0	5
20% (5-year)	7	0	7
10% (10-year)	8	0	8
4% (25-year)	8	1	7
1% (100-year)	9	2	7

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,054,749	$1,853,479	1.11
Elevate Structures	$2,054,749	$951,900	2.16
Acquisition/Supplemental Housing/Demolition	$3,379,482	$855,928	3.95

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

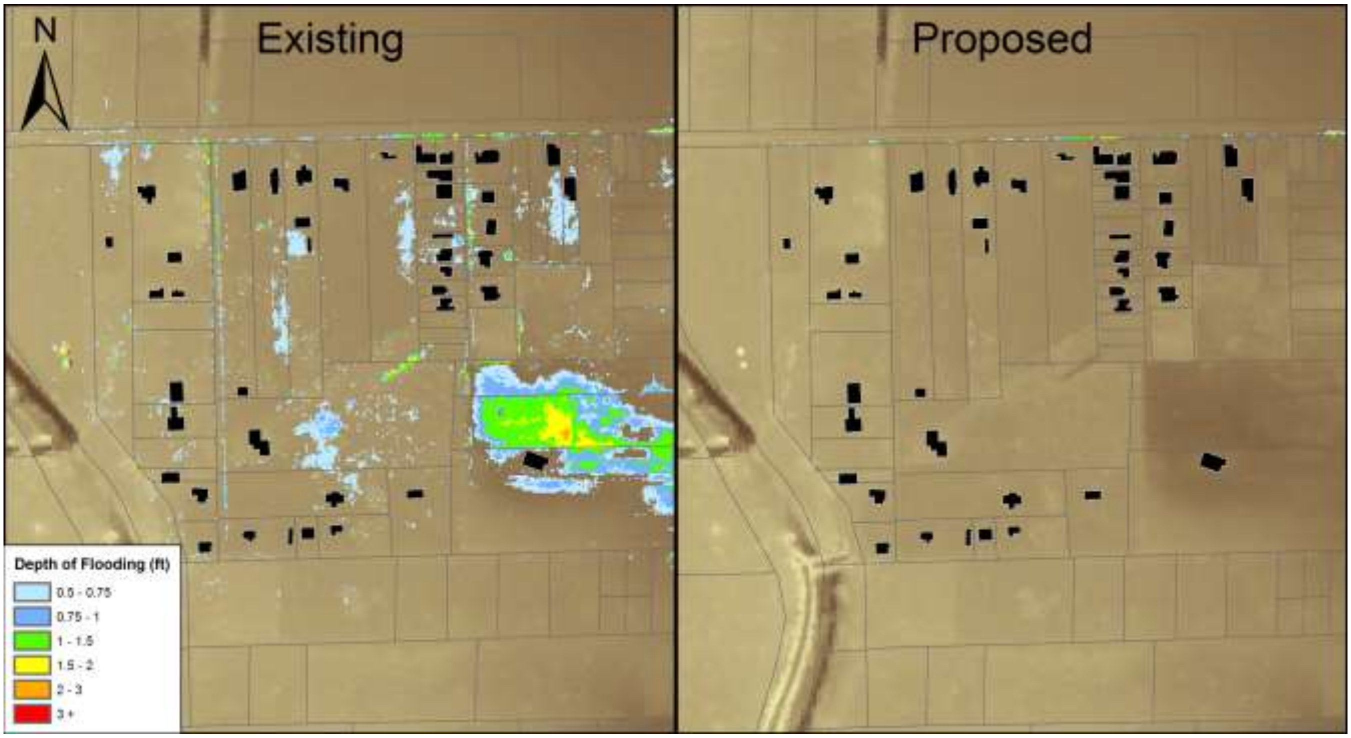


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	0	5
Inundated Lots	55	9	46
Inundated Roadway (LF)	45	0	45

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

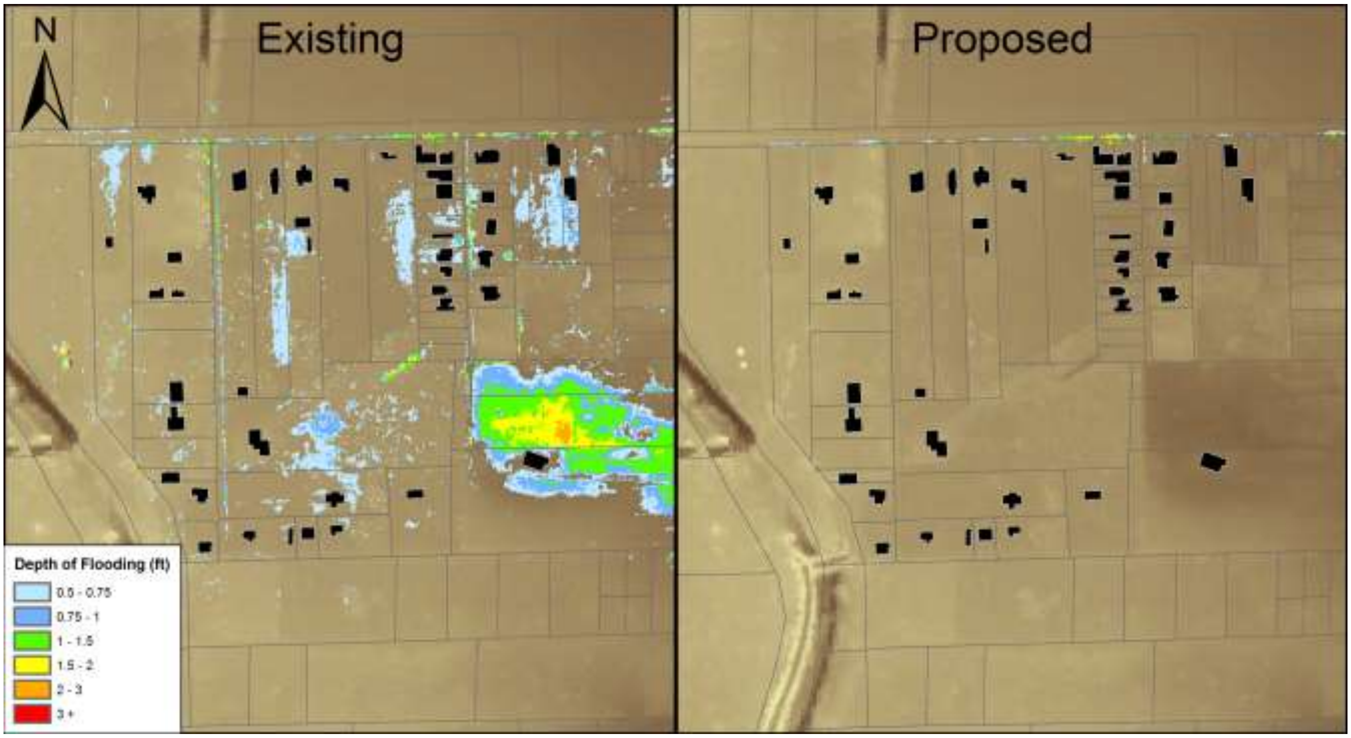


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	55	14	41
Inundated Roadway (LF)	75	10	65

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

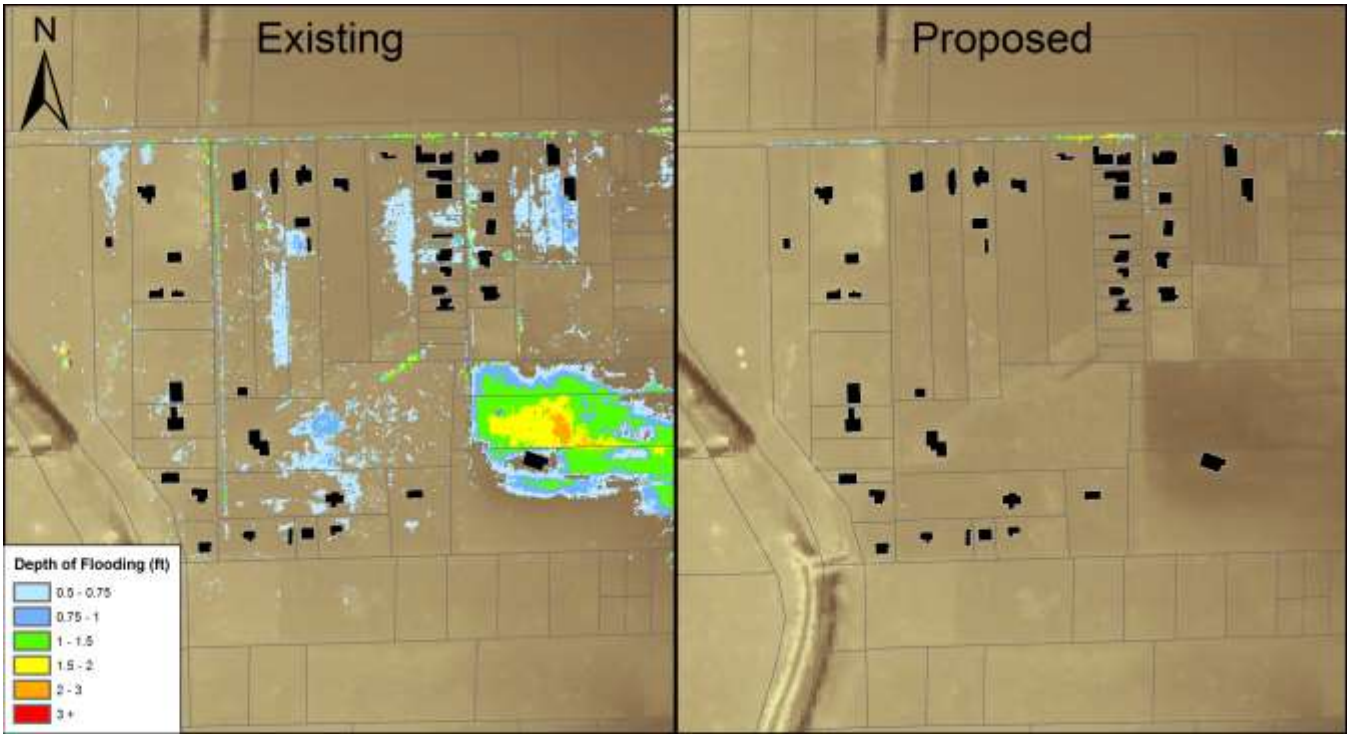


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	55	19	36
Inundated Roadway (LF)	100	10	90

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

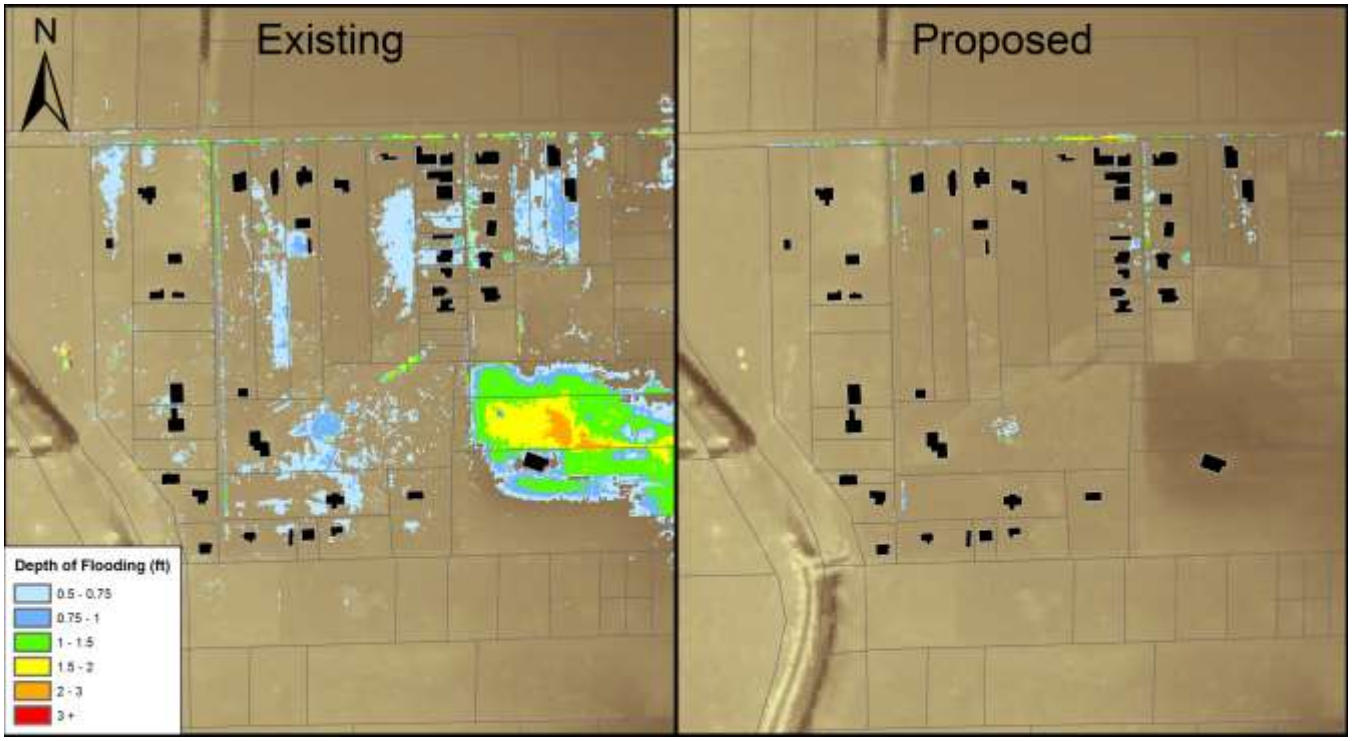


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	1	7
Inundated Lots	55	29	26
Inundated Roadway (LF)	115	15	100

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Coronado, Cameron County

Recommended Mitigation Project cont.:

Project Figure

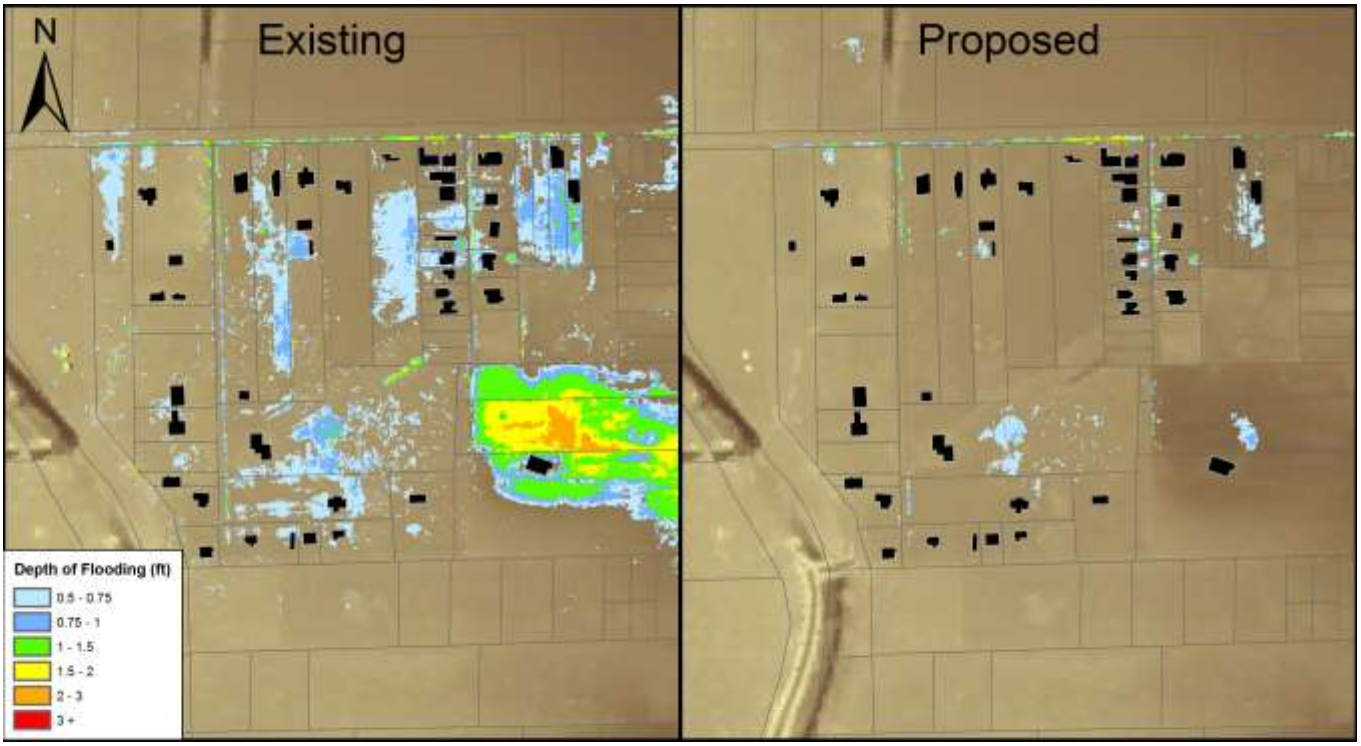


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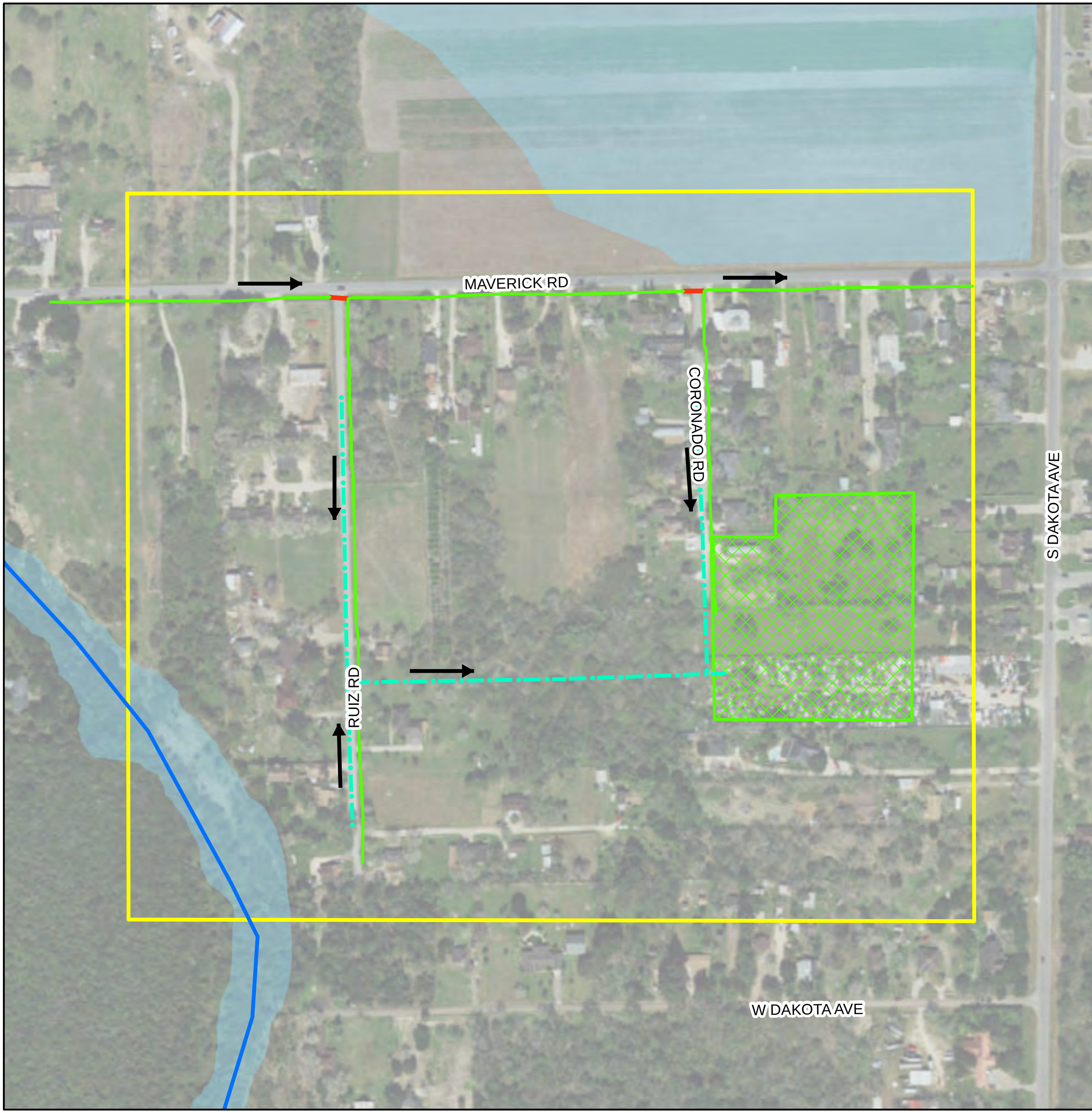
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	2	7
Inundated Lots	56	36	20
Inundated Roadway (LF)	165	55	110

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Coronado
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Proposed Retention Pond
- Coronado Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

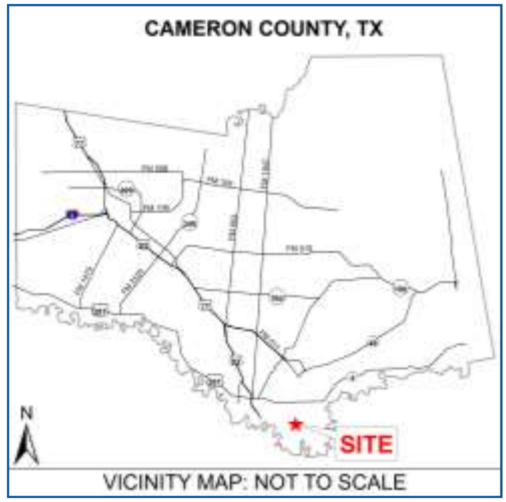
Colonia: Dakota Mobile Home Park, Cameron County

Basin: Brownsville North Main Drain

Category: A1

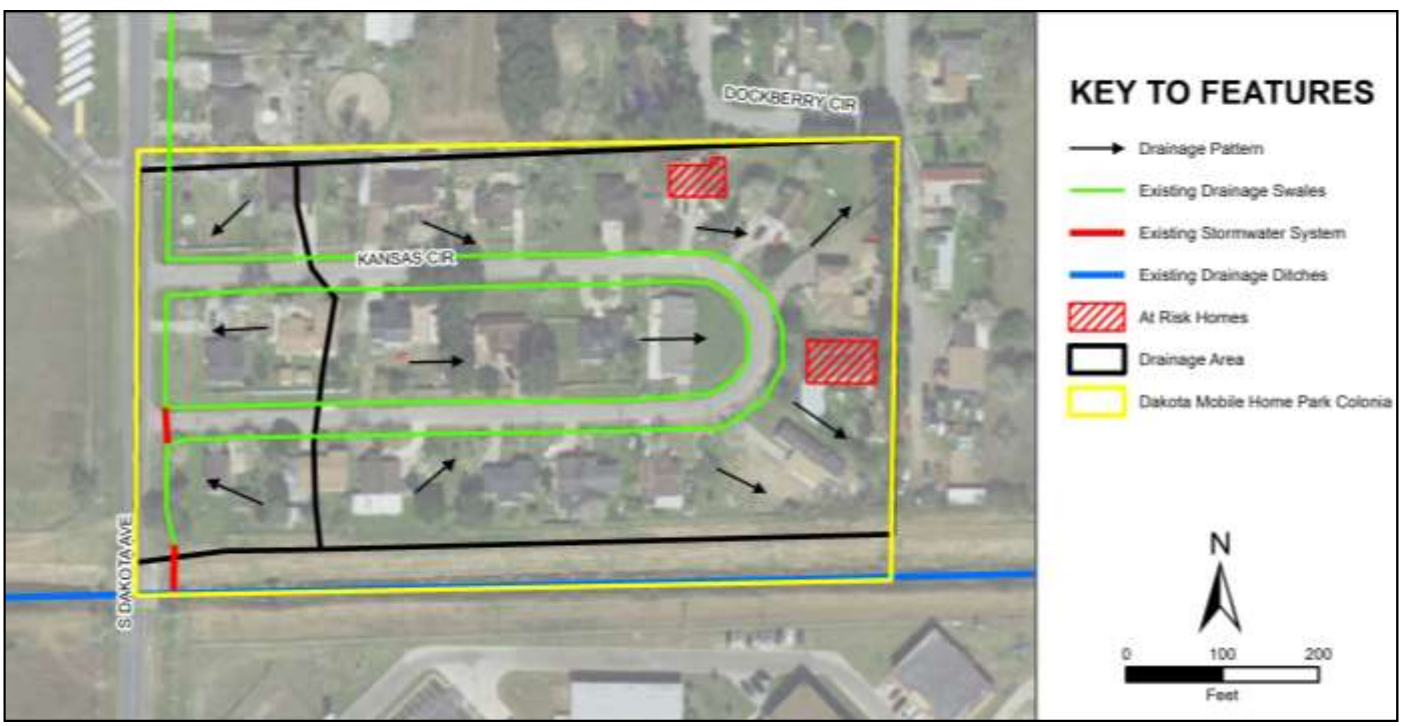
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Dakota Mobile Home Park colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 8-acre colonia are generally to the east with a portion draining to the west towards S. Dakota Ave. The existing drainage system consists of open swales along Kansas Circle and S. Dakota Ave that outfall into the regional drainage system to the south. The colonia does not have adequate roadside swale conveyance due to undersized swales, vegetation and sediment build-up. The colonia experiences residential lot and street flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Dakota Mobile Home Park, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Improve and install the roadside drainage system with a retention pond to mitigate off-site impacts
    - Install storm drain pipe to the north of the colonia
    - Improve and/or install adequately sized road crossing culverts and driveway culverts
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements and expansion of the roadside drainage system, installation of a storm drain line, with a retention facility. The improvements include 375 linear feet of 18-inch diameter pipe, 260 linear feet of 24-inch diameter pipe, 350 linear feet of 36-inch diameter pipe, one area inlet, 2,200 linear feet of grassy swales, 3,490 linear feet of roadside swale excavation and grading, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 13.1 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Dakota Mobile Home Park		
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	28,633.33
2	**DRAINAGE IMPROVEMENTS**	$	96,836.67
3	**POND EXCAVATION IMPROVEMENTS**	$	347,270.00
	Sub-Total =	$	**472,740.00**
	Engineering (10%)	$	47,274.00
	Contingency (20%)	$	94,548.00
	Total =	$	**614,562.00**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	1	0	1
4% (25-year)	1	0	1
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$472,005	$614,562	0.77
Elevate Structures	$472,005	$208,350	2.27
Acquisition/Supplemental Housing/Demolition	$492,749	$230,605	2.14

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

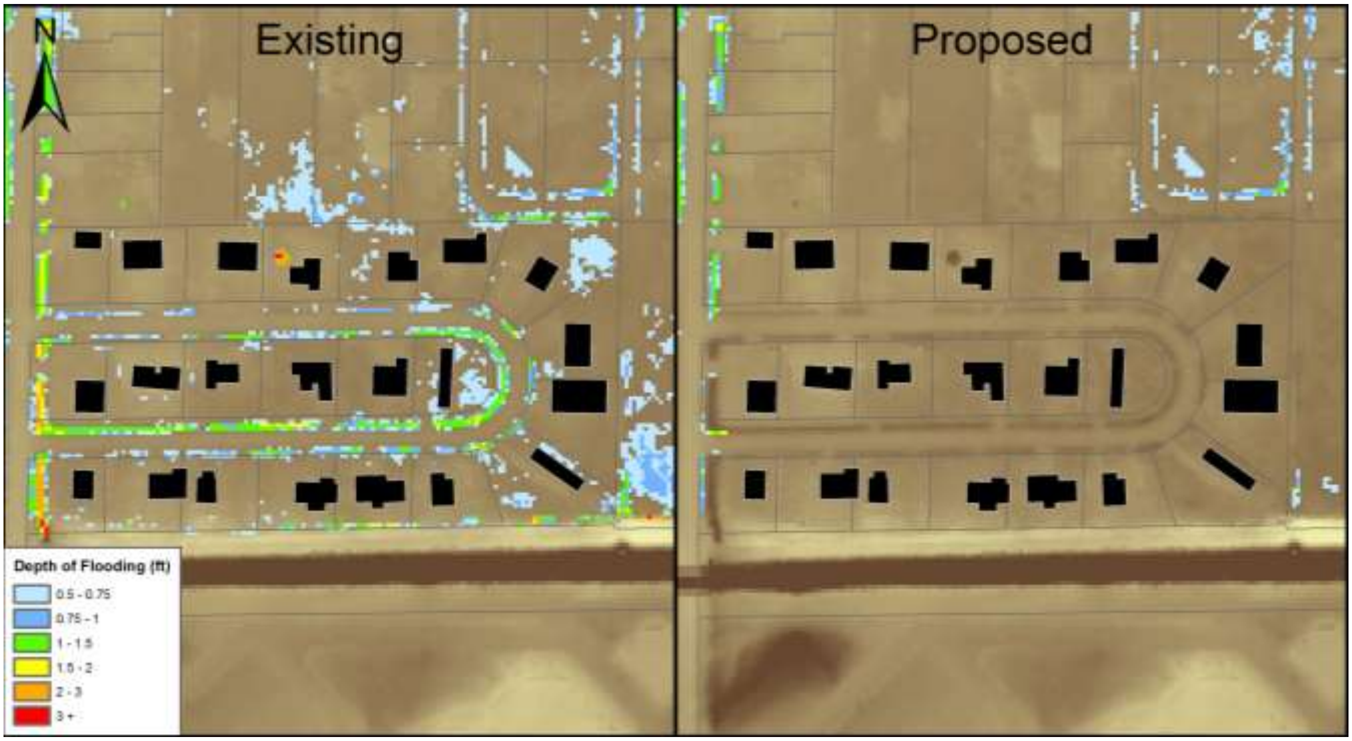


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	3	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

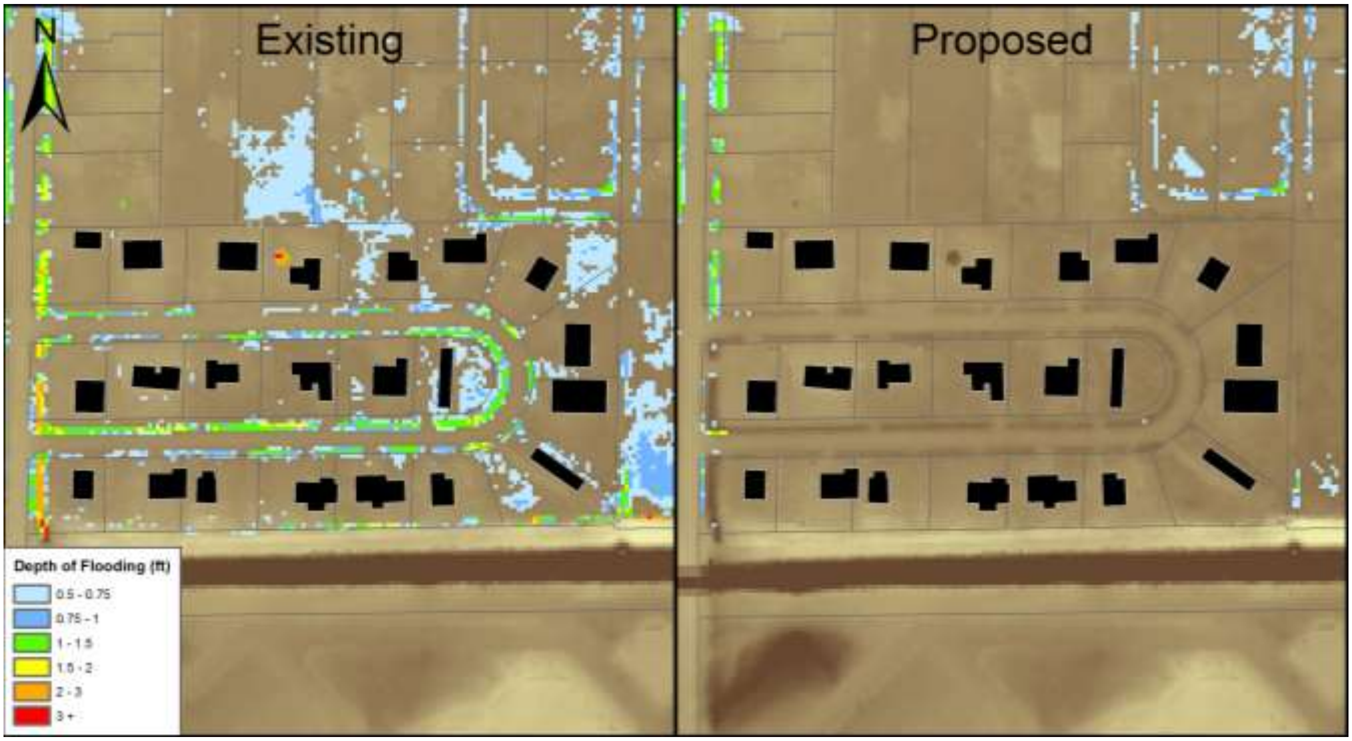


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	3	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

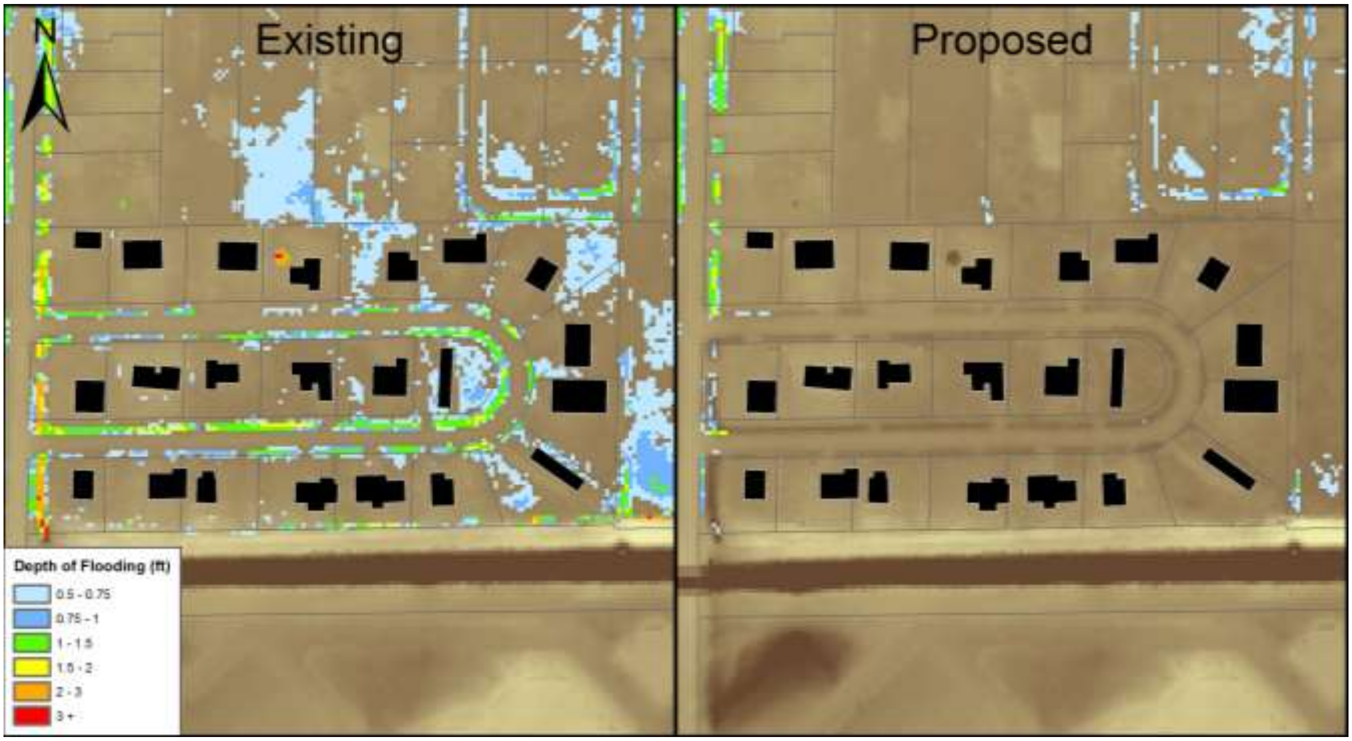


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	22	3	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

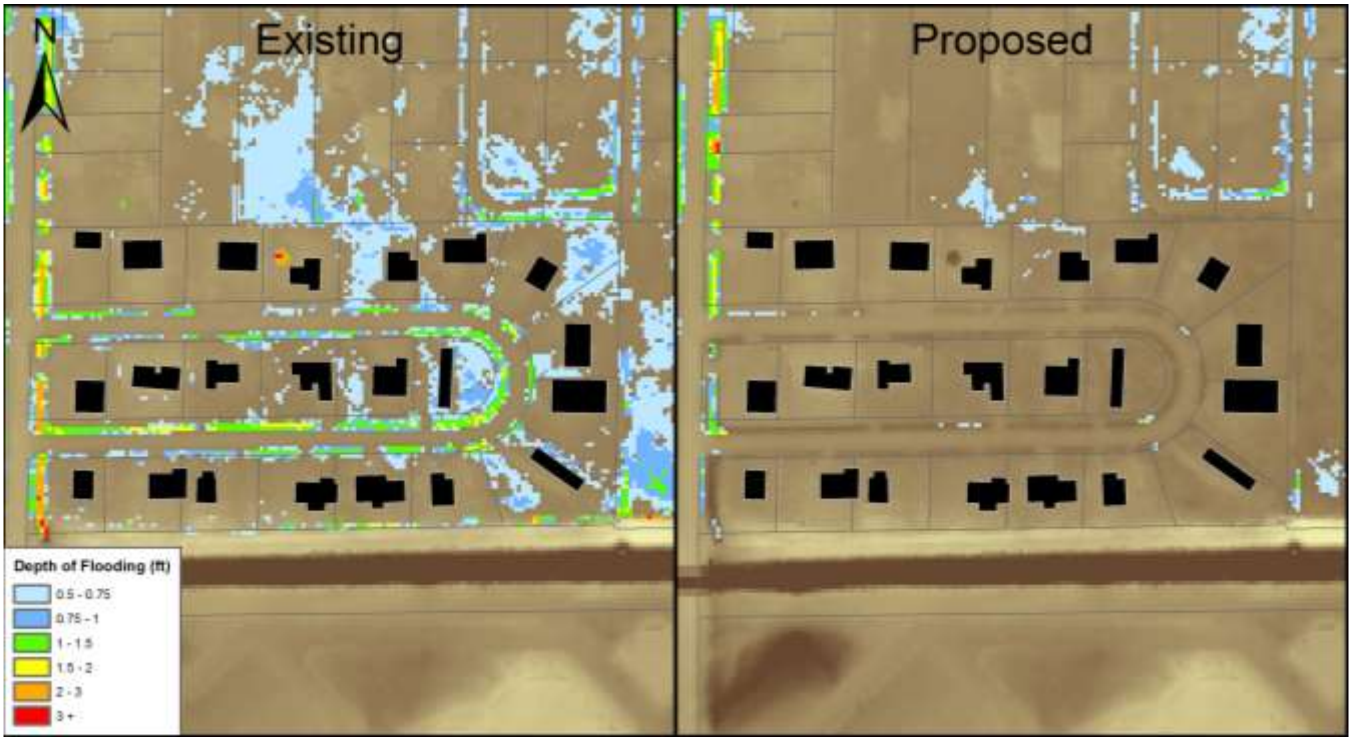


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	22	7	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Dakota Mobile Home Park, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

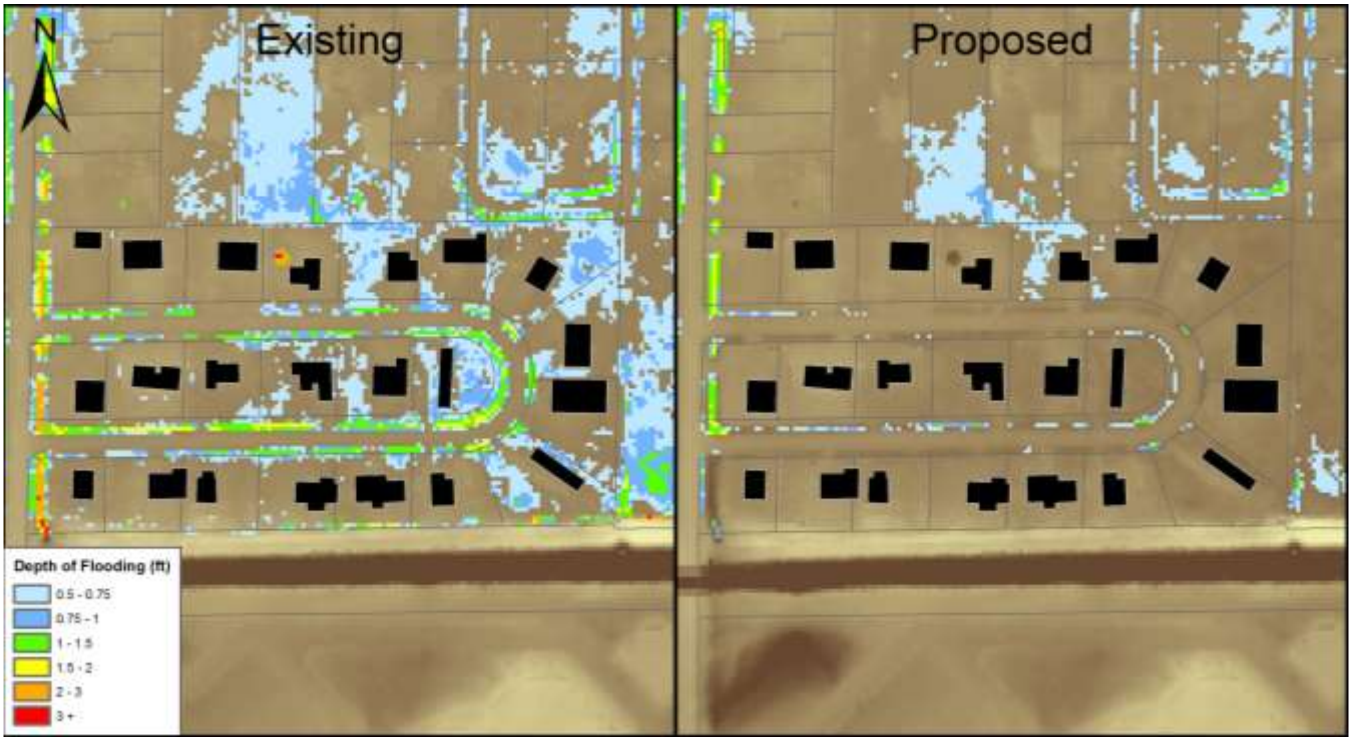


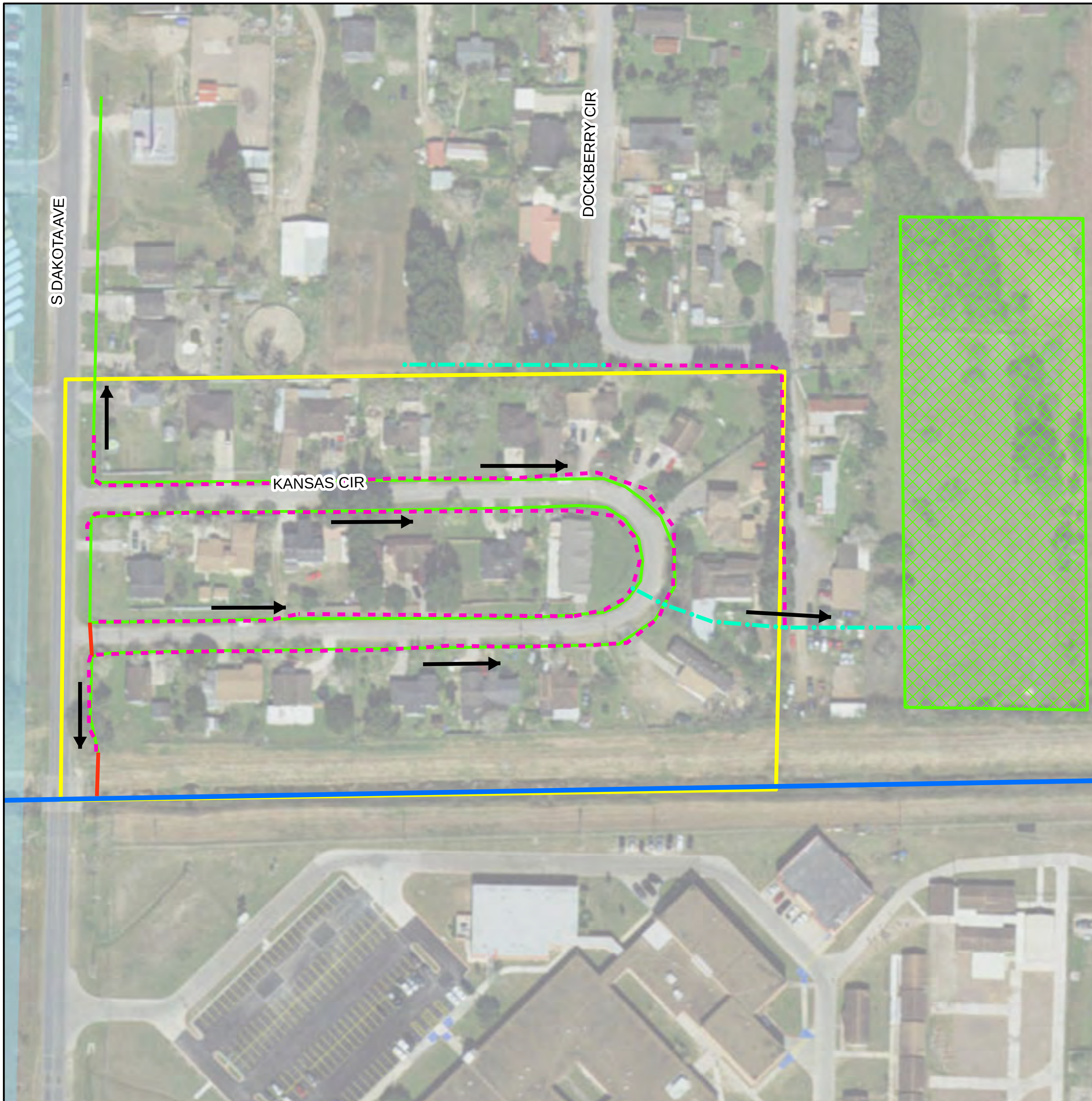
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	22	11	11
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Dakota Mobile Home Park
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Drainage Swales
- Proposed Stormwater System
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Dakota Mobile Home Park

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

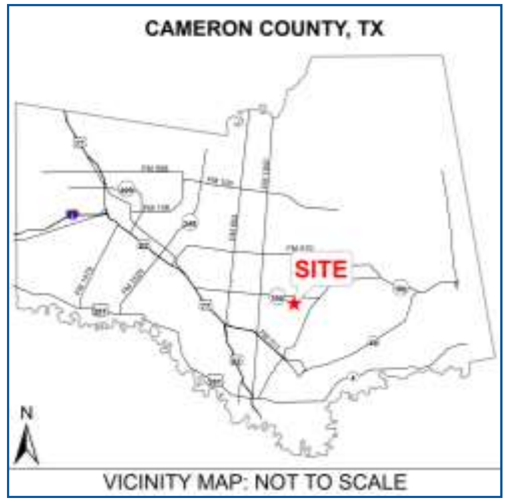
Colonia: Del Mar Heights, Cameron County

Basin: Brownsville North Main Drain

Category: A1

"Filling the Gap"

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Del Mar Heights colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 300-acre colonia are from the north to south towards the lower 250 acres of the colonia, which are within the FEMA Zone AE 100-year floodplain. The existing drainage system in the northern portion of the colonia consists of roadsides swales that are generally undersized and restricted by sediment and vegetation. The colonia experiences frequent residential lot and street flooding from local storm events as well as some structure flooding during significant regional storm events. Areas with a high flooding potential exist throughout the colonia due to the flat terrain. Cameron County has recently acquired four homes exist within the southern Zone AE floodplain, and therefore, no proposed improvements are evaluated in this area. Figures 1-5 illustrate the existing and proposed conditions inundation maps in the northern portion of the colonia for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Del Mar Heights, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install and/or improve roadside swales throughout the colonia
    - Improve and/or install adequately sized road crossing culverts and driveway culverts
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes a roadside ditch and driveway culvert improvements with a retention facility. The improvements include 6,300 linear feet of ditch excavation and grading, 740 linear feet of 18-inch diameter culverts, 60 linear feet of 36-inch diameter pipe, and 3,600 linear feet of grassy swales between homes in order to allow drainage to roadside swales. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 12 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Del Mar Heights Colonia		
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	46,750.00
2	**DRAINAGE IMPROVEMENTS**	$	97,740.00
3	**POND EXCAVATION IMPROVEMENTS**	$	346,060.00
	Sub-Total =	**$**	**490,550.00**
	Engineering (10%)	$	49,055.00
	Contingency (20%)	$	98,110.00
	Total =	**$**	**637,715.00**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.7 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Del Mar Heights, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	1	0	1
1% (100-year)	1	0	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$421,344	$637,715	0.66
Elevate Structures	$421,344	$272,755	1.54
Acquisition/Supplemental Housing/Demolition	$647,859	$145,527	4.45

Colonia: Del Mar Heights, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	119	44	75
Inundated Roadway (LF)	220	0	220

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Del Mar Heights, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

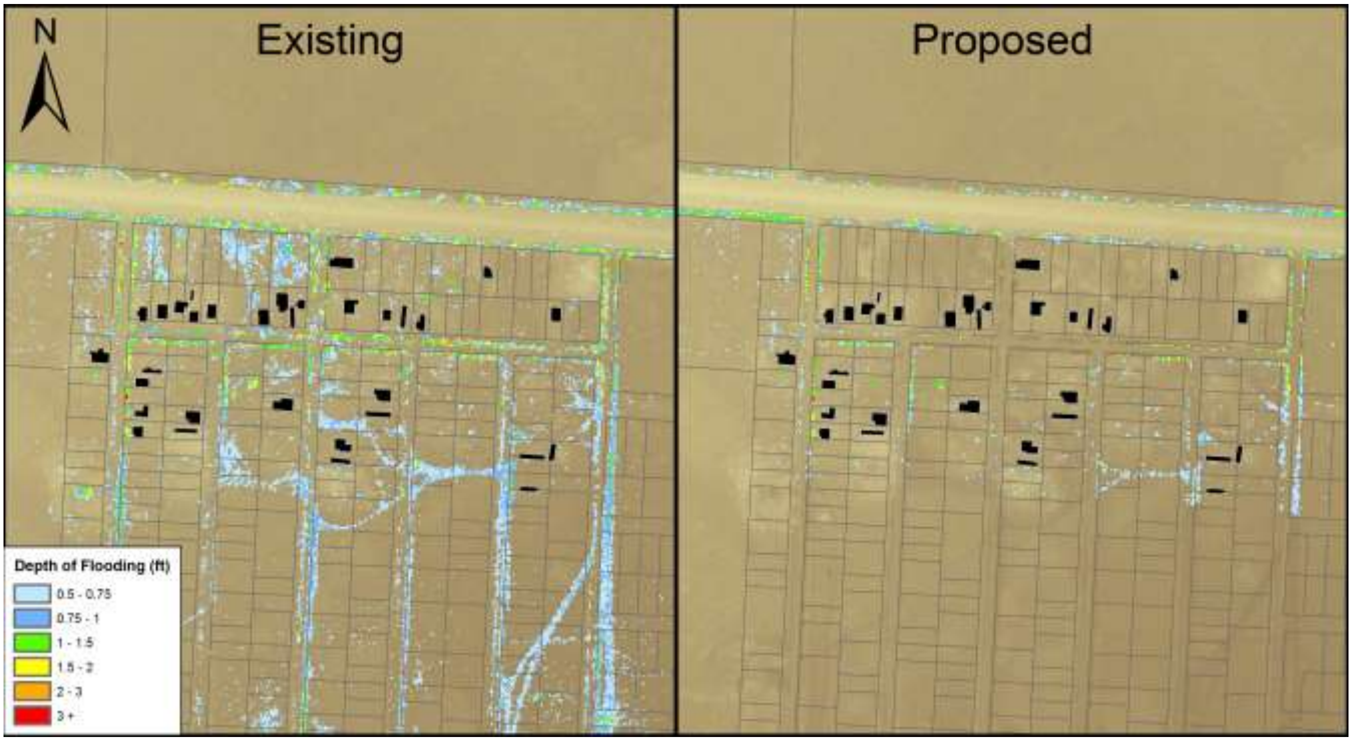


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	121	76	45
Inundated Roadway (LF)	360	0	360

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figure:

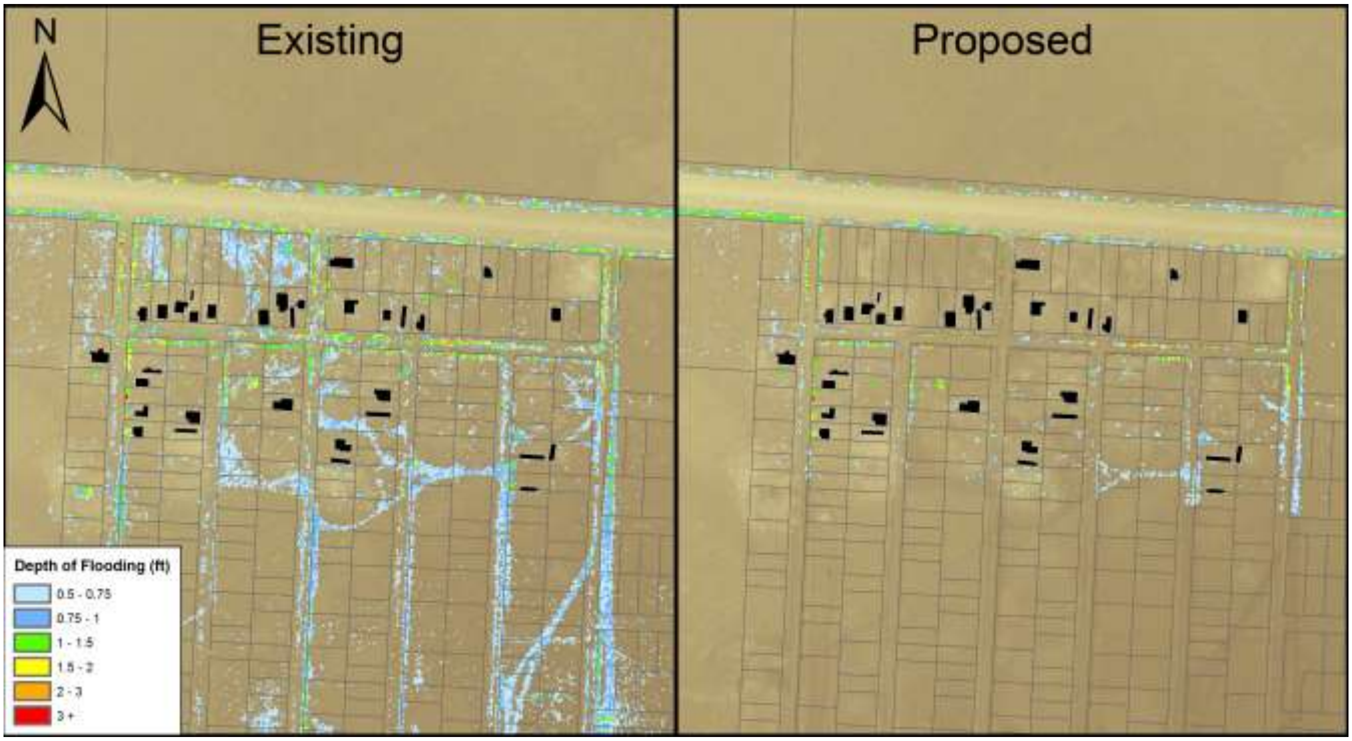


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	122	78	44
Inundated Roadway (LF)	450	0	450

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figure:

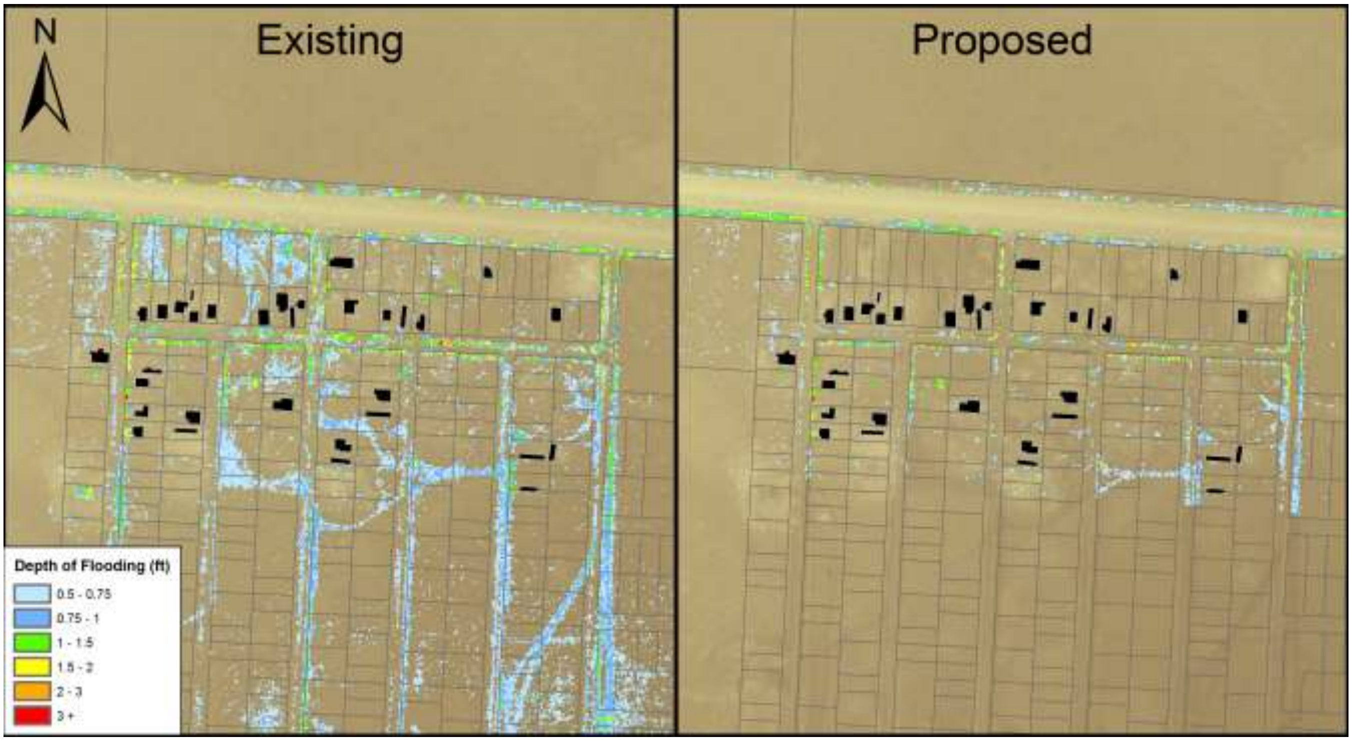


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	122	84	38
Inundated Roadway (LF)	450	30	420

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Del Mar Heights, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

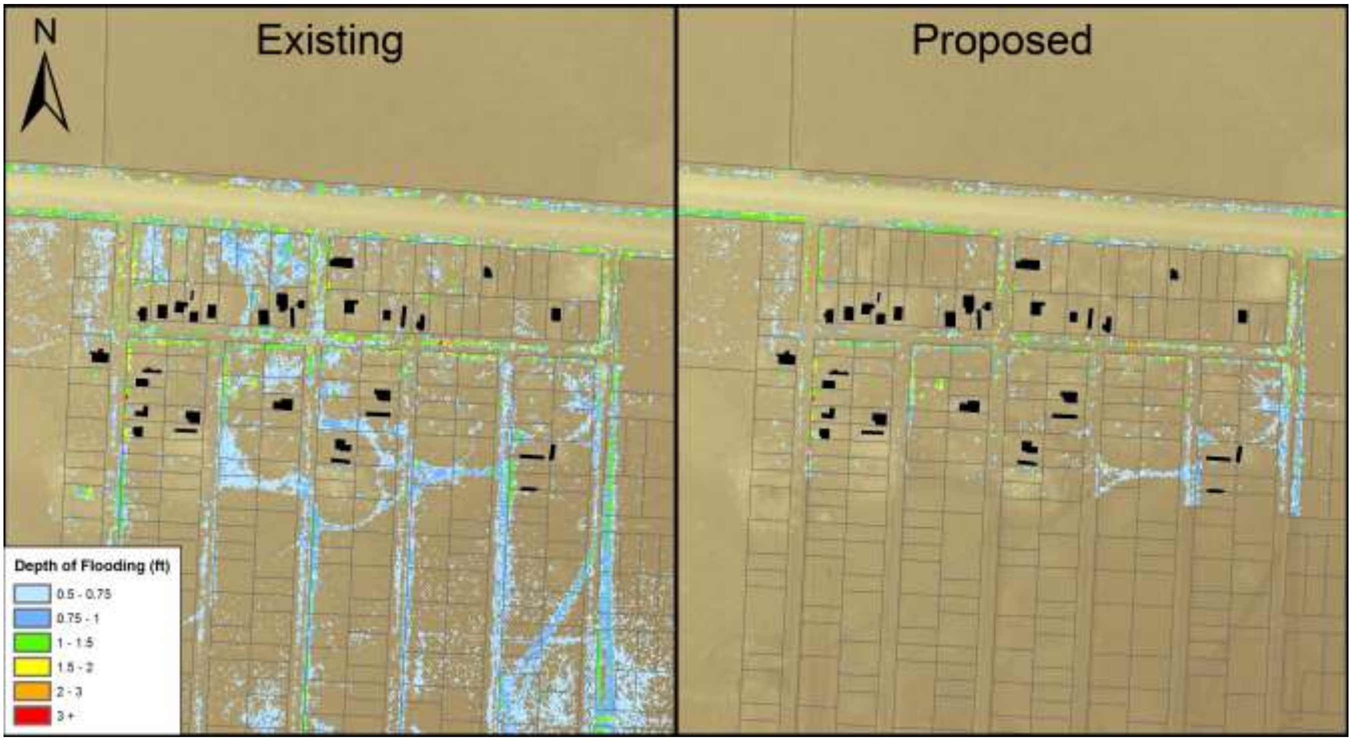
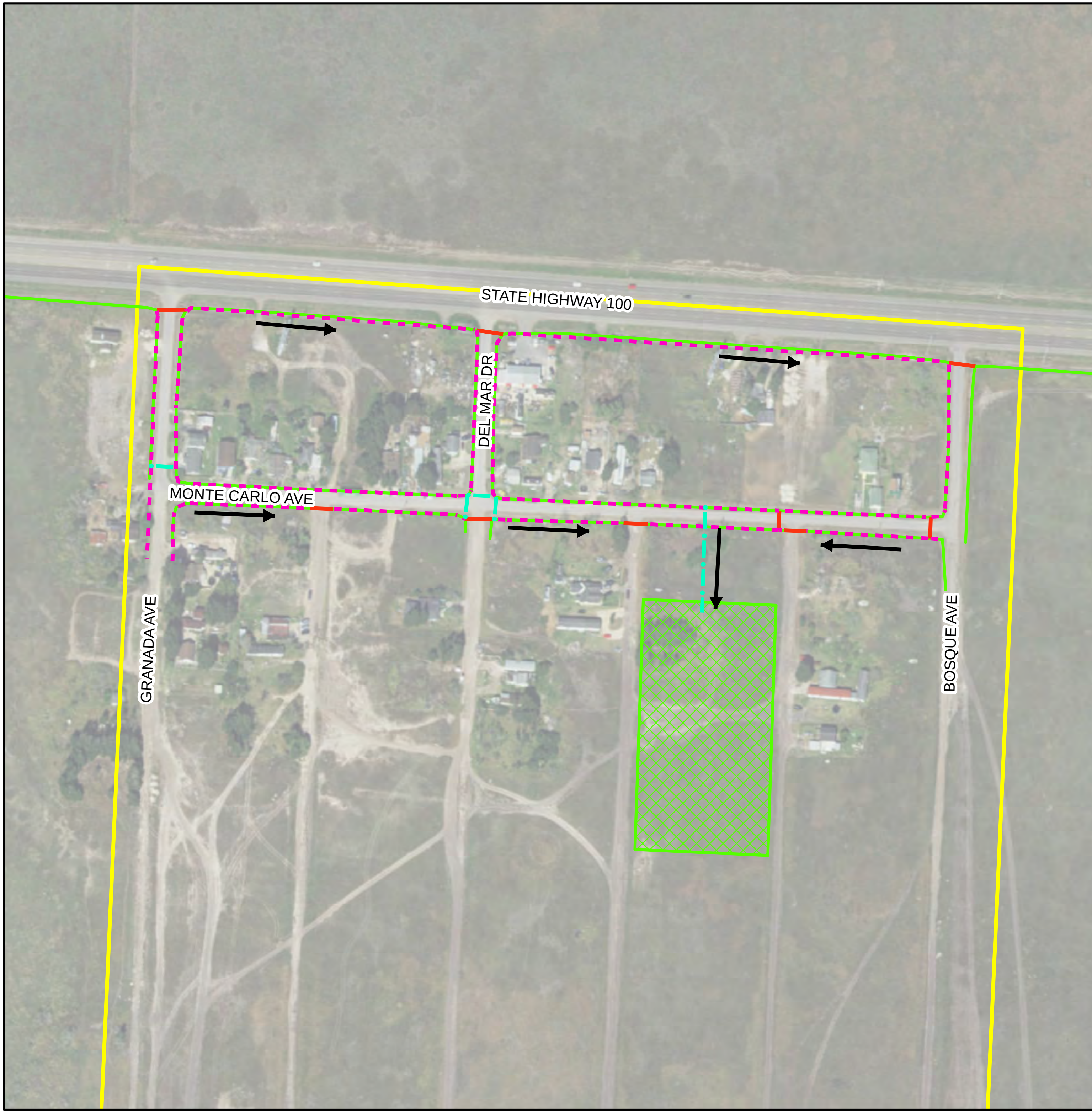


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	122	92	30
Inundated Roadway (LF)	810	80	730

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Del Mar Heights
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormsewer System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Retention Pond
- Del Mar Heights Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

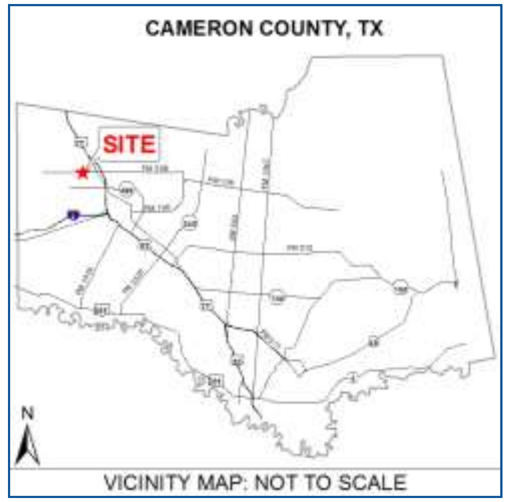
"Filling the Gap"

Colonia: Eggers, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Eggers colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 27-acre colonia are generally from the southwest to northeast, towards Combes-Santa Rosa Road (TX-107). The colonia does not have adequate roadside ditch conveyance and frequently experiences residential lot and street flooding as well as some structural flooding from local events. Model results indicate that the northeast corner of the colonia within the FEMA Zone AH 100-year floodplain is a high-risk flooding area, as well as other areas throughout the very flat terrain of the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Eggers, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install/improve roadside swales and culvert upgrades along Davis Rd. and TX-107
  - Install grassy swales between lots
  - Install a retention pond to eliminate off-site impacts
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside ditch and driveway culvert improvements along David Rd. and TX-107. The improvements include 210 linear feet of 18-inch driveway culverts and 1,200 linear feet of ditch excavation and grading along David Rd. and TX-107. Construction of swales between homes are proposed in order to allow drainage to the roadside swales. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 18 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Eggers Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	17,760.00
2	**DRAINAGE IMPROVEMENTS**	$	47,608.89
3	**POND EXCAVATION IMPROVEMENTS**	$	480,370.00
	Sub-Total =	**$**	**545,738.89**
	Engineering (10%)	$	54,573.89
	Contingency (20%)	$	109,147.78
	Total =	**$**	**709,460.56**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.7 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	1	0
20% (5-year)	3	1	2
10% (10-year)	4	1	3
4% (25-year)	4	1	3
1% (100-year)	6	1	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,190,148	$709,460	3.09
Elevate Structures	$2,190,148	$778,500	2.81
Acquisition/Supplemental Housing/Demolition	$2,478,363	$640,229	3.87

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	1	0
Inundated Lots	19	3	16
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	1	2
Inundated Lots	18	3	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

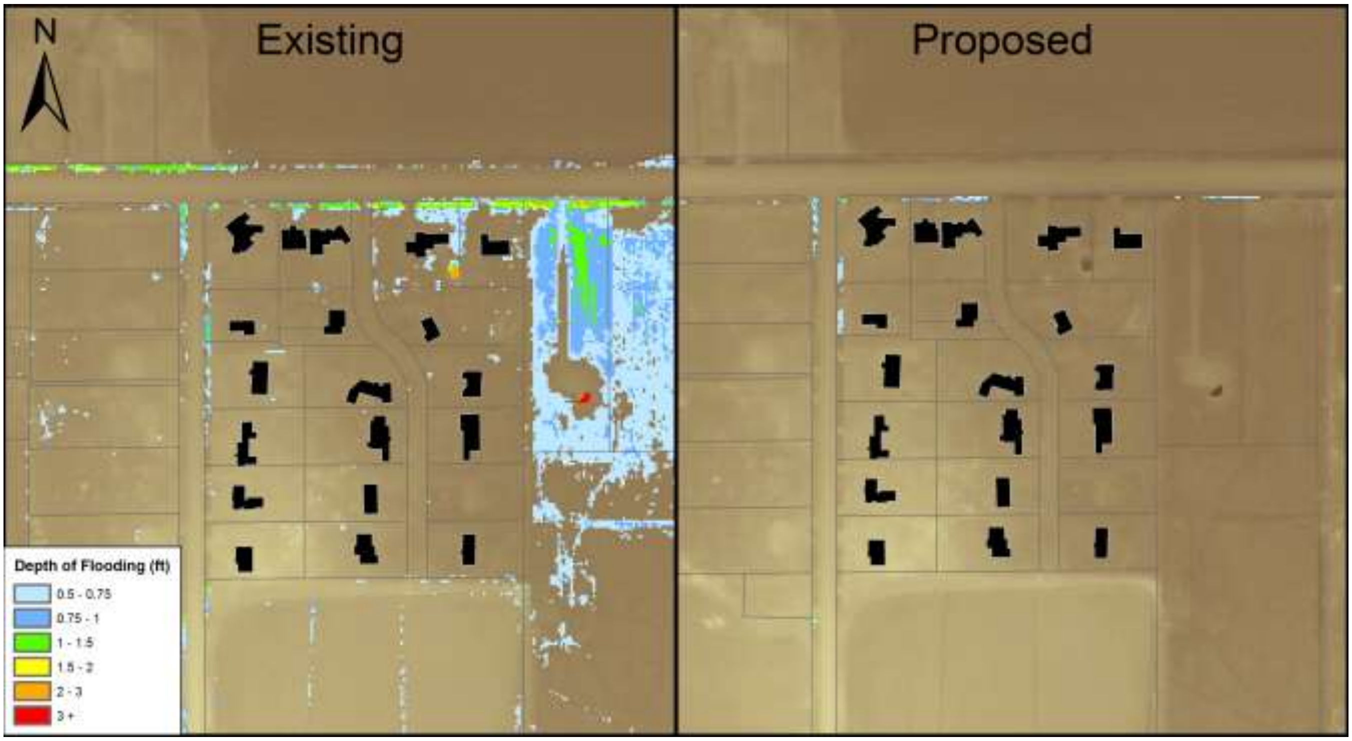


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	1	3
Inundated Lots	18	4	14
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

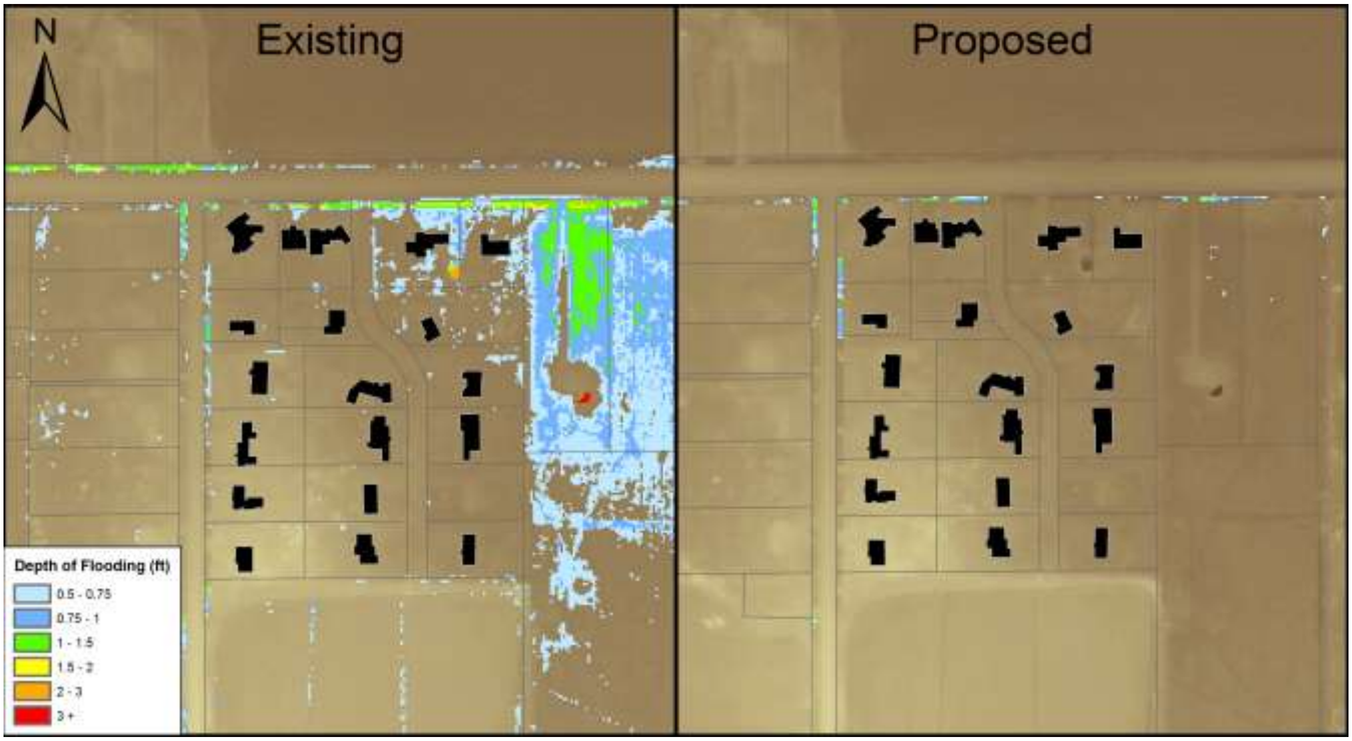


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	1	3
Inundated Lots	18	5	13
Inundated Roadway (LF)	10	0	10

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Eggers, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

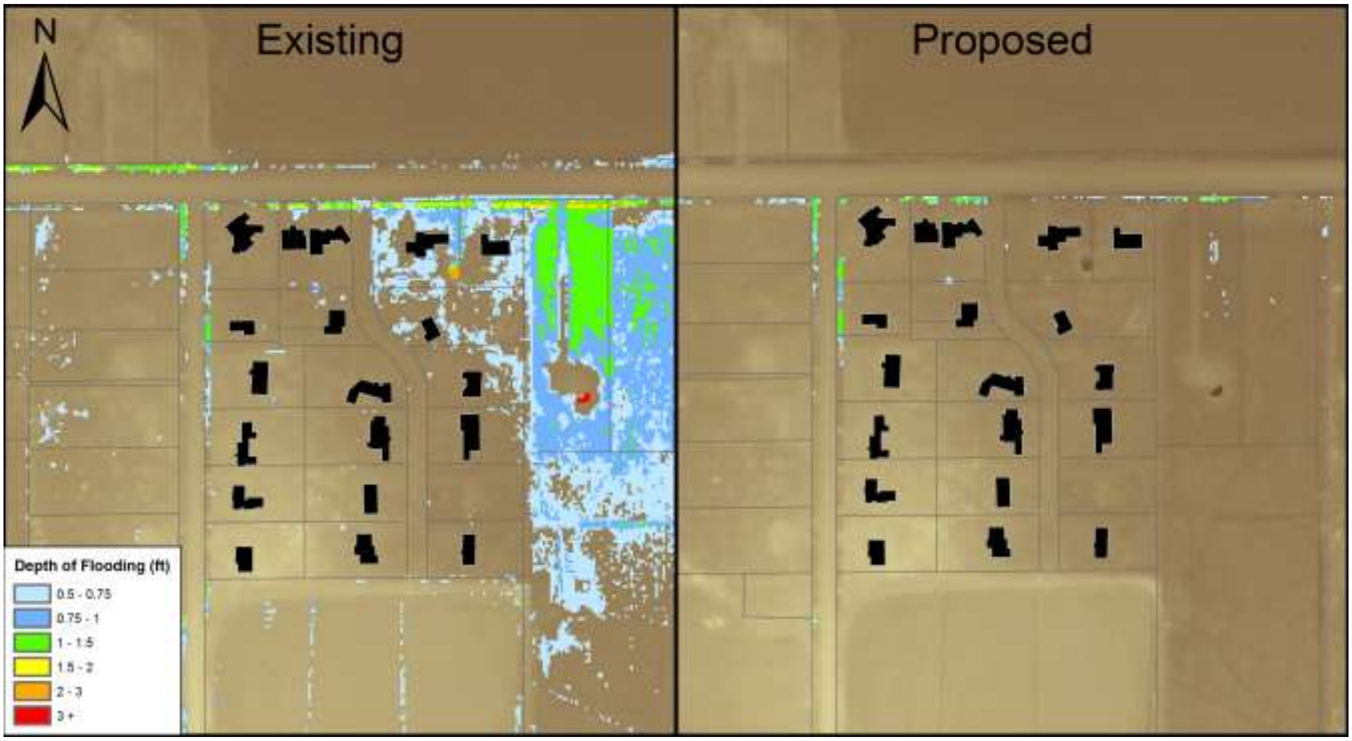
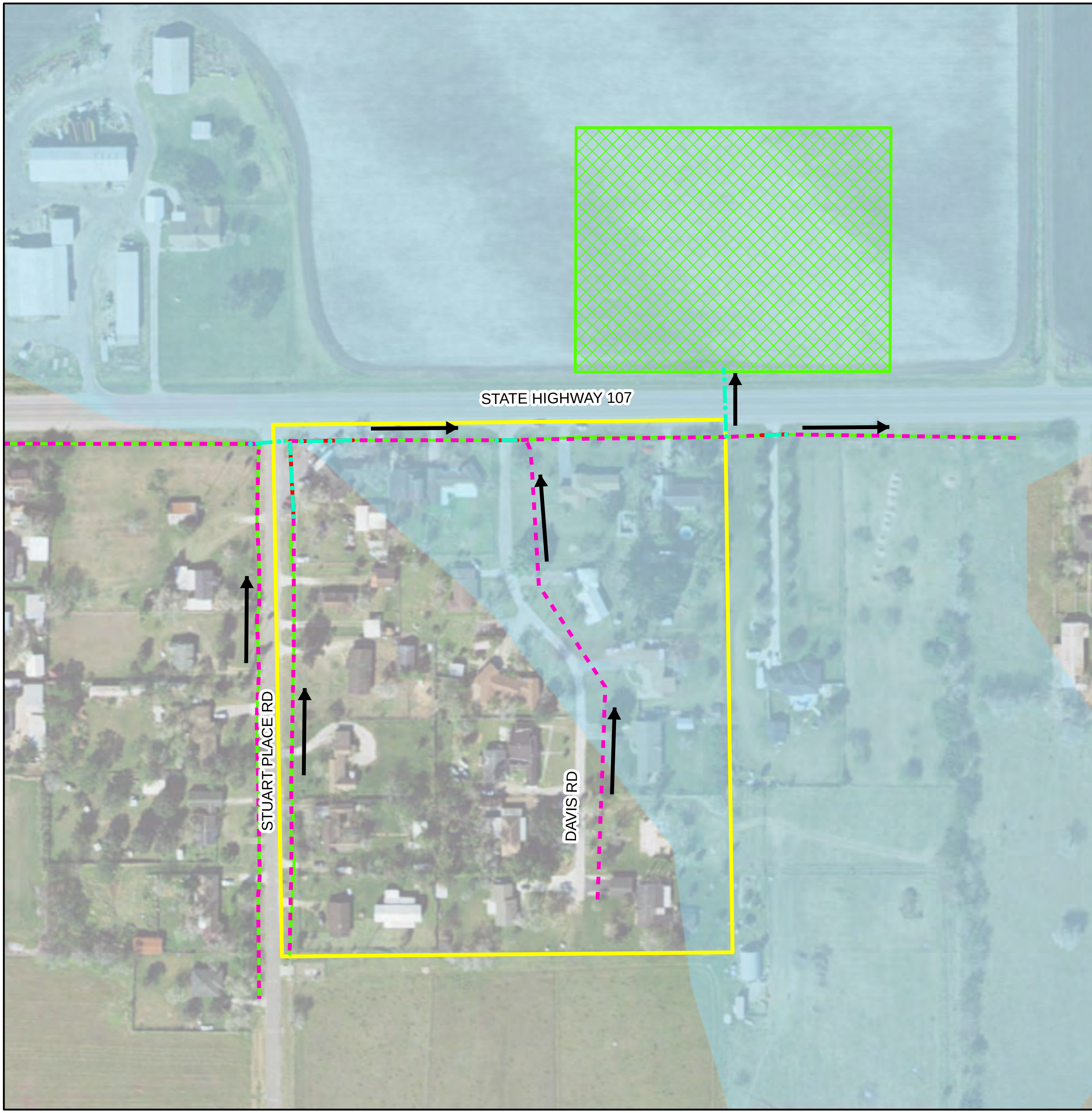


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	1	5
Inundated Lots	18	7	11
Inundated Roadway (LF)	10	0	10

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Eggers
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existings Stormwater System
- Existing Drainage Swales
- Proposed Retention Pond
- Eggers Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

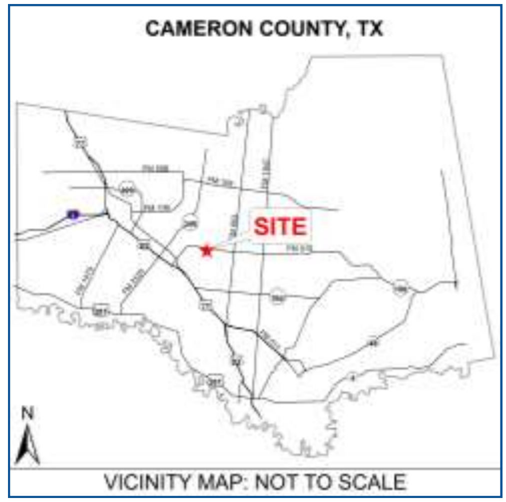
"Filling the Gap"

Colonia: Glenwood Acres, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Glenwood Acres colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 51-acre colonia are generally to the south. This colonia is located entirely within the FEMA Zone AH 100-year floodplain. The colonia has an existing roadside drainage system. Due to inadequate roadside swale conveyance, Glenwood Acres experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Glenwood Acres, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install and improve the roadside drainage system with retention ponds to mitigate off-site impacts
    - Improve and/or install adequately sized road crossing culverts and driveway culverts
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside drainage system improvements and installation of open swales with two retention facilities. The improvements include 9,500 linear feet of ditch excavation and grading, 825 linear feet of 18-inch diameter pipe, 225 linear feet of 36-inch diameter pipe, 170 linear feet of 48-inch diameter pipe, fourteen 36-inch safety end treatments, 3,800 linear feet of grassy swales between homes in order to allow drainage to roadside swales, and associated pavement improvements. The proposed retention ponds are sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 64 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Glenwood Acres Colonia

	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	67,333.33
2	**DRAINAGE IMPROVEMENTS**	$	226,669.44
3	**POND EXCAVATION IMPROVEMENTS**	$	1,668,590.00
	Sub-Total =	**$**	**1,962,592.78**
	Engineering (10%)	$	196,259.28
	Contingency (20%)	$	392,518.56
	Total =	**$**	**2,551,370.61**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention ponds is approximately 9.9 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	1	1
20% (5-year)	3	1	2
10% (10-year)	3	1	2
4% (25-year)	4	1	3
1% (100-year)	4	1	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$448,772	$2,551,371	0.18
Elevate Structures	$448,772	$314,175	1.43
Acquisition/Supplemental Housing/Demolition	$1,482,549	$334,911	4.43

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

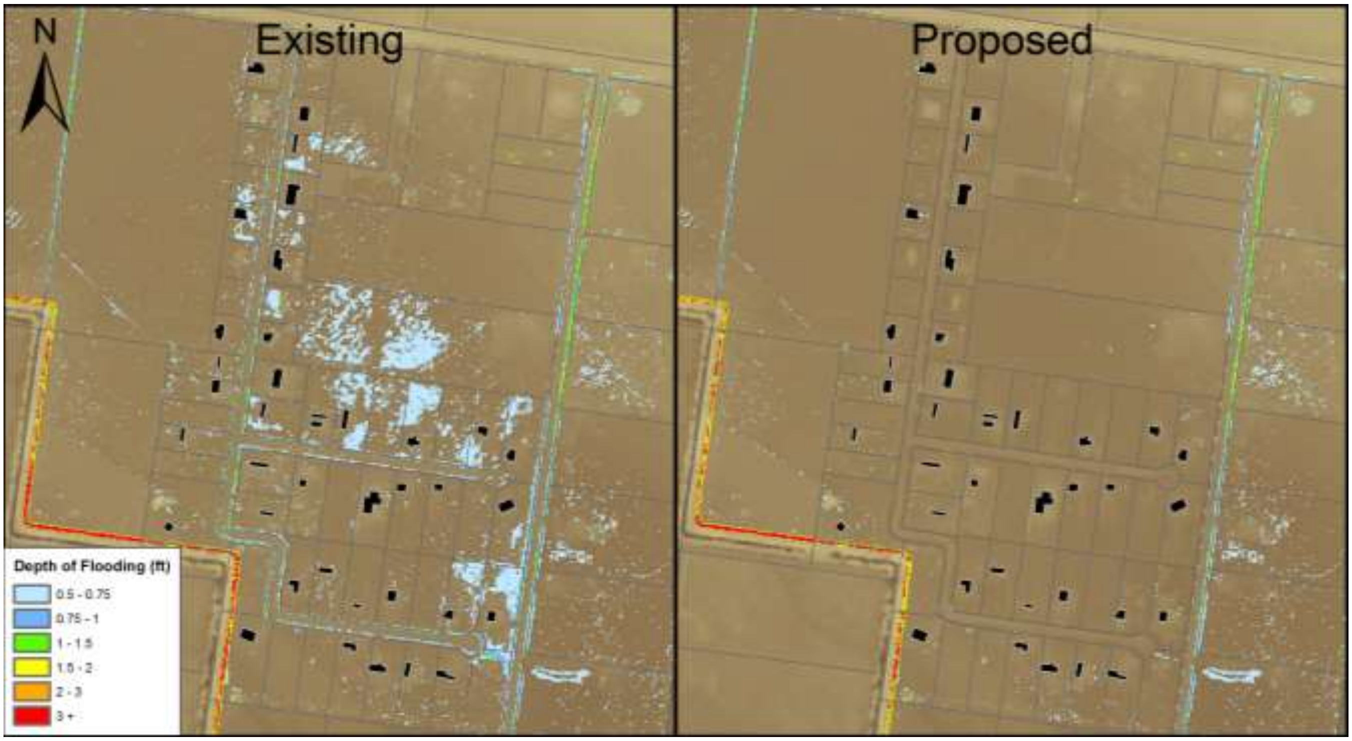


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	1	1
Inundated Lots	56	27	29
Inundated Roadway (LF)	5	5	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

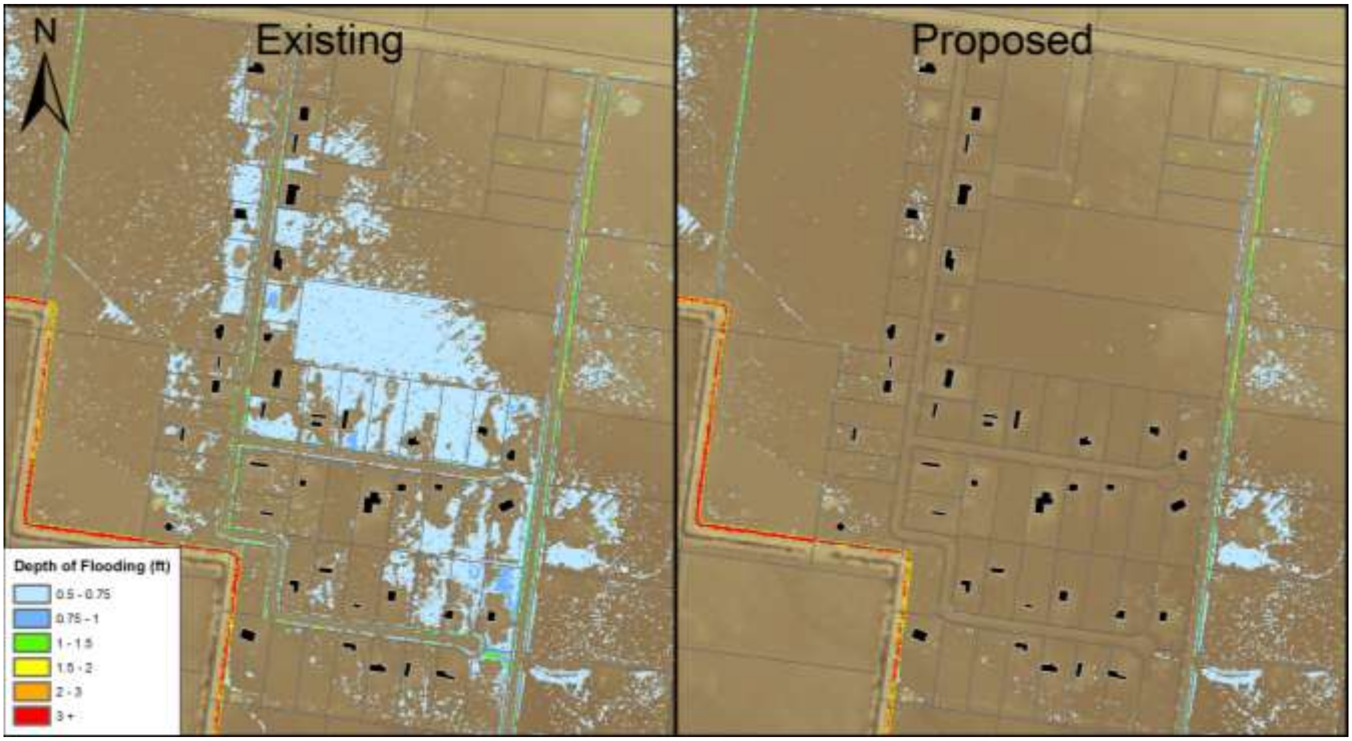


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	1	2
Inundated Lots	56	29	27
Inundated Roadway (LF)	10	5	5

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

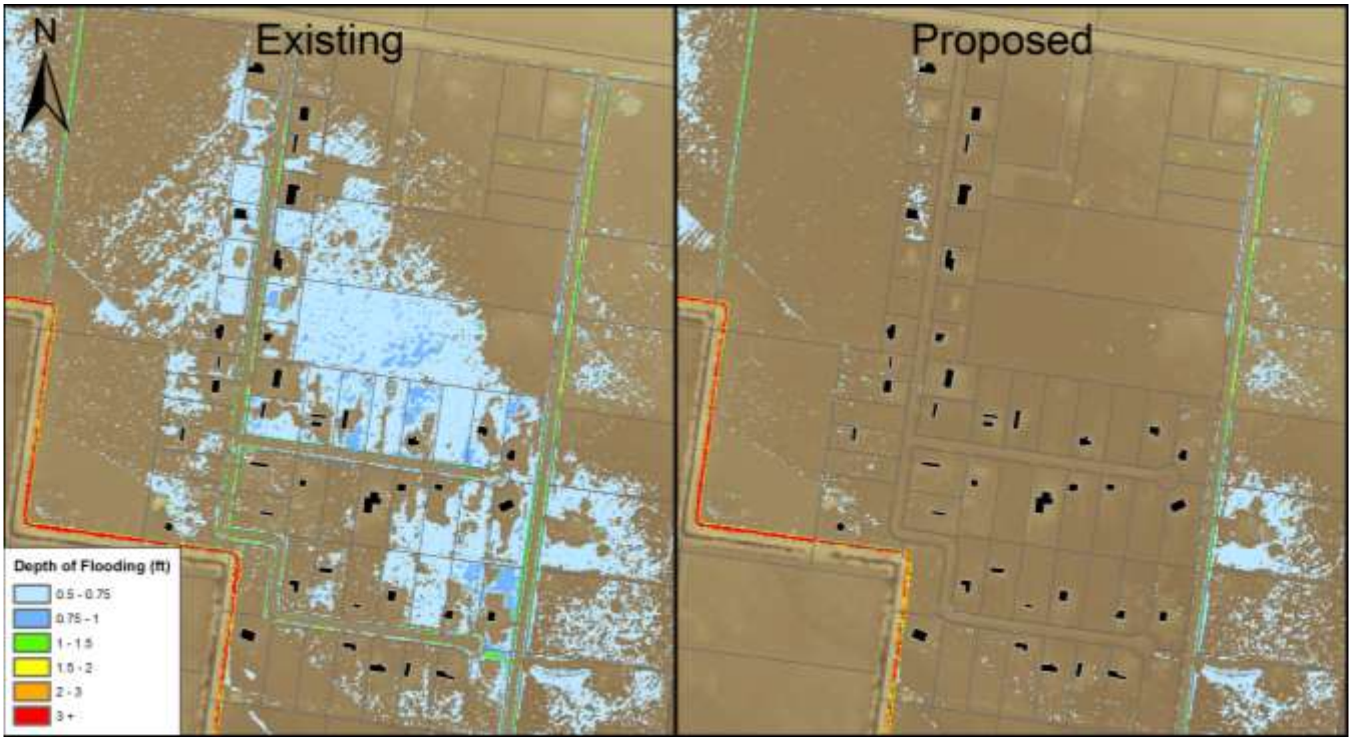


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	1	2
Inundated Lots	56	32	24
Inundated Roadway (LF)	30	5	25

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

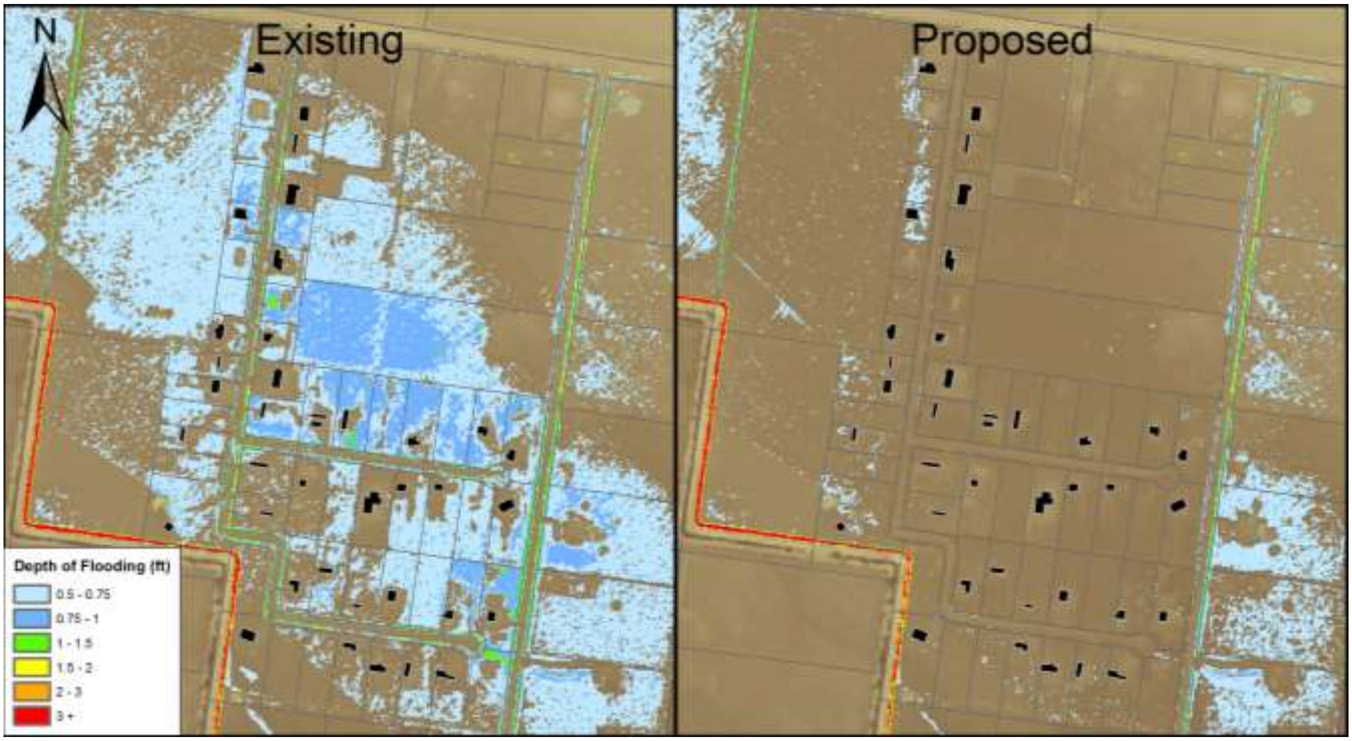


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	1	3
Inundated Lots	56	35	21
Inundated Roadway (LF)	90	5	85

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Glenwood Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

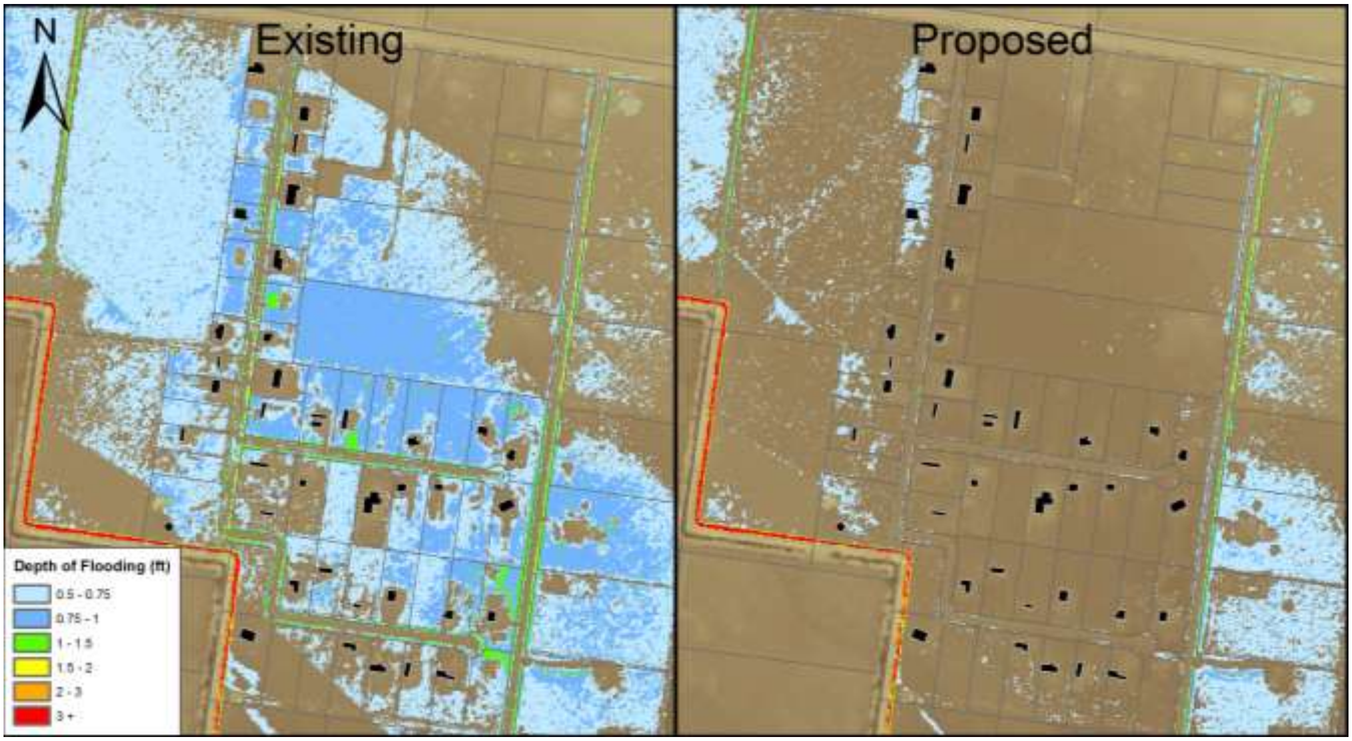


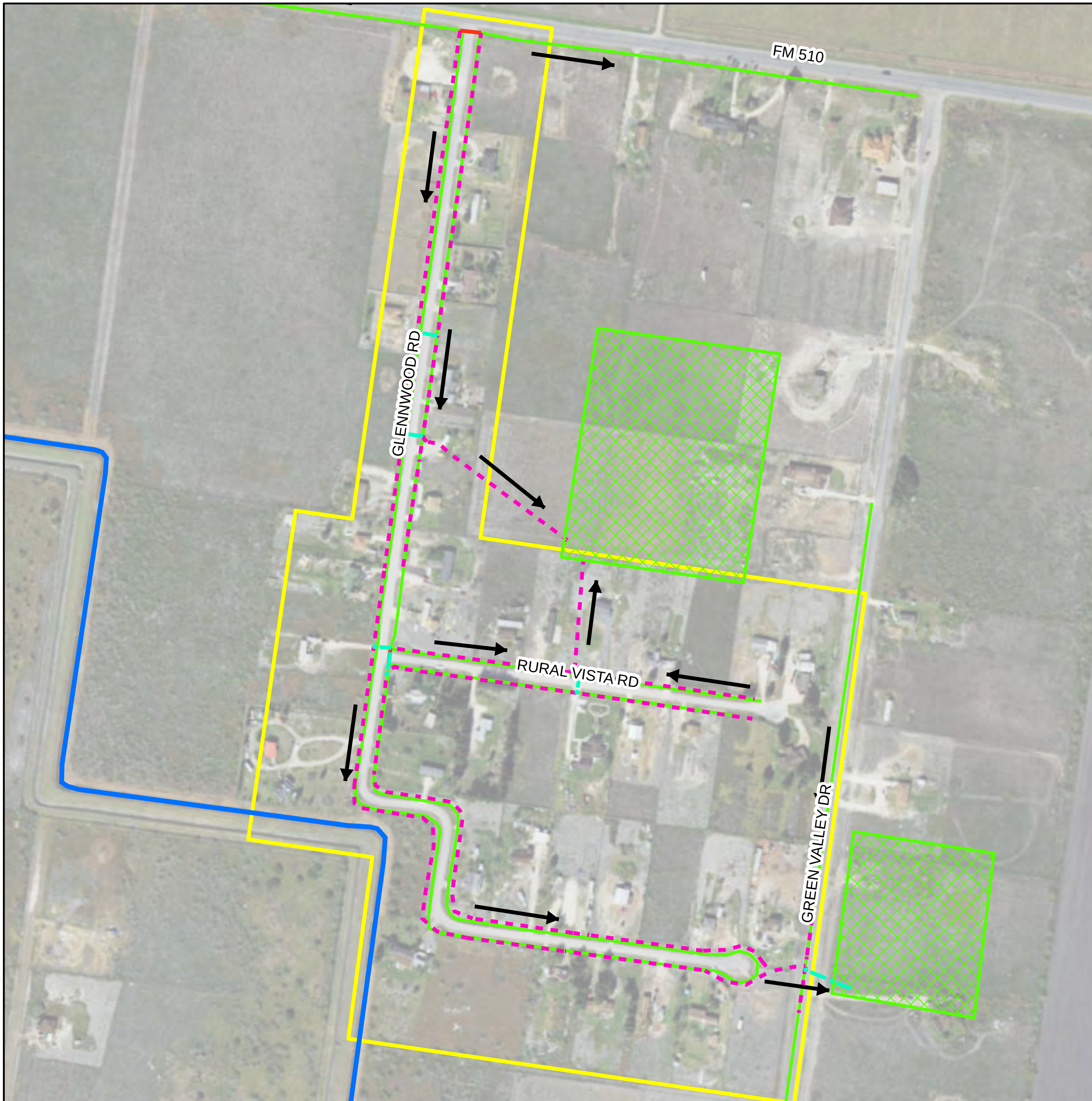
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	1	3
Inundated Lots	56	43	13
Inundated Roadway (LF)	270	5	265

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Glenwood Acres
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Drainage Swales
- Proposed Stormwater System
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain*
- Proposed Retention Pond
- Glenwood Acres Colonia

*Entire map extent is in the floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

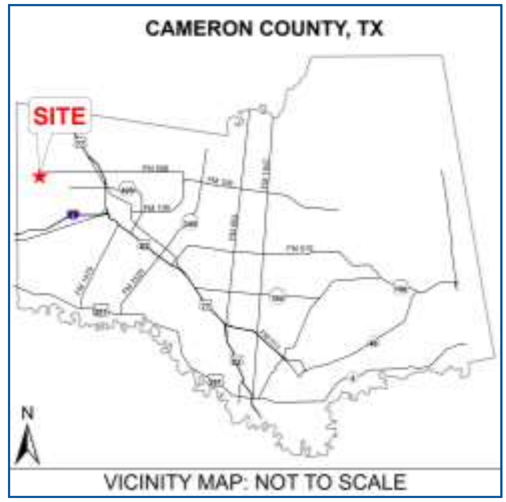
"Filling the Gap"

Colonia: Grande Acres, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Grande Acres colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 17-acre colonia are generally to the west towards Retama Street. The colonia has an existing roadside drainage system, and pipe culverts under S. Seventh Street and Retama Street. Due to inadequate conveyance of stormwater caused by undersized infrastructure, vegetation, and sediment build-up, Grande Acres experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Grande Acres, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside drainage system improvements with a retention facility. The improvements include 510 linear feet of 18-inch diameter pipe, 100 linear feet of 30-inch diameter pipe, 100 linear feet of 36-inch diameter pipe, 125 linear feet of 48-inch diameter pipe, ten 36-inch safety end treatments, 3,400 linear feet of grassy swales between homes in order to allow drainage to roadside swales, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 12.1 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Grande Acres Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	42,283.33
2	**DRAINAGE IMPROVEMENTS**	$	124,328.89
3	**POND EXCAVATION IMPROVEMENTS**	$	318,230.00
	Sub-Total =	$	**484,842.22**
	Engineering (10%)	$	48,484.22
	Contingency (20%)	$	96,968.44
	Total =	$	**630,294.89**
NOTE	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	2	0	2
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$211,325	$630,295	0.34
Elevate Structures	$211,325	$169,800	1.24
Acquisition/Supplemental Housing/Demolition	$220,860	$114,539	1.53

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

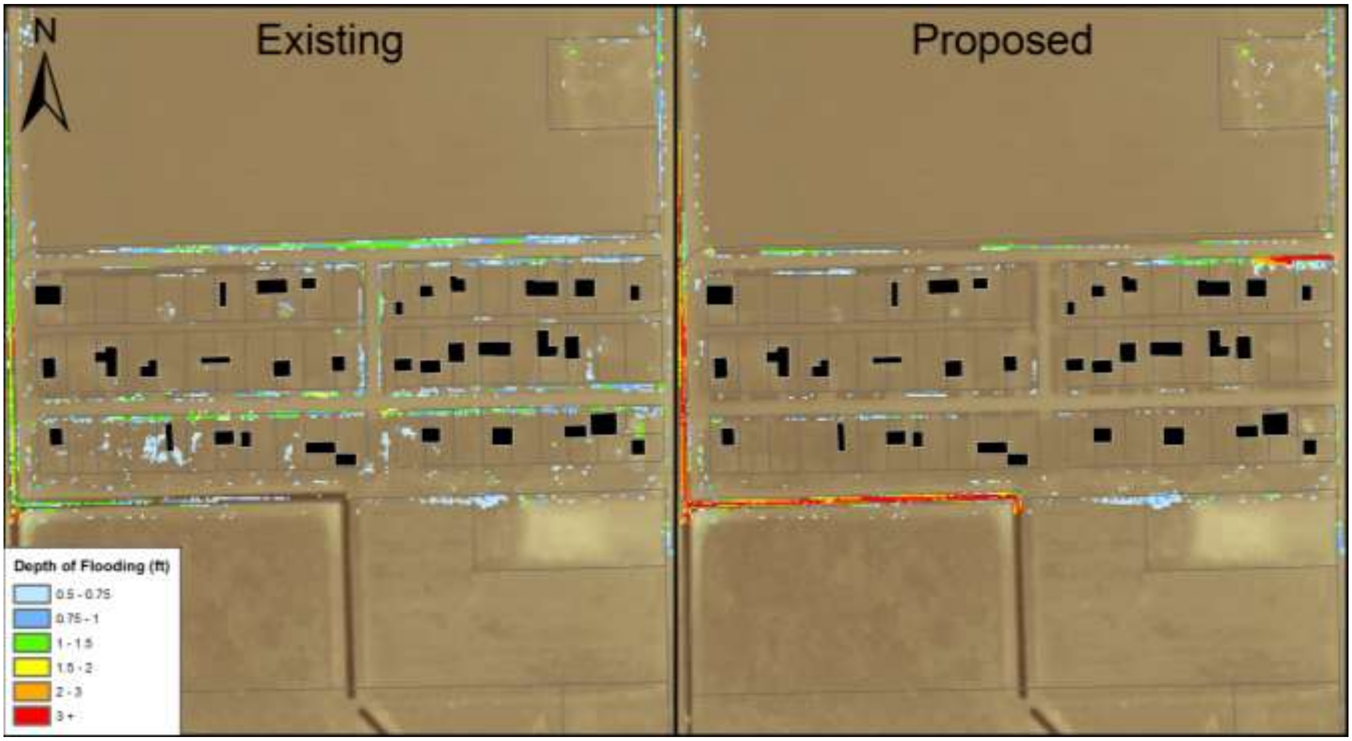


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	49	35	14
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

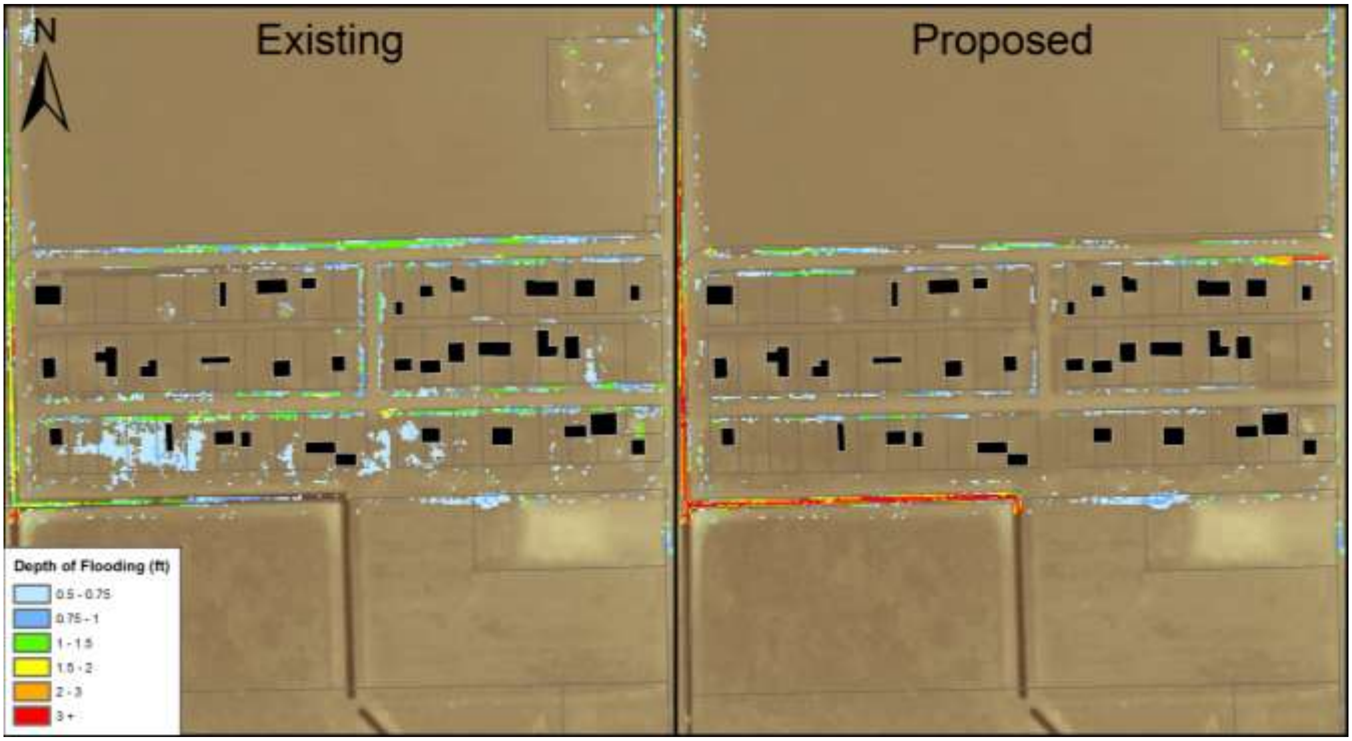


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	52	42	10
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

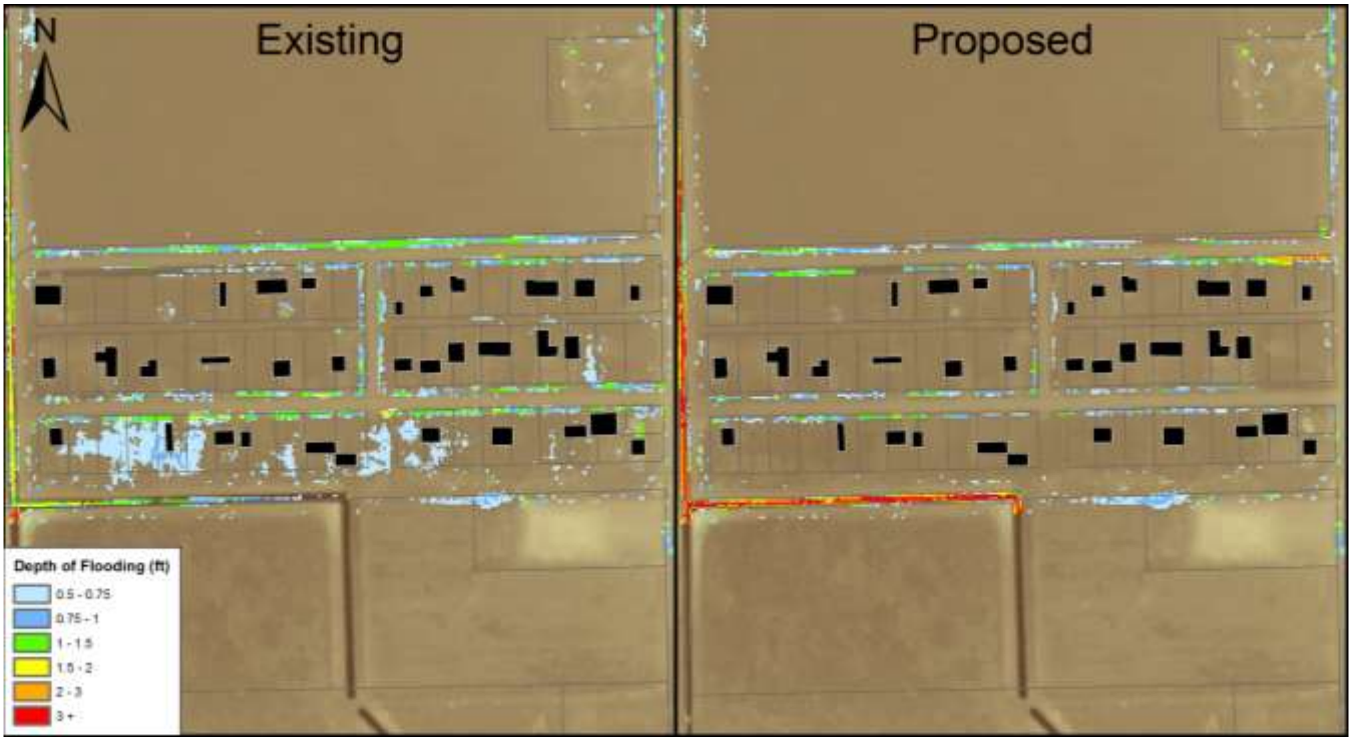


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	52	44	8
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

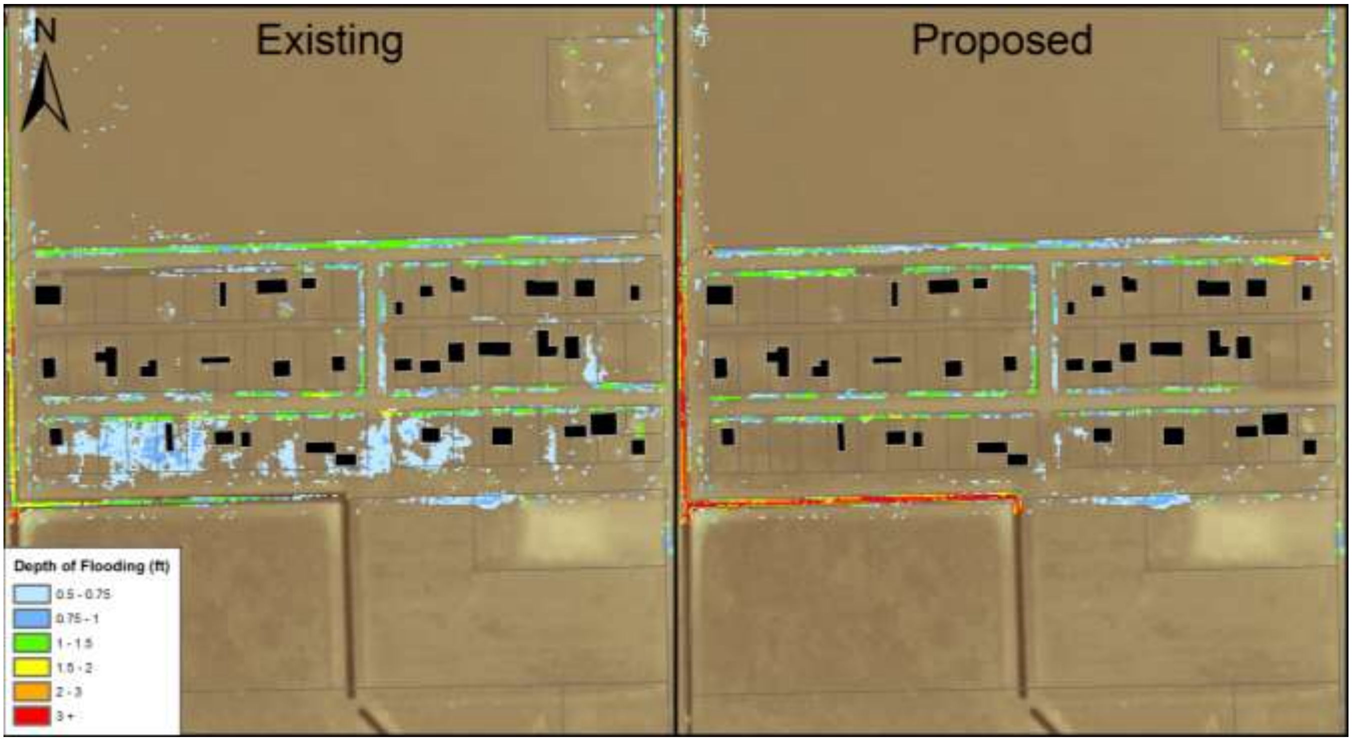


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	48	5
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Grande Acres, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

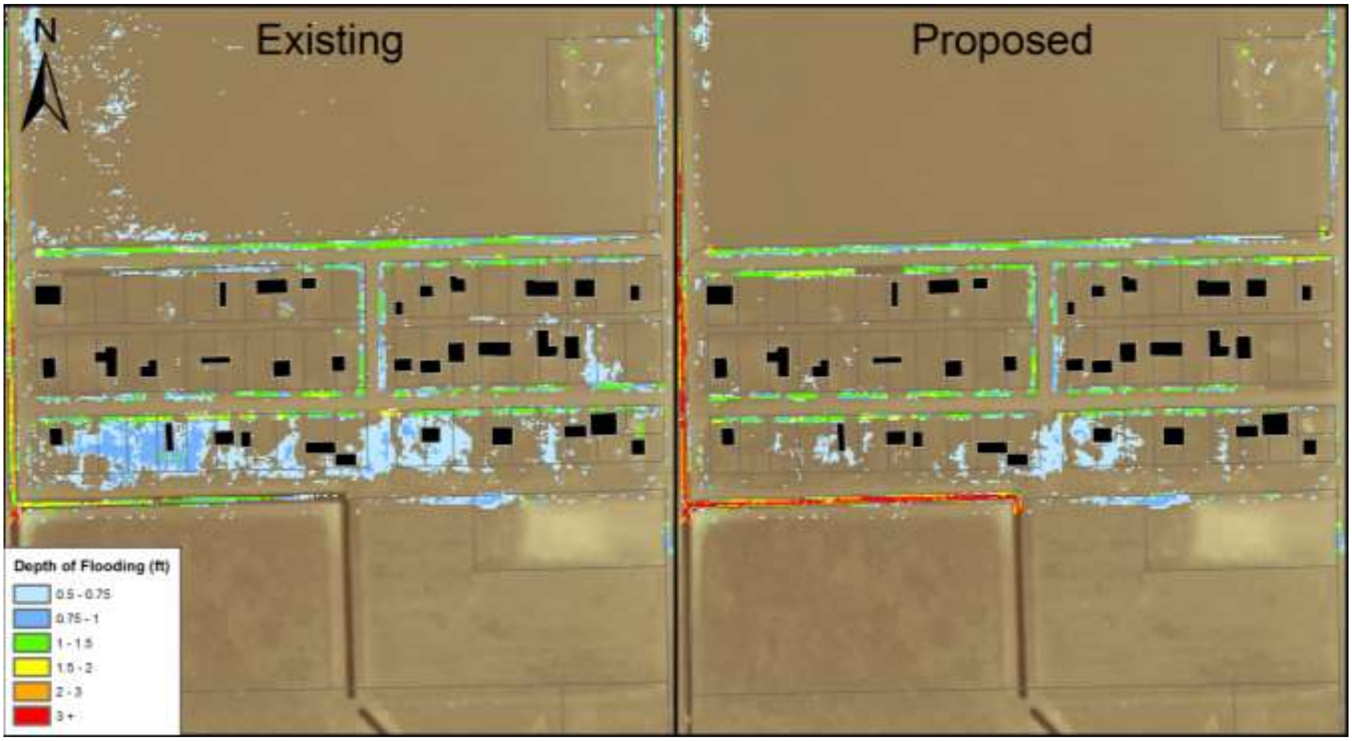


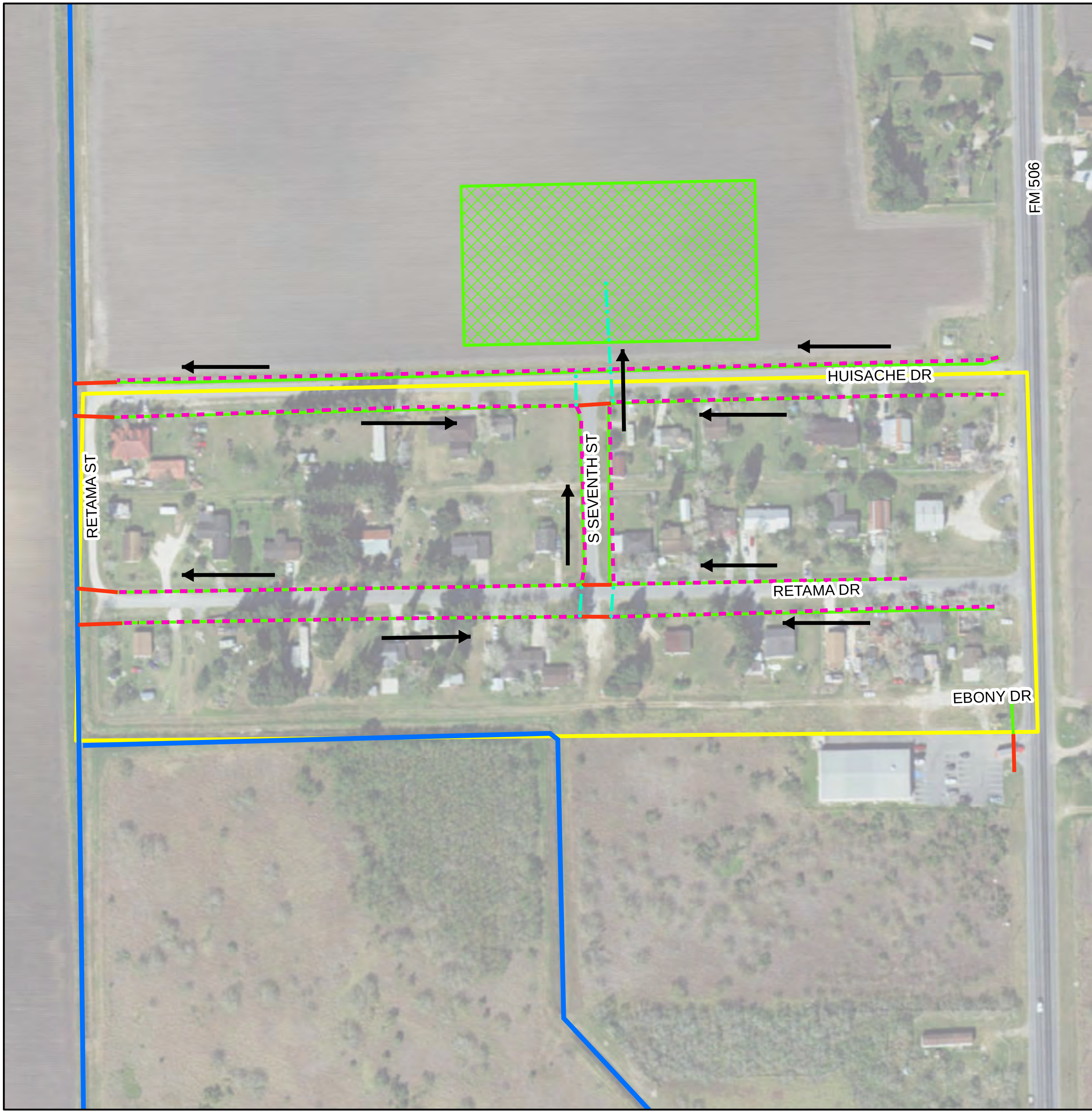
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	53	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Grande Acres
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Existing Drainage Ditches
- Proposed Retention Pond
- Existing Floodplain
- Grande Acres Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

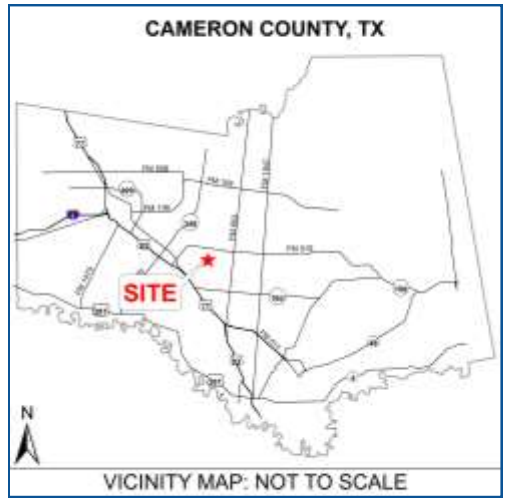
Colonia: Green Valley Farms, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

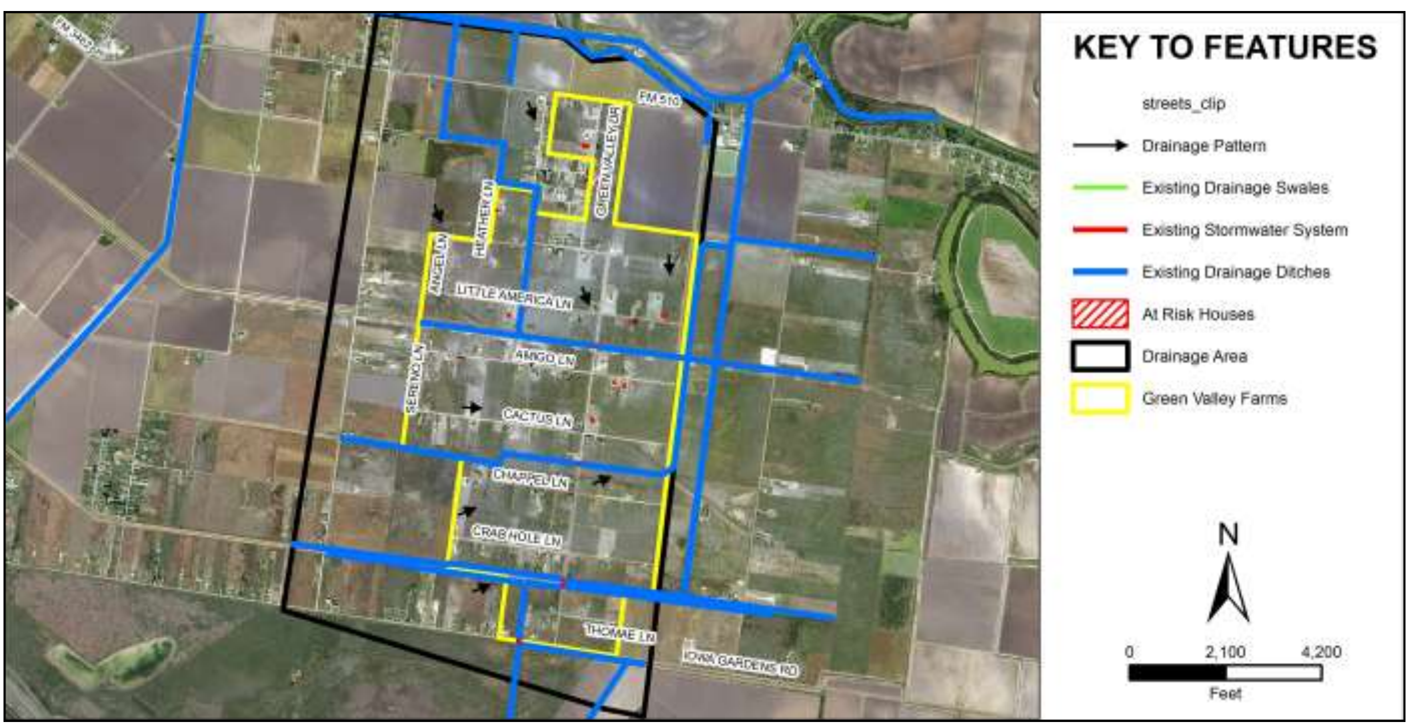
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Green Valley Farms colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 1,122-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system, roadside swales, and drainage ditches that are generally undersized and restricted by sediment and vegetation. The county has recently bought the land for a retention pond in this area after a study was conducted over the drainage in this site. Green Valley Farms experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Green Valley Farms, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install new underground drainage system with a retention ponds
    - Install roadside swales
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 75 linear feet of 18-inch diameter pipe, 260 linear feet of 24-inch diameter pipe, 260 linear feet of 36-inch diameter pipe, 200 linear feet of 48-inch diameter pipe, 215 linear feet of 60-inch diameter pipe, 10,200 linear feet of grassy swale, 6,910 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention ponds are sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 1,559 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention ponds, the colonia's extreme location in the floodplain, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Green Valley Farms

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	8,627.78
2	**DRAINAGE IMPROVEMENTS**	$	150,677.00
3	**POND EXCAVATION IMPROVEMENTS**	$	39,821,100.00
	Sub-Total =	$	39,980,404.78
	Engineering (10%)	$	3,998,040.48
	Contingency (20%)	$	7,996,080.96
	Total =	$	51,974,526.21

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention ponds is approximately 172.8 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Green Valley Farms, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	3	2	1
10% (10-year)	5	3	2
4% (25-year)	6	3	3
1% (100-year)	10	8	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,425,829	$51,986,870	0.03
Elevate Structures	$1,425,829	$979,425	1.46
Acquisition/Supplemental Housing/Demolition	$3,051,808	$1,301,737	2.34

Colonia: Green Valley Farms, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

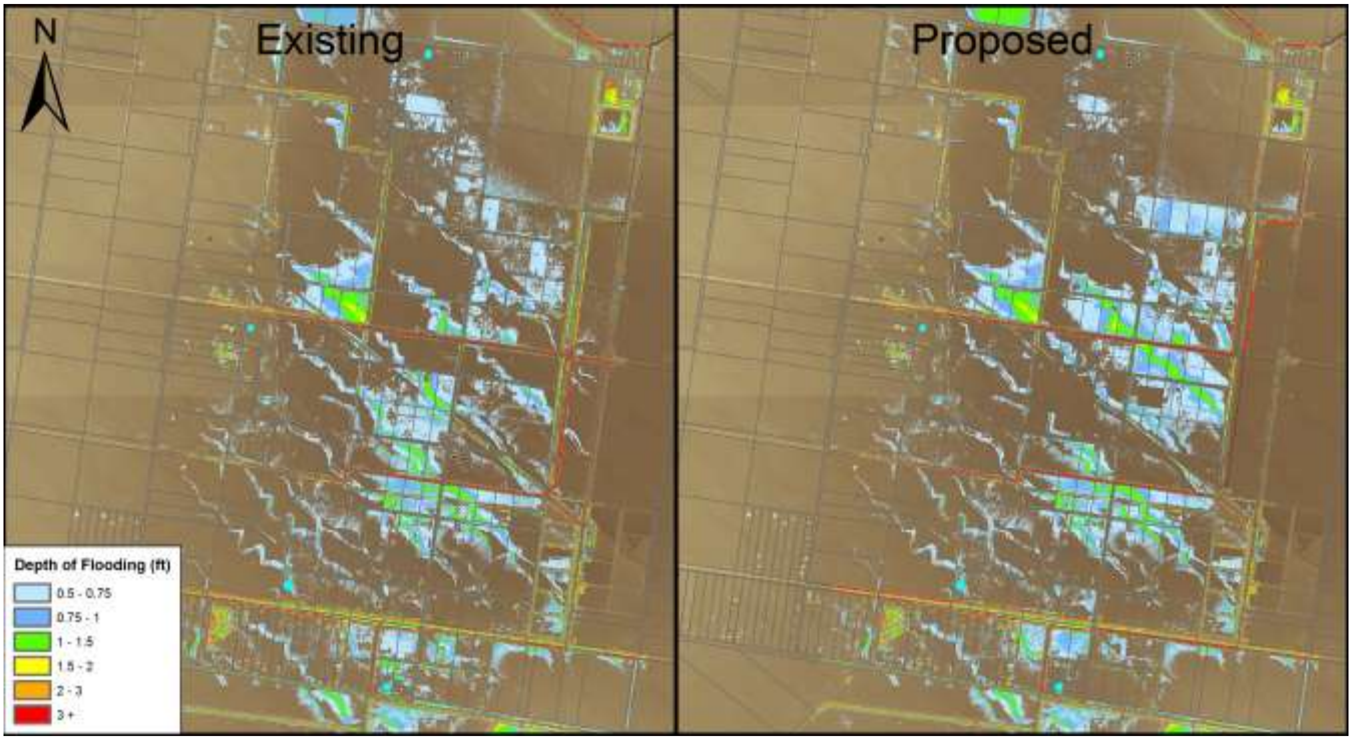


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	239	239	0
Inundated Roadway (LF)	1030	1030	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Green Valley Farms, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

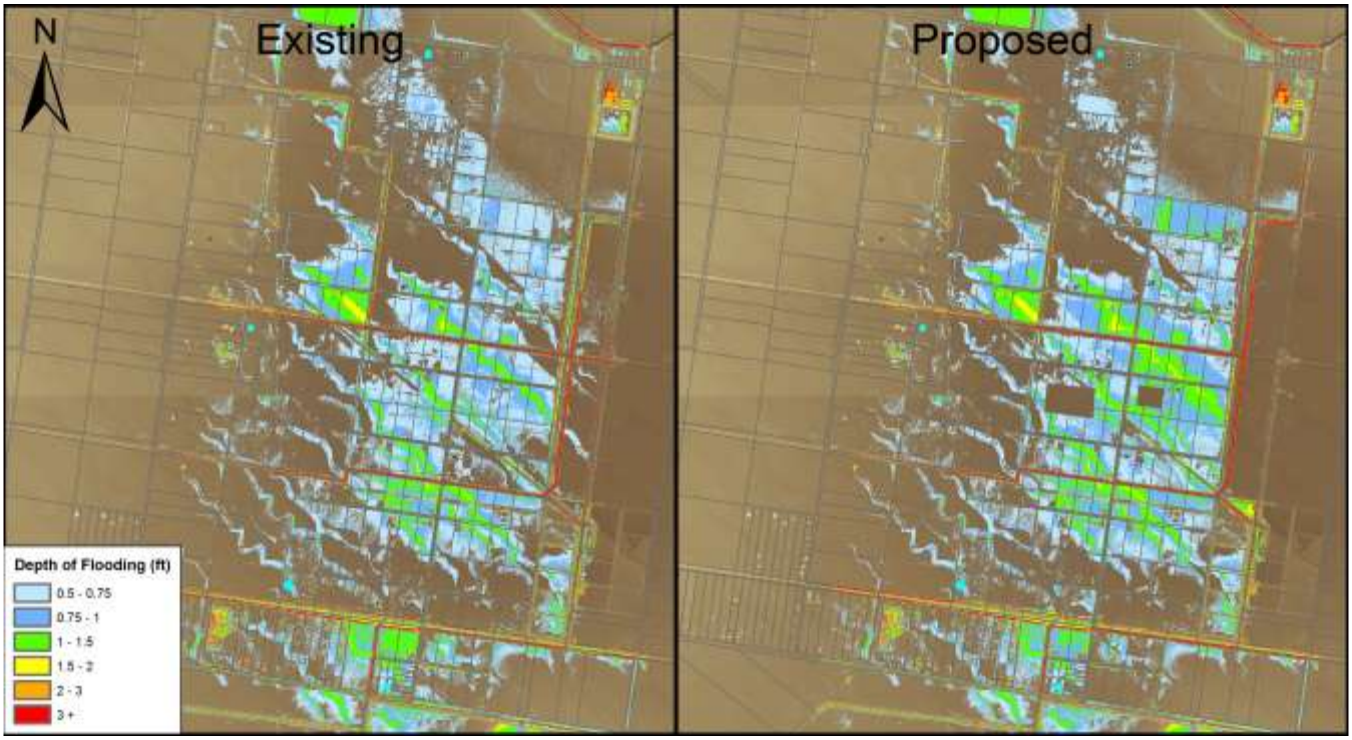


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	2	1
Inundated Lots	241	241	0
Inundated Roadway (LF)	1630	1630	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Green Valley Farms, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

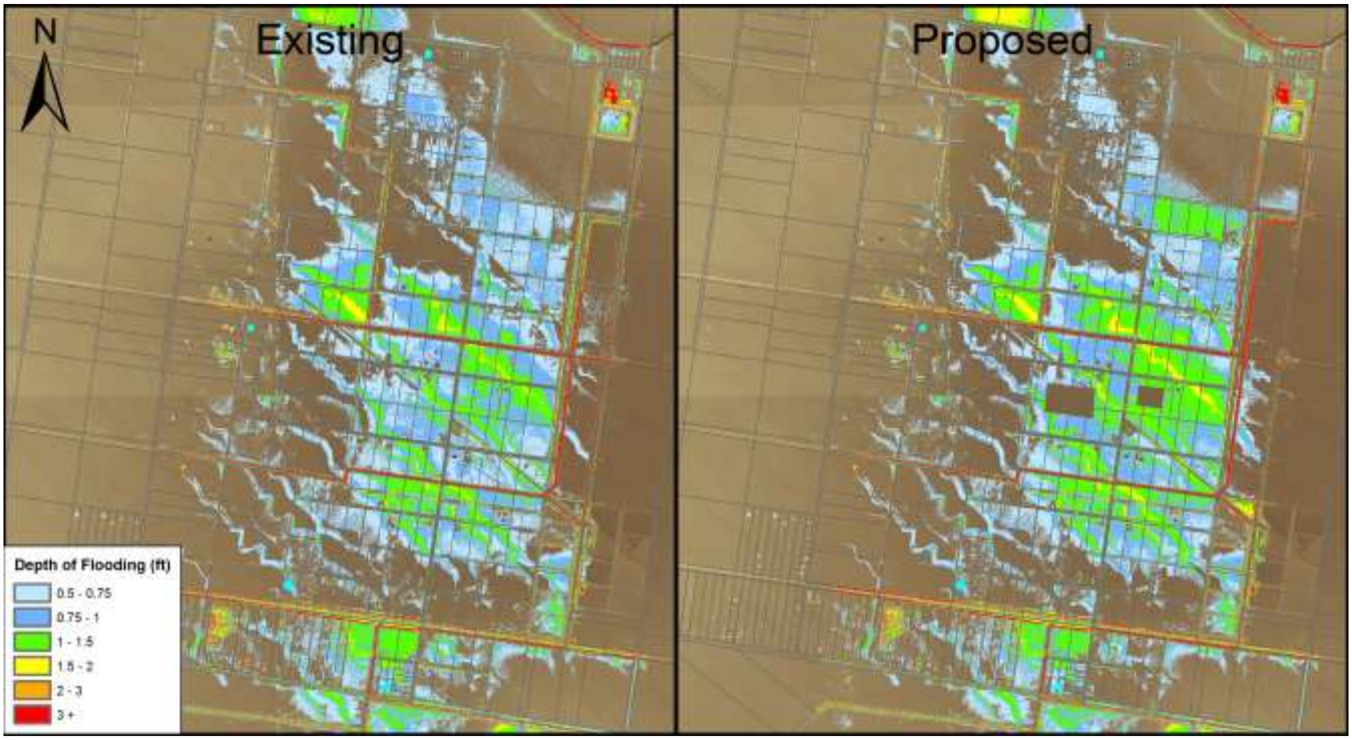


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	3	2
Inundated Lots	241	241	0
Inundated Roadway (LF)	2080	2080	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Green Valley Farms, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

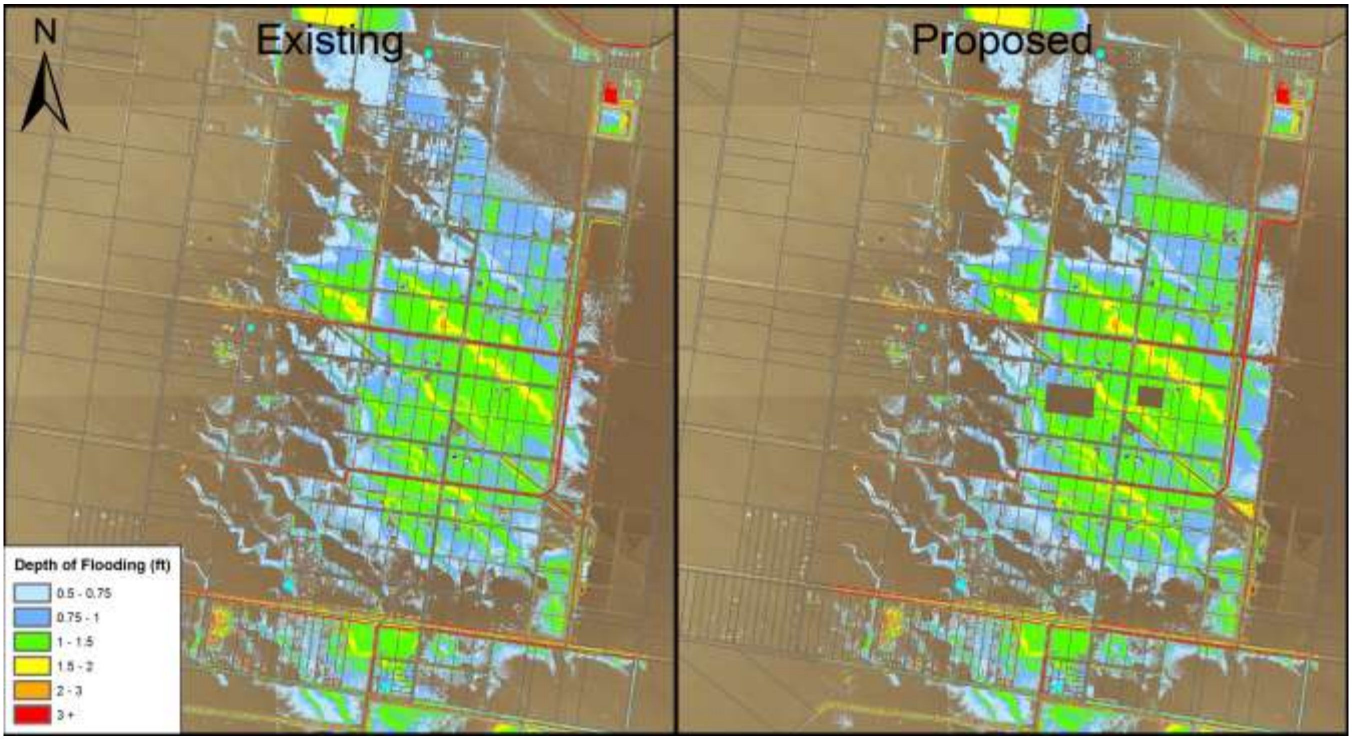


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	3	3
Inundated Lots	241	241	0
Inundated Roadway (LF)	3550	3550	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figures:

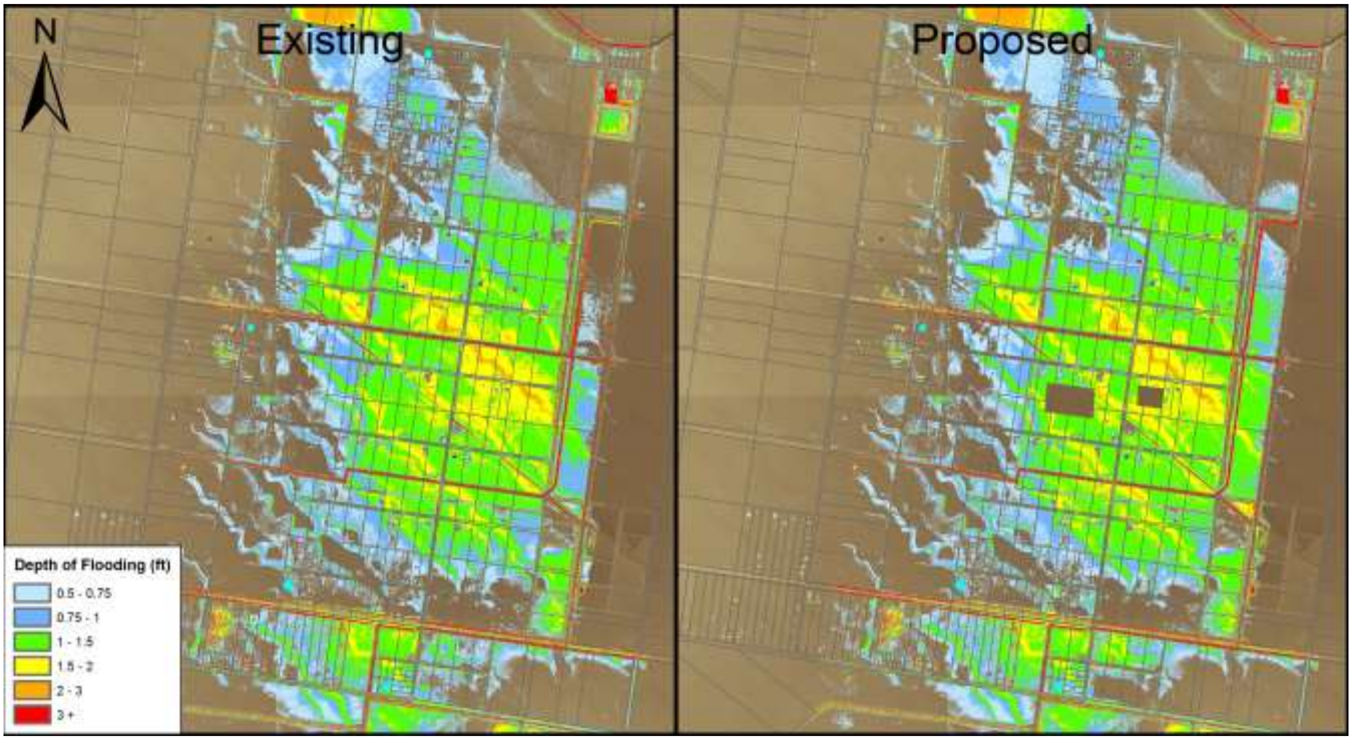


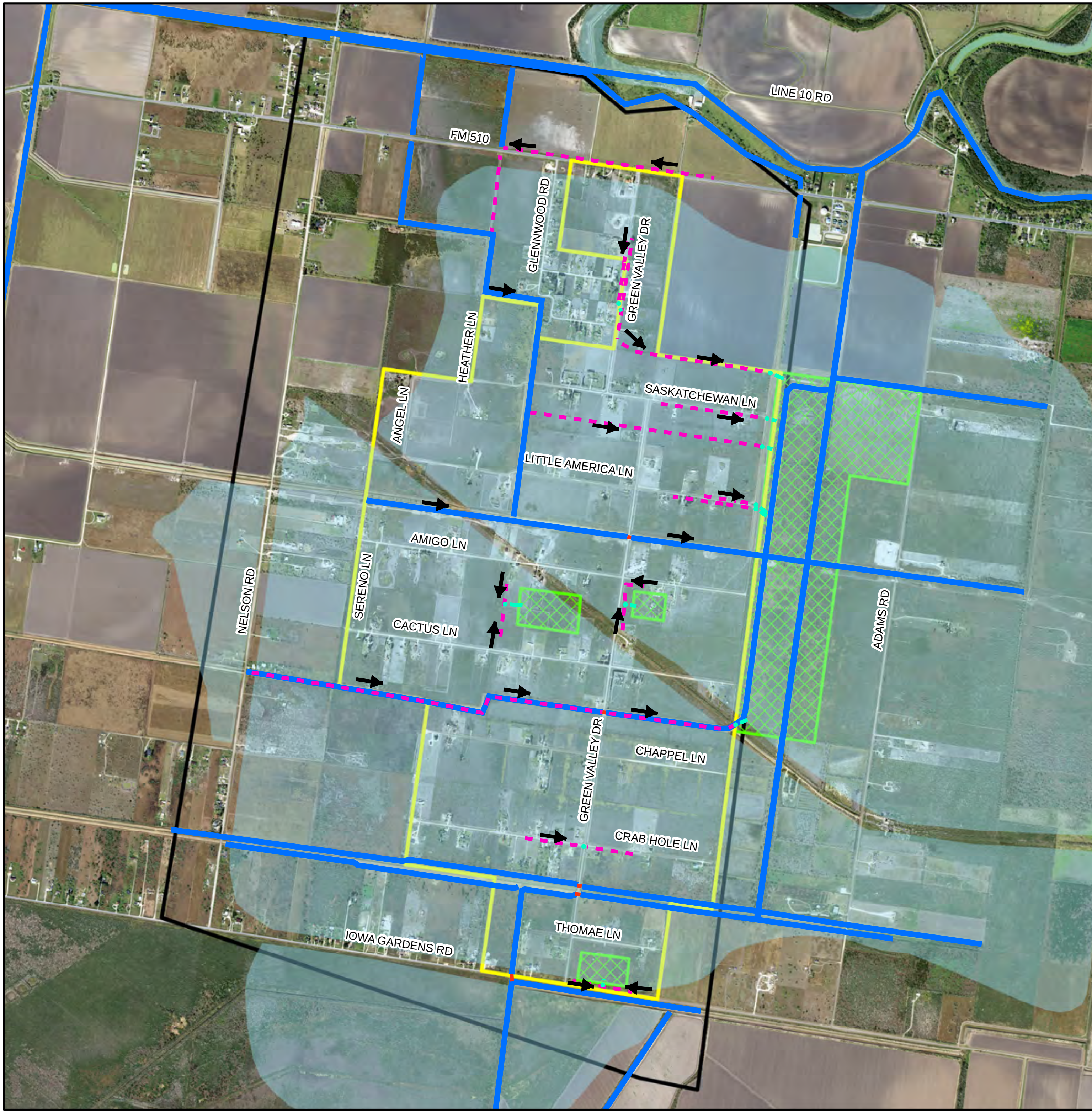
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	10	8	2
Inundated Lots	241	241	0
Inundated Roadway (LF)	7240	7240	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Green Valley Farms
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Green ValleyFarms
- Proposed Retention Pond
- Drainage Area

N

0 500 1,000 2,000
Feet

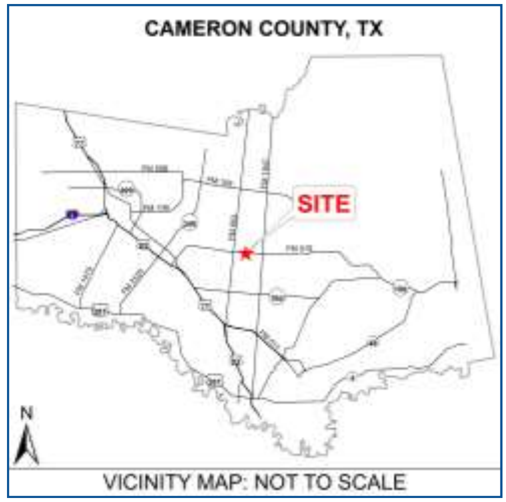
STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Colonia: La Coma, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the La Coma colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 27-acre colonia are generally to the east. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. La Coma experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: La Coma, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
    - Improve and/or install adequately sized driveway culverts
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements to the roadside drainage system with a retention facility. The improvements include 90 linear feet of 18-inch diameter pipe, 405 linear feet of 24-inch diameter pipe, 100 linear feet of 30-inch diameter pipe, 390 linear feet of 36-inch diameter pipe, 2200 liner feet of grassy swale, 2770 linear feet of roadside swale grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 28.3 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST La Coma Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	23,833.33
2	**DRAINAGE IMPROVEMENTS**	$	70,961.11
3	**POND EXCAVATION IMPROVEMENTS**	$	739,310.00
	Sub-Total =	**$**	**834,104.44**
	Engineering (10%)	$	83,410.44
	Contingency (20%)	$	166,820.89
	Total =	**$**	**1,084,335.78**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	2	1	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$324,553	$1,084,356	0.30
Elevate Structures	$324,553	$302,475	1.07
Acquisition/Supplemental Housing/Demolition	$724,186	$229,813	3.15

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

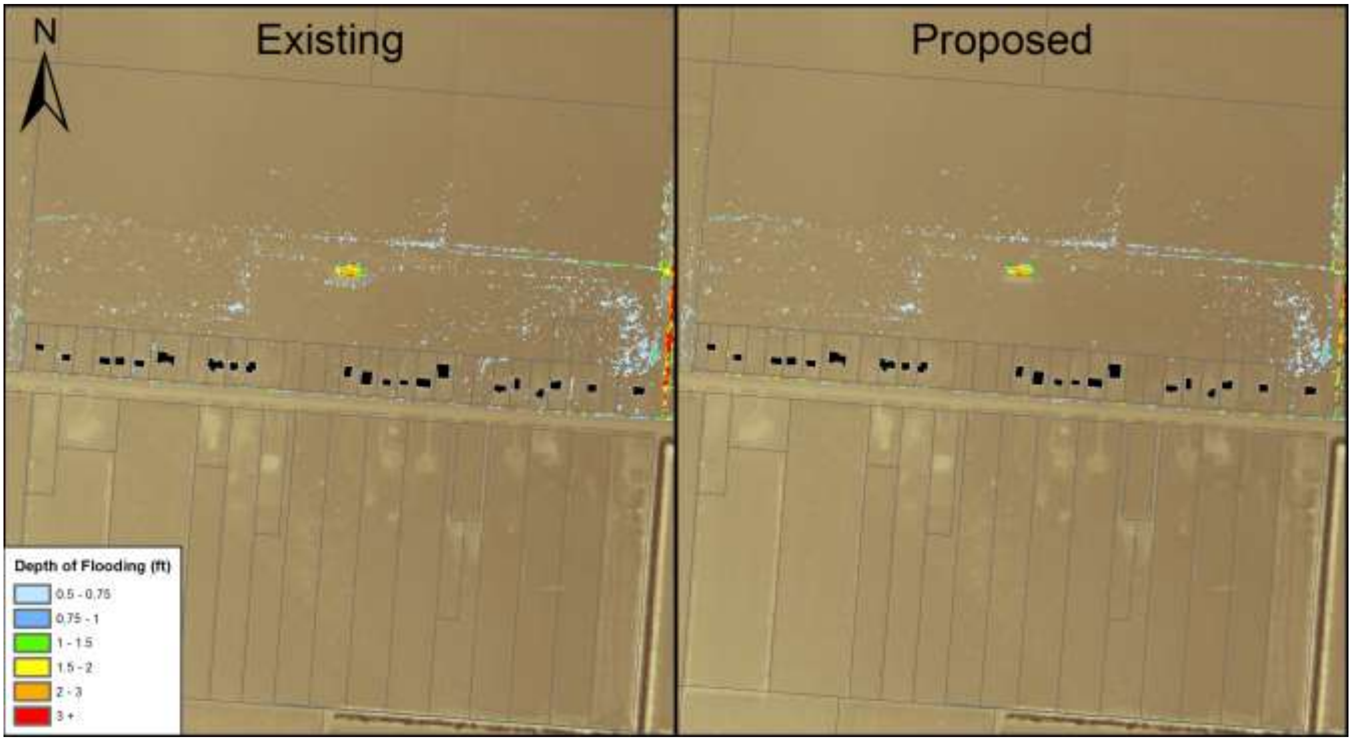


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	27	16	11
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

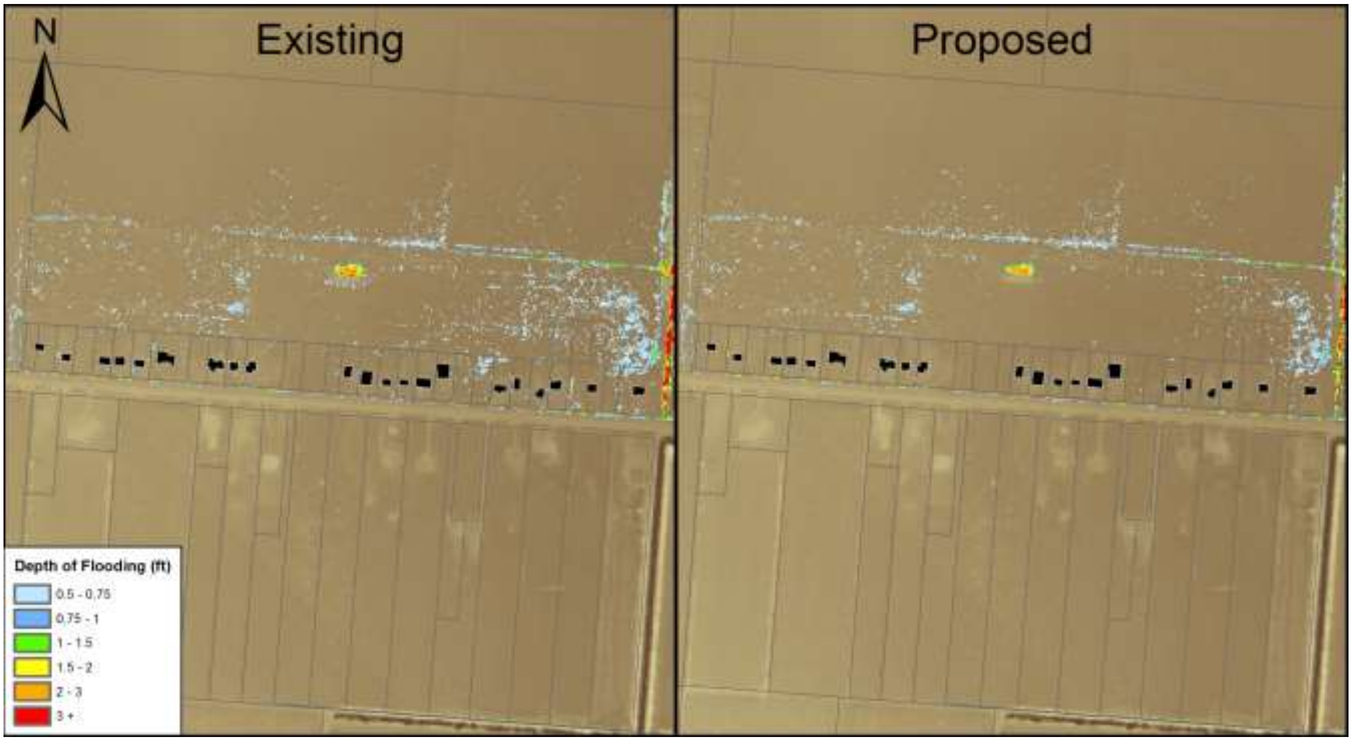


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	27	18	9
Inundated Roadway (LF)	10	5	5

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

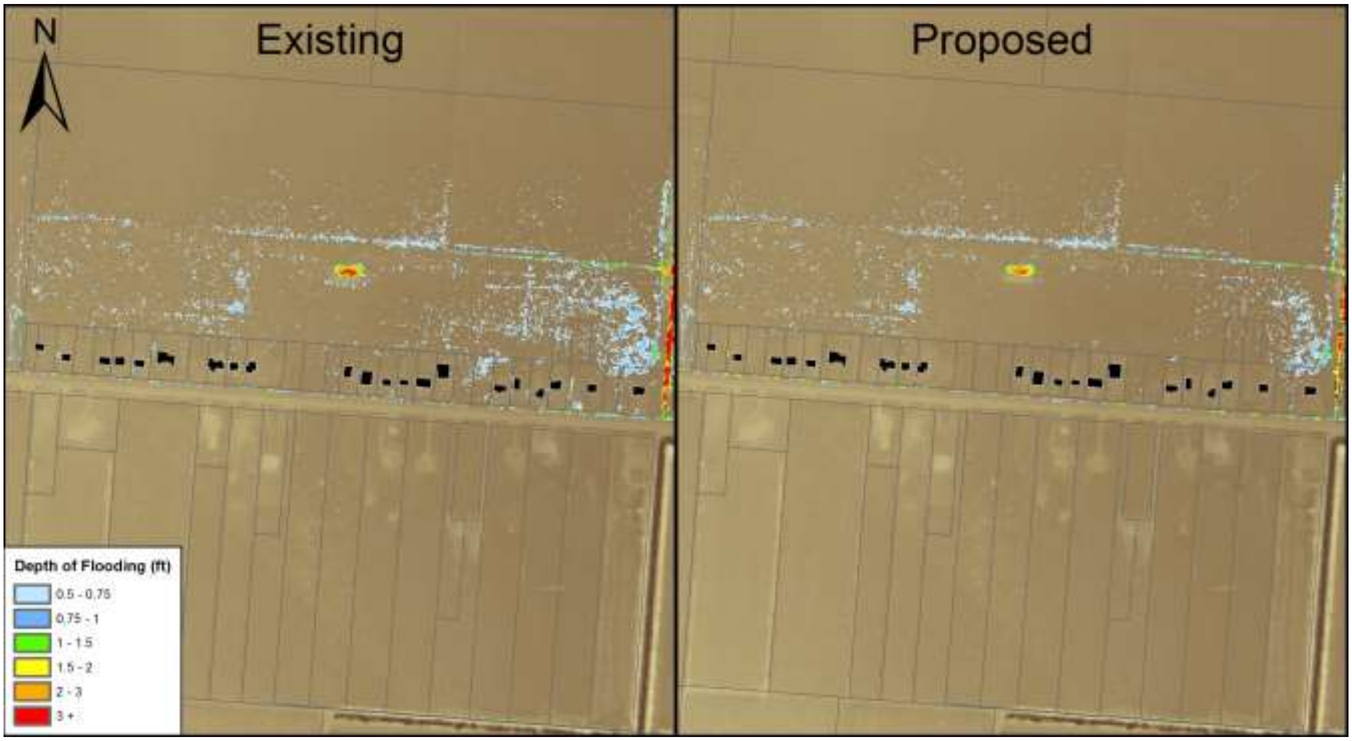


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	27	19	8
Inundated Roadway (LF)	30	5	25

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

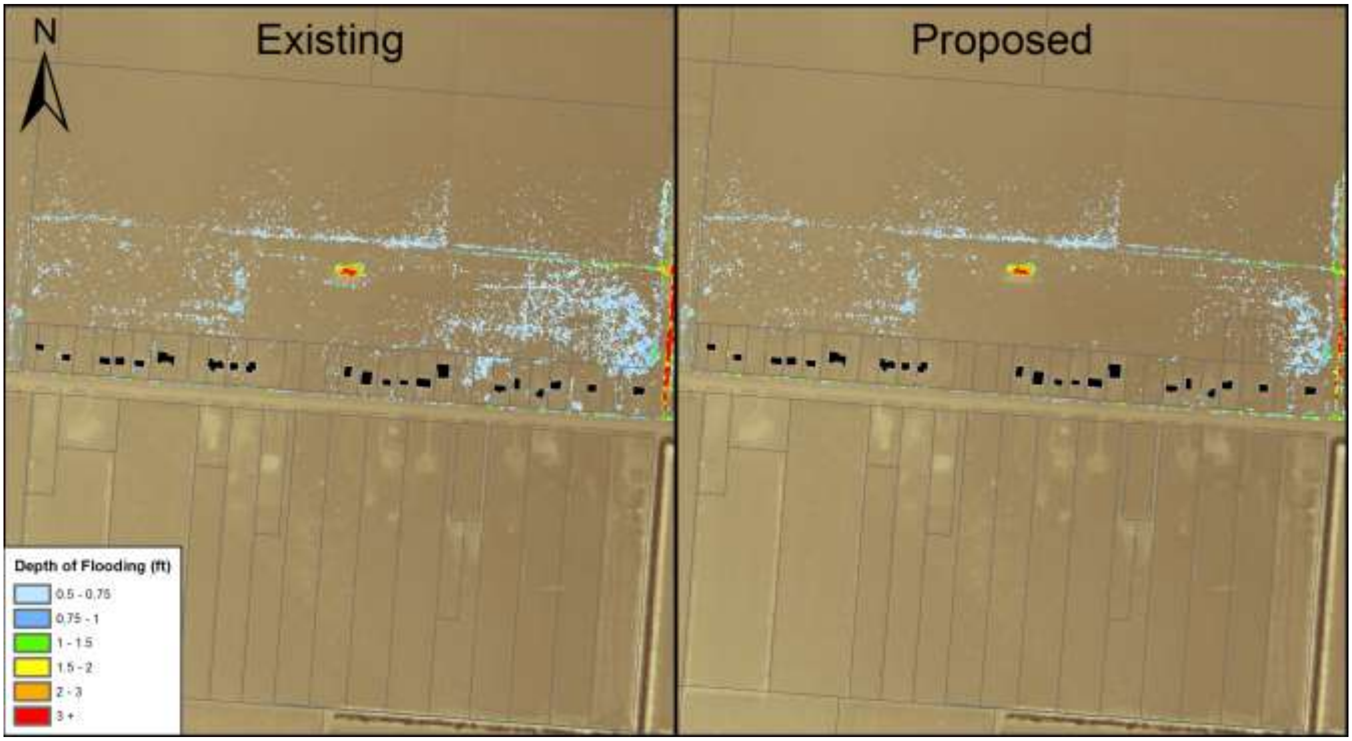


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	27	22	5
Inundated Roadway (LF)	90	5	85

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Coma, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

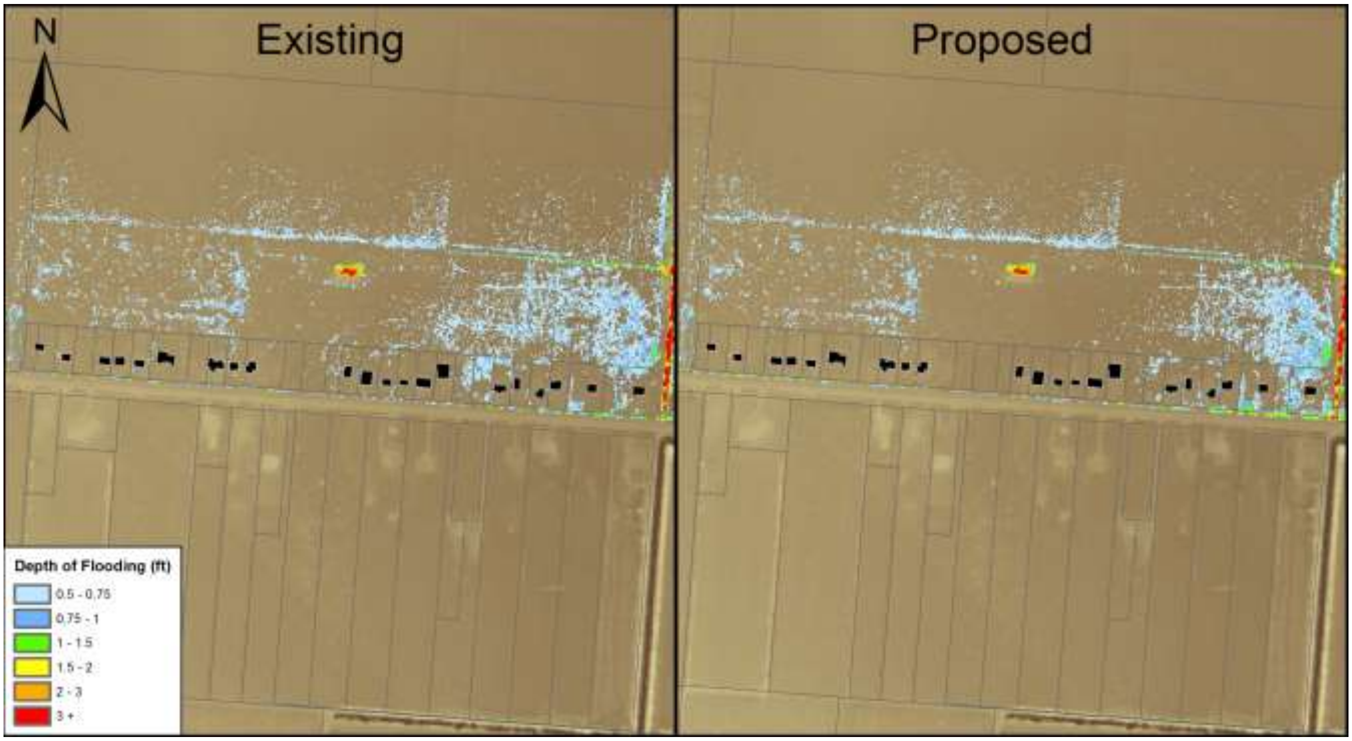


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	1	1
Inundated Lots	27	24	3
Inundated Roadway (LF)	270	5	265

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

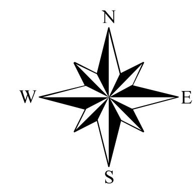
Colonia: La Coma
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Retention Pond
- La Coma Colonia
- Existing Floodplain



0 175 350 700
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

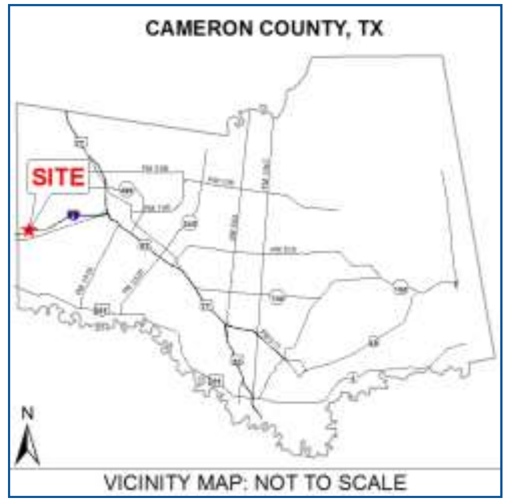
"Filling the Gap"

Colonia: La Feria Gardens, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the La Feria Gardens colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Ri sk:

Drainage patterns within this 20-acre colonia are generally from the higher ground on the western half of the colonia to the lower eastern half. While the colonia currently consists entirely of mobile homes elevated above 100-year flood depths, the colonia does not have an existing drainage system and experiences residential lot and street flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: La Feria Gardens, Cameron County

"Filling the Gap"

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install an underground drainage system with a retention pond to eliminate off-site impacts
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes an underground drainage system with a retention facility. The improvements include 1,670 linear feet of 18-inch diameter pipe, 200 linear feet of 24-inch diameter pipe, 220 feet of 30-inch diameter pipe, 560 feet of 36-inch diameter pipe, pavement and curb/gutter for 4,200 linear feet of roadway, 16 curb inlets, and four 60-inch manholes. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 10 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
La Feria Gardens Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	**864,441.00**
2	**DRAINAGE IMPROVEMENTS**	$	**186,820.00**
3	**POND EXCAVATION IMPROVEMENTS**	$	**269,830.00**
	Sub-Total =	**$**	**1,321,091.00**
	Engineering (10%)	$	132,109.10
	Contingency (20%)	$	264,218.20
	Total =	**$**	**1,717,418.30**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Since flooding within this colonia is limited to streets and properties with no inundation of structures, a benefit-cost ratio is not able to be computed.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$1,717,418	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing/Demolition	$0	N/A	N/A

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	52	0	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	59	0	59
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	67	0	67
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

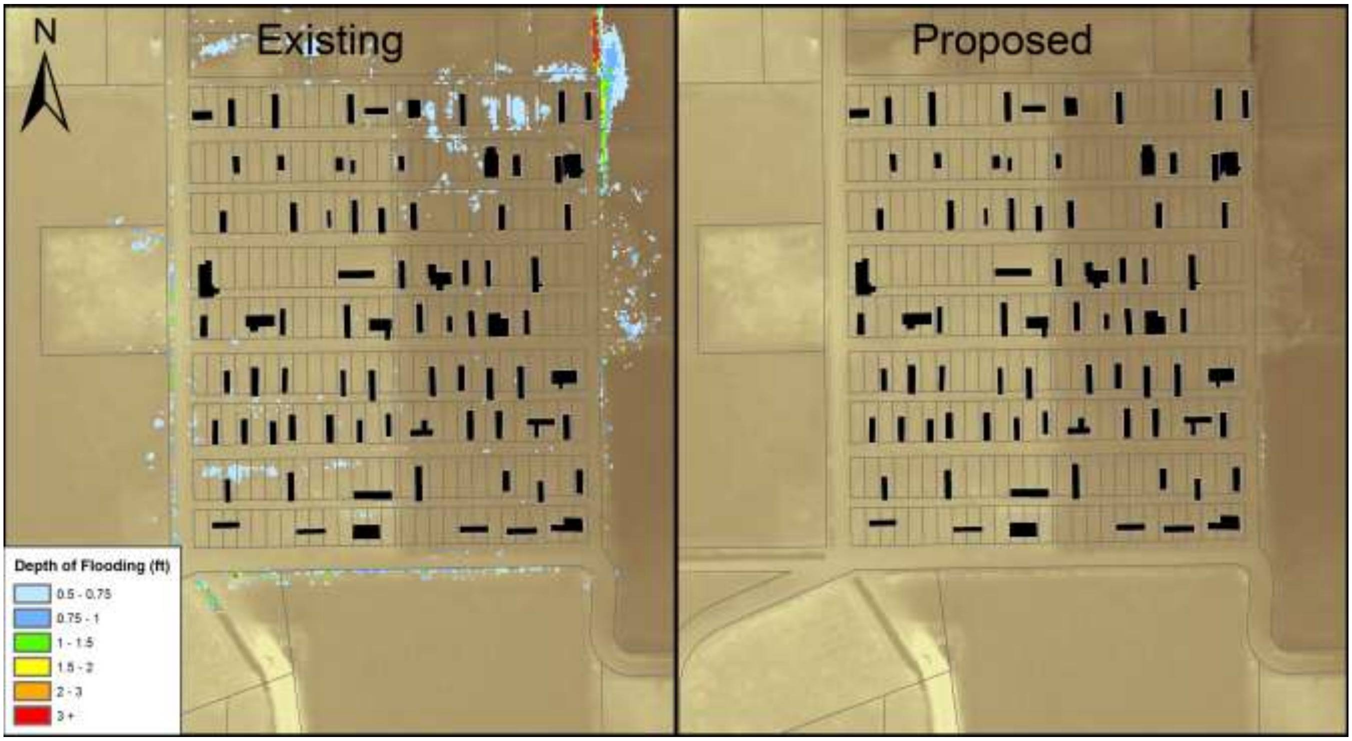


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	71	0	71
Inundated Roadway (LF)	30	0	30

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: La Feria Gardens, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

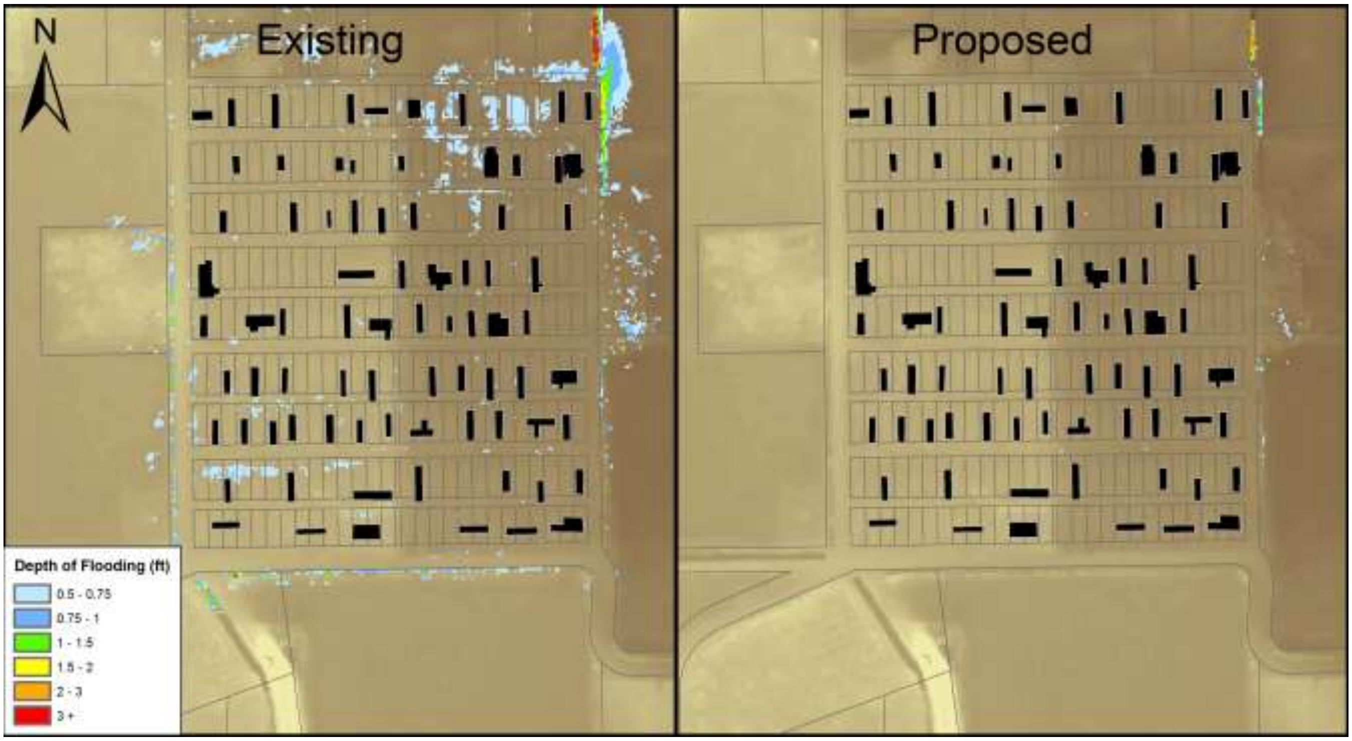


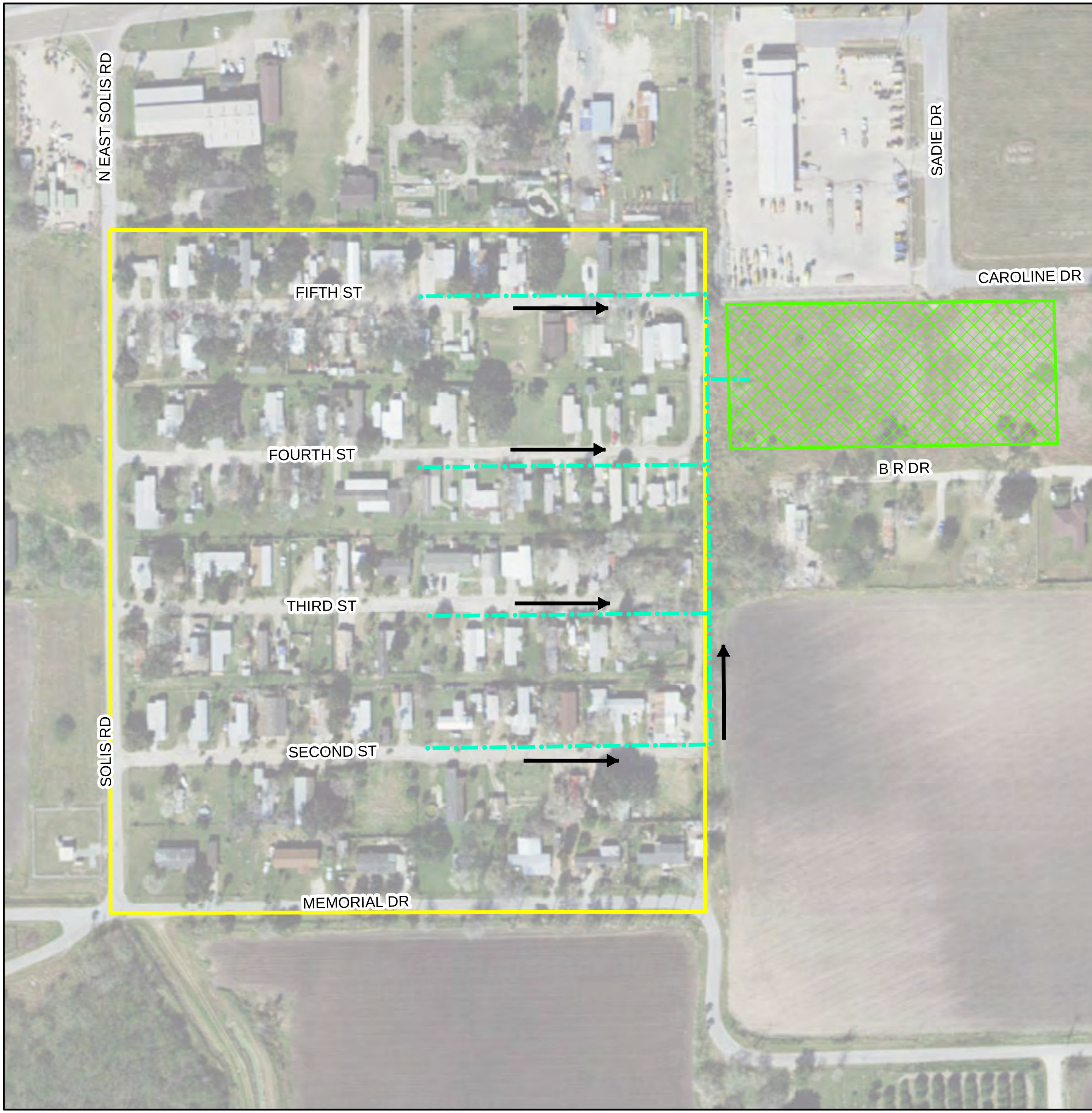
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	93	2	91
Inundated Roadway (LF)	70	0	70

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: La Feria Gardens
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Retention Pond
- La Feria Gardens Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

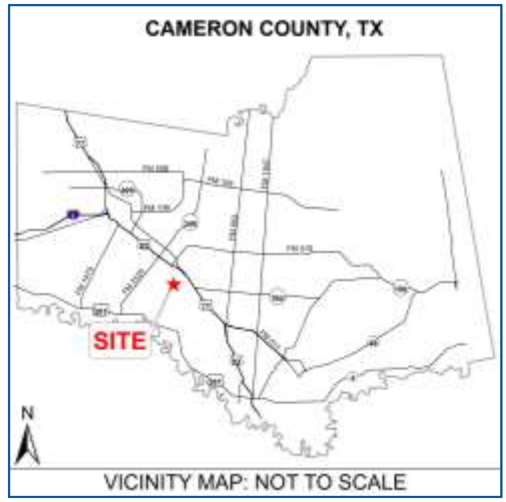
"Filling the Gap"

Colonia: Lago, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Lago colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 35-acre colonia are generally towards the west of the colonia, where there is an existing pond. The pond is about 5 acres, highly vegetated, and is in the FEMA Zone A 100-year floodplain. The colonia has an existing roadside drainage system. Due to inadequate conveyance of stormwater, Lago experiences residential lot and street flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Lago, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with an upgrade to the existing pond to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes upgrading and installing a new roadside drainage system and an upgraded retention facility within the existing pond. The improvements include 375 linear feet of 18-inch diameter pipe, 245 linear feet of 24-inch diameter pipe, 415 linear feet of 36-inch diameter pipe, 6,000 linear feet of grassy swale, 4,100 linear feet of roadside ditch excavation and grading, and associated pavement improvements. The existing pond within the colonia will be retrofitted to increase the storage capacity. The proposed retention pond upgrade is sized to retain on-site runoff up to the 25-year storm with an increased storage area capacity of 18.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond upgrade, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Lago Colonia

	IMPROVEMENTS		COST
1	PAVING IMPROVEMENTS	$	34,833.33
2	DRAINAGE IMPROVEMENTS	$	124,769.44
3	POND EXCAVATION IMPROVEMENTS	$	497,164.80
	Sub-Total =	$	656,767.58
	Engineering (10%)	$	65,676.76
	Contingency (20%)	$	131,353.52
	Total =	$	853,797.85

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4.6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	1	0	1
4% (25-year)	3	0	3
1% (100-year)	4	0	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$595,700	$853,798	0.70
Elevate Structures	$595,700	$451,350	1.32
Acquisition/Supplemental Housing/Demolition	$205,485	$389,916	0.53

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

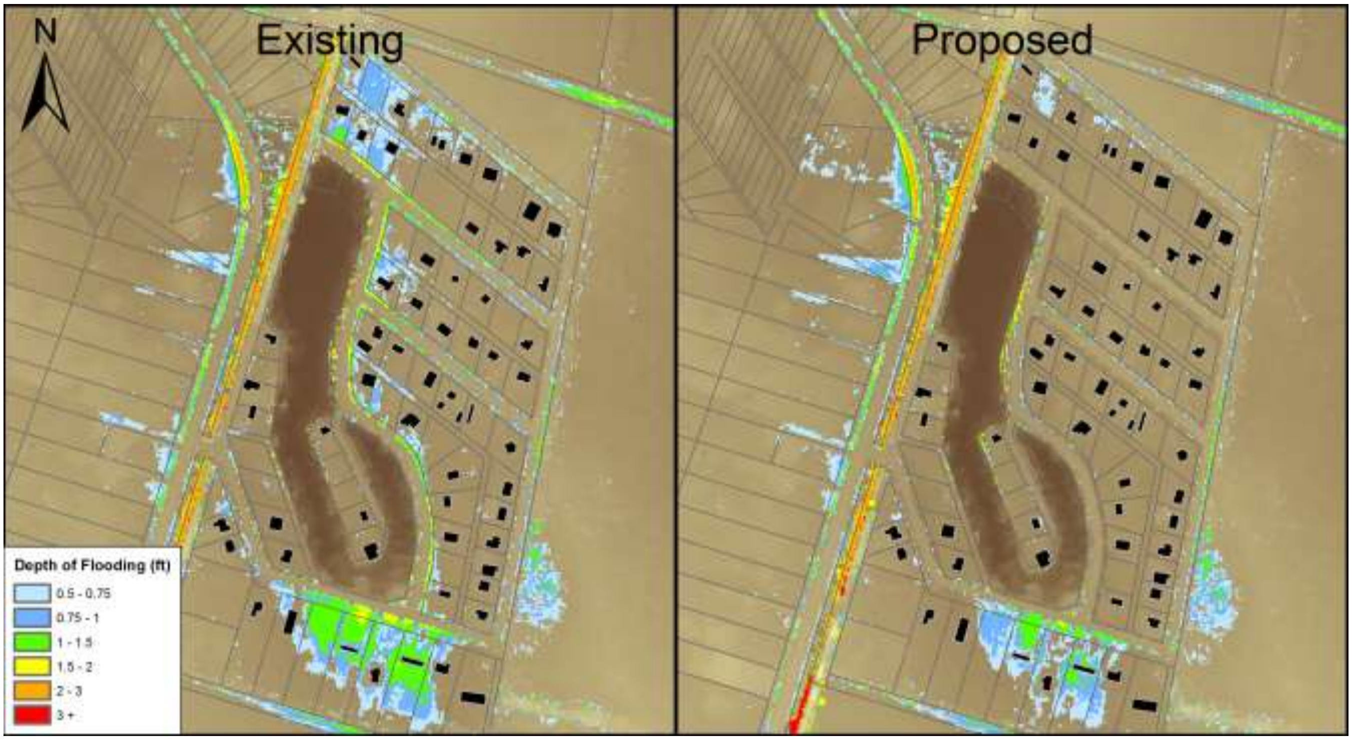


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	74	57	17
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

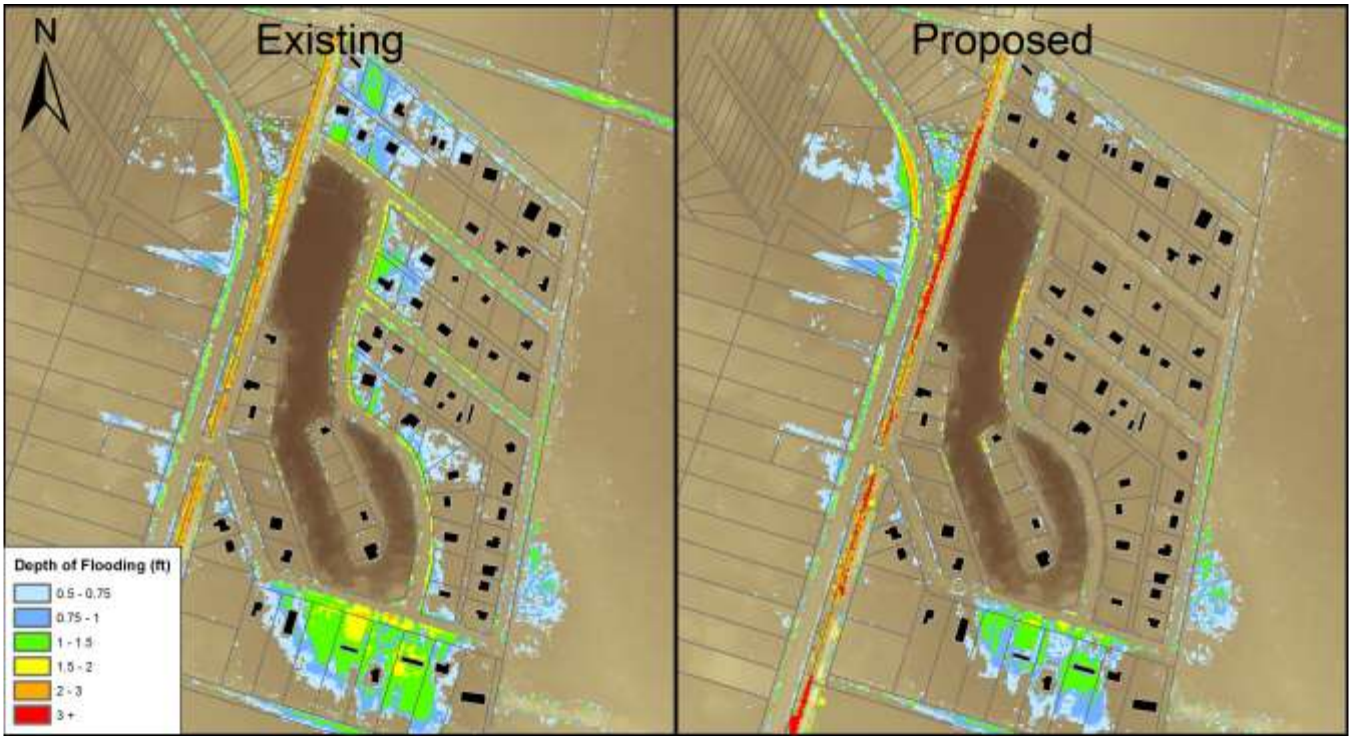


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	77	63	14
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

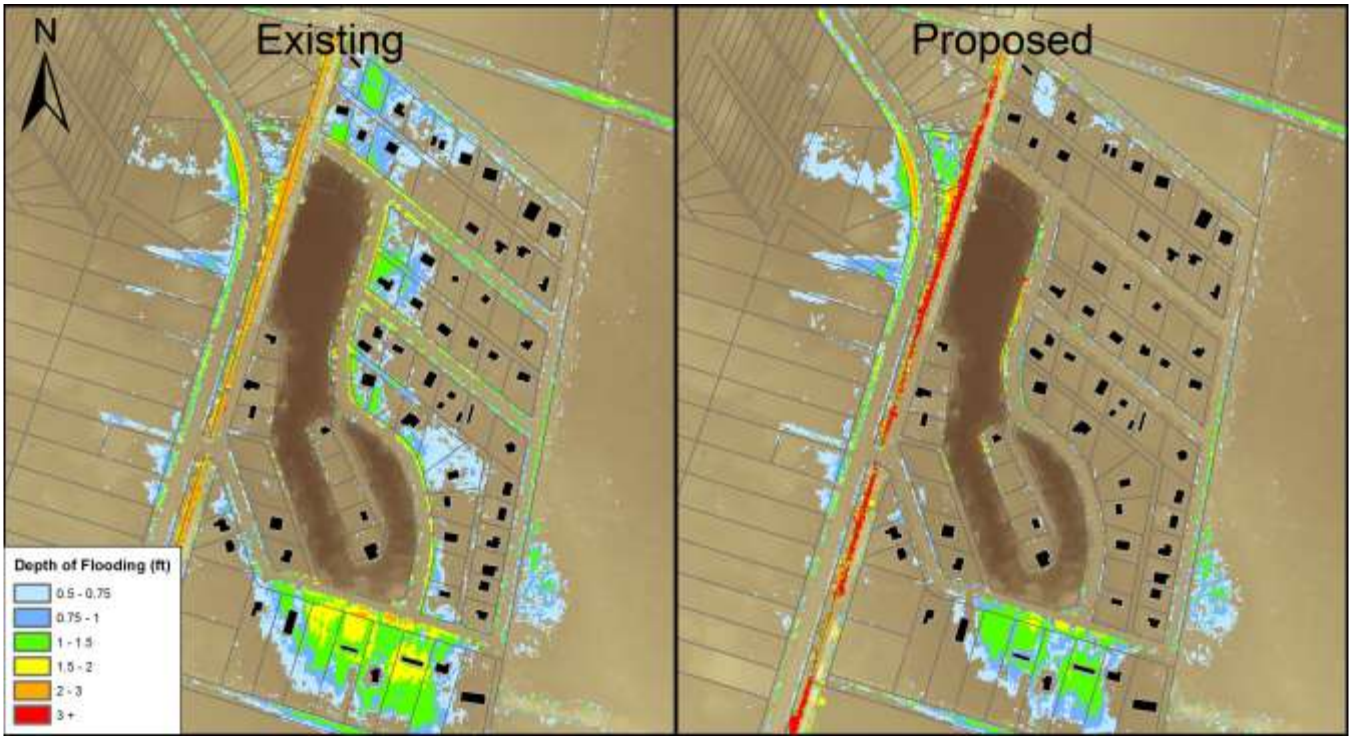


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	77	65	12
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

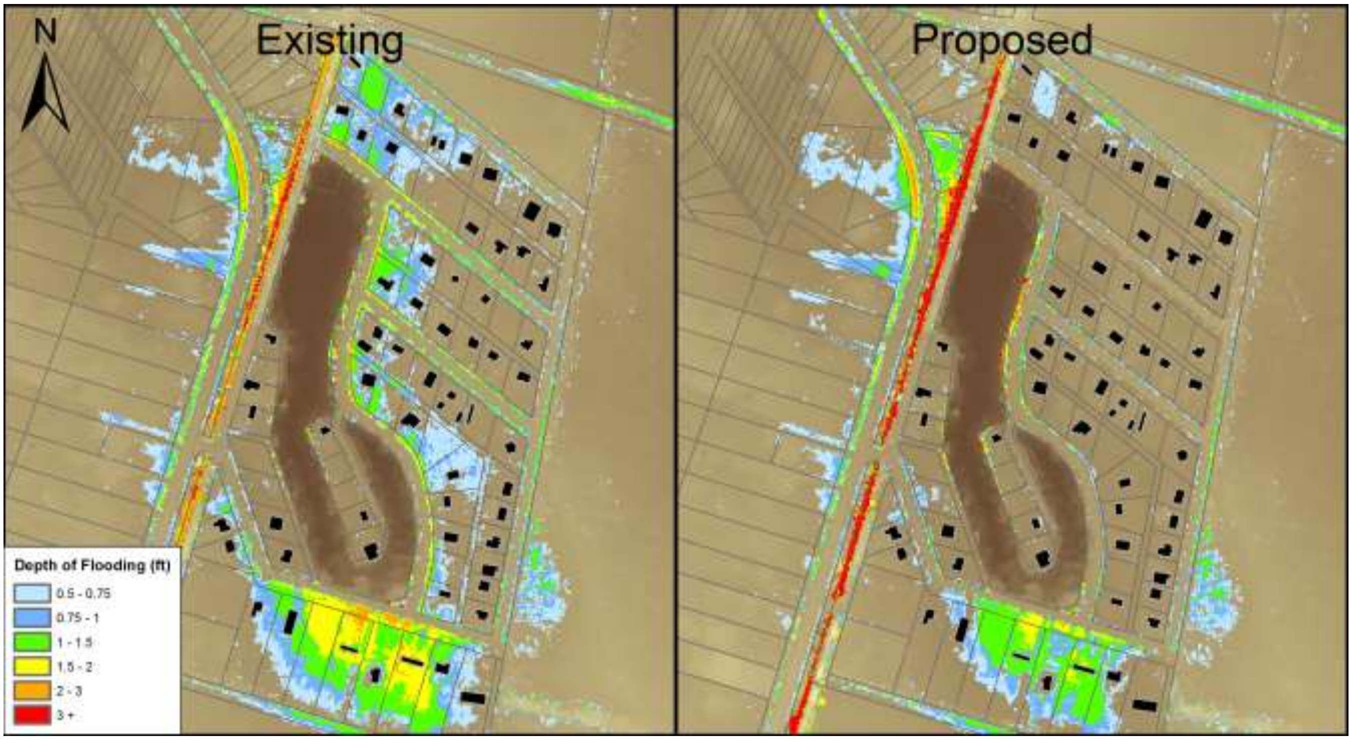


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	78	67	11
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lago, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

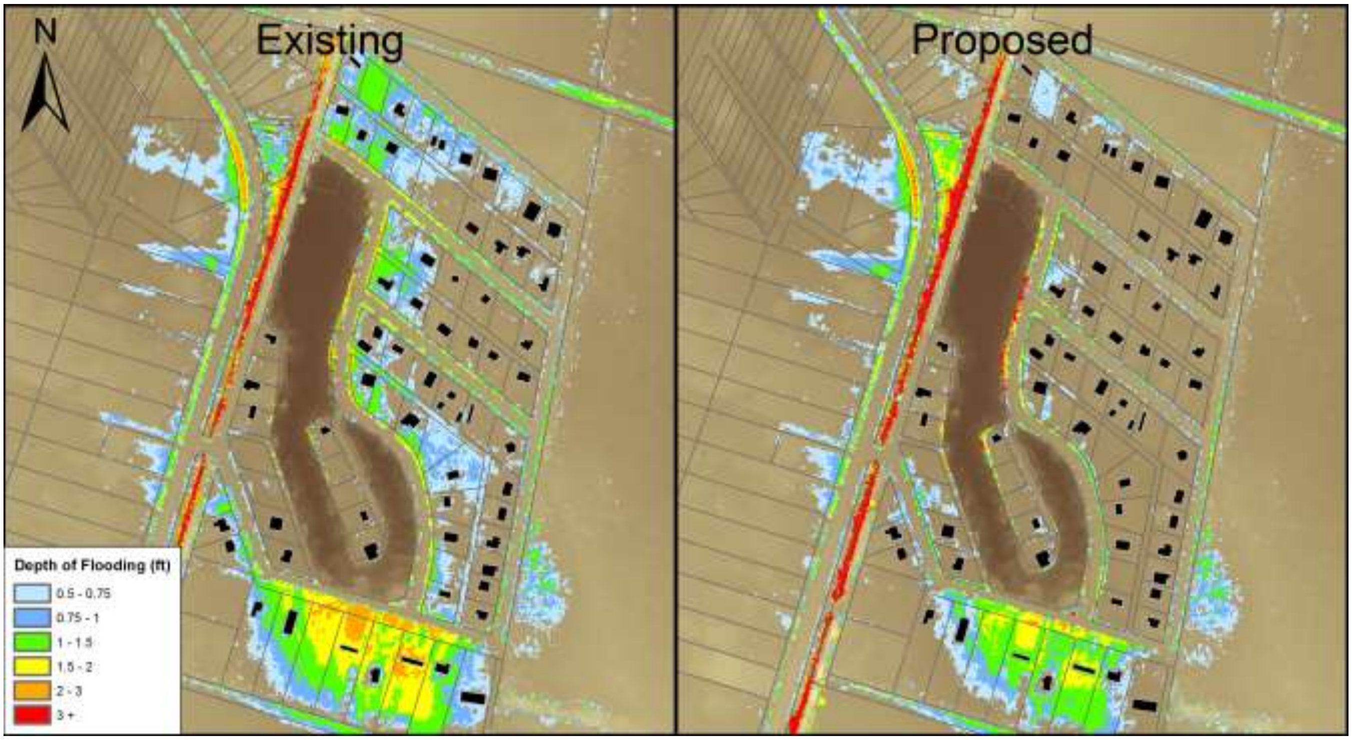


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	79	70	9
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Lago
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Existing Drainage Ditches
- Proposed Retention Pond
- Lago Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

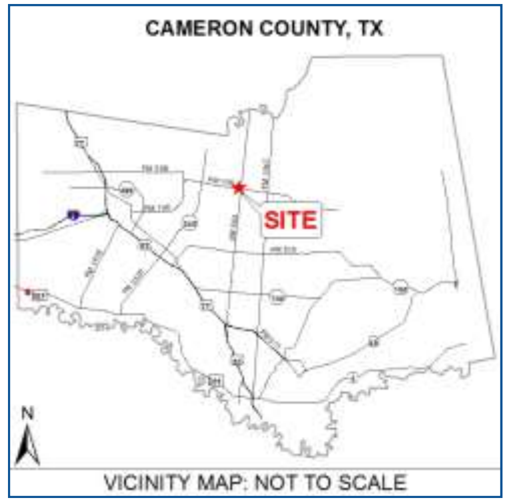
"Filling the Gap"

Colonia: Las Yescas, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Las Yescas colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 16-acre colonia are generally from the northwest to the south and southeast. This colonia is located entirely within the FEMA Zone AH 100-year floodplain. The colonia does not have adequate roadside swale conveyance and frequently experiences residential lot and street flooding, as well as some structural flooding during significant regional storm events. Model results indicate that high-risk flooding areas exist throughout the very flat terrain of the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Las Yescas, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install an underground drainage system with a retention pond to eliminate off-site impacts
  - Improve roadside swales along FM 106 and along the west side of the colonia
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes an underground drainage system with a retention facility. The improvements include 630 linear feet of 18-inch diameter pipe, 590 linear feet of 24-inch diameter pipe, 340 feet of 30-inch diameter pipe, pavement and curb/gutter for 1,320 linear feet of roadway, 8 curb inlets, and two 60-inch manholes. The project also include excavation and grading of the perimeter swales along FM 106 and the west side of the colonia to improve drainage from perimeter home lots. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Las Yescas Colonia			
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	278,116.67
2	**DRAINAGE IMPROVEMENTS**	$	149,458.89
3	**POND EXCAVATION IMPROVEMENTS**	$	208,120.00
	Sub-Total =	**$**	**635,695.56**
	Engineering (10%)	$	63,569.56
	Contingency (20%)	$	127,139.11
	Total =	**$**	**826,404.22**
NOTE	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	3	0	3
10% (10-year)	3	0	3
4% (25-year)	3	0	3
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,196,453	$826,404	2.66
Elevate Structures	$2,196,453	$331,800	6.62
Acquisition/Supplemental Housing/Demolition	$2,206,776	$295,972	7.46

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

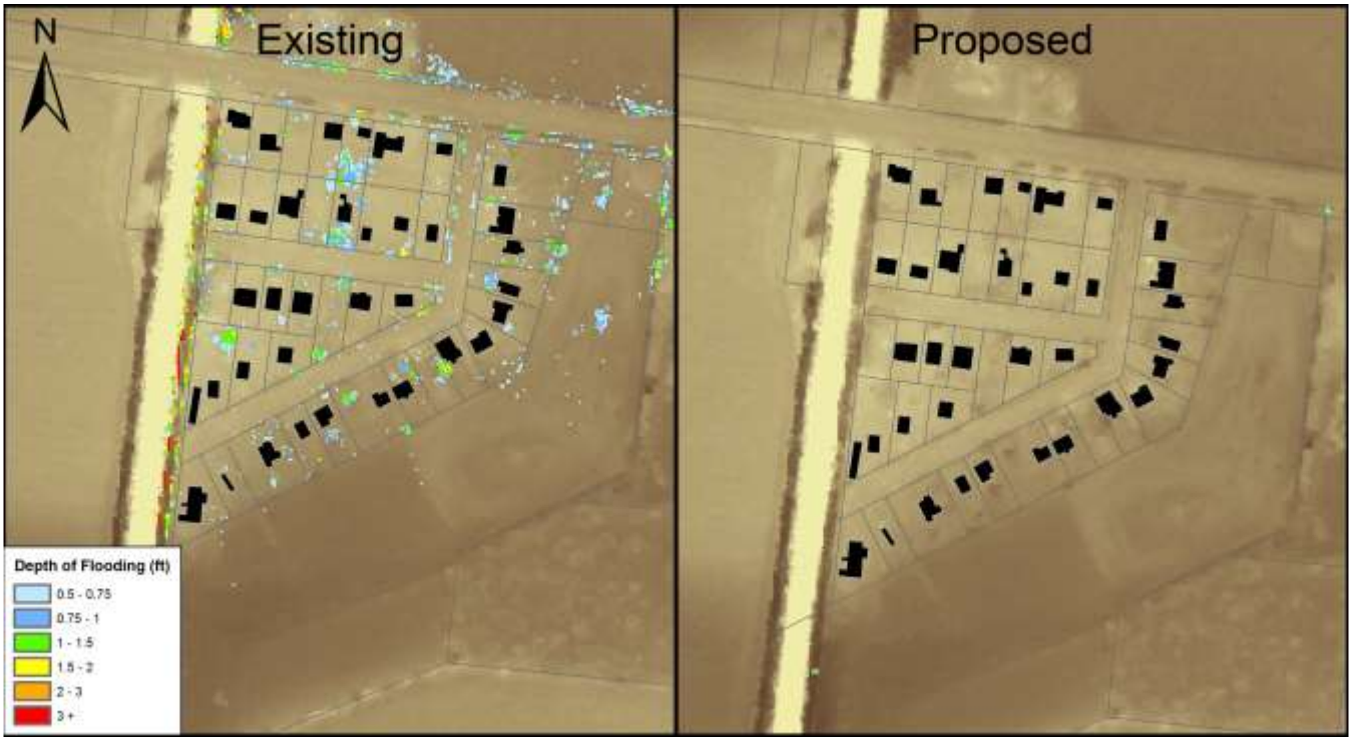


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	39	0	39
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

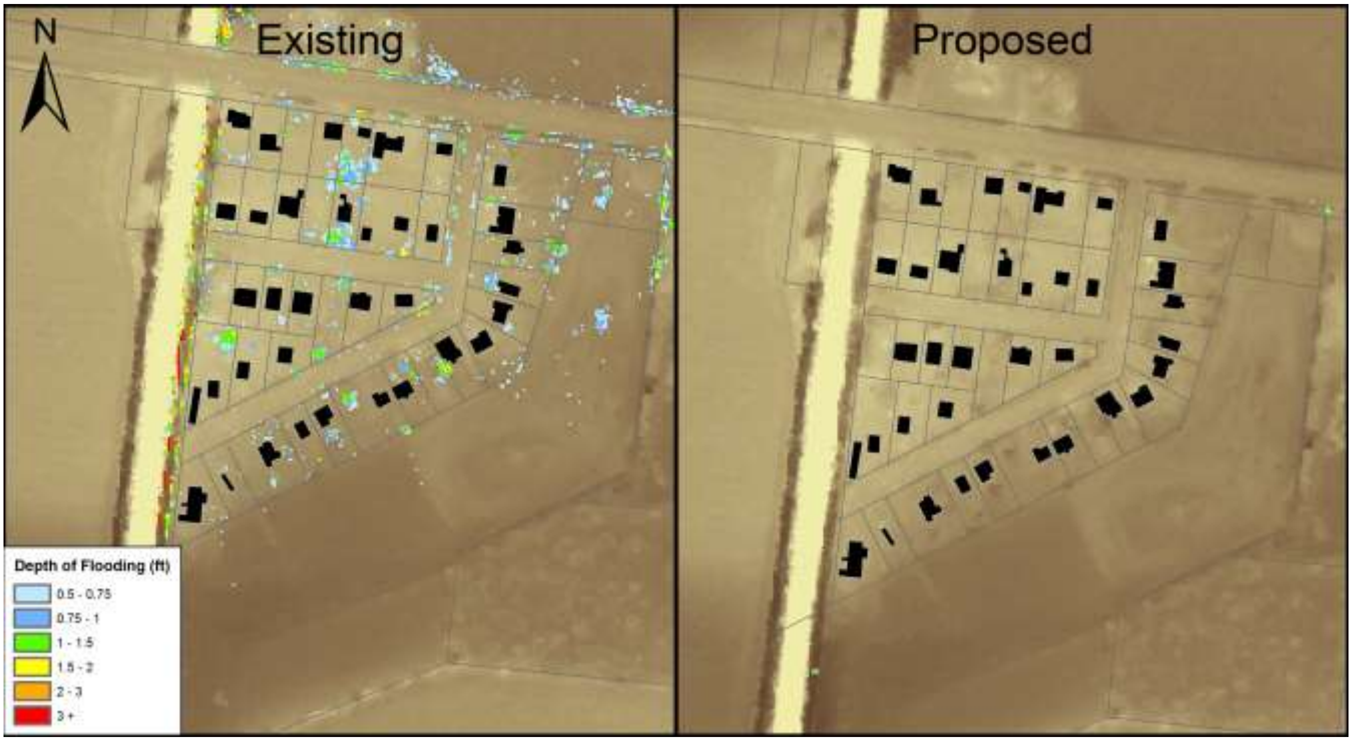


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	39	0	39
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

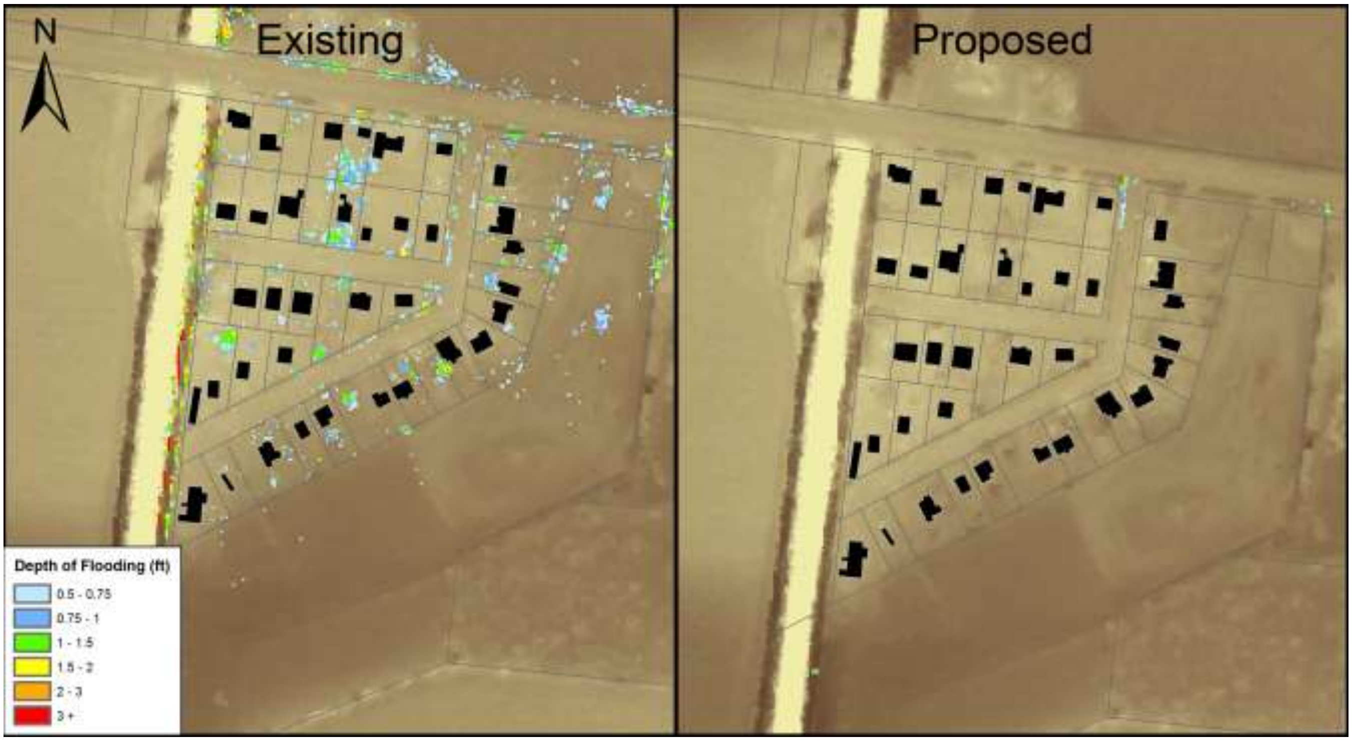


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	39	1	38
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

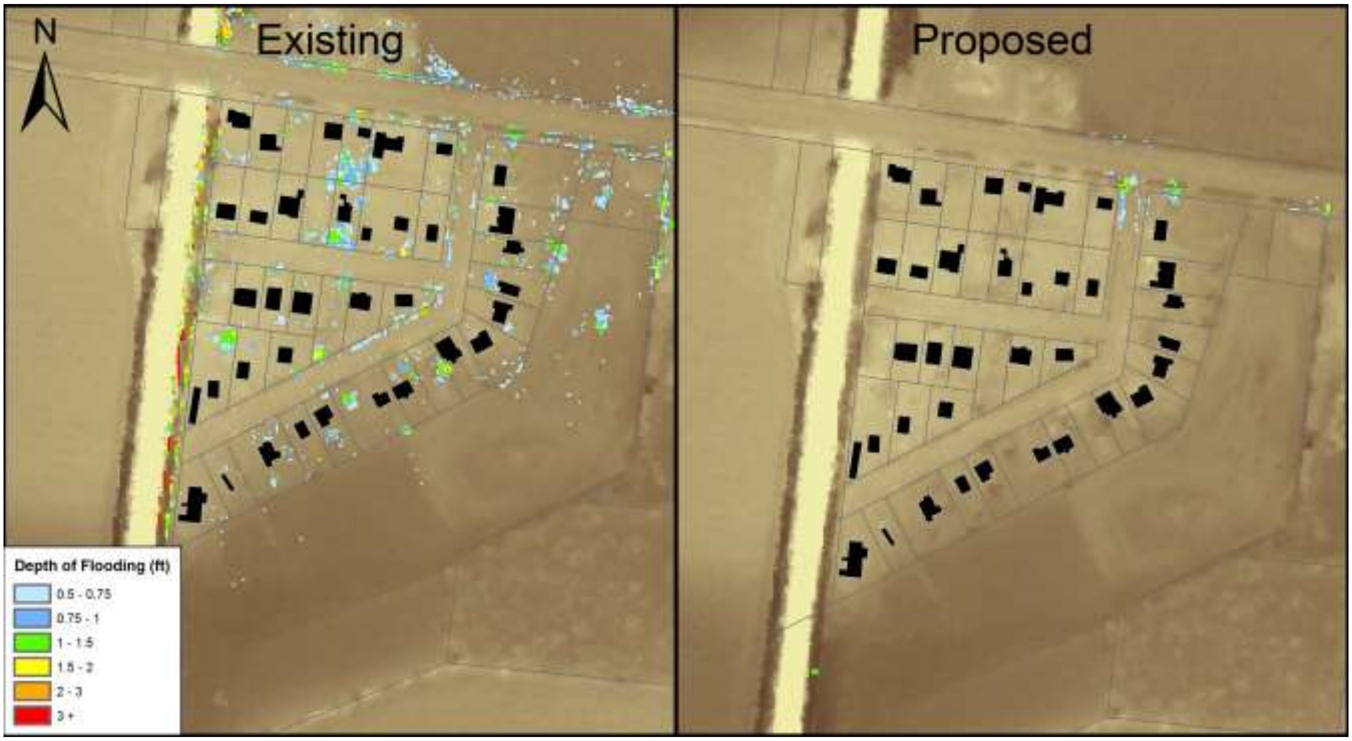


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	39	2	37
Inundated Roadway (LF)	21	20	1

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Las Yescas, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

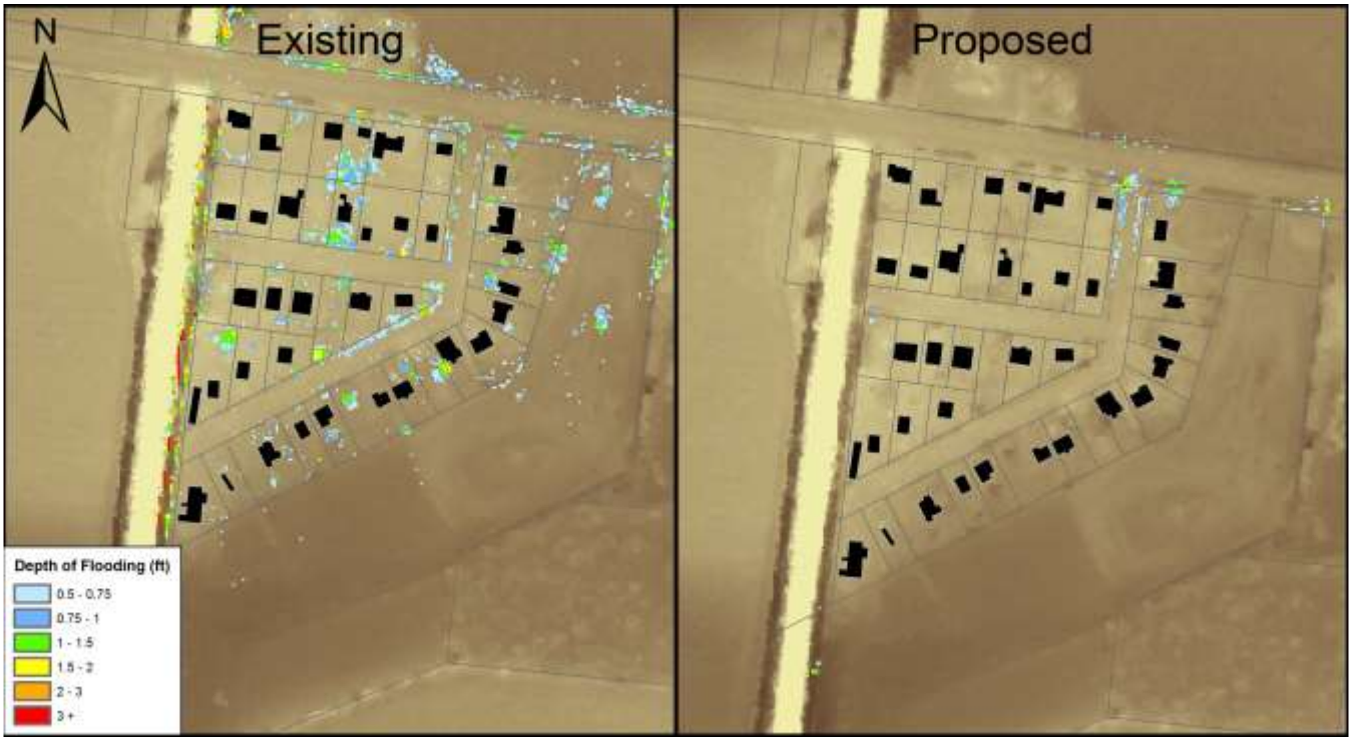


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	39	2	37
Inundated Roadway (LF)	26	26	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Las Yescas
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Retention Pond
- Las Yescas Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

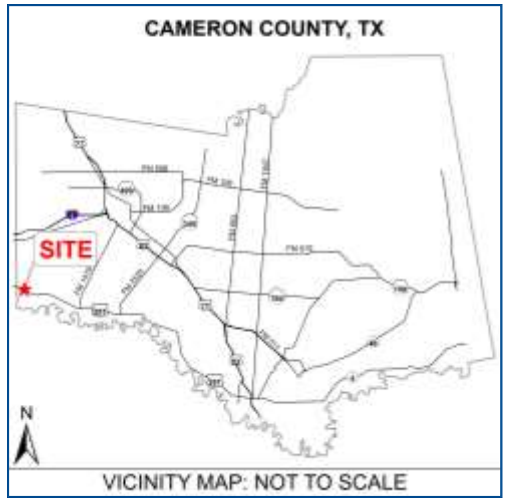
Colonia: Longoria Townsite, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Longoria Townsite colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 9-acre colonia are northerly in general, however, conveyance patterns vary within the colonia due to flat terrain. The colonia has an existing roadside swale drainage system, and a very small amount of underground storm drain system. Longoria Townsite does not have the infrastructure to adequately convey stormwater runoff and therefore experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Longoria Townsite, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes an underground drainage system with a retention facility to mitigate off-site impacts. The improvements include 665 linear feet of 18-inch diameter pipe, 360 linear feet of 24 -inch diameter pipe, pavement and curb/gutter for 2,300 linear feet of curb and gutter, 8 curb inlets, and associated pavements improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 6.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Longoria Townsites Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	239,815.56
2	**DRAINAGE IMPROVEMENTS**	$	114,966.67
3	**POND EXCAVATION IMPROVEMENTS**	$	179,080.00
	Sub-Total =	**$**	**533,862.22**
	Engineering (10%)	$	53,386.22
	Contingency (20%)	$	106,772.44
	Total =	**$**	**694,020.89**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Longoria Townsite, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	3	0	3
10% (10-year)	4	0	4
4% (25-year)	4	0	4
1% (100-year)	4	2	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$625,555	$694,021	0.90
Elevate Structures	$625,555	$225,300	2.78
Acquisition/Supplemental Housing/Demolition	$886,836	$237,307	3.74

Colonia: Longoria Townsite, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

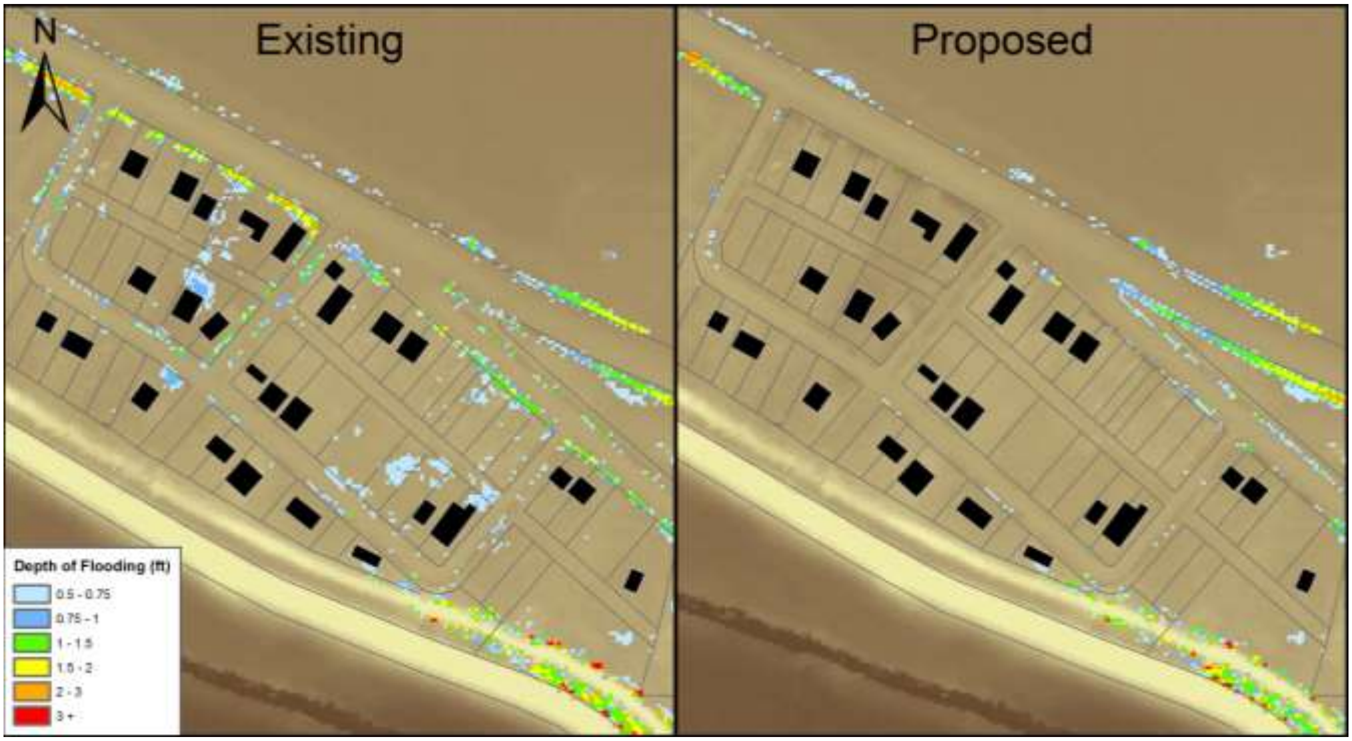


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	40	16	24
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figure:

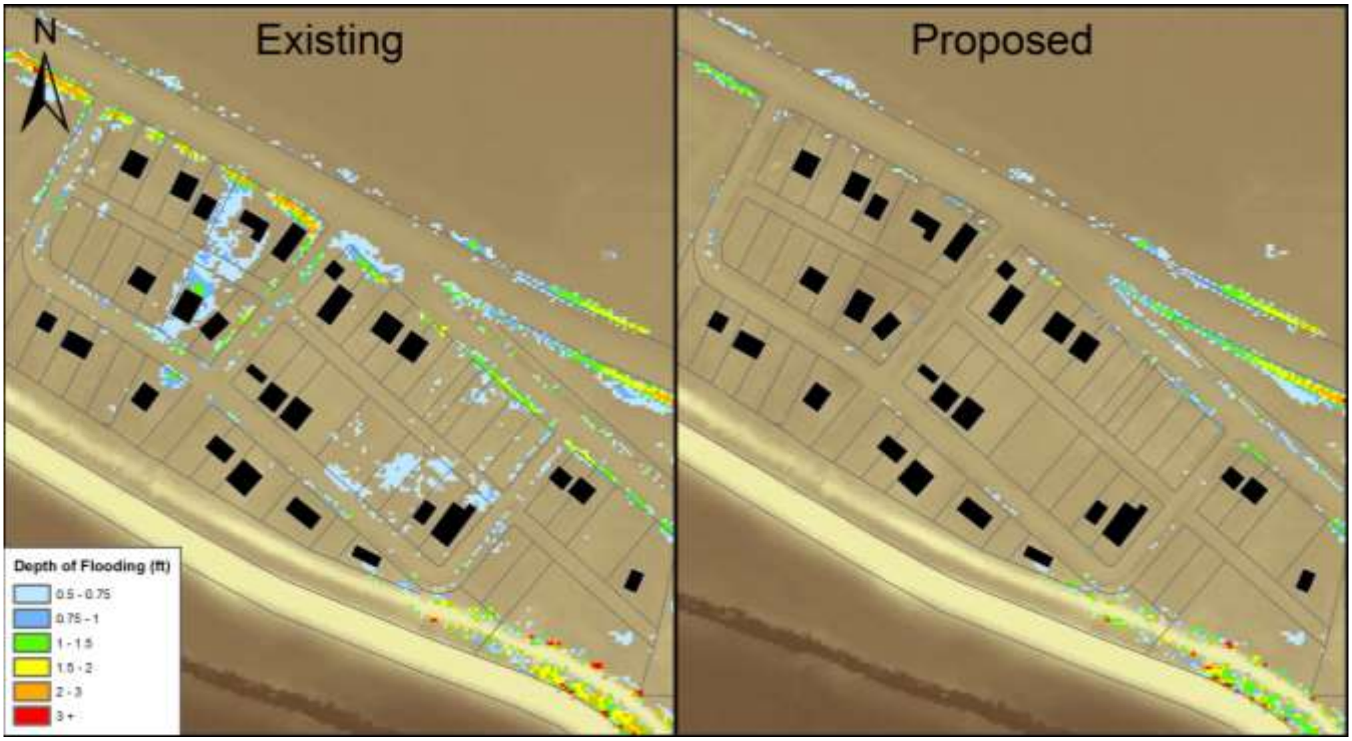


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	41	24	17
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Longoria Townsite, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

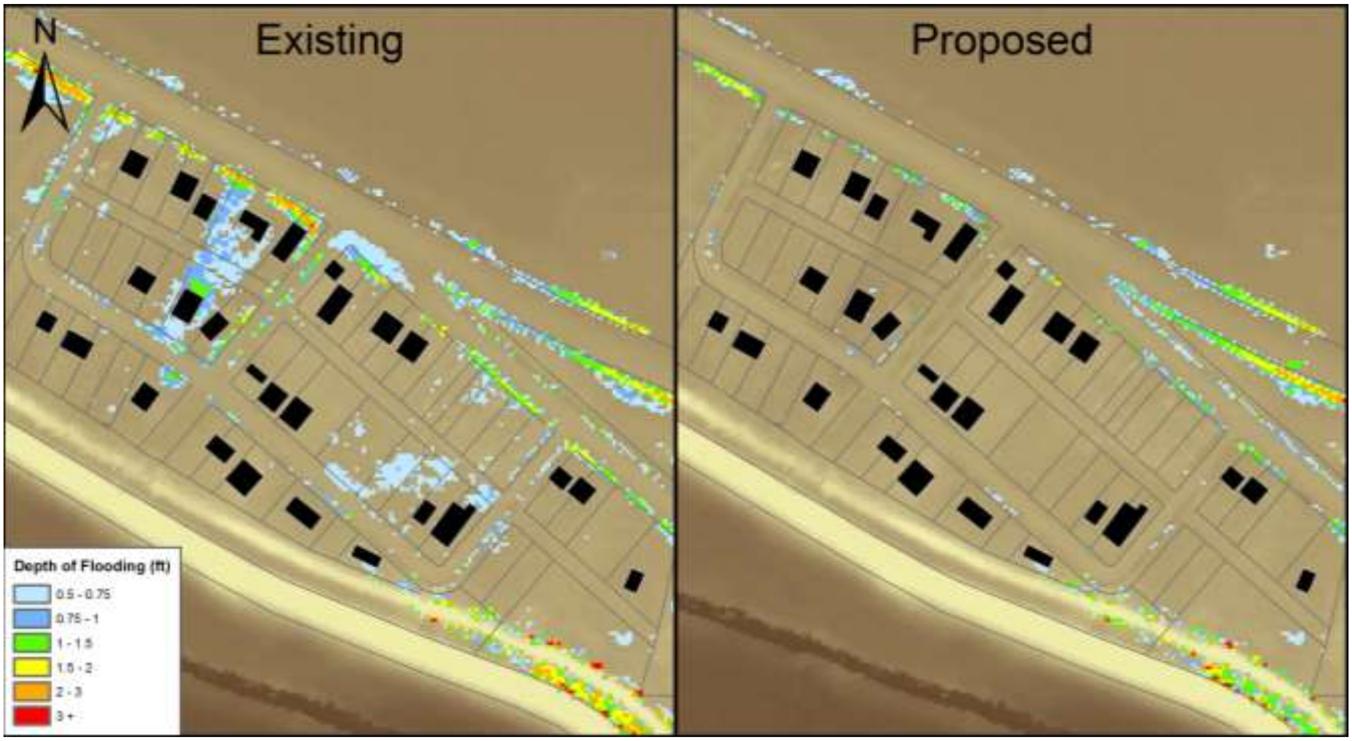


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	41	26	15
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Longoria Townsite, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

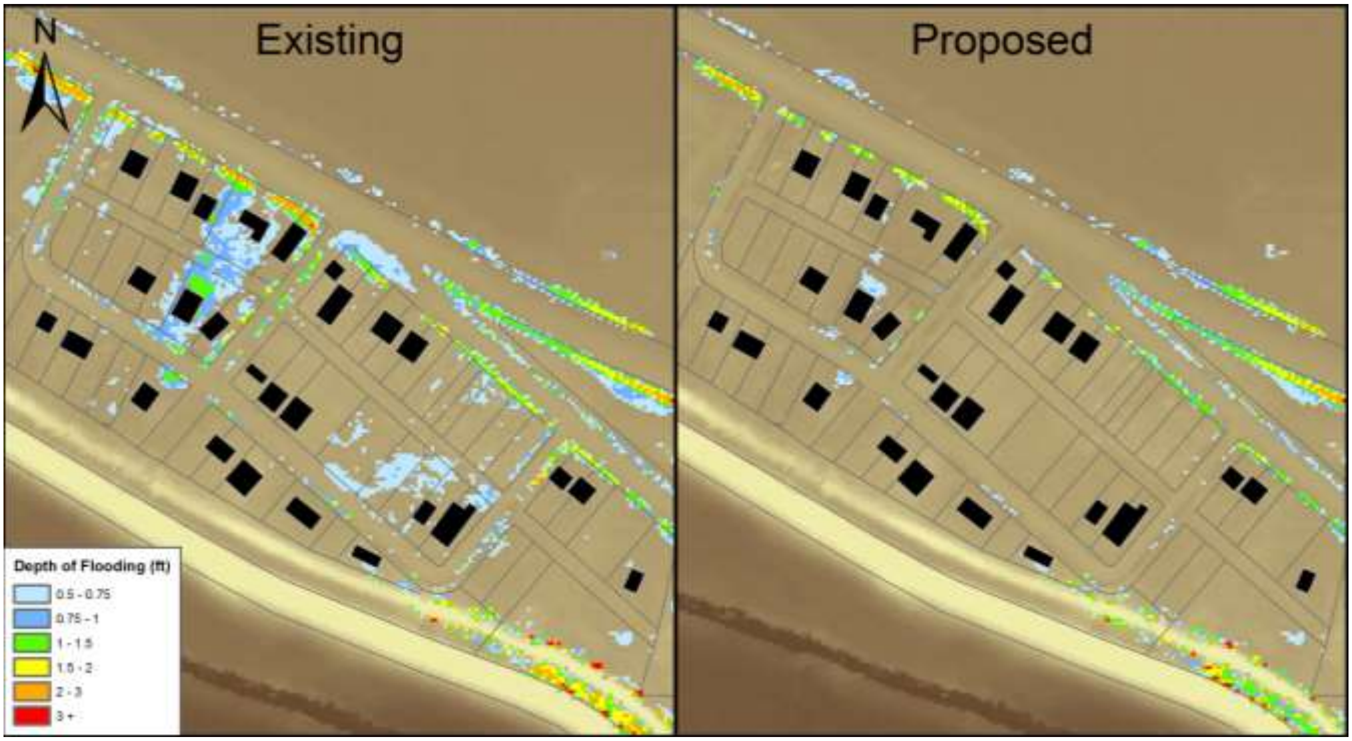


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	41	27	14
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Longoria Townsite, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

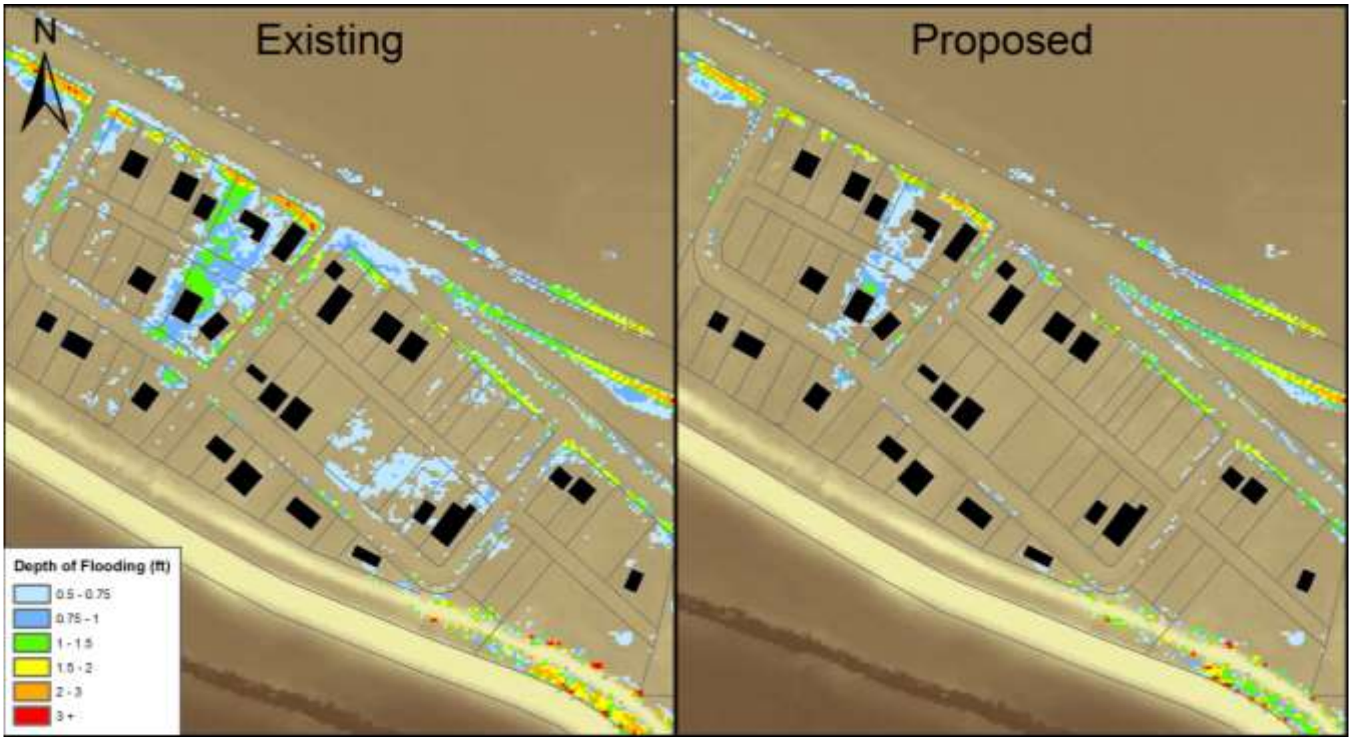
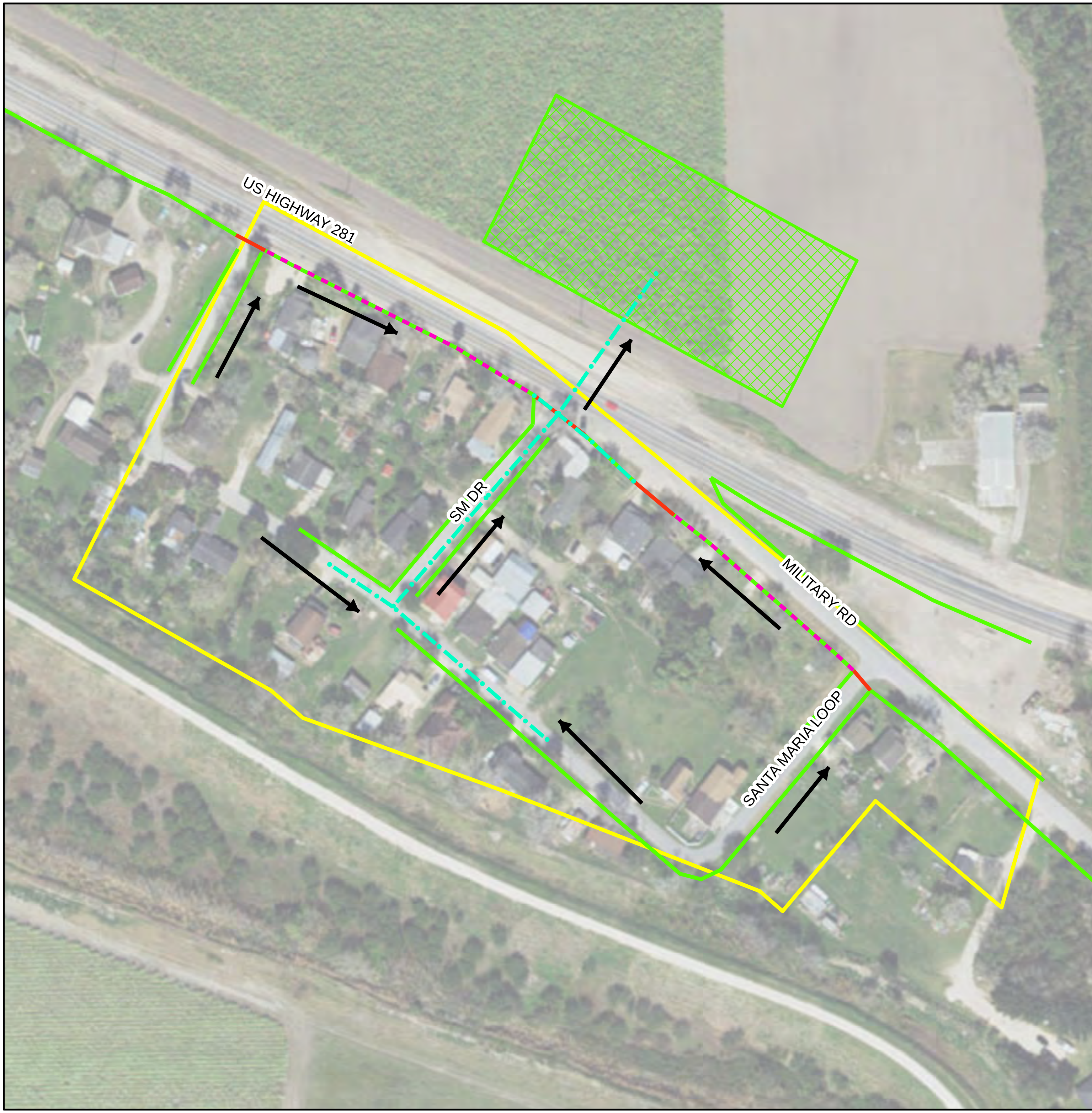


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	2	4
Inundated Lots	43	27	16
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Longoria Townsite
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Existing Floodplain
- Proposed Retention Pond
- Longoria Townsites Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

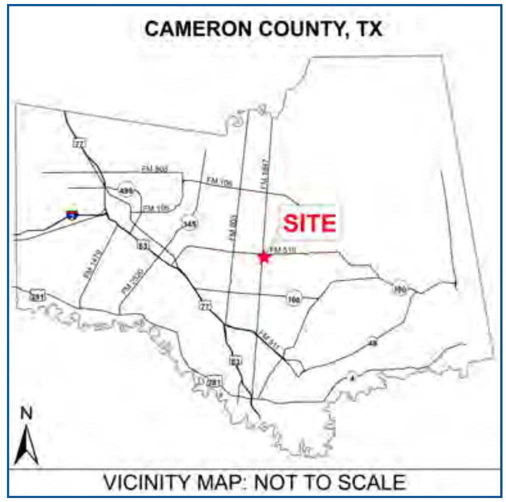
Colonia: Lourdes Street, Cameron County

Basin: Resaca de los Fresnos

Category: A1

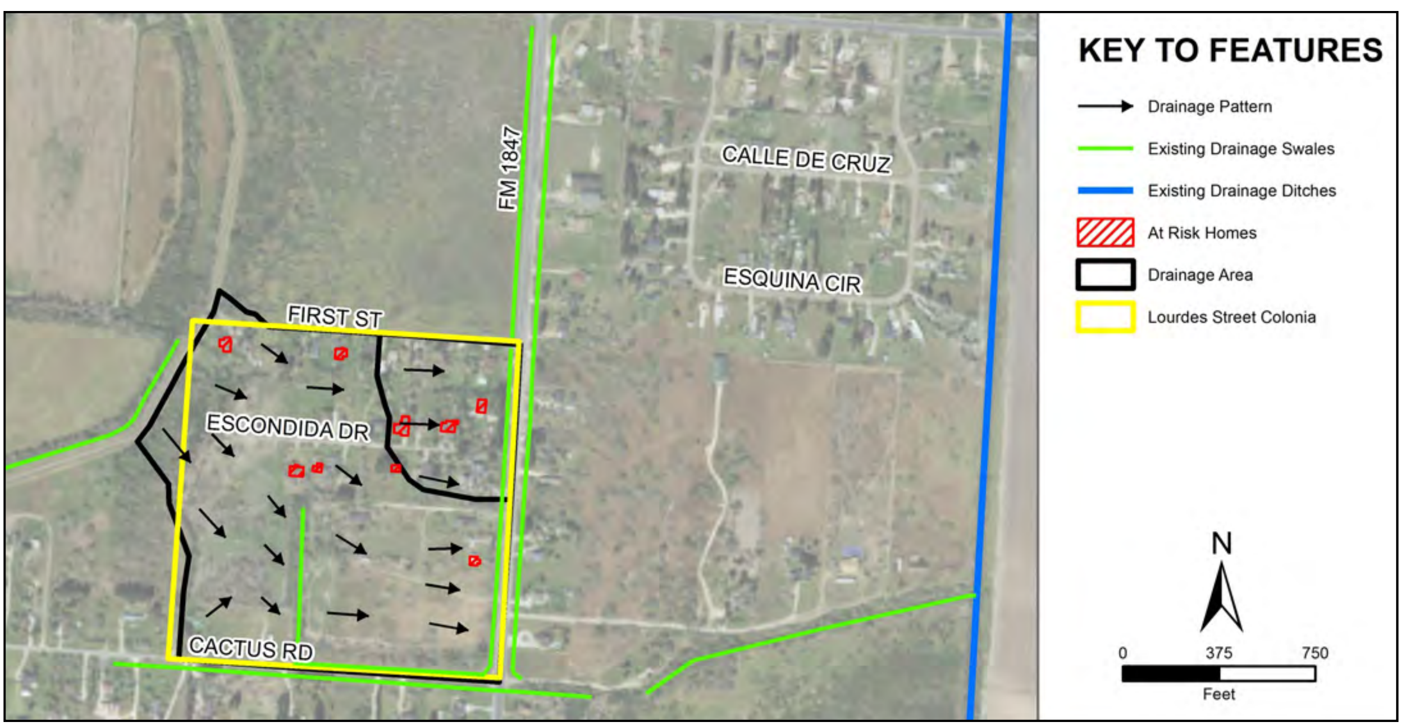
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Lourdes Street colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 37-acre colonia are generally from the west to east towards FM 1847. The entire colonia is located within the FEMA 100-year floodplain. The highest concentration of habitable structures is located in the northern portion of the colonia. Homes located in this area have the highest risk of inundation. The colonia does not have adequate roadside ditch conveyance and frequently experiences residential lot and street flooding, as well as some structural flooding from local events. Culverts under driveways are either non-existent, damaged, or undersized. The colonia also lacks a proper lateral ditch connection to a Drainage District 4 drain located southeast of the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Lourdes Street, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install roadside ditches along First St., Escondida Dr., Cactus Rd., and FM 1847
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
  - Install two retention ponds to eliminate off-site impacts north and southeast of the colonia
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside ditch and driveway culvert improvements along First St., Escondida Dr., Cactus Rd. and FM 1847. The improvements include 820 linear feet of 18 inch driveway culverts and 1,528 linear feet of ditch excavation and grading along First St., Escondida Dr., Cactus Rd., and FM 1847. In addition, construction of 1,900 linear feet of grassy swales between homes are proposed in order to allow drainage to the roadside swales. The proposed retention ponds are sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 24 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

Underground utilities appear to be located adjacent to and within the colonia, roadways that include water lines and telephone lines will make construction of roadside ditches more challenging and expensive. Coordination will be required by the county in regards to the installation of grassy swales on private property. The county will need to acquire drainage easements for the proposed retention pond and drainage swales. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Lourdes Street Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	**$**	**181,042.00**
2	**DRAINAGE IMPROVEMENTS**	**$**	**178,565.00**
3	**POND EXCAVATION IMPROVEMENTS**	**$**	**626,780.00**
4	**UTILITY RELOCATION**	**$**	**137,900.00**
	Sub-Total =	**$**	**1,124,287.00**
	Engineering (10%)	$	112,428.70
	Contingency (20%)	$	224,857.40
	Total =	**$**	**1,461,573.10**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.8 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Lourdes Street, Cameron County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	9	1	8
20% (5-year)	9	1	8
10% (10-year)	9	1	8
4% (25-year)	9	1	8
1% (100-year)	9	1	8

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$6,061,333	$1,461,573	4.15
Elevate Structures	$6,061,333	$841,350	7.20
Acquisition/Supplemental Housing/Demolition	$6,267,103	$728,190	8.61

Colonia: Lourdes Street, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

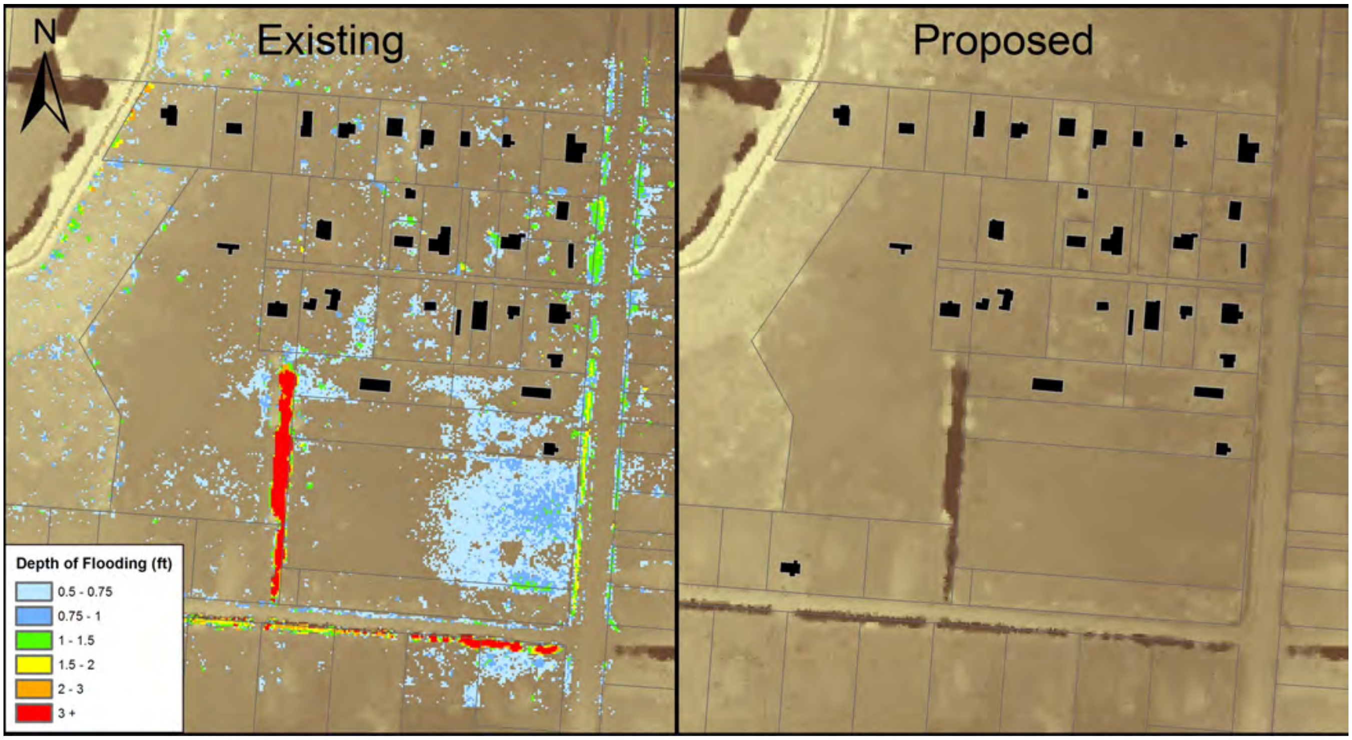


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	1	8
Inundated Lots	37	0	37
Inundated Roadway (LF)	225	0	225

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lourdes Street, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

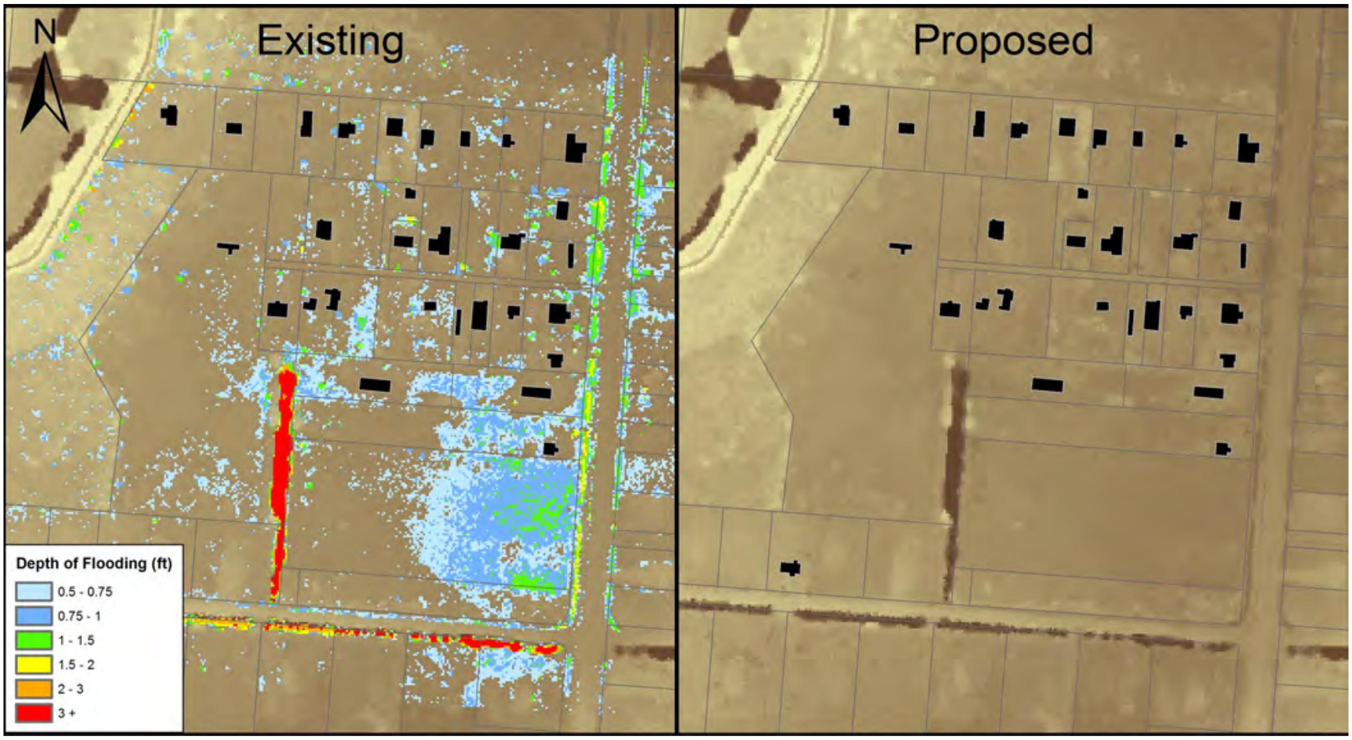


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	1	8
Inundated Lots	37	0	37
Inundated Roadway (LF)	270	0	270

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lourdes Street, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

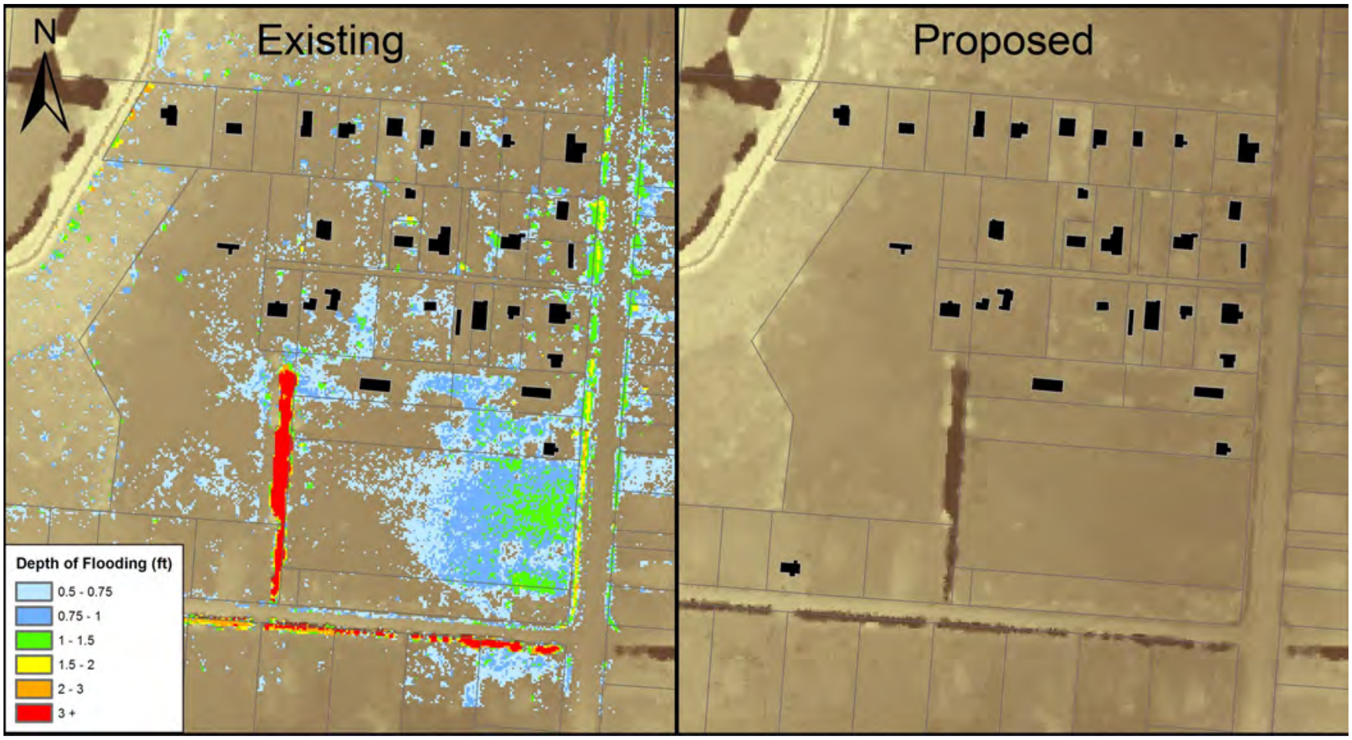


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	1	8
Inundated Lots	37	0	37
Inundated Roadway (LF)	360	0	360

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lourdes Street, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

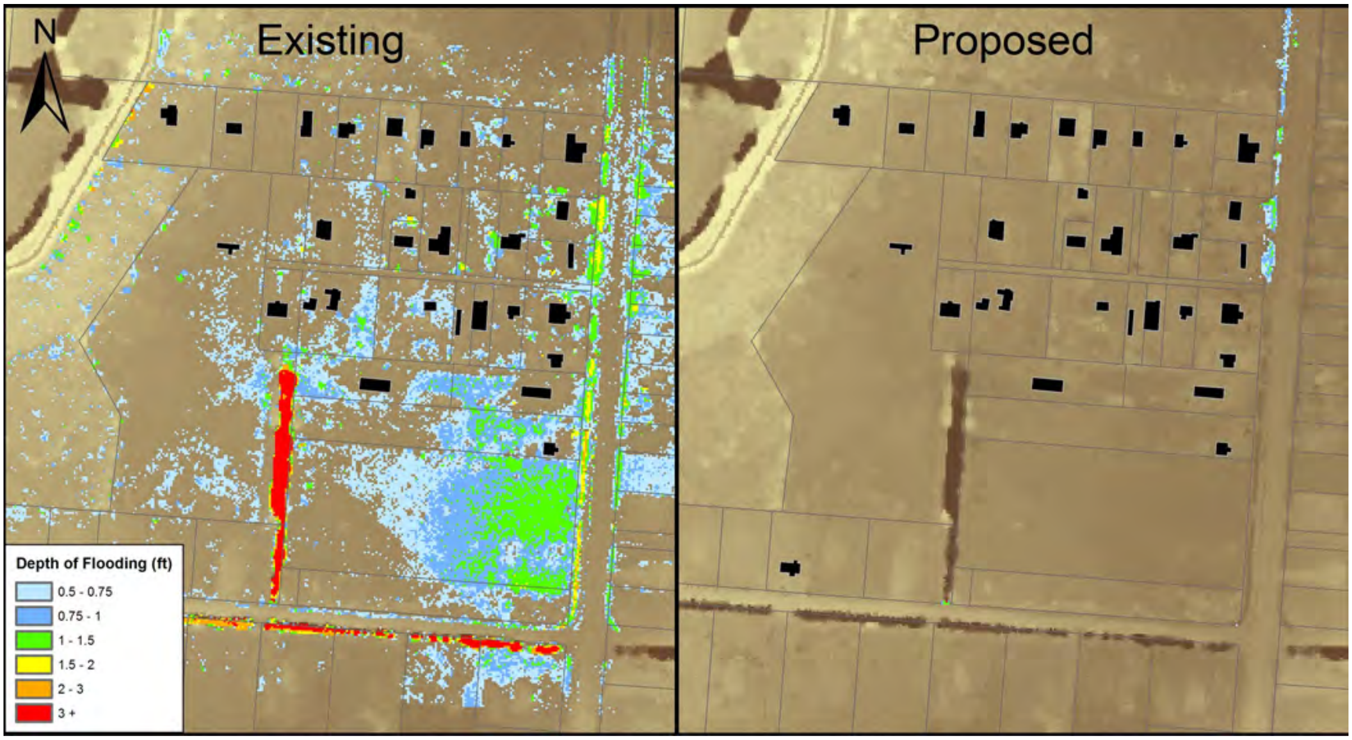


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	1	8
Inundated Lots	37	4	33
Inundated Roadway (LF)	510	0	510

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lourdes Street, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

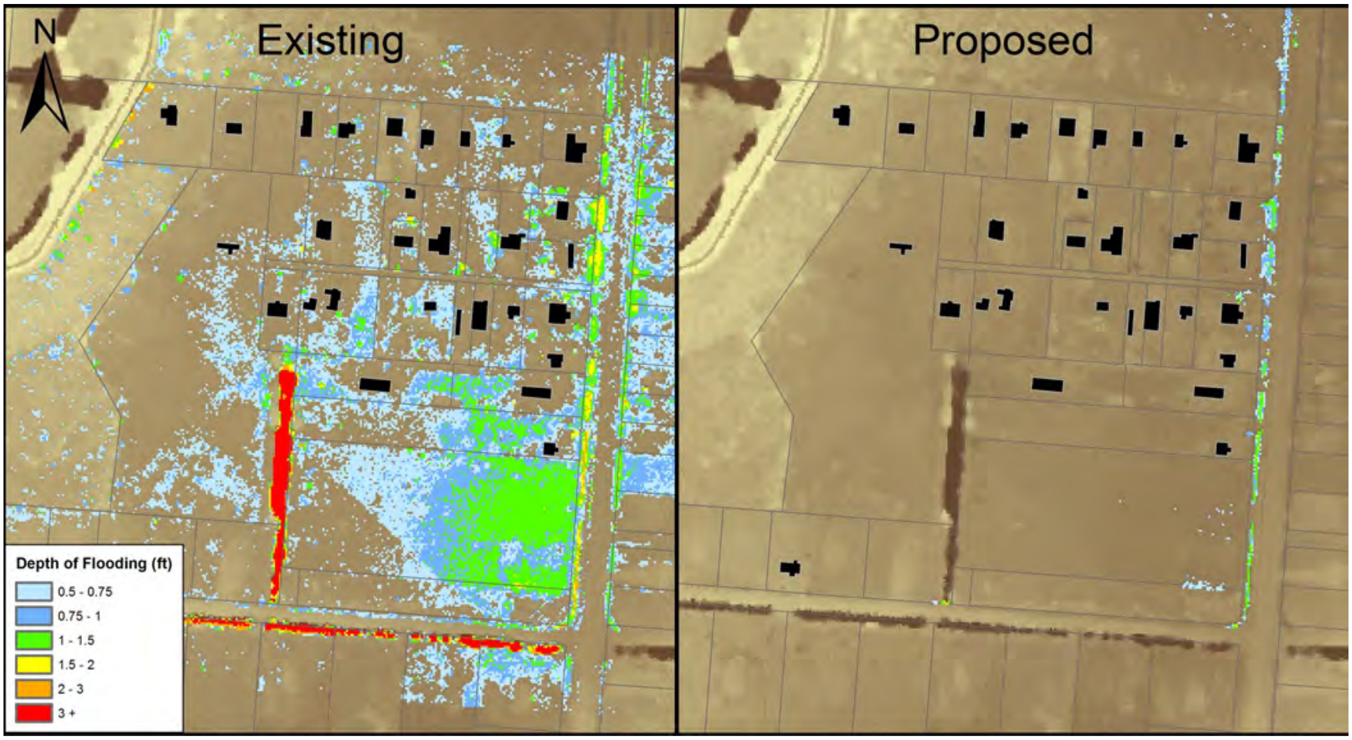


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	1	8
Inundated Lots	37	8	29
Inundated Roadway (LF)	740	2	738

Notes:

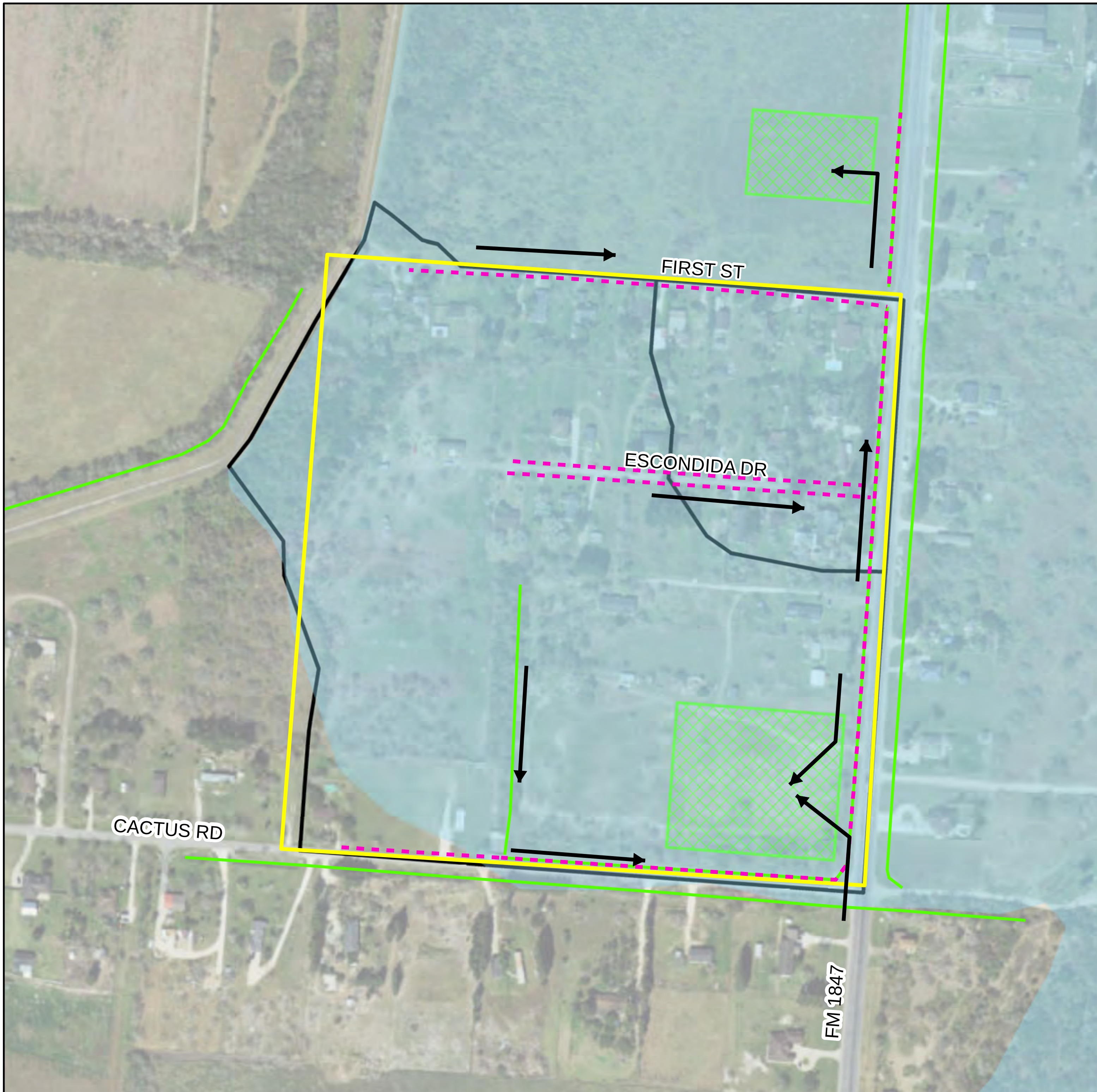
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: **Lourdes Street**
County: **Cameron County**

Recommended Conceptual Plan

NOT FOR CONSTRUCTION



Legend

- Proposed Drainage Pattern
- Proposed Drainage Swales
- Existing Drainage Swales
- Lourdes Street Colonia
- Existing Floodplain
- Proposed Retention Ponds
- Drainage Area

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

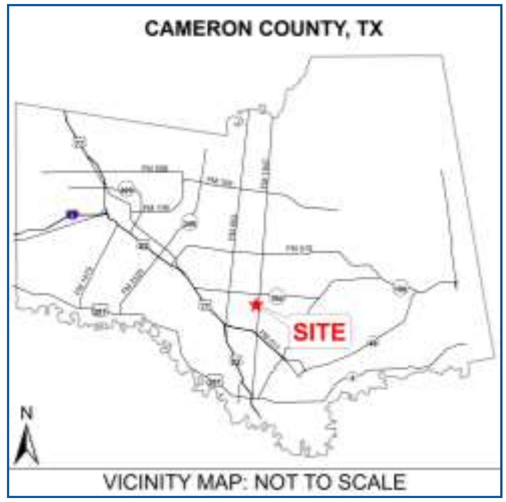
"Filling the Gap"

Colonia: Nogal Street, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Nogal Street colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 403-acre colonia are generally southeasterly. More than 90% of the Nogal Street colonia is located within the FEMA Zone AH 100-year floodplain. The colonia has an existing roadside drainage system, and pipe culverts that cross under FM 1847. Nogal Street experiences residential lot and street flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Nogal Street, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install an open ditch drainage system with a retention pond to mitigate off-site impacts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes a roadside drainage system improvements and the addition of a retention facility to mitigate off-site impacts. The improvements include 2,300 linear feet of ditch excavation and grading, 45 linear feet of 36-inch diameter pipe, four 36-inch safety end treatments, and 3,800 linear feet of grassy swales between homes in order to allow drainage to roadside swales. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 31.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Nogal Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	-
2	**DRAINAGE IMPROVEMENTS**	$	170,950.00
3	**POND EXCAVATION IMPROVEMENTS**	$	808,280.00
	Sub-Total =	**$**	**979,230.00**
	Engineering (10%)	$	97,923.00
	Contingency (20%)	$	195,846.00
	Total =	**$**	**1,272,999.00**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.8 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Nogal Street, Cameron County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	1	0	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$409,296	$1,272,999	0.32
Elevate Structures	$409,296	$1,097,712	0.37
Acquisition/Supplemental Housing/Demolition	$1,806,223	$126,033	14.33

Colonia: Nogal Street, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

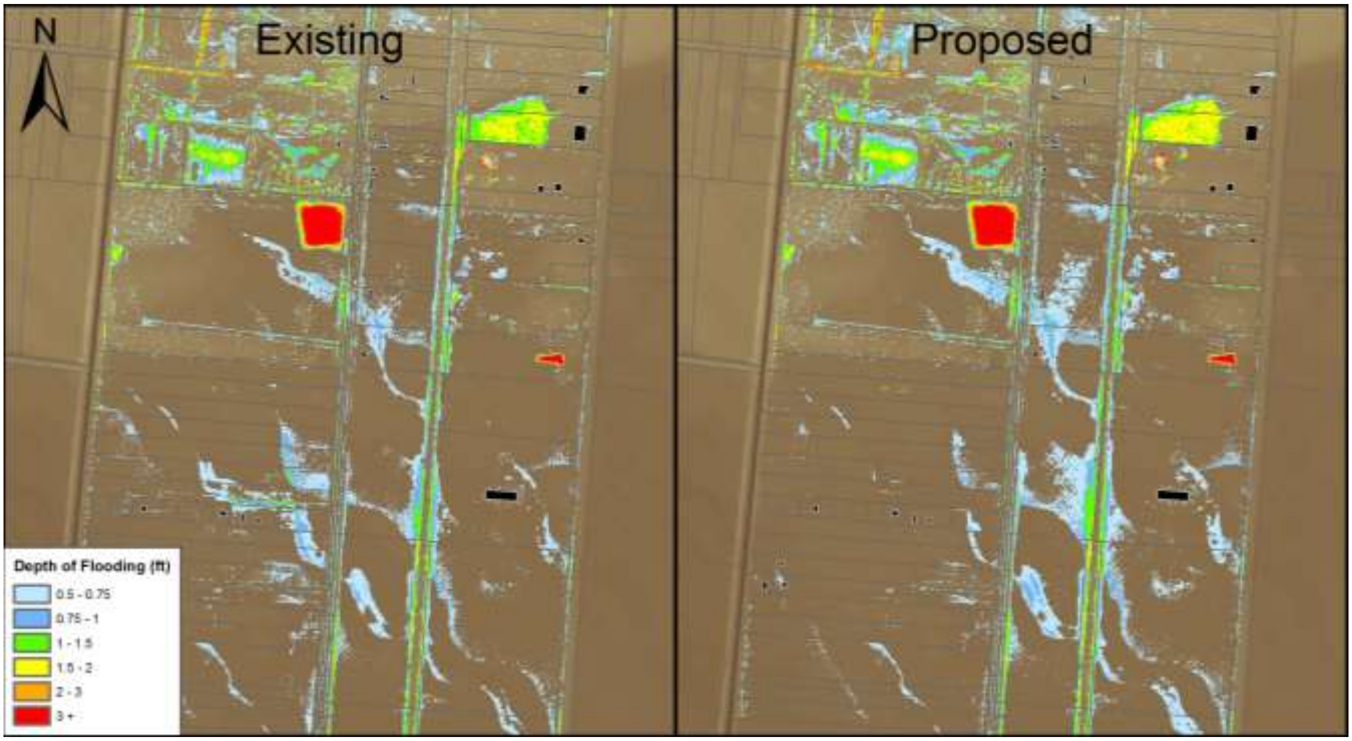


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	67	62	5
Inundated Roadway (LF)	240	240	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Nogal Street, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

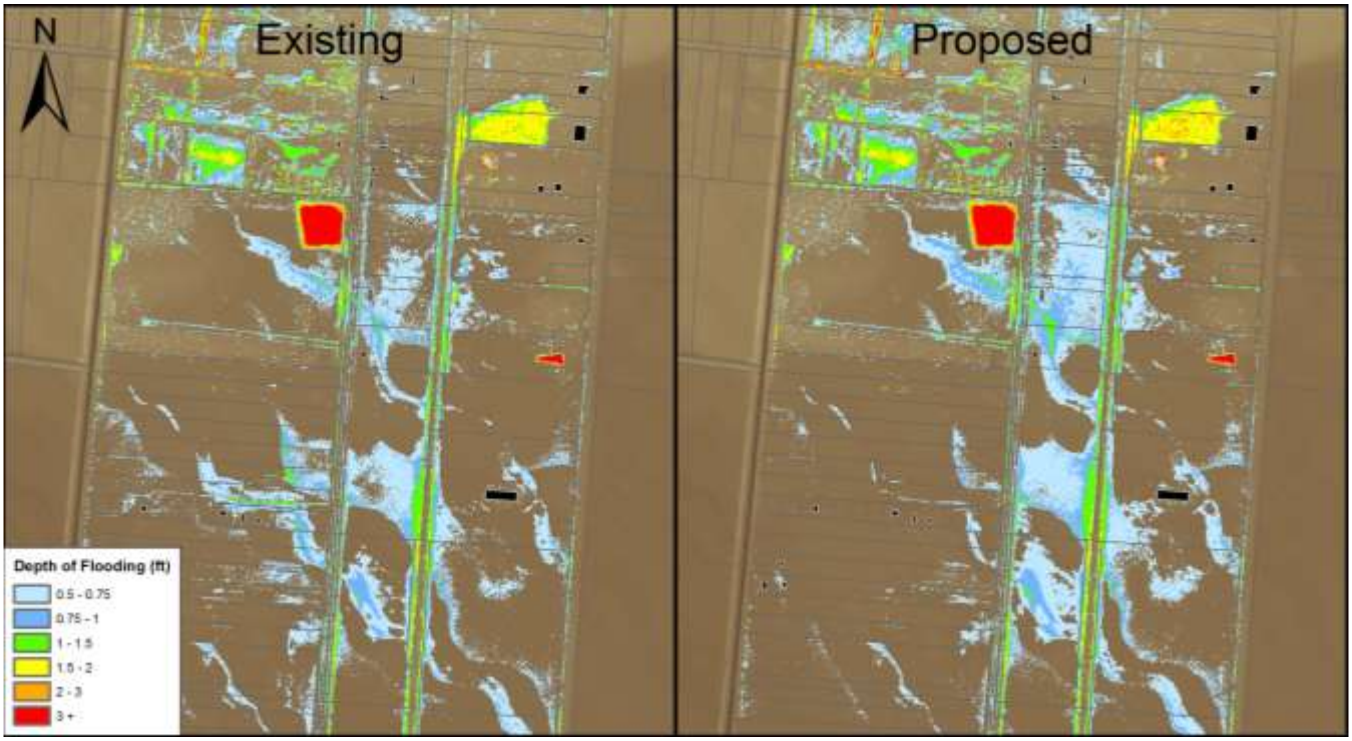


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	67	63	4
Inundated Roadway (LF)	510	510	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Nogal Street, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

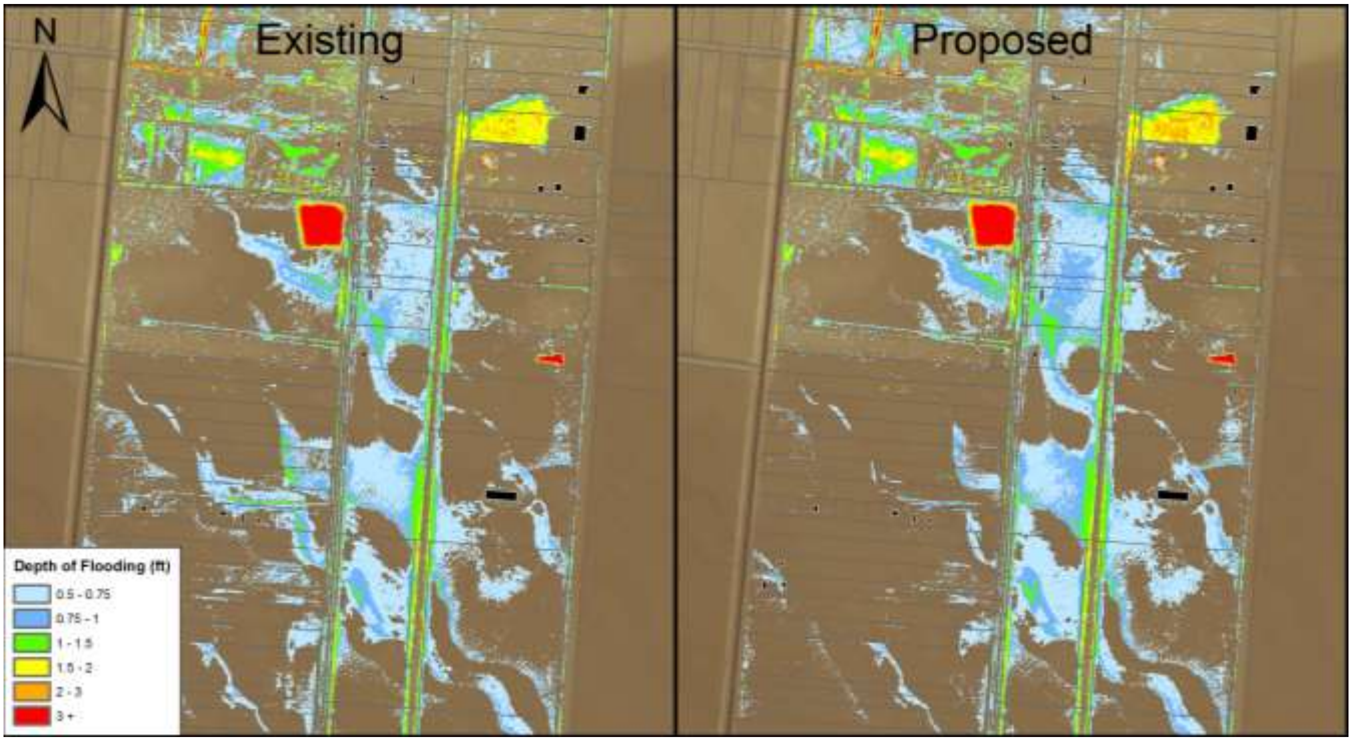


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	67	63	4
Inundated Roadway (LF)	700	700	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Nogal Street, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

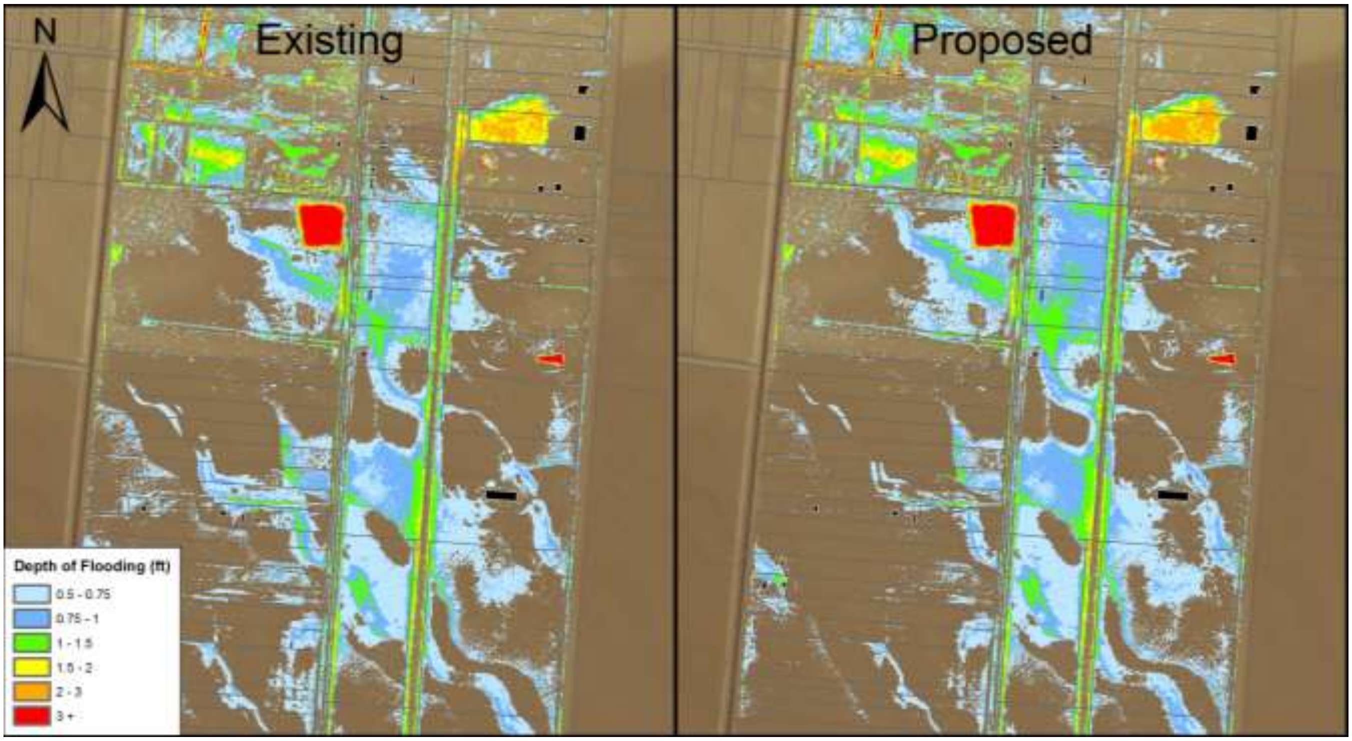


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	67	65	2
Inundated Roadway (LF)	1020	1020	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Nogal Street, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

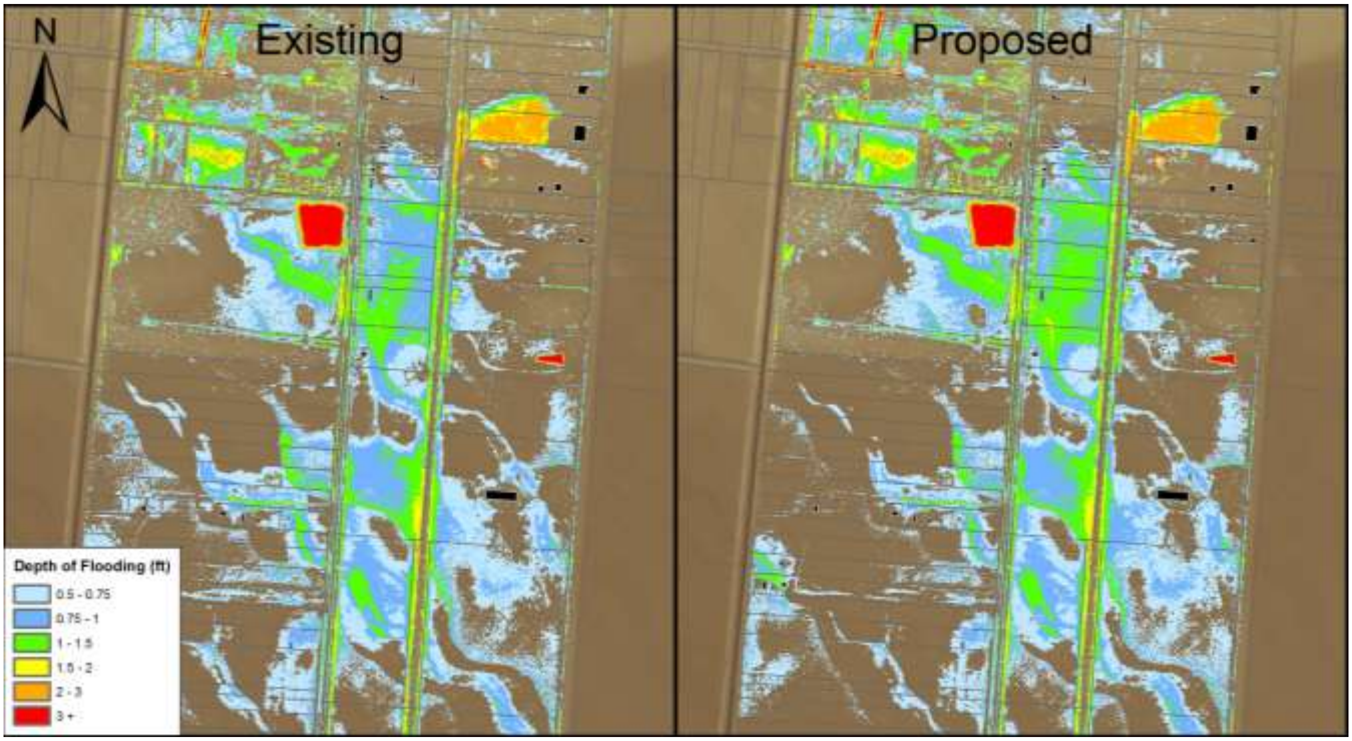


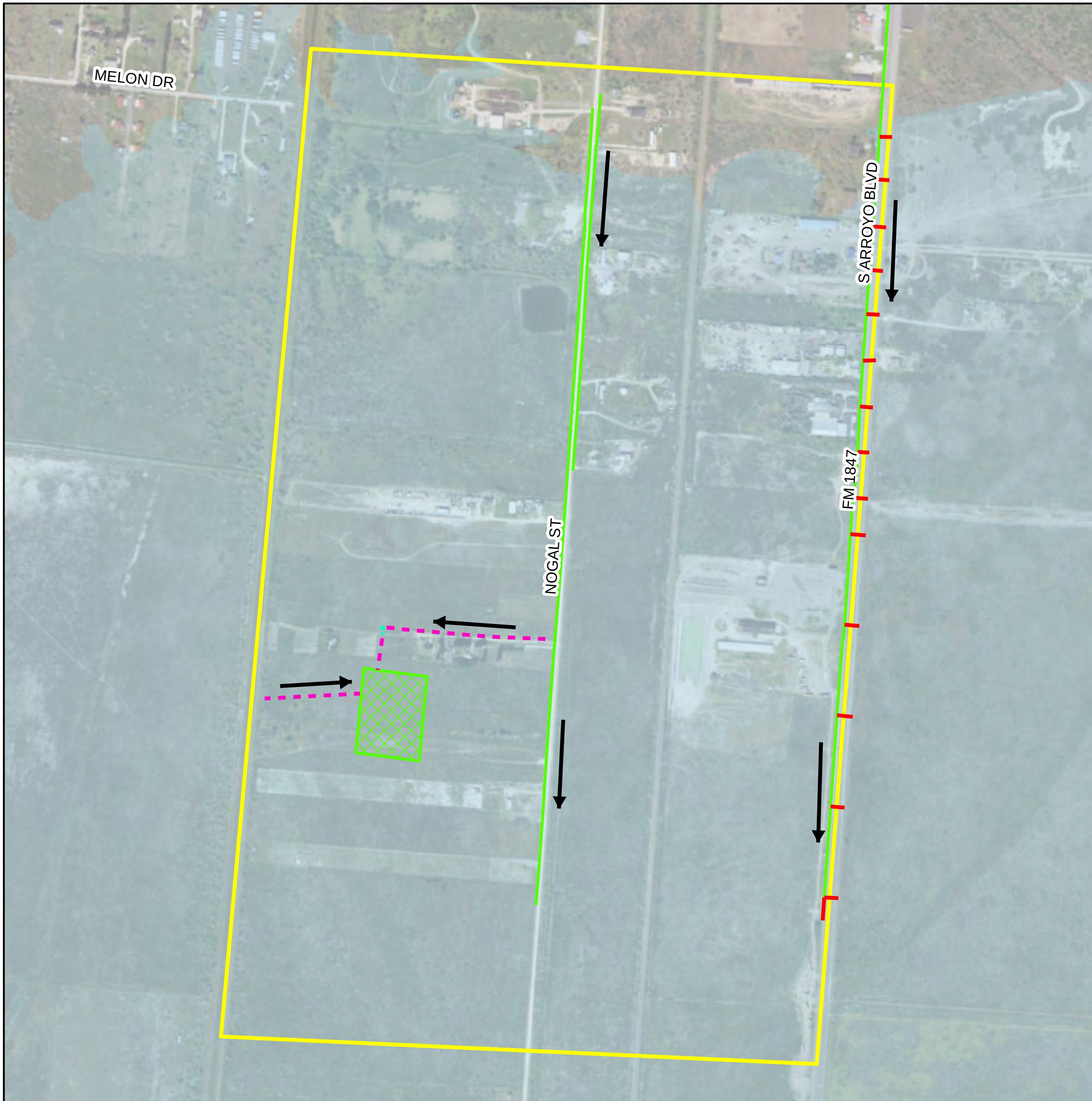
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	67	66	1
Inundated Roadway (LF)	1370	1370	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: **Nogal Street**
County: **Cameron County**

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Drainage Swales
- Proposed Stormwater System
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Retention Pond
- Existing Floodplain
- Nogal Street Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

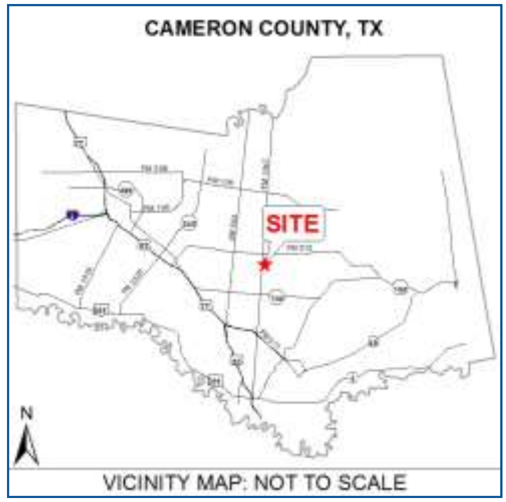
Colonia: Paredes Estates, Cameron County

Basin: Resaca De Los Fresnos

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Paredes Estates colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions



Areas of Risk:

Drainage patterns within this 20-acre colonia are generally from the south to the north and northwest towards the existing regional drainage ditch approximately 1,200 feet north of the colonia along FM 1847. This colonia is located entirely within the FEMA Zone AE 100-year floodplain. The existing drainage system consists of roadside swales along Bingley Rd. and FM 1847; however, there are no direct connections to the regional drainage systems immediately east and northwest of the colonia. Model results show that high-risk areas exist throughout the very flat terrain of the colonia, especially within a large low-lying area behind homes near the center of the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Paredes Estates, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install and/or improve roadside swales along Bingley Rd and FM 1847
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
  - Install a retention pond to eliminate off-site impacts north of the colonia
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside swales and driveway culvert improvements with a retention facility. The improvements include 2,500 linear feet of swale excavation and grading along Bingley Rd. and FM 1847, 350 linear feet of 18-inch diameter driveway culverts, 100 linear feet of 36-inch diameter pipe, and 1,700 linear feet of grassy swales between homes in order to allow drainage to the roadside swales. The proposed retention pond is sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 13 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Paredes Estates Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	29,566.67
2	**DRAINAGE IMPROVEMENTS**	$	55,888.89
3	**POND EXCAVATION IMPROVEMENTS**	$	348,480.00
	Sub-Total =	**$**	**55,888.89**
	Engineering (10%)	$	43,393.56
	Contingency (20%)	$	86,787.11
	Total =	**$**	**564,116.22**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.8 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Paredes Estates, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	1	0	1
4% (25-year)	1	0	1
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$592,346	$564,116	1.05
Elevate Structures	$592,346	$269,775	2.20
Acquisition/Supplemental Housing/Demolition	$612,455	$263,662	2.32

Colonia: Paredes Estates, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

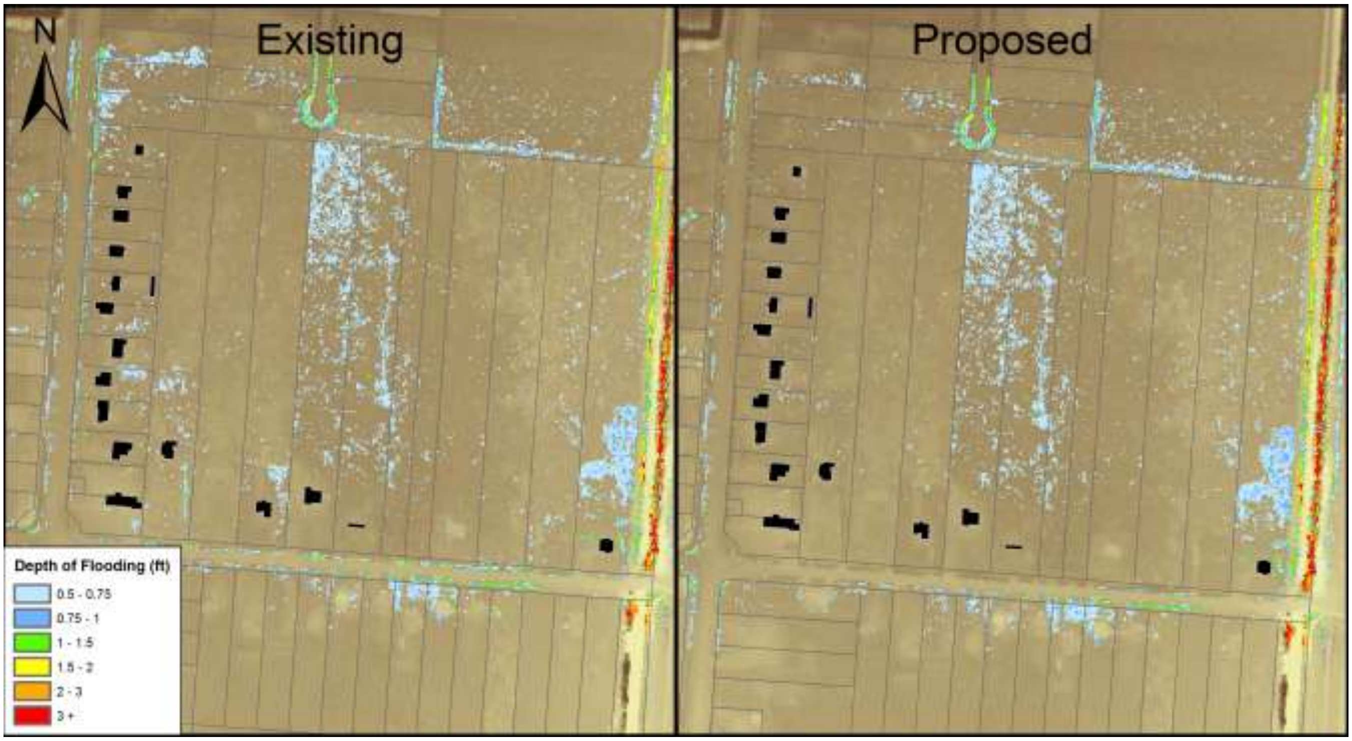


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	24	18	6
Inundated Roadway (LF)	24	18	6

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Paredes Estates, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

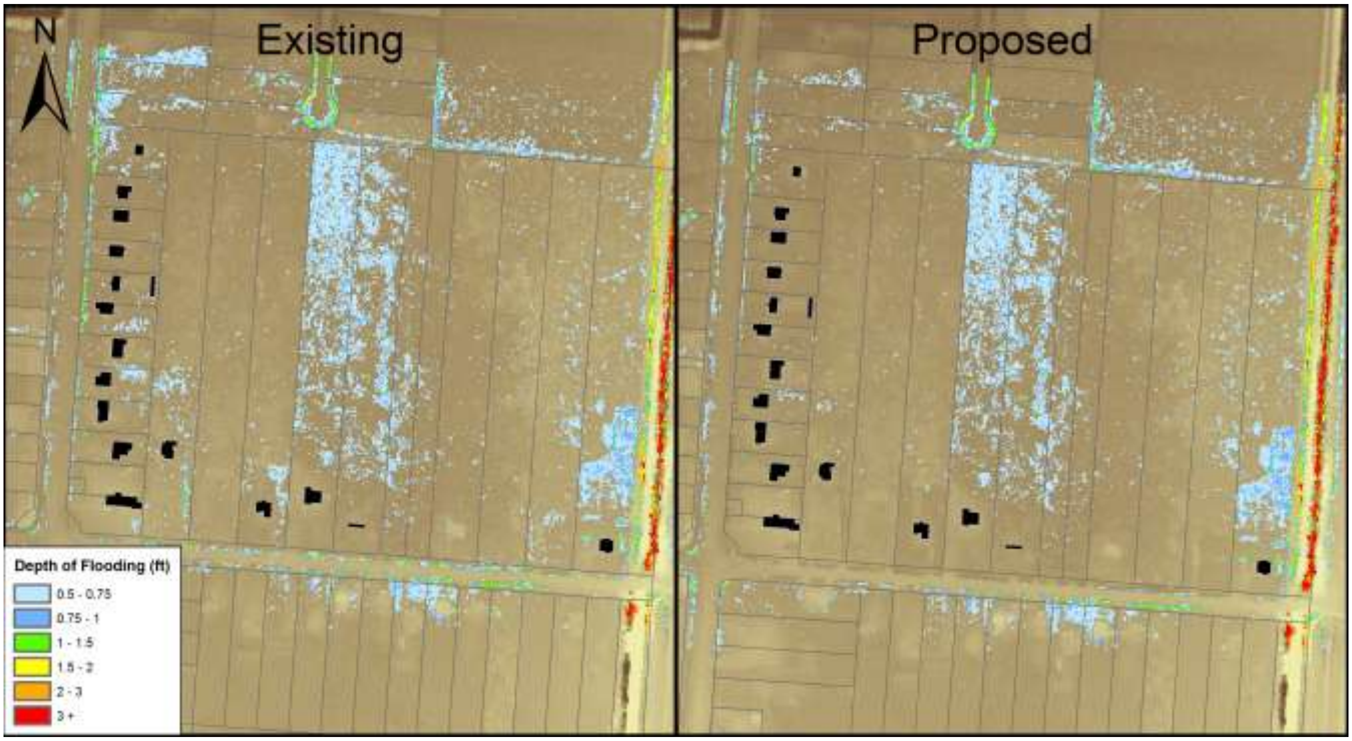


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	24	21	3
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Paredes Estates, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

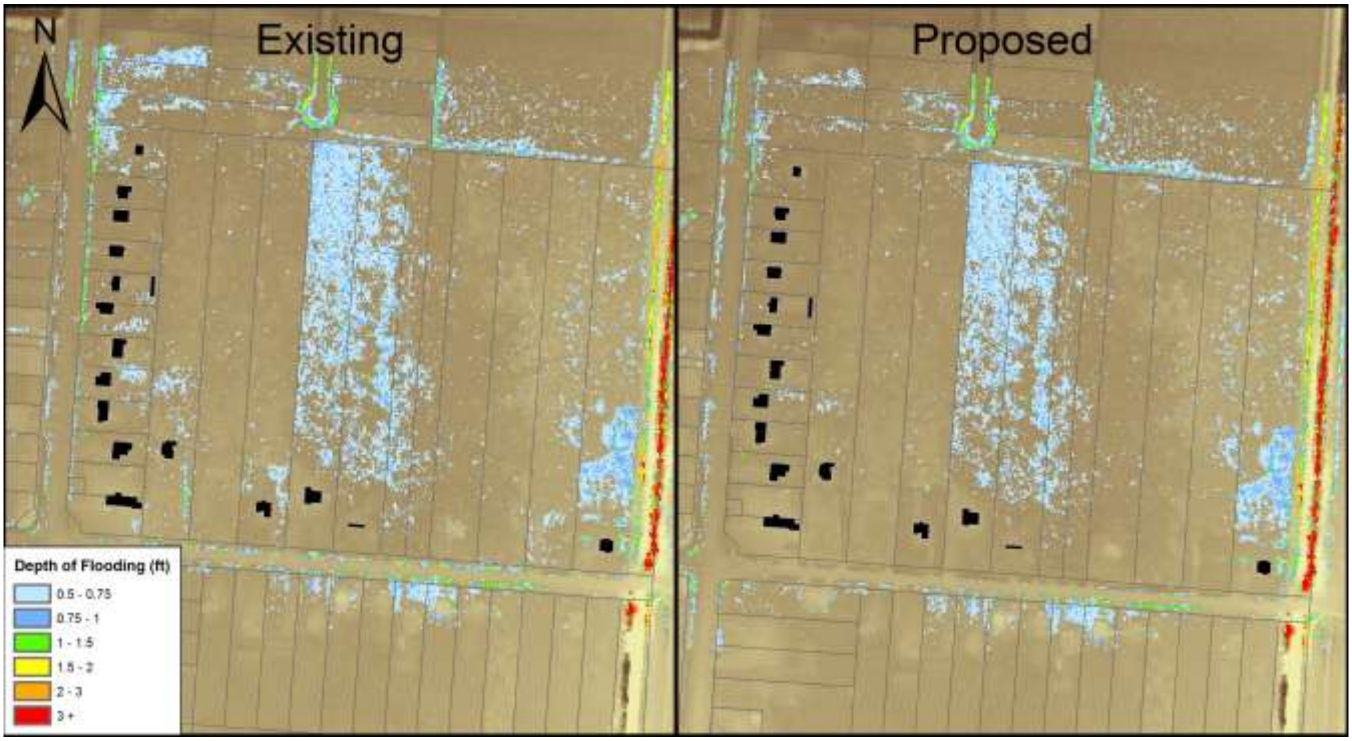


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	24	21	3
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Paredes Estates, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

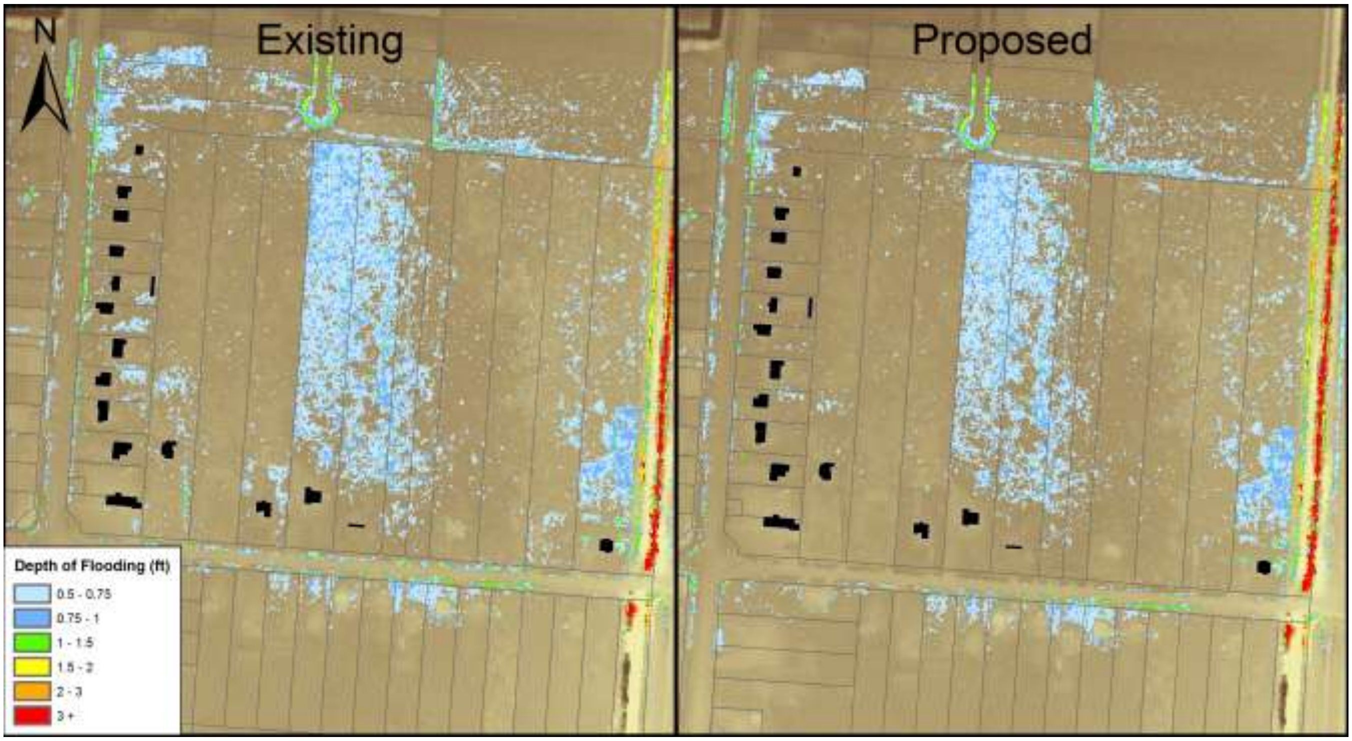


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	24	21	3
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figure:

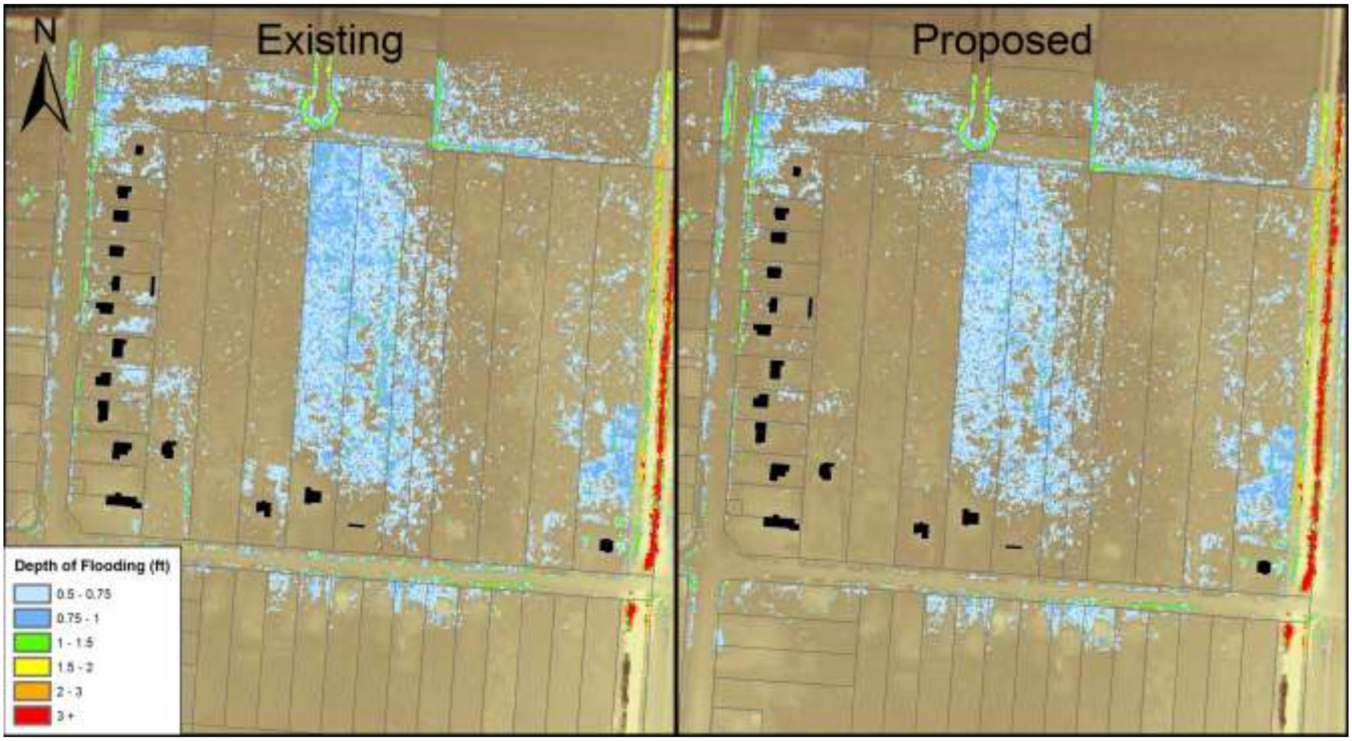
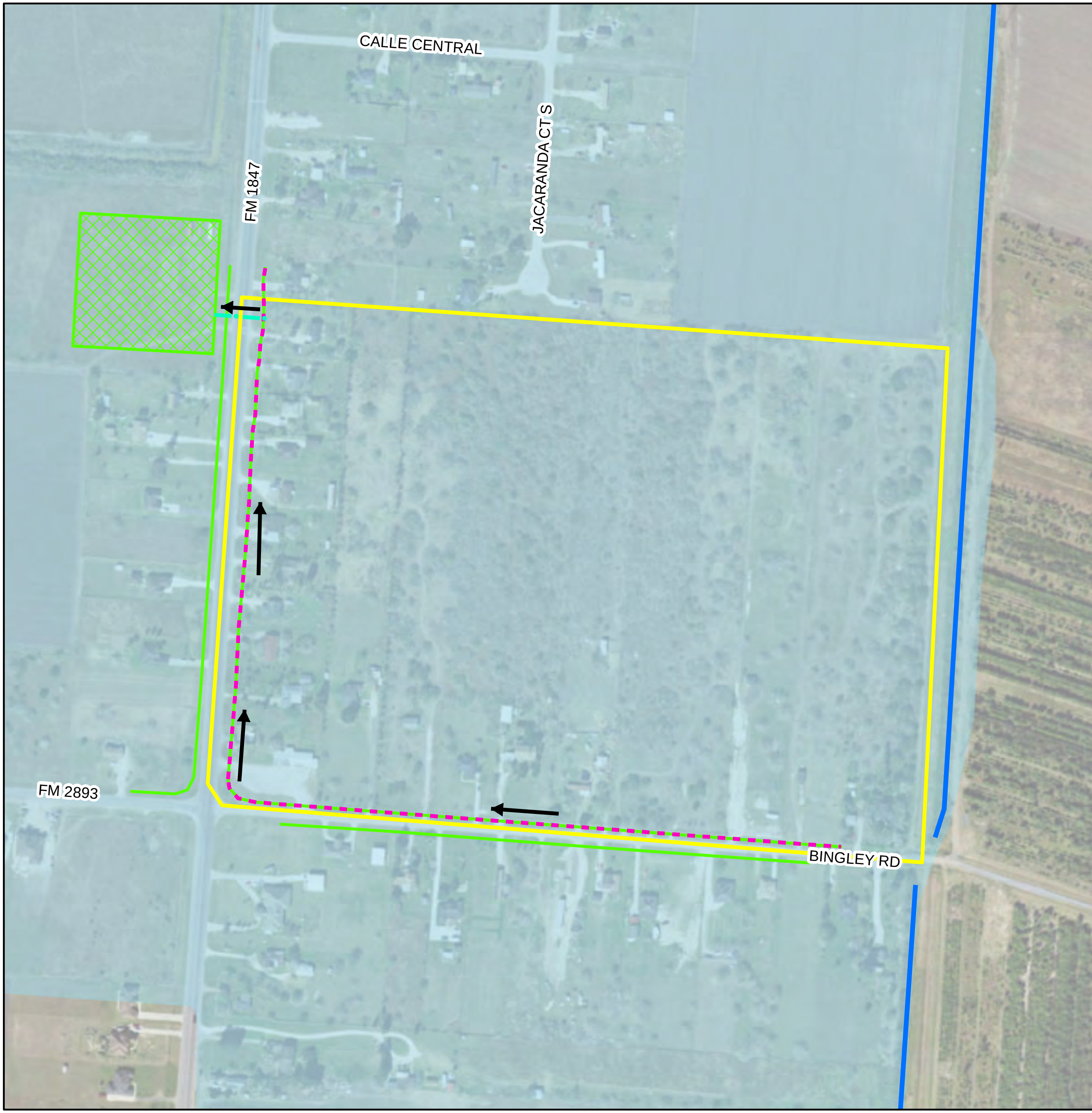


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	24	24	0
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Paredes Estates
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Drainage Ditches
- Proposed Retention Pond
- Paredes Estates Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

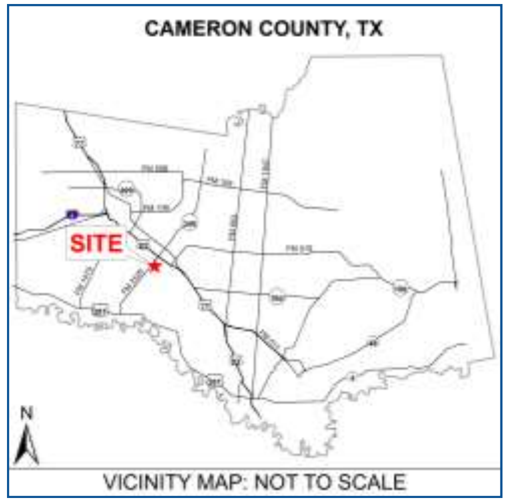
"Filling the Gap"

Colonia: Pennsylvania Ave., Cameron County

Basin: Arroyo Colorado

Category: A1

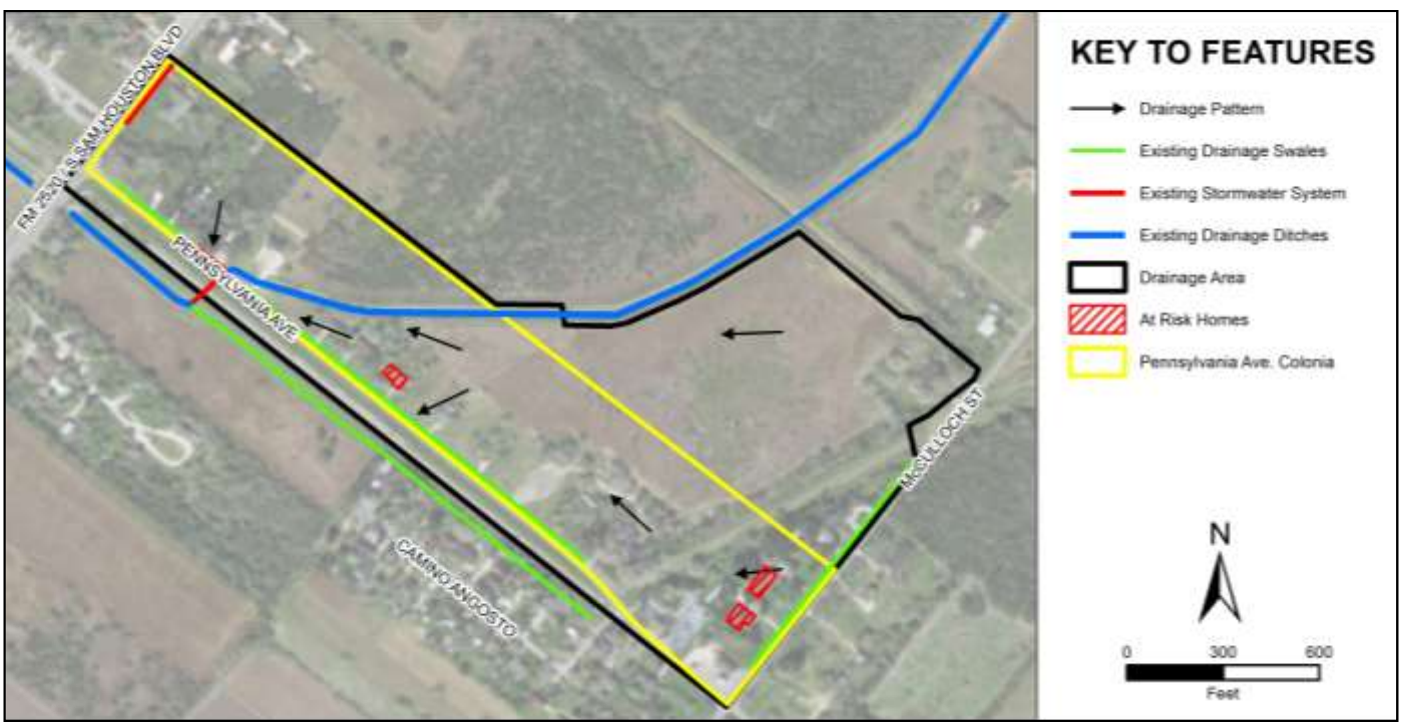
Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Pennsylvania Ave. colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 27-acre colonia are generally towards the drainage ditch that runs through the center of the colonia. The colonia has an existing drainage ditch system, roadside drainage system, and a very small amount of underground storm drain system. Pennsylvania Ave. experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Pennsylvania Ave., Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve and install the roadside drainage system with two retention ponds to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements and expansion of the roadside drainage system with two retention facilities. The improvements include 135 linear feet of 18-inch diameter pipe, 440 linear feet of 36-inch diameter pipe, 2200 linear feet of grassy swales, 2315 linear feet of roadside swale excavation and grading, and associated pavement improvements. The proposed retention ponds are sized to retain on-site runoff up to the 25-year storm with a total effective combined storage area of 7.7 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention ponds, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Pennsylvania Ave.

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	11,300.00
2	**DRAINAGE IMPROVEMENTS**	$	81,983.33
3	**POND EXCAVATION IMPROVEMENTS**	$	210,540.00
	Sub-Total =	$	303,823.33
	Engineering (10%)	$	30,382.33
	Contingency (20%)	$	60,764.67
	Total =	$	394,970.33

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention ponds is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$695,205	$394,970	1.76
Elevate Structures	$695,205	$483,525	1.44
Acquisition/Supplemental Housing/Demolition	$1,122,650	$548,271	2.05

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Figure:

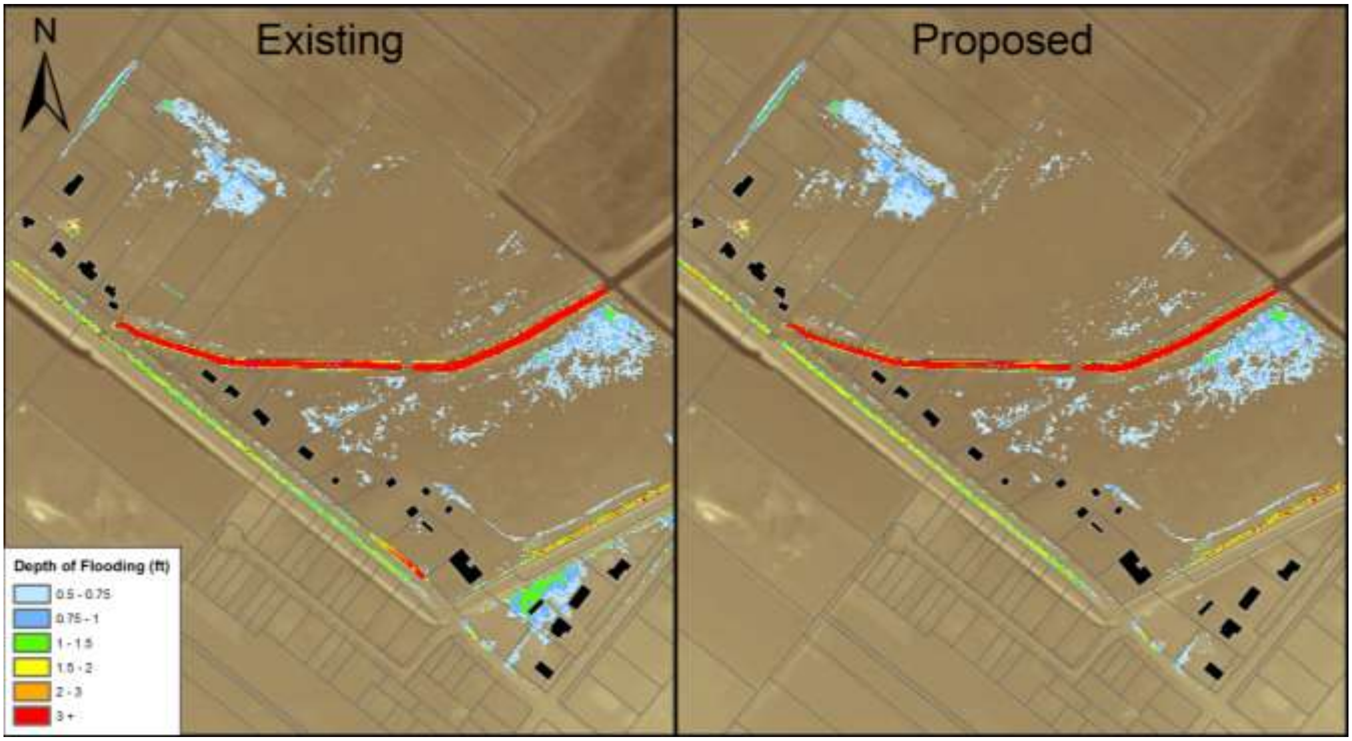


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	19	19	0
Inundated Roadway (LF)	9	9	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Figure:

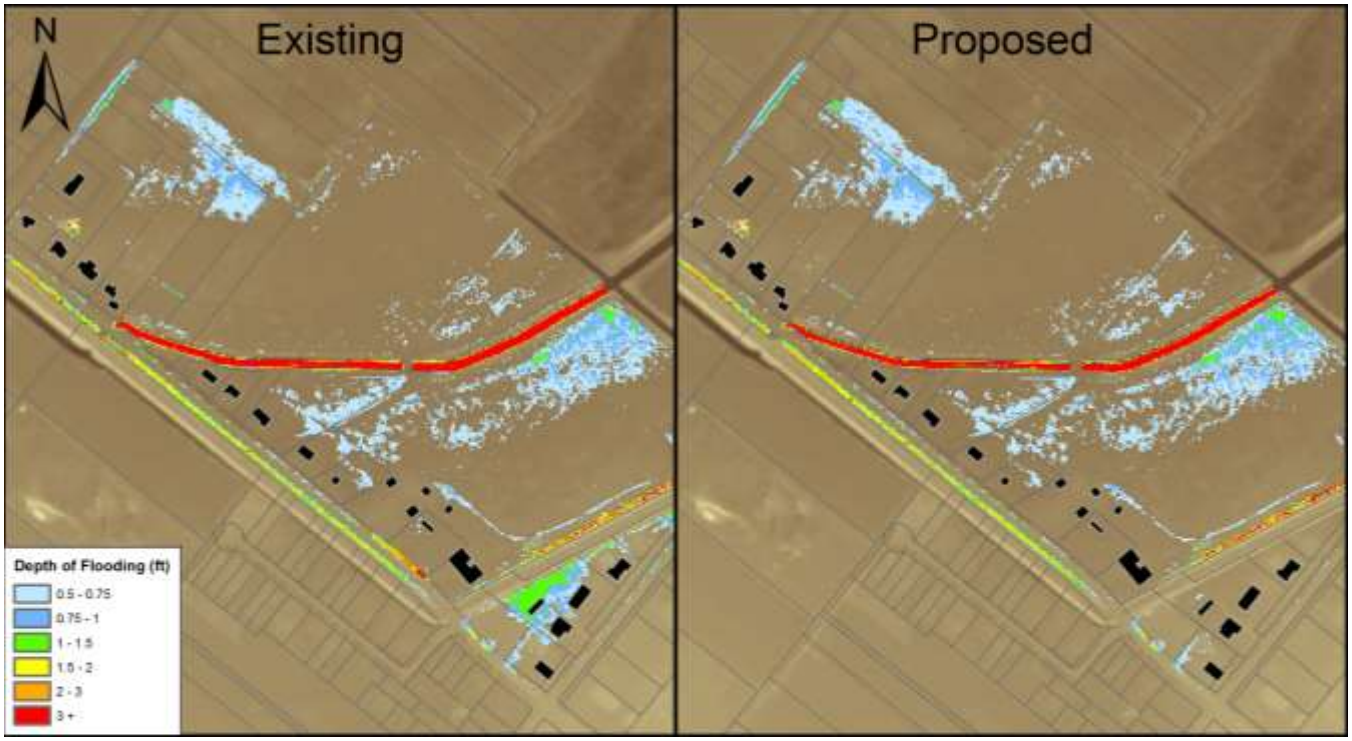


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	19	0
Inundated Roadway (LF)	9	9	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Figure:

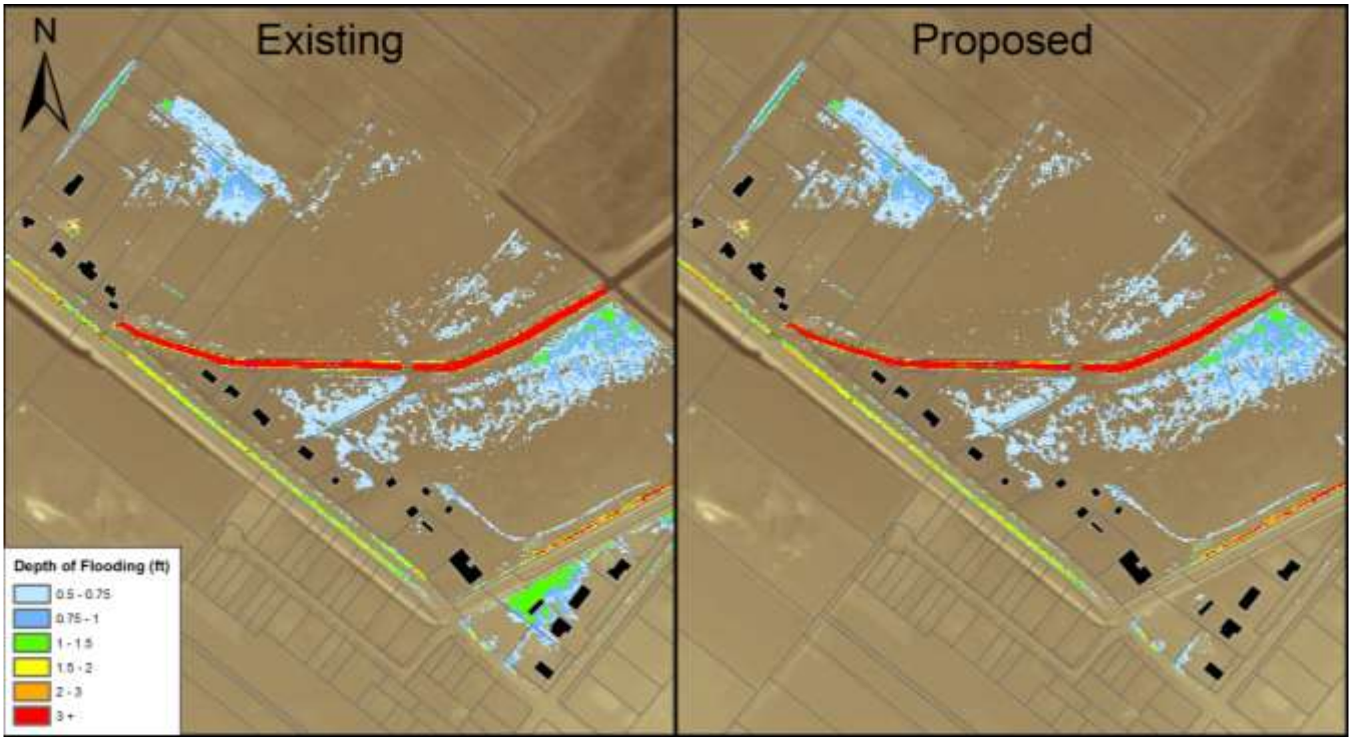


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	19	0
Inundated Roadway (LF)	9	9	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Figure:

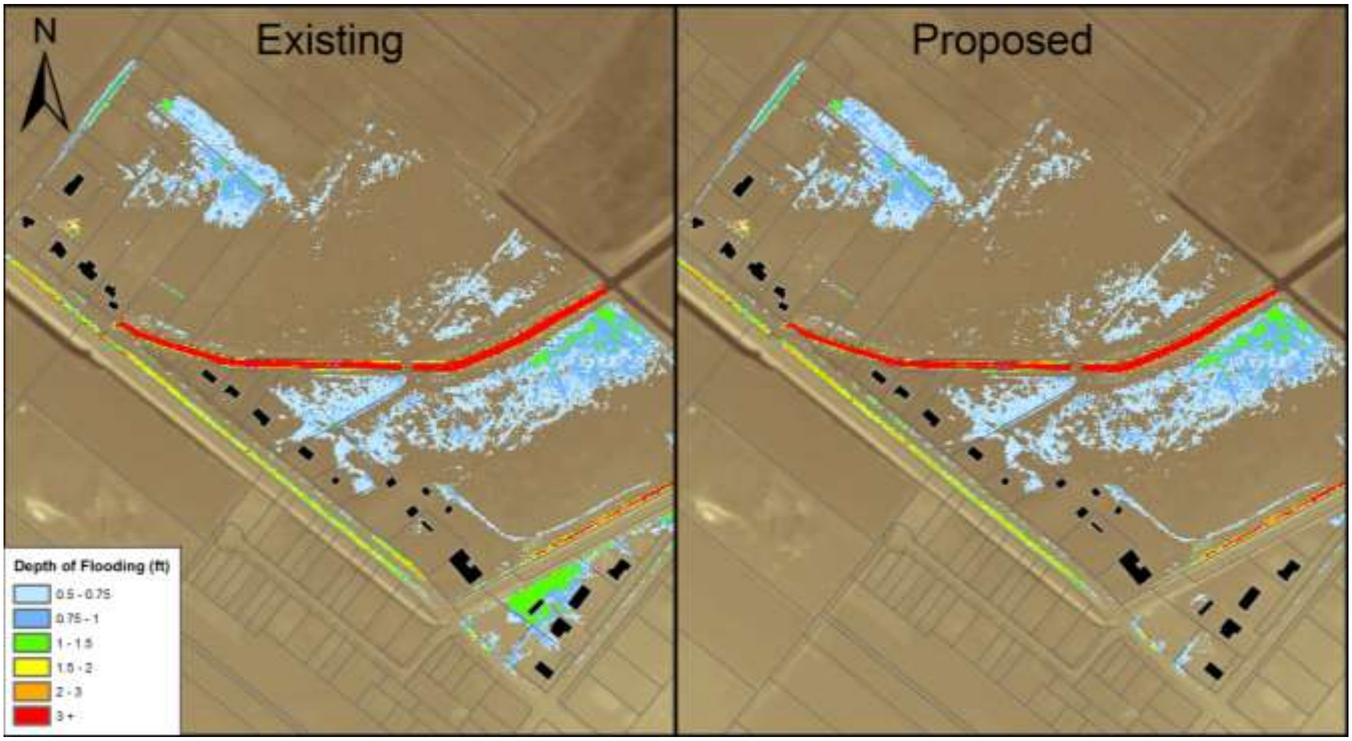


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	19	0
Inundated Roadway (LF)	9	9	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Pennsylvania Ave., Cameron County

Recommended Mitigation Project cont.:

Project Figure:

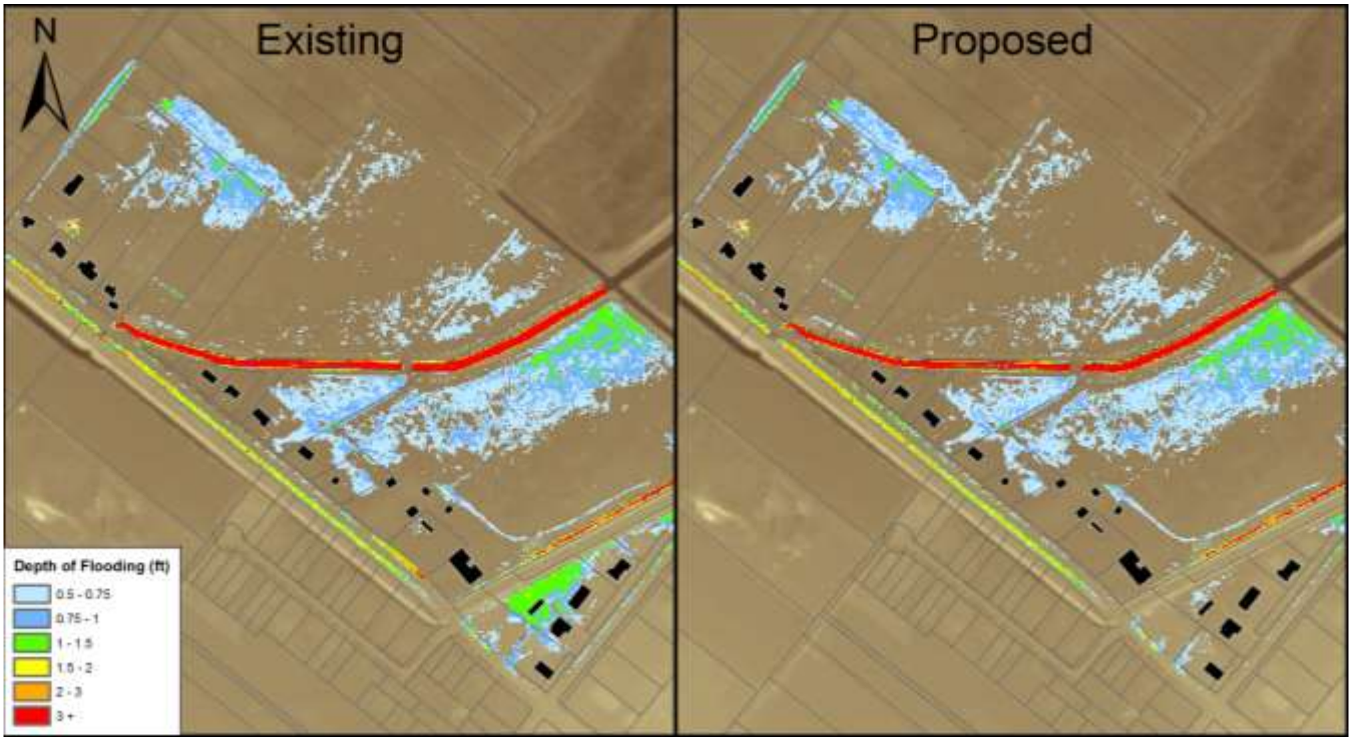


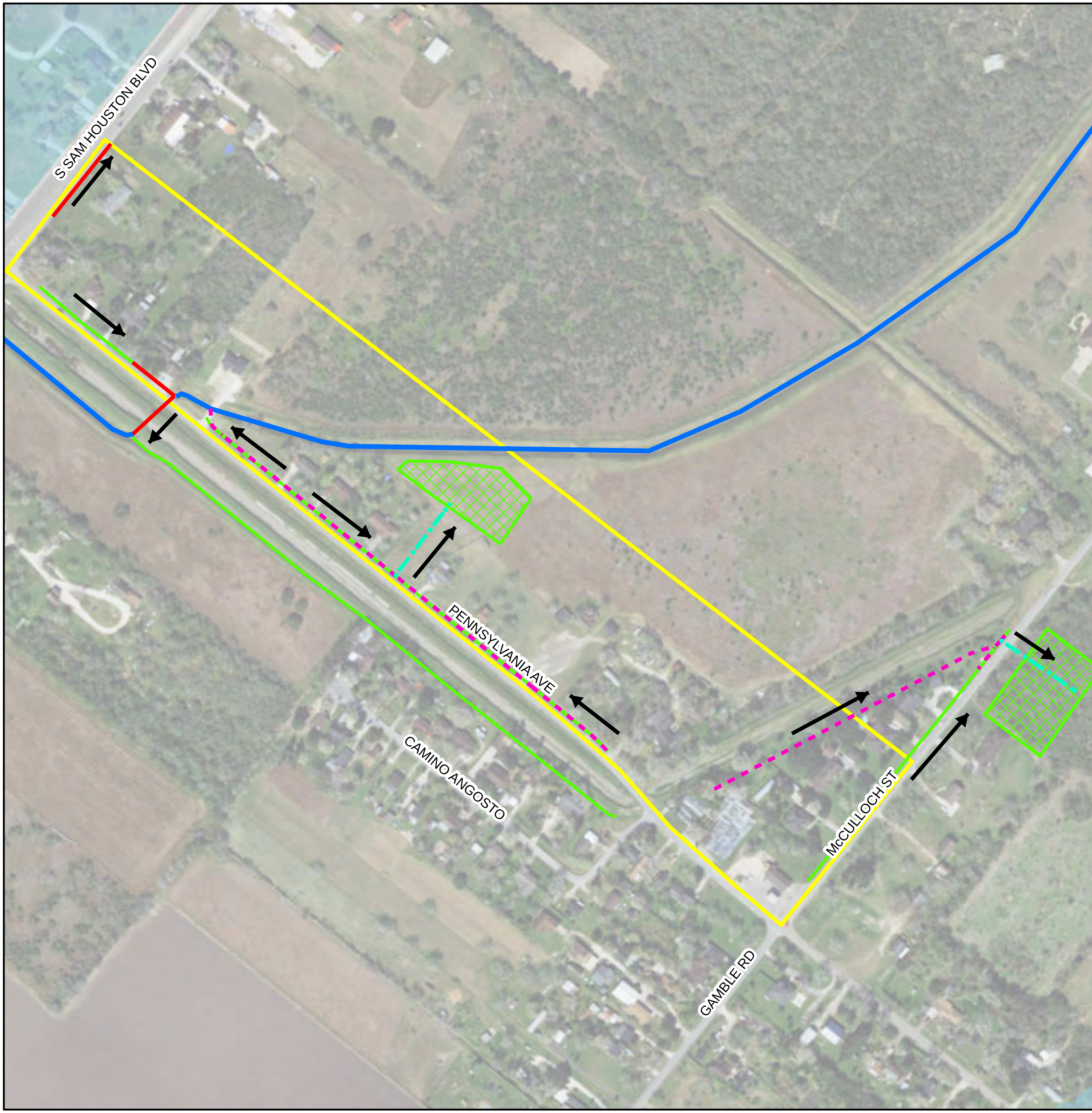
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	19	19	0
Inundated Roadway (LF)	9	9	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Pennsylvania Ave.
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Proposed Retention Pond
- Pennsylvania Ave. Colonia
- Existing Floodplain

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

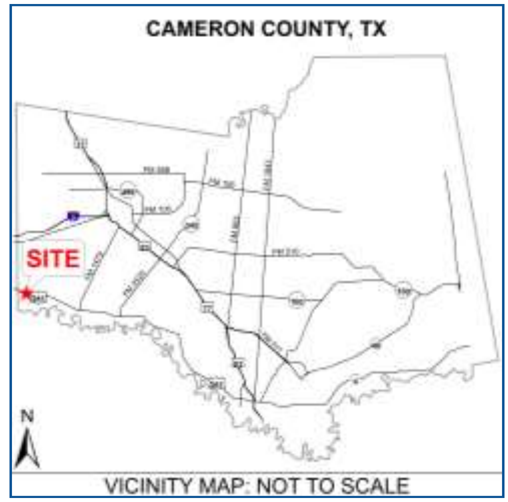
"Filling the Gap"

Colonia: Santa Maria, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Santa Maria colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 117-acre colonia runoff are generally towards the north and east with the northwest portion drainage towards the west. Runoff flows through residential roadside swales towards FM 2556 and US Highway 281 (main arterials), which do not have proper outfall connectivity to adjacent drainage ditches. Culverts under the main arterial roadways are undersized or restricted by sediment and vegetation. Although the County has improved the residential roadside swales, model results show that structures throughout the colonia have a high flooding potential due to very flat terrain within the colonia. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6-9 inches, dark blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red is more than 3 feet. Flood damages and potential benefits to the Santa Maria High School are not included in this analysis and should be evaluated in future phases of design.

Colonia: Santa Maria, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve conveyance in areas along US Hwy 281, FM 2556, Main St., Lee St., Boyd Ave., Robertson Ave., and Tutt Ave. with proposed roadside swales
  - Improve conveyance on home lots to roadside swales with strategically placed grassy swales
  - Install road crossing culverts and driveway culverts along US Hwy 281, FM 2556, Main St., and Tuff Ave.
  - Install outfalls to drainage ditch along northwest corner of colonia
  - Install two retention ponds to eliminate off-site impacts north and east of the colonia
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes roadside swales and driveway culvert improvements along US Highway 281 and FM 2556. Roadside swale improvements throughout the colonia are also included to ensure adequate connectivity to the proposed retention ponds. The improvements include 880 linear feet of driveway culvert improvements, 2 drop inlets, 1,680 linear feet of 24 inch RCP, and approximately 11,800 linear feet of roadside swale improvements. The proposed retention ponds are sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 58 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. Proposed outfalls to the drainage ditch west of the colonia along FM 2556 may require authorization from Irrigation District #4. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Santa Maria Colonia		
	IMPROVEMENTS		COST
1	DRIVEWAY IMPROVEMENTS	$	34,850.00
2	DRAINAGE IMPROVEMENTS	$	279,893.00
2	POND EXCAVATION IMPROVEMENTS	$	1,515,888.00
	Sub-Total =	$	1,830,631.00
	Engineering (10%)	$	183,063.10
	Contingency (20%)	$	366,126.20
	Total =	$	2,379,820.30
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 9.0 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	11	4	7
20% (5-year)	12	6	6
10% (10-year)	12	6	6
4% (25-year)	12	6	6
1% (100-year)	14	6	8

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$7,286,759	$2,379,820	3.06
Elevate Structures	$7,286,759	$1,128,975	6.45
Acquisition/Supplemental Housing/Demolition	$7,956,392	$1,005,060	7.92

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

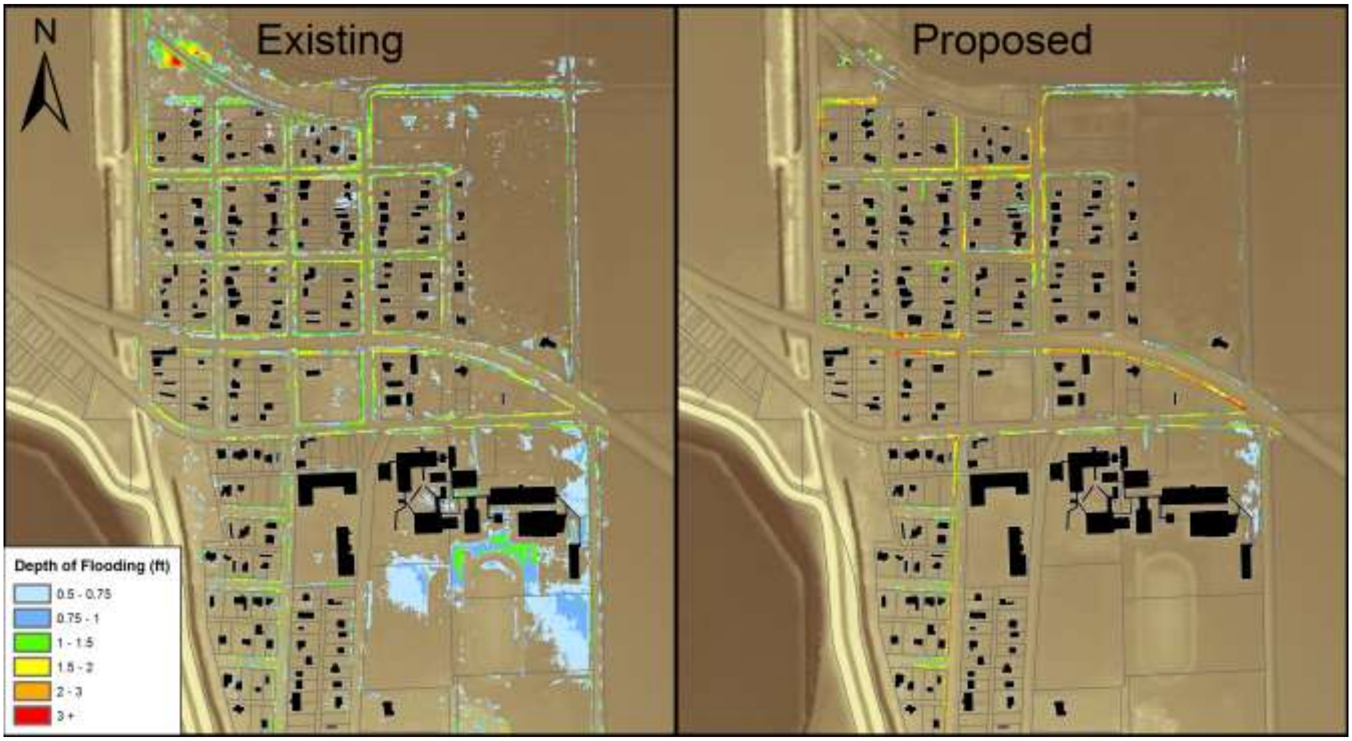


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	4	7
Inundated Lots	210	70	140
Inundated Roadway (LF)	170	50	120

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

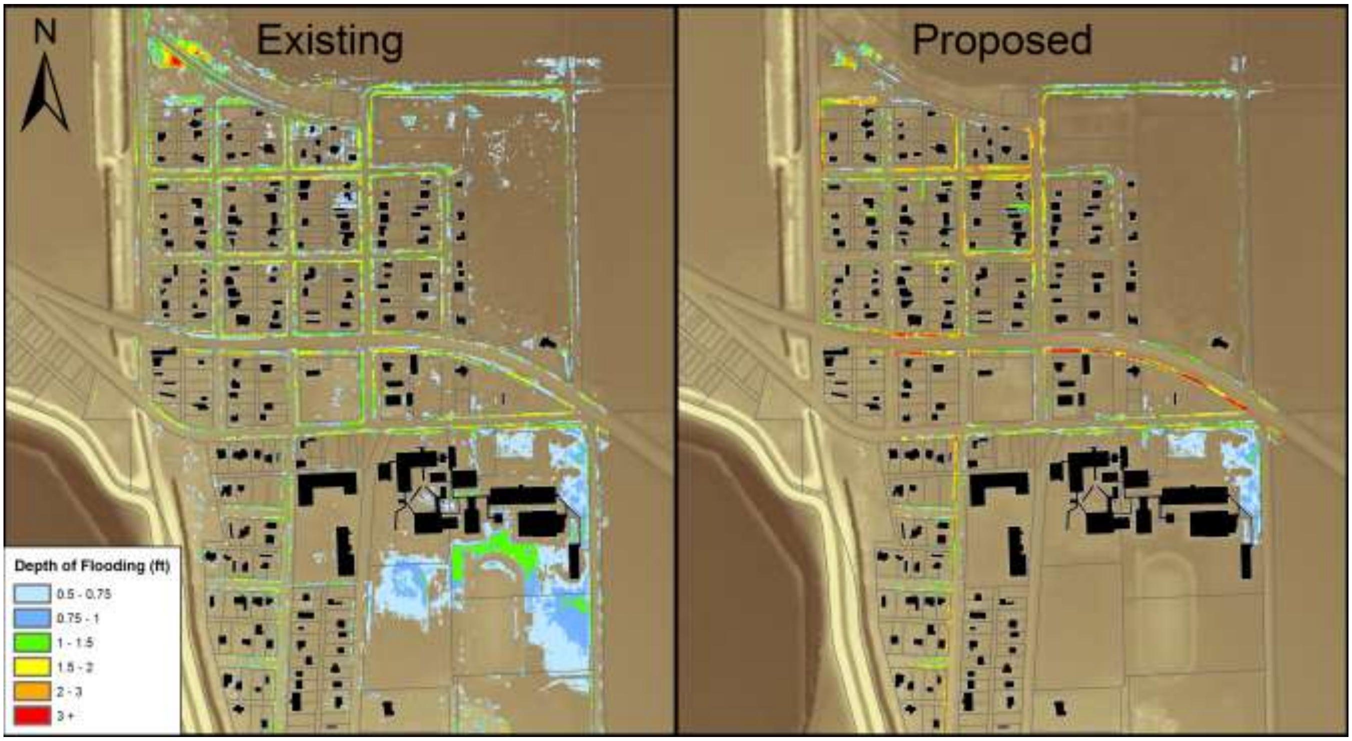


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	6	6
Inundated Lots	215	100	115
Inundated Roadway (LF)	250	60	190

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

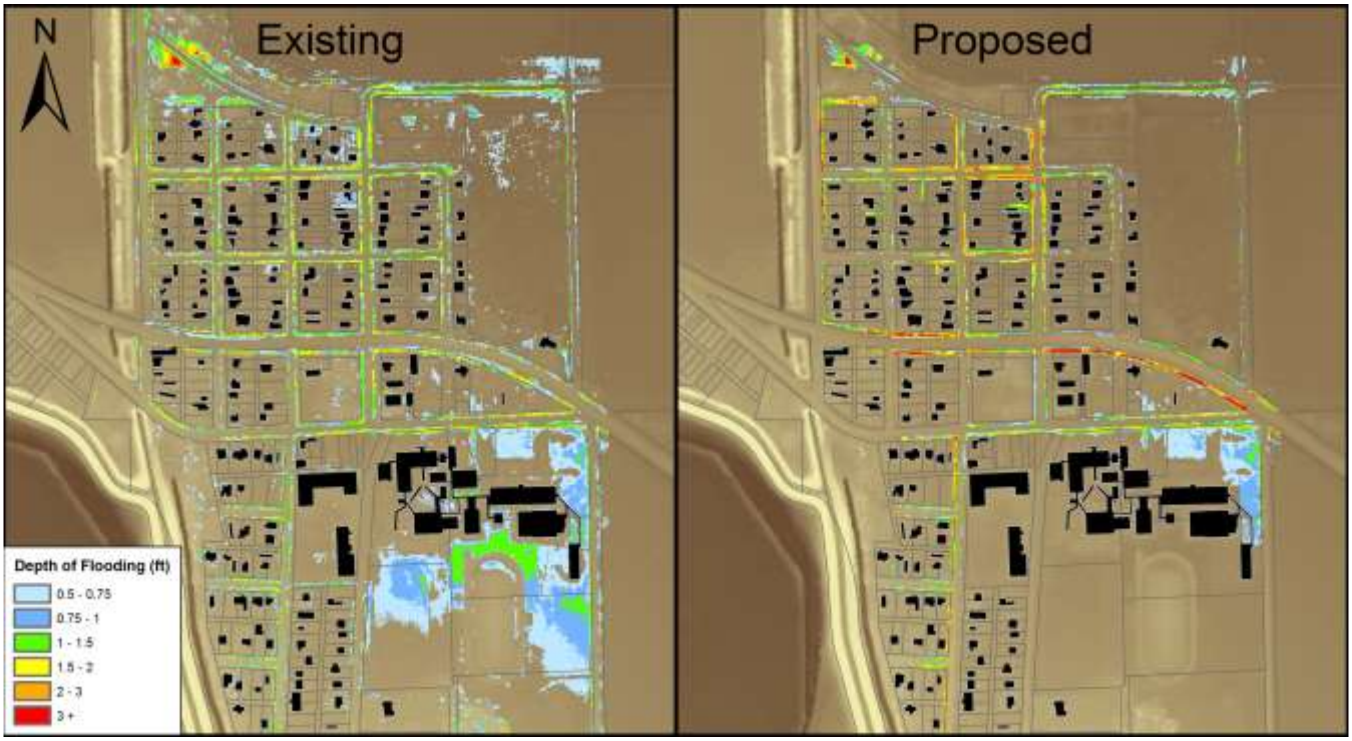


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	6	6
Inundated Lots	220	115	105
Inundated Roadway (LF)	250	170	80

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

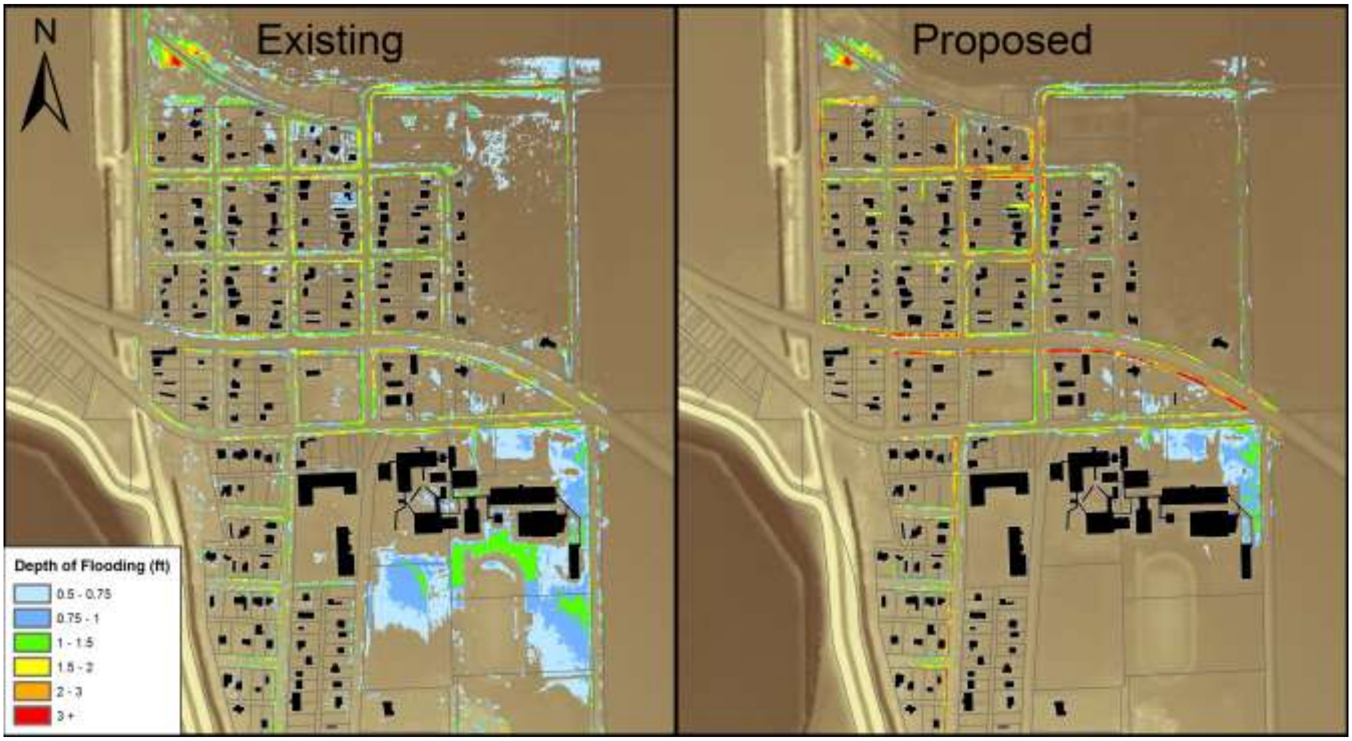


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	6	6
Inundated Lots	225	125	100
Inundated Roadway (LF)	310	220	90

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Maria, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

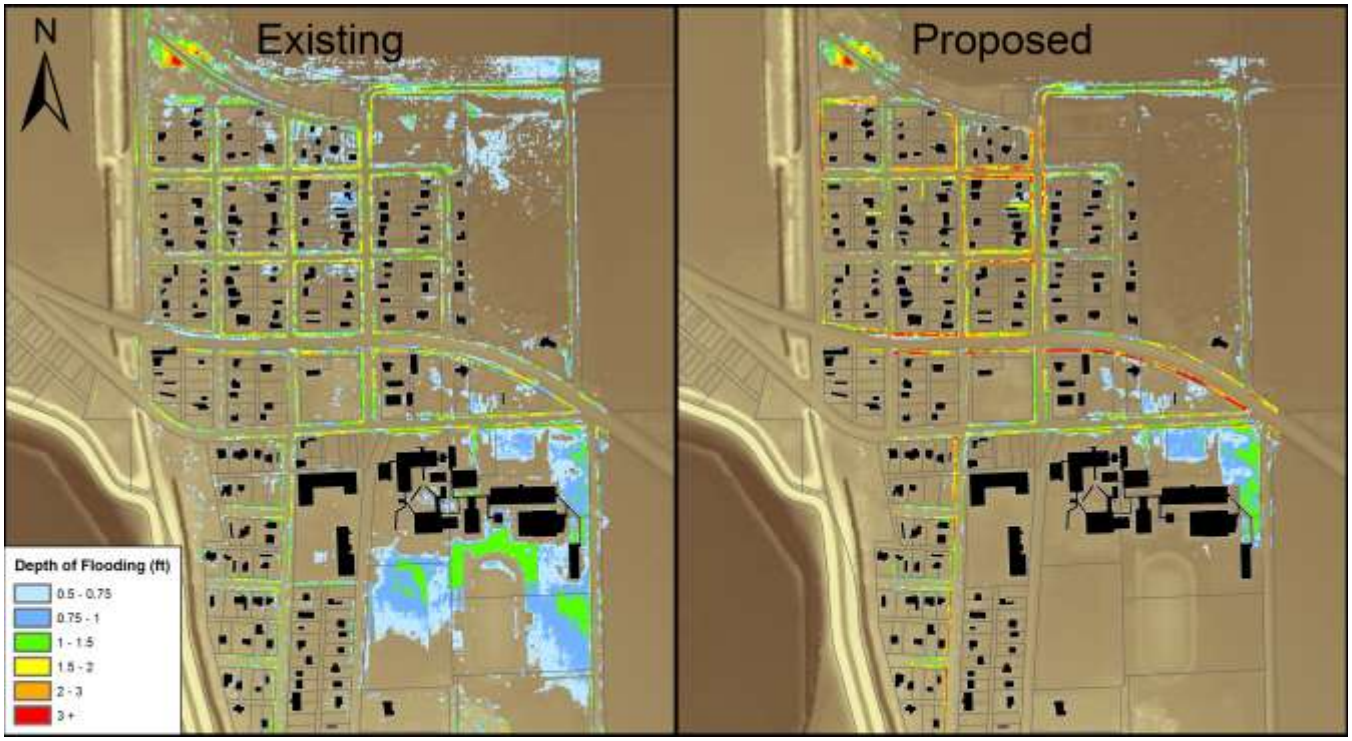


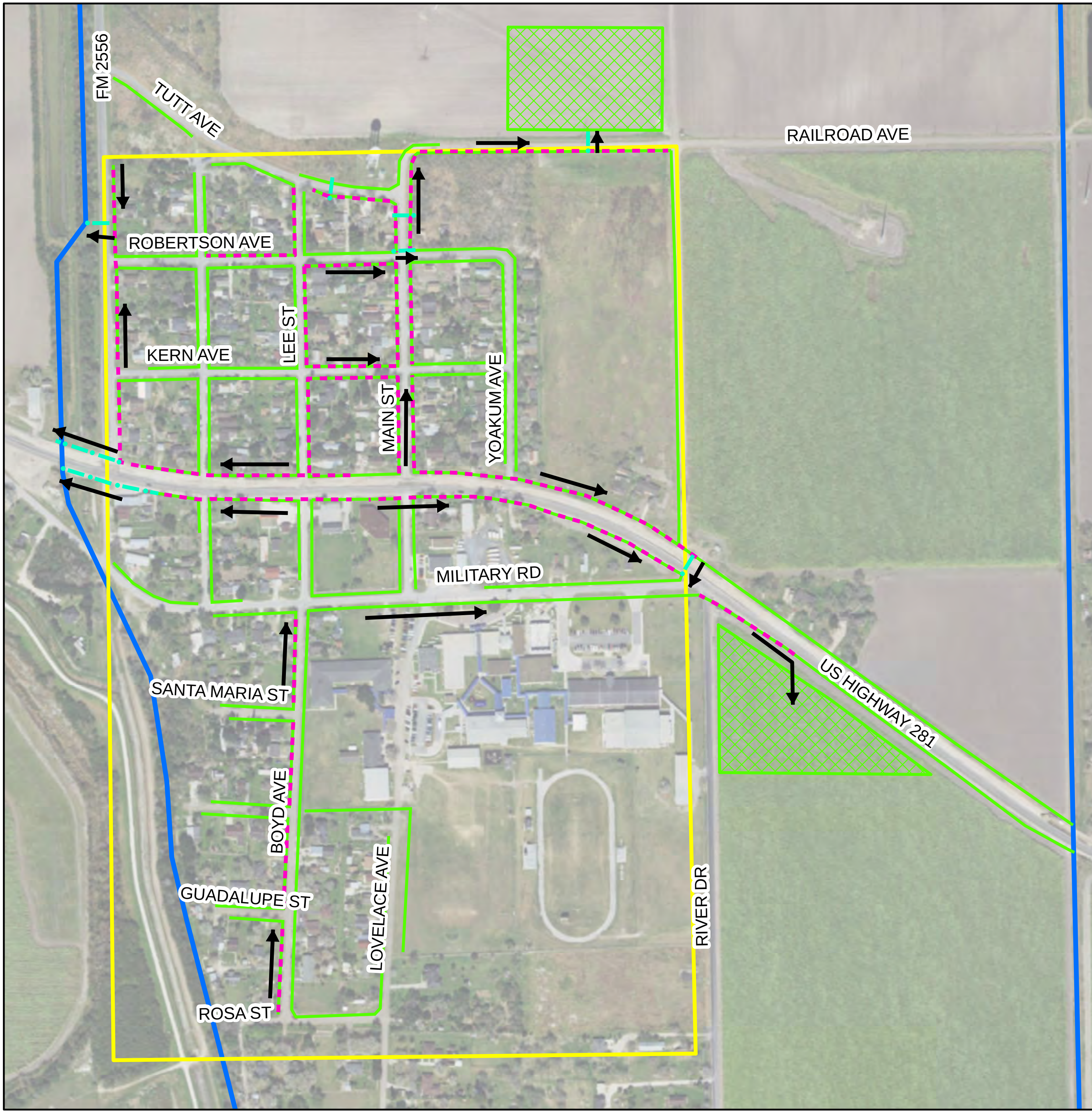
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	14	6	8
Inundated Lots	230	135	95
Inundated Roadway (LF)	350	270	80

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Santa Maria
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Drainage Ditches
- Proposed Retention Pond
- Santa Maria Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

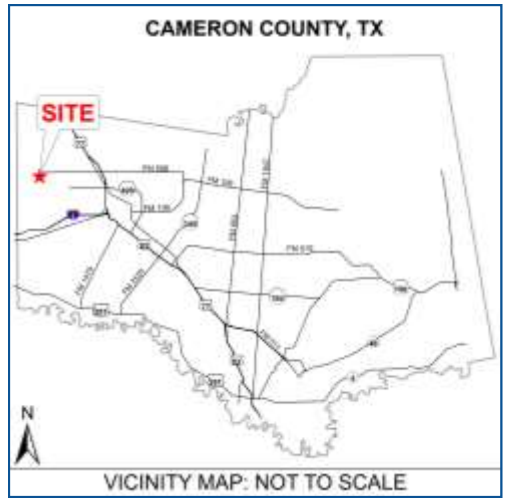
Colonia: Santa Rosa No. 13, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Santa Rosa No. 13 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 47-acre colonia are southerly. The colonia has an existing roadside drainage system, and a very small amount of underground storm drain system. Due to inadequate conveyance of stormwater, Santa Rosa No. 13 experiences residential lot and street flooding in nearly every rainfall event. Ponding occurs in areas of low terrain, especially on the west side of FM 506. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Santa Rosa No. 13, Cameron County

"Filling the Gap"

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install and Improve the roadside drainage system to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes a roadside drainage system improvements. The improvements include 610 linear feet of swale excavation and grading, 60 linear feet of 18-inch diameter pipe, 45 linear feet of 24-inch diameter pipe, 35 linear feet of 30-inch diameter pipe, two 36-inch safety end treatments, 500 linear feet of grassy swales between homes in order to allow drainage to roadside swales, and associated pavement improvements.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Santa Rosa 13 Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	4,333.33
2	**DRAINAGE IMPROVEMENTS**	$	14,847.22
3	**POND EXCAVATION IMPROVEMENTS**	$	-
	Sub-Total =	**$**	**19,180.56**
	Engineering (10%)	$	1,918.06
	Contingency (20%)	$	3,836.11
	Total =	**$**	**24,934.72**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Santa Rosa No. 13, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	1	0	1
1% (100-year)	1	0	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$38,201	$24,935	1.53
Elevate Structures	$38,201	$117,000	0.33
Acquisition/Supplemental Housing/Demolition	$247,092	$103,268	2.39

Colonia: Santa Rosa No. 13, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

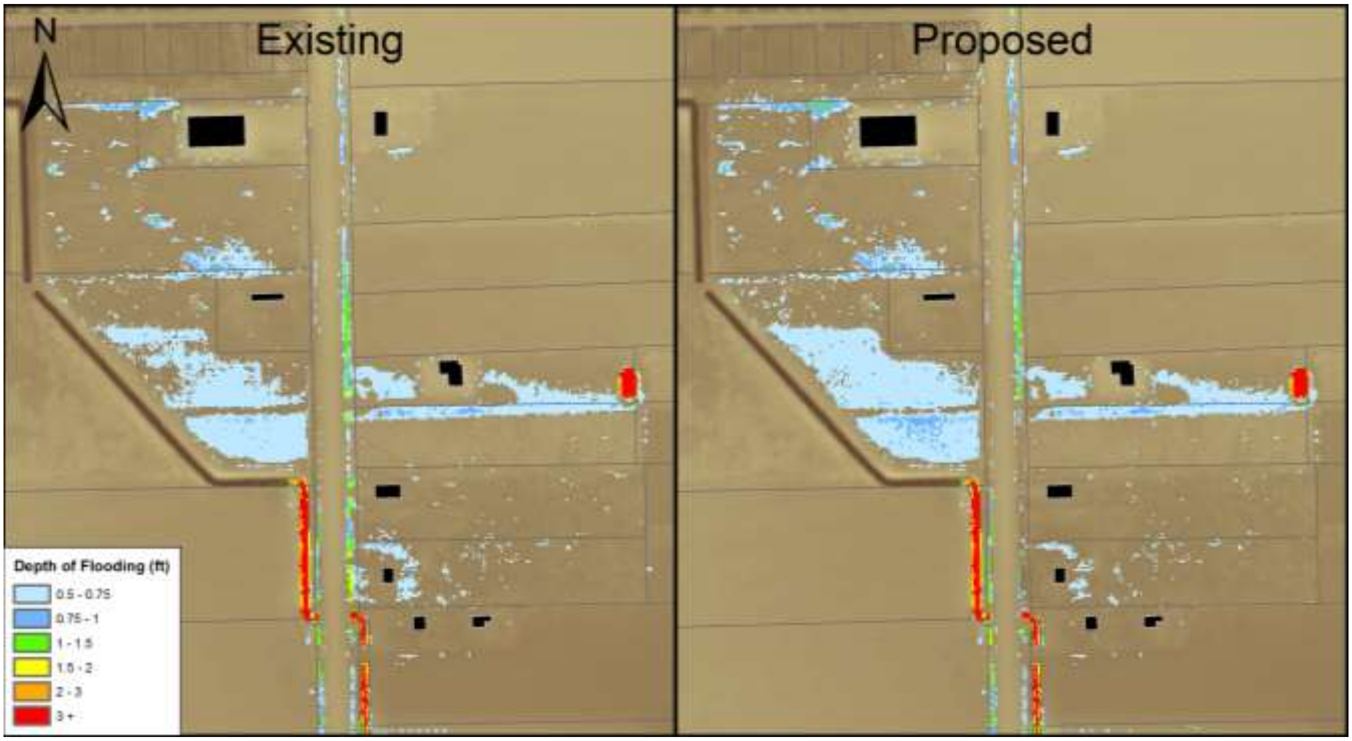


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	16	14	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa No. 13, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

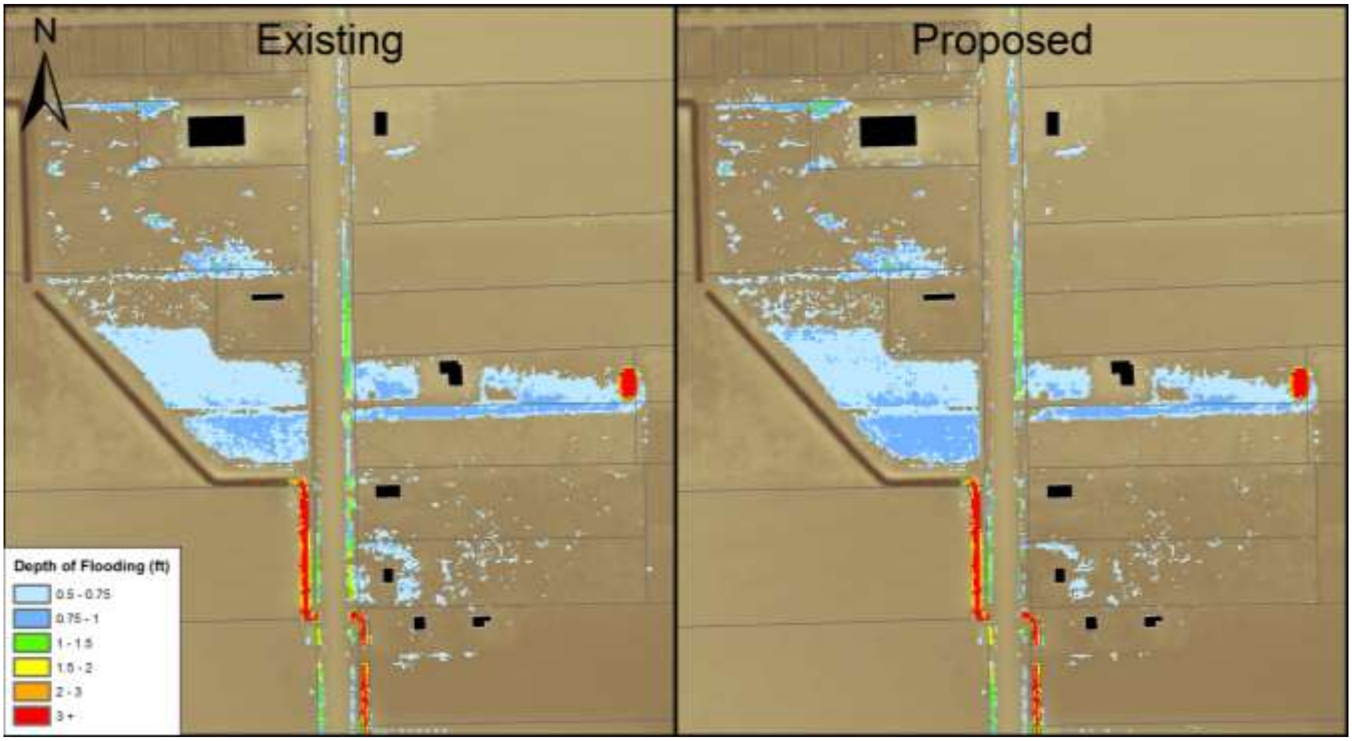


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	16	14	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Recommended Mitigation Project cont.:

Project Figure:

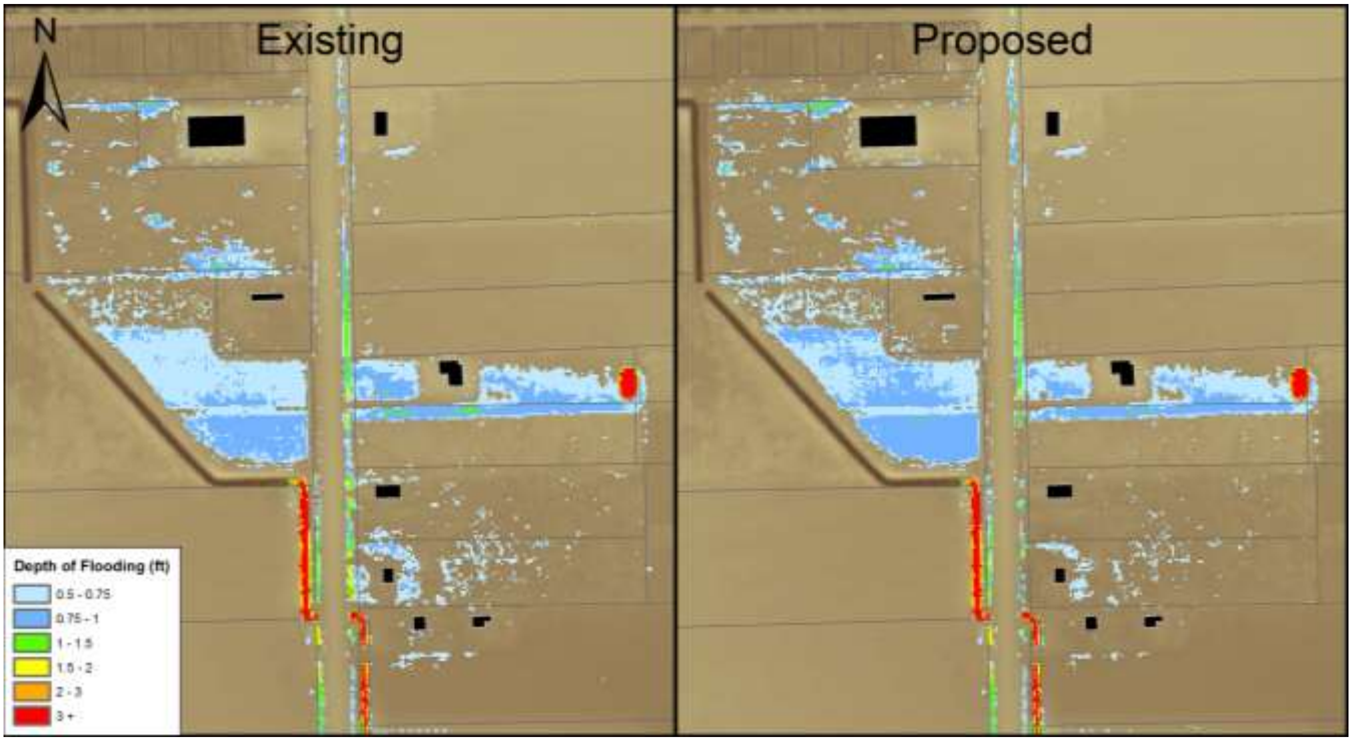


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	16	15	1
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa No. 13, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

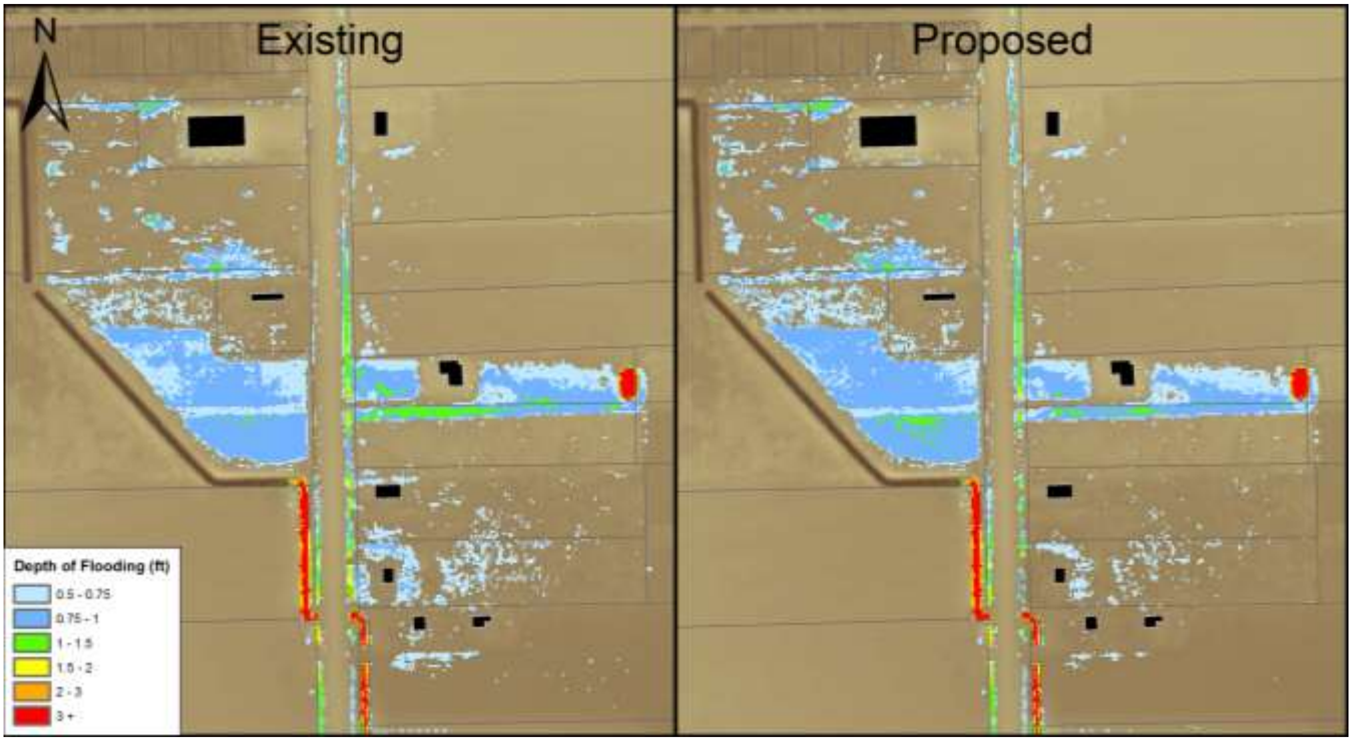


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	16	15	1
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa No. 13, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

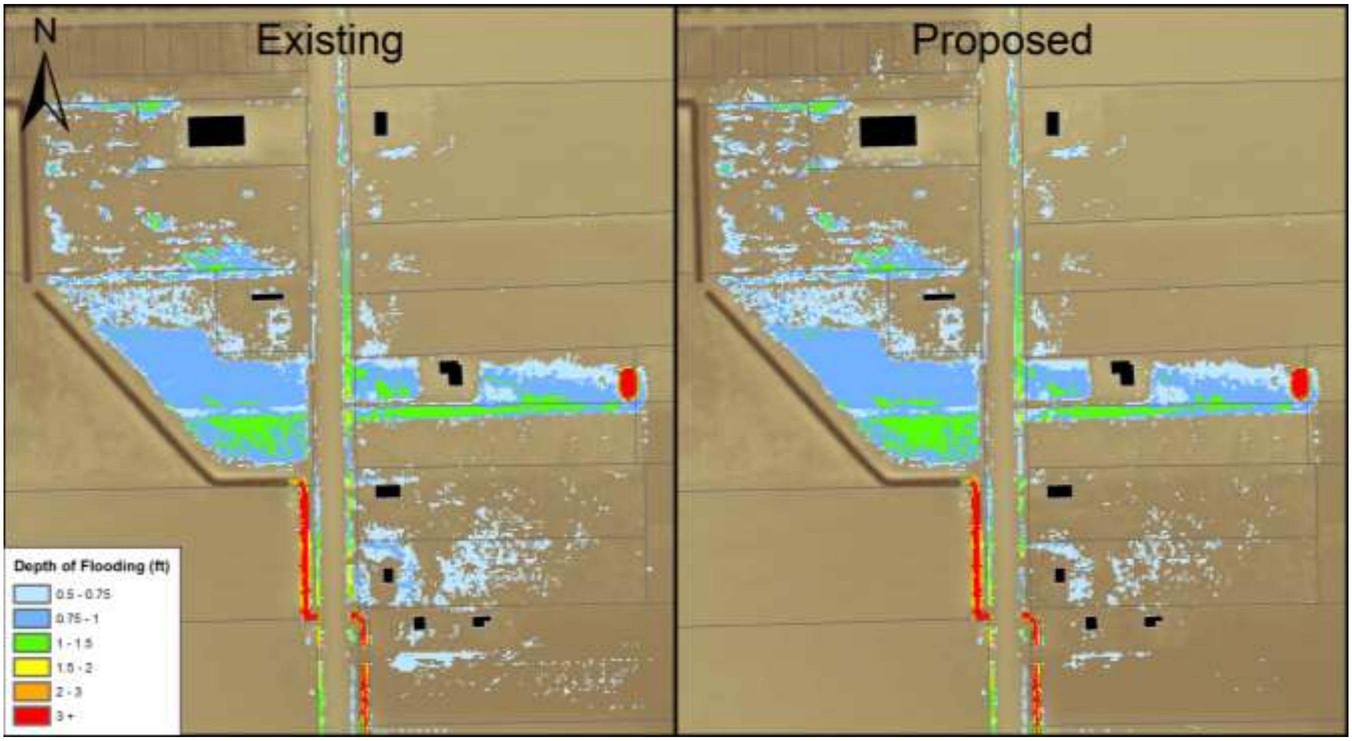
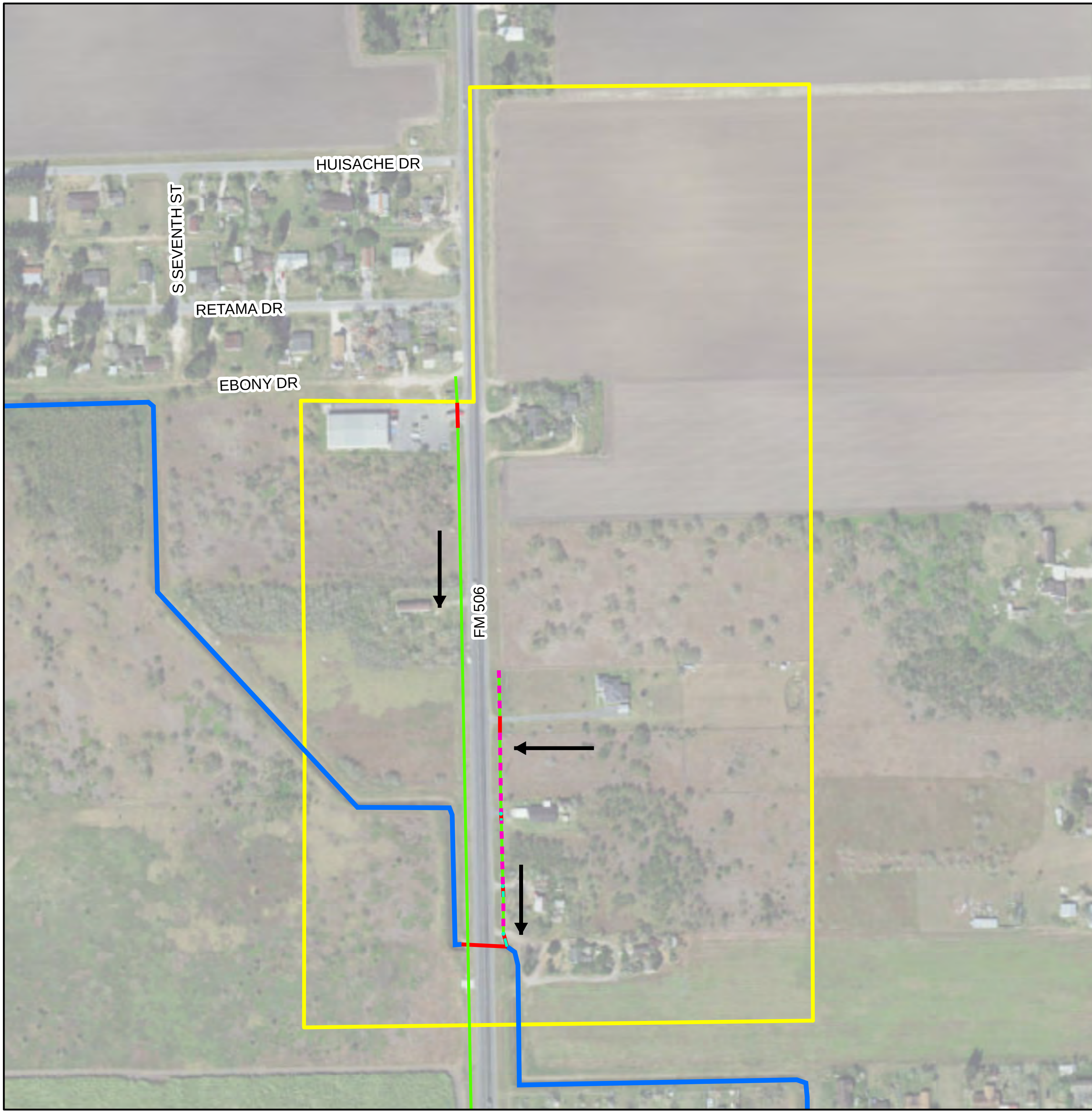


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	16	15	1
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Santa Rosa No. 13
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Santa Rosa No. 13 Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

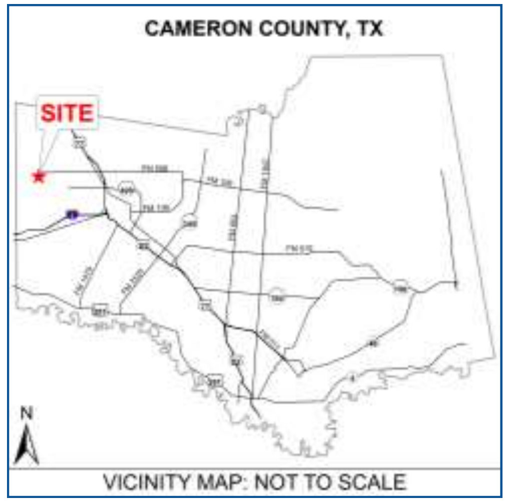
Colonia: Santa Rosa Annex, Cameron County

Basin: Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Santa Rosa Annex colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 23-acre colonia are generally towards the center of the colonia. Runoff collects in an existing drainage ditch system flowing through the center of the colonia. Roadside drainage system, and pipe culverts connect roadside swales and outfall into the drainage ditch. Due to undersized infrastructure, Santa Rosa Annex experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Santa Rosa Annex, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with retention ponds to mitigate off-site impacts
  - Improve and/or install adequately sized road crossing culverts and driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements of the existing roadside drainage system with two retention facilities. The improvements include 2,550 linear feet of ditch excavation and grading, 375 linear feet of 18-inch diameter pipe, 270 linear feet of 24-inch diameter pipe, 220 linear feet of 36-inch diameter pipe, eight 36-inch safety end treatments, 2,500 linear feet of grassy swales between homes in order to allow drainage to roadside swales, and associated pavement improvements. The proposed retention ponds are sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 14 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention ponds, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Santa Rosa Annex Colonia		
	IMPROVEMENTS	COST	
1	PAVING IMPROVEMENTS	$	30,183.33
2	DRAINAGE IMPROVEMENTS	$	83,470.00
3	POND EXCAVATION IMPROVEMENTS	$	379,940.00
	Sub-Total =	$	493,593.33
	Engineering (10%)	$	49,359.33
	Contingency (20%)	$	98,718.67
	Total =	$	641,671.33
NOTE	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention ponds is approximately 3.4 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$799,756	$641,672	1.25
Elevate Structures	$799,756	$202,200	3.96
Acquisition/Supplemental Housing/Demolition	$1,040,520	$242,359	4.29

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

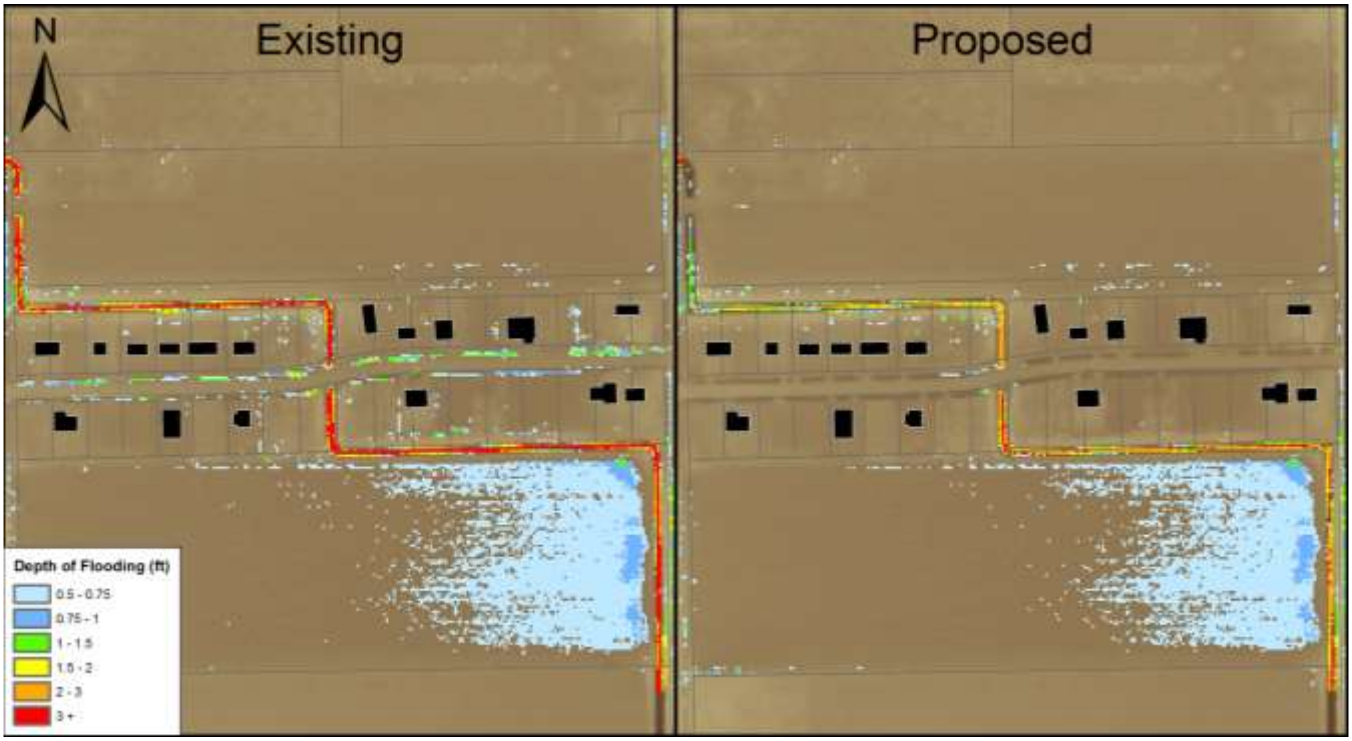


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	36	22	14
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

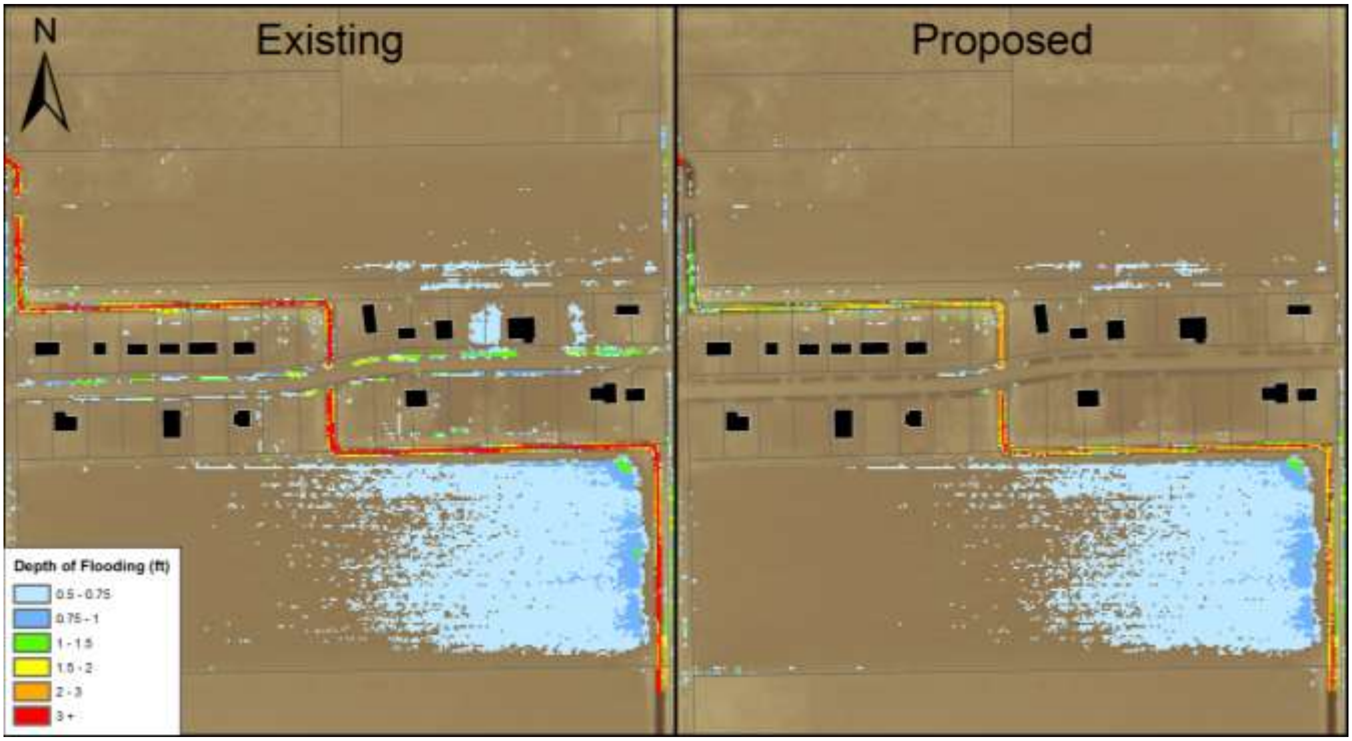


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	37	23	14
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

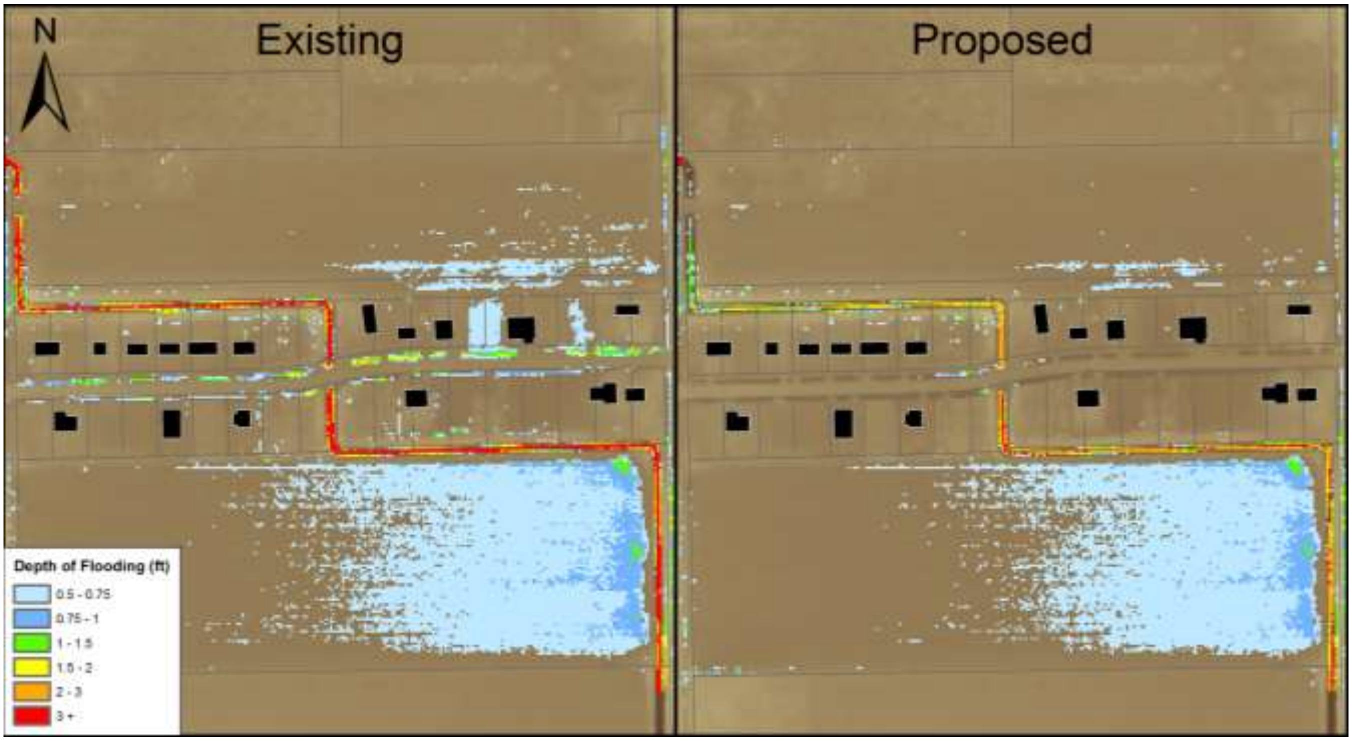


Figure 10: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	38	25	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

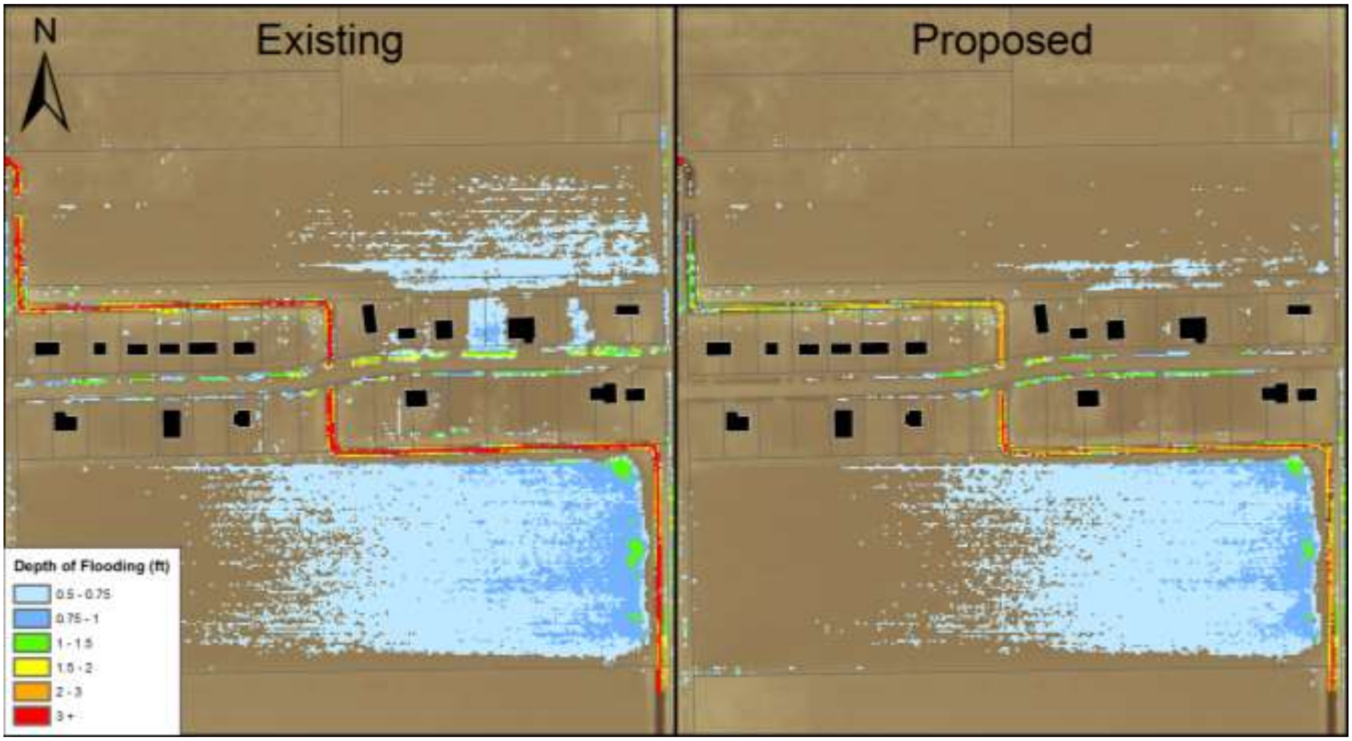


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	38	29	9
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Santa Rosa Annex, Cameron County

Recommended Mitigation Project cont.:

Project Figure:

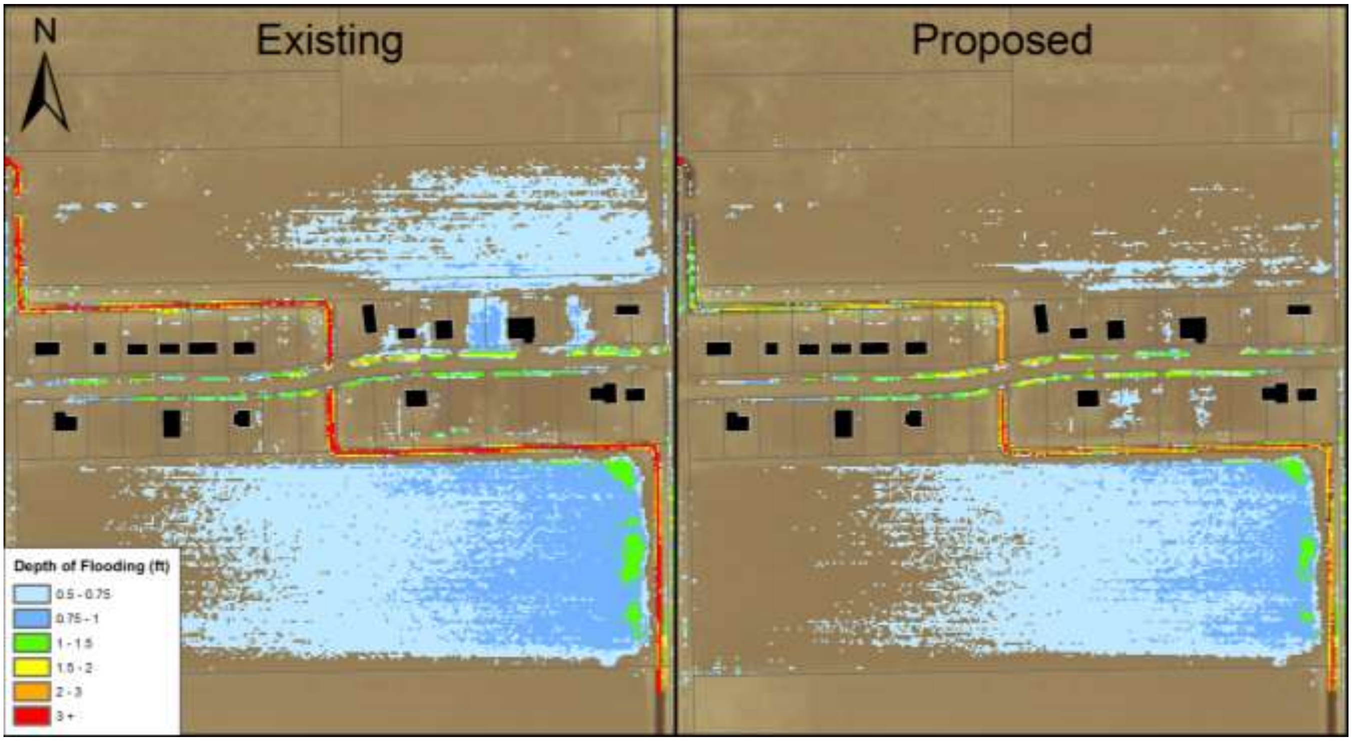


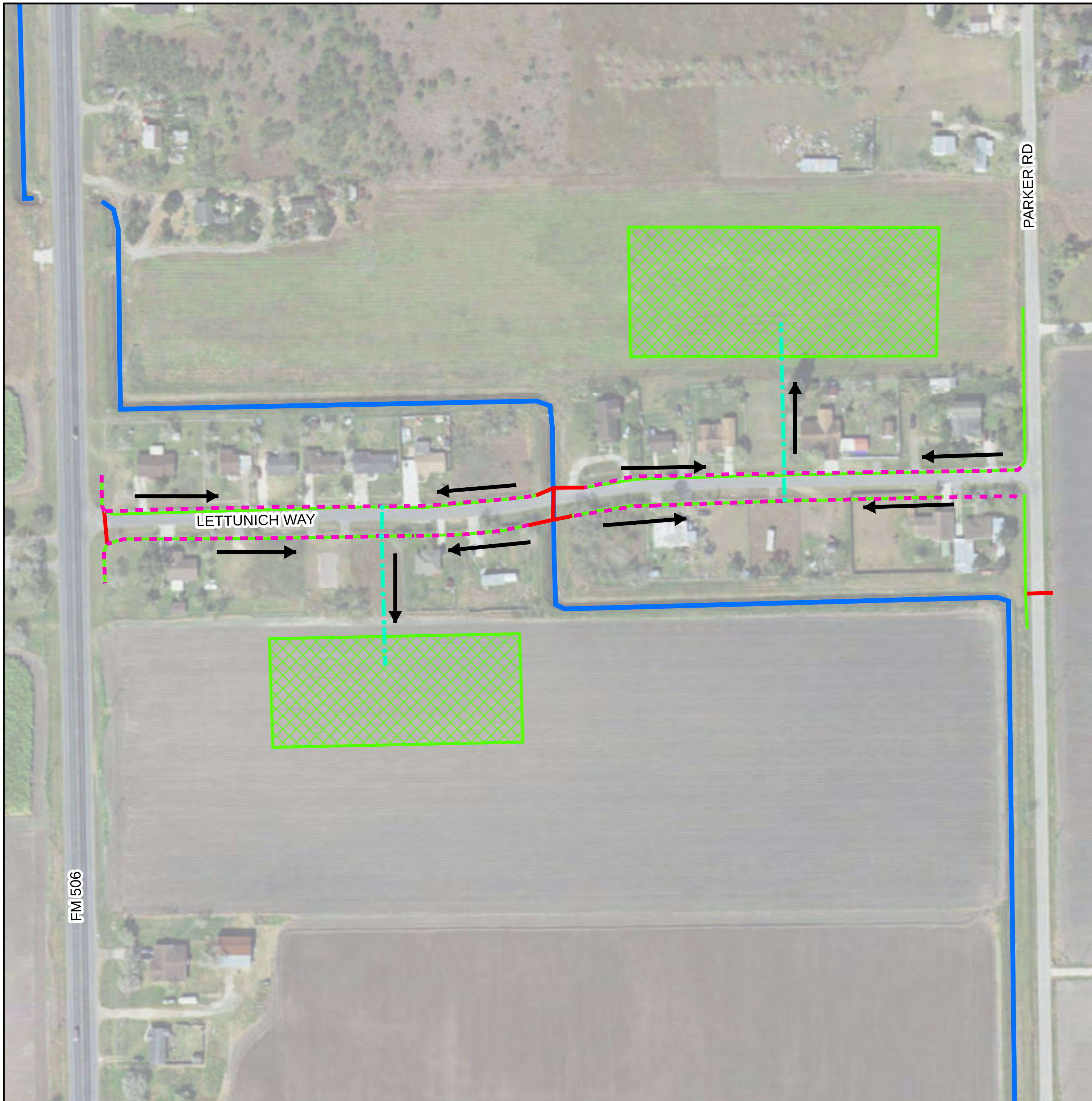
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	38	35	3
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Santa Rosa Annex
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Proposed Retention Pond
- Existing Floodplain
- Santa Rosa Annex Colonia

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

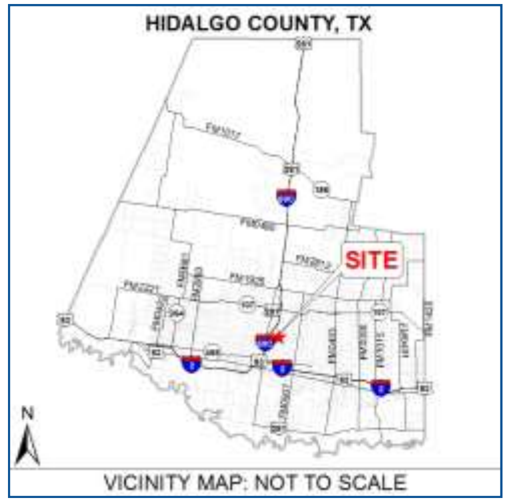
Colonia: Alberta Estates No.2, Hidalgo County

Basin: North Main Drain

Category: A1

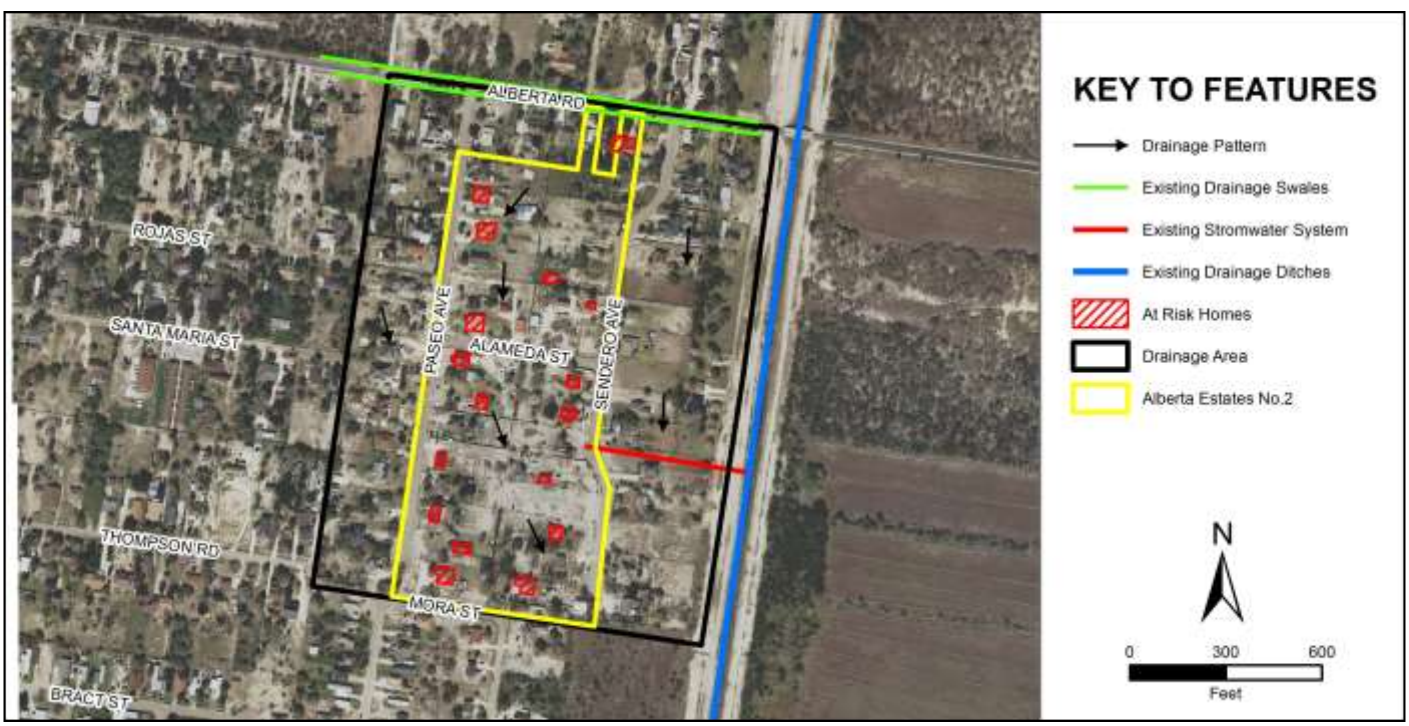
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Alberta Estates No. 2 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 19-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Alberta Estates No. 2 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Alberta Estates No.2, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install curb inlets
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 80 linear feet of 18-inch diameter pipe, 380 linear feet of 24-inch diameter pipe, 300 linear feet of 30-inch diameter, 1,825 linear feet of 36-inch diameter pipe, 330 linear feet of 42-inch diameter pipe, 280 linear feet of 48-inch diameter pipe, 2,700 linear feet of grassy swale, 425 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 19.3 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Alberta Estates No. 2		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	670,941.78
2	**DRAINAGE IMPROVEMENTS**	$	75,422.22
3	**POND EXCAVATION IMPROVEMENTS**	$	509,410.00
	Sub-Total =	**$**	**1,255,774.00**
	Engineering (10%)	$	125,577.40
	Contingency (20%)	$	251,154.80
	Total =	**$**	**1,632,506.20**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	3	0	3
10% (10-year)	5	0	5
4% (25-year)	12	0	12
1% (100-year)	17	3	14

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$3,116,644	$1,632,506	1.91
Elevate Structures	$3,116,644	$1,509,525	2.06
Acquisition/Supplemental Housing/Demolition	$3,517,582	$1,908,959	1.84

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

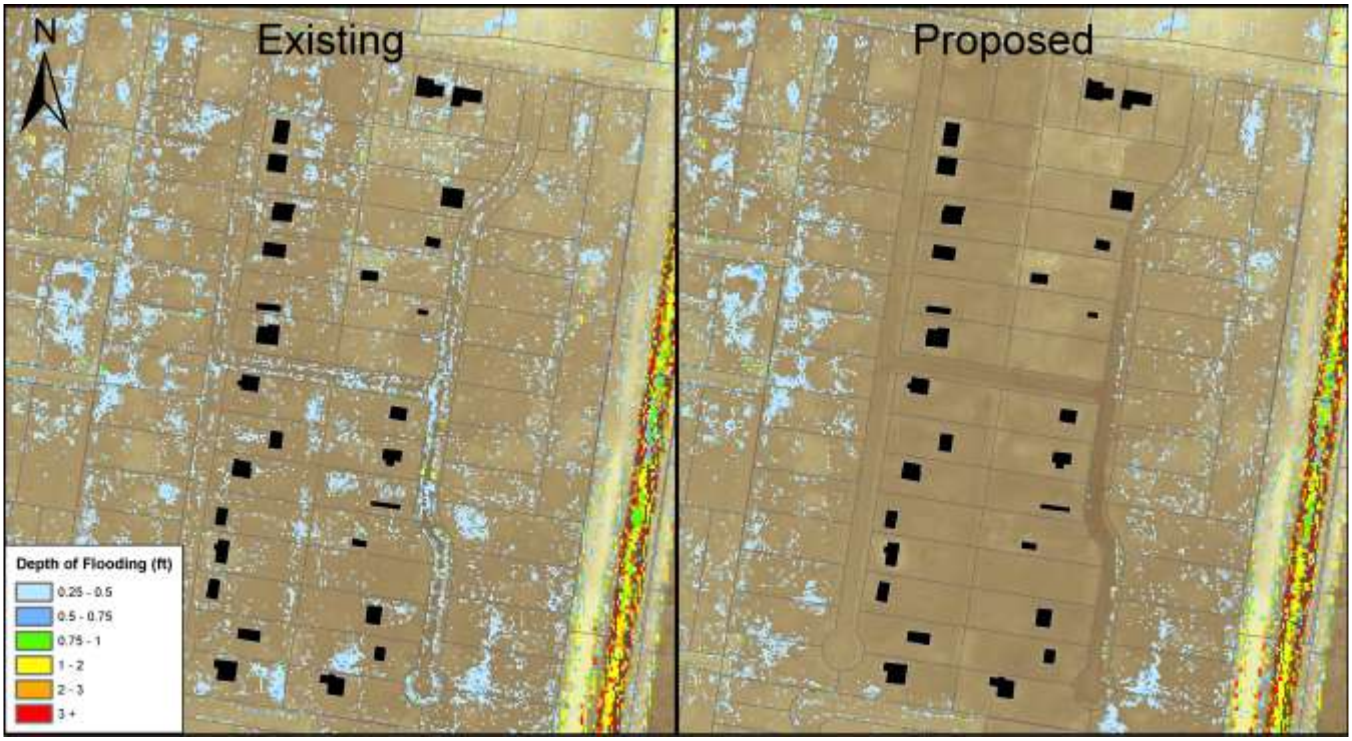


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	30	2	28
Inundated Roadway (LF)	490	20	470

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

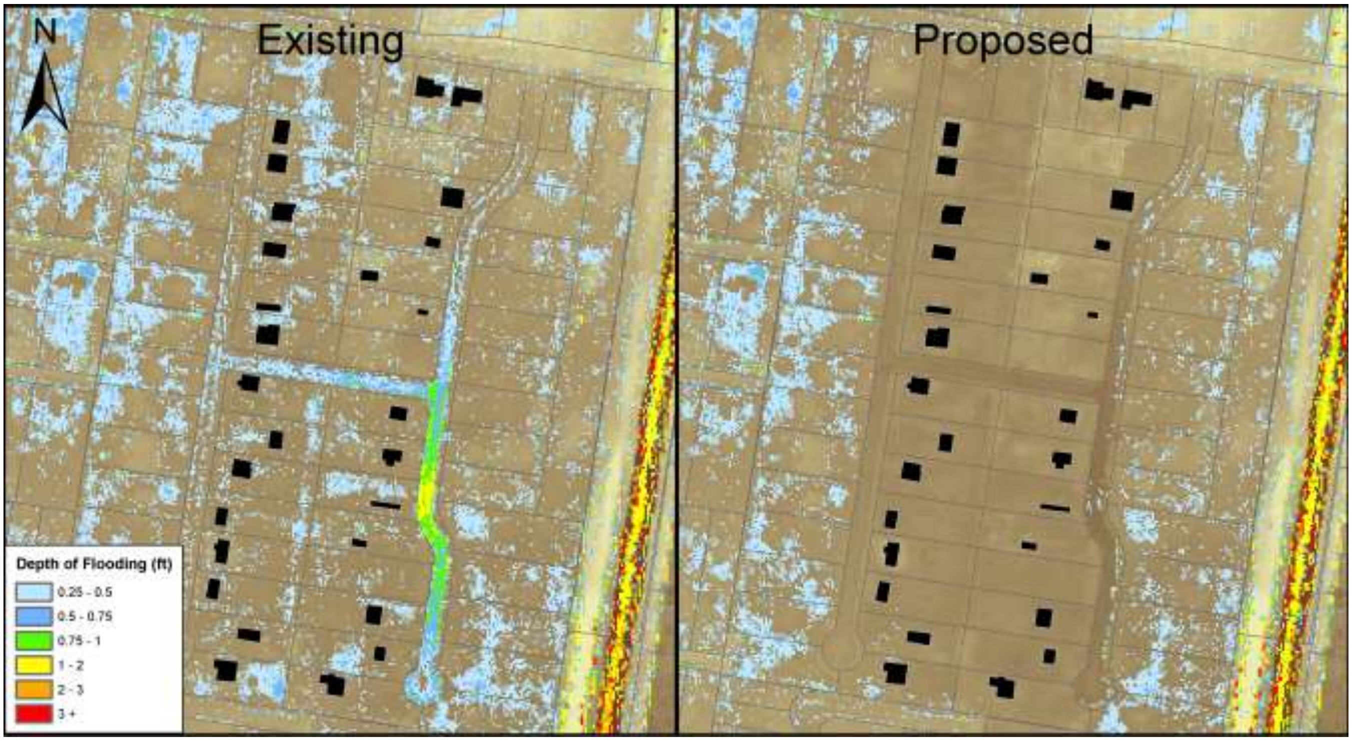


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	30	4	26
Inundated Roadway (LF)	1615	20	1595

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

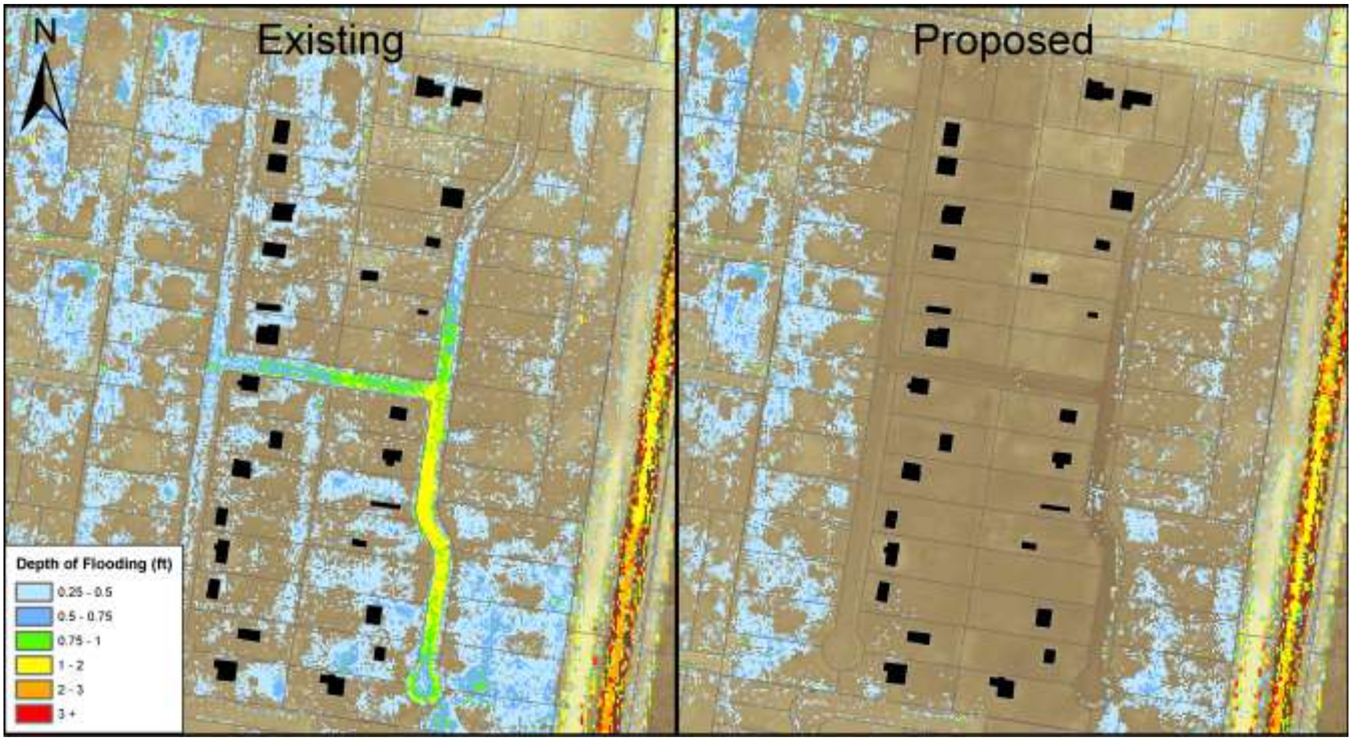


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	0	5
Inundated Lots	30	4	26
Inundated Roadway (LF)	2450	45	2405

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

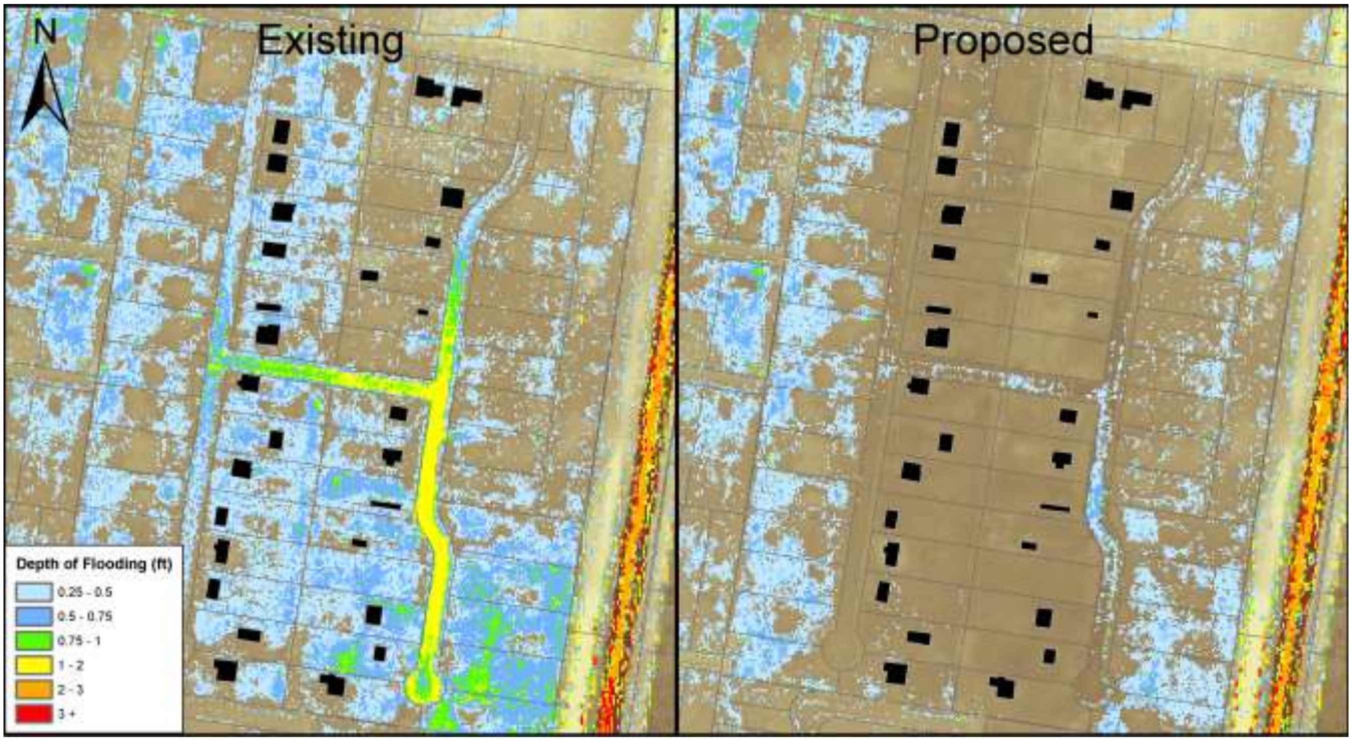


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	0	12
Inundated Lots	30	8	22
Inundated Roadway (LF)	2875	570	2305

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Alberta Estates No.2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

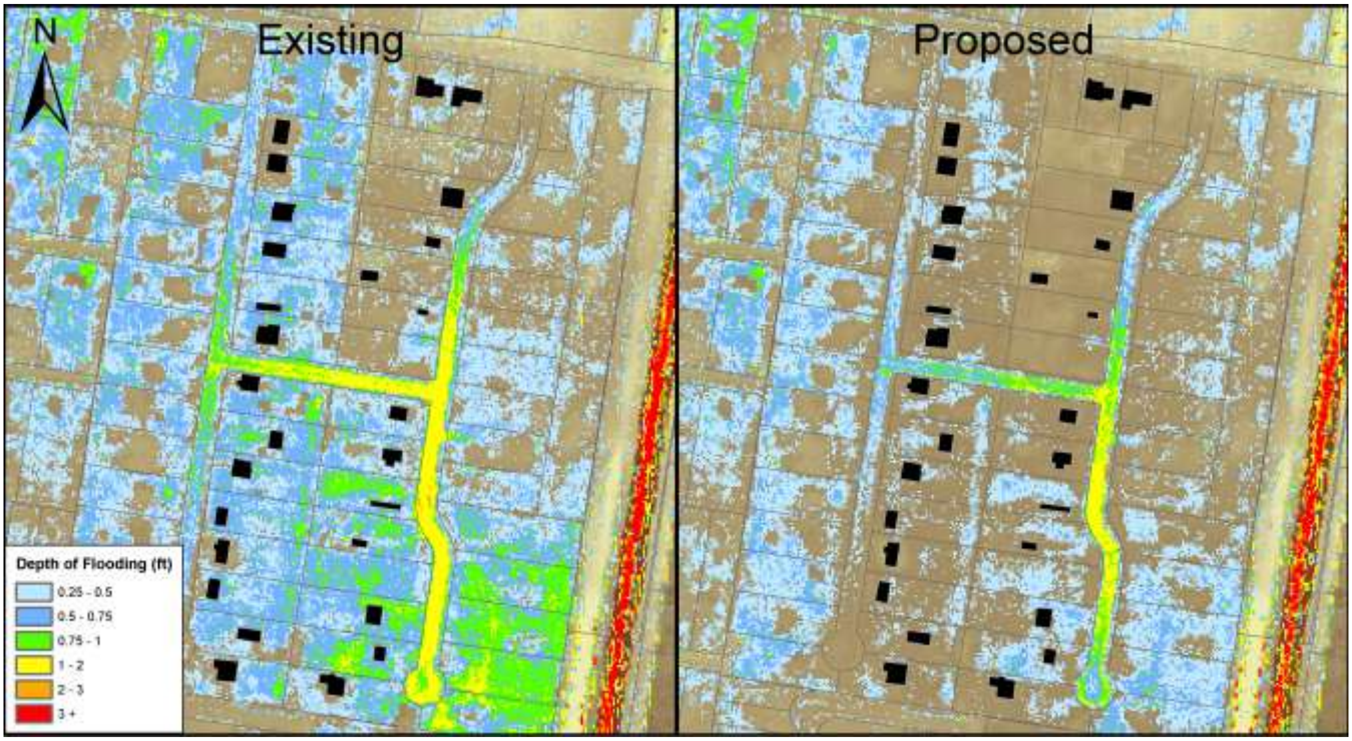


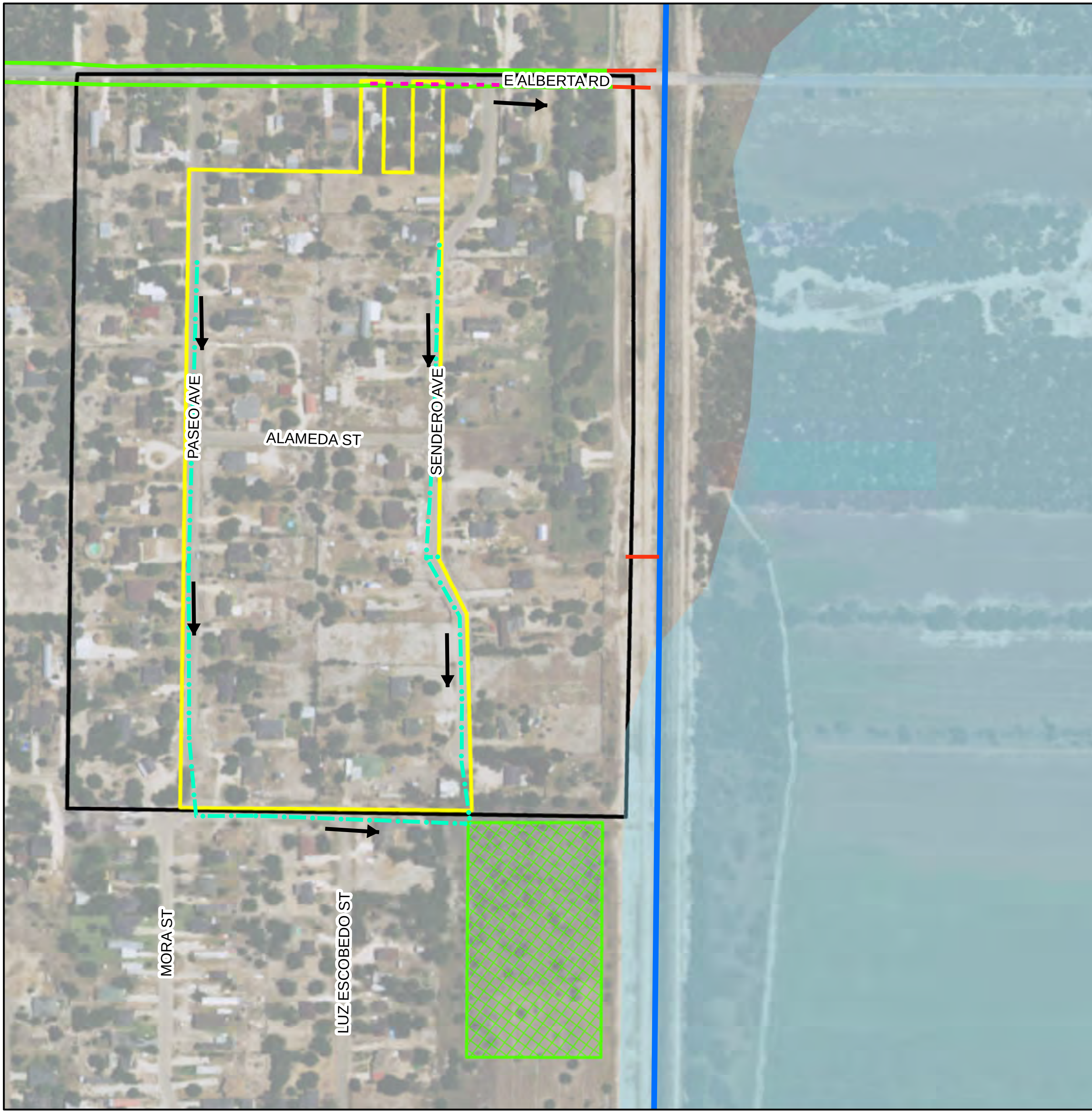
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	17	3	14
Inundated Lots	30	29	1
Inundated Roadway (LF)	3065	2640	425

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Alberta Estates No. 2
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed RetentionPond
- Alberta Estates No.2 Boundary
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Arriaga Subdivision, Hidalgo County

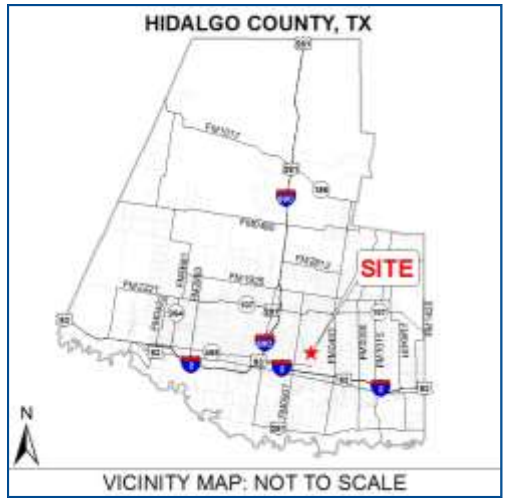
Basin: North Main Drain

Category: A1

"Filling the Gap"

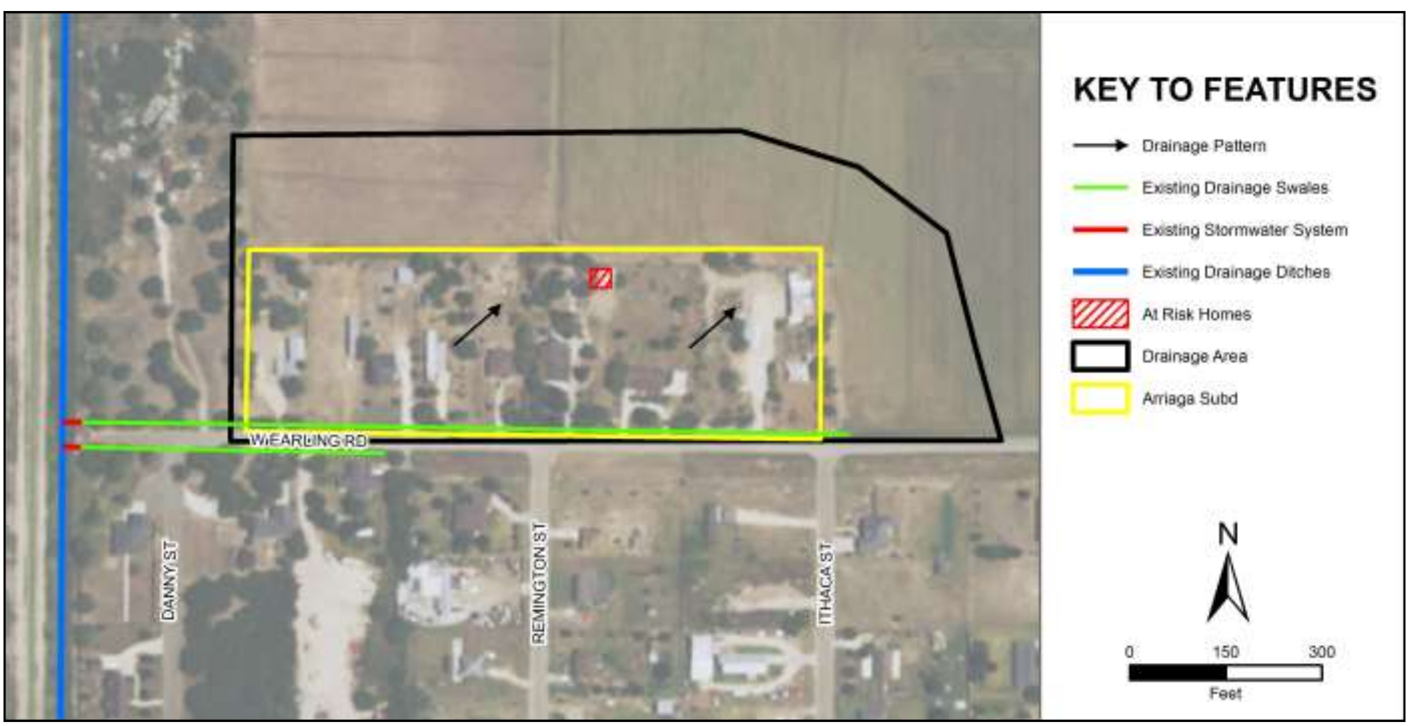
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Arriaga Subdivision colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 6-acre colonia are generally to the north. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. Arriaga Subdivision experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Arriaga Subdivision, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    * Improve the roadside drainage system with a retention pond to mitigate off-site impacts
    * Improve and/or install adequately sized driveway culverts
    * Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    * Elevate structures
    * Buyout of flood prone properties
    * Land use zoning change
    * Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements to the roadside drainage system with a retention facility. The improvements include 800 linear feet of grassy swale and 1,740 linear feet of roadside ditch grading and excavation. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 15.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Arriaga		
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	-
2	**DRAINAGE IMPROVEMENTS**	$	31,700.00
3	**POND EXCAVATION IMPROVEMENTS**	$	411,400.00
	Sub-Total =	**$**	**443,100.00**
	Engineering (10%)	$	44,310.00
	Contingency (20%)	$	88,620.00
	Total =	**$**	**576,030.00**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.0 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Arriaga Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	1	0	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$217,008	$576,030	0.38
Elevate Structures	$217,008	$123,600	1.76
Acquisition/Supplemental Housing/Demolition	$227,413	$90,350	2.52

Colonia: Arriaga Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

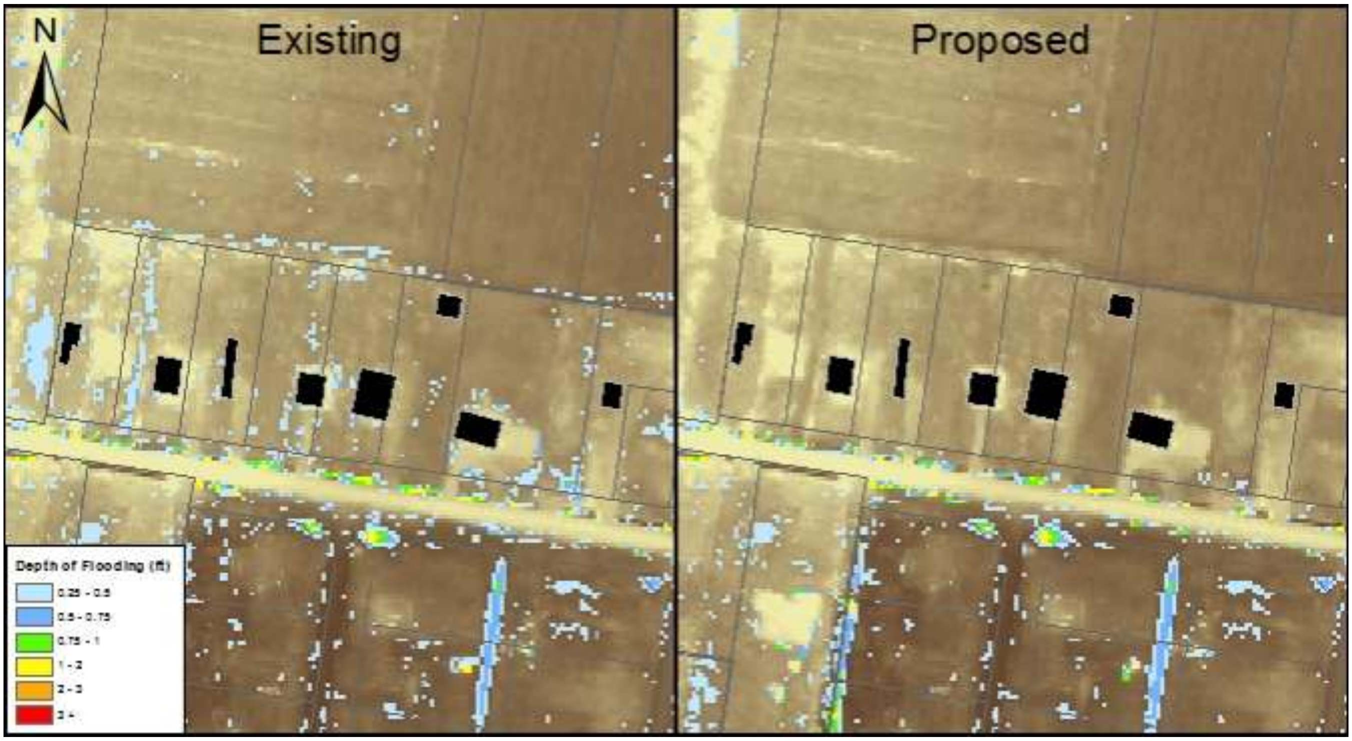


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	3	5
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figure:

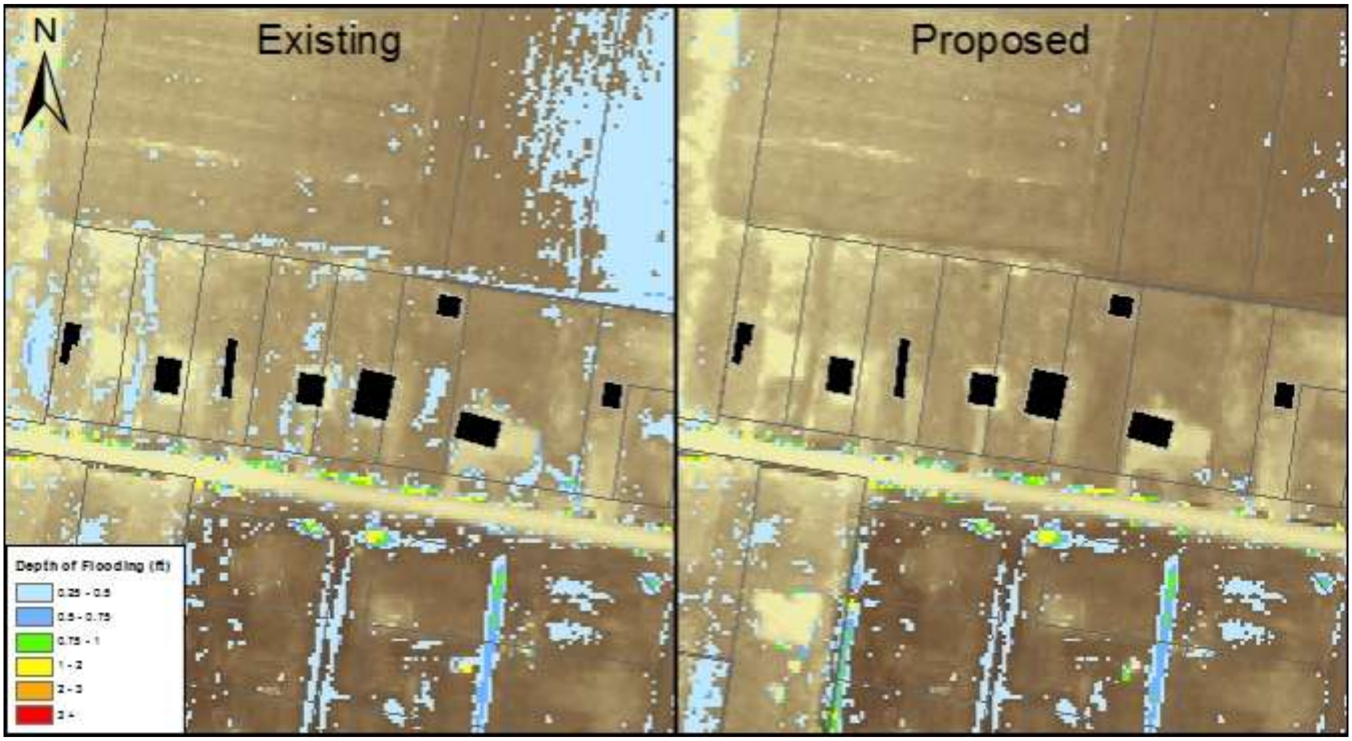


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	3	5
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Arriaga Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

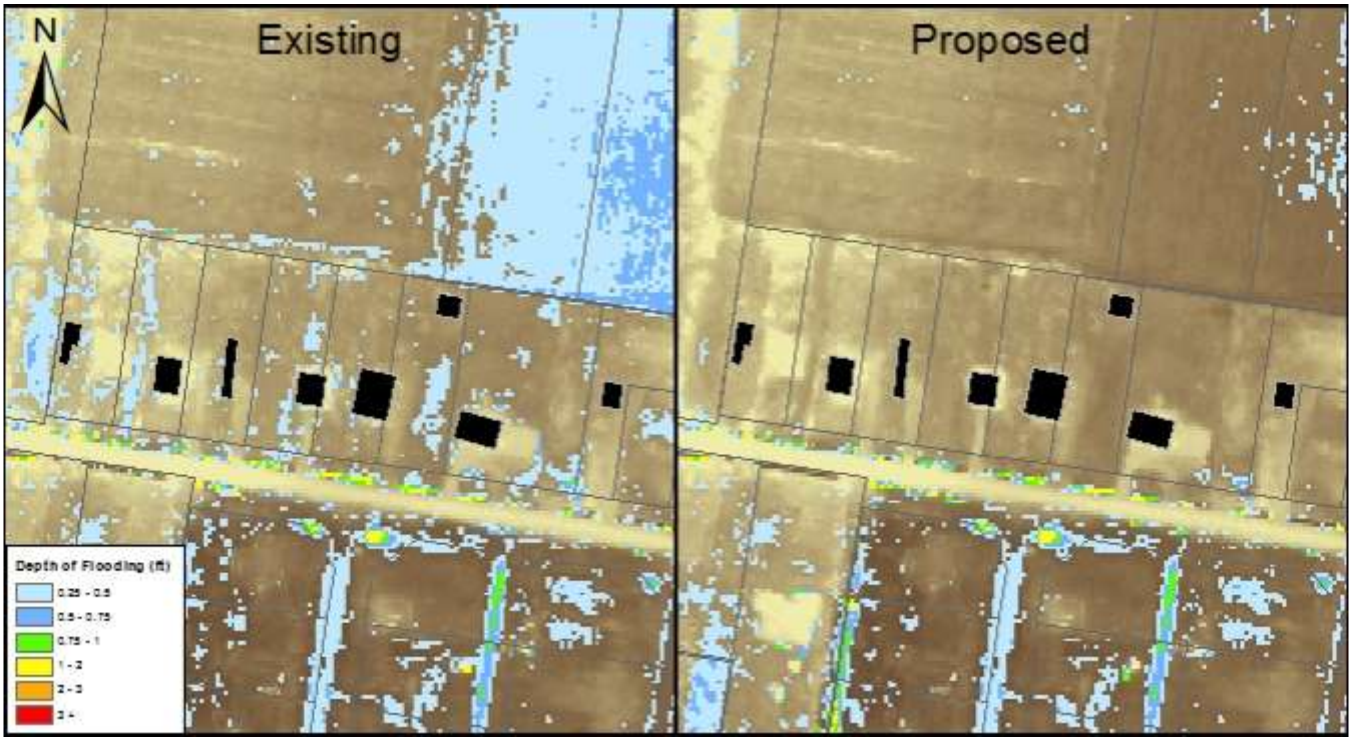


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	4	4
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Arriaga Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

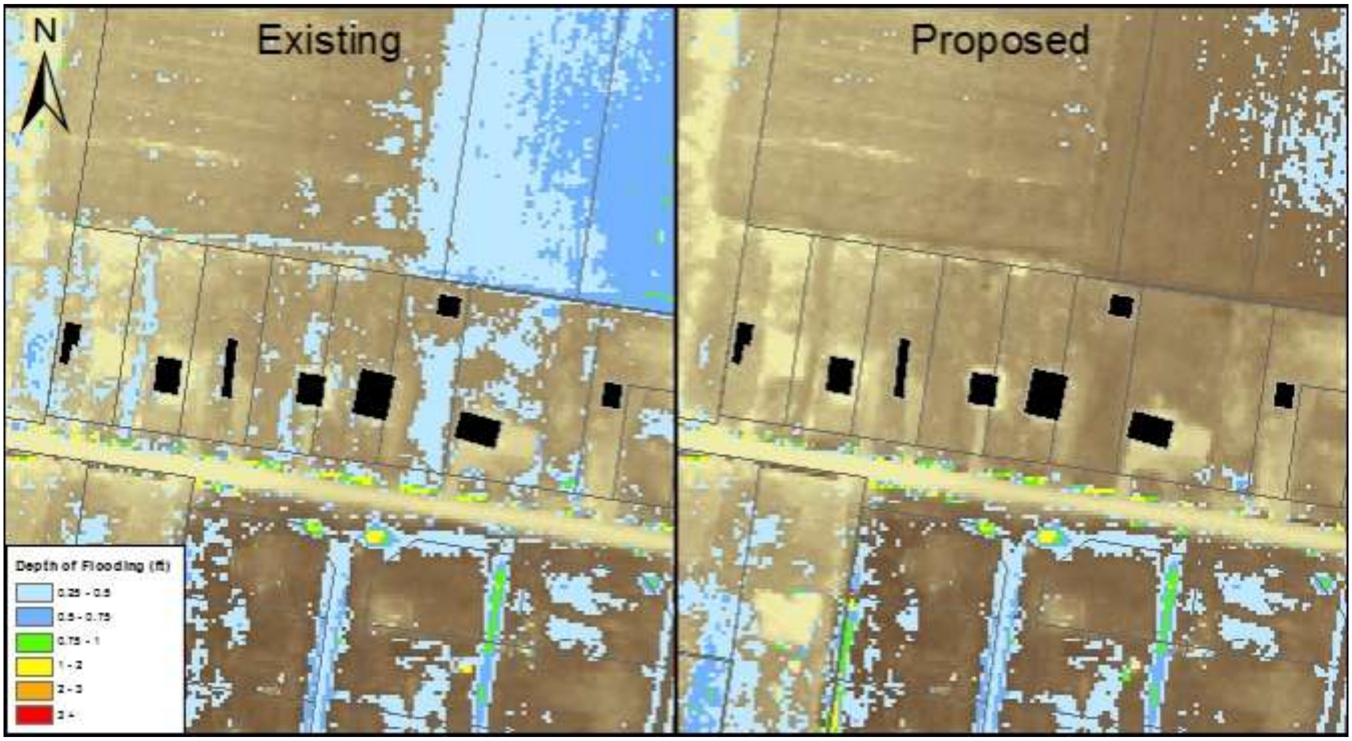


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	4	4
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Arriaga Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

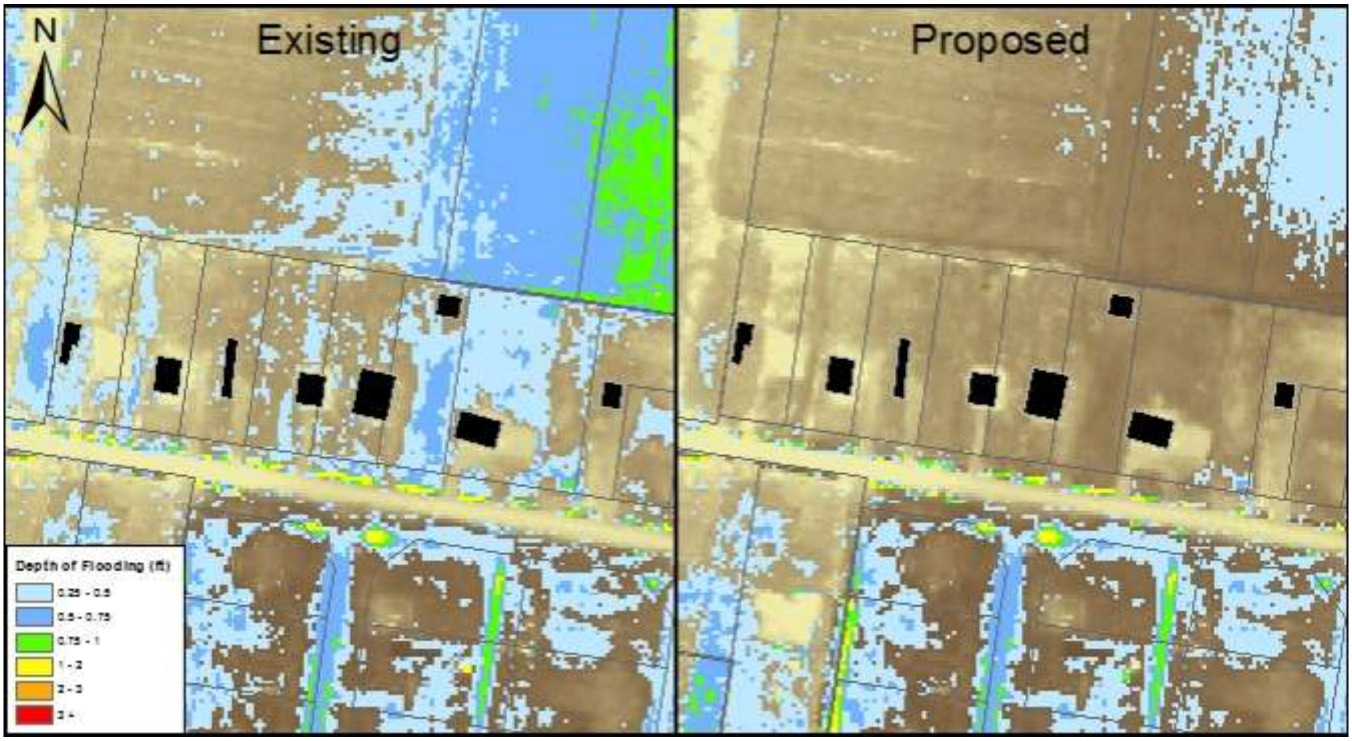


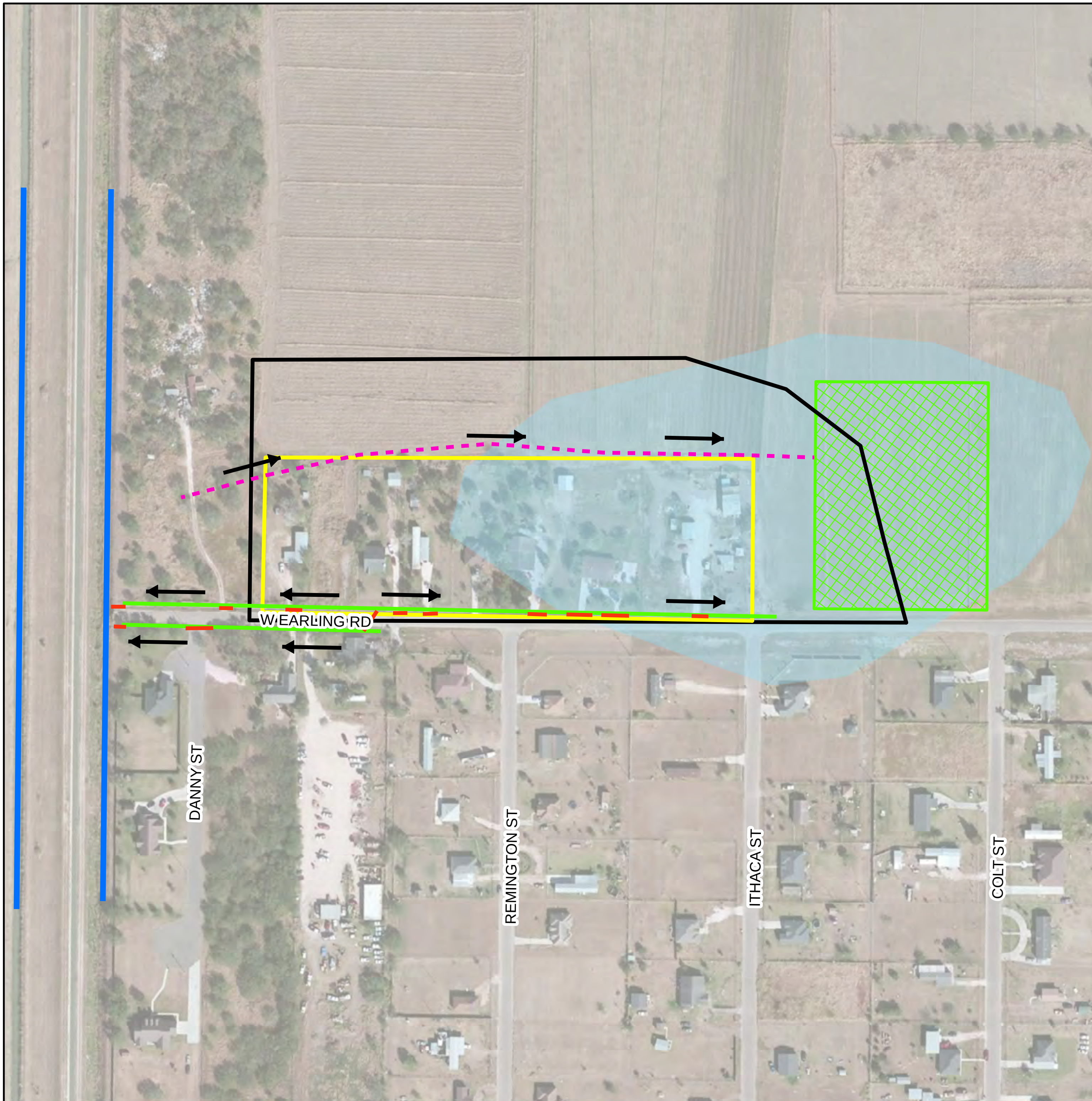
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	8	5	3
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Arriaga Subd
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Stormwater System
- Existing Drainage Swales
- Existing Drainage Ditches
- Arriaga Subd Colonia
- Existing Floodplain
- Proposed Retention Pond
- Drainage Area

N

0 62.5 125 250
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

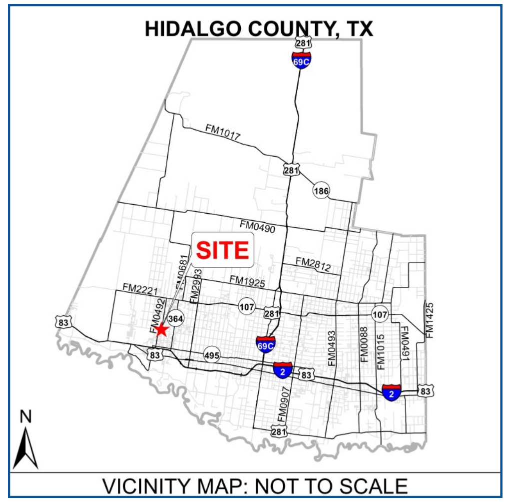
Colonia: Basham #12, Hidalgo County

Basin: North Main Drain

Category: A1

“Filling the Gap”

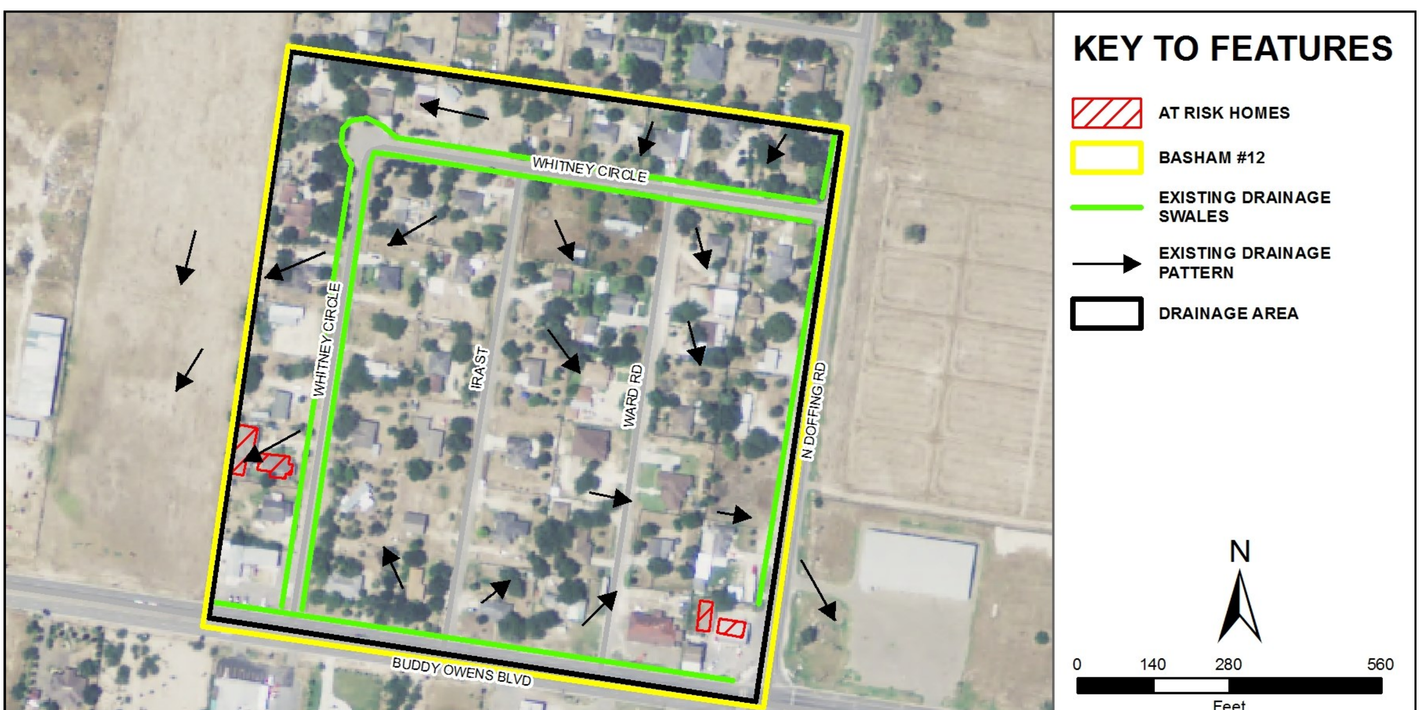
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Basham #12 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Basham #12 consist of approximately 26 acres of fully developed residential land. Currently there are swales and culverts along Whitney Circle, however these swales do not have an outfall. The swales along Doffing Road appear to drain into a grate inlet at the south end of Doffing Road. From LIDAR observations it is apparent that the runoff currently flows toward the southeast and southwest, as a result structures on low lots and along the west and southeast corner of the subdivisions are at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 11.7 inches, orange 11.7 to 14.4 inches, and red more than 14.4 inches.



Colonia: Basham #12, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install roadside swales with culverts along all streets to convey runoff to Buddy Owens Blvd.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The results of the existing conditions 2D model indicates that the colonia currently does not provide adequate drainage, as a result several structures are at risk of being flooded. The recommended improvements have been designed to provide protection from flooding for a 10-Yr storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 1,591 linear feet of 18-inch diameter pipe, 2,013 linear feet of 24-inch diameter pipe, 950 linear feet of 30-inch diameter pipe, 424 linear feet of 36-inch diameter pipe, and 32 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 9.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
BASHAM #12		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$626,570.00
2	Drainage Improvements	$423,995.00
3	Pond Excavation Improvements	$247,940.06
	Sub-Total =	**$1,298,505.06**
	Engineering Fees (10%) =	**$129,850.51**
	Contingency (20%) =	**$259,701.01**
	Total =	**$1,688,056.58**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	4	0	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$169,436.00	$1,688,056.58	0.10
Elevate Structures	$169,436.00	$495,975.00	0.34
Acquisition/Supplemental Housing / Demolition	$855,713.00	$402,546.60	2.13

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

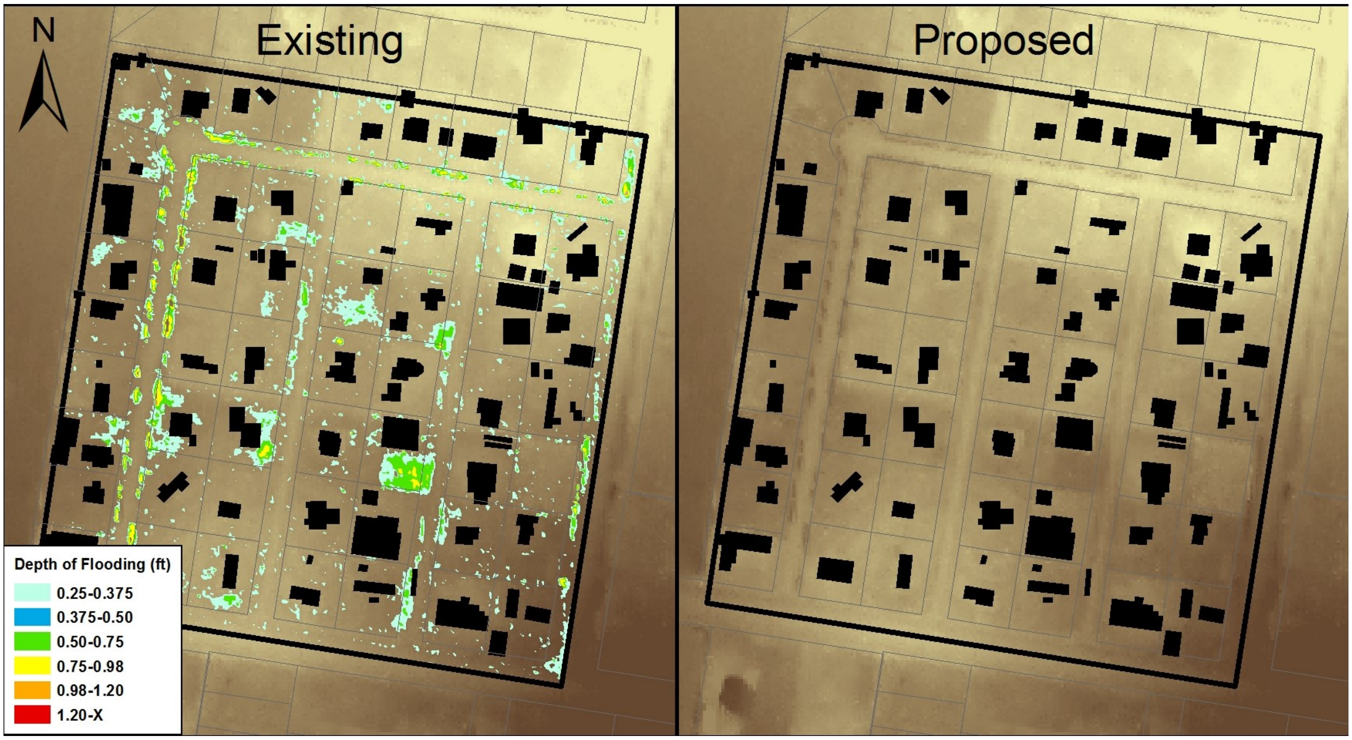


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	53	0	53
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

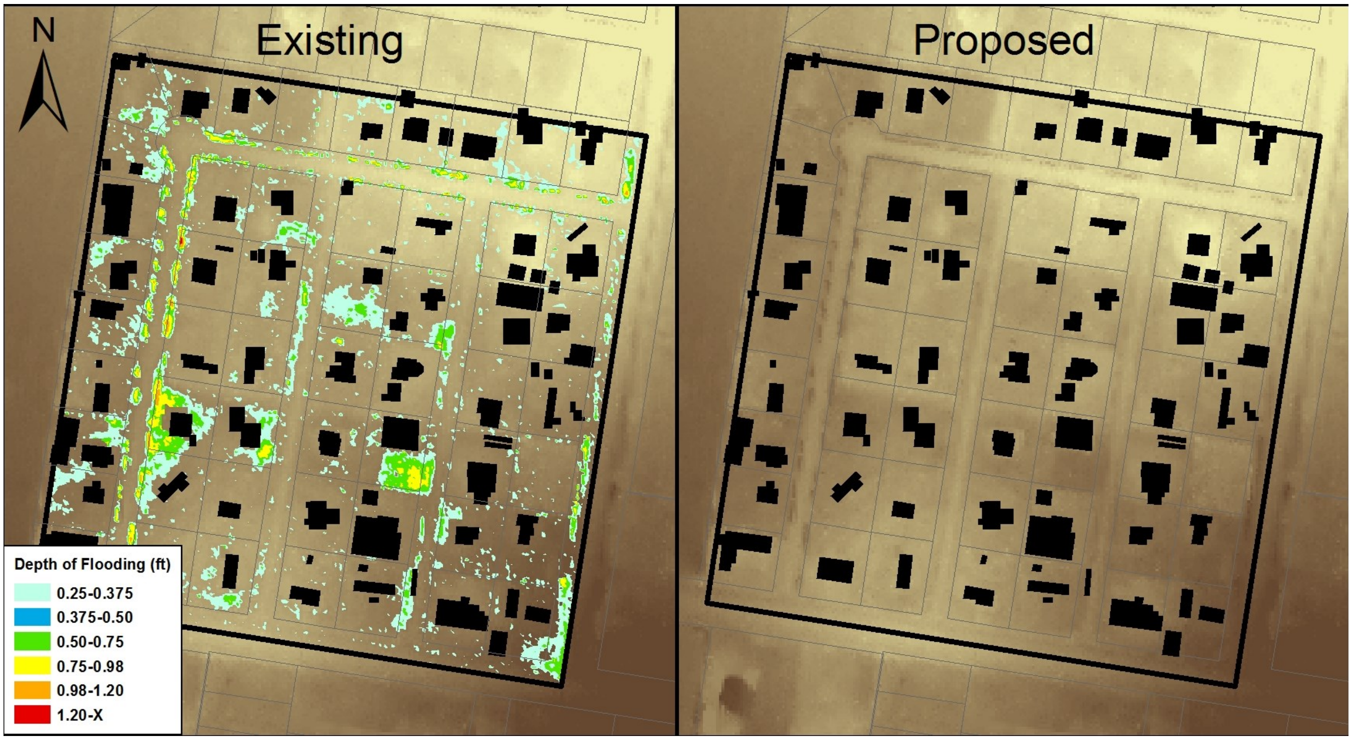


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	53	0	53
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

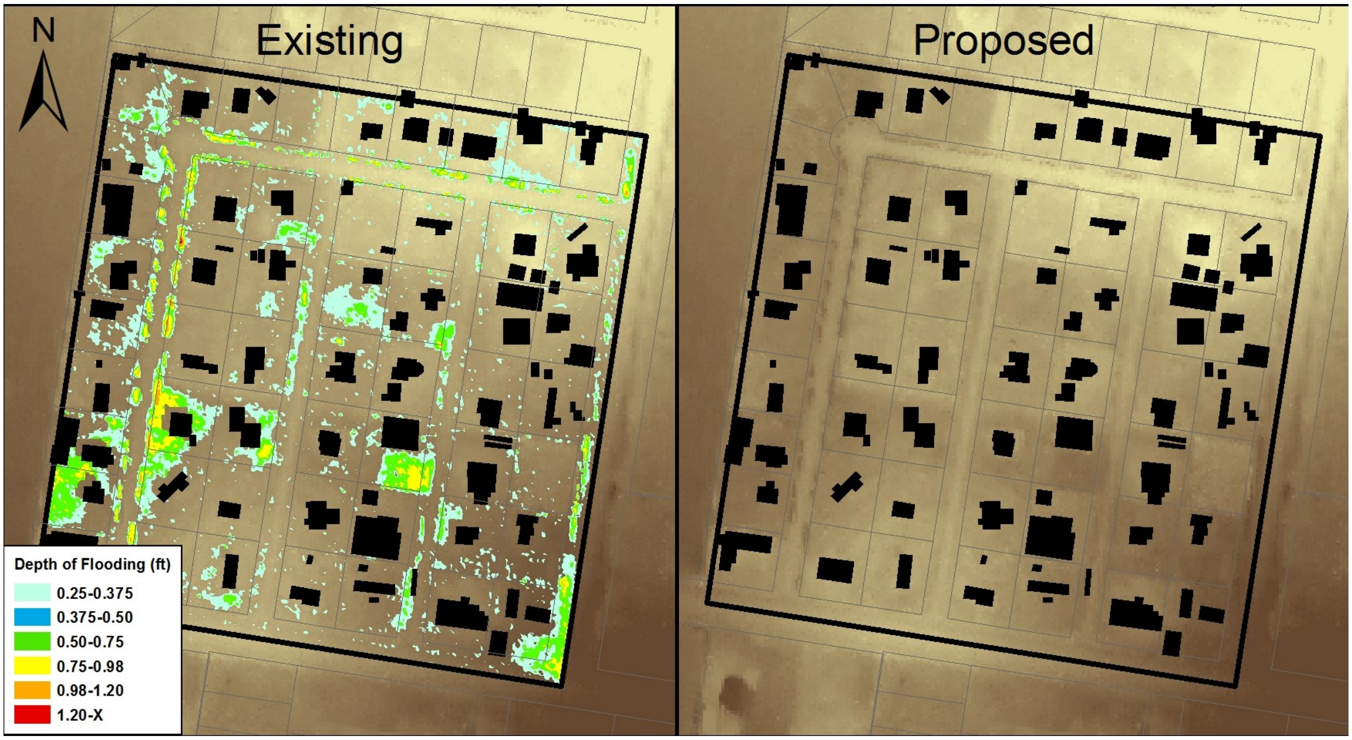


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	0	53
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

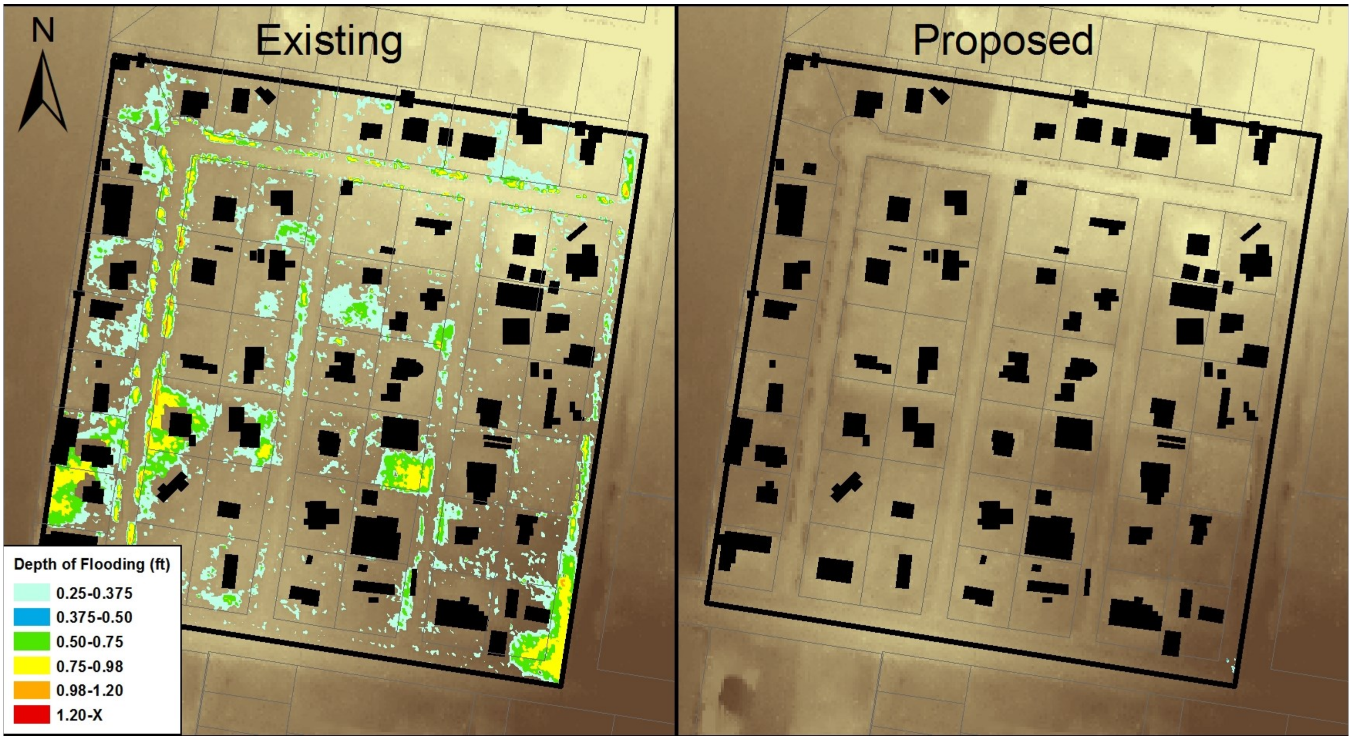


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	0	53
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Basham #12, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

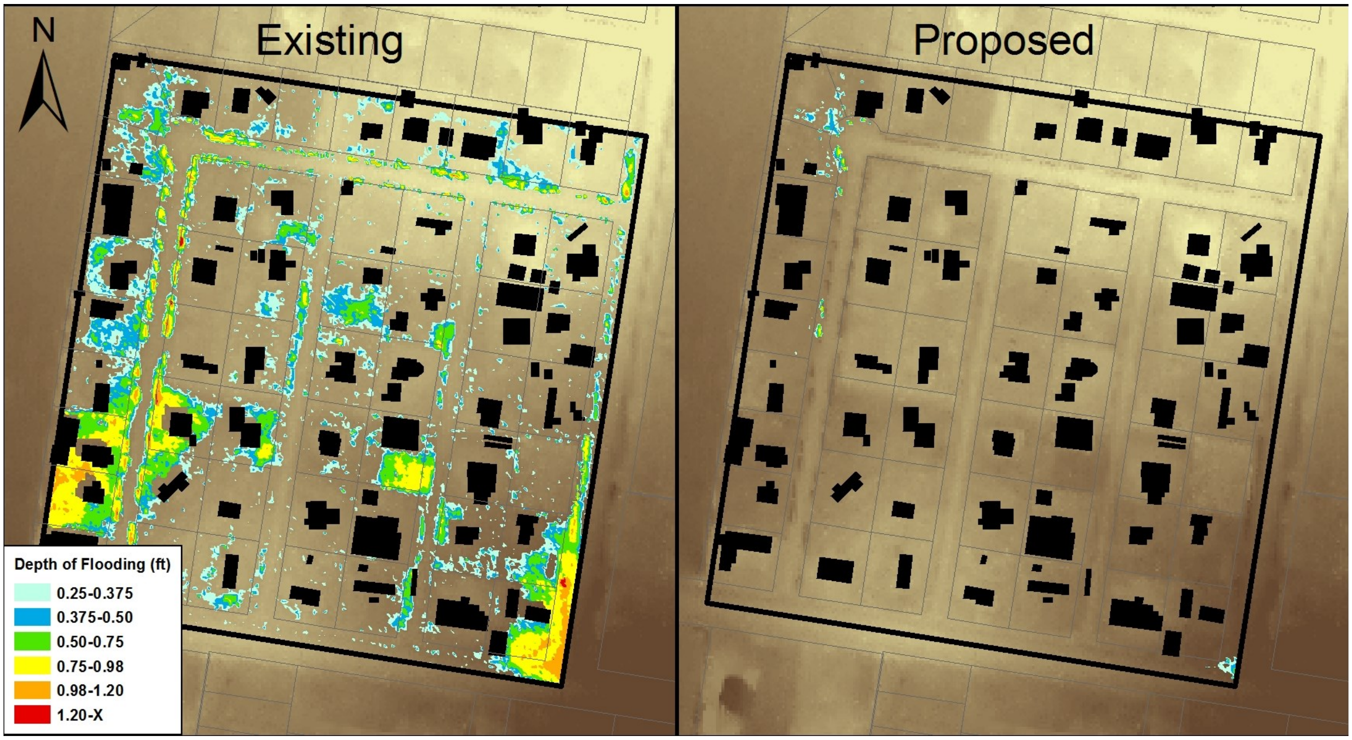
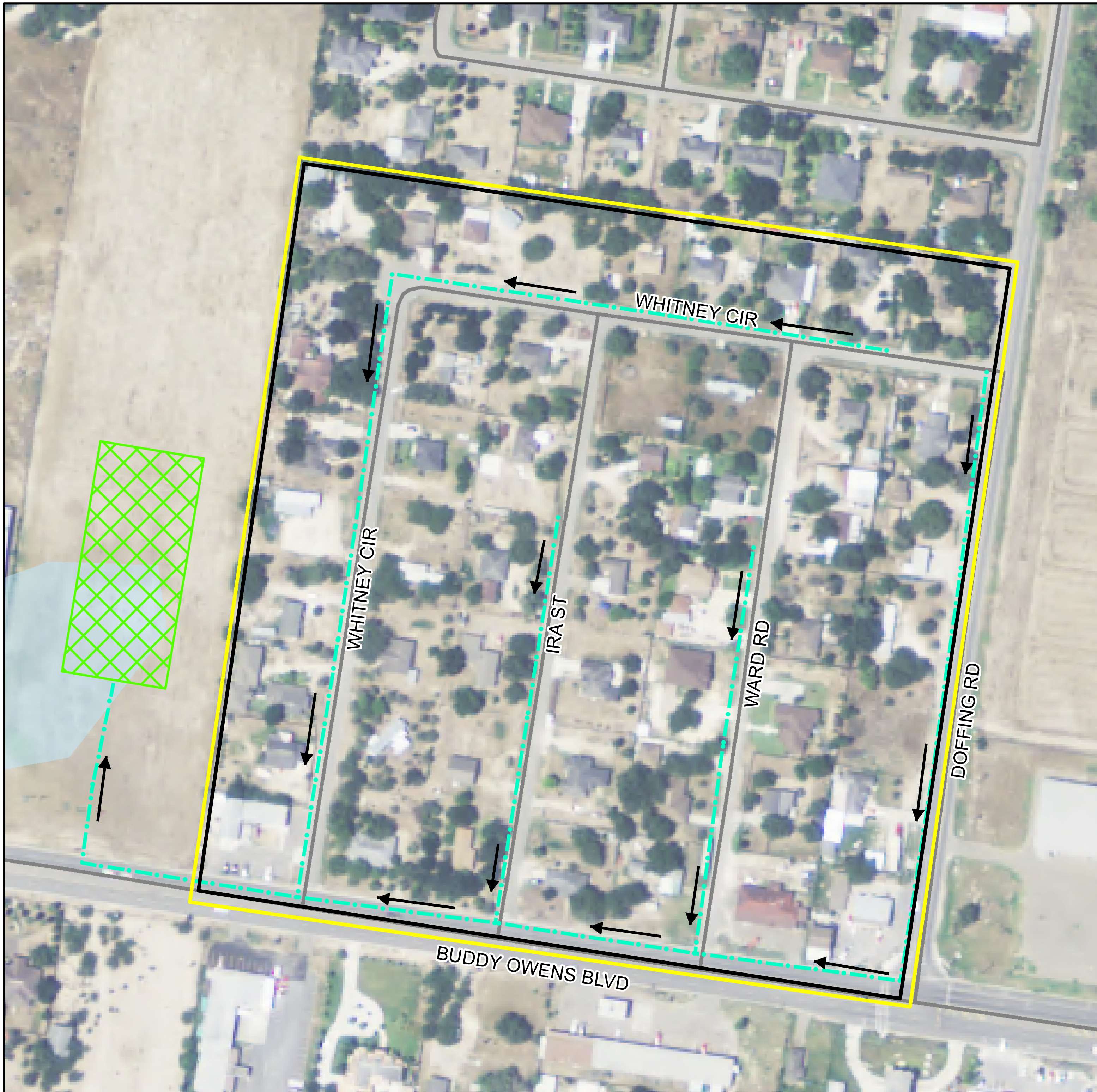


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	53	5	48
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Basham #12
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STROMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- BASHAM #12
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 125 250 375
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

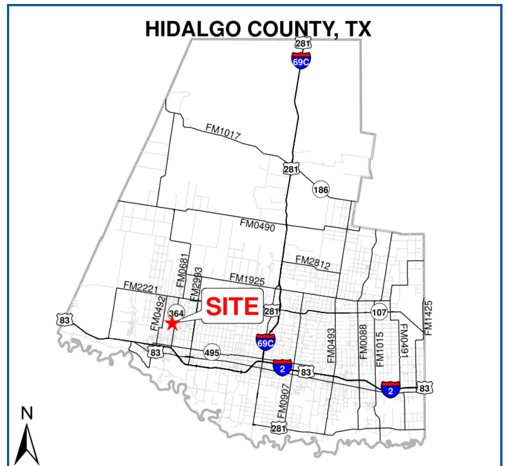
Colonia: Basham #4, Hidalgo County

Basin: North Main Drain

Category: A1

“Filling the Gap”

Hydrology / Hydraulic Analysis:

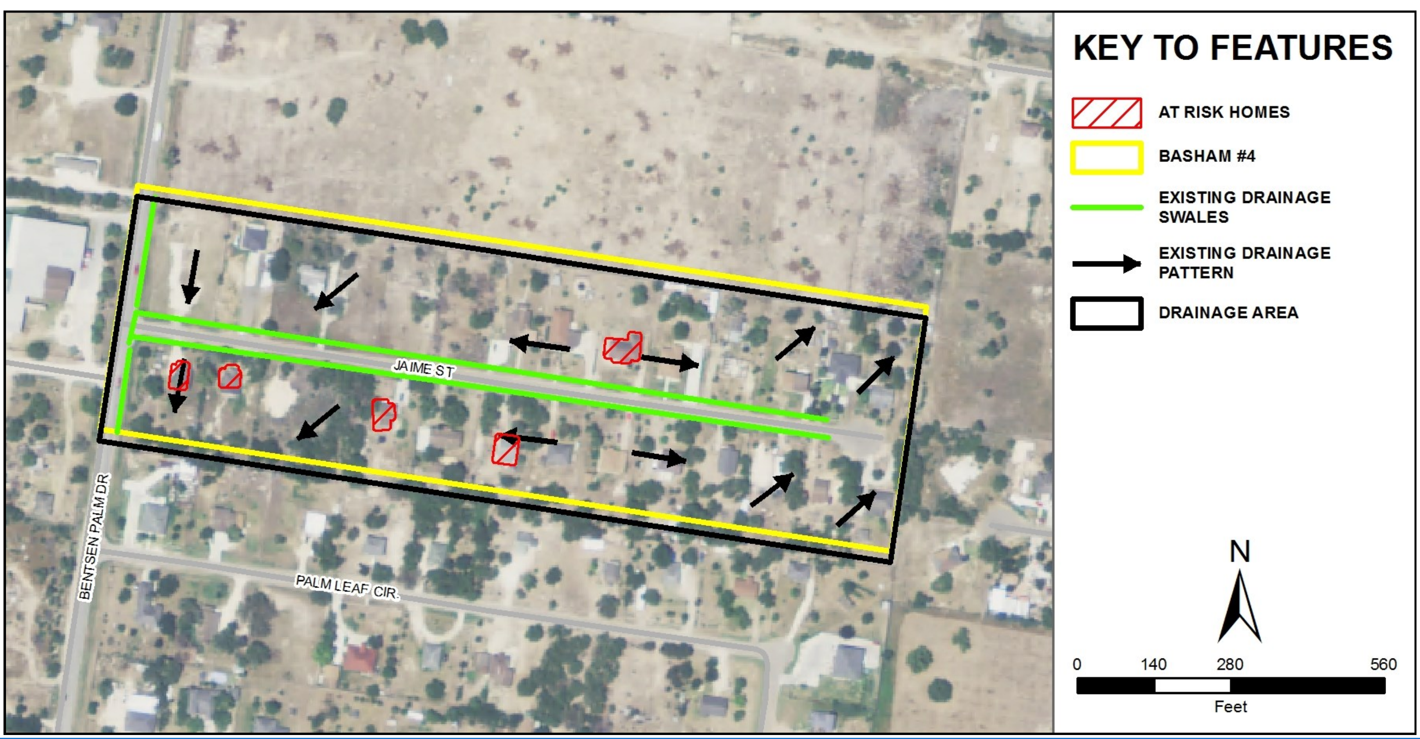


VICINITY MAP: NOT TO SCALE

A 2-dimensional hydrodynamic model of the colonia Basham #4 storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Basham #4 consist of approximately 15 acres. Currently the colonia does not have a drainage system. The terrain is fairly flat and a portion of the northeast corner of the colonia is in the 100-Yr floodplain. The model results indicate that the northeast and southwest corners of the colonia are high-risk flooding areas. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 8 inches, blue 8 to 10 inches, green 10 to 12 inches, yellow 12 to 18 inches, orange 18 to 28 inches, and red more than 28 inches.



Colonia: Basham #4, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install roadside swales with culverts to convey runoff to Bentsen Palm Dr.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
Based on the results of the existing conditions 2D model, it was determined that the structures currently at risk of being flooded are at opposite ends of the colonia. The recommended improvements have been designed to provide protection from flooding for a 10-Yr storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 950 linear feet of 24-inch diameter pipe, 597 linear feet of 36-inch diameter pipe, 7 curb inlets and one 60-inch concrete manhole. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4.9 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
BASHAM #4

	IMPROVEMENTS	COST
1	Paving Improvements	$207,672.00
2	Drainage Improvements	$159,862.00
3	Pond Excavation Improvements	$130,520.00
	Sub-Total =	**$498,054.00**
	Engineering Fees (10%) =	**$49,805.40**
	Contingency (20%) =	**$99,610.80**
	Total =	**$647,470.20**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Basham #4, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,797,261	$647,470	2.78
Elevate Structures	$1,797,261	$230,550	7.80
Acquisition/Supplemental Housing / Demolition	$1,858,273	$263,227	7.06

Colonia: Basham #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

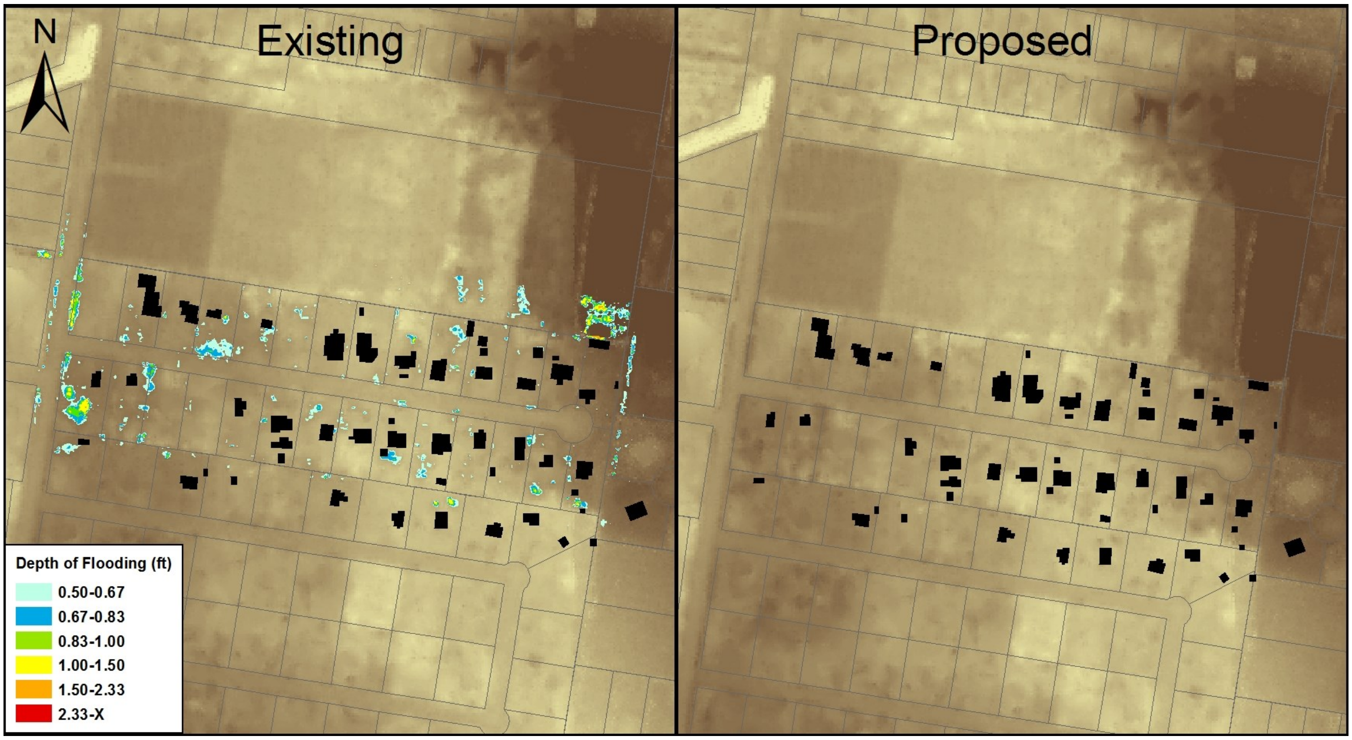


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	28	0	28
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Basham #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

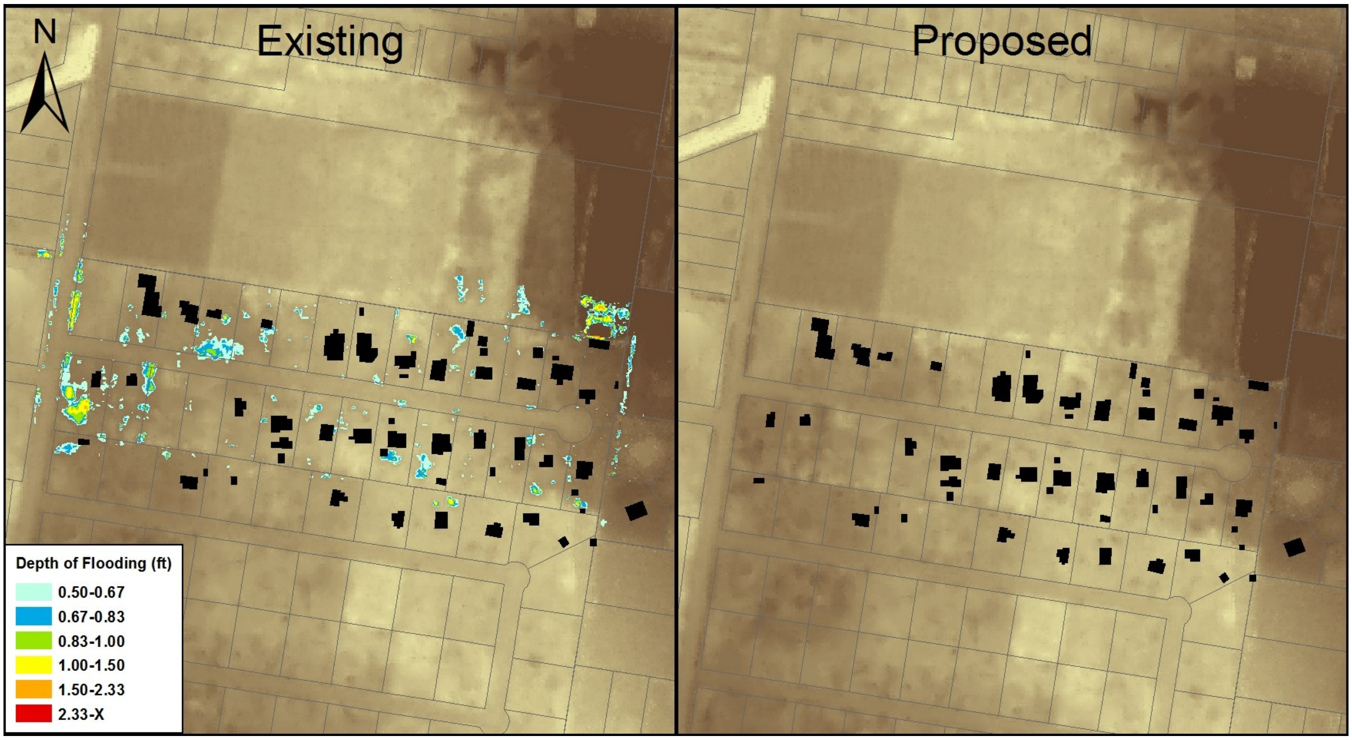


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	28	0	28
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Basham #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

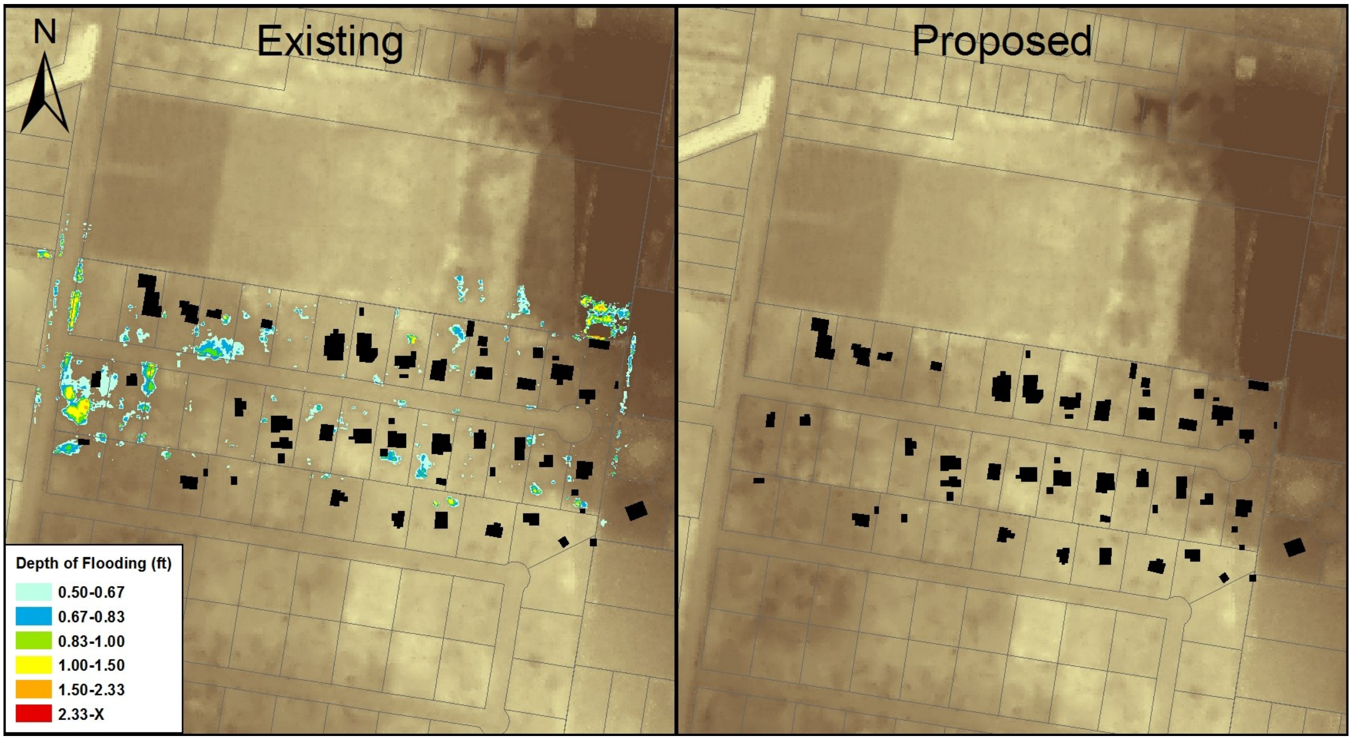


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	28	0	28
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Basham #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

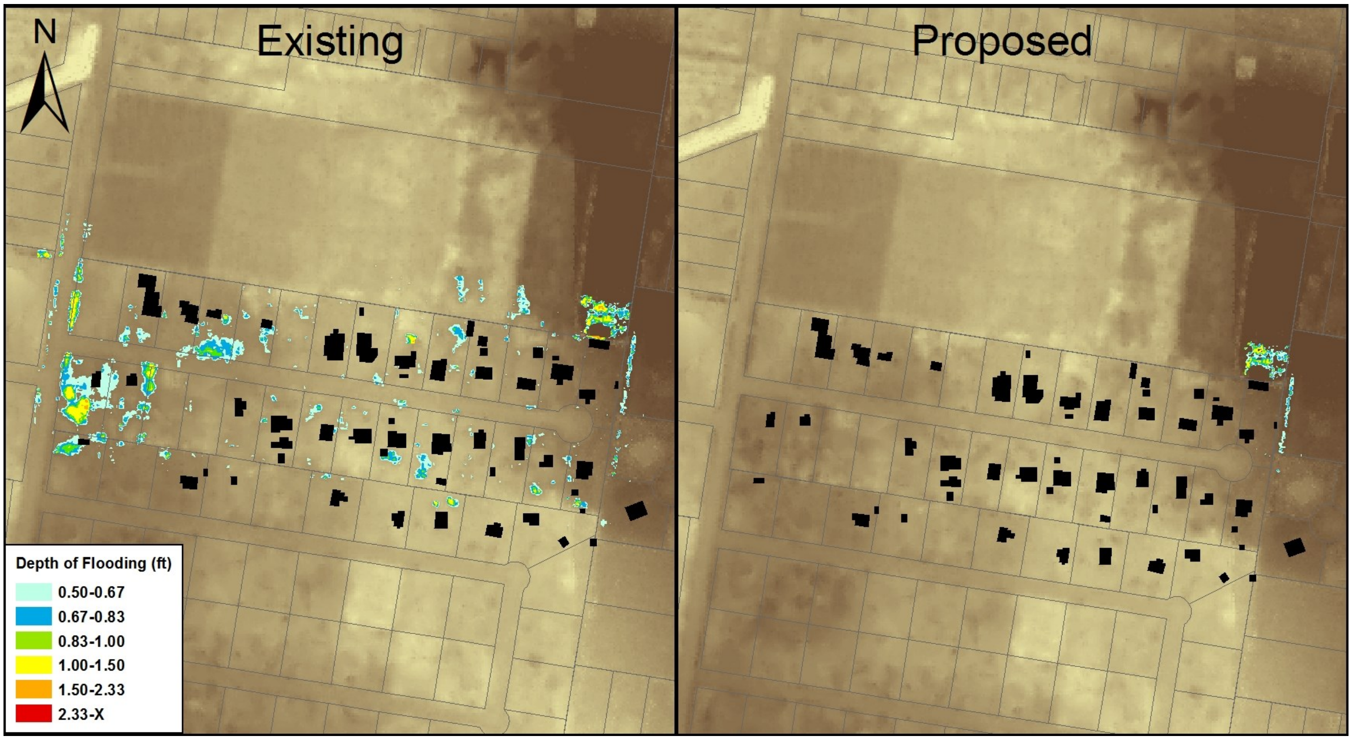


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	28	1	27
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Basham #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

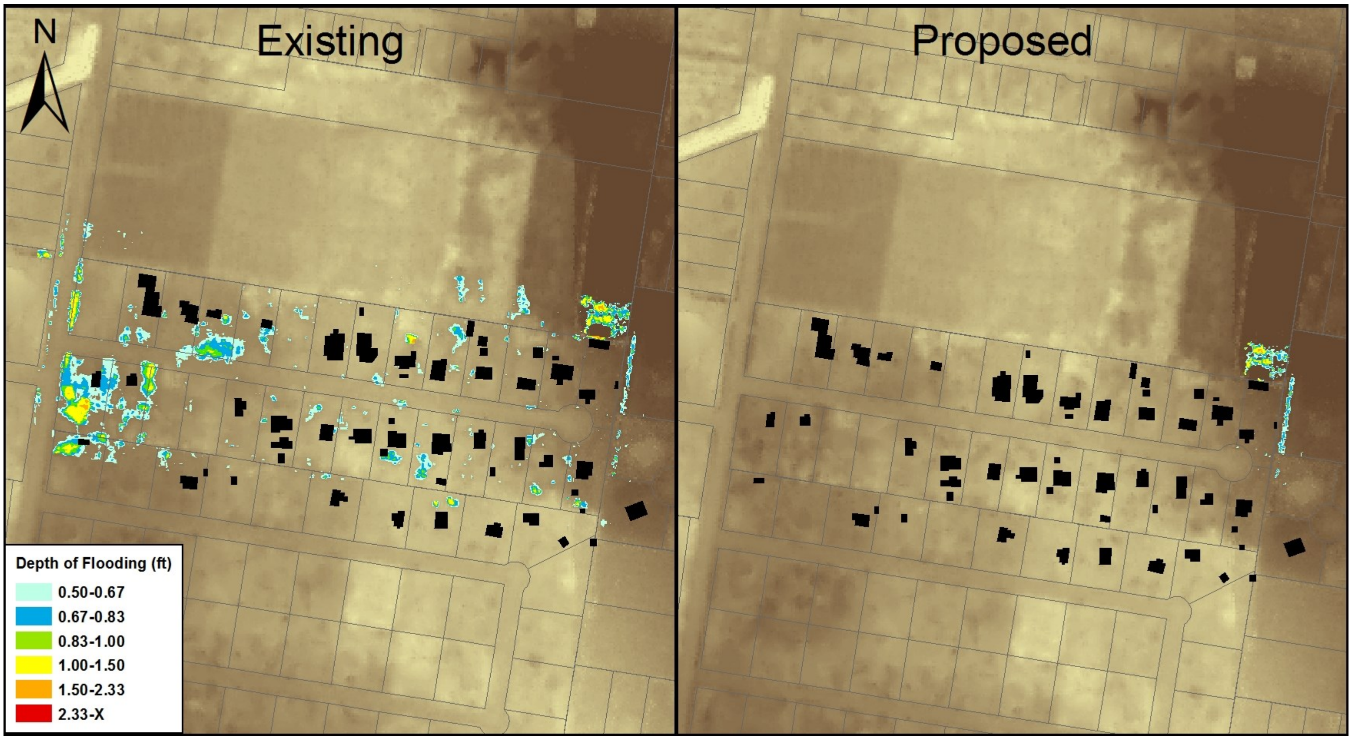


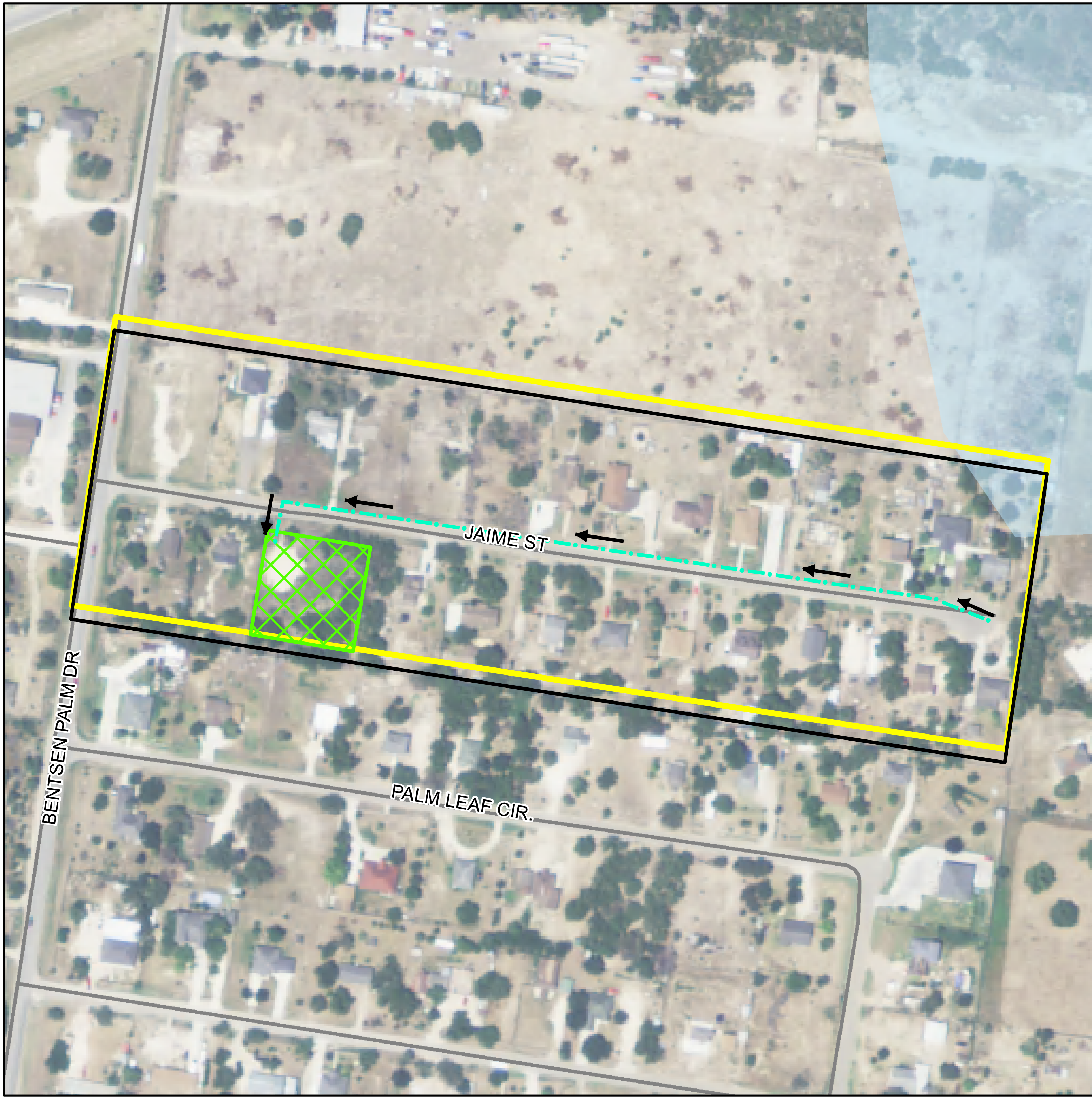
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	28	1	27
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

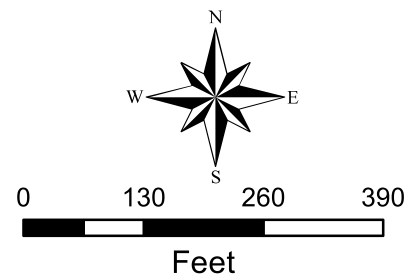
Colonia: Basham #4
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- BASHAM #4
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

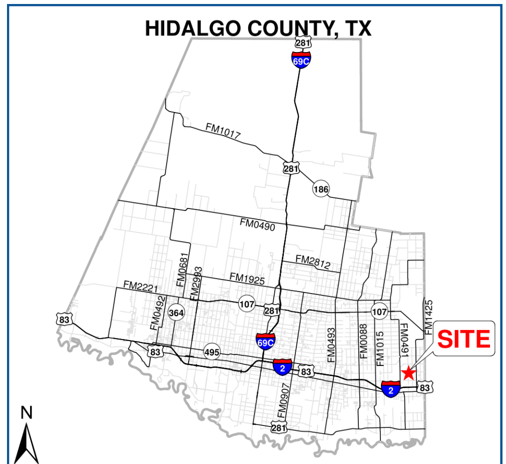
Colonia: Capisallo Park, Hidalgo County

Basin: Arroyo Colorado

Category: A1

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Hydrology / Hydraulic Analysis:

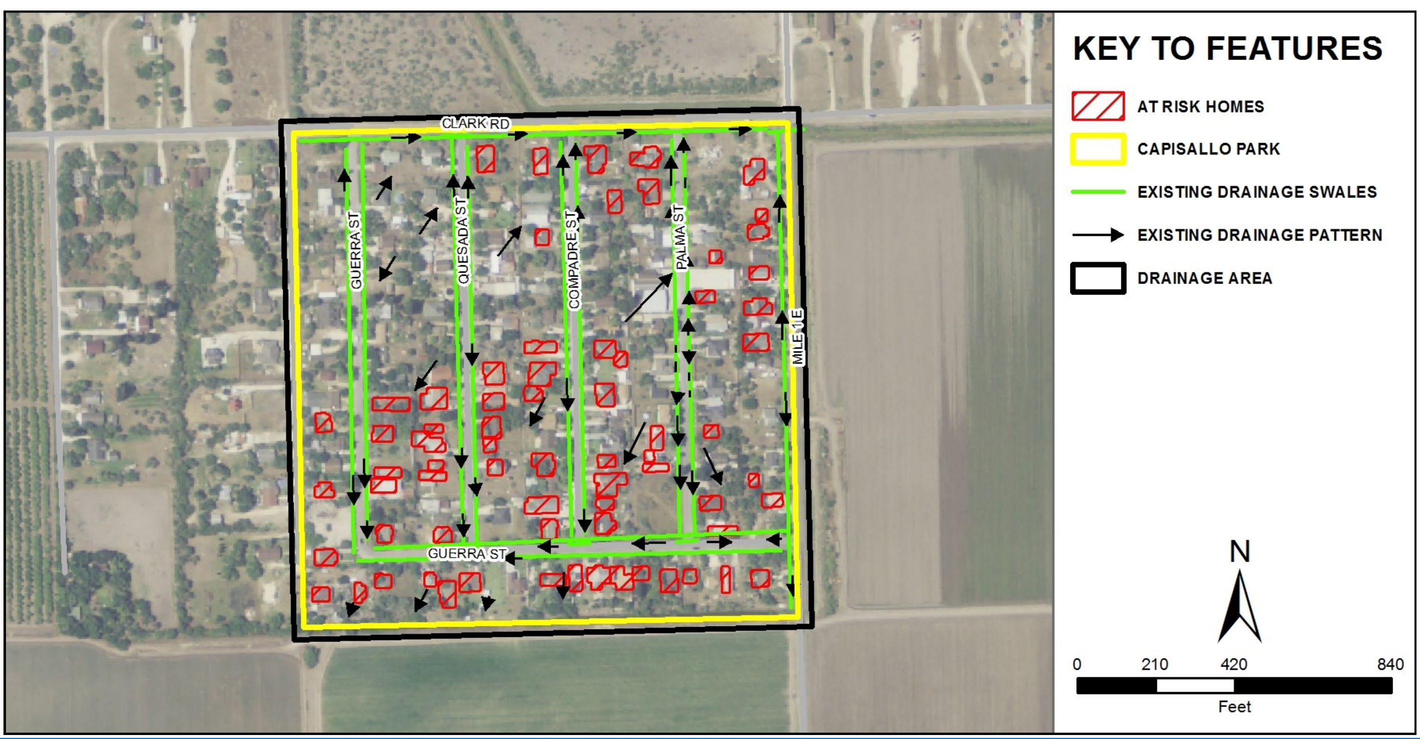


VICINITY MAP: NOT TO SCALE

A 2-dimensional hydrodynamic model of the colonia Capisallo Park storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Capisallo Park consists of approximately 44 acres. The current drainage system consists of swales and culverts that outfall into existing drain ditches along the north, south, and east sides of the colonia. The model results indicate that the high-risk flooding areas are along the northeast and south portions of the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6-15 inches, blue 15 to 24, green 24 to 30 inches, yellow 30 to 36 inches, orange 36 to 48 inches and red more than 48 inches.



Colonia: Capisallo Park, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Improve the existing outlets by installing bigger pipes
  - Re-grade the existing swales to convey runoff to a new retention pond.
  - Install a new underground drainage system with a new retention pond.
  - Install a detention pond with pump.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Purchase of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements consists of a new underground drainage system with a retention facility; it has been designed to provide protection from flooding for a 10-Year storm. The recommended system consists of 108 linear feet of 18-inch diameter pipe, 5,032 linear feet of 24-inch diameter pipe, 1,706 linear feet of 36-inch diameter pipe, and 719 linear feet of 48-inch diameter pipe. Twenty eight new inlets and six concrete manholes are also included in the improvements. The proposed retention pond is sized to retain the onsite runoff of up the 25-Year storm with an effective storage volume of 18.7 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST CAPISALLO PARK		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$1,163,431.00
2	Drainage Improvements	$620,660.00
3	Pond Excavation Improvements	$498,712.50
	Sub-Total =	**$2,282,803.50**
	Engineering Fees (10%) =	**$228,280.35**
	Contingency (20%) =	**$456,560.70**
	Total =	**$2,967,644.55**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Capisallo Park, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	5	2	3
20% (5-year)	7	2	5
10% (10-year)	10	2	8
4% (25-year)	11	2	9
1% (100-year)	11	2	9

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$4,277,993	$2,967,645	1.44
Elevate Structures	$4,277,993	$903,525	4.73
Acquisition/Supplemental Housing / Demolition	$2,838,531	$697,940	4.07

Colonia: Capisallo Park, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

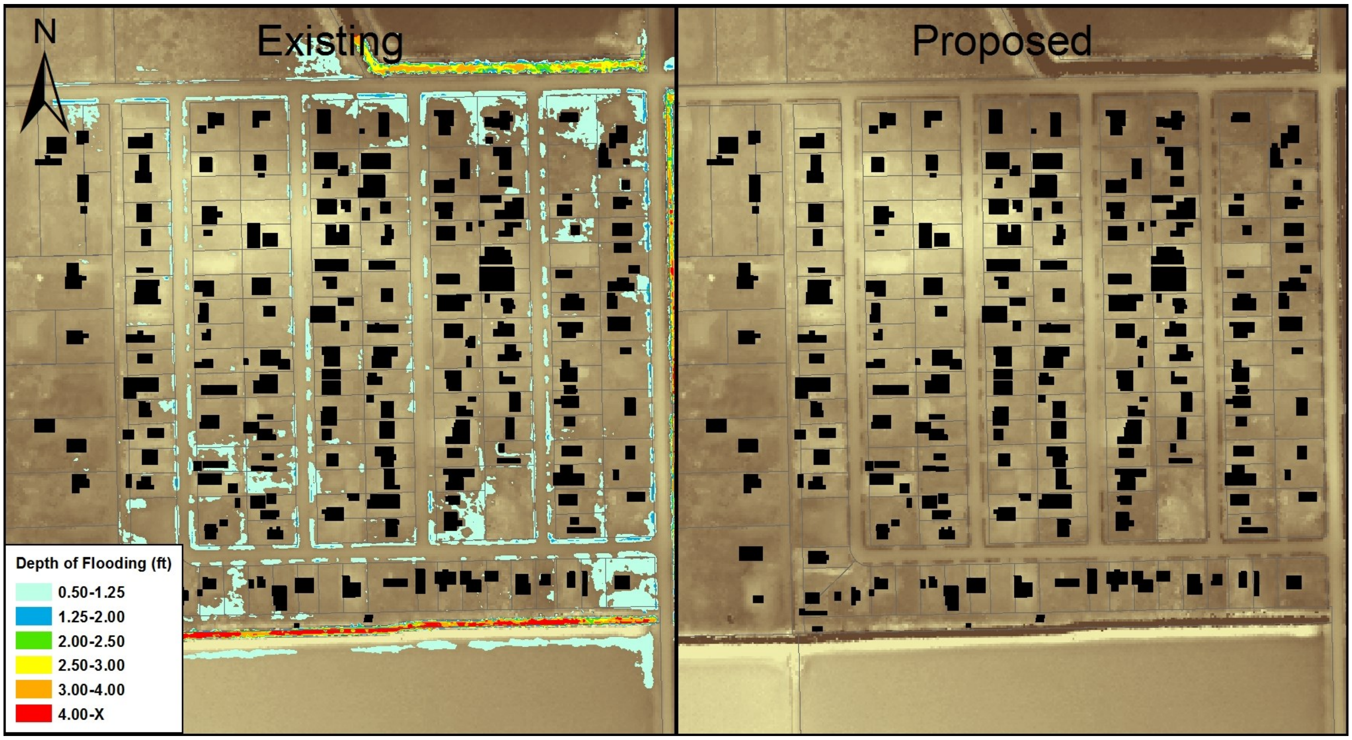


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	2	3
Inundated Lots	112	0	112
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Capisallo Park, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

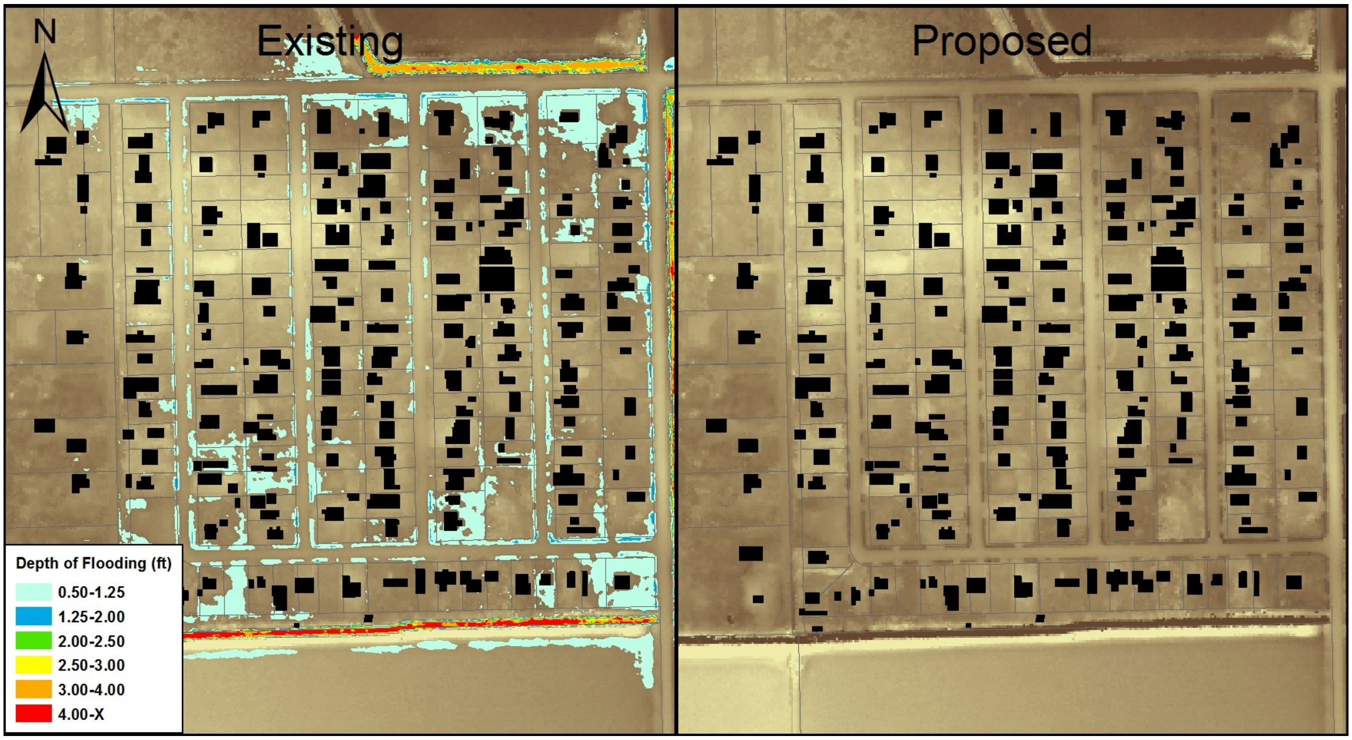


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	2	5
Inundated Lots	119	0	119
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Capisallo Park, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

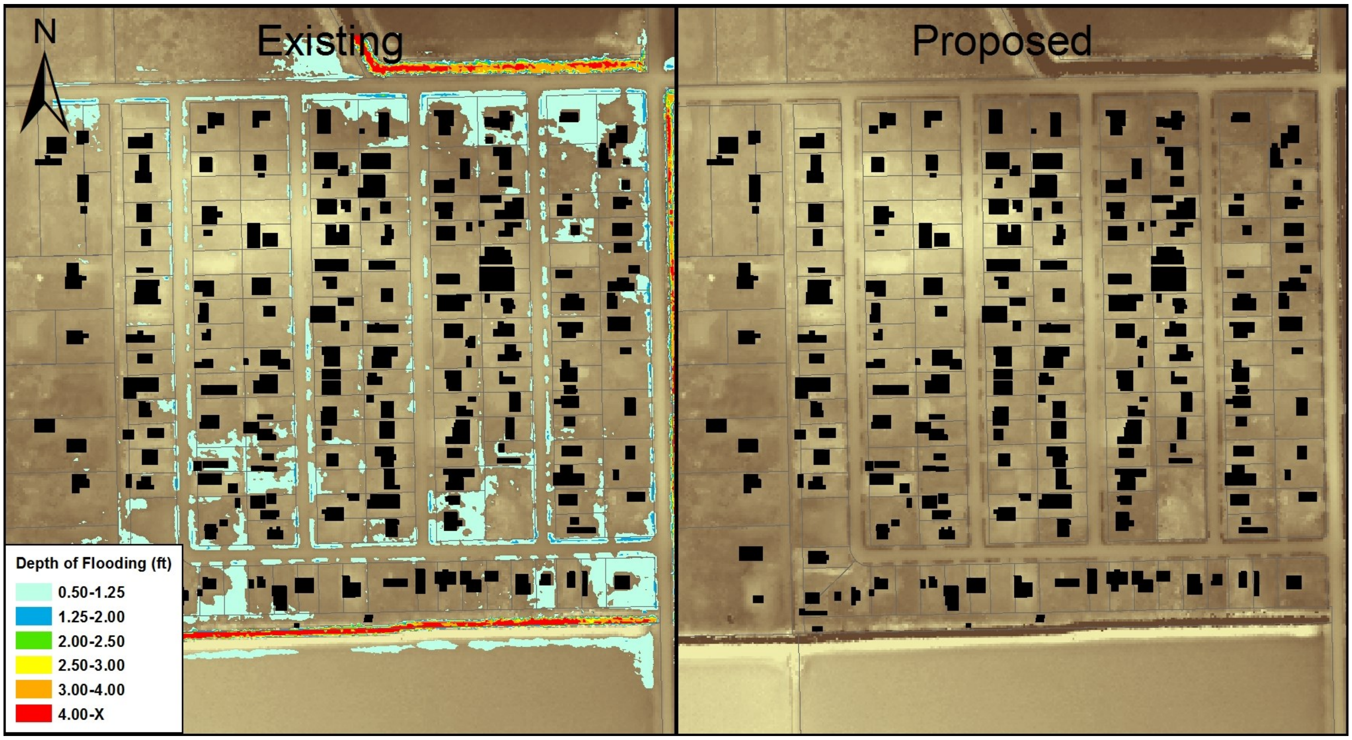


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	10	2	8
Inundated Lots	121	0	121
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Capisallo Park, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

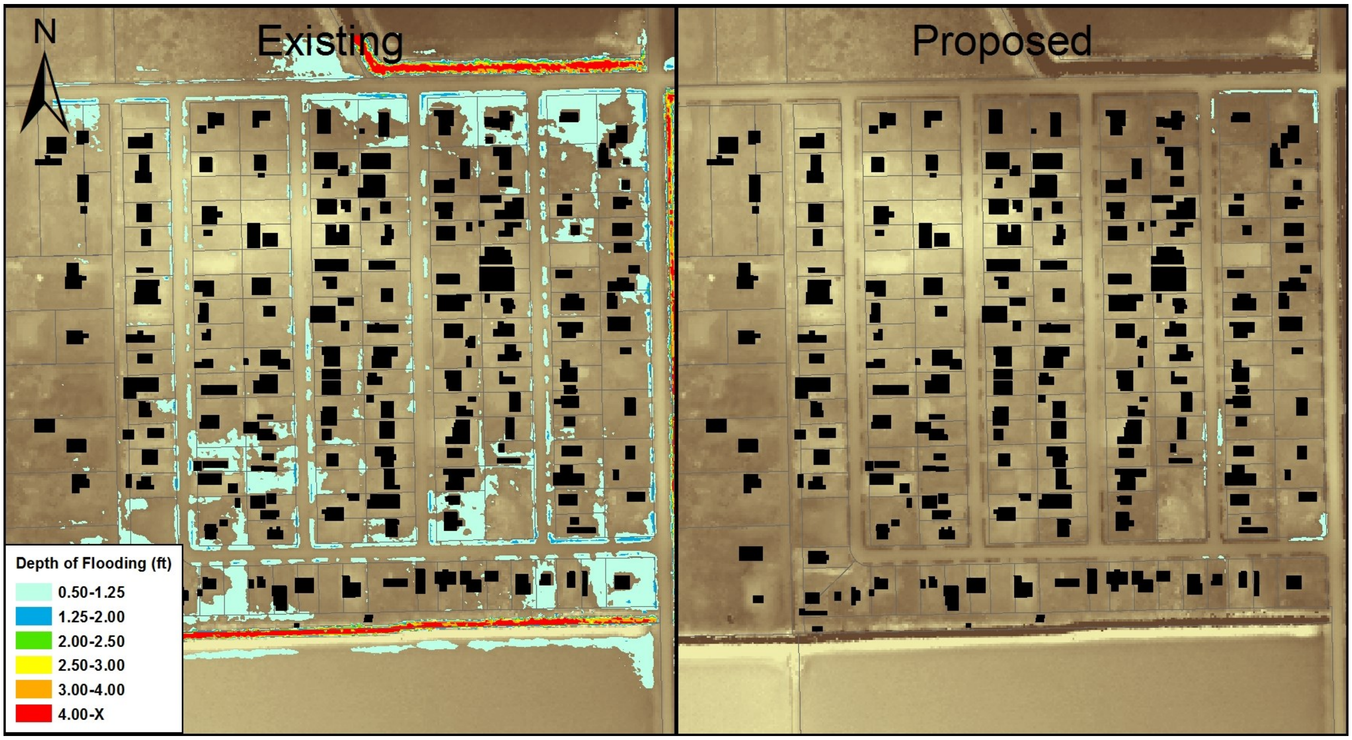


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	2	9
Inundated Lots	121	7	114
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Recommended Mitigation Project cont.:

Project Figures:

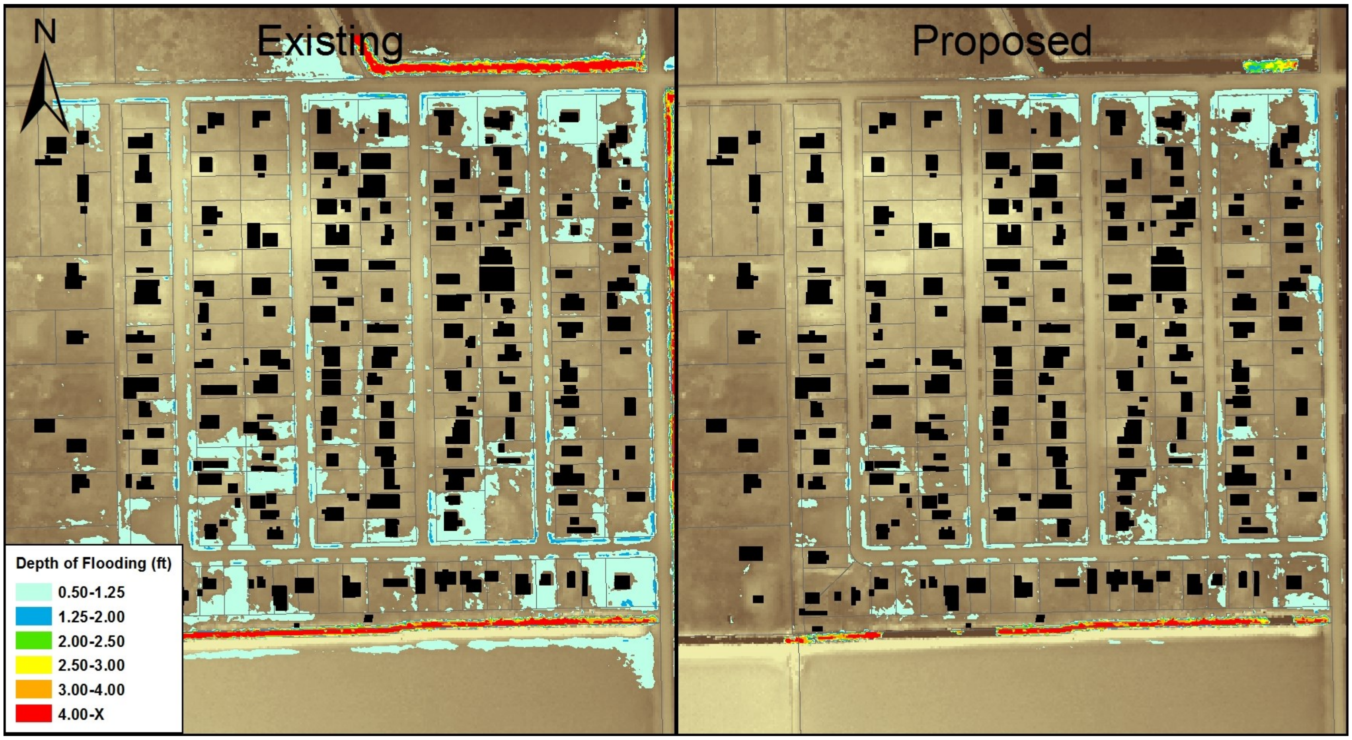
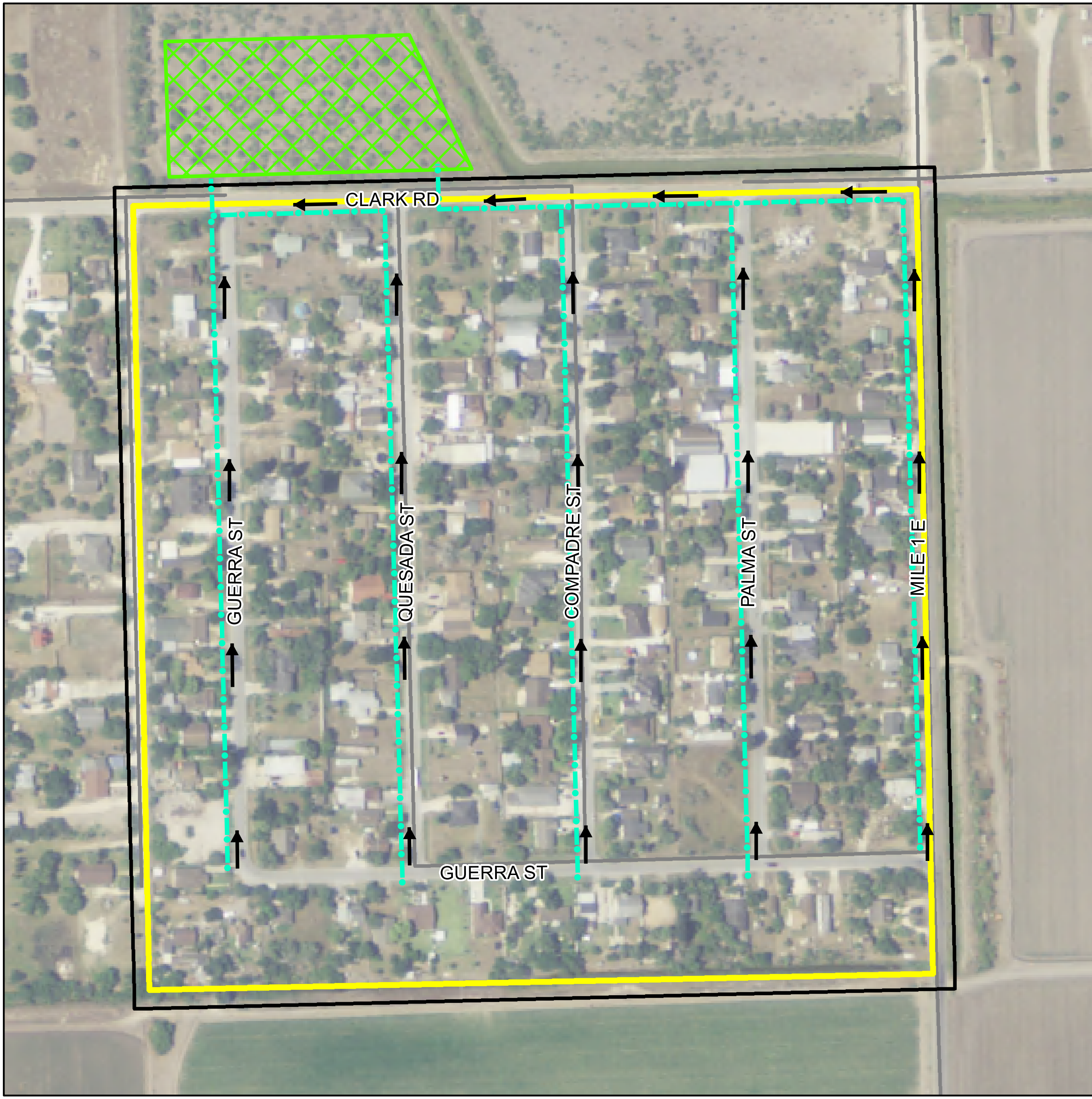


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	2	9
Inundated Lots	124	63	61
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Capisallo Park
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

STREETS
PROPOSED STORMWATER SYSTEM
PROPOSED DRAINAGE FLOW
CAPISALLO PARK
DRAINAGE AREA
25-YR RETENTION POND
EXISTING FLOODPLAIN

N W E S

0 140 280 420
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

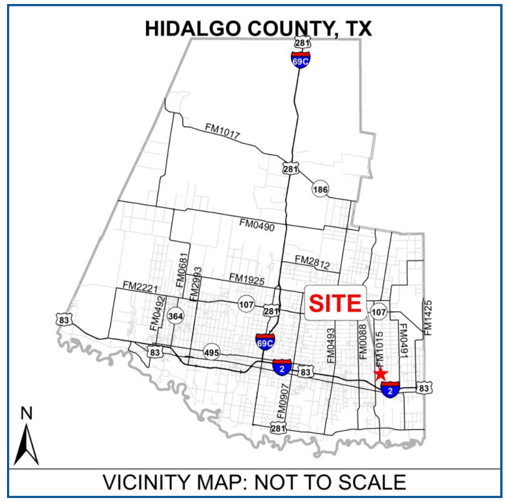
"Filling the Gap"

Colonia: Chapa #5, Hidalgo County

Basin: North Floodway

Category: A1

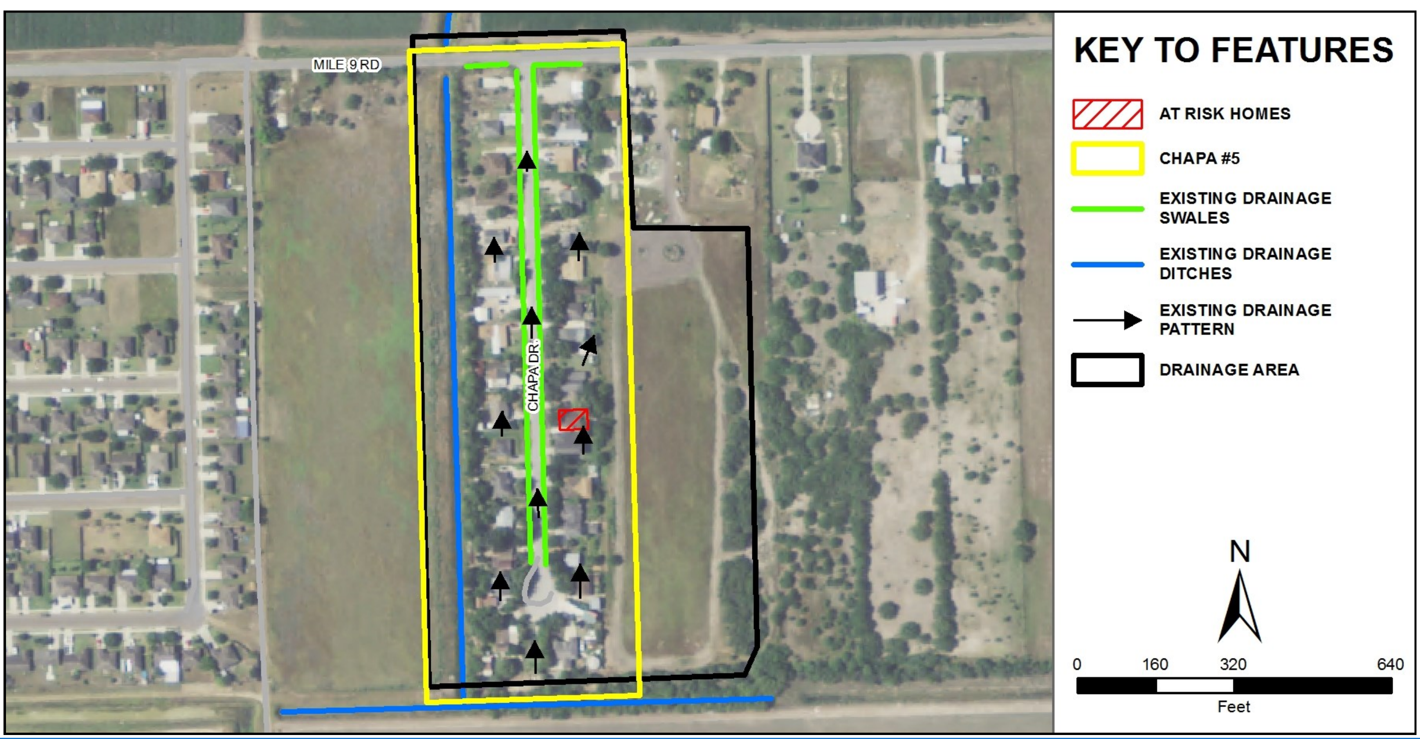
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Chapa #5 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Chapa #5 consists of approximately 7 acres of residential developed land with an offsite drainage area of approximately 11 acres of agricultural land. The current drainage system consists of very poorly maintained swales along Chapa Drive that do not provide adequate drainage for the colonia. The existing drainage pattern indicates runoff flows toward the north of the subdivision and outfalls to the Mile 9 Road swale. There are major drainage ditches along the west side and south side of the colonia. The results of the existing conditions 2D model indicate highest risk of flooding in the northern portion of the subdivision. Based on the LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events that may overflow the existing drain ditches into the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 14.4 inches, orange 14.4 to 20 inches, and red more than 20 inches.



Colonia: Chapa #5, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Improve and maintain roadside swales to outfall into existing drainage ditches.
  - Design a regional approached solution.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements have been designed to provide protection from flooding for a 10-Yr storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 501 linear feet of 24-inch diameter pipe, 205 linear feet of 30-inch diameter pipe, 520 linear feet of 36-inch diameter pipe, and 12 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 8.11 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce flooding potential from localized storm events, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
CHAPA #5		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$191,876.33
2	Drainage Improvements	$135,268.00
3	Pond Excavation Improvements	$218,564.44
	Sub-Total =	**$545,708.78**
	Engineering Fees (10%) =	**$54,570.88**
	Contingency (20%) =	**$109,141.76**
	Total =	**$709,421.41**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Chapa #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	1	0	1
1% (100-year)	1	0	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$58,812.00	$709,421.41	0.08
Elevate Structures	$58,812.00	$21,600.00	2.72
Acquisition/Supplemental Housing / Demolition	$63,168.00	$64,411.50	0.98

Recommended Mitigation Project cont.:

Project Figures:

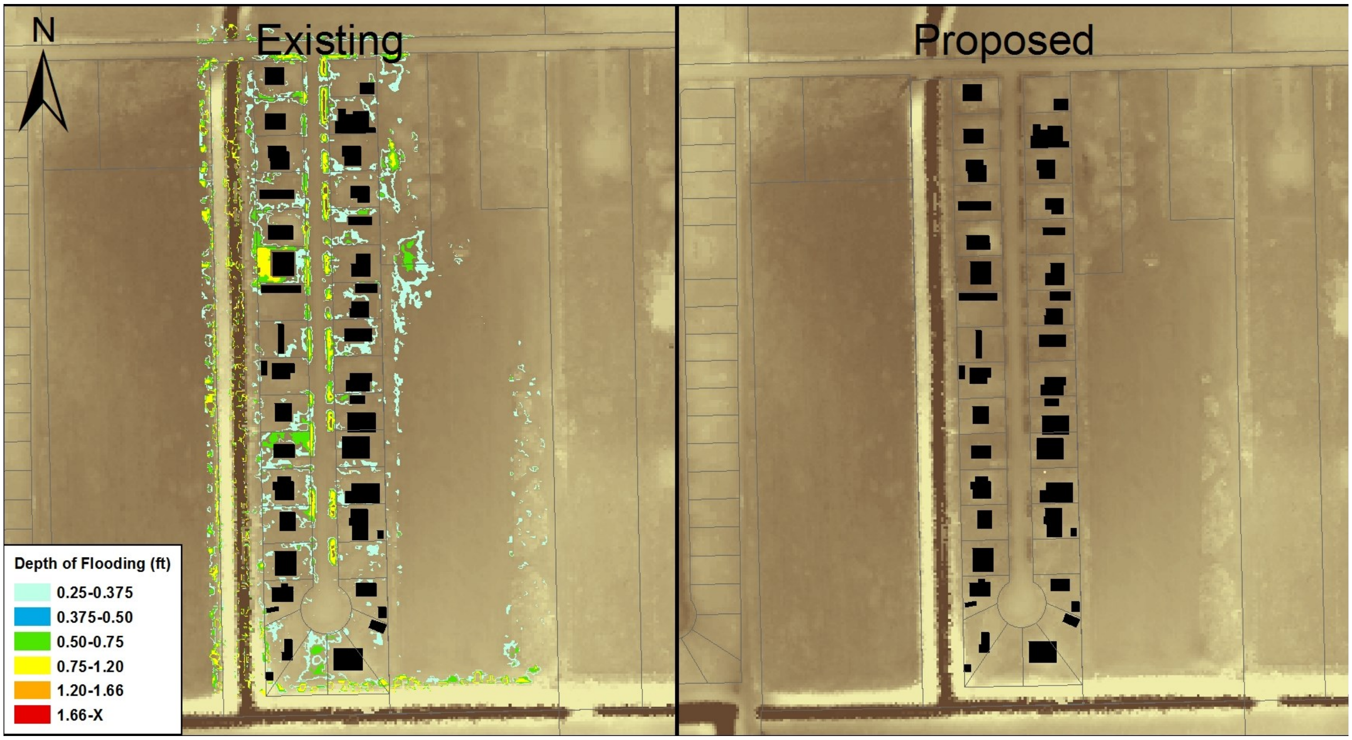


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	34	0	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Chapa #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

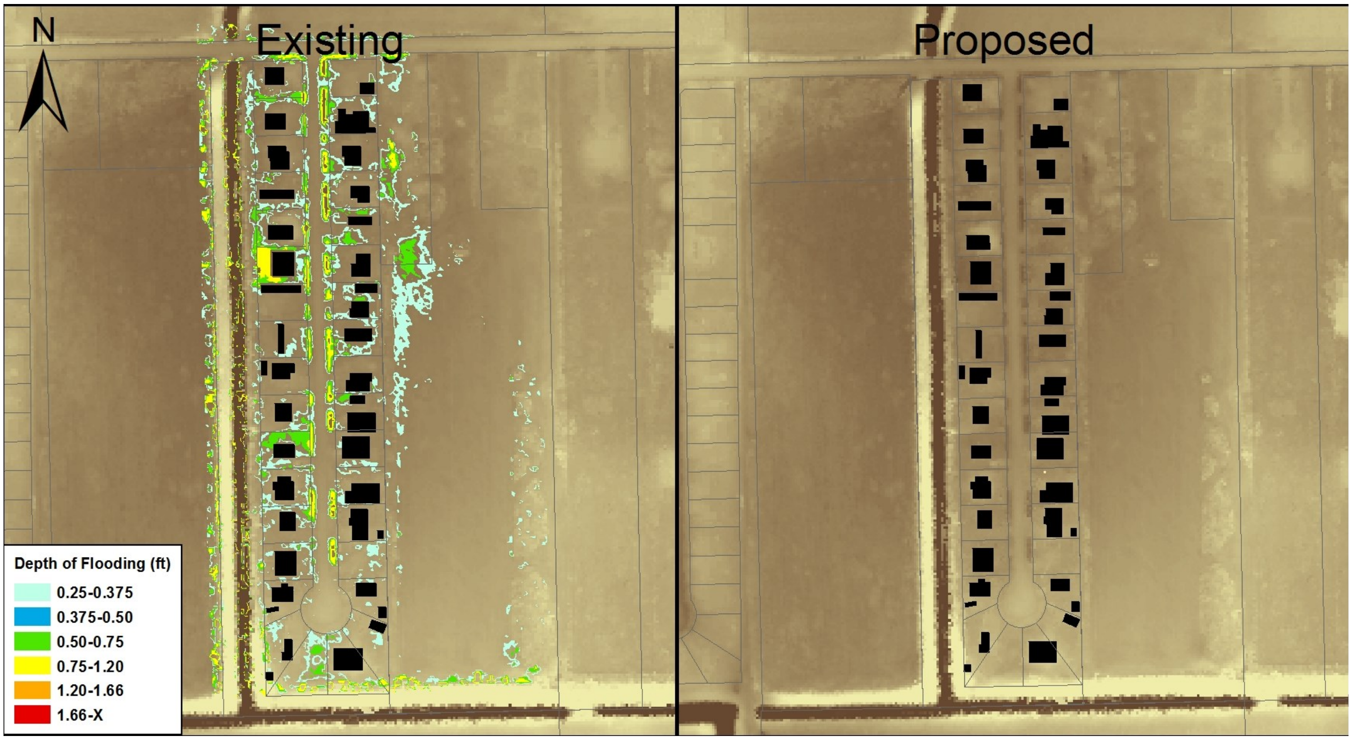


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	0	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Chapa #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

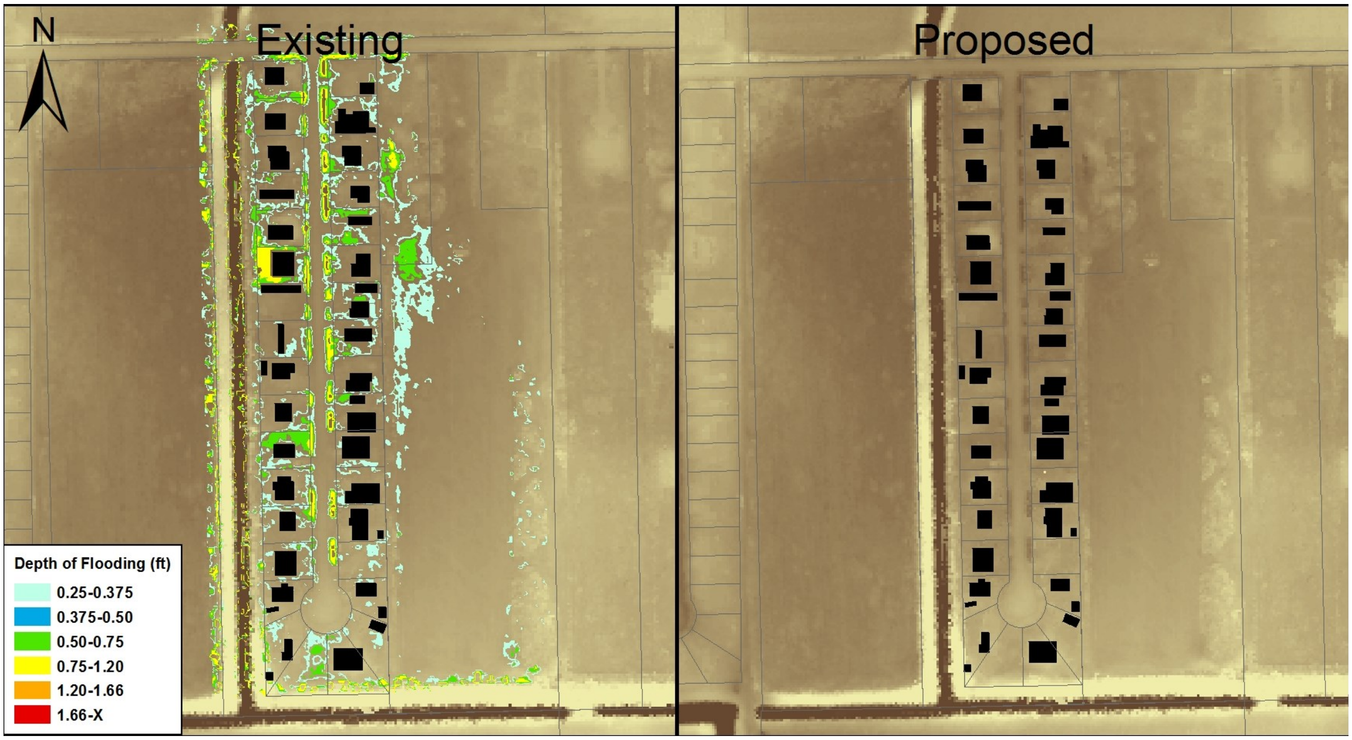


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	8	26
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Chapa #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

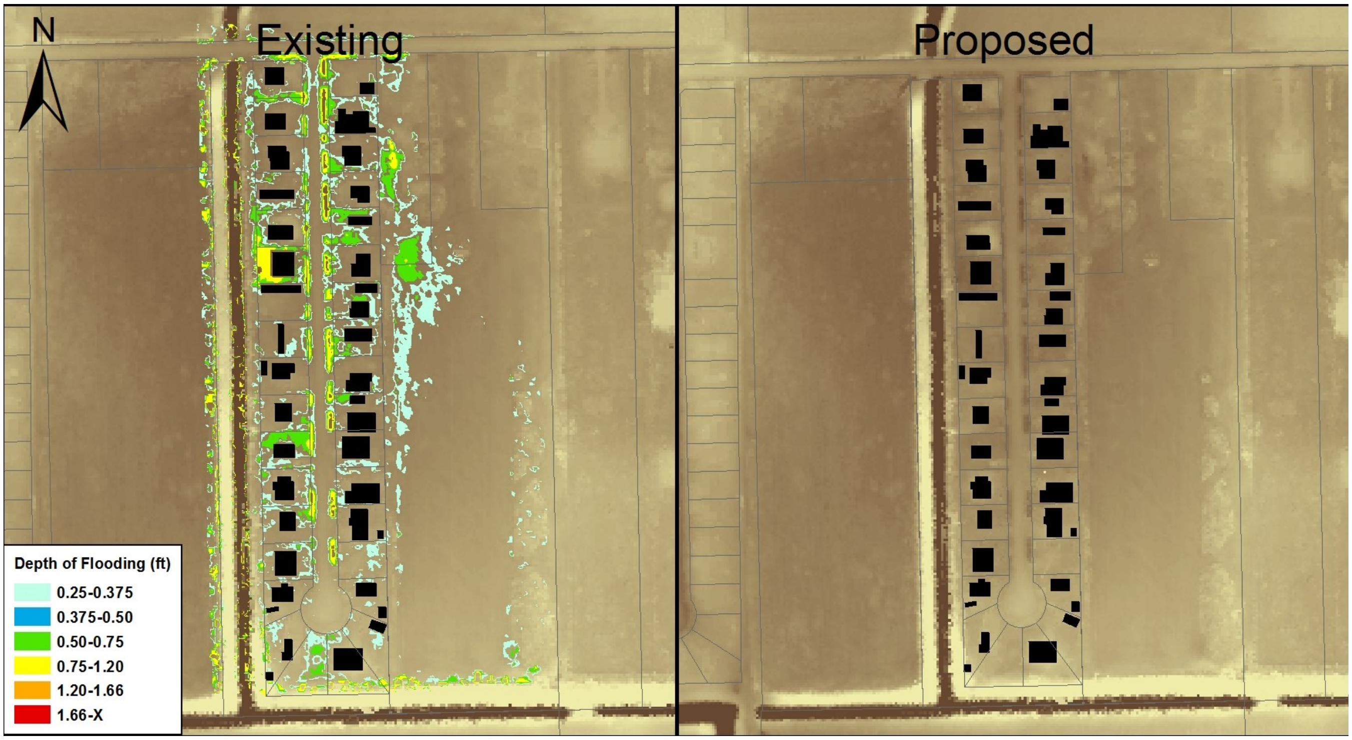


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	13	21
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Chapa #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

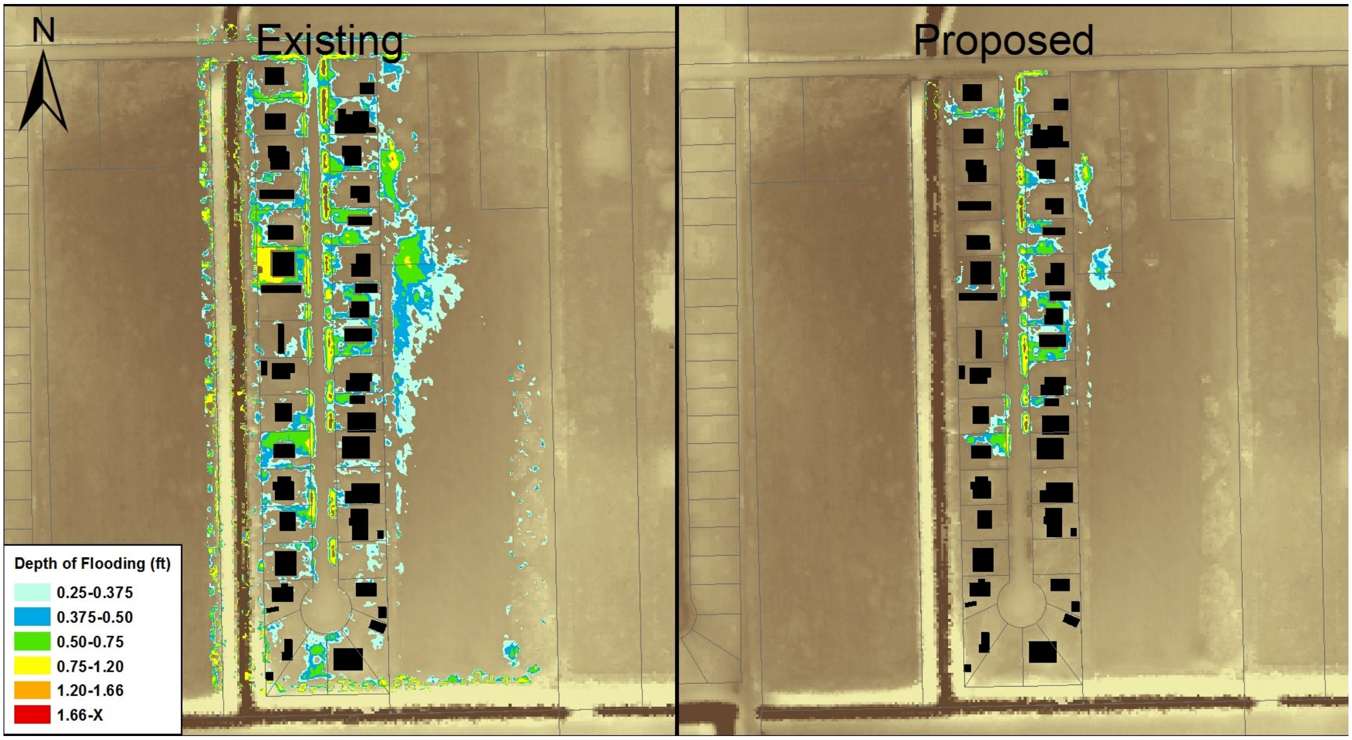
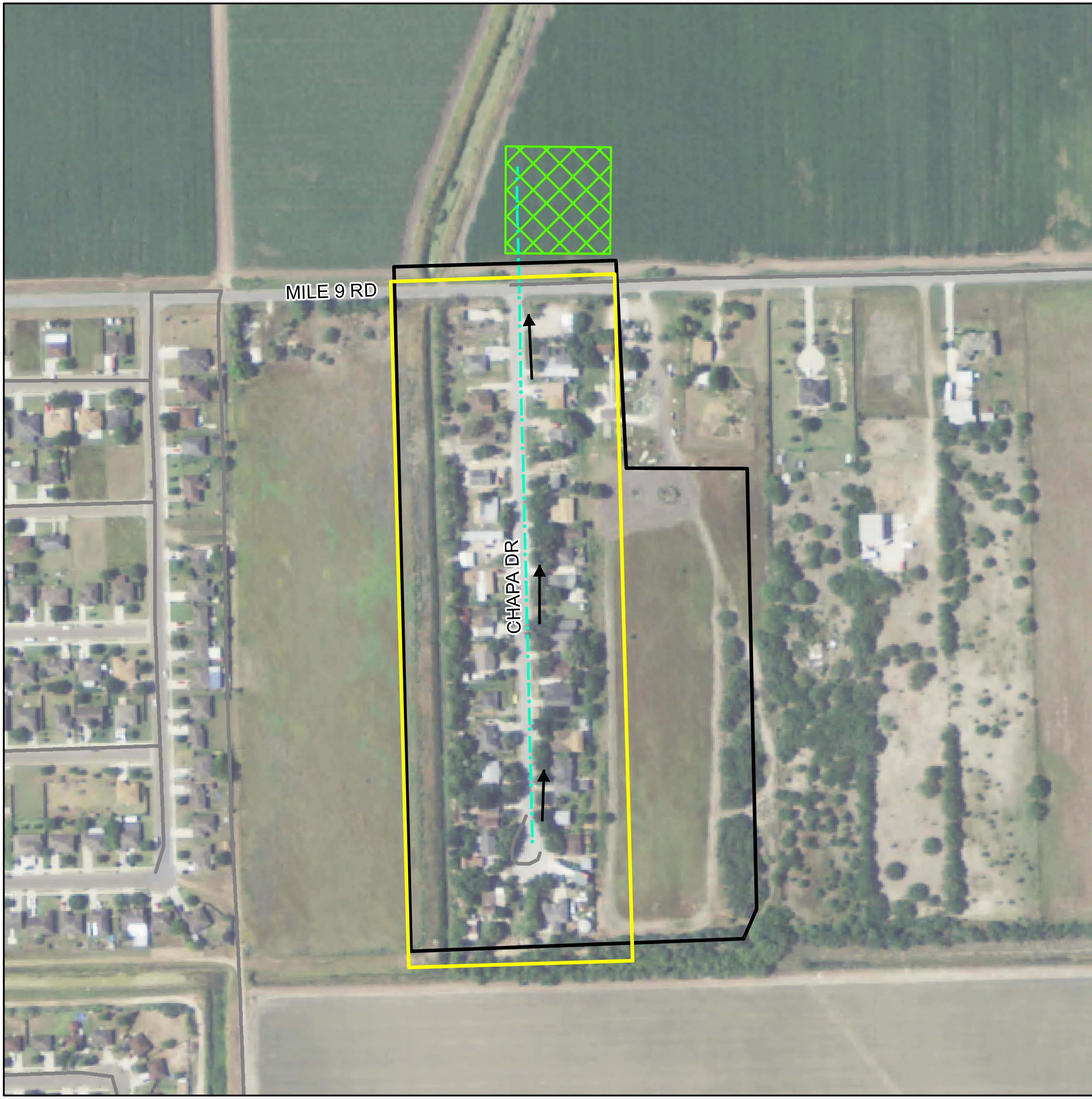


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	17	17
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Chapa #5
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- CHAPA #5
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

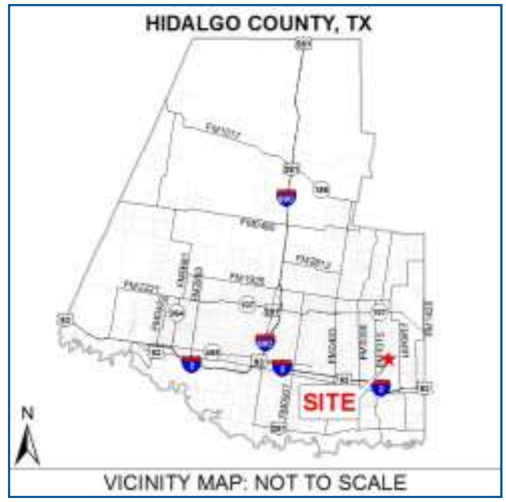
Colonia: Chapa Subdivision, Hidalgo County

Basin: North Floodway

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Chapa Subdivision colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 12-acre colonia are generally to the south. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. Chapa Subdivision experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Chapa Subdivision, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
  - Improve and/or install adequately sized driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements to the roadside drainage system with a retention facility. The improvements include 250 linear feet of 18-inch diameter pipe, 380 linear feet of 24-inch diameter pipe, 700 linear feet of grassy swale, 770 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 6.86 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Chapa Subdivision		
	IMPROVEMENTS	COST	
1	PAVING IMPROVEMENTS	$	7,583.33
2	DRAINAGE IMPROVEMENTS	$	29,035.56
3	POND EXCAVATION IMPROVEMENTS	$	186,340.00
	Sub-Total =	$	222,958.89
	Engineering (10%)	$	22,295.89
	Contingency (20%)	$	44,591.78
	Total =	$	289,846.56
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Chapa Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$349,695	$289,846	1.21
Elevate Structures	$349.695	$329,100	1.06
Acquisition/Supplemental Housing/Demolition	$610,124	$505,085	1.21

Colonia: Chapa Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

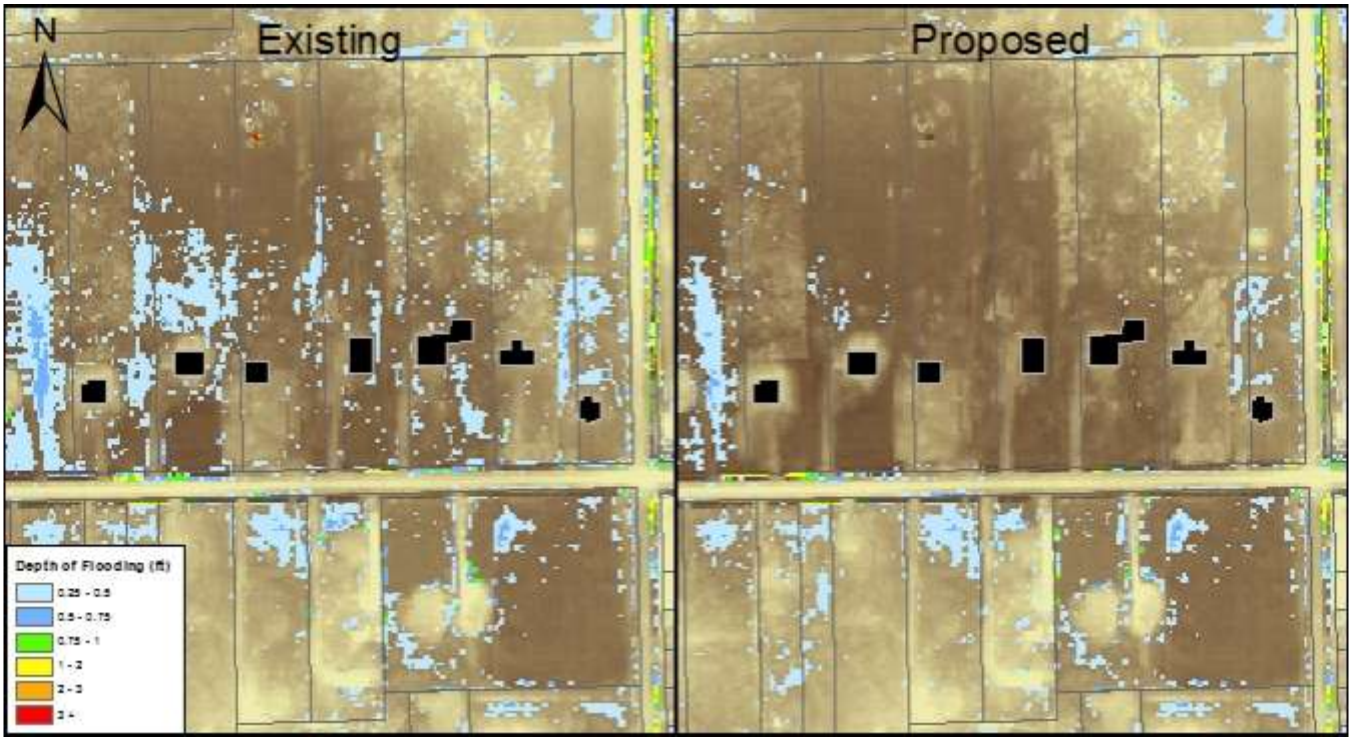


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	7	1	6
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Chapa Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

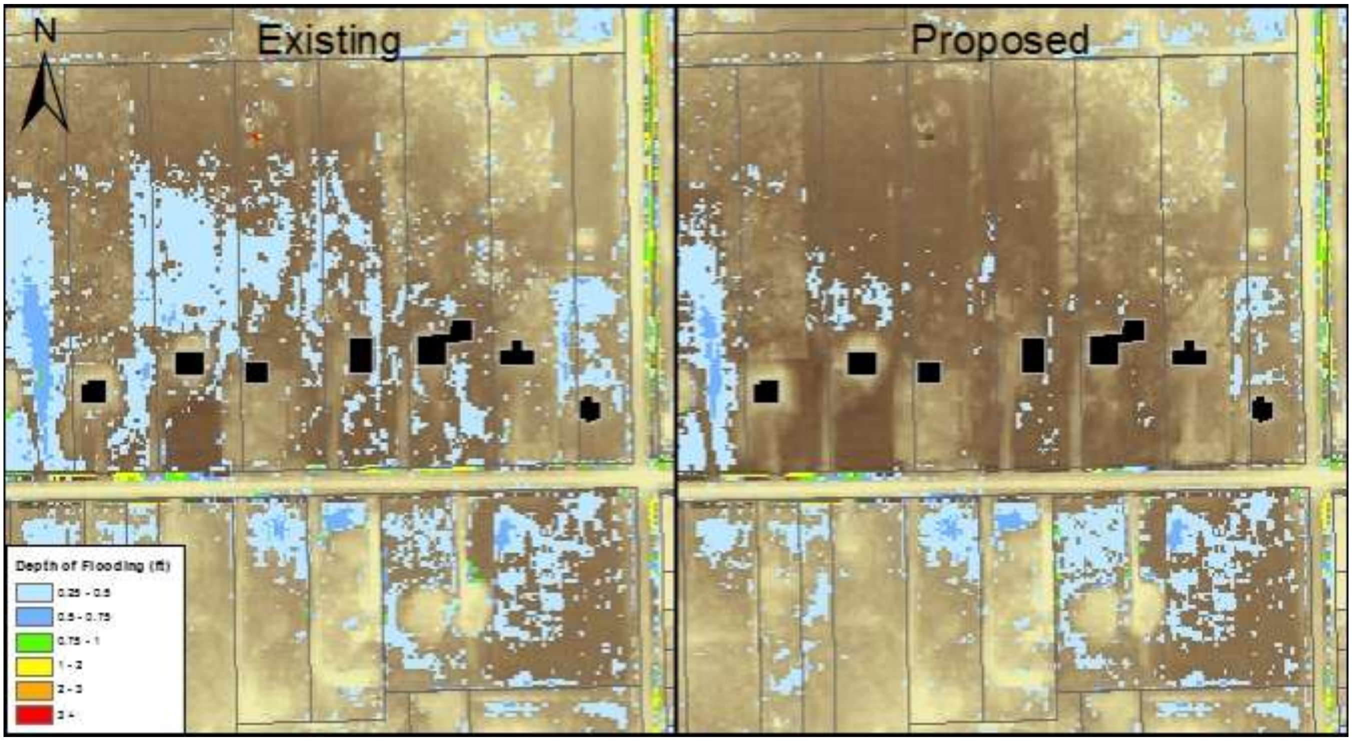


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	7	0	7
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Chapa Subdivision, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figure:

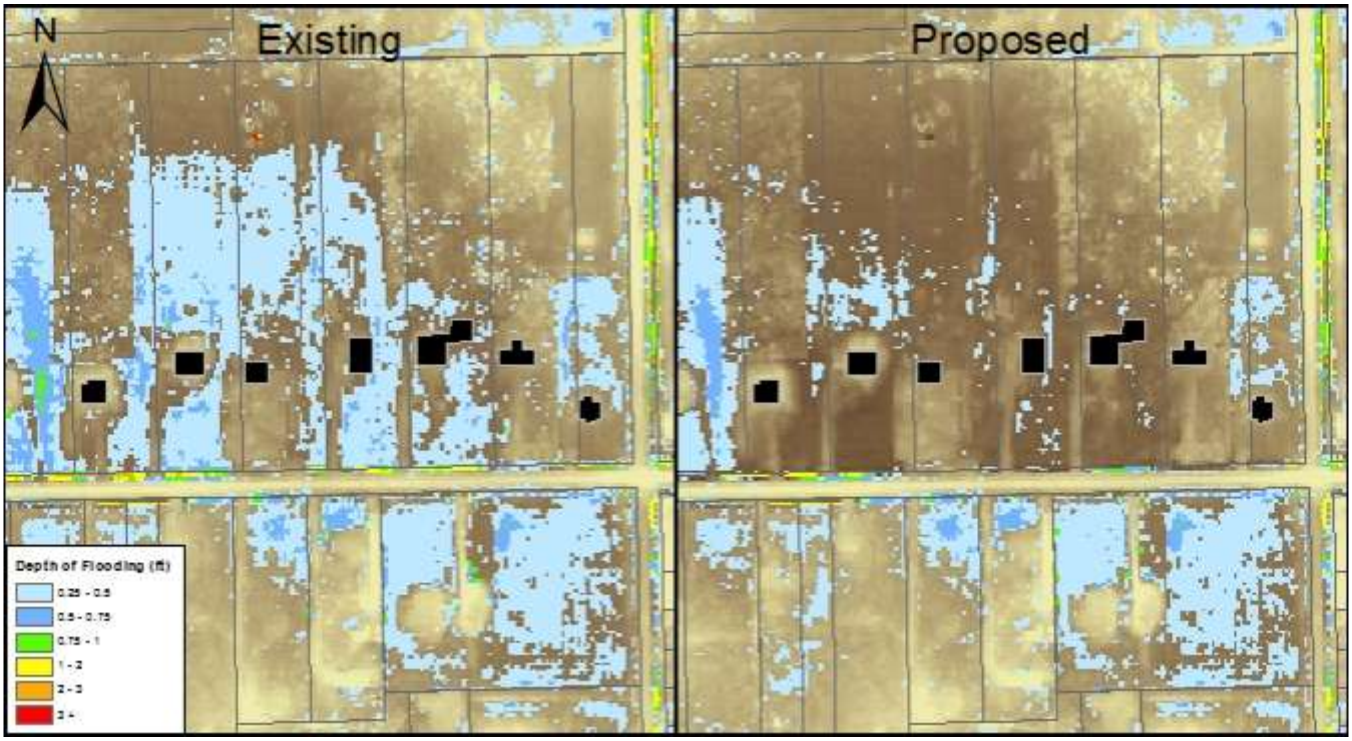


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	7	0	7
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Chapa Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

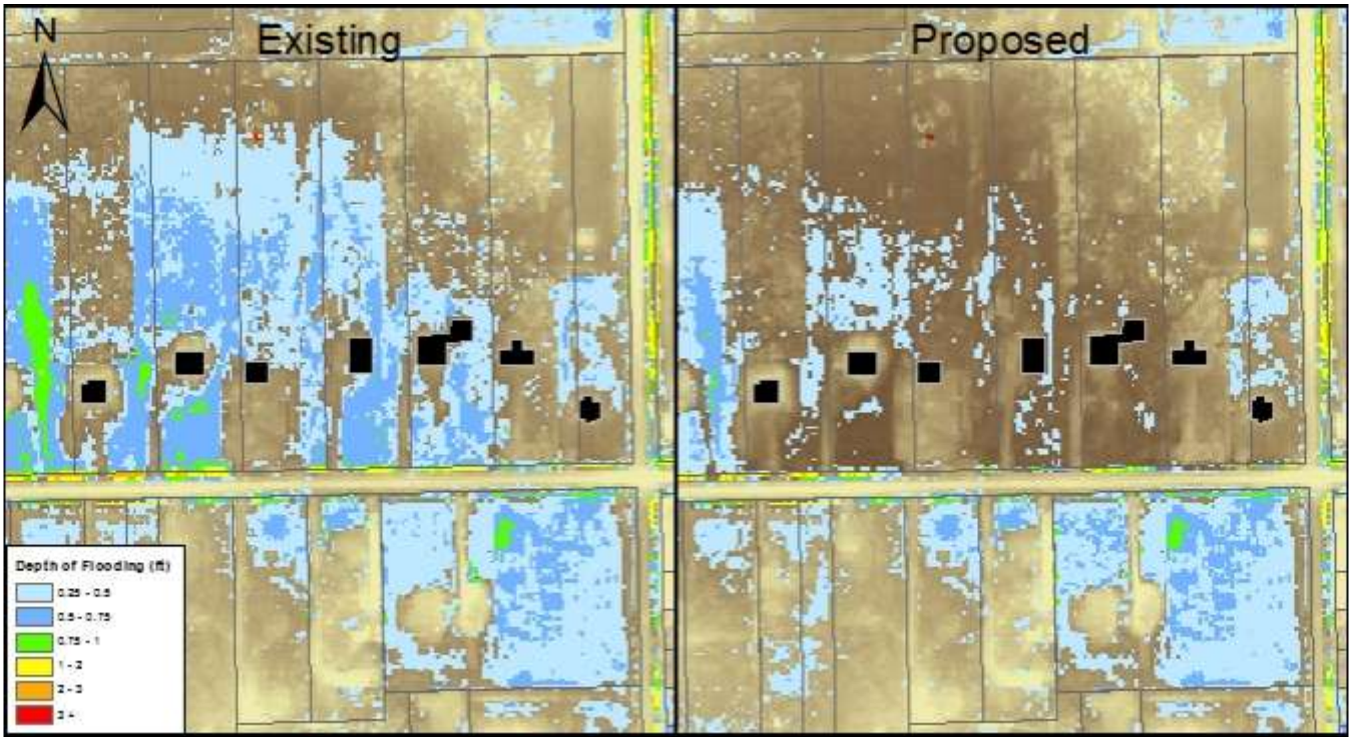


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	7	0	7
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Chapa Subdivision, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

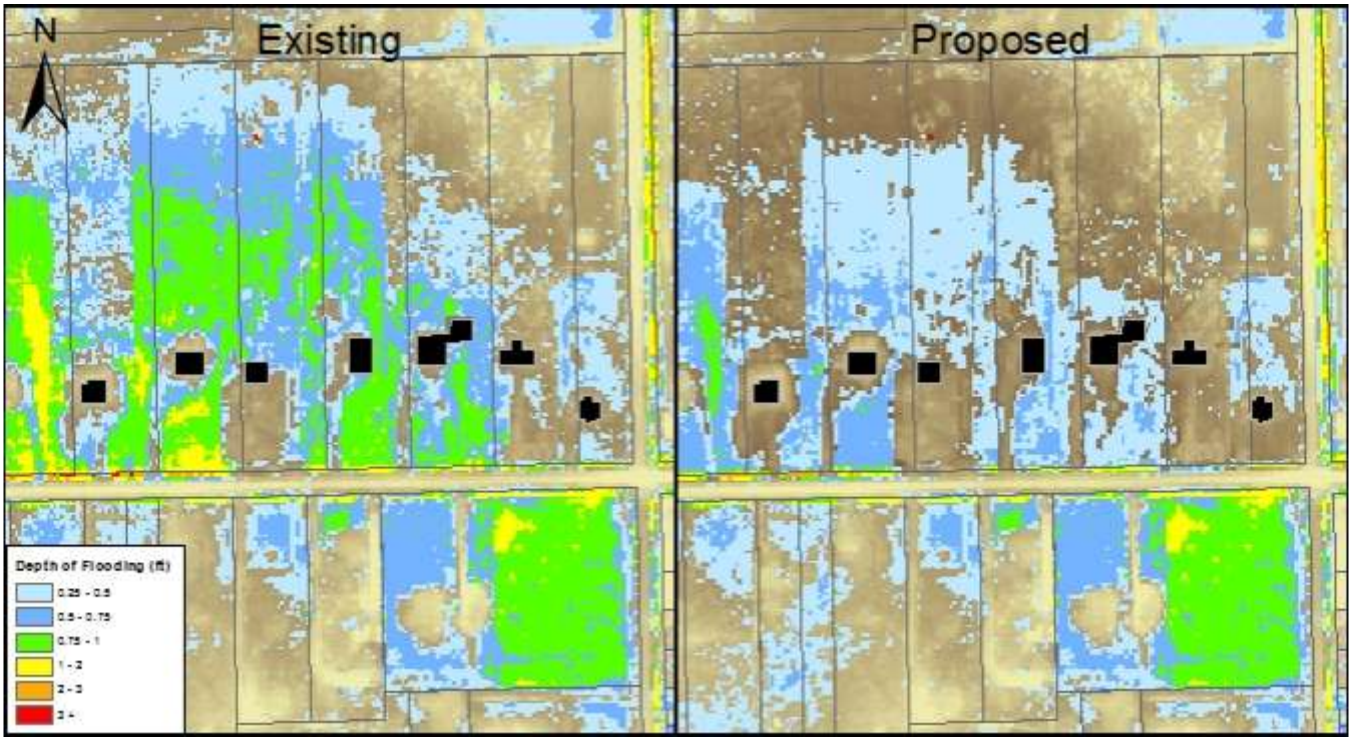
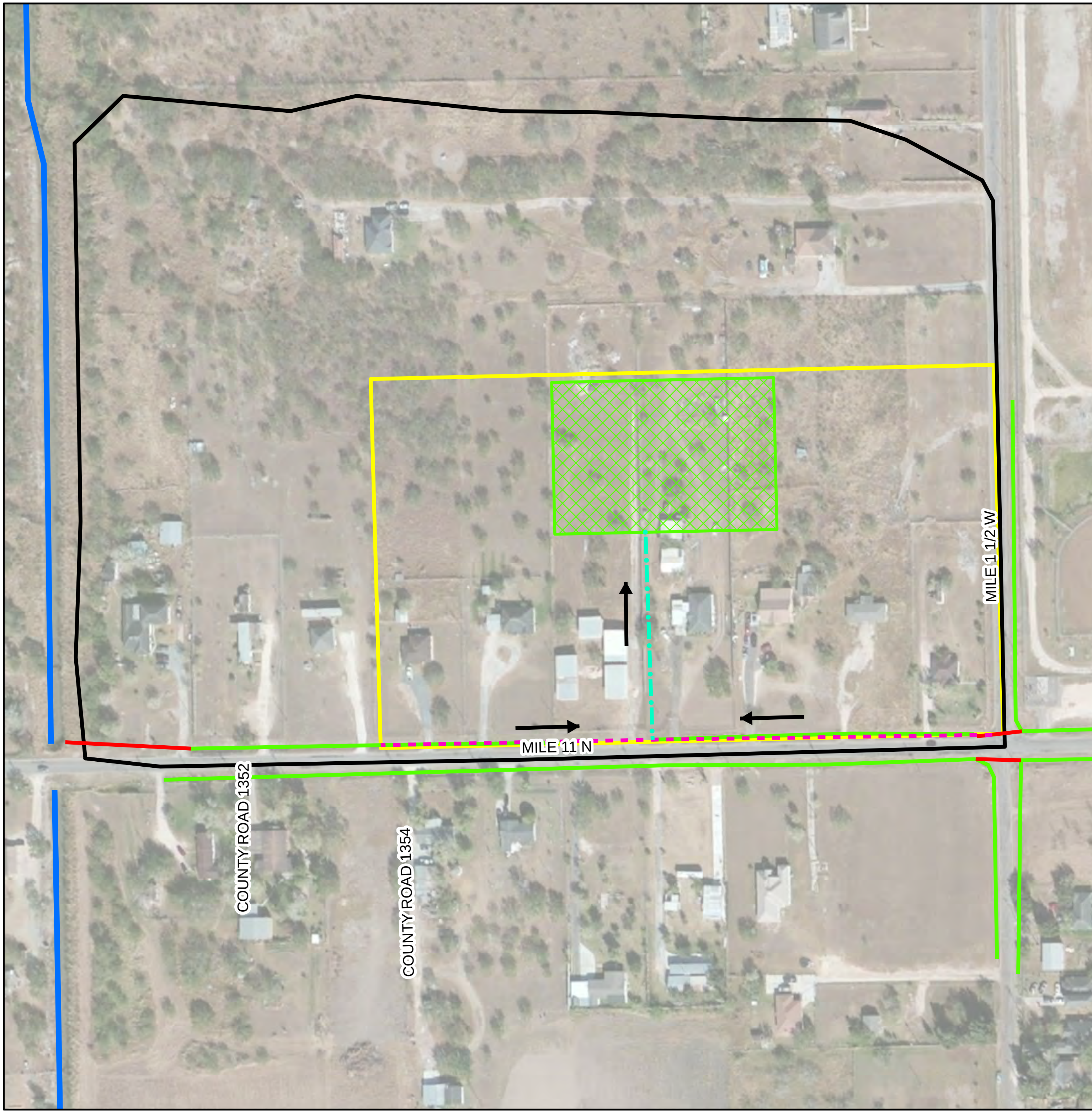


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	7	0	7
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Chapa Subd
County: Hidalgo County

Recommended Conceptual Plan
NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Chapa Subd Colonia
- Drainage Area

N

0 100 200 400
Feet

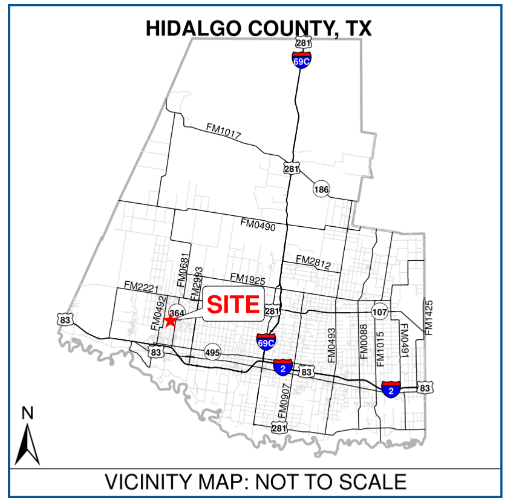
STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Colonia: Chula Vista Acres, Hidalgo County

Basin: North Main Drain

Category: A1

Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Chula Vista Acres storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Chula Vista Acres consists of approximately 19.8 acres with an additional contributing drainage basin of approximately 13.1 acres. The current drainage system consists of swales and culverts that appear to drain toward Bentsen Palm Drive. The model results indicate that the current drainage system does not adequately carry the storm runoff even when subjected to the 10-Year storm and smaller storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 8 inches, blue 8 to 12 inches, green 12 to 18 inches, yellow 18 to 24 inches, orange 24 to 30 inches and red more than 30 inches.

Colonia: Chula Vista Acres, Hidalgo County

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Re-grade the existing swales to convey runoff to a new retention pond.
    - Install an underground drainage system with a retention pond.
    - Intercept offsite runoff and provide additional volume to the proposed retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements consists of a new underground drainage system with a retention pond. The new system was designed to provide protection from flooding for a 10-Year storm and retention for a 25-Year storm. The new system consists of 812 linear feet of 24-inch diameter pipe, 774 linear feet of 30-inch diameter pipe, eight curb inlets, and one concrete manhole. The proposed retention pond is sized to retain both the onsite and offsite runoff of up to the 25-Year storm and it entails a facility with an effective storage volume of 17.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
CHULA VISTA ACRES

	IMPROVEMENTS	COST
1	Paving Improvements	$252,530.00
2	Drainage Improvements	$135,534.00
3	Pond Excavation Improvements	$474,675.00
	Sub-Total =	**$862,739.00**
	Engineering Fees (10%) =	**$86,273.90**
	Contingency (20%) =	**$172,547.80**
	Total =	**$1,121,560.70**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	17	8	9
20% (5-year)	17	8	9
10% (10-year)	19	8	11
4% (25-year)	20	9	11
1% (100-year)	21	17	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,579,133	$1,121,561	1.41
Elevate Structures	$1,579,133	$1,855,050	0.85
Acquisition/Supplemental Housing / Demolition	$5,965,155	$2,153,794	2.77

Colonia: Chula Vista Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

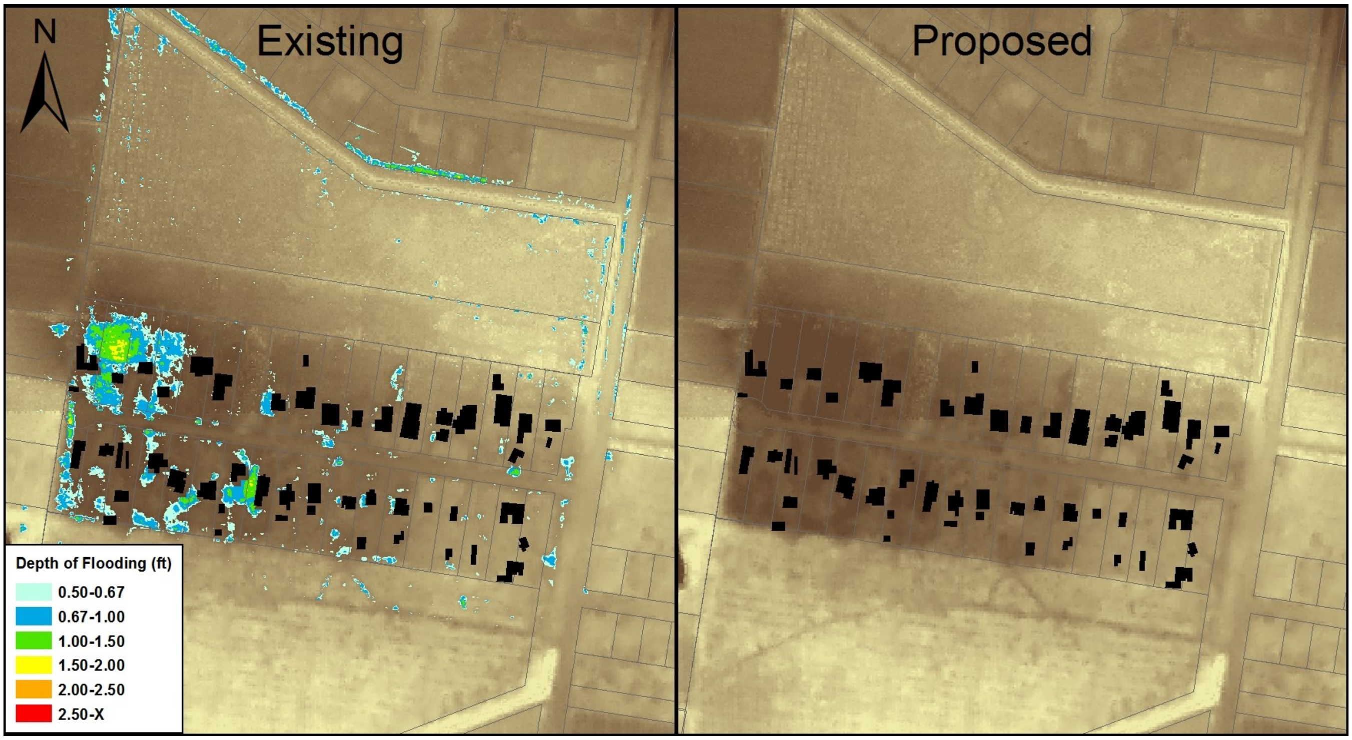


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	17	8	9
Inundated Lots	36	0	36
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Chula Vista Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

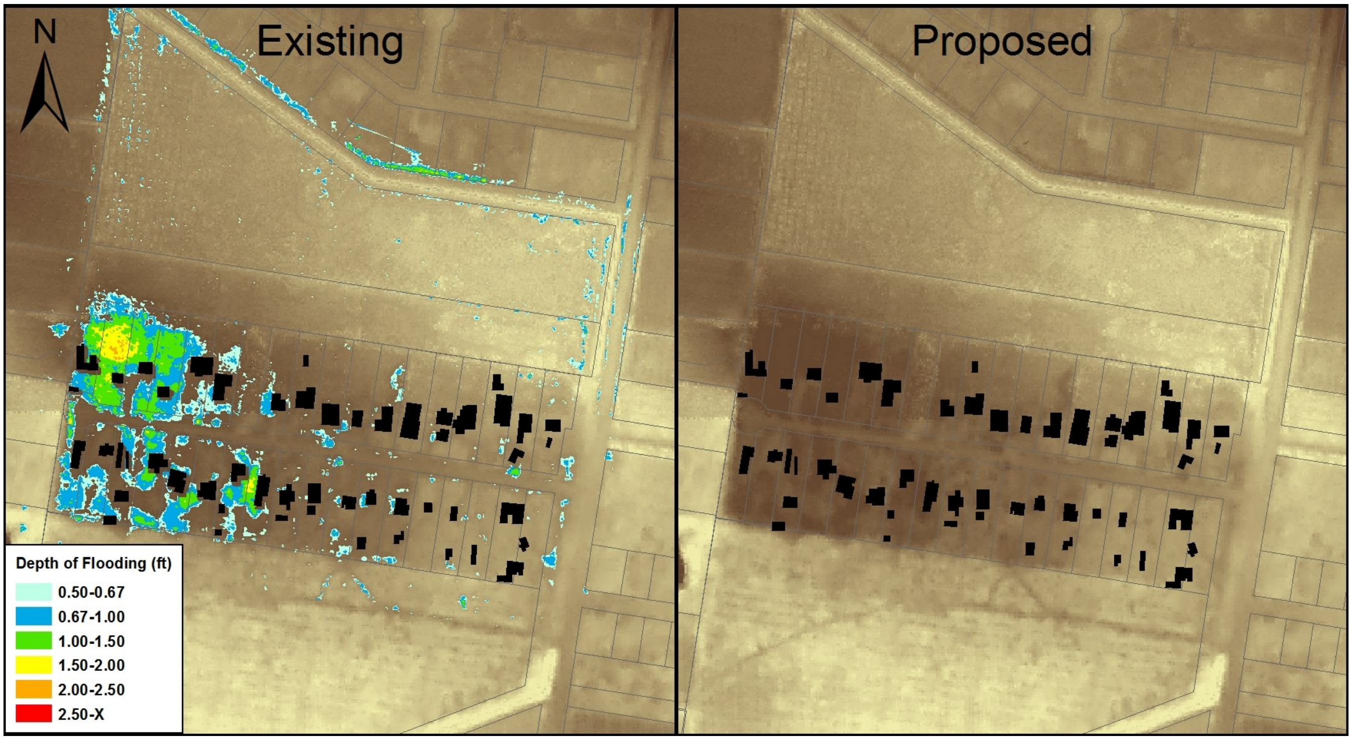


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	17	8	9
Inundated Lots	36	0	36
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Chula Vista Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

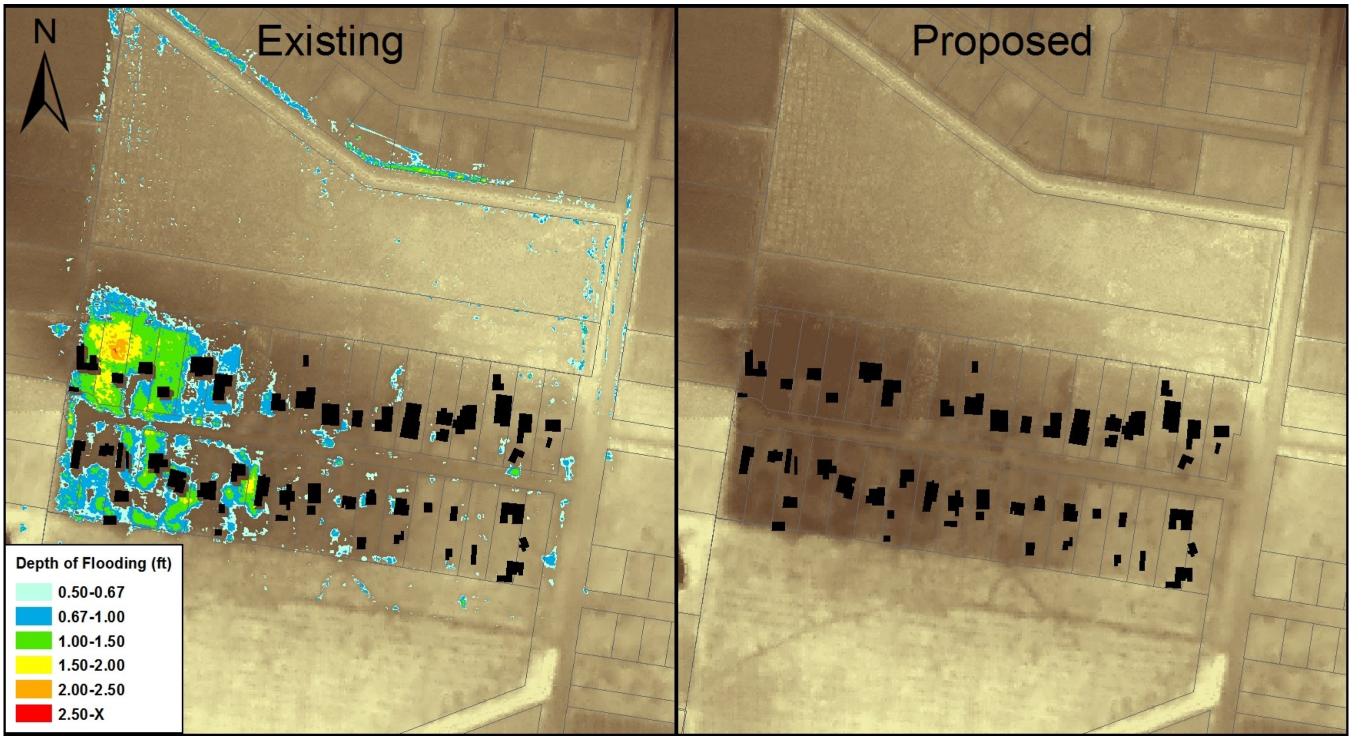


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	19	8	11
Inundated Lots	36	0	36
Inundated Roadway (LF)	14	0	14

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Chula Vista Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

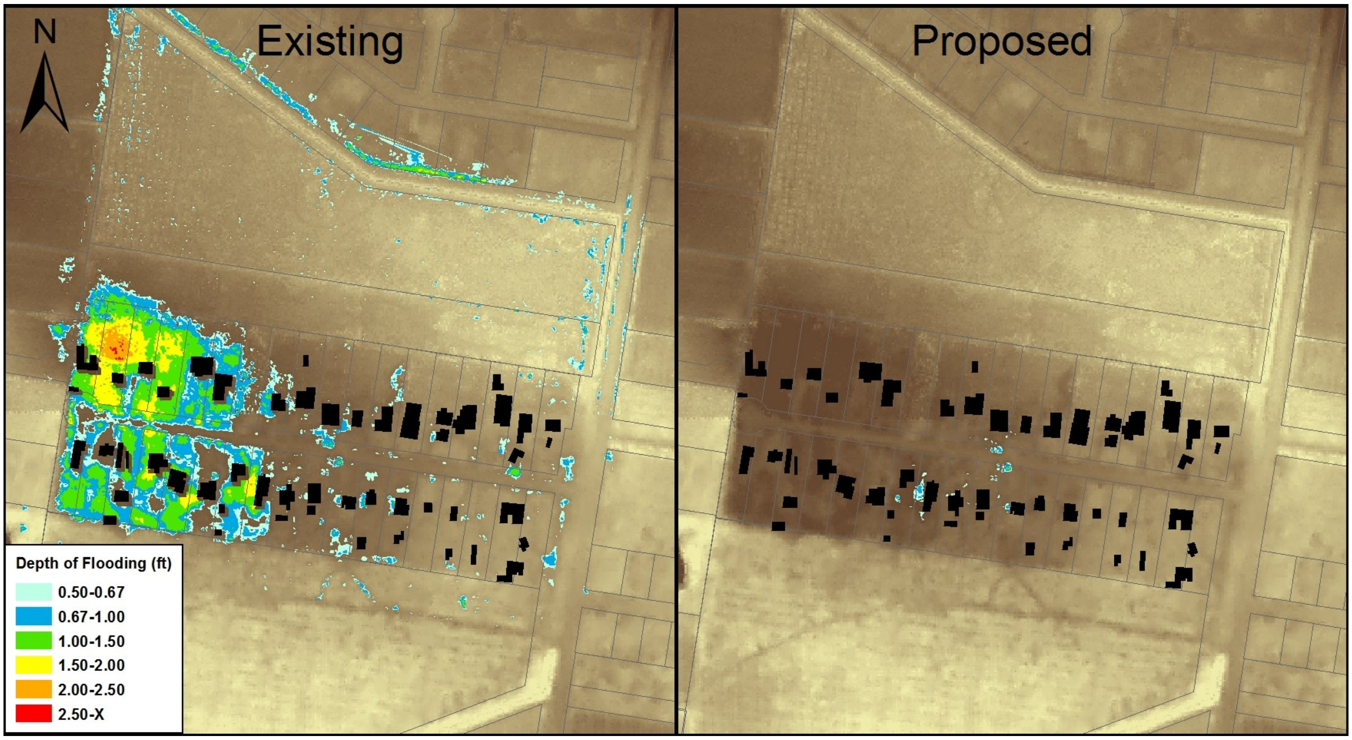


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	20	9	11
Inundated Lots	36	8	28
Inundated Roadway (LF)	135	0	135

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Chula Vista Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

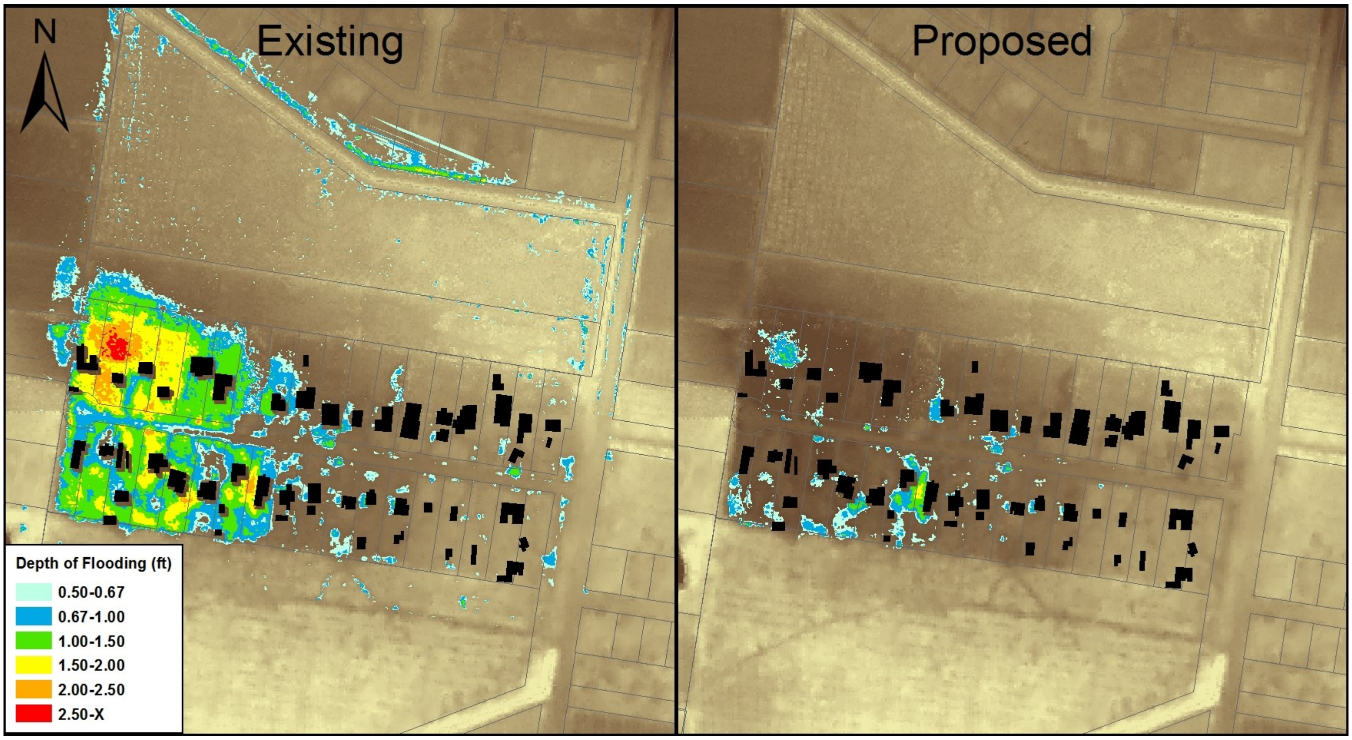
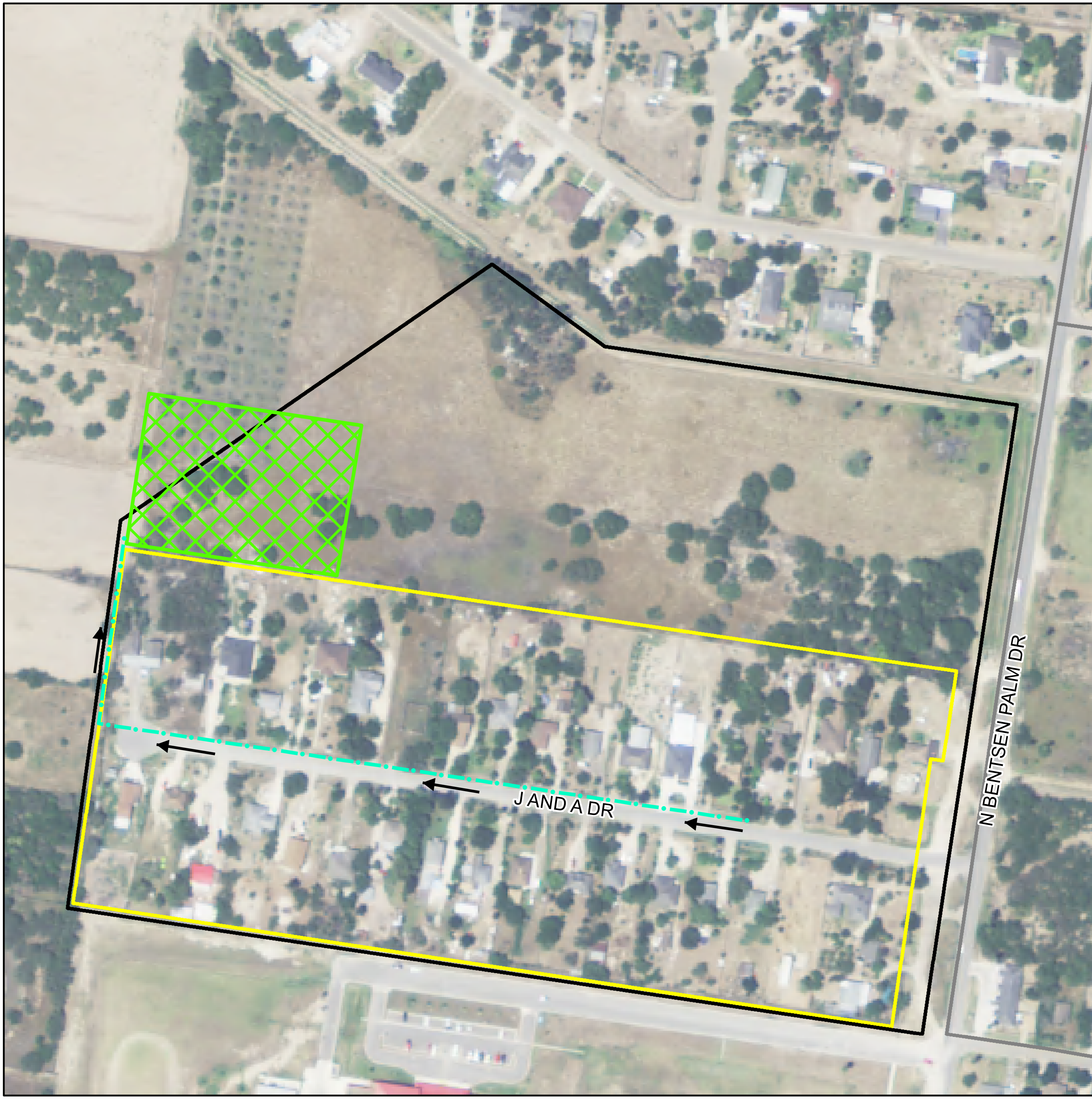


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	21	17	4
Inundated Lots	36	26	10
Inundated Roadway (LF)	416	0	416

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Chula Vista Acres
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- CHULA VISTA ACRES
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 140 280 420
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

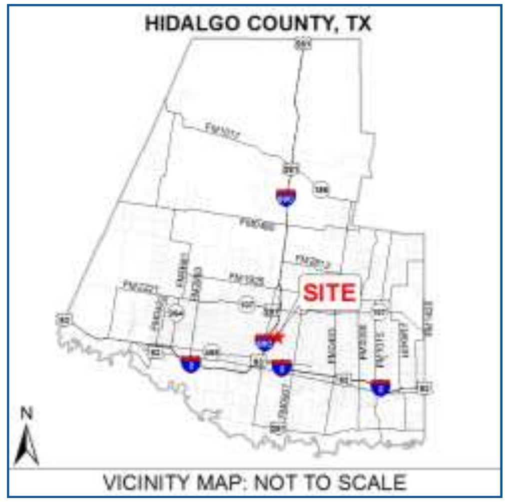
Colonia: Cotter and Welch Tract, Hidalgo County

Basin: North Main Drain

Category: A1

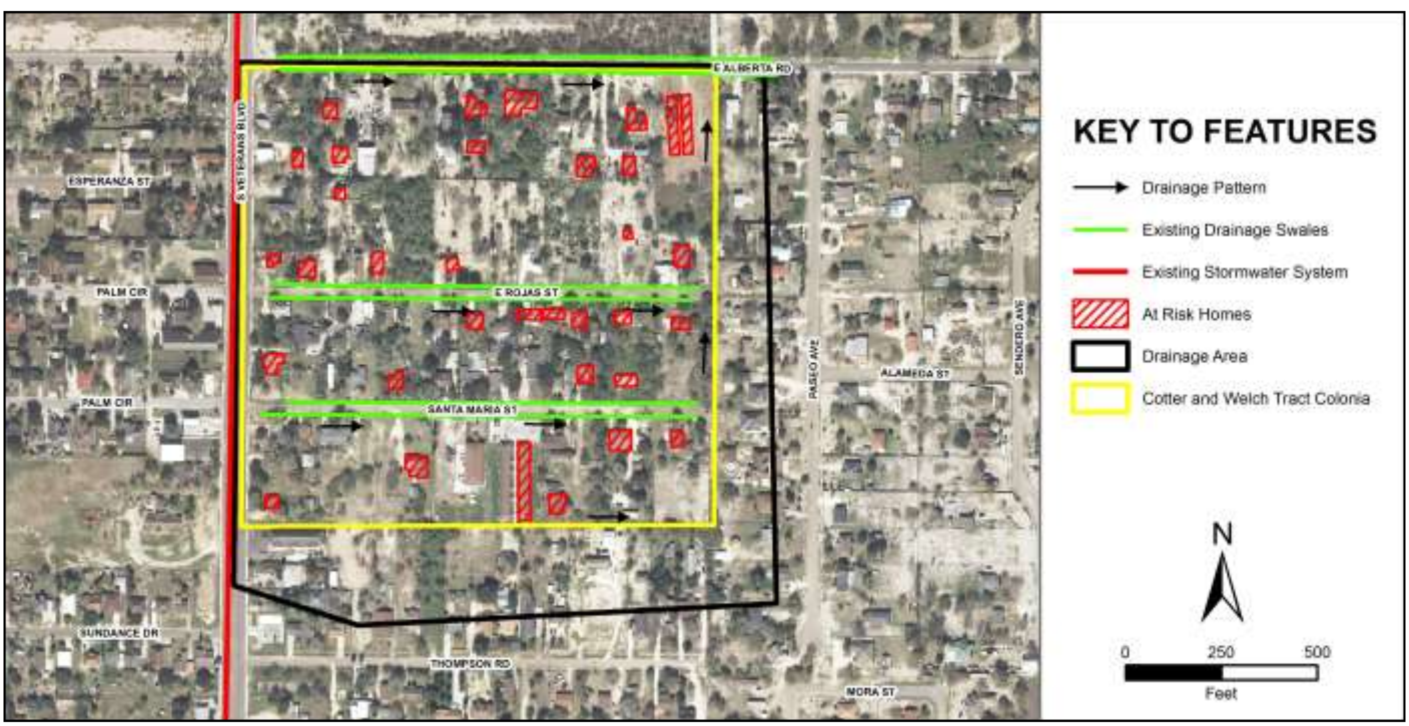
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Cotter Tract and Welch Tract colonias were built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within these gross 34-acre colonias are generally to the north and east. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. Cotter Tract and Welch Tract both experience residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Cotter and Welch Tract, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
  - Improve and/or install adequately sized driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

Due to the location and densely populated nature of both the Cotter Tract and Welch Tract colonias, the two areas were combined for this study to create one solution.

To reduce local flooding potential, the recommended project includes improvements to the roadside drainage system with a retention facility. The improvements include 740 linear feet of 18-inch diameter pipe, 320 linear feet of 24-inch diameter pipe, 30 linear feet of 36-inch diameter pipe, 225 linear feet of 48-inch diameter pipe, 6,600 linear feet of grassy swale, 1,780 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 19.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, the densely populated area, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Cotter Tract and Welch Tract

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	59,550.00
2	**DRAINAGE IMPROVEMENTS**	$	111,380.56
3	**POND EXCAVATION IMPROVEMENTS**	$	516,670.00
	Sub-Total =	**$**	**687,600.56**
	Engineering (10%)	$	68,760.06
	Contingency (20%)	$	137,520.11
	Total =	**$**	**893,880.72**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	14	0	14
20% (5-year)	18	0	18
10% (10-year)	21	0	21
4% (25-year)	24	0	24
1% (100-year)	34	8	26

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$15,103,516	$893,880	16.90
Elevate Structures	$15,103,516	$3,737,400	4.04
Acquisition/Supplemental Housing/Demolition	$15,881,187	$4,200,663	3.78

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

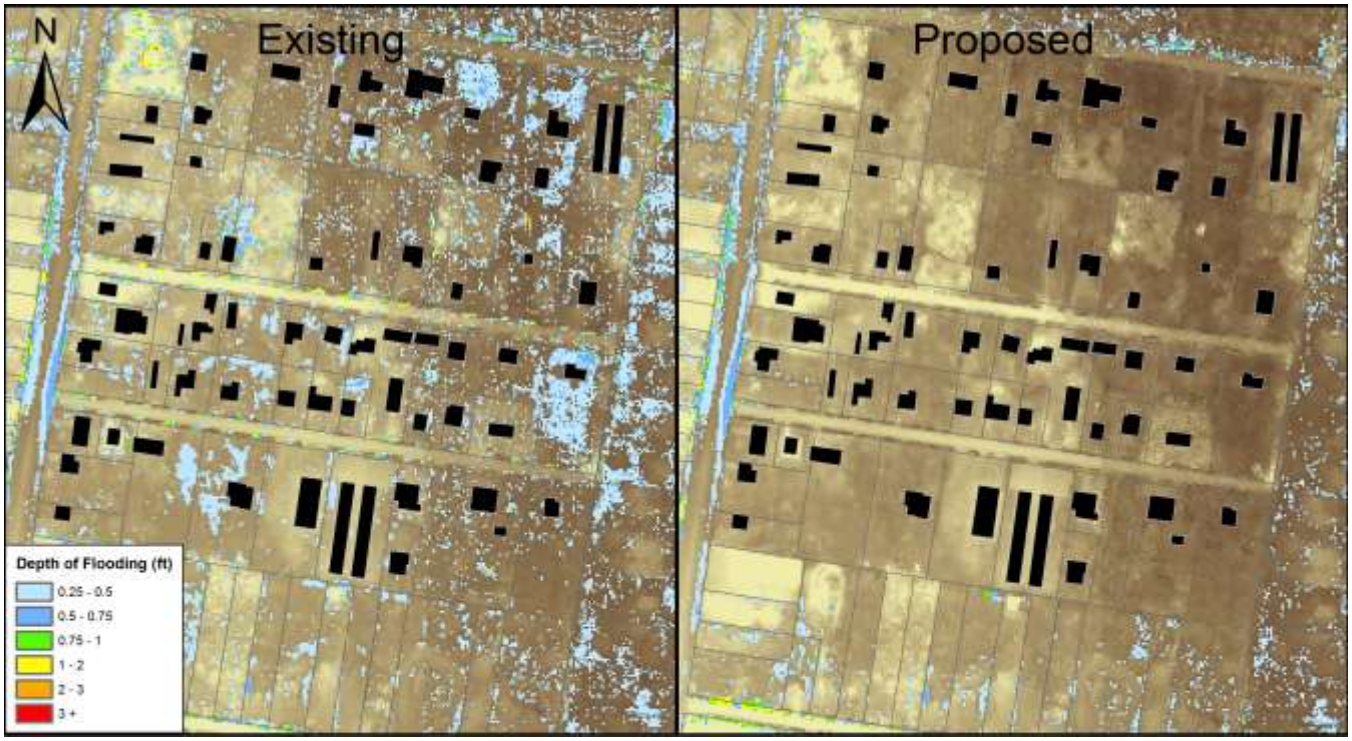


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	14	0	14
Inundated Lots	58	11	47
Inundated Roadway (LF)	70	65	5

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

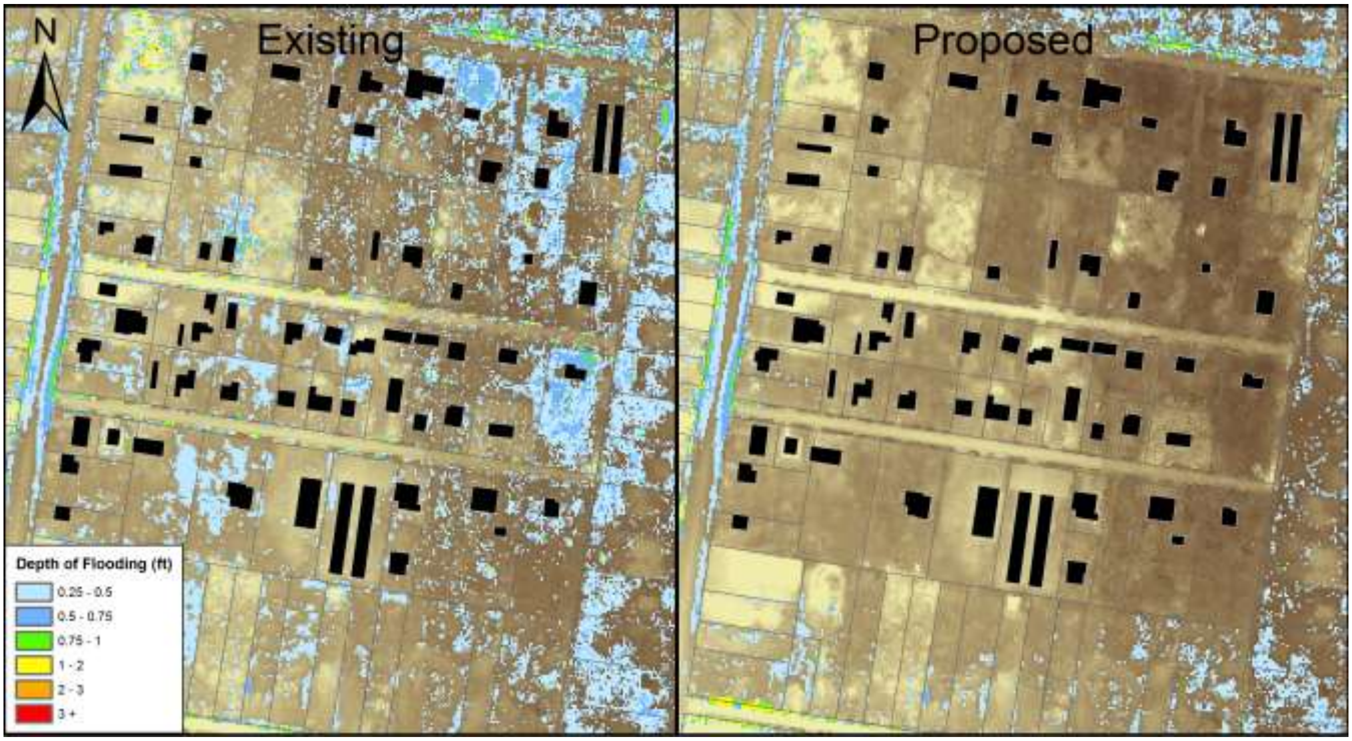


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	18	0	18
Inundated Lots	58	11	47
Inundated Roadway (LF)	100	85	15

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figure:

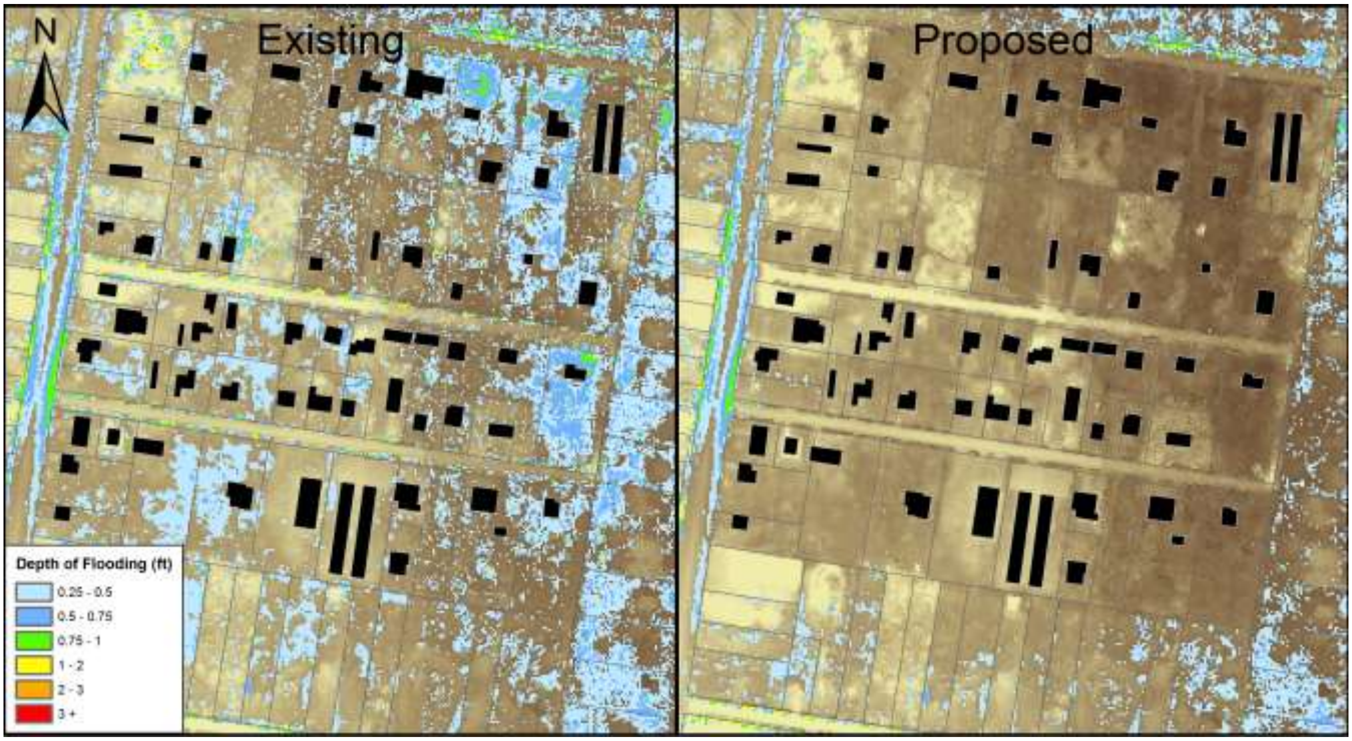


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	21	0	21
Inundated Lots	58	13	45
Inundated Roadway (LF)	180	130	50

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	24	0	24
Inundated Lots	58	15	43
Inundated Roadway (LF)	340	180	160

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

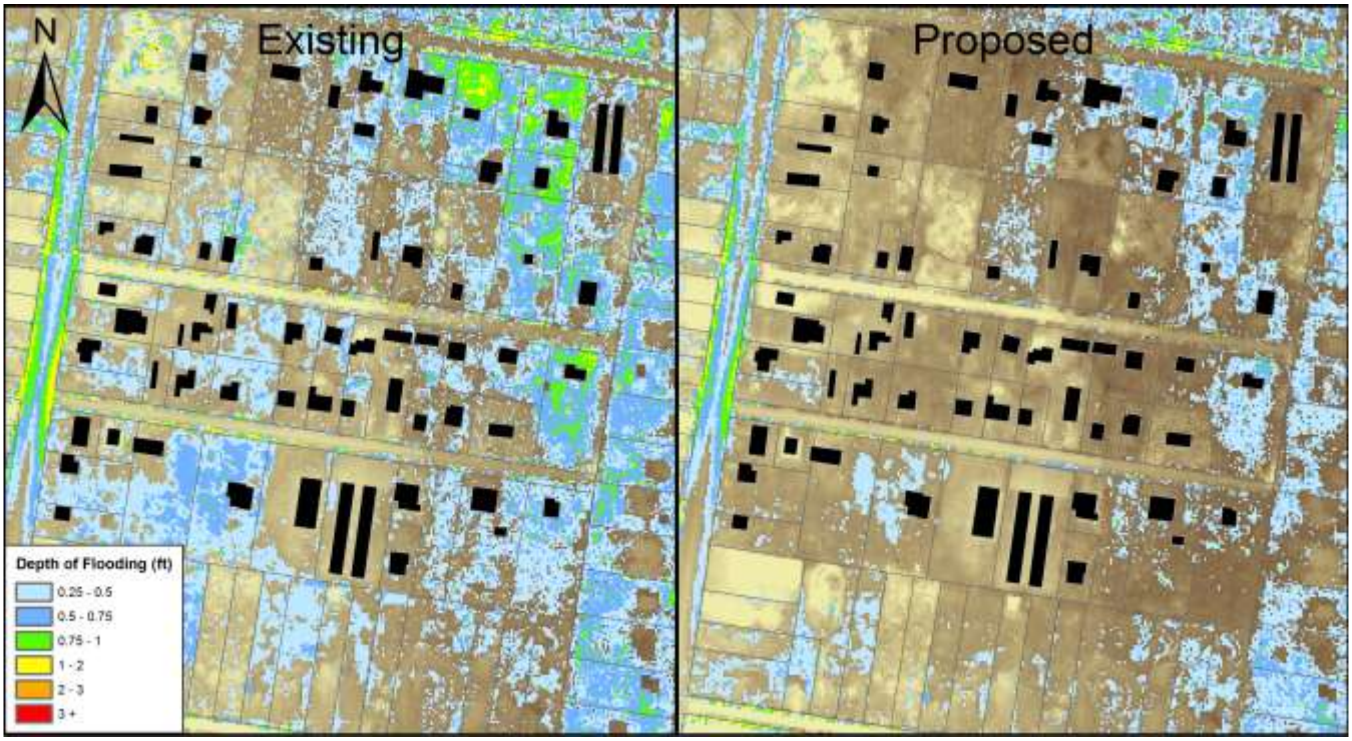


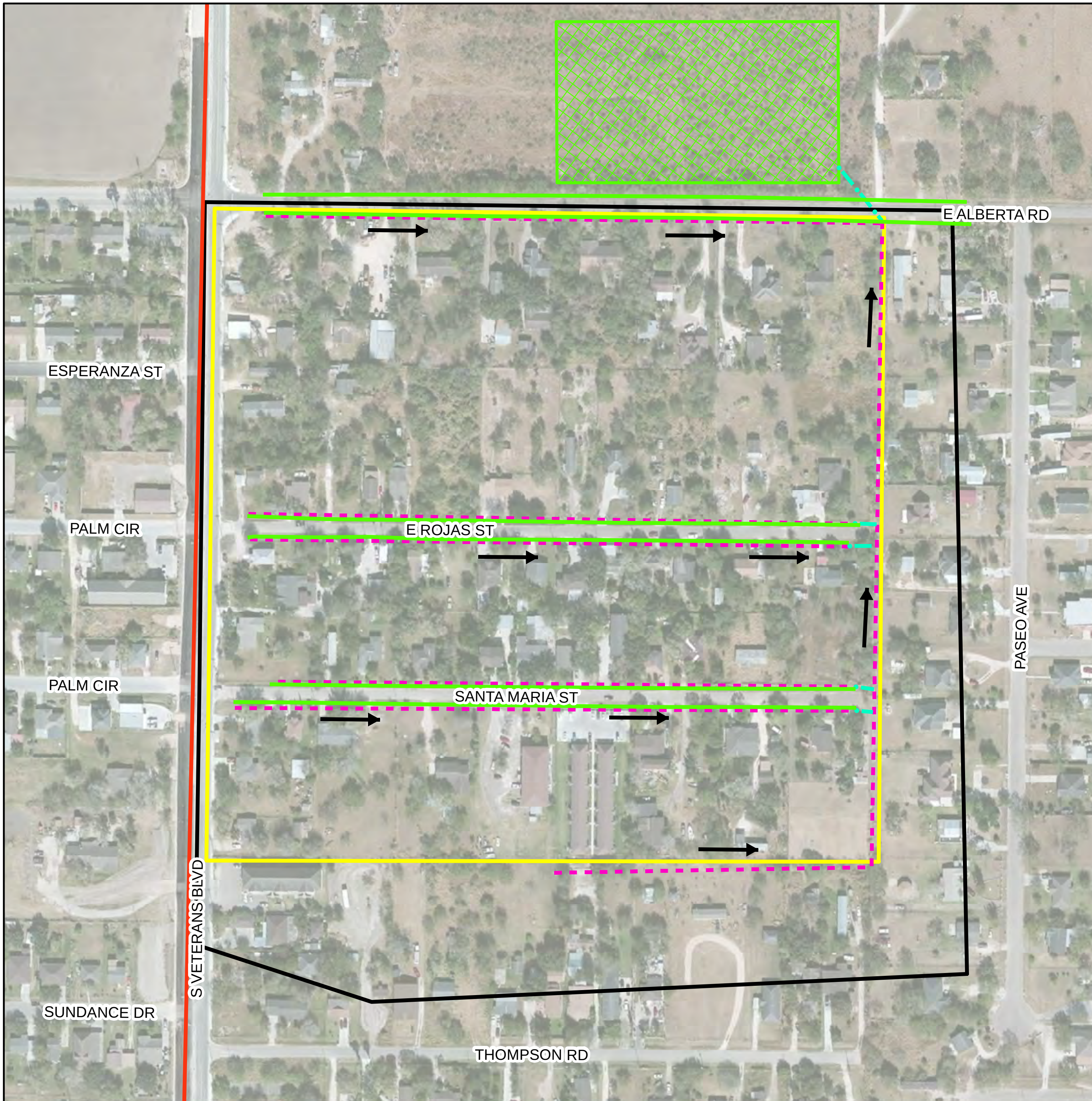
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	34	8	26
Inundated Lots	58	39	19
Inundated Roadway (LF)	635	395	240

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Cotter & Welch Tract
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Floodplain
- Proposed Retention Pond
- Cotter Welch Tract Boundary
- Drainage Area

N

0 62.5 125 250
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Cuellar Subd. #1, Hidalgo County

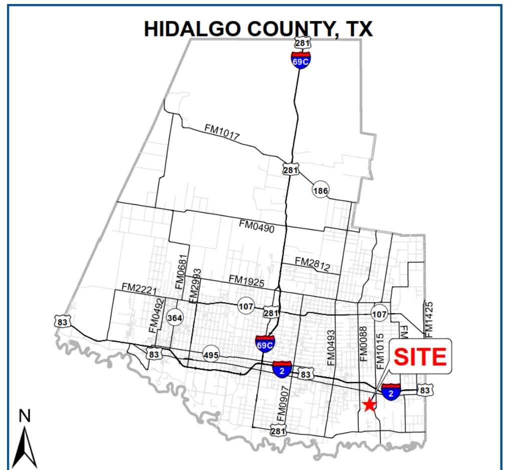
Basin: Upper Arroyo Colorado

Category: A1

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Hydrology / Hydraulic Analysis:

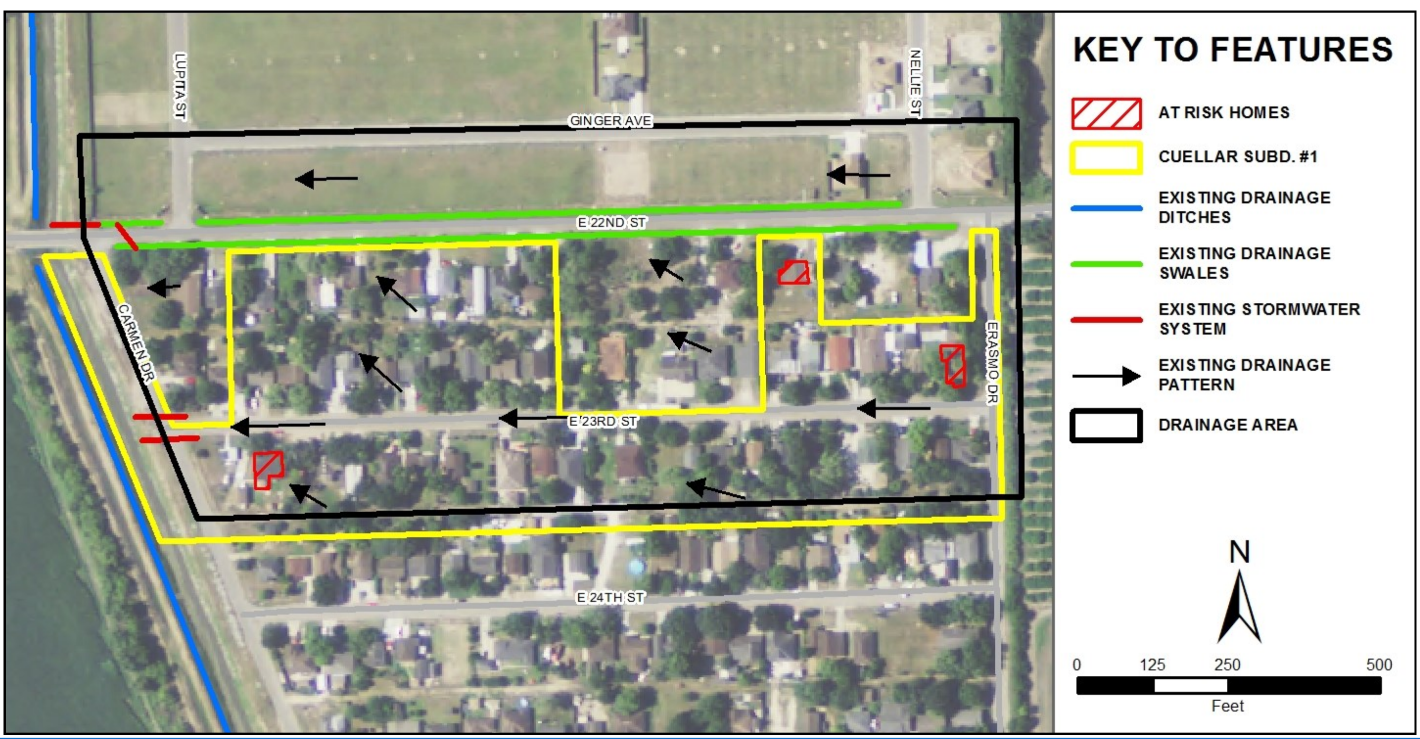
A 2-dimensional hydrodynamic model of the colonia Cuellar Subd. #1 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will improve protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology assumptions.



VICINITY MAP: NOT TO SCALE

Areas of Risk:

Cuellar Subd. #1 consists of approximately 12 acres of fully developed residential land with an offsite drainage area of approximately 9 acres of residential land. The colonia currently has curb and gutter along 23rd Street with two curb inlets at the west end of the street that connect to two grate inlets across Carmen Drive and outfall into the existing drainage ditch via two 12-inch diameter pipes. Additionally drainage improvements are currently in progress, these include swales along the north and south sides of 22nd Street with culverts along every driveway. These improvements were included in the existing conditions modeling for this colonia. The model results indicate that the properties at risk of flooding are likely on low lots and ponding occurs as runoff flows across the property. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches and red more than 24 inches.



Colonia: Cuellar Subd. #1, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install more inlets along the streets to convey runoff to the existing drainage ditch.
    - Increase the outfall pipes sizes.
    - Install a new underground drainage system with a retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Purchase of flood prone structures
    - Set construction regulations
    - Land use zoning change

Recommended Mitigation Project:

Project Description:
The recommended improvements include replacing the existing 12-inch outfall pipes on 23rd Street with two 18-inch pipes, and replacing the 15-inch outfall pipe on 22nd Street with an 18-inch pipe. The new system involves carrying the discharges of the 10-Year storm of the total runoff. The recommended system includes 290 linear feet of 18-inch diameter pipe.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
A potential challenge may be ponding; grading may be required within the low lots to provide positive drainage and prevent future ponding issues.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
CUELLAR SUBD. #1		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$3,780.00
2	Drainage Improvements	$26,680.00
3	Pond Excavation Improvements	$0.00
	Sub-Total =	**$30,460.00**
	Engineering Fees (10%) =	**$3,046.00**
	Contingency (20%) =	**$6,092.00**
	Total =	**$39,598.00**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Cuellar Subd. #1, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$39,598.00	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Cuellar Subd. #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

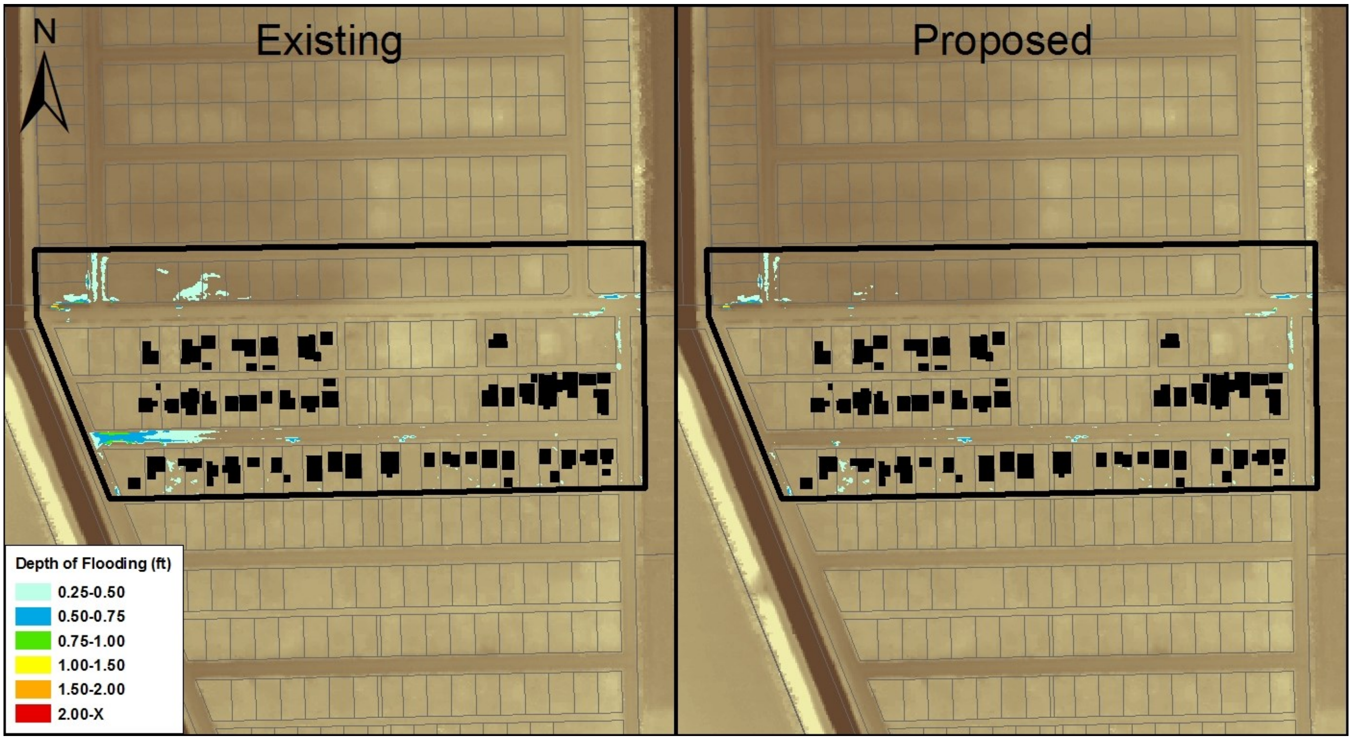


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	15	14	1
Inundated Roadway (LF)	270	0	270

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuellar Subd. #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

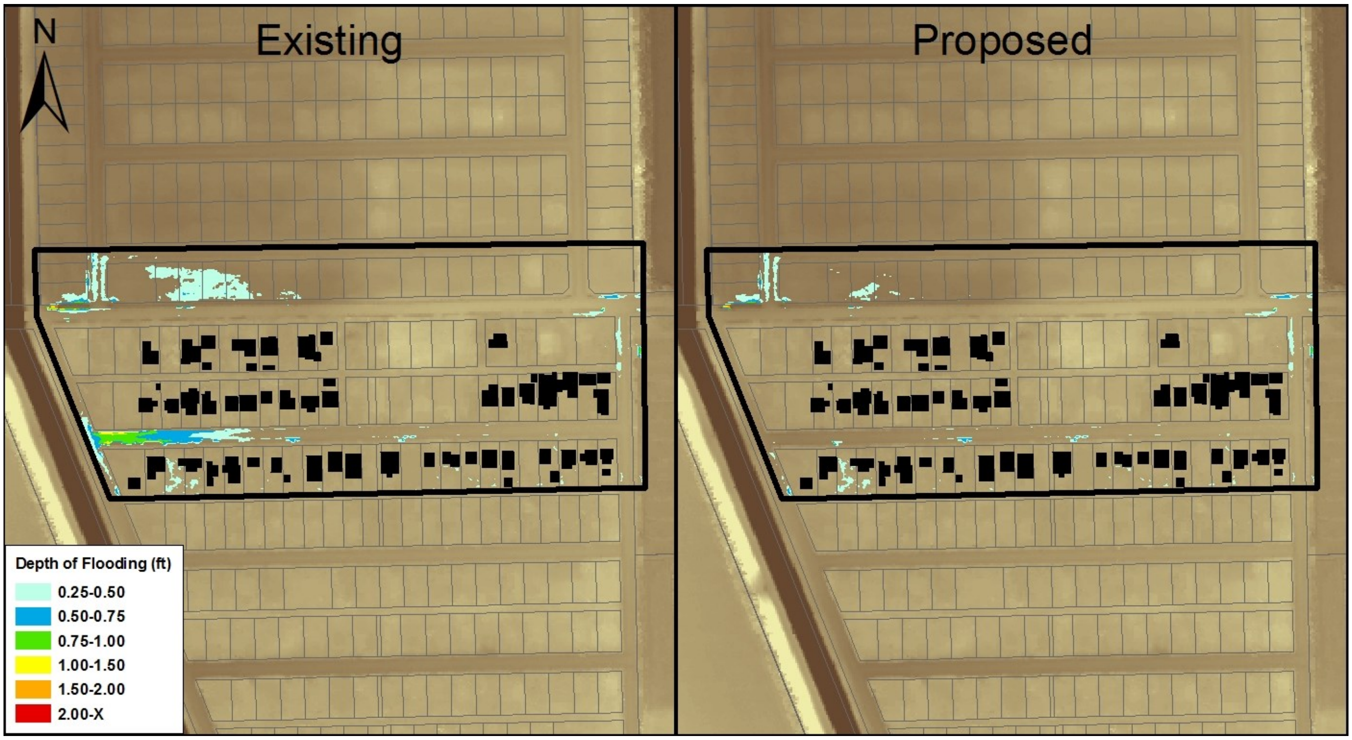


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	15	14	1
Inundated Roadway (LF)	360	0	360

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuellar Subd. #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

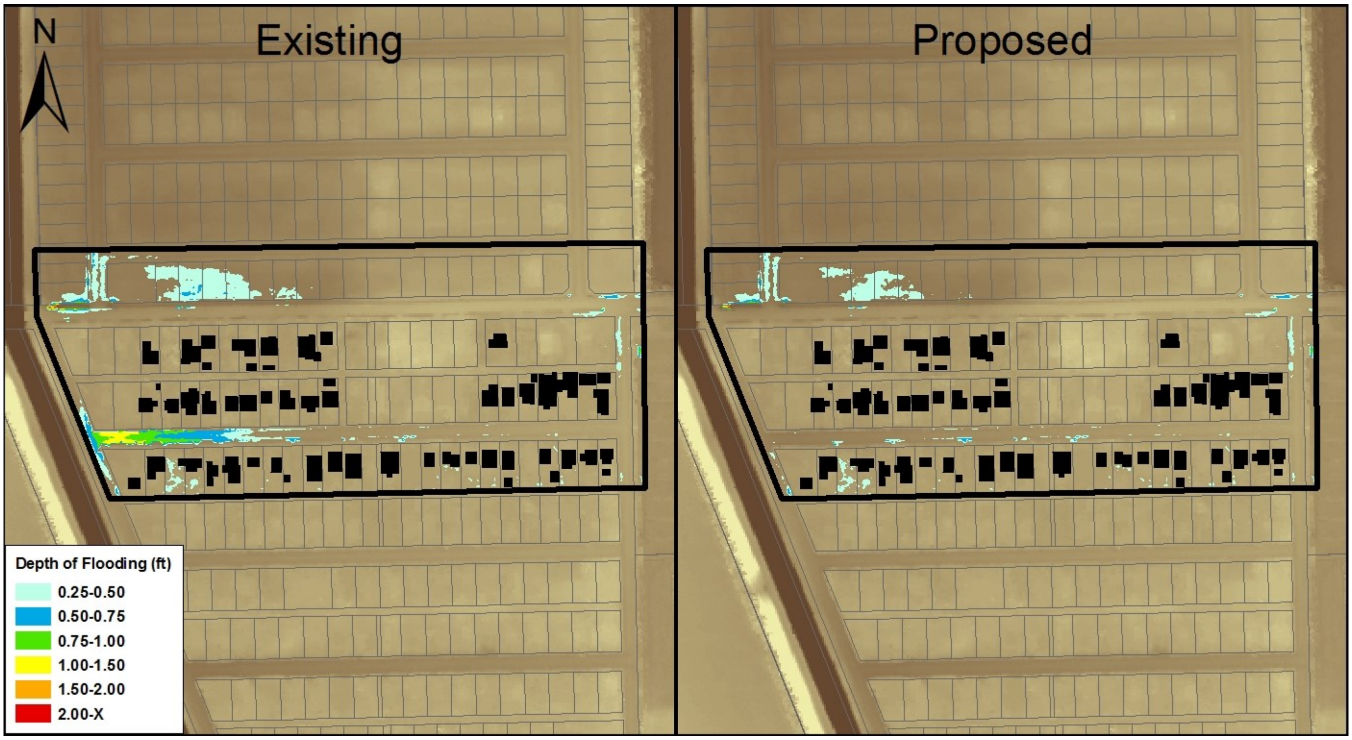


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	16	14	2
Inundated Roadway (LF)	393	0	393

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuellar Subd. #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

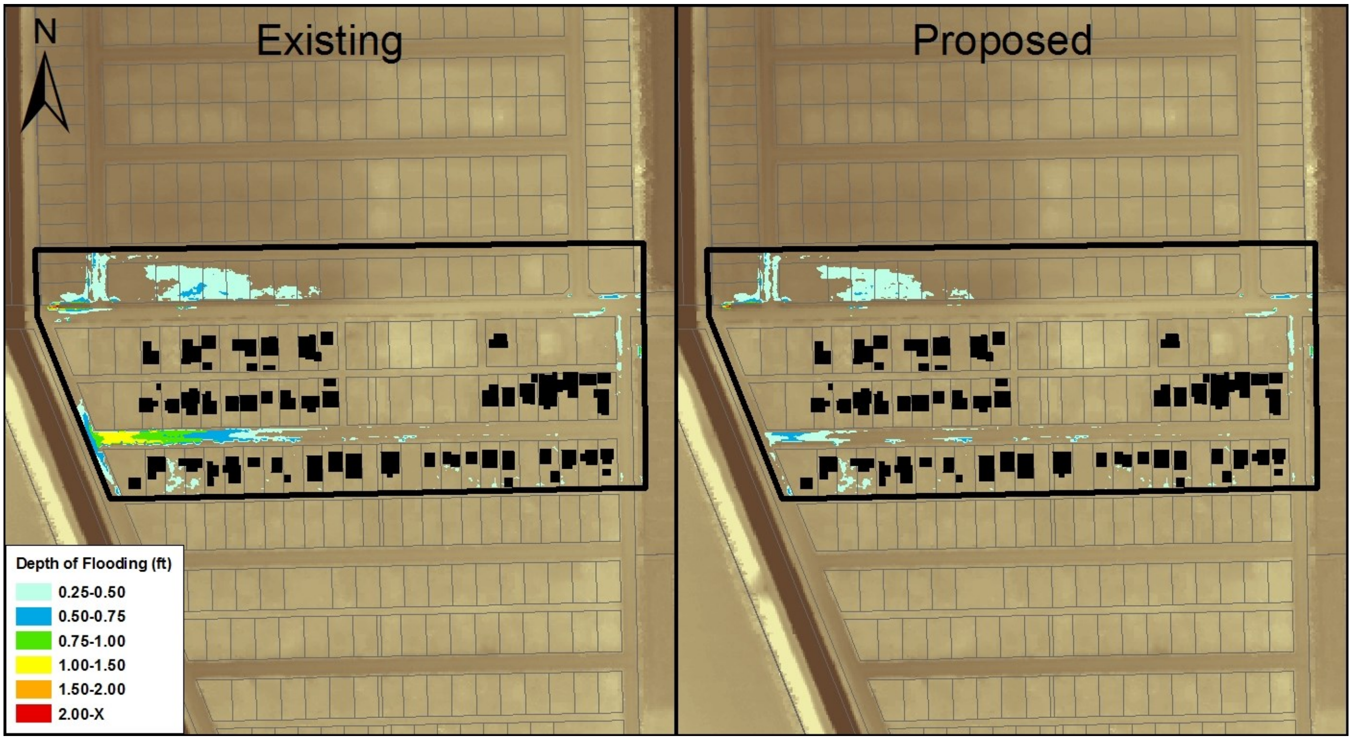


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	18	17	1
Inundated Roadway (LF)	423	141	282

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuellar Subd. #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

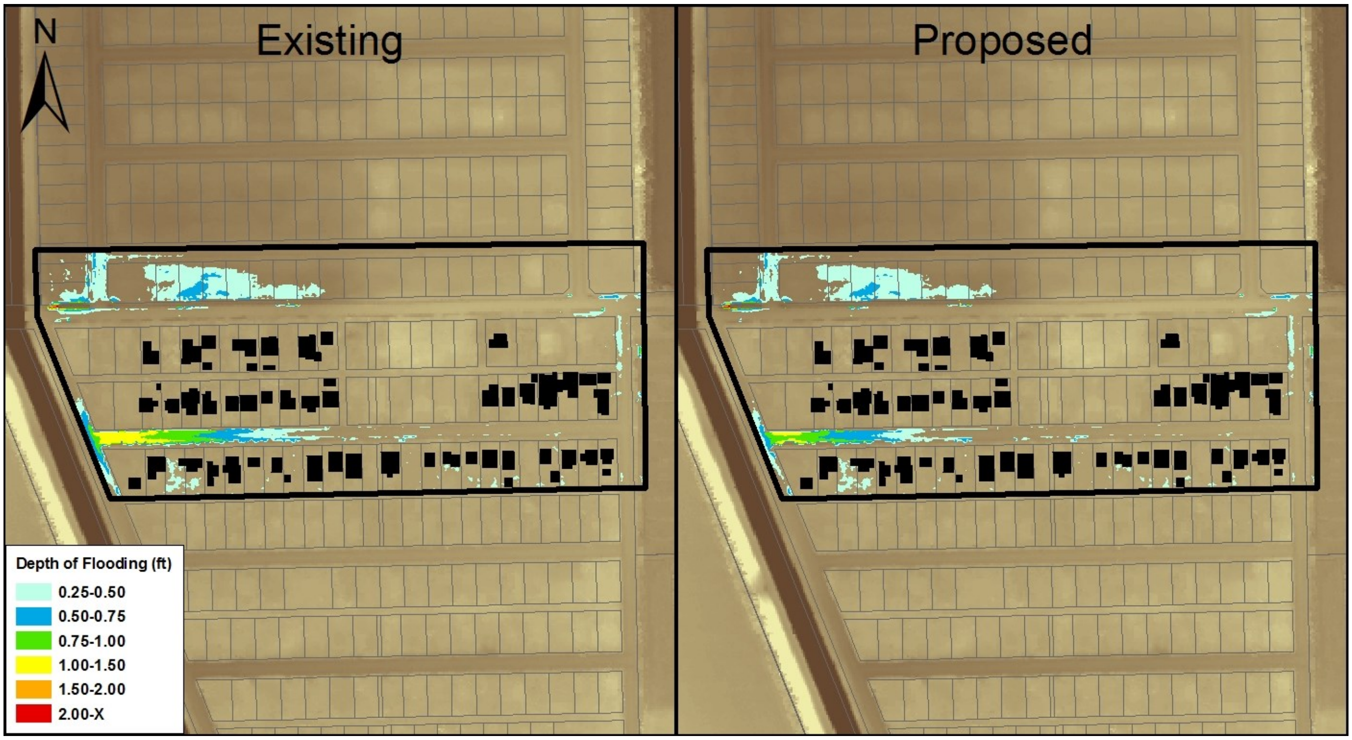
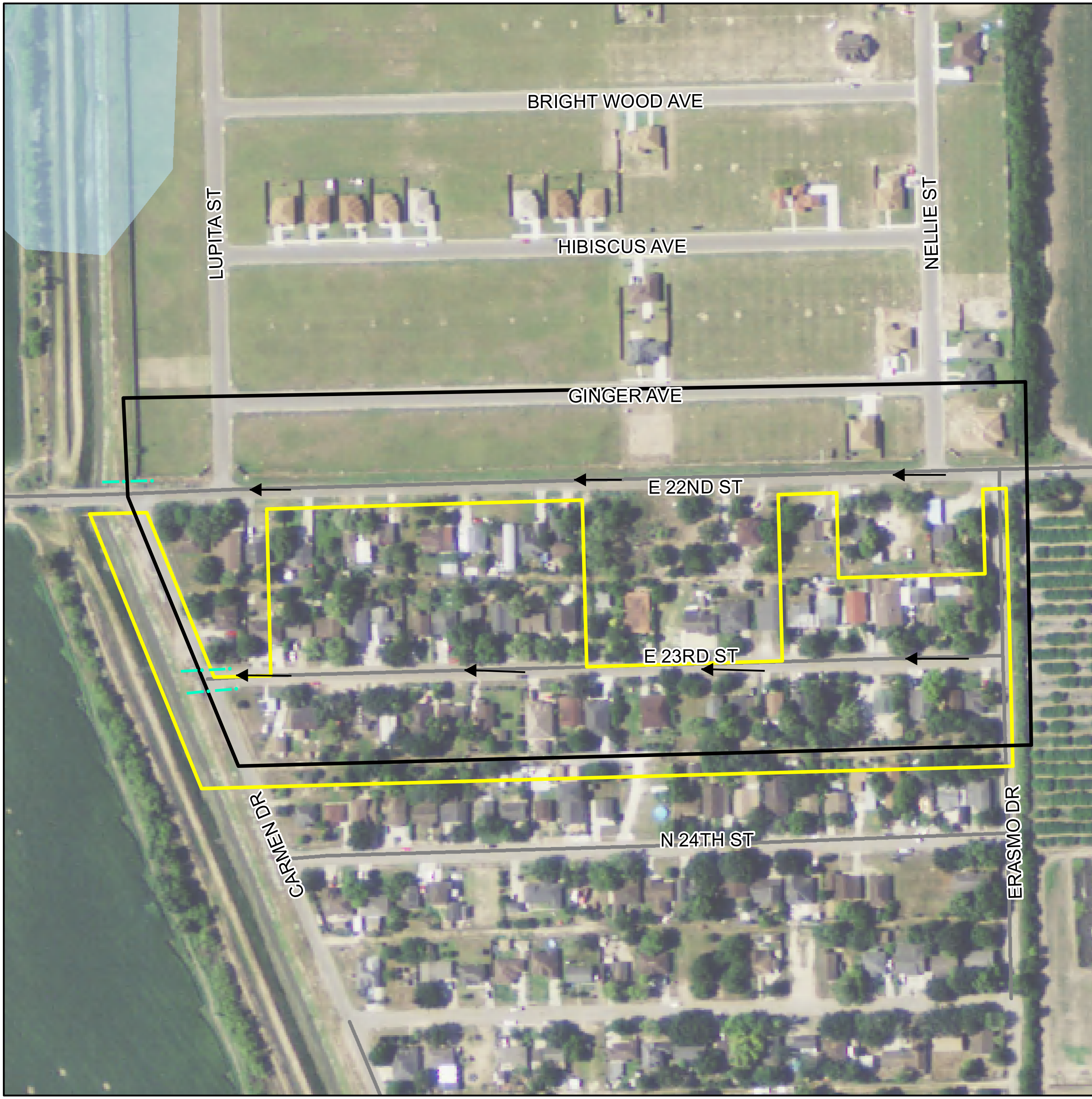


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	20	18	2
Inundated Roadway (LF)	502	380	122

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Cuellar Subd. #1

County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE PATTERN
- CUELLAR SUBD. #1
- DRAINAGE AREA
- EXISTING FLOODPLAIN

N E S W

0 150 300 450

Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

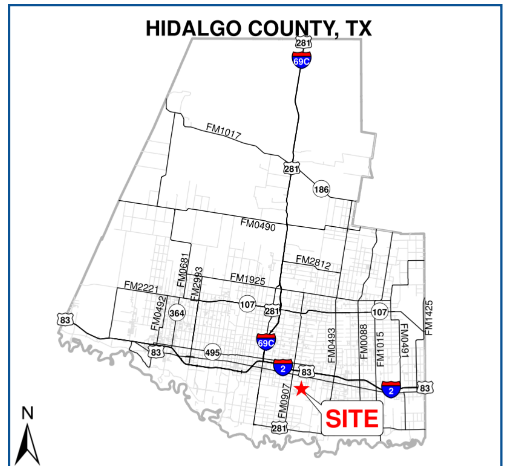
"Filling the Gap"

Colonia: El Gato, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

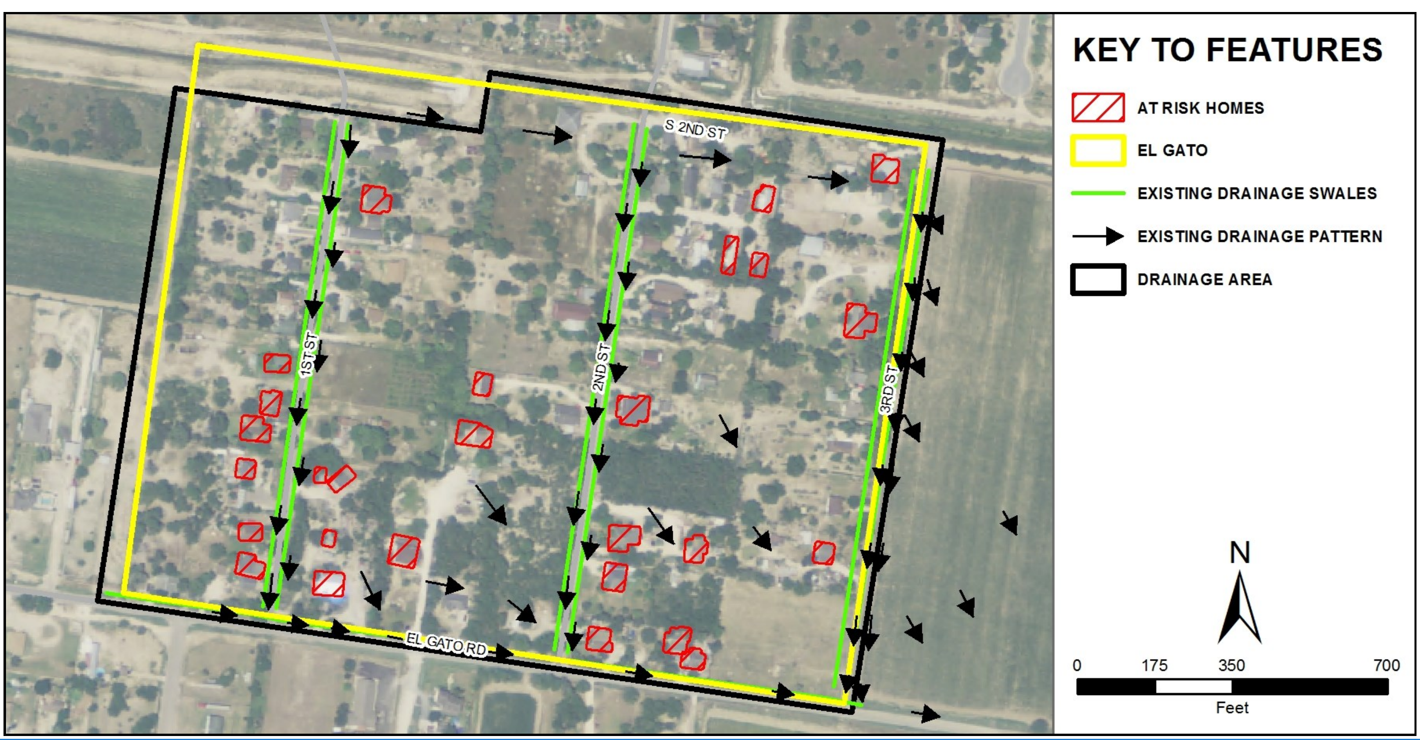


VICINITY MAP: NOT TO SCALE

A 2-dimensional hydrodynamic model of the colonia El Gato storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology assumptions.

Areas of Risk:

El Gato consists of approximately 49.6 acres and currently does not have a drainage system. The model results indicate most high-risk flooding areas are along the west and south portions of the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 8 inches, blue 8 to 12, green 12 to 20 inches, yellow 20 to 28 inches, orange 28 to 36 inches and red more than 36 inches.



Colonia: El Gato, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  * Install culverts and swales to convey runoff to the existing drainage ditches.
  * Install a new underground drainage system with a retention pond
  *
- The non structural alternatives for this project are as follows:
  * Elevate structures
  * Purchase of flood prone structures
  * Set construction regulations
  * Land use zoning change

Recommended Mitigation Project:

Project Description:
The recommended improvements include installing a new underground drainage system with a retention facility. The criteria used to design the new system involves carrying the discharges of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system includes 310 linear feet of 18-inch diameter pipe, 1,261 linear feet of 24-inch diameter pipe, 1,574 linear feet of 30-inch diameter pipe, 812 linear feet of 36-inch diameter pipe, and 974 linear feet of 42-inch diameter pipe. Twenty four inlets and two concrete manholes are also included in the improvements. The proposed retention pond is sized to retain the onsite runoff of up to the 25-Year storm and it entails a facility with an effective storage volume of 23 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
EL GATO

	IMPROVEMENTS	COST
1	Paving Improvements	$817,388.00
2	Drainage Improvements	$475,873.00
3	Pond Excavation Improvements	$622,622.50
	Sub-Total =	**$1,915,883.50**
	Engineering Fees (10%) =	**$191,588.35**
	Contingency (20%) =	**$383,176.70**
	Total =	**$2,490,648.55**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	1	1
20% (5-year)	2	1	1
10% (10-year)	2	1	1
4% (25-year)	3	1	2
1% (100-year)	4	2	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$871,754	$2,490,649	0.35
Elevate Structures	$871,754	$384,900	2.26
Acquisition/Supplemental Housing / Demolition	$2,543,053	$469,598	5.42

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

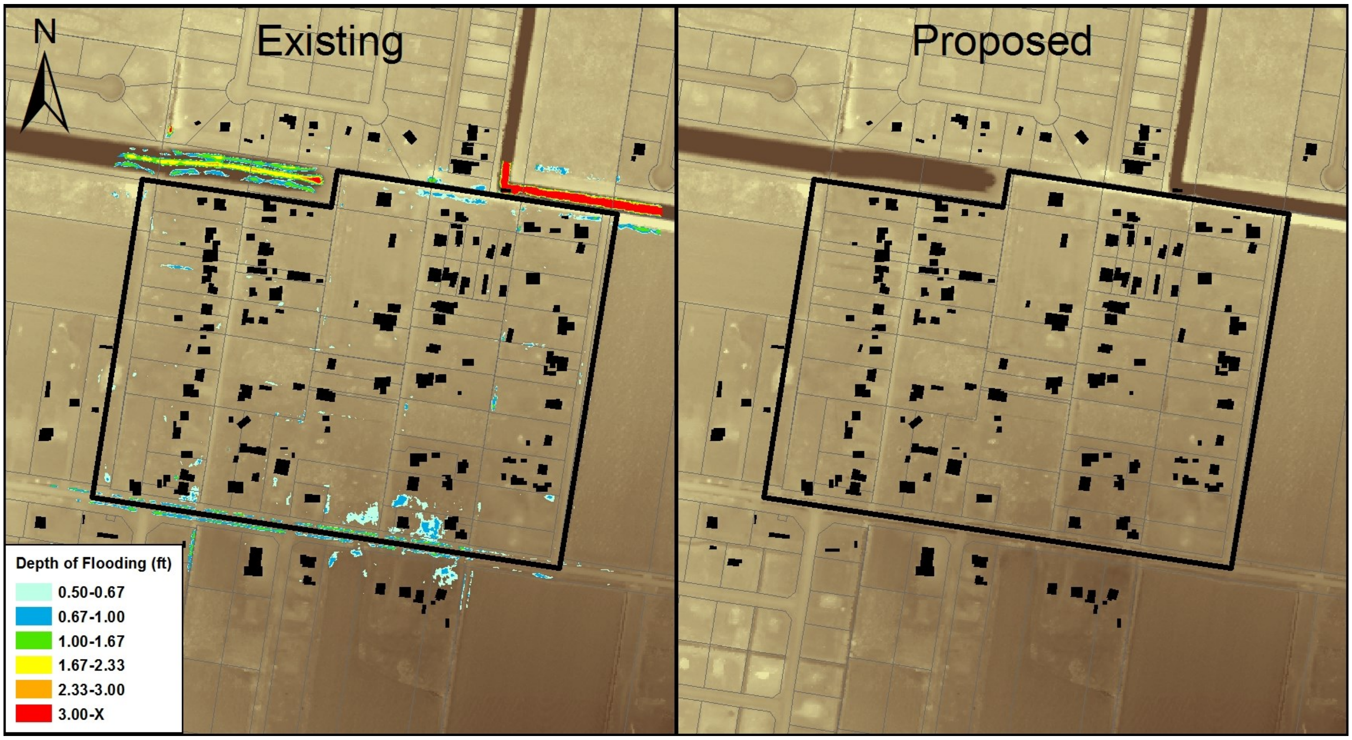


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	1	1
Inundated Lots	37	0	37
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

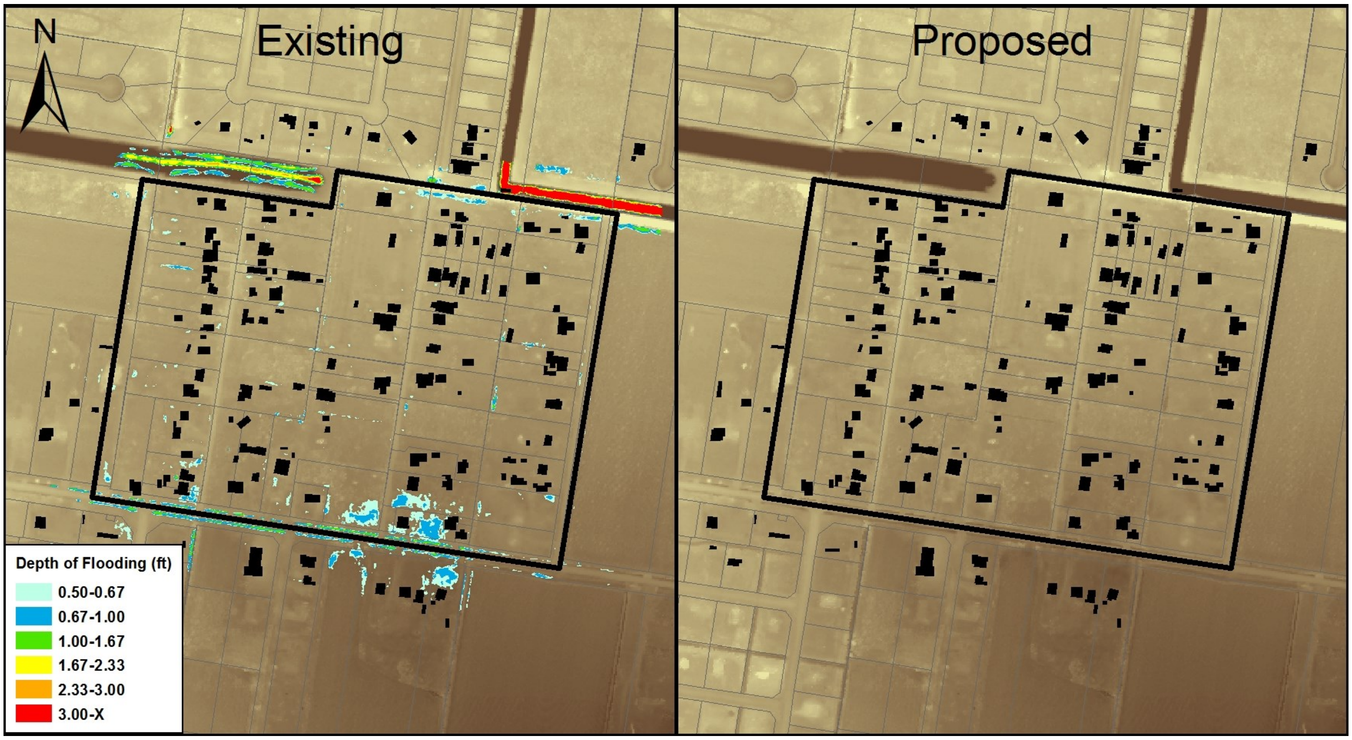


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	1	1
Inundated Lots	41	0	41
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

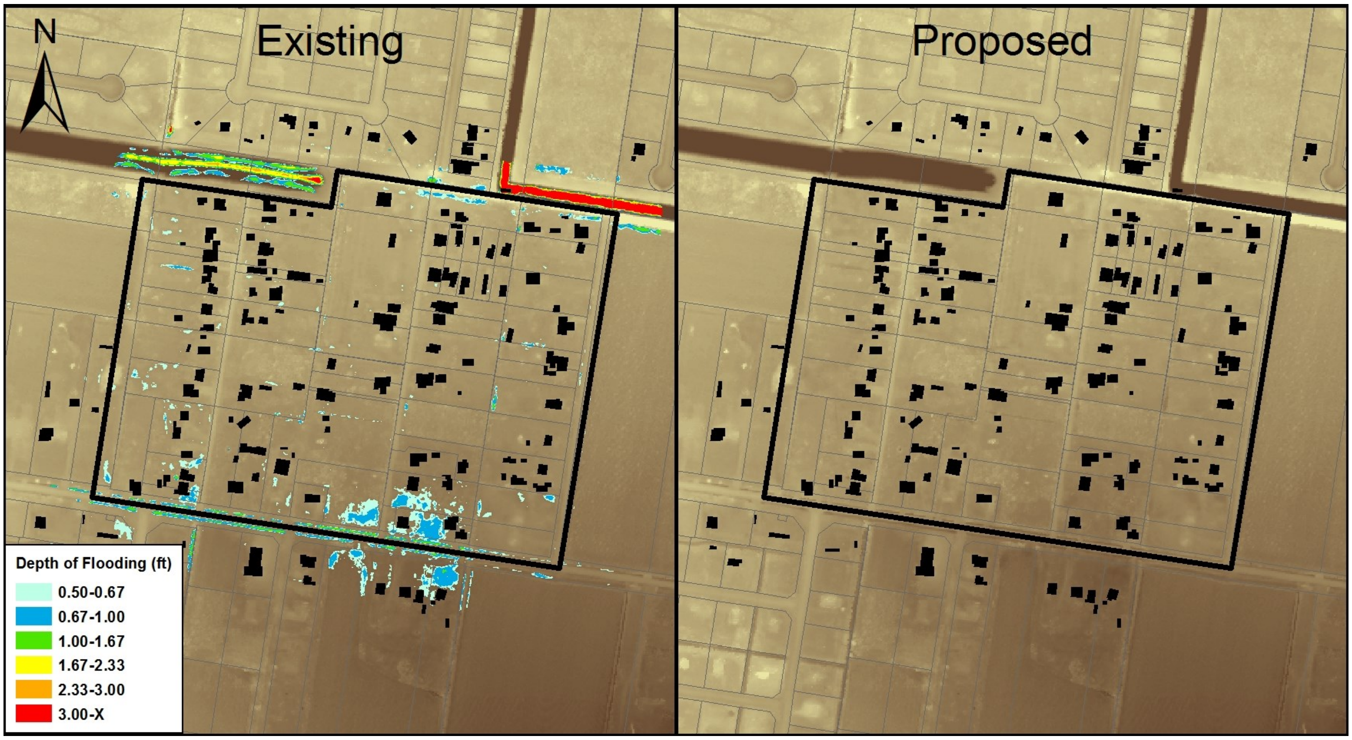


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	1	1
Inundated Lots	43	0	43
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

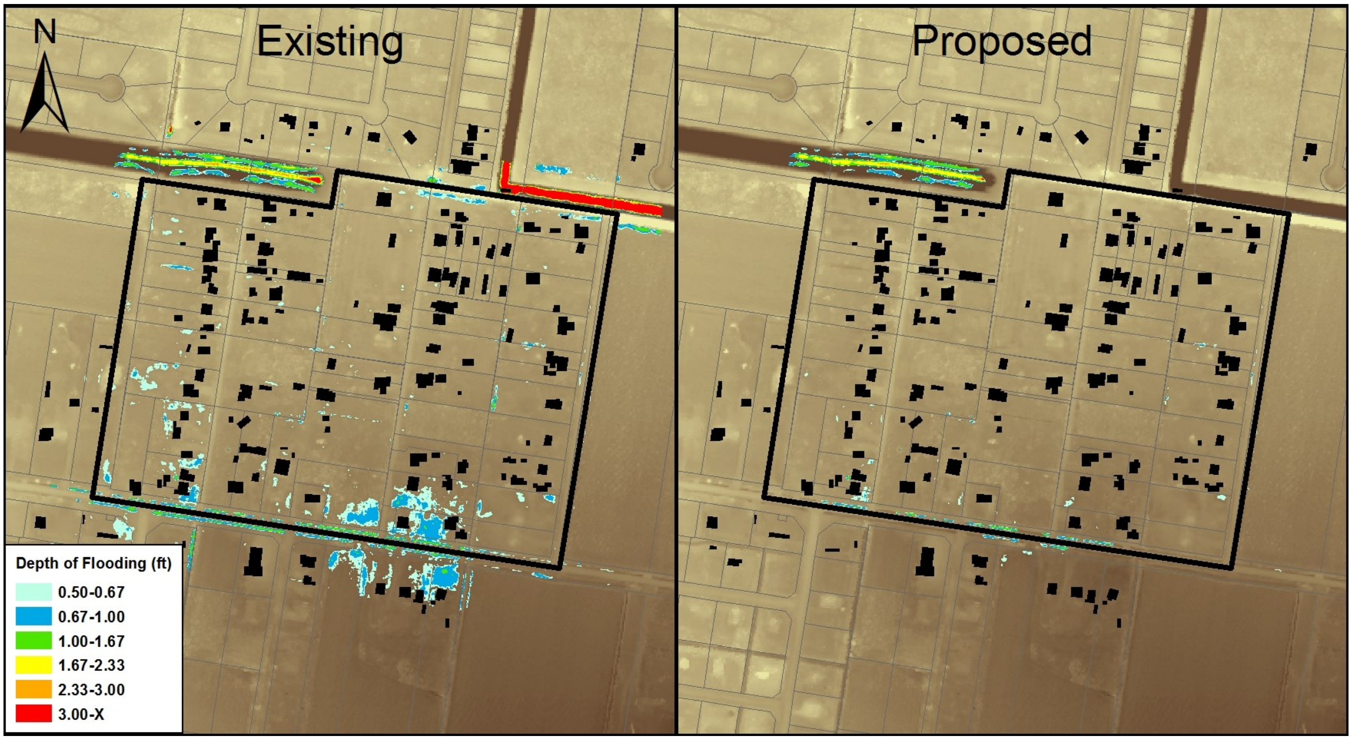


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	1	2
Inundated Lots	48	18	30
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: El Gato, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

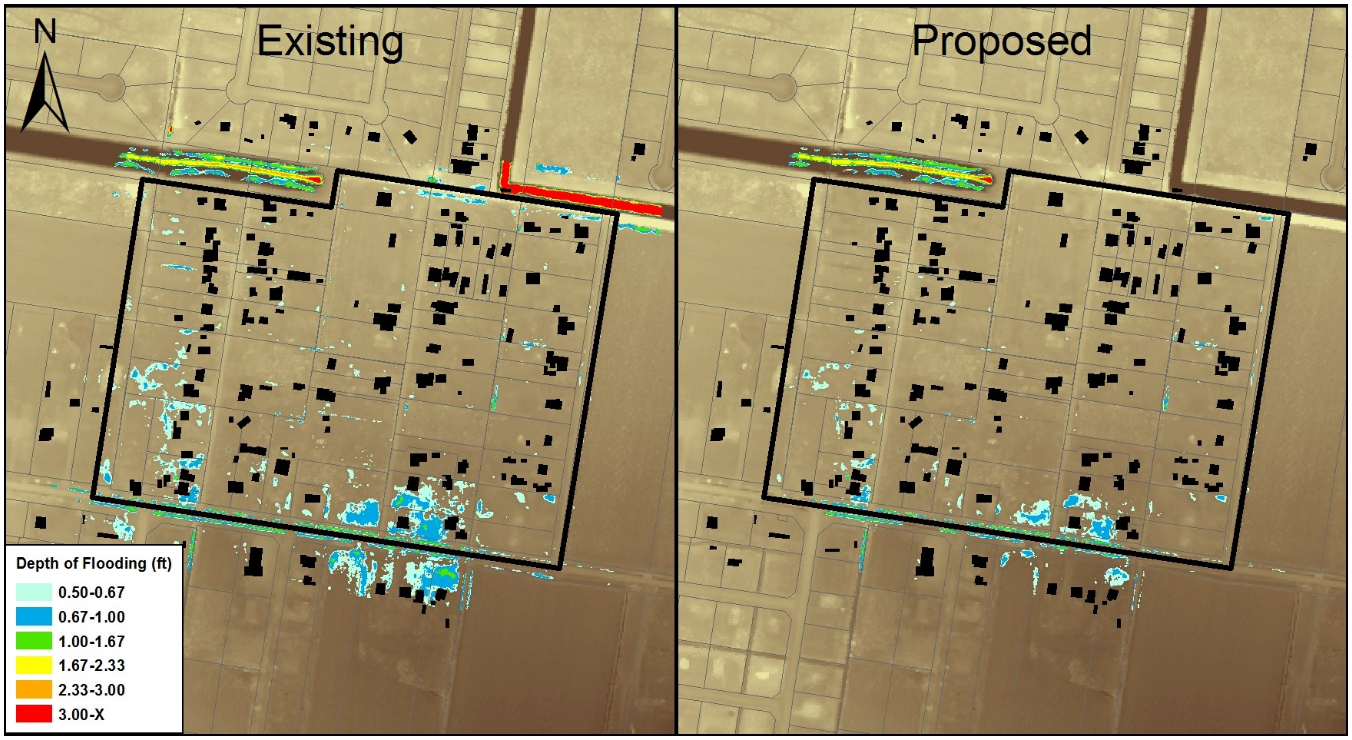
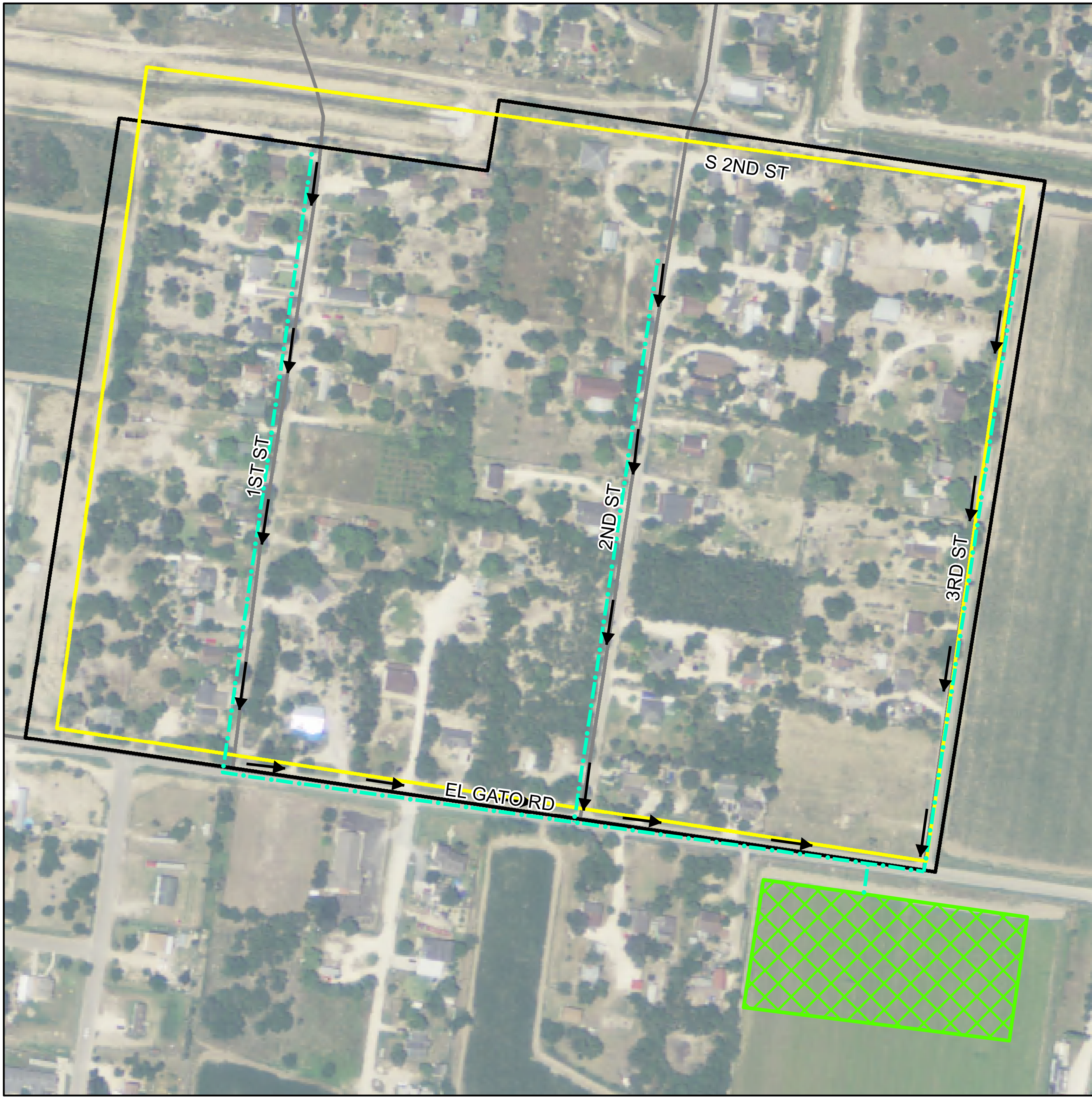


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	2	2
Inundated Lots	51	34	17
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: El Gato
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- EL GATO
- 25-YR RETENTION POND
- DRAINAGE AREA
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

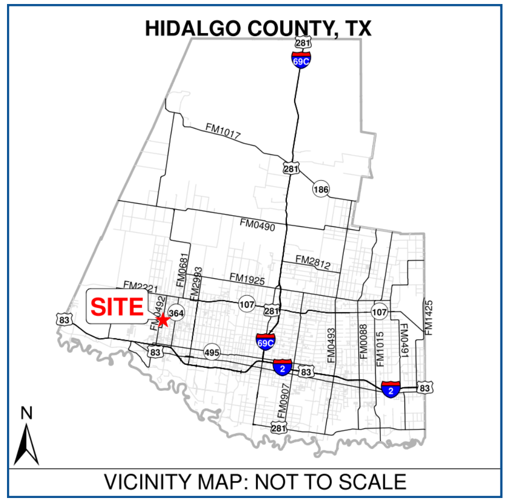
"Filling the Gap"

Colonia: Enrique Bazan Subd., Hidalgo County

Basin: North Main Drain

Category: A1

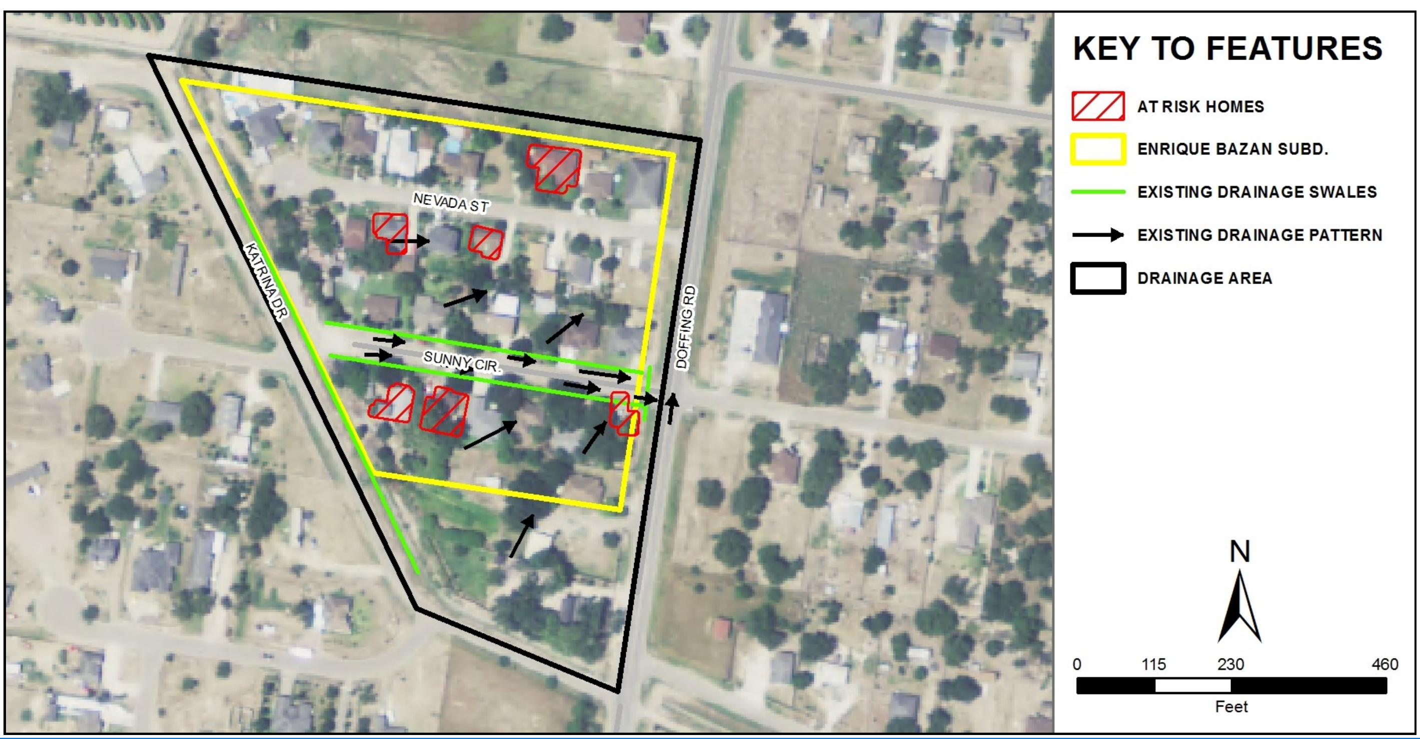
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Enrique Bazan Subdivision storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Enrique Bazan Subdivision consists of approximately 10 acres of which approximately 1.7 acres are within the 100-Year floodplain. The model results indicate runoff flows toward the northeast corner of the colonia, however high-risk flooding areas were identified throughout the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 8 inches, blue 8 to 10 inches, green 10 to 12 inches, yellow 12 to 15 inches, orange 15 to 30 inches, and red more than 30 inches.



Colonia: Enrique Bazan Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install roadside swales with culverts to convey runoff to a retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 422 linear feet of 24-inch diameter pipe, and four curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 5.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
ENRIQUE BAZAN

	IMPROVEMENTS	COST
1	Paving Improvements	$182,590.00
2	Drainage Improvements	$47,646.00
3	Pond Excavation Improvements	$140,495.00
	Sub-Total =	**$370,731.00**
	Engineering Fees (10%) =	**$37,073.10**
	Contingency (20%) =	**$74,146.20**
	Total =	**$481,950.30**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Enrique Bazan Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	6	3	3
20% (5-year)	6	3	3
10% (10-year)	6	3	3
4% (25-year)	6	3	3
1% (100-year)	6	4	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$967,053	$481,950	2.01
Elevate Structures	$967,053	$108,675	8.90
Acquisition/Supplemental Housing / Demolition	$999,882	$121,977	8.20

Colonia: Enrique Bazan Subd., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

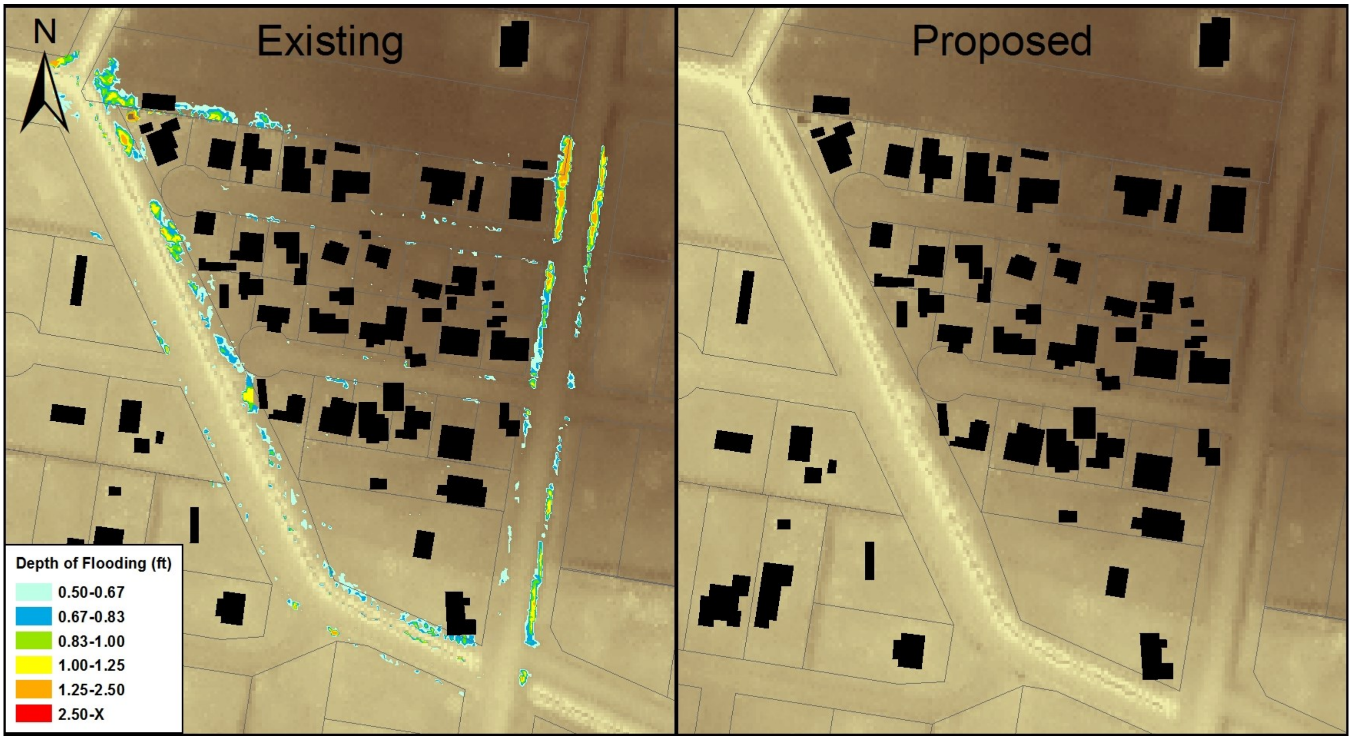


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	3	3
Inundated Lots	22	0	22
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Recommended Mitigation Project cont.:

Project Figures:

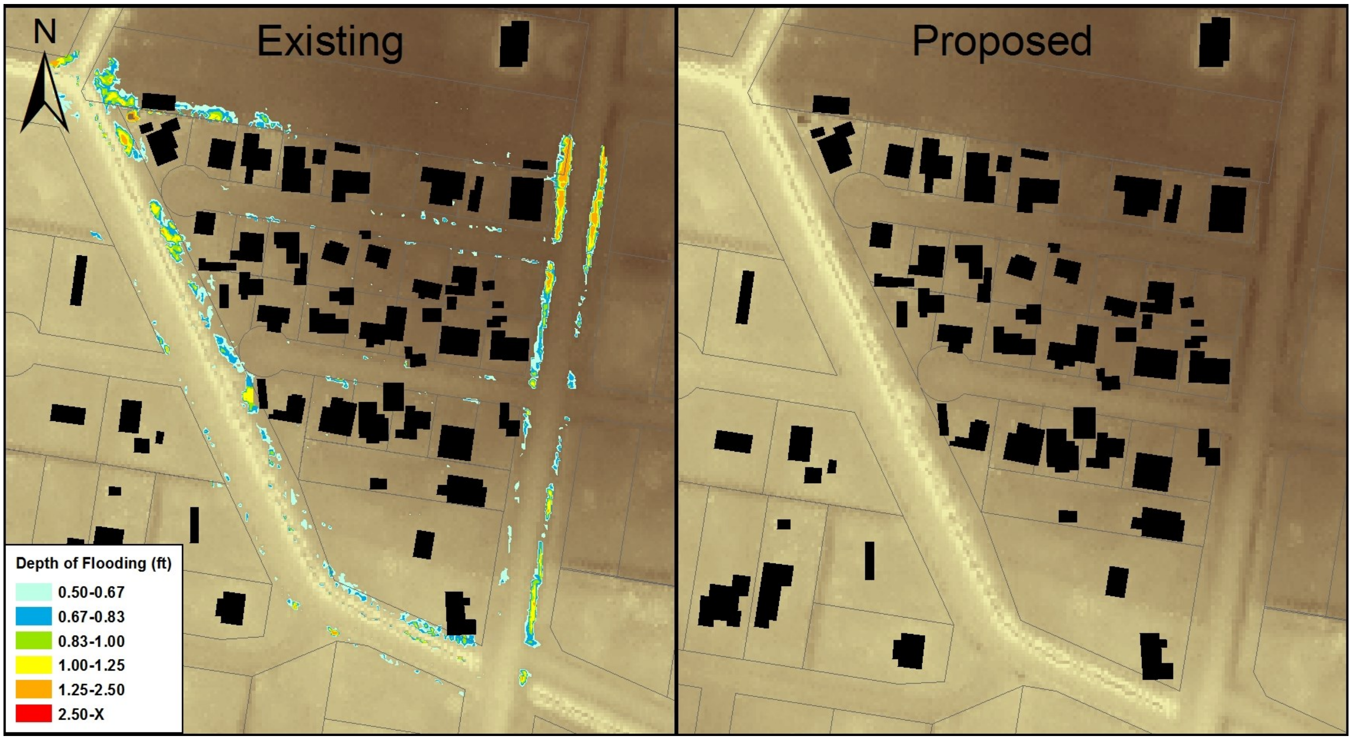


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	3	3
Inundated Lots	22	0	22
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Enrique Bazan Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

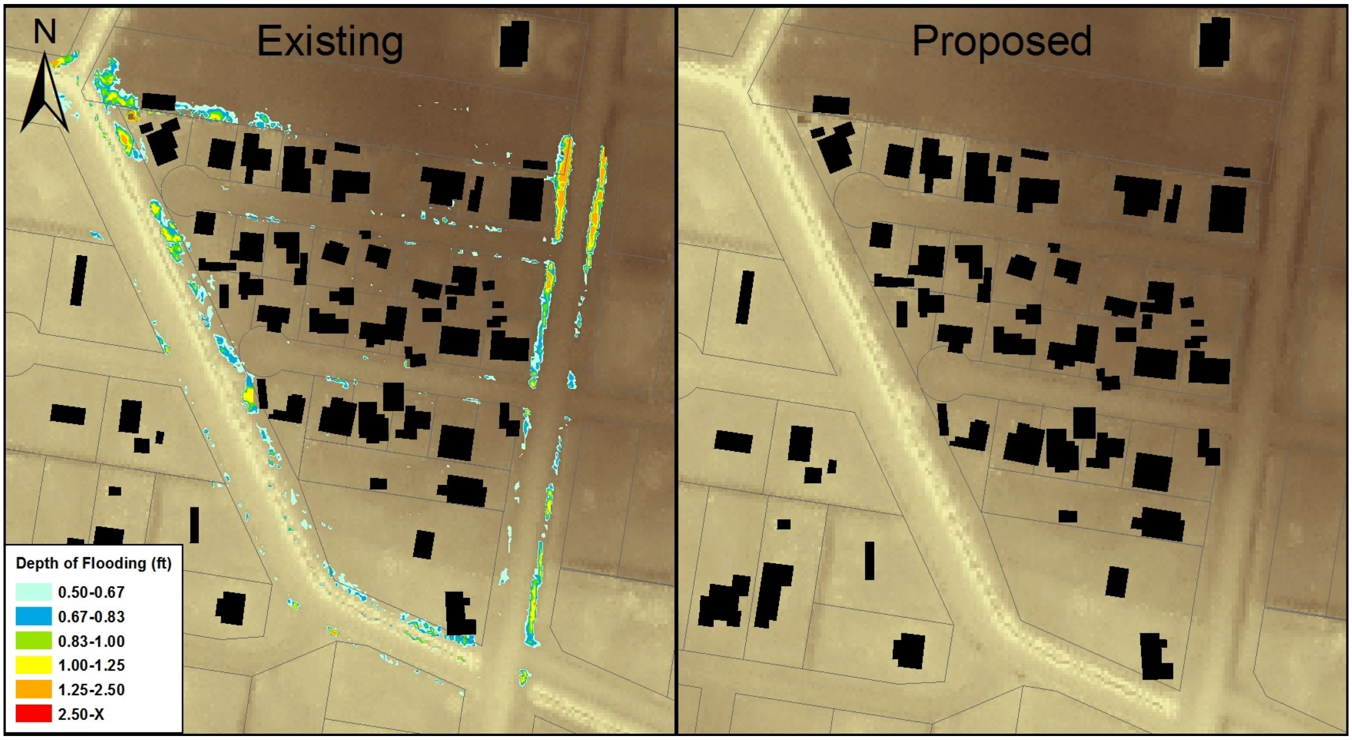


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	3	3
Inundated Lots	22	0	22
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Enrique Bazan Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

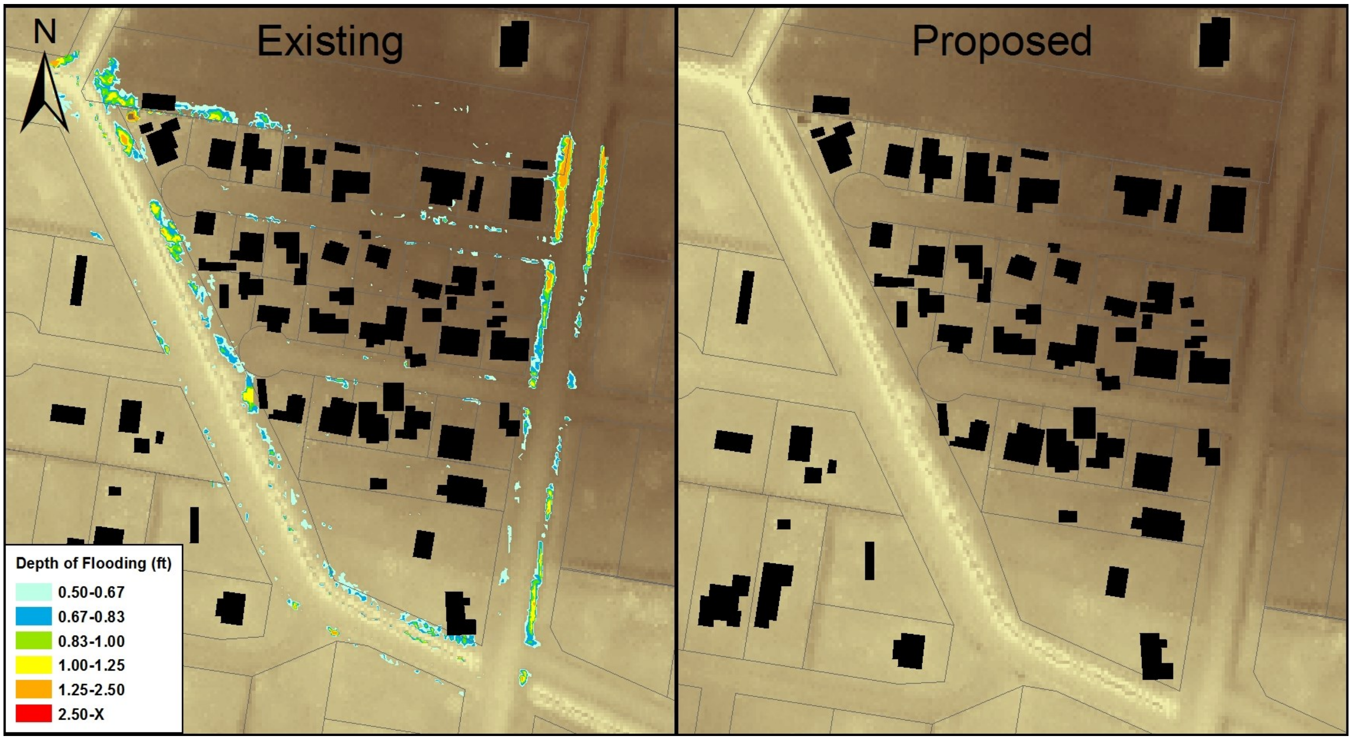


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	3	3
Inundated Lots	22	0	22
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Enrique Bazan Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

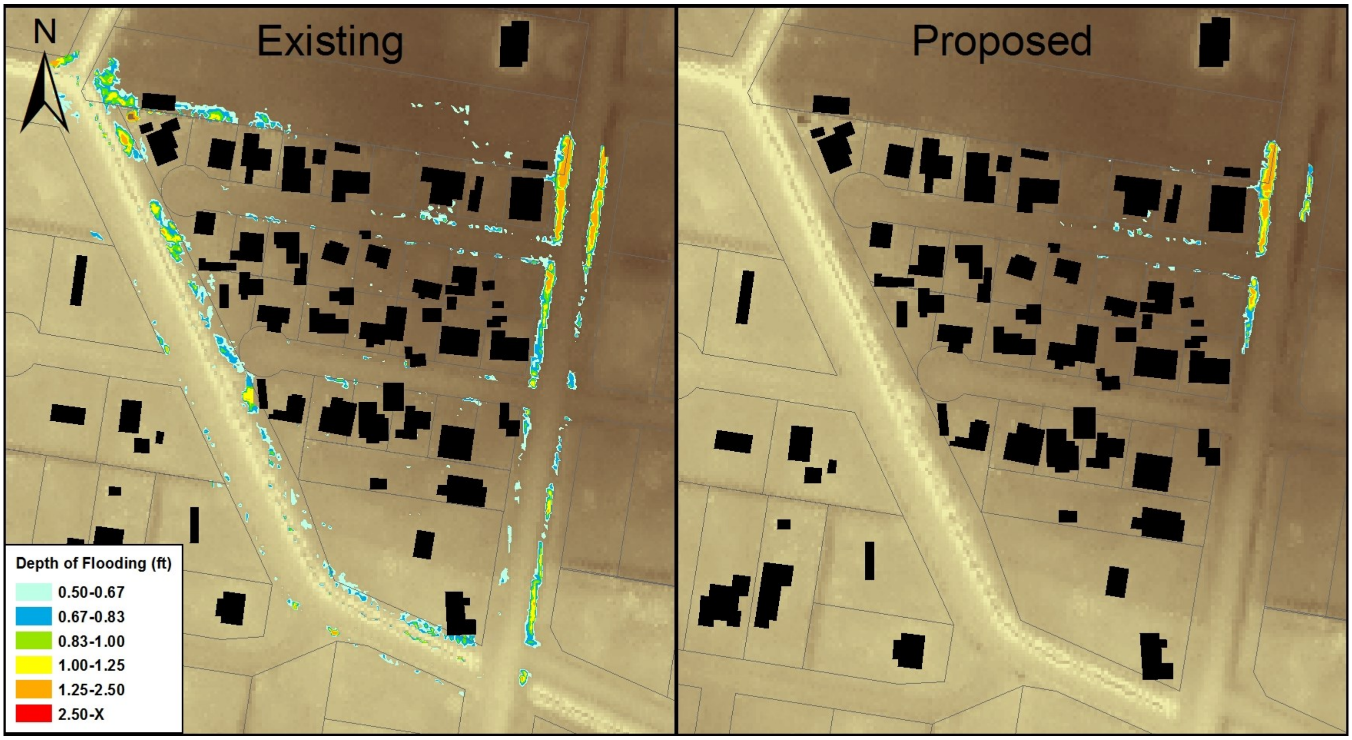
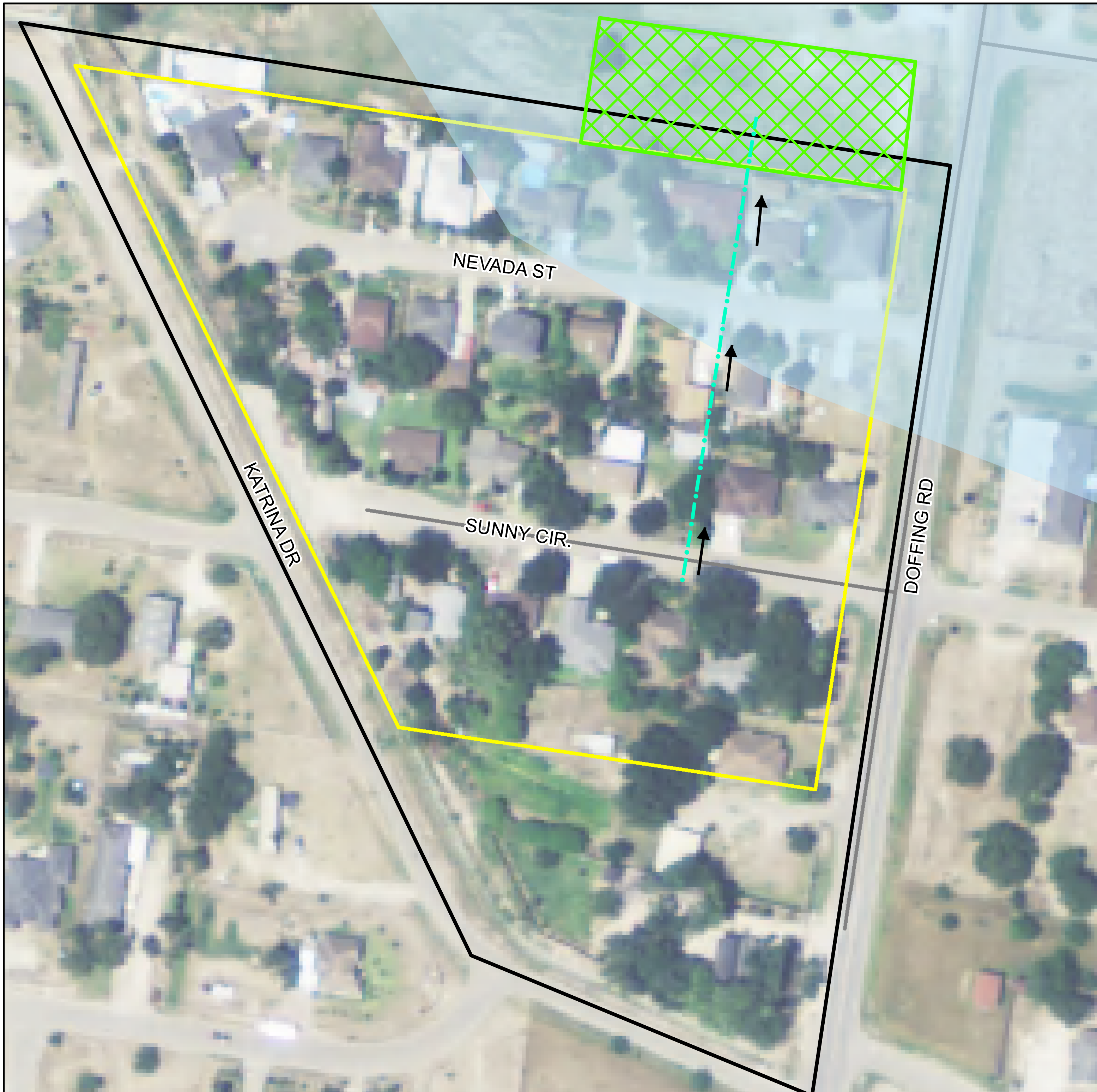


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	4	2
Inundated Lots	22	7	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Enrique Bazan Subd
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPPOSED DRAINAGE FLOW
- ENRIQUE BAZAN SUBD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

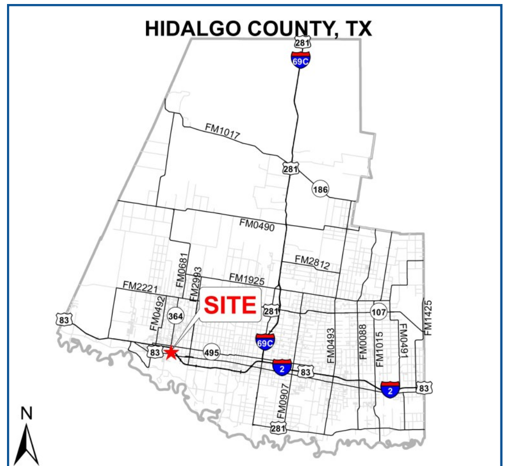
Colonia: Hilda Subd., Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

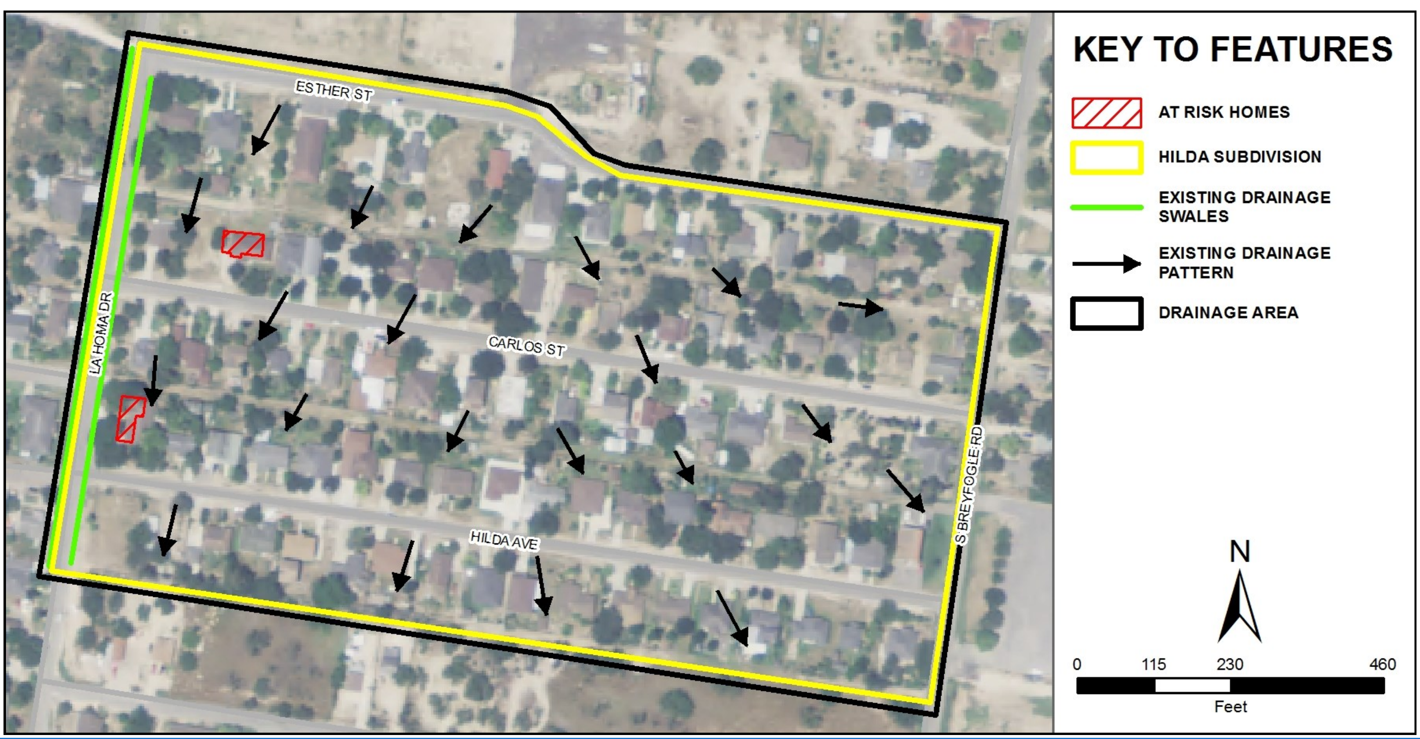
A 2-dimensional hydrodynamic model of the colonia Hilda Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



VICINITY MAP: NOT TO SCALE

Areas of Risk:

Hilda Subdivision consists of approximately 24 acres of fully developed residential land. The current natural flow indicates runoff flows southeast and southwest, nevertheless, stormwater is conveyed by curb and gutter to Breyfogle Road and La Homa Drive. The results of the existing conditions 2D model indicate that there might be some ponding along the streets, additionally, the structures at risk of flooding from localized storm events may be on lots at lower elevations than the street. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 14.4 inches, orange 14.4 to 20 inches, and red more than 20 inches.



Colonia: Hilda Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Intercept runoff at the street intersections with grate inlets and convey storm water to the existing drainage ditch south of the colonia.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

The recommended improvements have been designed to the Hidalgo County standards for new subdivisions and provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. In addition to the recommended system, lot grading would be essential in solving the ponding issues. The new system consists of 2,928 linear feet of 18-inch diameter pipe, 912 linear feet of 24-inch diameter pipe, 774 linear feet of 30-inch diameter pipe, and 34 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 10.01 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
HILDA SUBD		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$687,185.00
2	Drainage Improvements	$384,409.00
3	Pond Excavation Improvements	$269,769.56
	Sub-Total =	**$1,341,363.56**
	Engineering Fees (10%) =	**$134,136.36**
	Contingency (20%) =	**$268,272.71**
	Total =	**$1,743,772.63**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Hilda Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	1	0	1
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$547,852.00	$1,743,772.63	0.31
Elevate Structures	$547,852.00	$242,700.00	2.26
Acquisition/Supplemental Housing / Demolition	$571,171.00	$213,546.60	2.67

Recommended Mitigation Project cont.:

Project Figures:

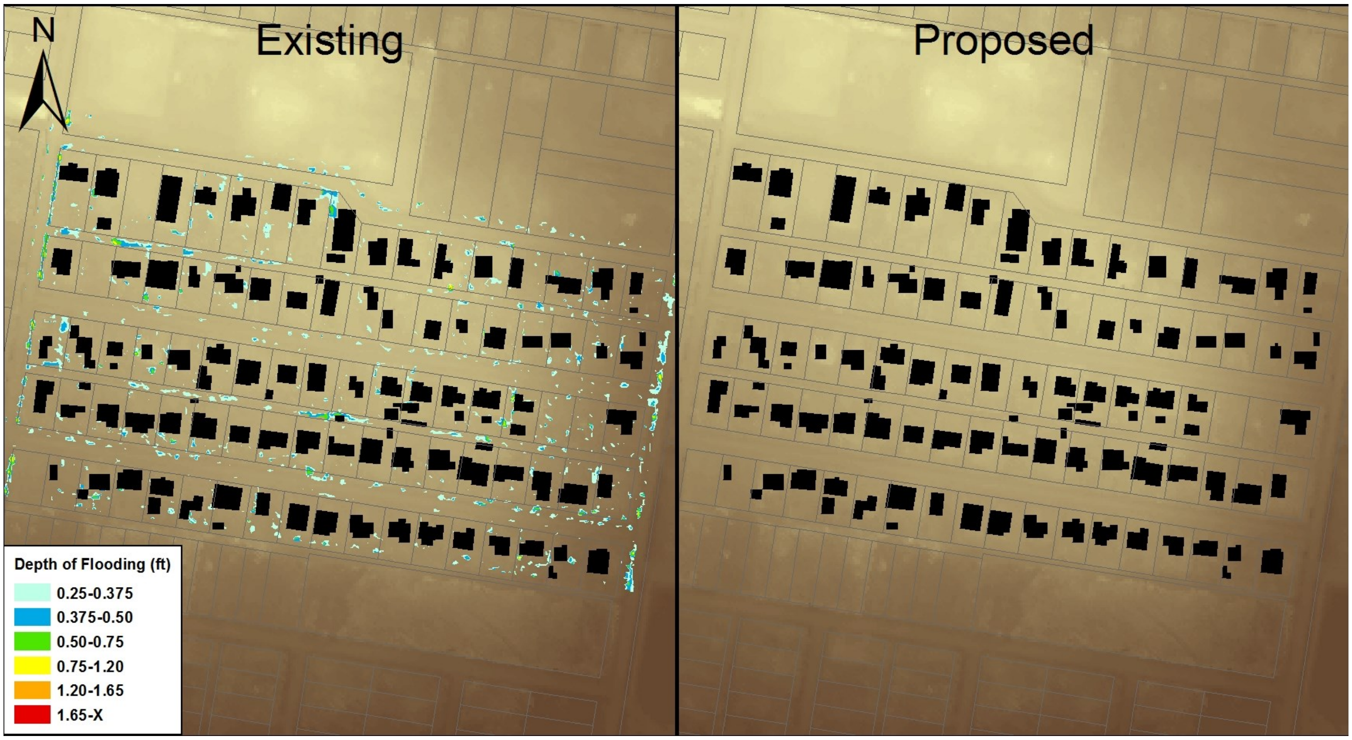


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	88	0	88
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hilda Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

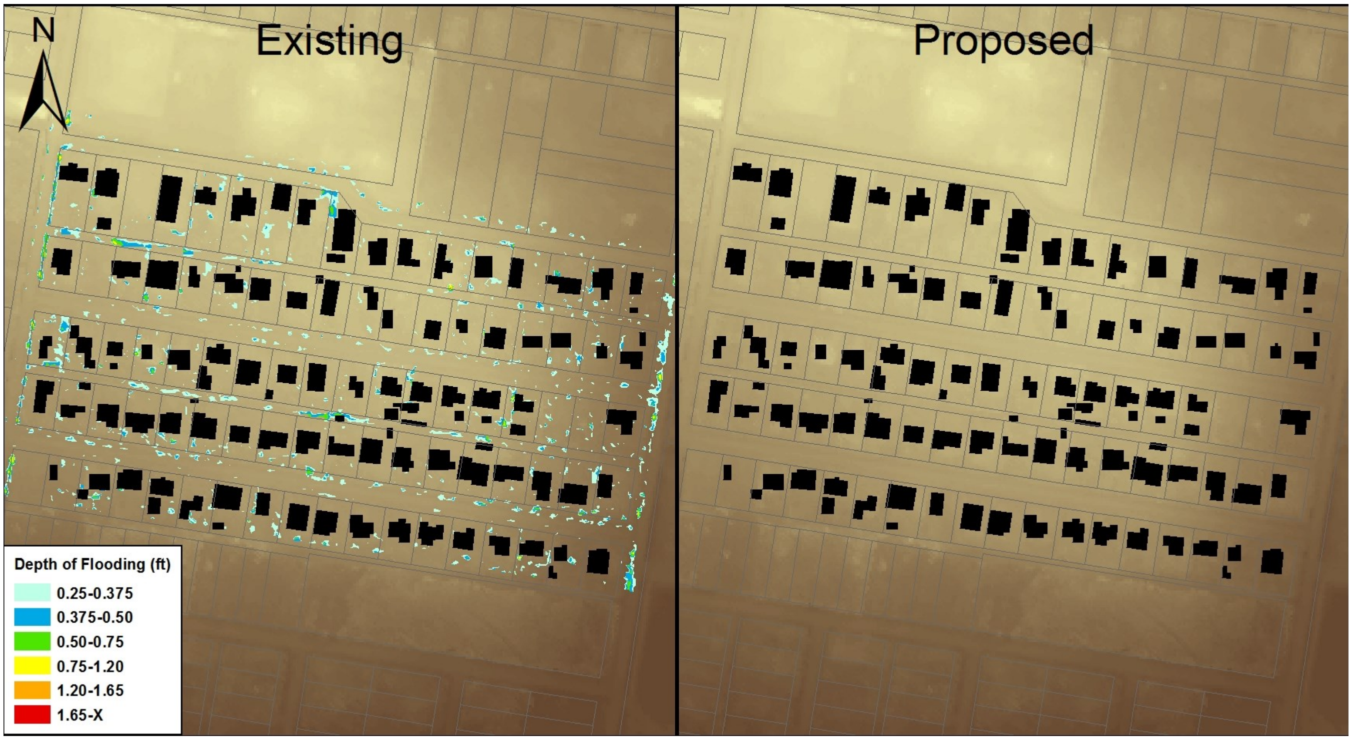


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	88	0	88
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hilda Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

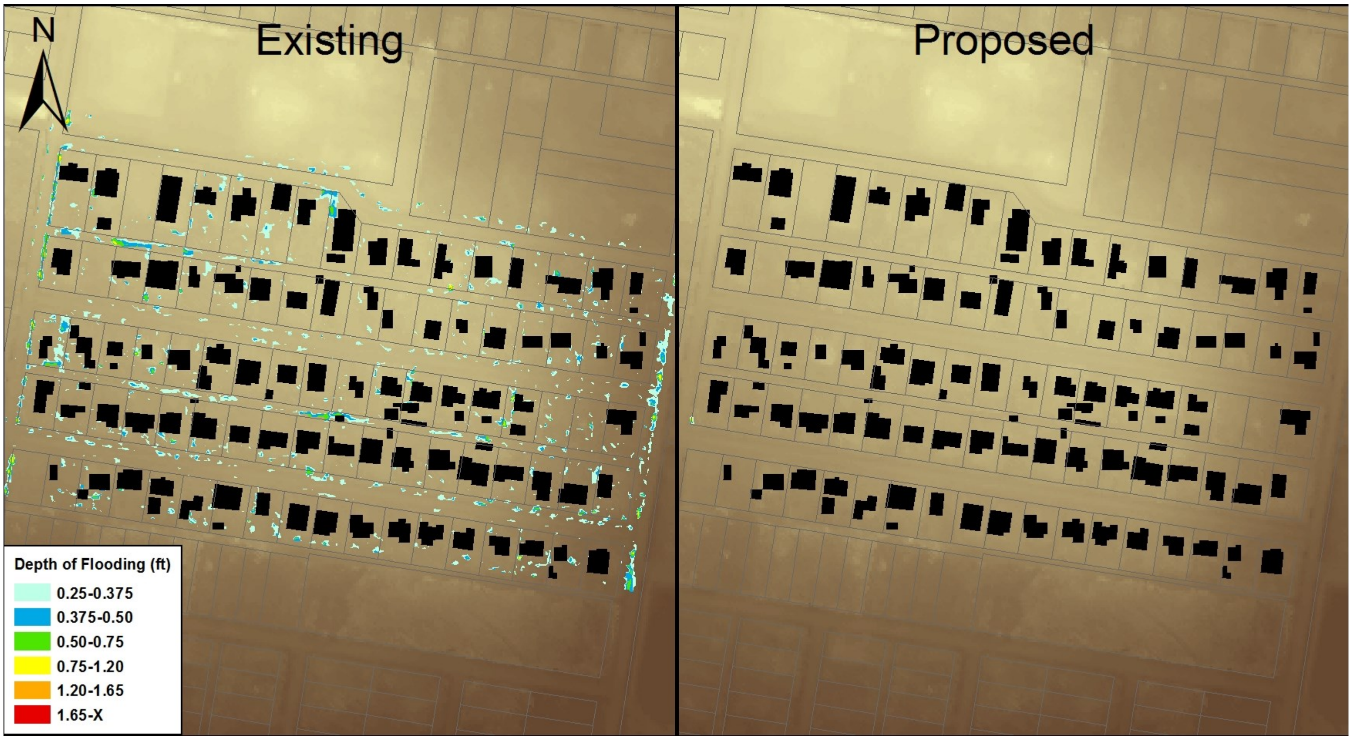


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	88	1	87
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hilda Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

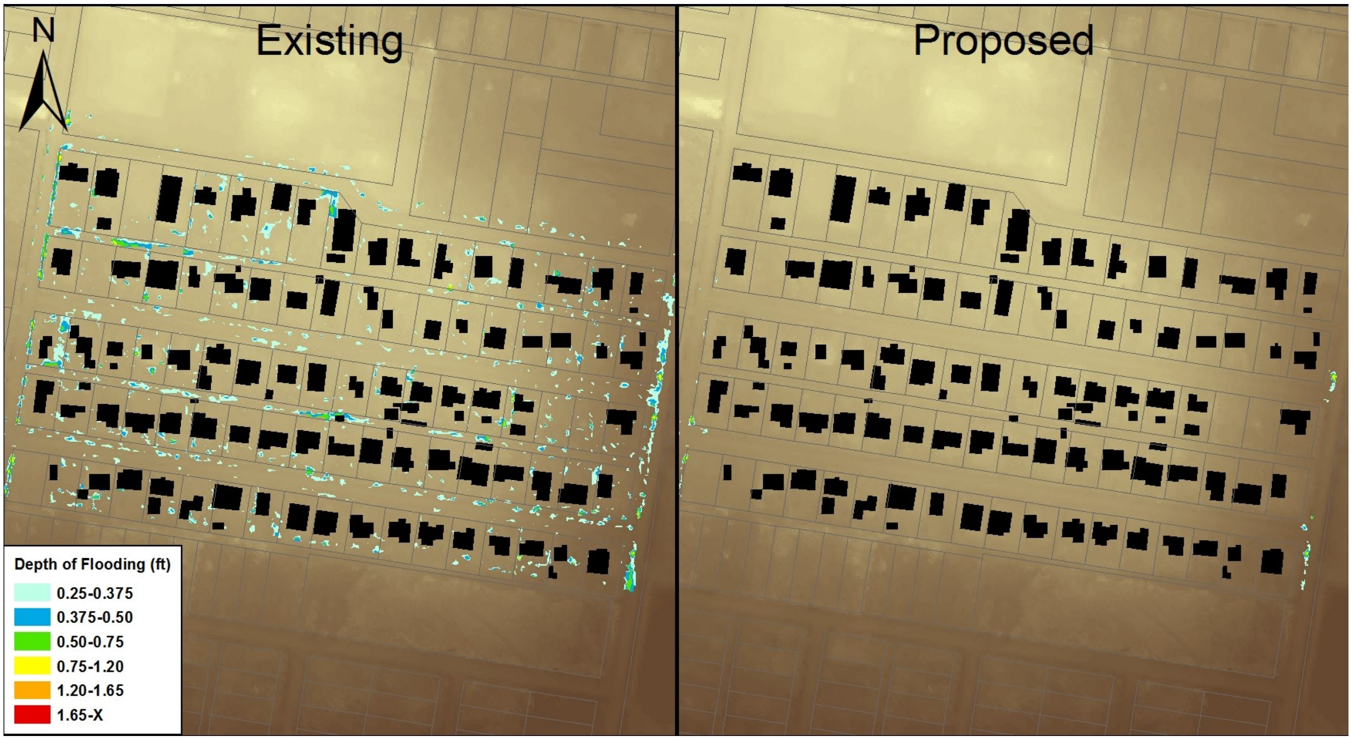


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	88	3	85
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hilda Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

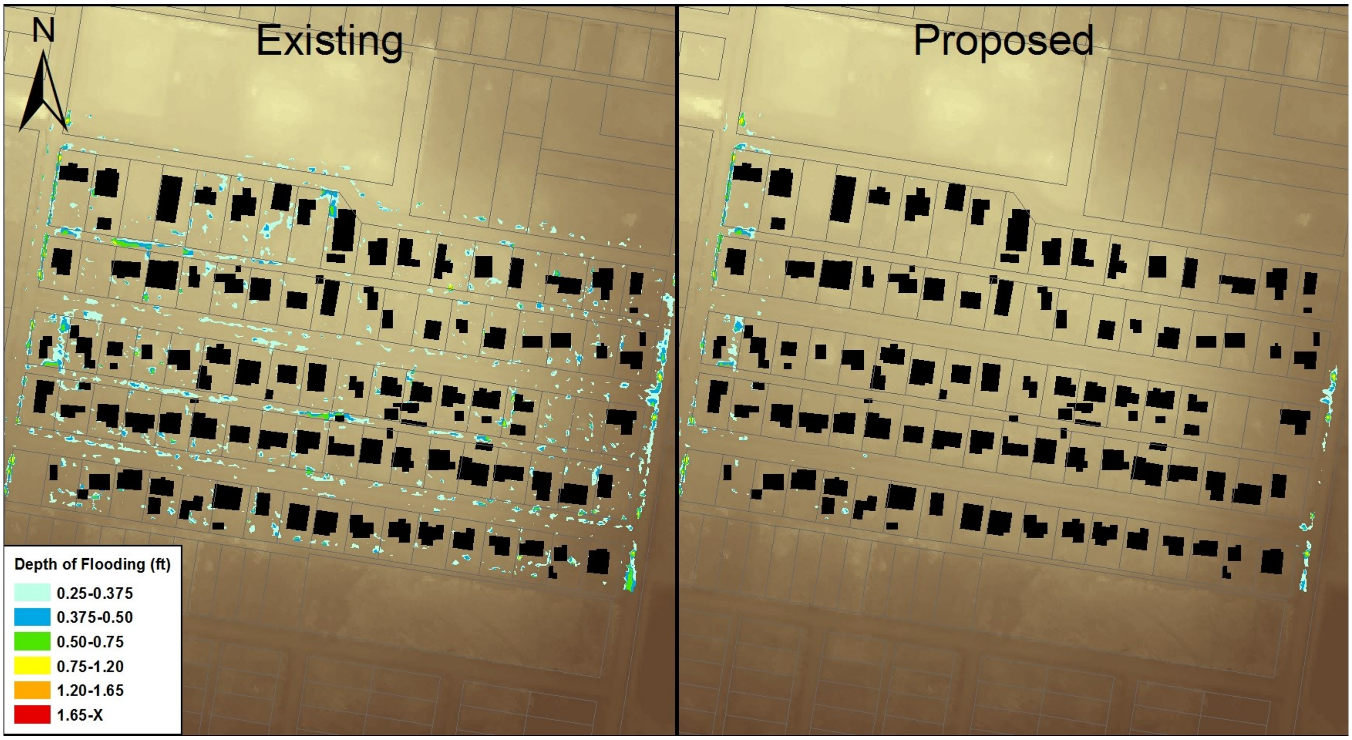
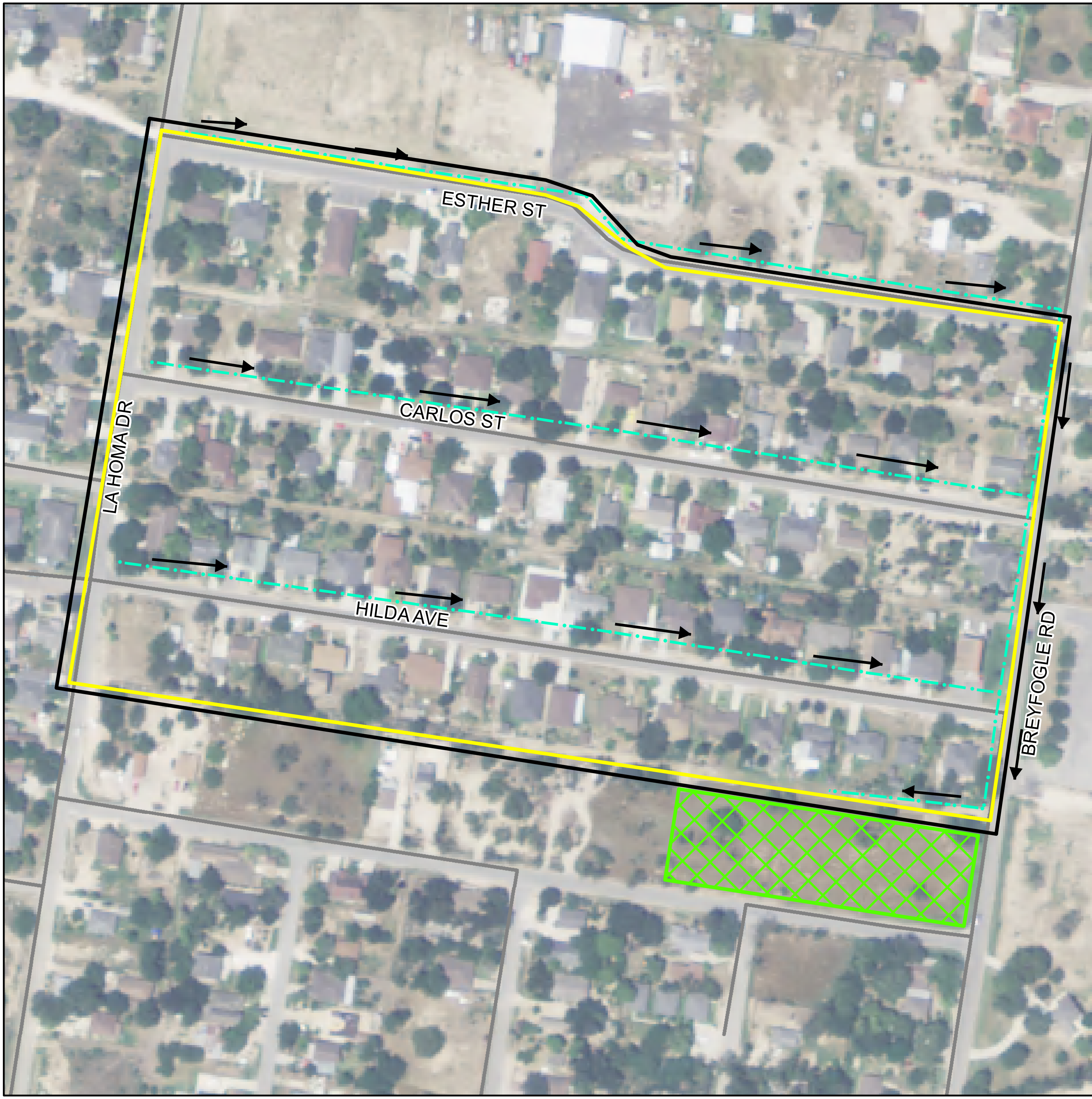


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	89	13	76
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Hilda Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- HILDA SUBD.
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

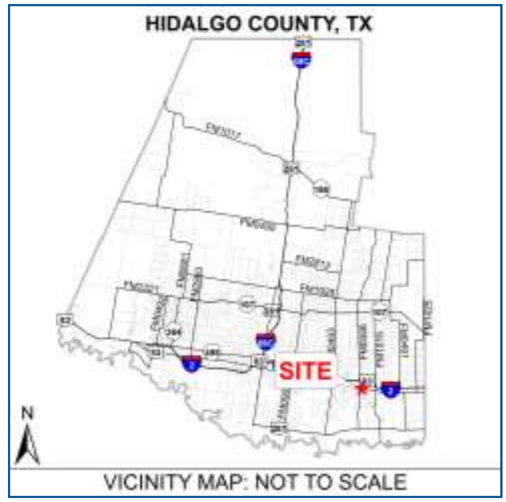
Colonia: **J.R. Subdivision No. 2, Hidalgo County**

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the J.R. Subdivision No. 2 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 11-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. J.R. Subdivision No. 2 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: J.R. Subdivision No. 2, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install roadside swales
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 210 linear feet of 18-inch diameter pipe, 334 linear feet of 24-inch diameter pipe, 2,100 linear feet of grassy swale, 1,605 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 5.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
JR No. 2 Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	7,583.33
2	**DRAINAGE IMPROVEMENTS**	$	54,929.00
3	**POND EXCAVATION IMPROVEMENTS**	$	142,780.00
	Sub-Total =	$	**205,292.33**
	Engineering (10%)	$	20,529.23
	Contingency (20%)	$	41,058.47
	Total =	$	**266,880.03**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	2	0	2
10% (10-year)	3	0	3
4% (25-year)	3	0	3
1% (100-year)	6	1	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,045,239	$266,880	3.92
Elevate Structures	$1,045,239	$570,600	1.83
Acquisition/Supplemental Housing/Demolition	$1,335,119	$657,395	2.03

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Colonia: J.R. Subdivision No. 2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

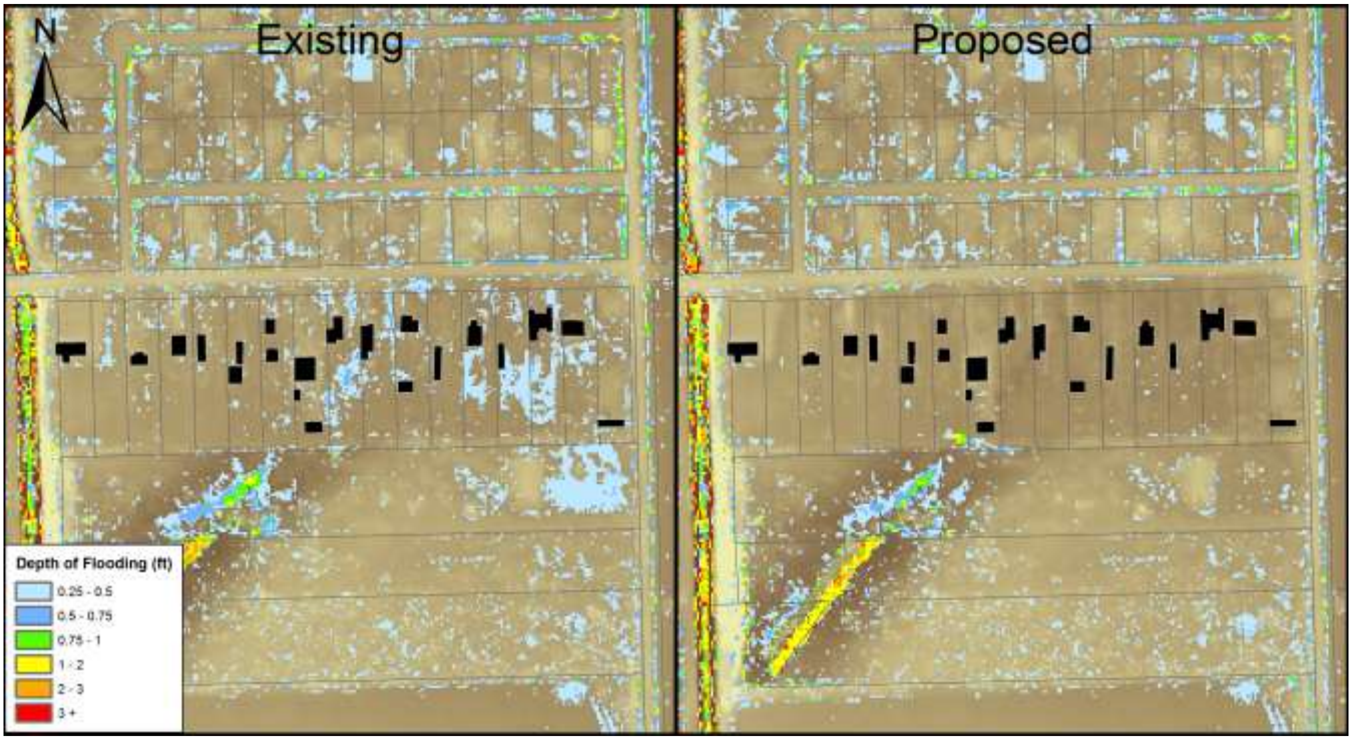


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	17	14	3
Inundated Roadway (LF)	45	0	45

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figures:

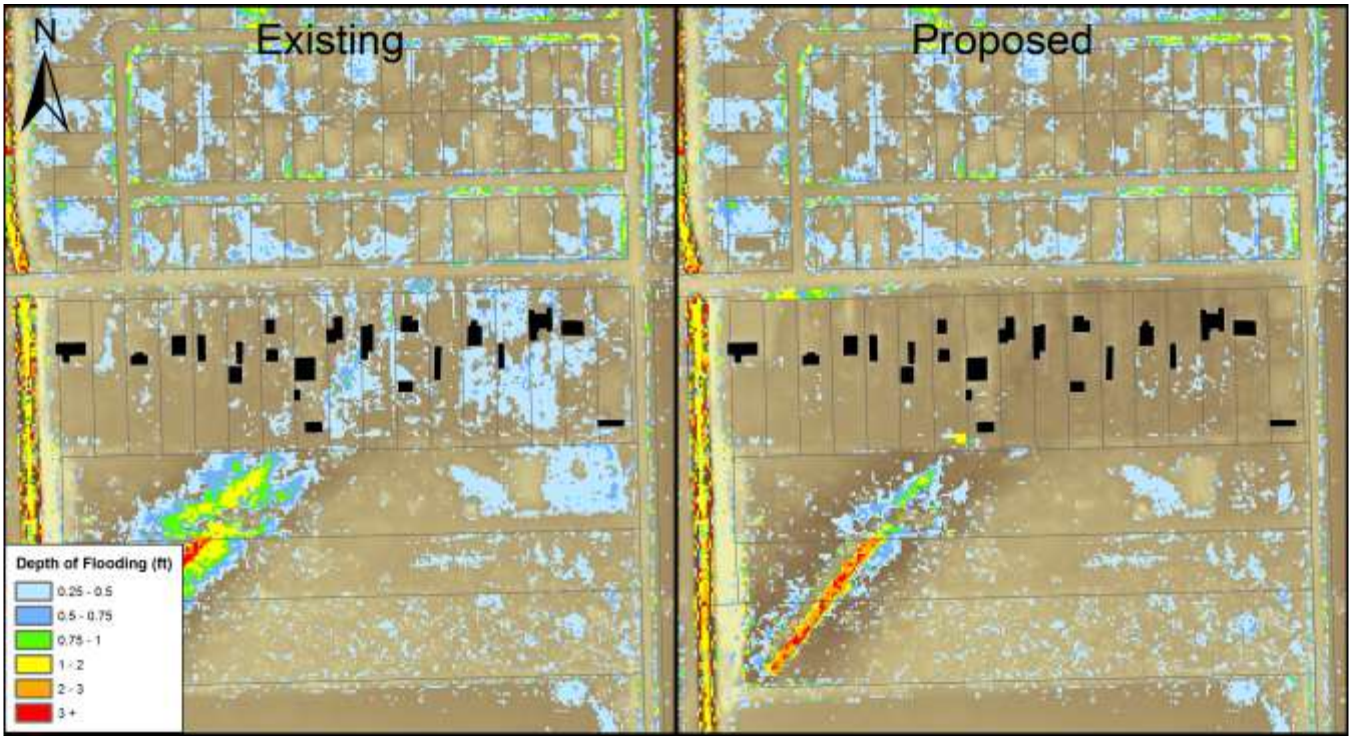


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	17	15	2
Inundated Roadway (LF)	45	0	45

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: J.R. Subdivision No. 2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

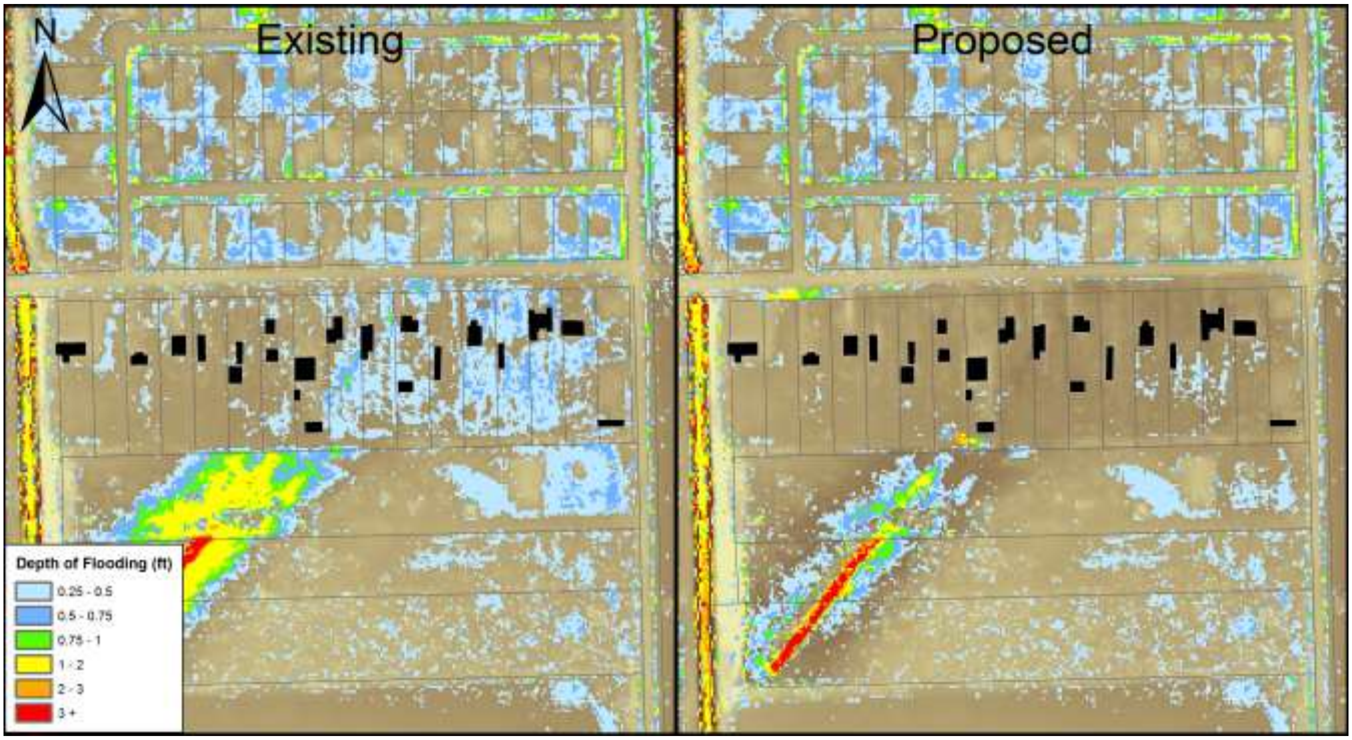


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	17	15	2
Inundated Roadway (LF)	45	0	45

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: J.R. Subdivision No. 2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

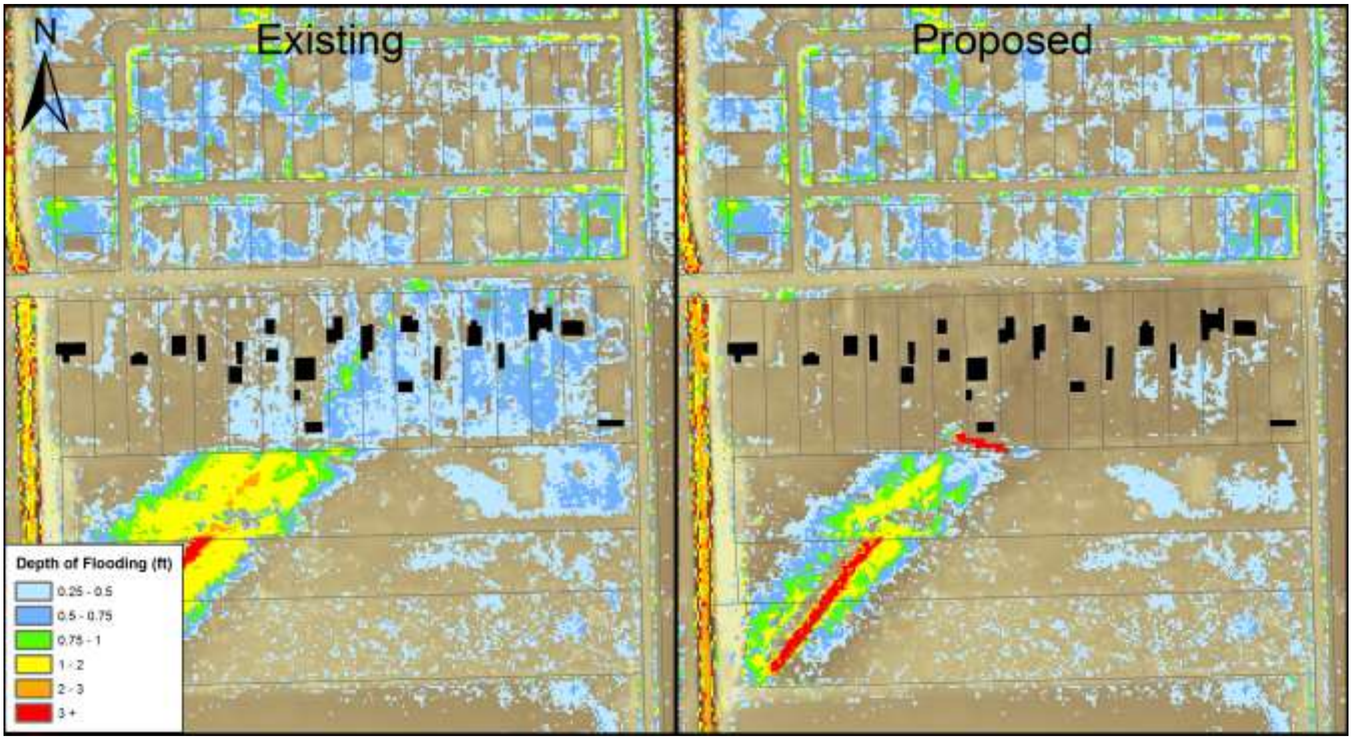


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	17	17	0
Inundated Roadway (LF)	45	0	45

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: J.R. Subdivision No. 2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

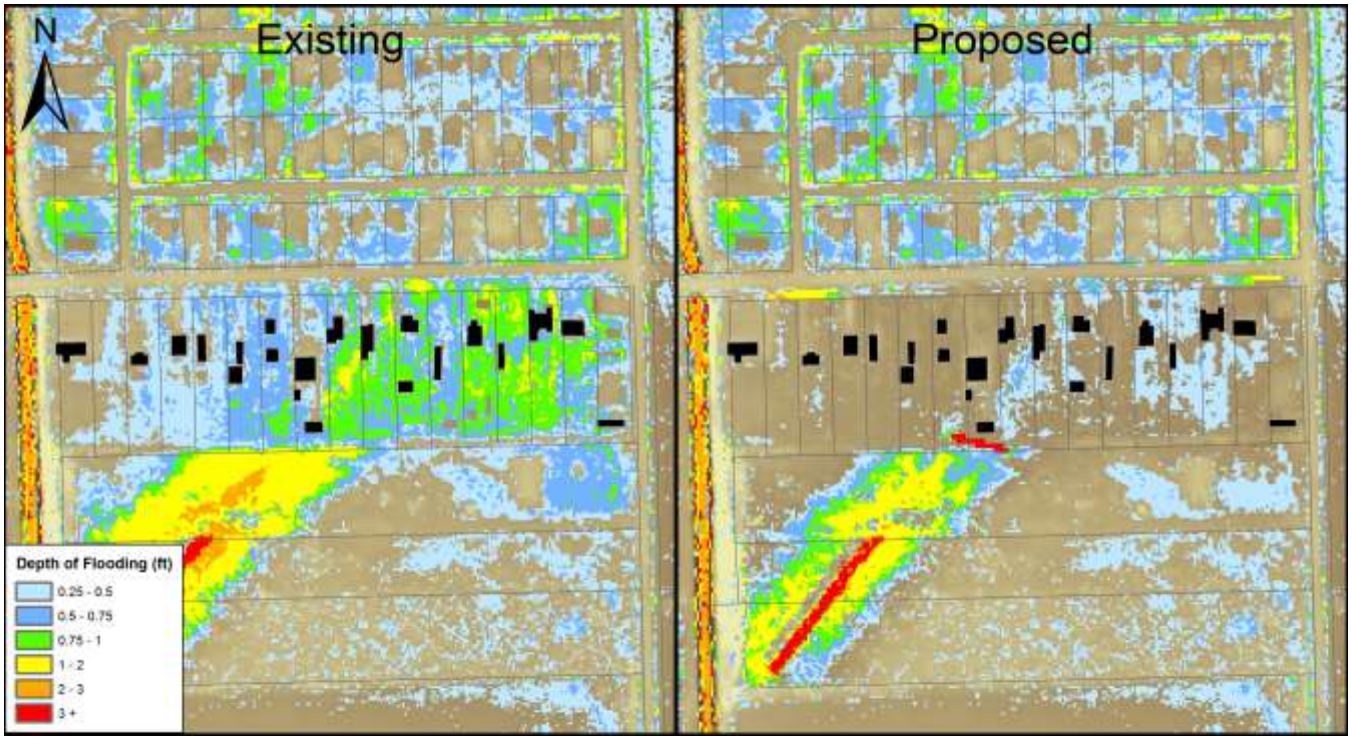


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	1	5
Inundated Lots	17	17	0
Inundated Roadway (LF)	45	0	45

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: JR Subdivision No. 2
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- J.R. Subdivision No. 2
- Existing Floodplain
- Proposed Retention Pond
- Drainage Area

N

0 50 100 200
Feet

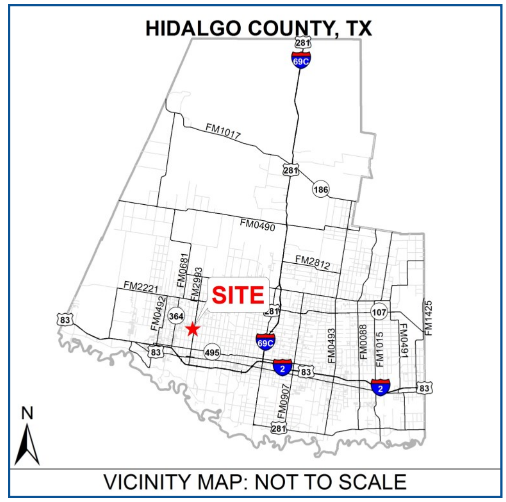
"Filling the Gap"

Colonia: Linda Vista Estates, Hidalgo County

Basin: North Main Drain

Category: A1

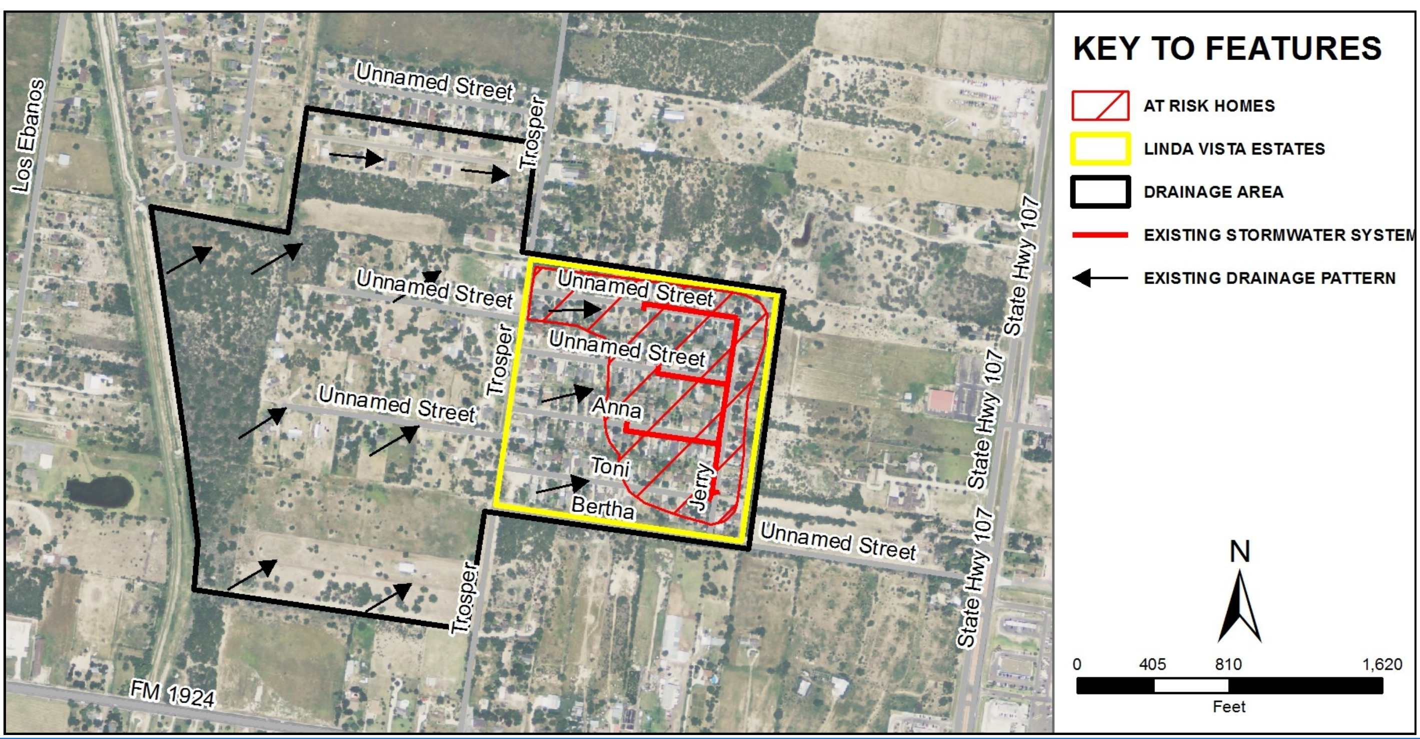
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Linda Vista Estates storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

The colonia is relatively flat and receives waters from the west basins that flow over Trosper Rd. into the residential streets. The existing drainage system consists of 11 inlets and 2,850 linear feet of 18-inch diameter pipe draining a total of 40 acres of onsite runoff plus the offsite runoff of an additional 100 acres to the west of the colonia. The model results indicate that the current capacity of the existing drain system is clearly insufficient to adequately carry the storm runoff within the underground system even when subjected to the 10 year storm and smaller ones. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively, as the underground system became hydraulically surcharged and incapable of carrying the storm runoff. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 8 inches, blue 8 to 10 inches, green 10 to 12 inches, yellow 12 to 15 inches, orange 15 to 18 inches and red more than 18 inches.



Colonia: Linda Vista Estates, Hidalgo County

"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Improve the existing underground storm system by splitting the system into two separate systems.
  - Increase the capacity of the storm system by doubling the pipes.
  - Replace the existing undersized inlets with properly sized inlets.
  - Create a retention pond and outfall on the east side of the colonia.
  - Re-grade the east dead ends of Ann Blvd. and Bertha Blvd. to create an overflow.
  - Buyout of flood prone structures

- The offsite drainage to be addressed with the following alternatives:
  - Elevate structures
  - Intercept the runoff with new roadside swales on Trosper Rd. and route it through a storm drainage system to a retention pond.
  - Additional volume can be added to the proposed onsite retention pond.

Recommended Mitigation Project:

Project Description:

The criteria used to design the new system involves carrying the discharges of the 10-Year storm of the onsite runoff and retention of both the offsite and onsite runoff of the 25-Year storm. Based on the results of the existing conditions 2D model, the recommended improvements include the removal and replacement of the existing drainage system with larger inlets and pipes and the construction of a retention facility on the east side of the colonia. The new system consists of 406 linear feet of 24-inch diameter pipe, 734 linear feet of 30-inch diameter pipe, 1,457 linear feet of 36-inch diameter pipe and 2,084 linear feet of 48-inch diameter pipe. Twenty one new inlets are also included in the improvements. The proposed retention pond is sized to retain both the onsite and offsite runoff of up to the 25-Year storm and it entails a facility with an effective storage volume of 45.9 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land for the proposed retention pond, the limited available space in the ROW of Trosper Rd. for the construction of roadside swales and utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
LINDA VISTA ESTATES

	IMPROVEMENTS	COST
1	Paving Improvements	$654,000.00
2	Drainage Improvements	$614,000.00
3	Pond Excavation Improvements	$1,223,000.00
	Sub-Total =	**$2,491,000.00**
	Engineering Fees (10%) =	**$249,100.00**
	Contingency (20%) =	**$498,200.00**
	Total =	**$3,238,300.00**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 8 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Linda Vista Estates, Hidalgo County

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	15	0	15
20% (5-year)	23	0	23
10% (10-year)	25	0	25
4% (25-year)	28	5	23
1% (100-year)	29	25	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$9,066,983	$3,238,300	2.80
Elevate Structures	$9,066,983	$2,450,775	3.70
Acquisition/Supplemental Housing / Demolition	$11,629,494	$2,782,319	4.18

Colonia: Linda Vista Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	15	0	15
Inundated Lots	58	0	58
Inundated Roadway (LF)	890	0	890

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Recommended Mitigation Project cont.:

Project Figures:

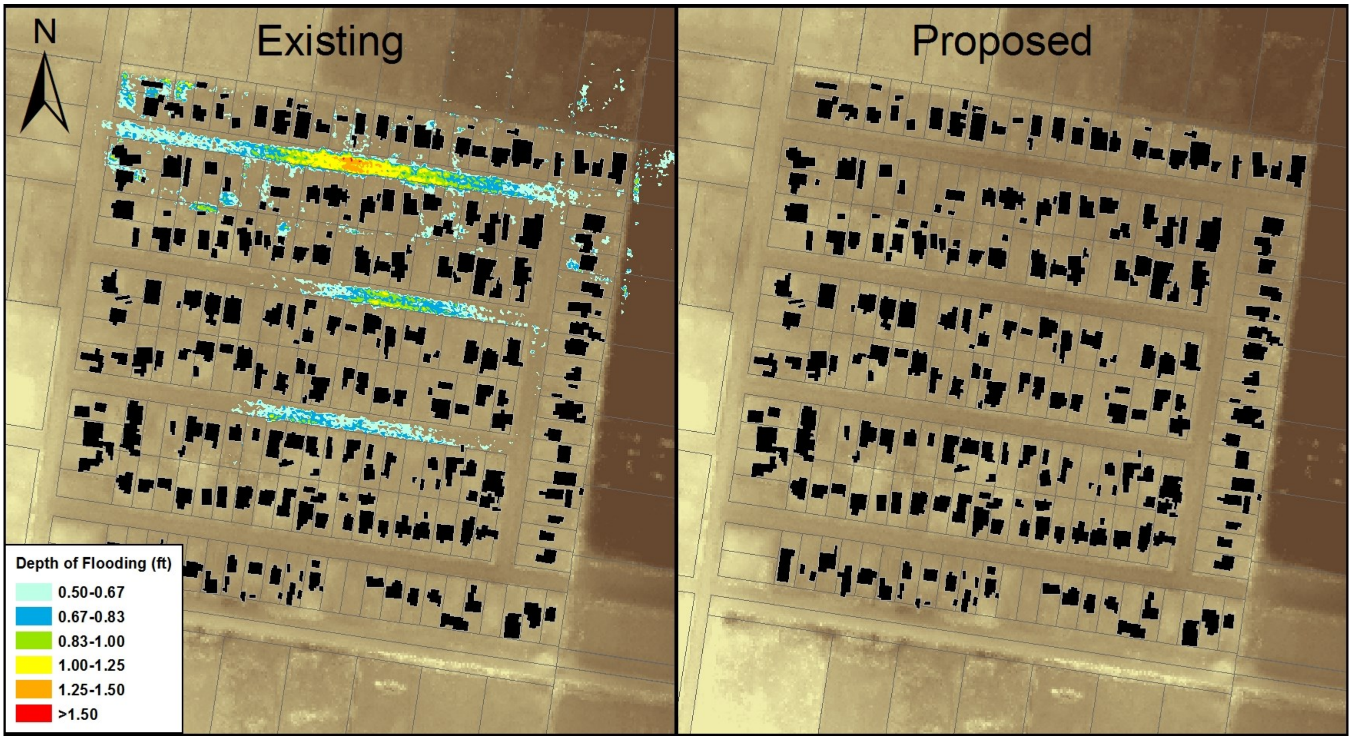


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	23	0	23
Inundated Lots	77	0	77
Inundated Roadway (LF)	1885	0	1885

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Linda Vista Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

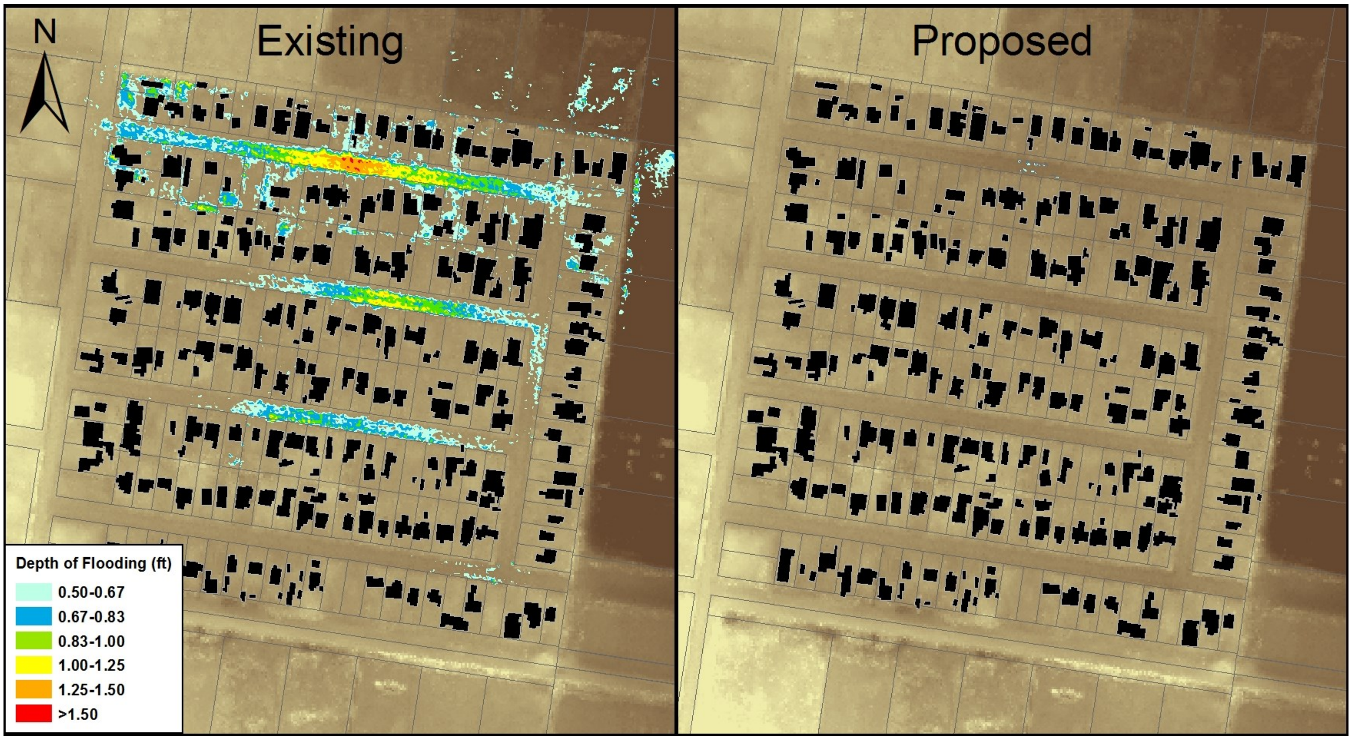


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	25	0	25
Inundated Lots	101	0	101
Inundated Roadway (LF)	2132	0	2132

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Linda Vista Estates, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

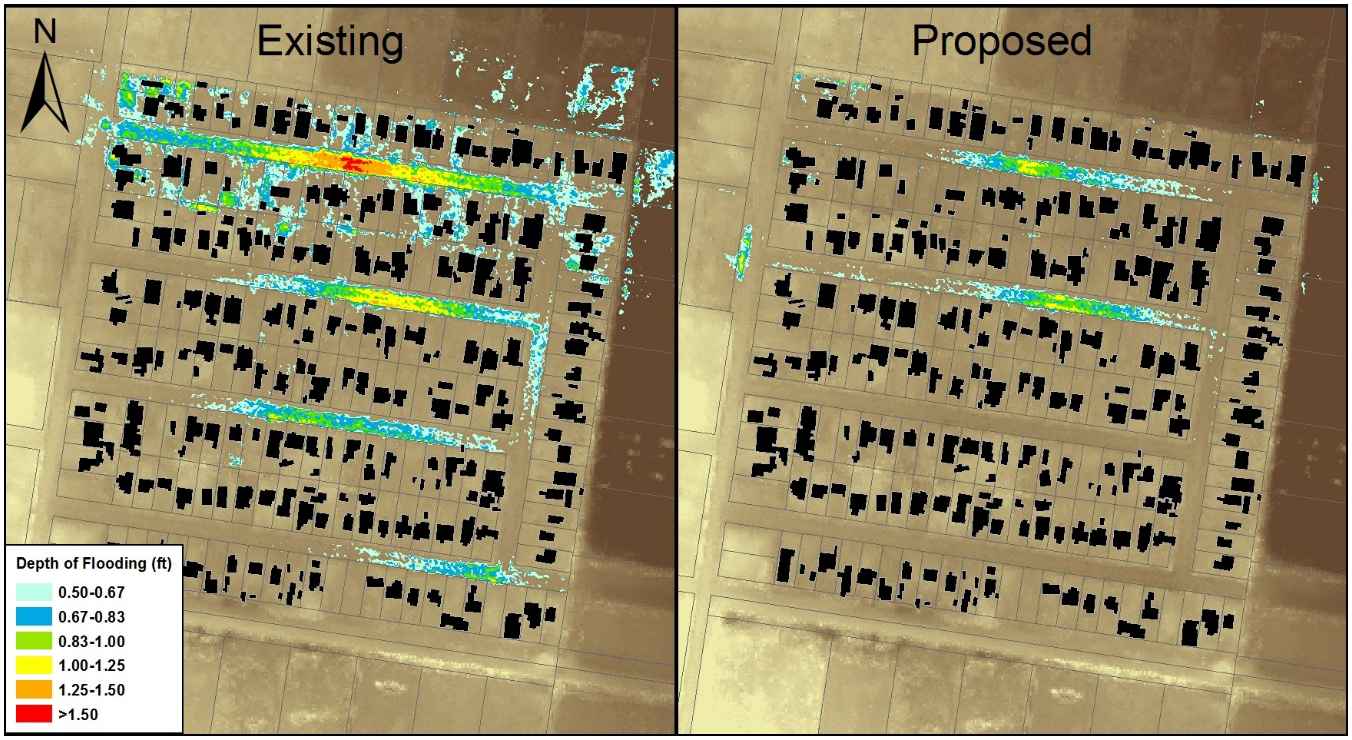


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	28	5	23
Inundated Lots	110	41	69
Inundated Roadway (LF)	2890	970	1920

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Linda Vista Estates, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

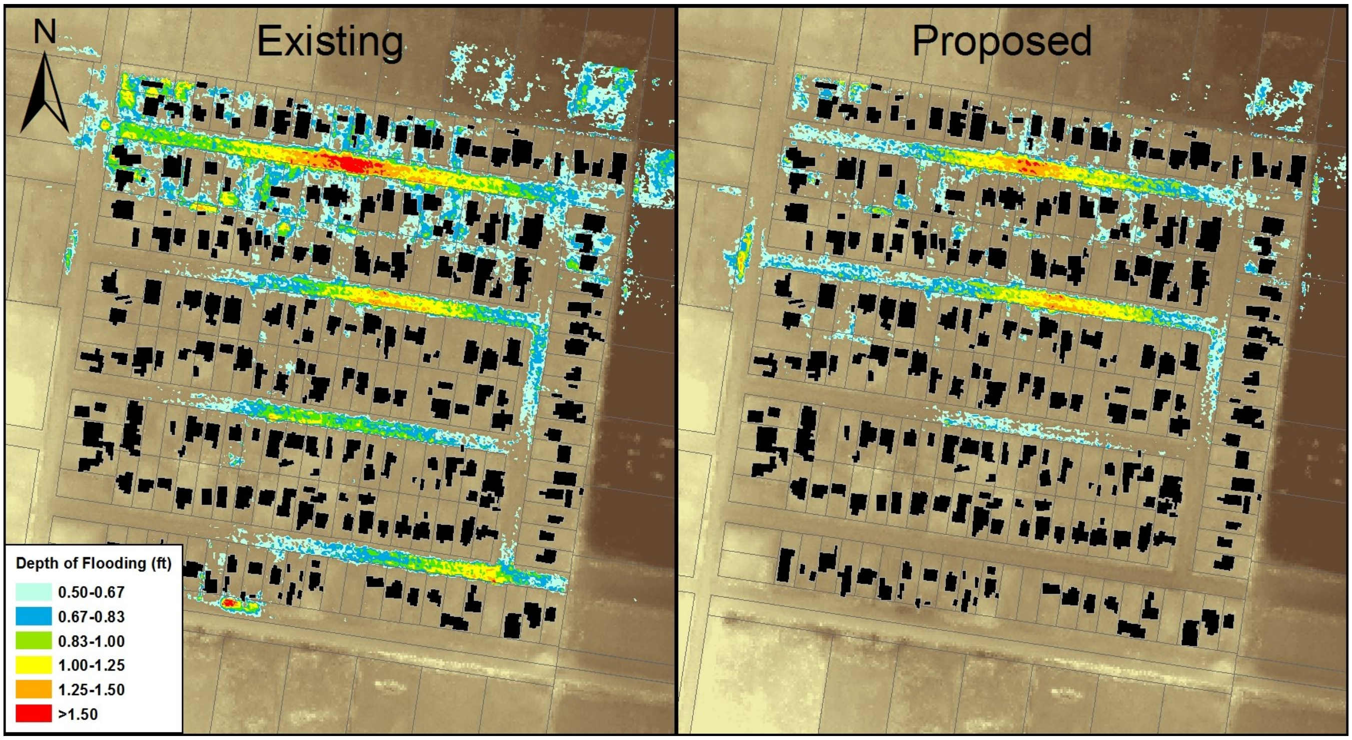
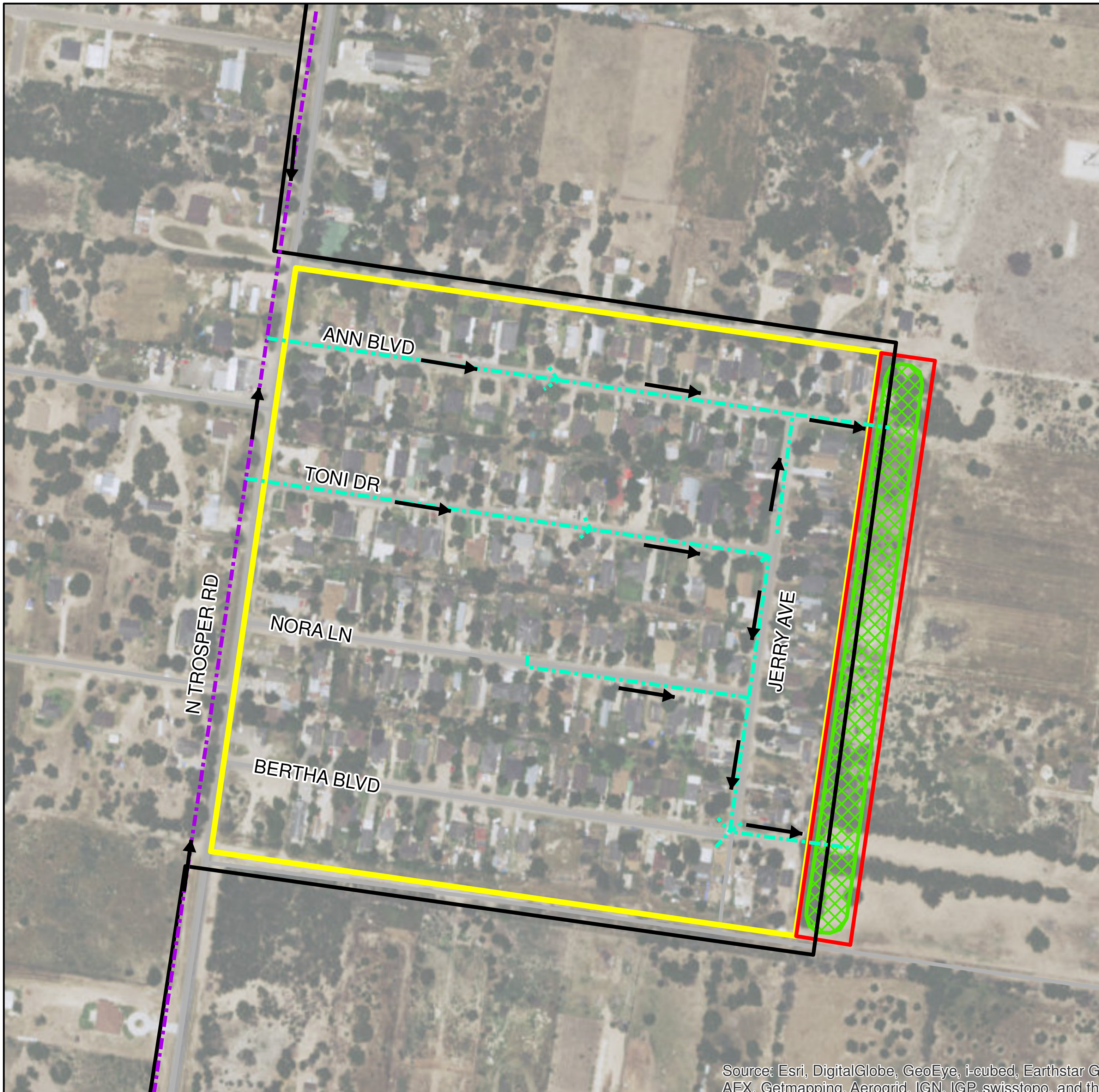


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	29	25	4
Inundated Lots	131	105	26
Inundated Roadway (LF)	3795	2552	1243

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Linda Vista Estates
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

PROP DRAINAGE SYSTEM
PROP ROADSIDE SWALE
LINDA VISTA ESTATES
OFFSITE CONTRIBUTING DRAINAGE
RETENTION POND ROW/EASEMENT
25-YR RETENTION POND
DRAINAGE SYSTEM FLOW

N W E S

0 200 400 600
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

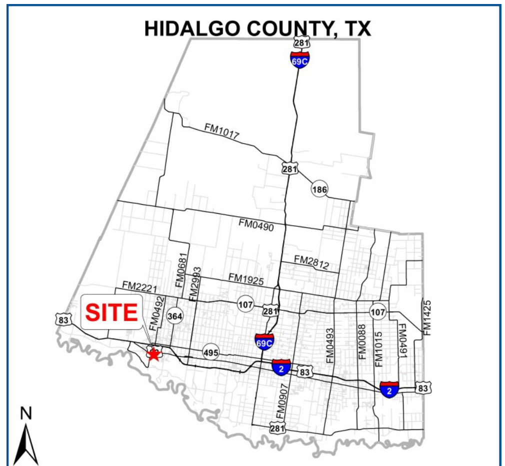
STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Colonia: Los Trevinos Subd. #3, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

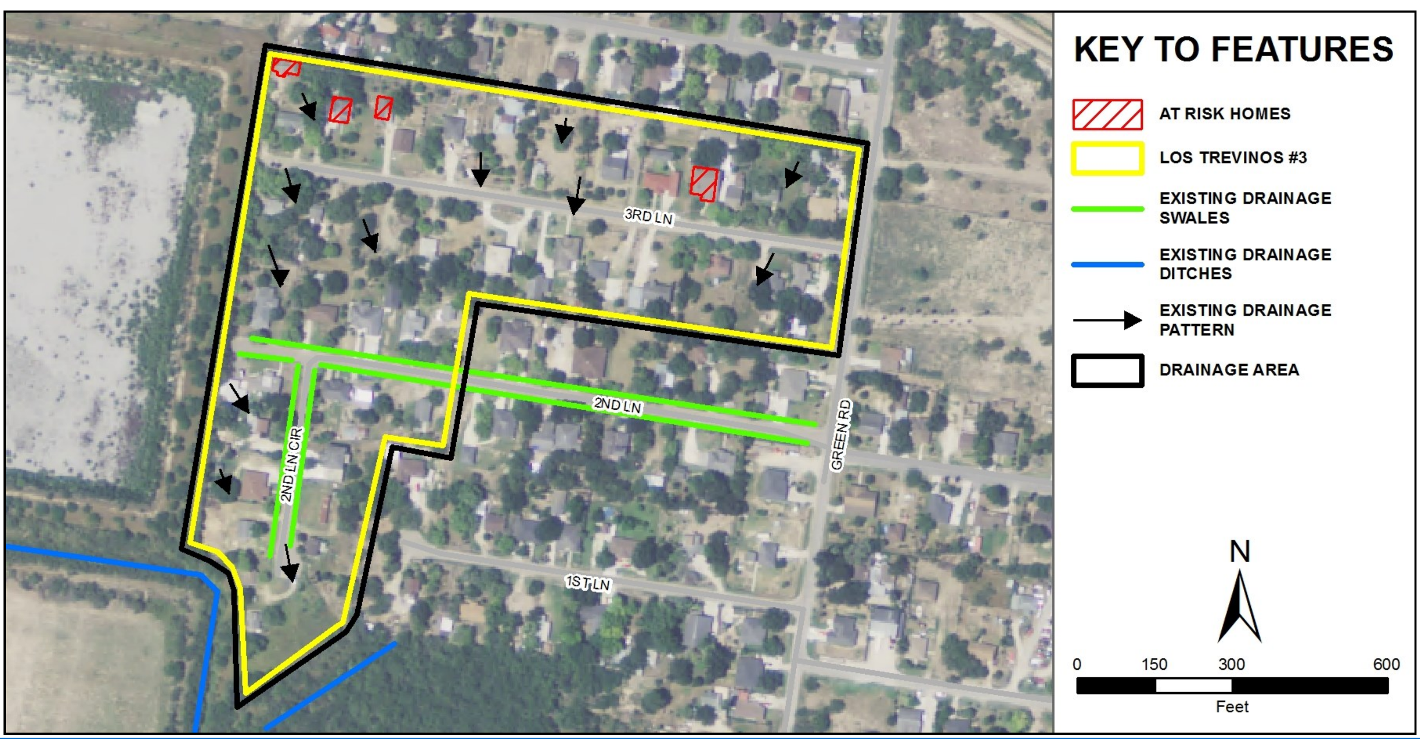


VICINITY MAP: NOT TO SCALE

A 2-dimensional hydrodynamic model of the colonia Los Trevinos #3 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Los Trevinos #3 consist of approximately 18 acres of residential developed land. The existing swales and culverts currently do not provide adequate drainage for the subdivision. There is an existing major drainage ditch that runs along the southwest corner of the colonia. The existing drainage pattern indicates runoff flows toward the south, however the existing conditions 2D model results indicate that there are some areas at risk of flooding in the northern portion of the subdivision. This may be attributed to low lots or drainage obstructions. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events that may overflow the existing drain ditch into the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 12 inches, orange 12 to 15 inches, and red more than 15 inches.



Colonia: Los Trevinos Subd. #3, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install an underground drainage system to outfall into the existing drainage ditch (may require widening).
    - Install roadside swales with culverts to convey runoff to Green Road.
    - Install roadside swales with culverts to convey runoff to the existing drainage ditch (may require widening).

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 144 linear feet of 18-inch diameter pipe, 1,091 linear feet of 24-inch diameter pipe, 723 linear feet of 30-inch diameter pipe, 116 linear feet of 33-inch diameter pipe , 650 linear feet of 36-inch diameter pipe, and 20 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4.93 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
LOS TREVINOS #3		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$407,690.00
2	Drainage Improvements	$282,866.00
3	Pond Excavation Improvements	$132,863.44
	Sub-Total =	**$823,419.44**
	Engineering Fees (10%) =	**$82,341.94**
	Contingency (20%) =	**$164,683.89**
	Total =	**$1,070,445.27**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Los Trevinos Subd. #3, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	4	0	4
10% (10-year)	4	0	4
4% (25-year)	4	0	4
1% (100-year)	4	0	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$464,727.00	$1,070,445.27	0.43
Elevate Structures	$464,727.00	$474,750.00	0.98
Acquisition/Supplemental Housing / Demolition	$1,119,270.00	$441,199.50	2.54

Colonia: Los Trevinos Subd. #3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

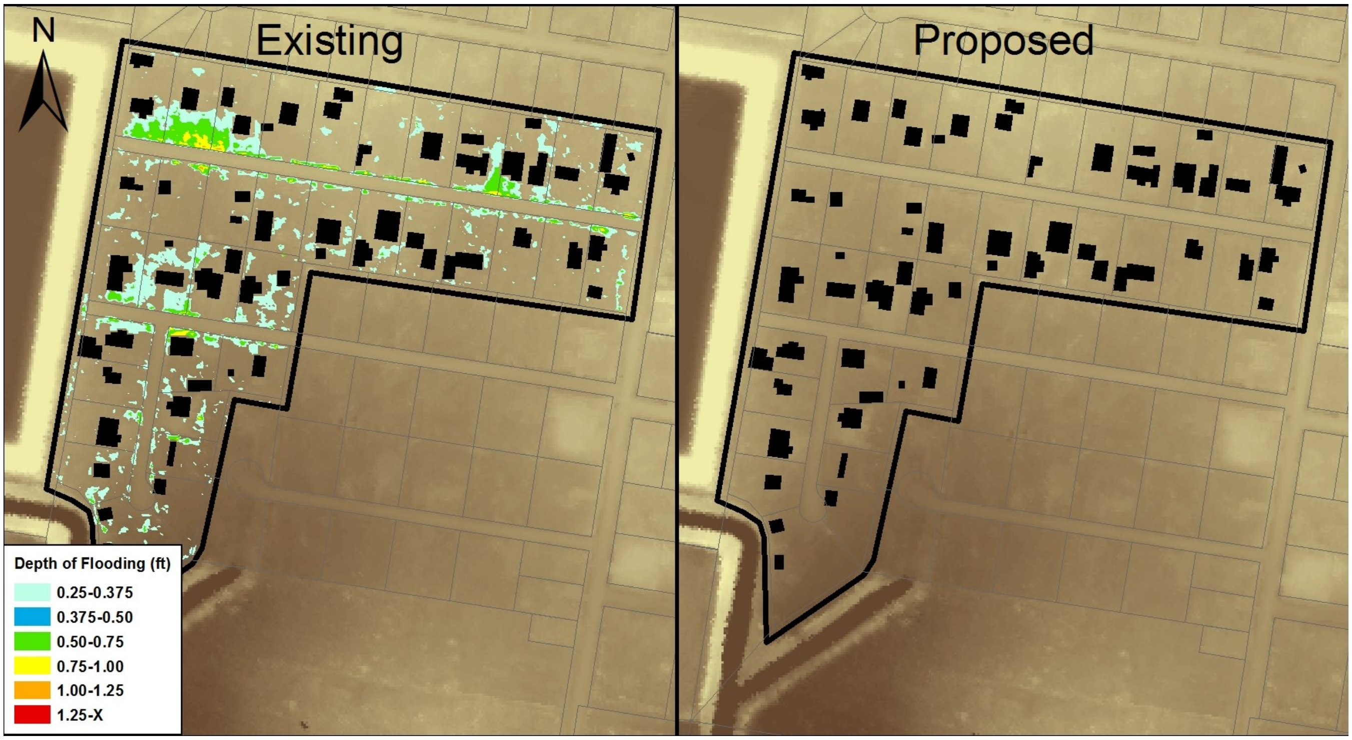


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	35	0	35
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

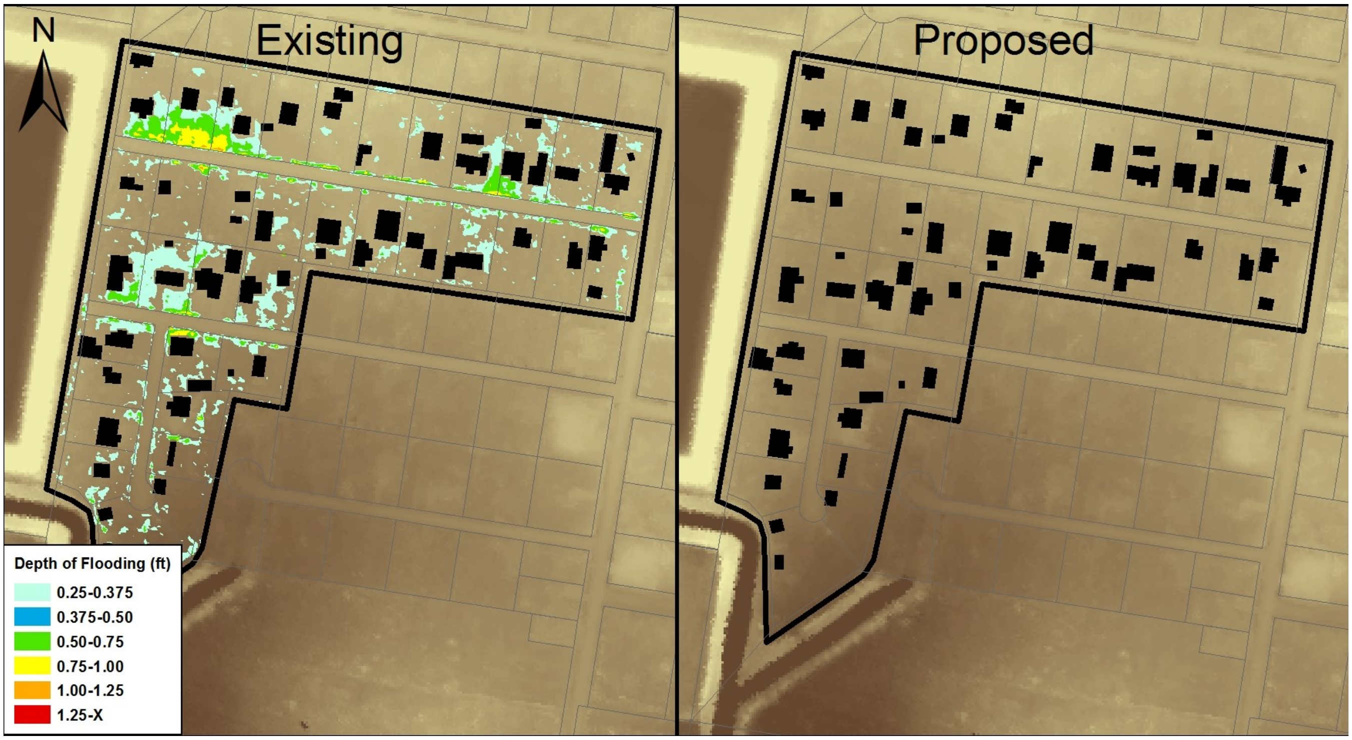


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	35	0	35
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

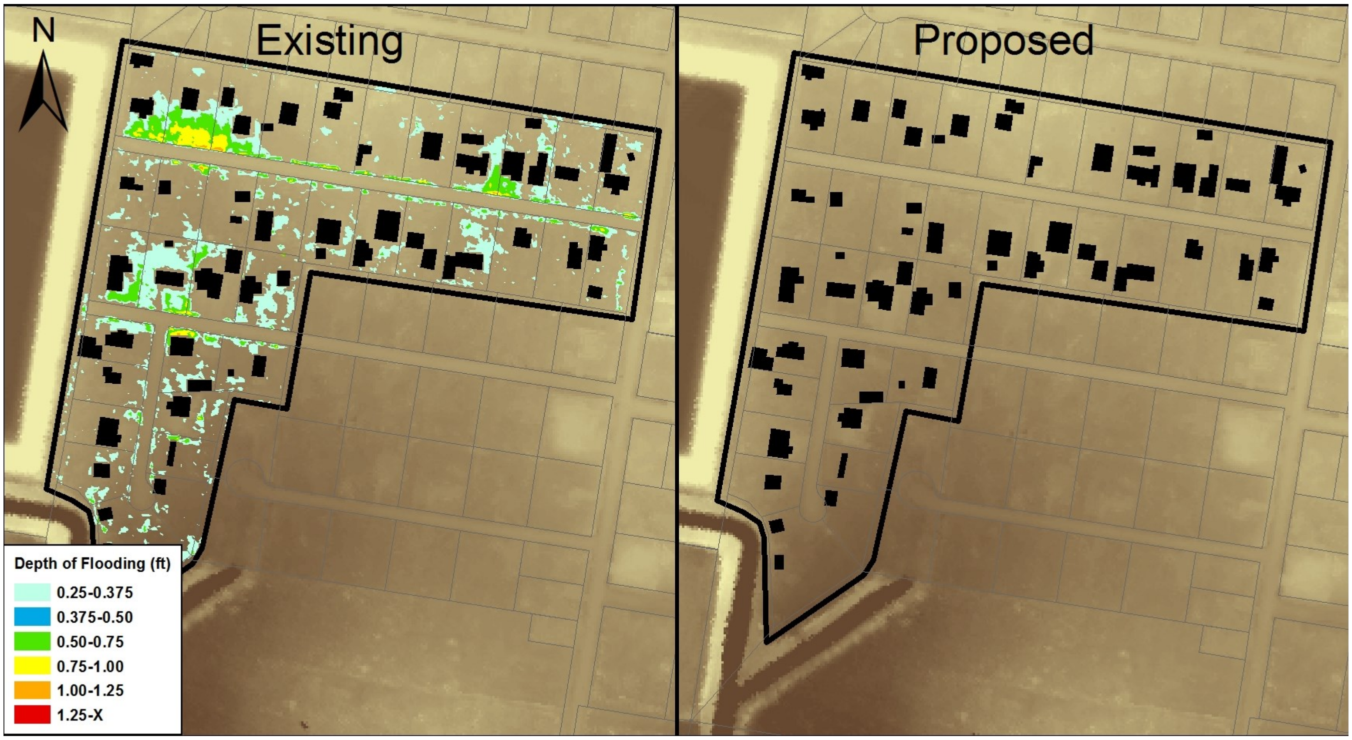


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	35	0	35
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

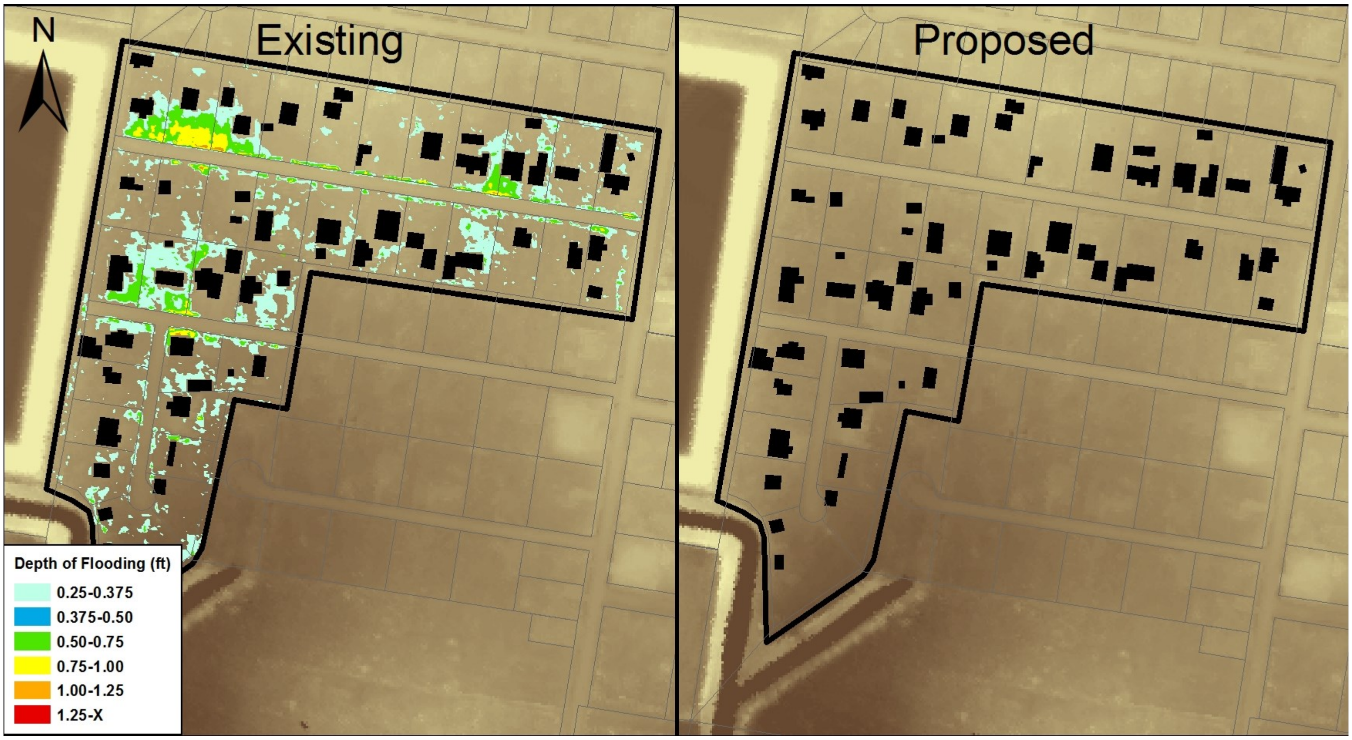


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	35	0	35
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

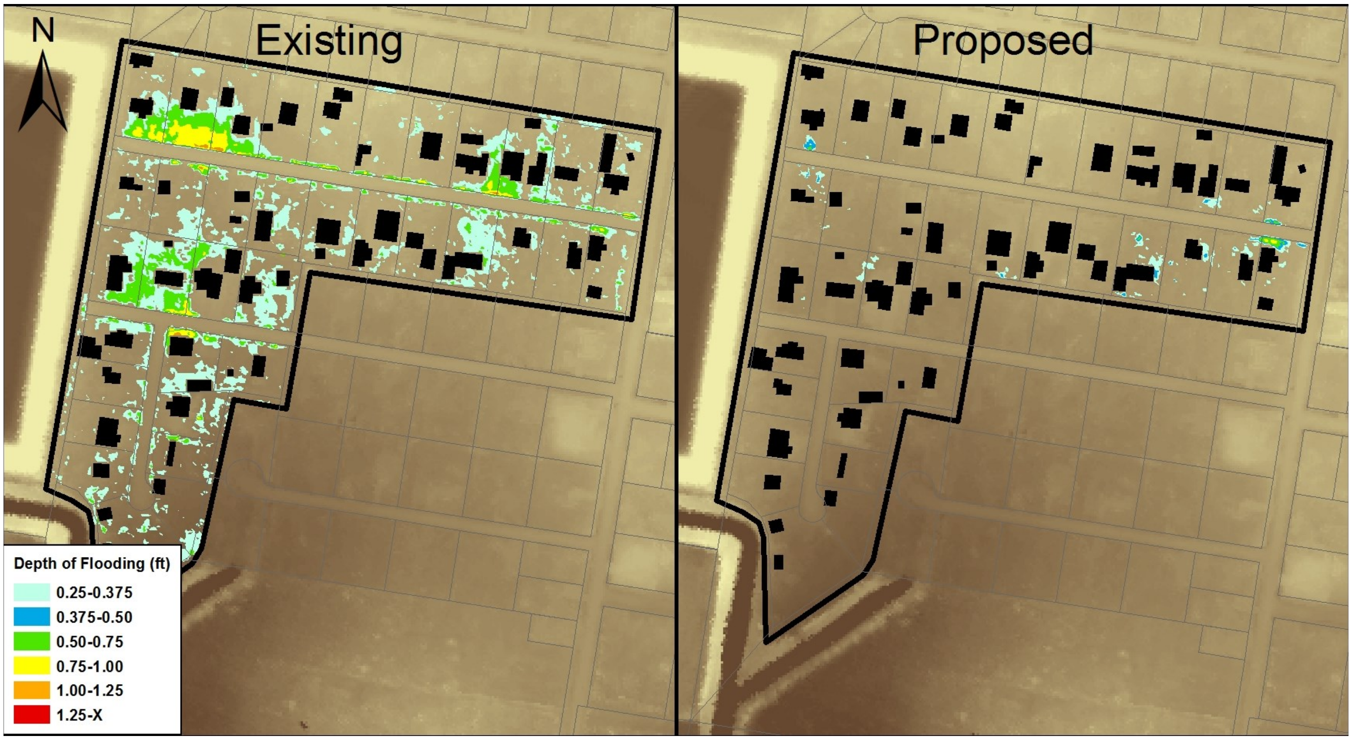
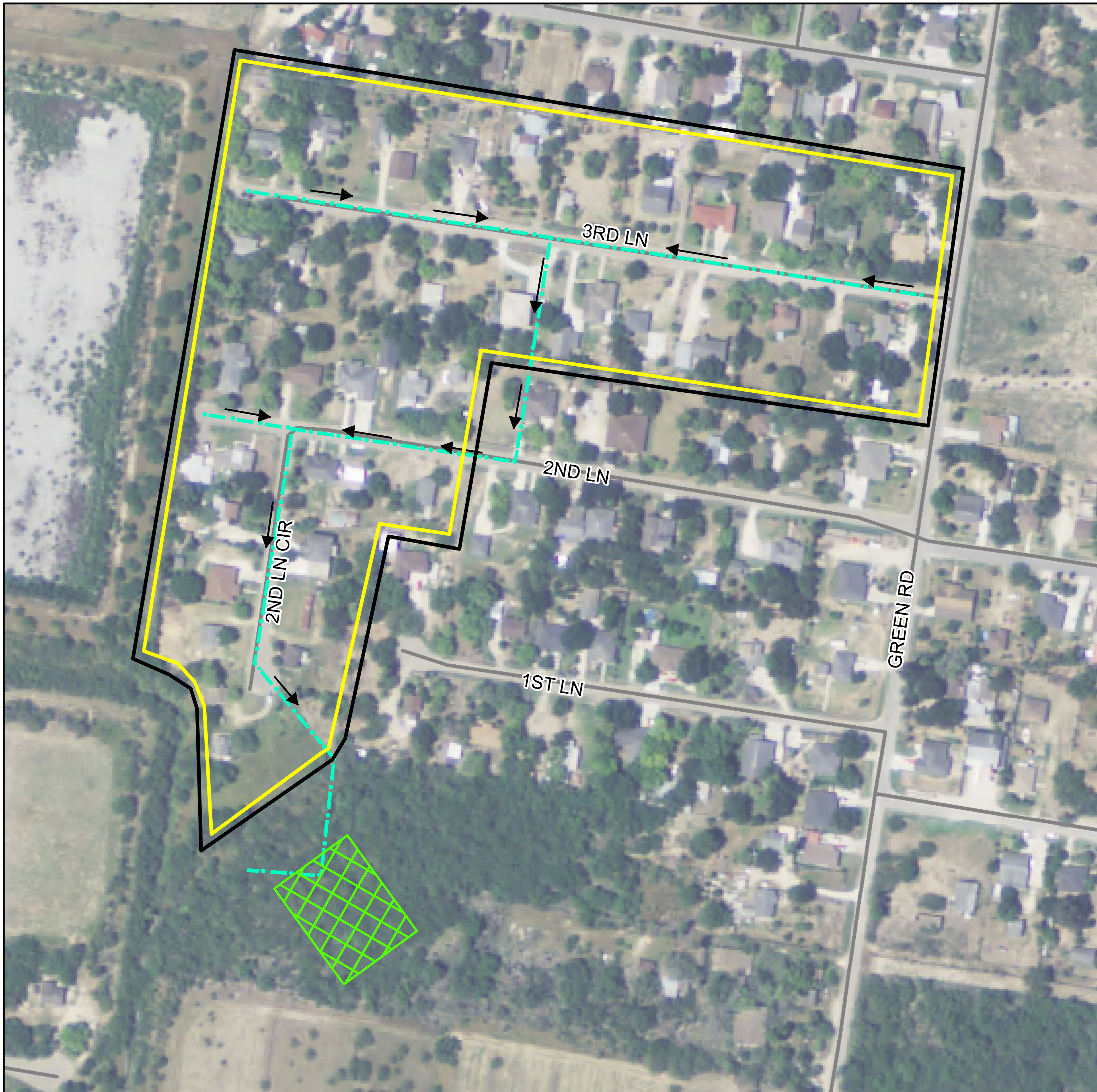


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	35	16	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Los Trevinos #3
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- LOS TREVINOS #3
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

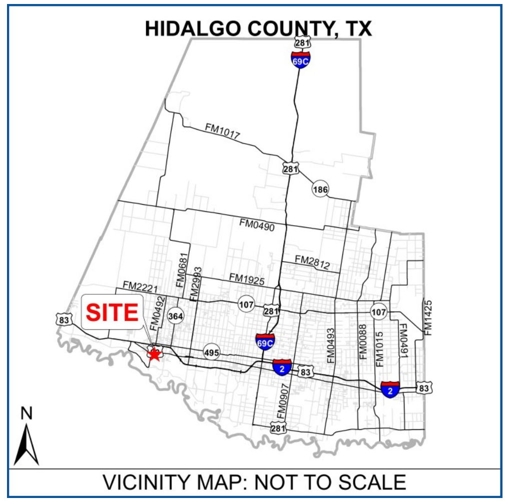
"Filling the Gap"

Colonia: Los Trevinos Subd. #4, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

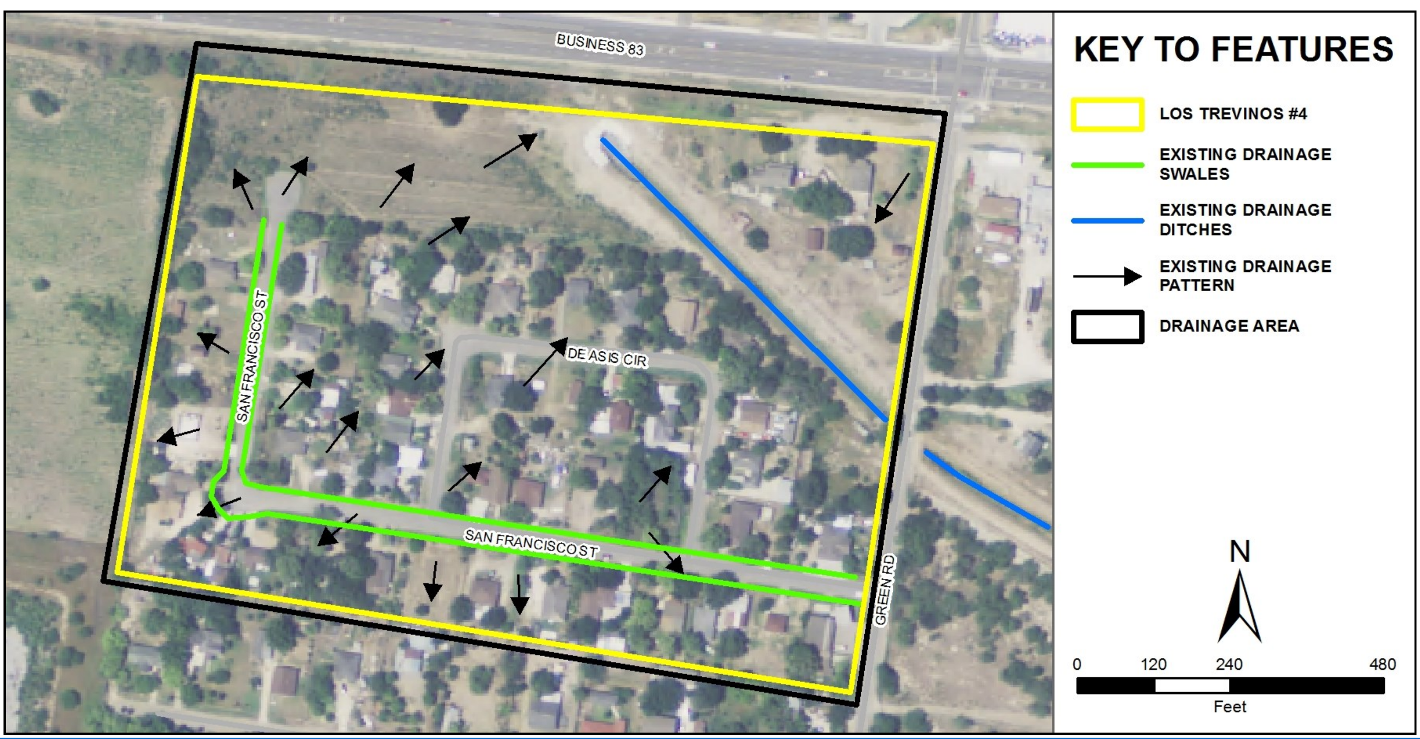
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Los Trevinos #4 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Los Trevinos #4 consists of approximately 24 acres of residential developed land. The existing drainage pattern indicates runoff flows toward the northeast corner of the subdivision. The existing swales and culverts that run along San Francisco Street do not have an outfall. The existing conditions 2D model results indicate that the areas of high risk of flooding are located along the northeast corner of the subdivision, where it appears the existing drainage ditch berm creates a drainage obstruction. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events that may overflow the existing drain ditch into the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 12 inches, orange 12 to 20 inches, and red more than 20 inches.



Colonia: Los Trevinos Subd. #4, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install roadside swales with culverts to convey runoff to Green Road.
    - Increase the volume of the existing drainage ditch and convey runoff into it.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 1,543 linear feet of 24-inch diameter pipe, 744 linear feet of 30-inch diameter pipe, and 14 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 5.24 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
LOS TREVINOS #4		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$377,665.33
2	Drainage Improvements	$197,755.00
3	Pond Excavation Improvements	$141,215.22
	Sub-Total =	**$716,635.55**
	Engineering Fees (10%) =	**$71,663.56**
	Contingency (20%) =	**$143,327.11**
	Total =	**$931,626.22**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ration is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$931,626.22	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Los Trevinos Subd. #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

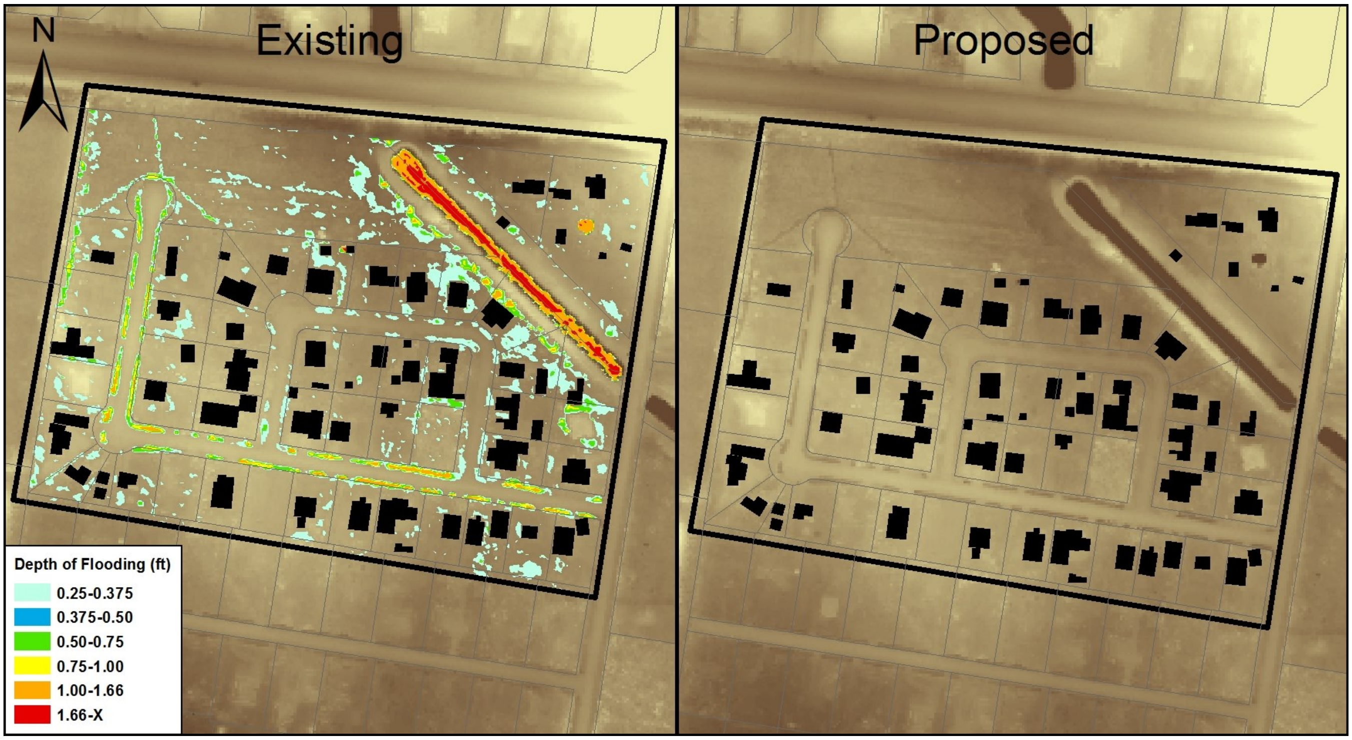


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	0	49
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

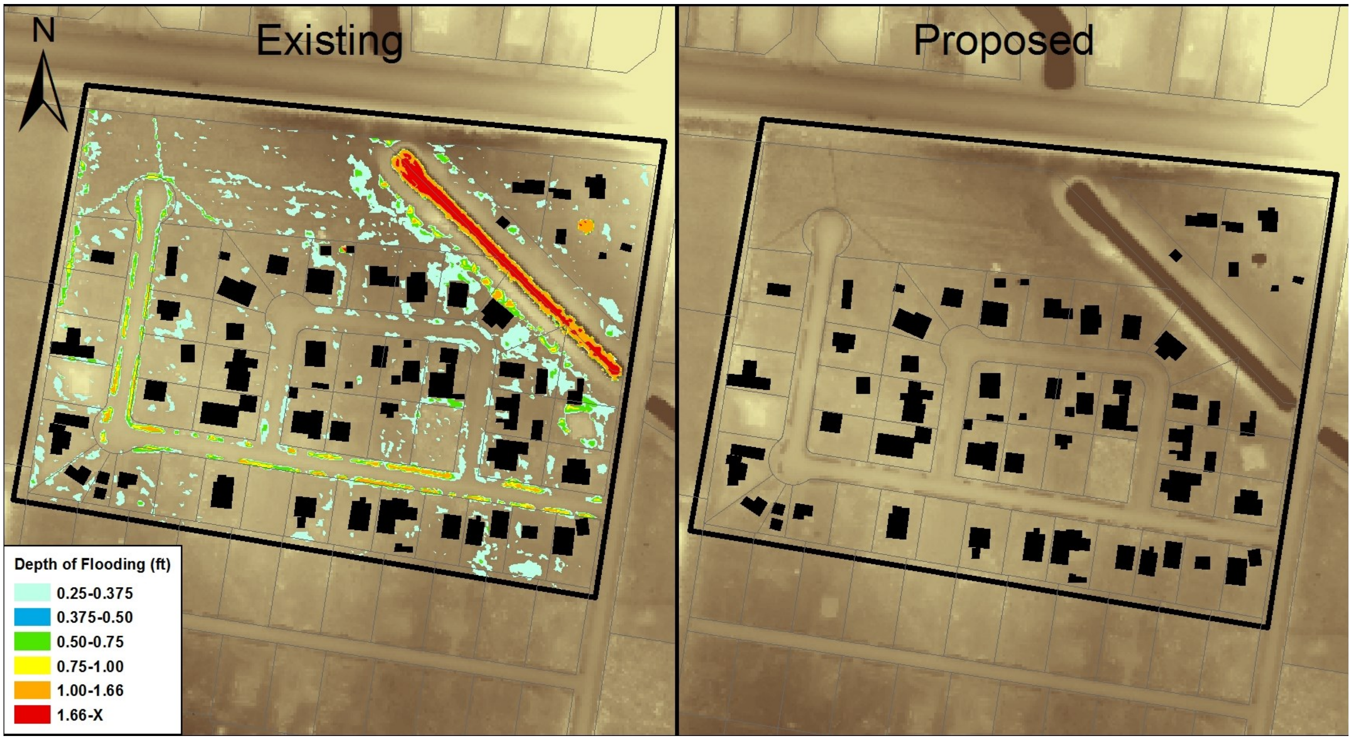


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	0	49
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

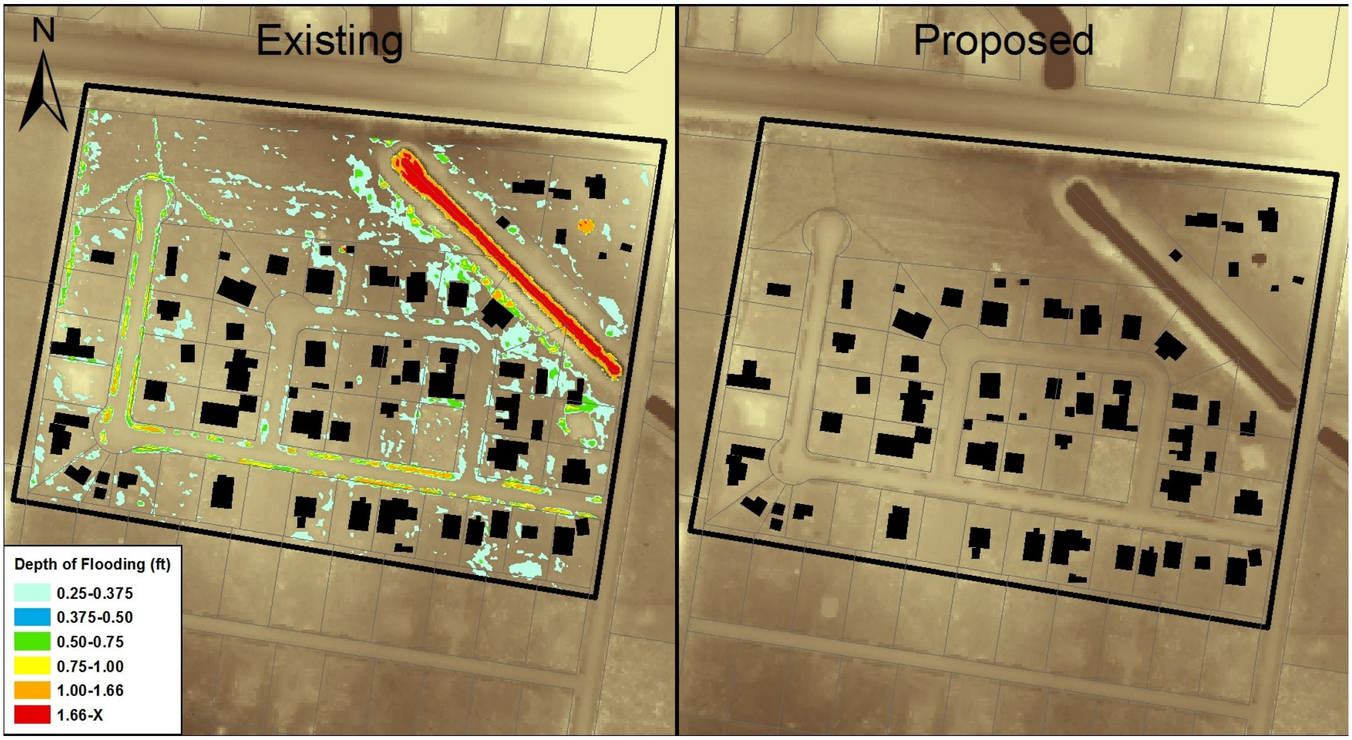


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	0	49
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

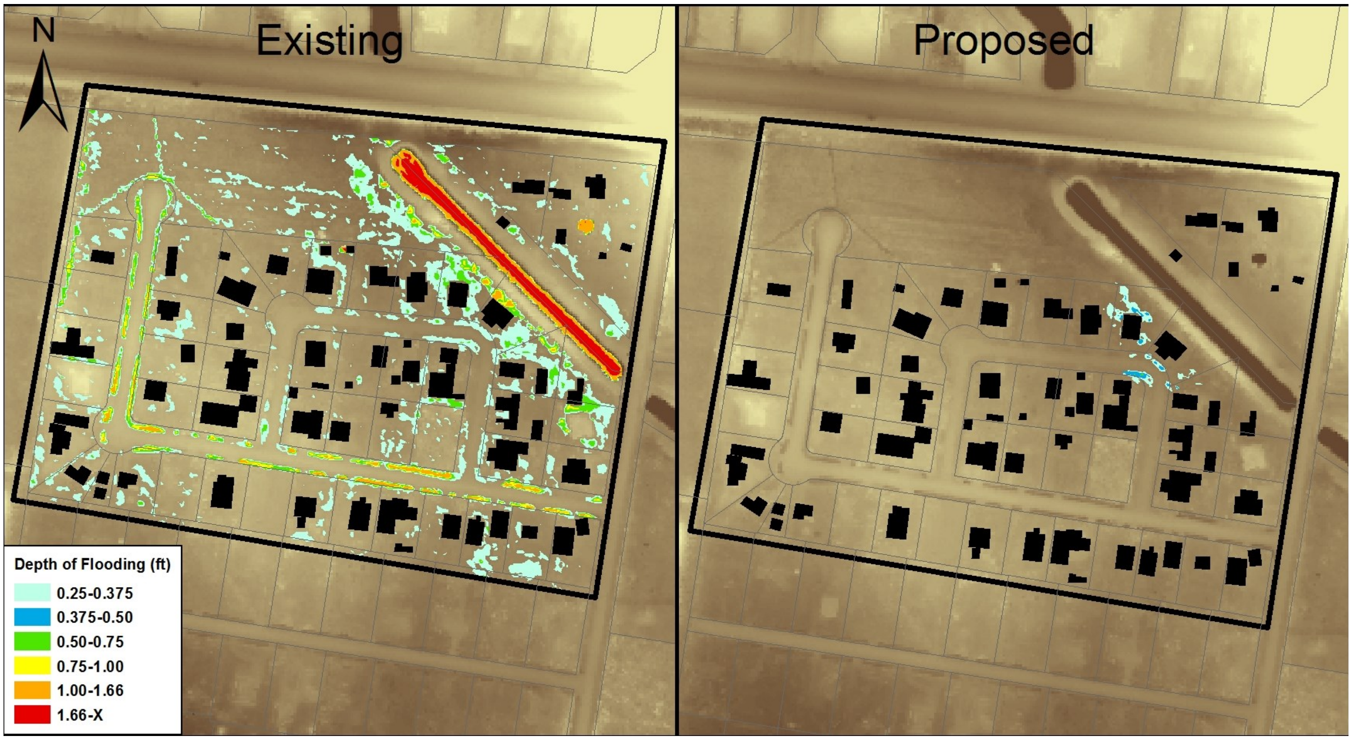


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	5	44
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

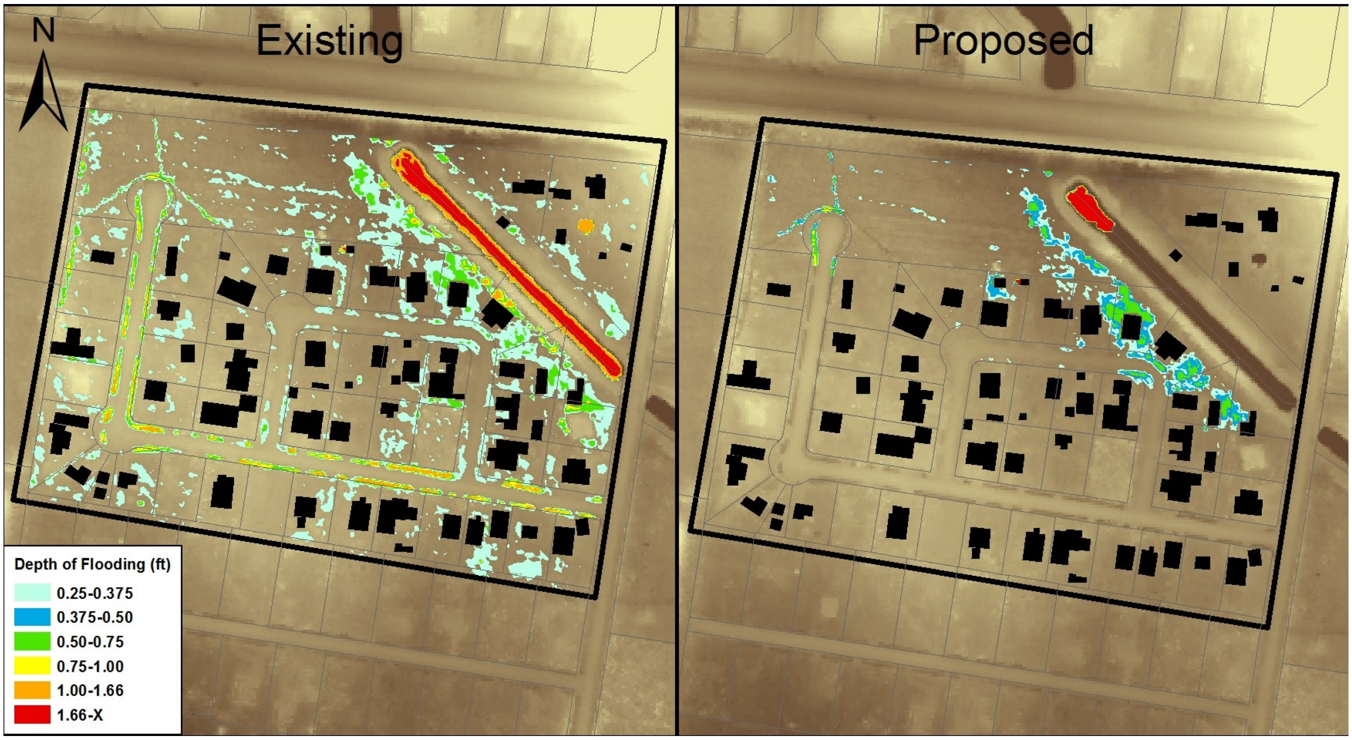


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	49	10	39
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Los Trevinos #4
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- LOS TREVINOS #4
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

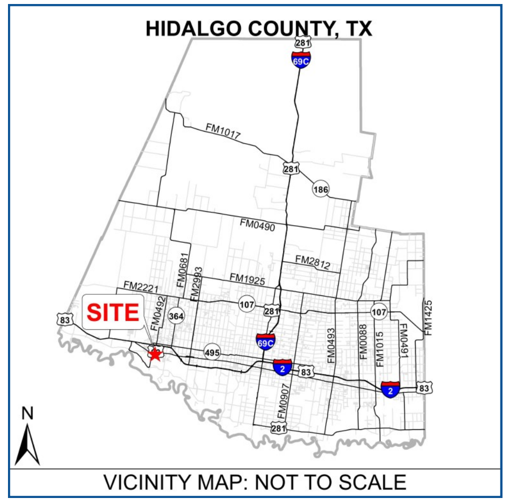
"Filling the Gap"

Colonia: Los Trevinos Subd. #5, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

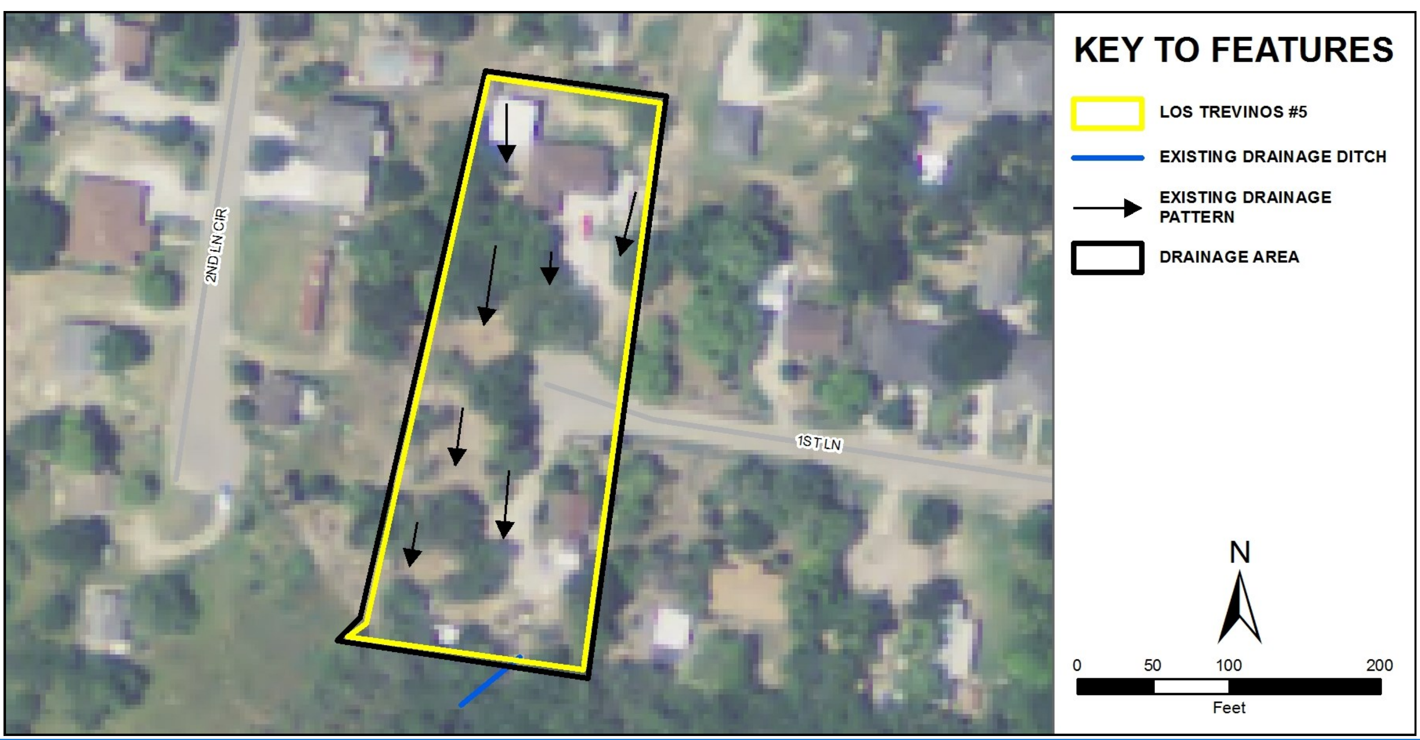
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Los Trevinos #5 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Los Trevinos #5 consists of two residential lots with an estimated area of 1.2 acres. The existing drainage pattern indicates runoff flows toward the existing drainage ditch located south of the colonia. The existing conditions 2D model results indicate that no structure is at high risk of flooding from a localized storm event. However, the model also indicates that the properties are at risk of flooding mostly due to the lots being low or having drainage obstructions. This colonia may experience flooding from localized events but should also be evaluated for risk of flooding due to regional storm events that may overflow the existing drain ditch into the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 15 inches, orange 15 to 18 inches, and red more than 18 inches.



Colonia: Los Trevinos Subd. #5, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install an underground drainage system to outfall into the existing drainage ditch.
  - Install roadside swales with culverts to convey runoff to Green Road.
  - Install roadside swales with culverts to convey runoff to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 314 linear feet of 18-inch diameter pipe, and 2 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 0.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
LOS TREVINOS #5		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$18,710.00
2	Drainage Improvements	$19,560.00
3	Pond Excavation Improvements	$10,779.94
	Sub-Total =	**$49,049.94**
	Engineering Fees (10%) =	**$4,904.99**
	Contingency (20%) =	**$9,809.99**
	Total =	**$63,764.93**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Los Trevinos Subd. #5, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$63,764.93	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Recommended Mitigation Project cont.:

Project Figures:

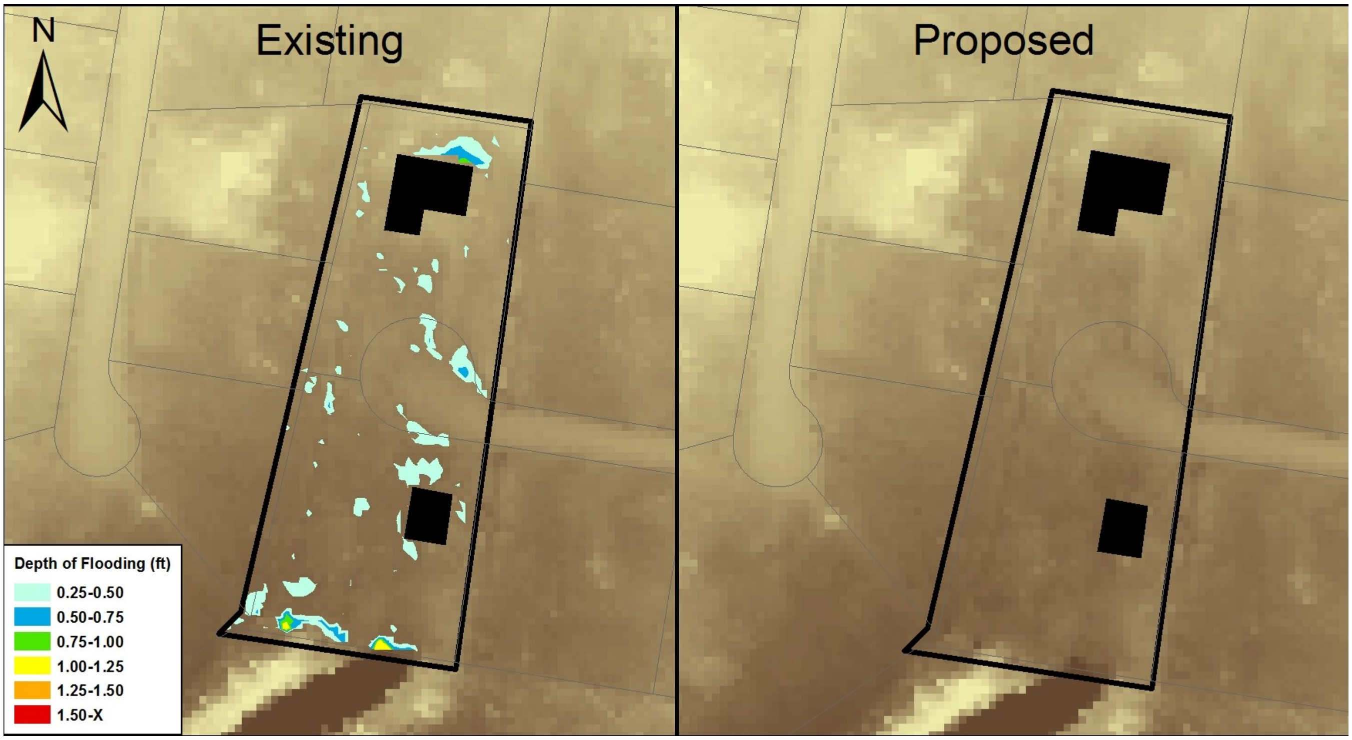


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	2	0	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

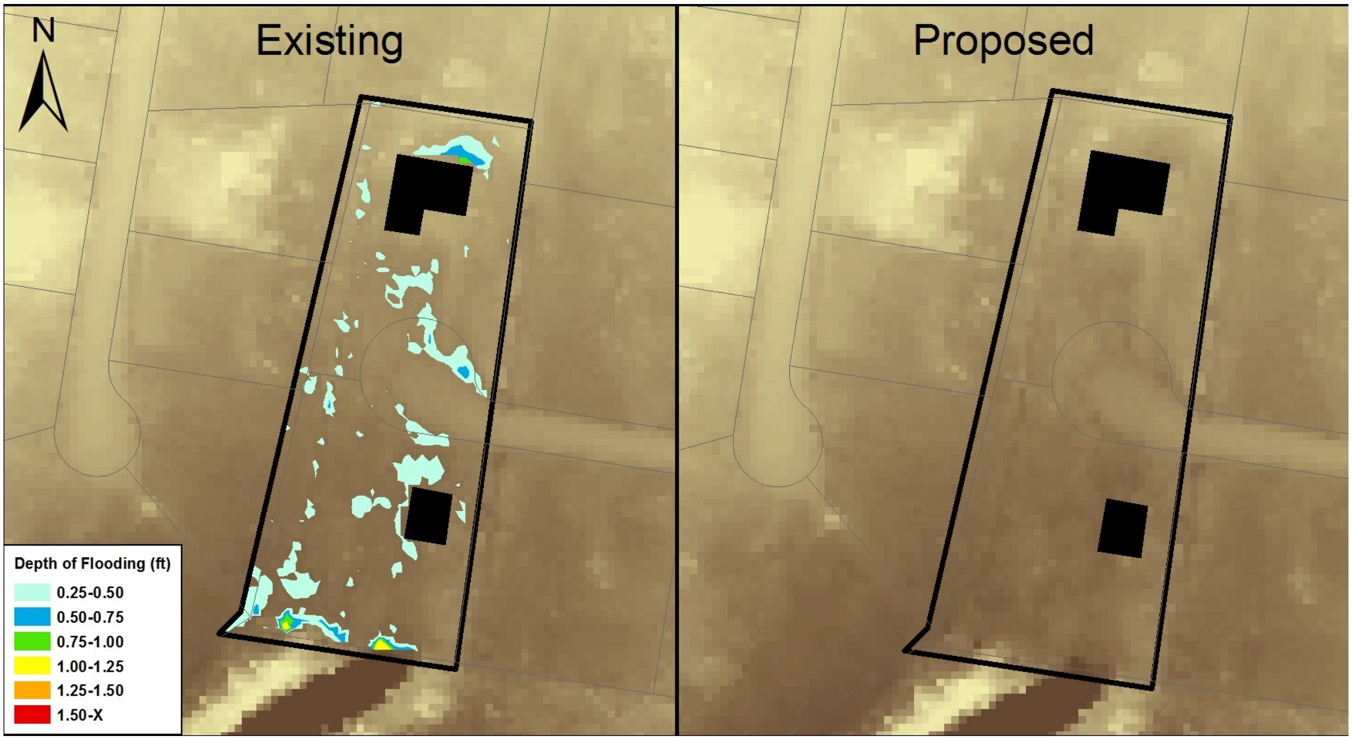


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	2	0	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

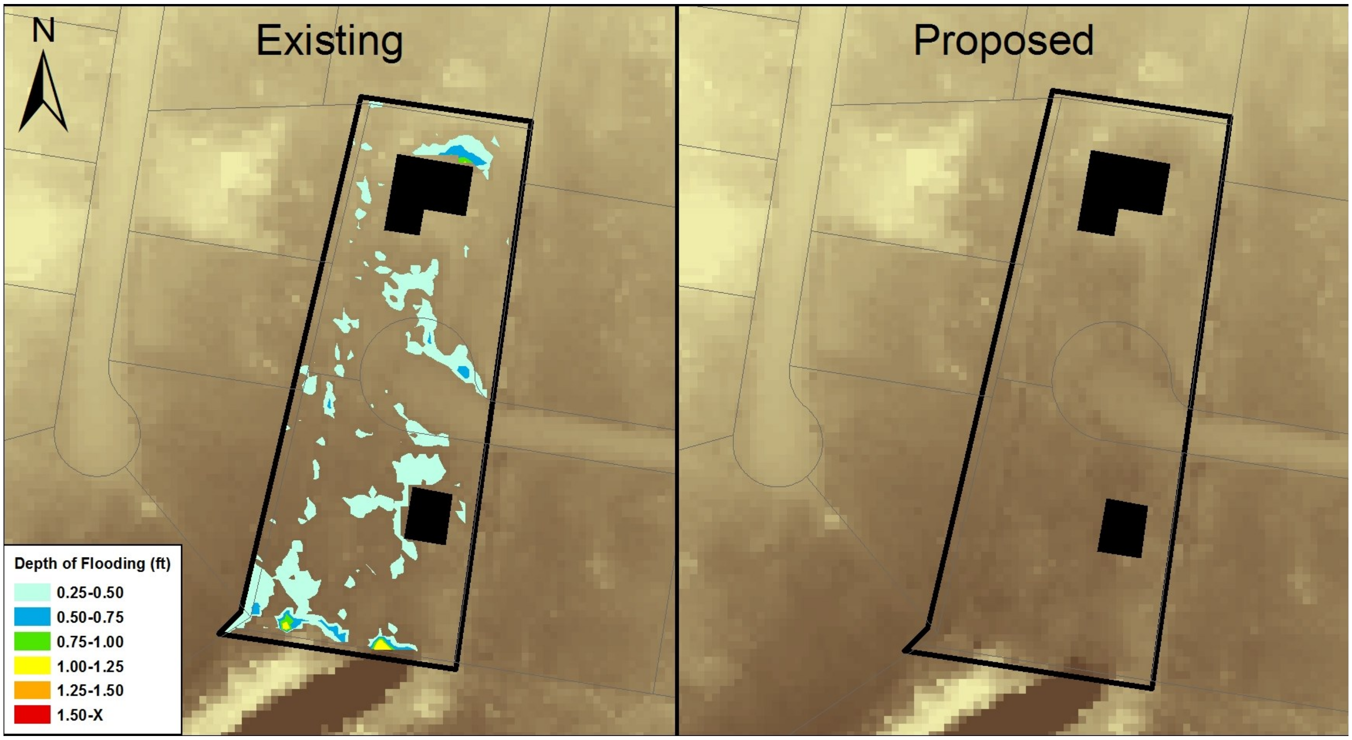


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	2	0	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

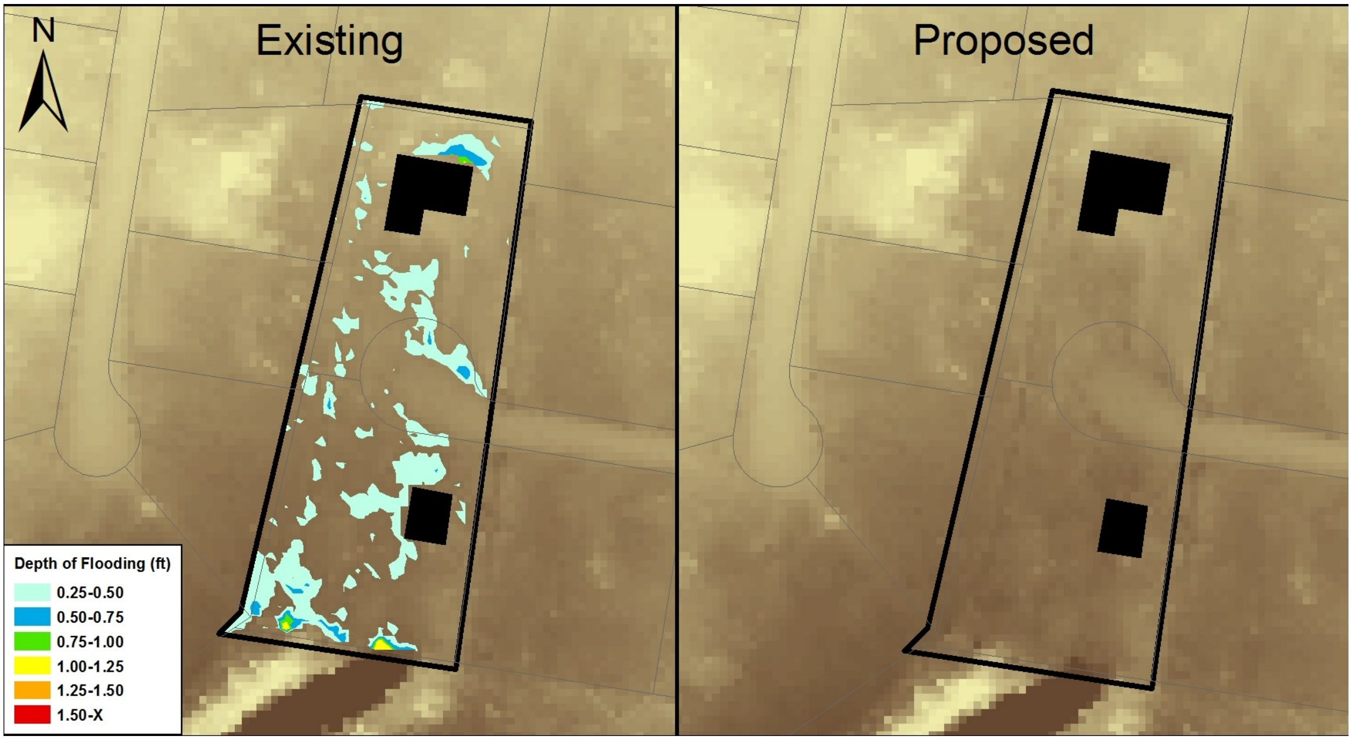


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	2	0	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Los Trevinos Subd. #5, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

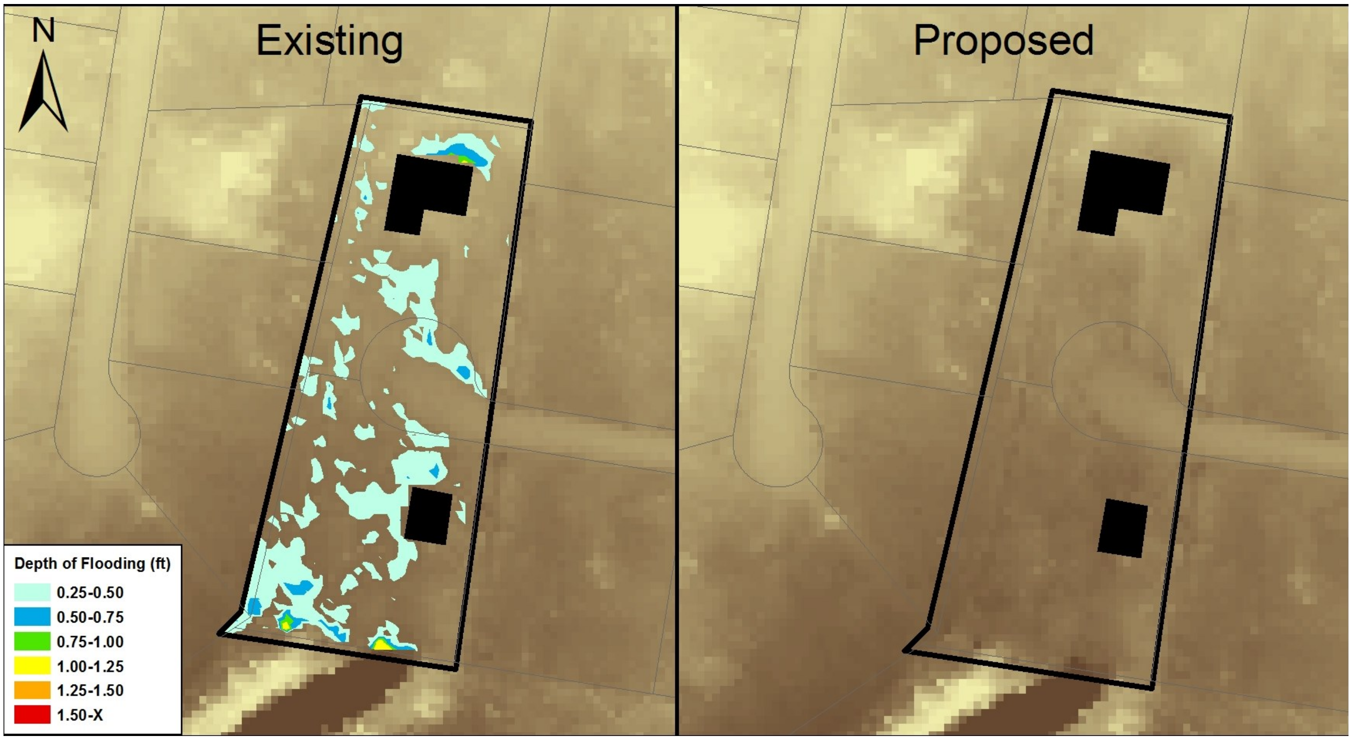
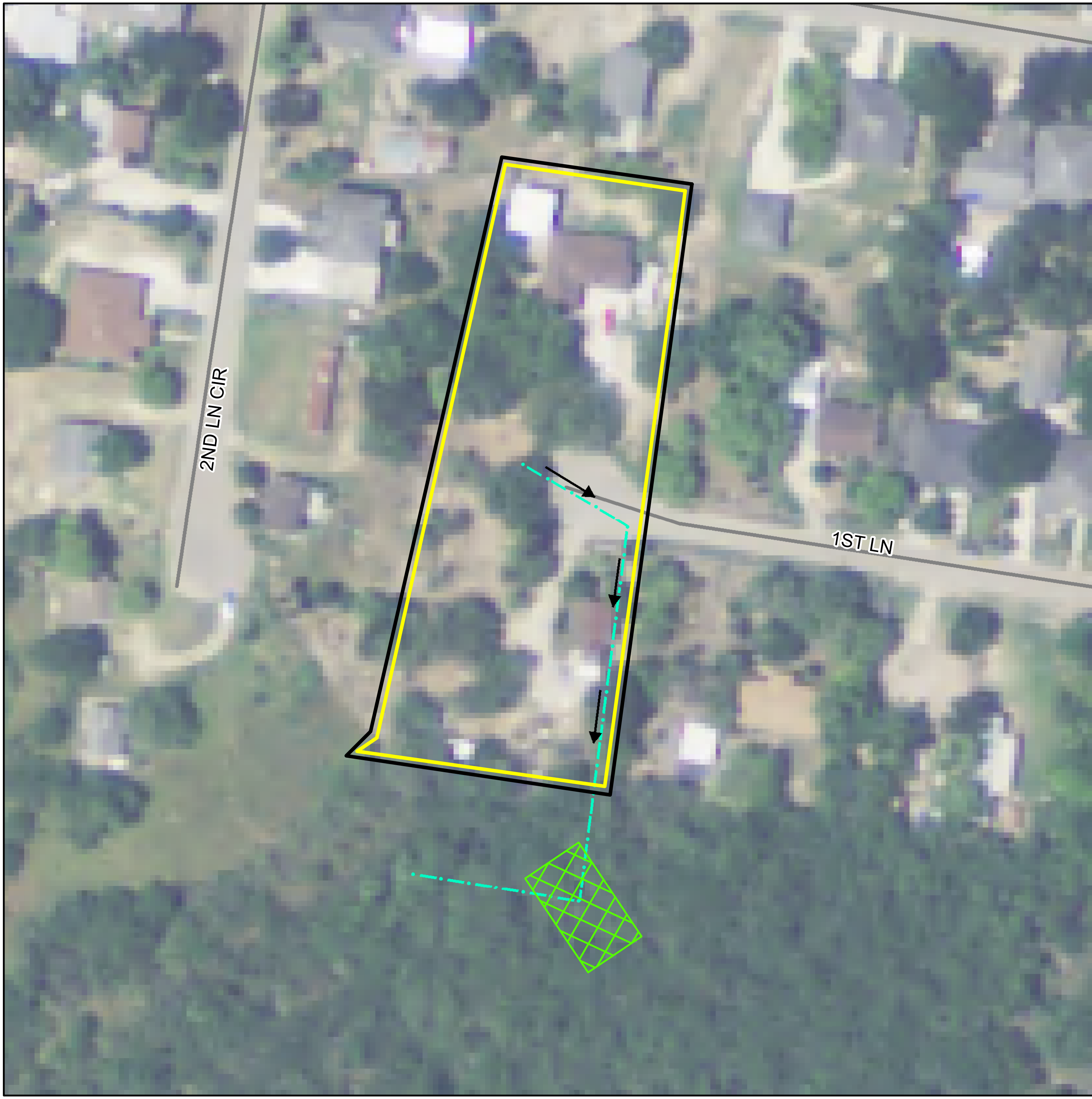


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	2	0	2
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

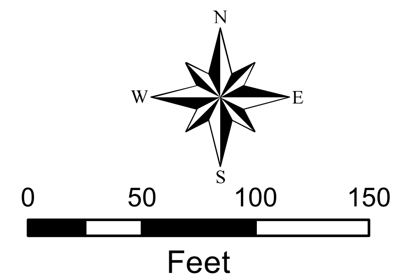
Colonia: Los Trevinos #5
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- LOS TREVINOS #5
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

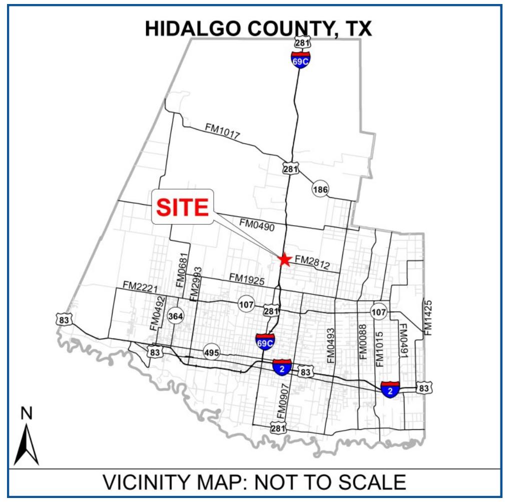
"Filling the Gap"

Colonia: North Santa Cruz Subd., Hidalgo County

Basin: North Main Drain

Category: A1

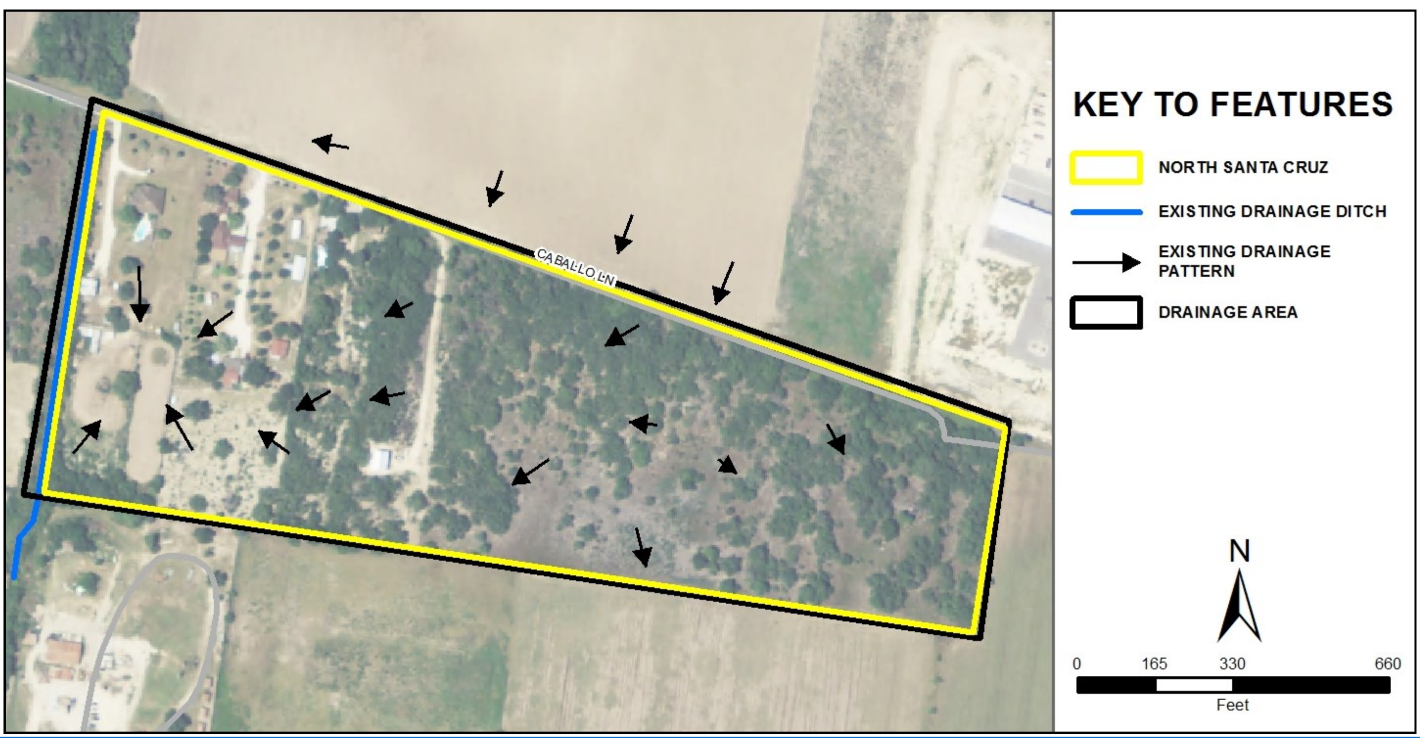
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia North Santa Cruz Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

North Santa Cruz Subd. consists of approximately 31 acres of partially developed residential land. Currently the colonia does not have a drainage system and it appears the entire colonia is within the 100-Year Floodplain. The existing conditions 2D model results indicate runoff flows from the east toward the west and south through the properties. The existing drainage ditch currently does not serve as an outfall for the colonia. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events. The Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: North Santa Cruz Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install roadside swales with culverts to provide some storage volume and convey runoff of the street.
    - Install swales to convey runoff to a retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The new system consists of a shallow retention facility sized to retain the onsite runoff of up to the 25-Year storm with an effective storage volume of 4.0 acre-feet. Runoff will flow into the retention pond via overland flow, however, swales may provide additional directional flow toward the retention pond.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
NORTH SANTA CRUZ SUBD.		
IMPROVEMENTS		**COST**
1	Paving Improvements	$0.00
2	Drainage Improvements	$0.00
3	Pond Excavation Improvements	$120,189.20
	Sub-Total =	**$120,189.20**
	Engineering Fees (10%) =	**$12,018.92**
	Contingency (20%) =	**$24,037.84**
	Total =	**$156,245.96**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: North Santa Cruz Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	N/A	$156,245.96	N/A
Elevate Structures	N/A	N/A	N/A
Acquisition/Supplemental Housing / Demolition	N/A	N/A	N/A

Colonia: North Santa Cruz Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

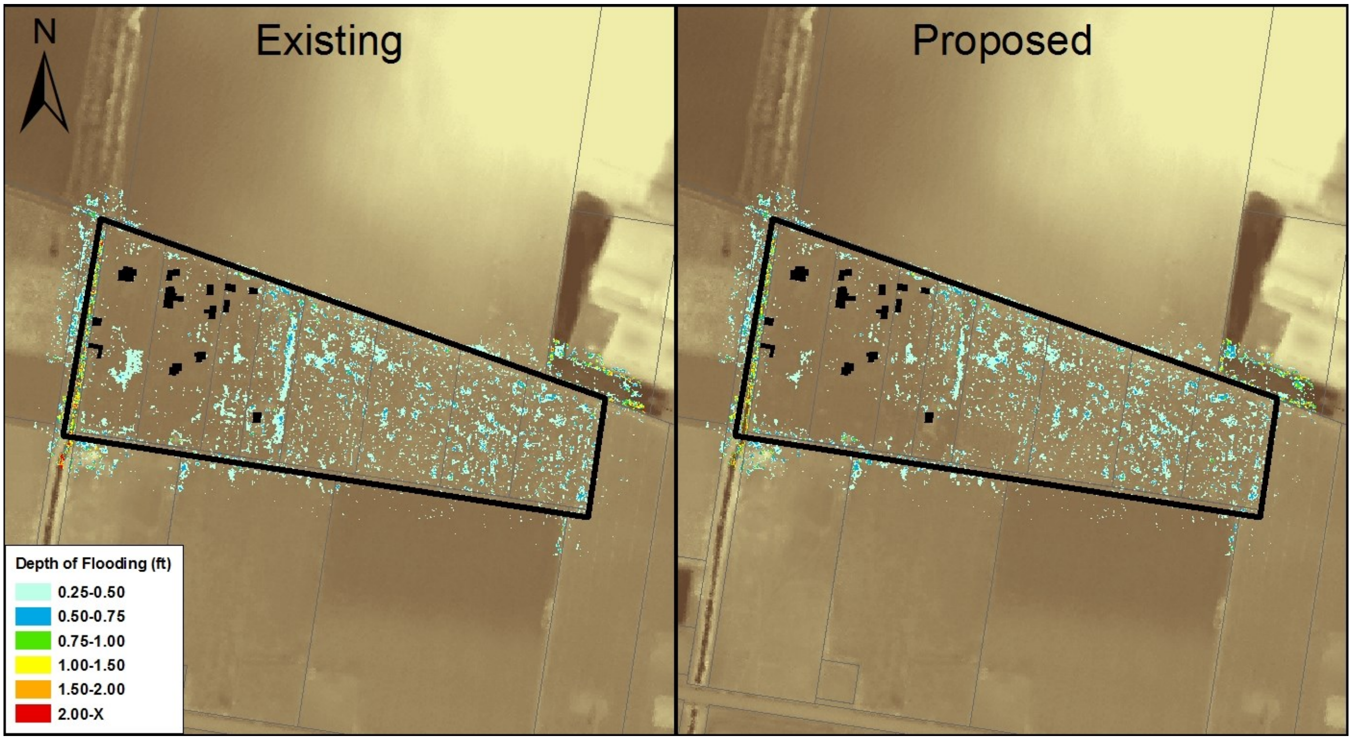


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	8	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: North Santa Cruz Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

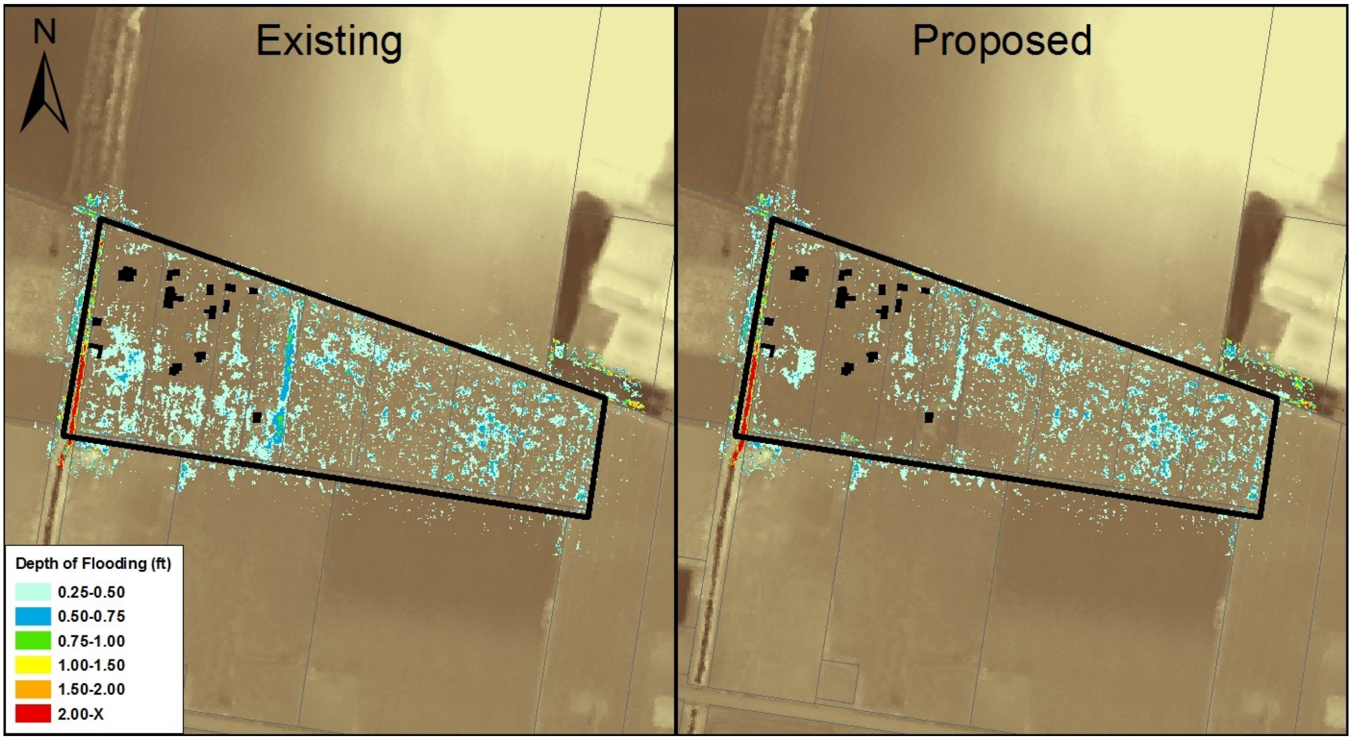


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	8	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

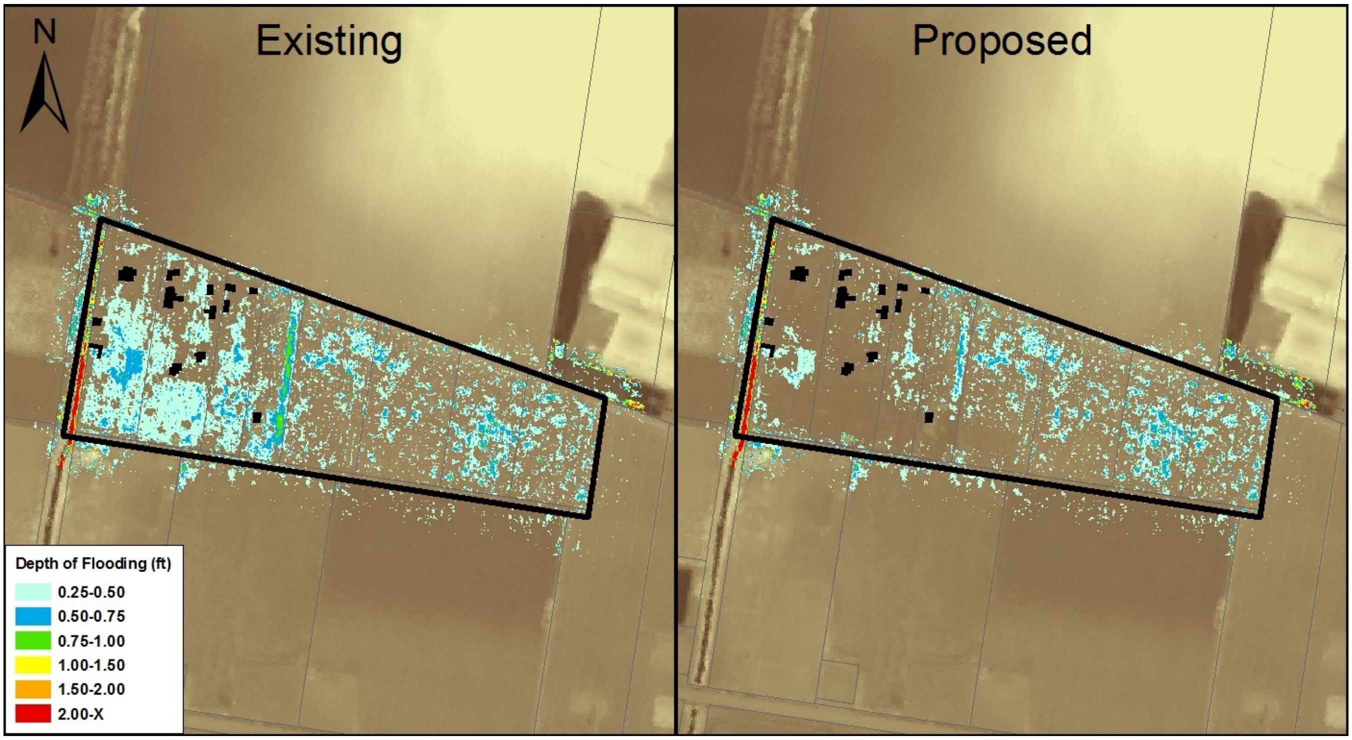


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	8	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: North Santa Cruz Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

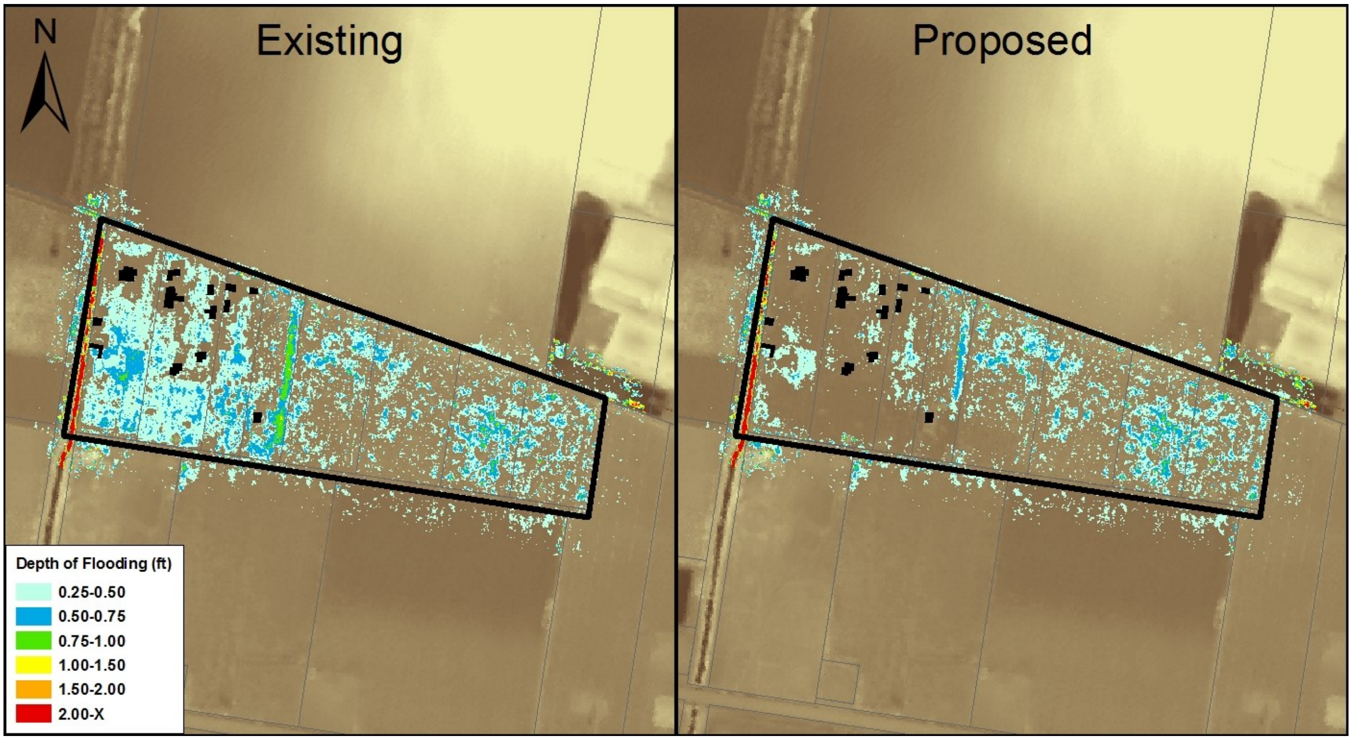


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	8	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: North Santa Cruz Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

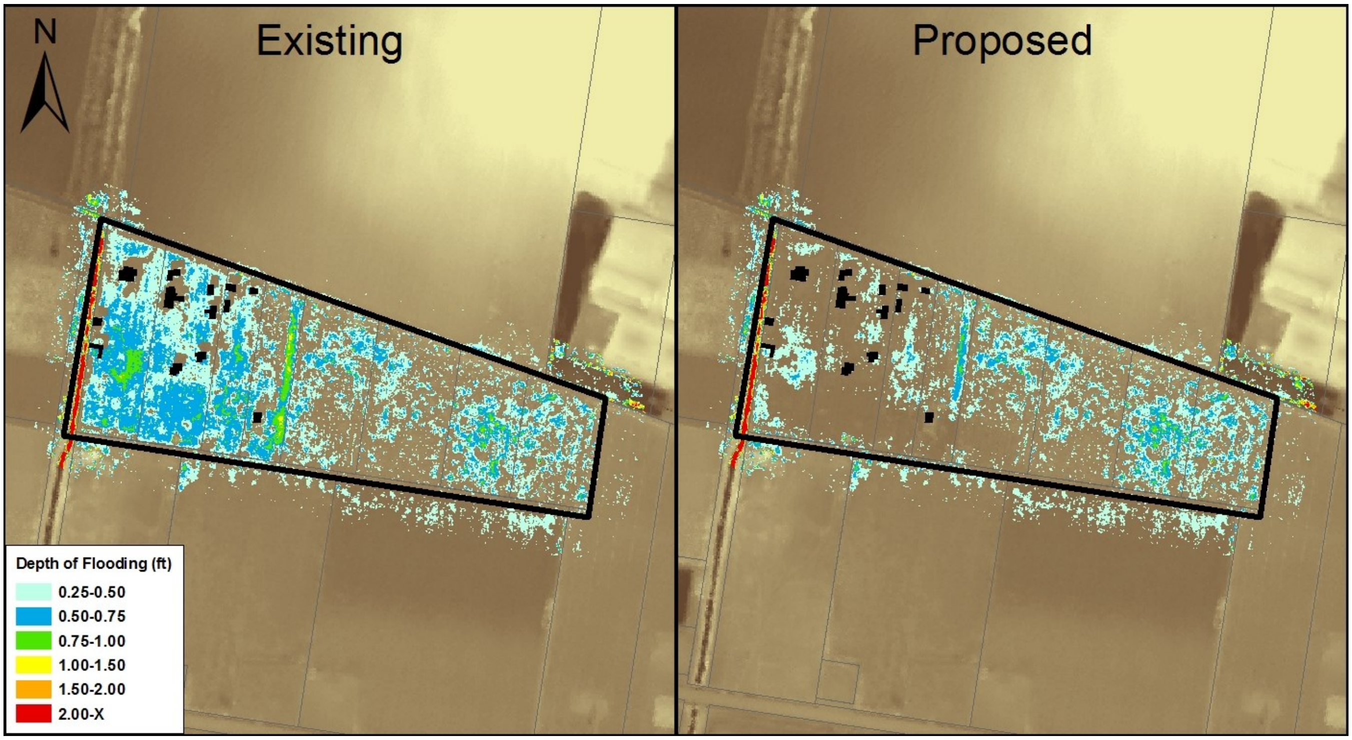
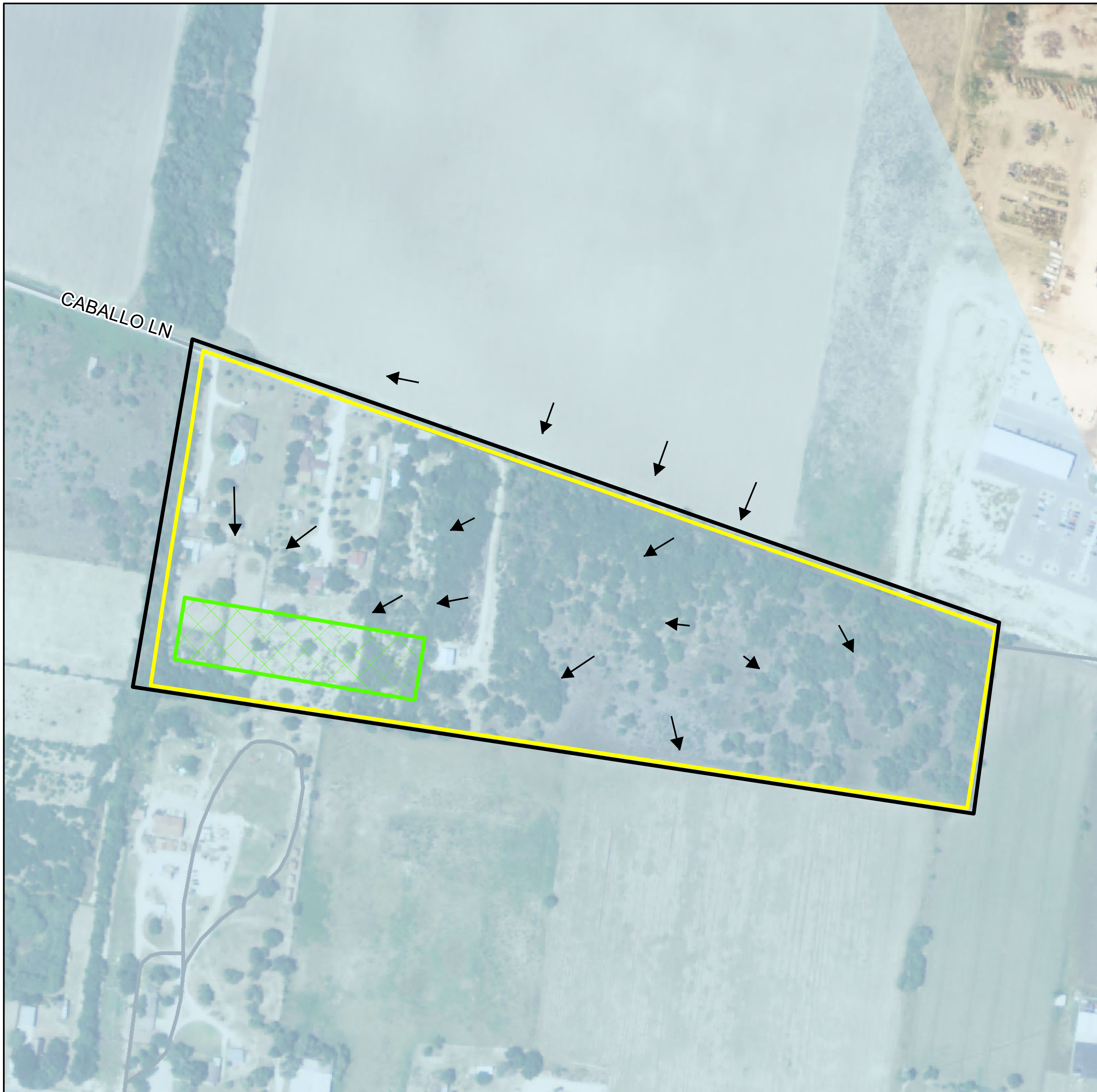


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	8	8	0
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

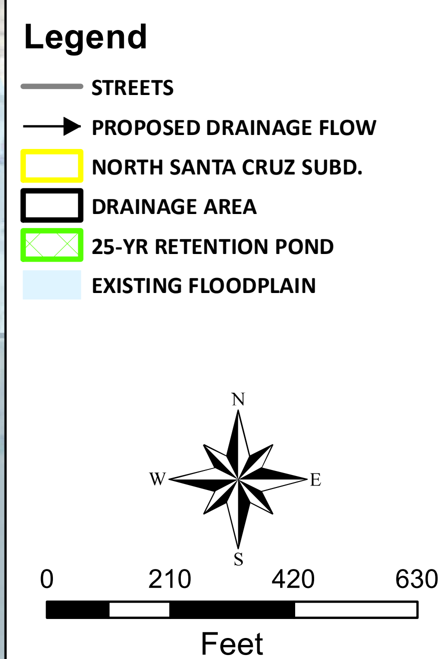


Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: North Santa Cruz Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

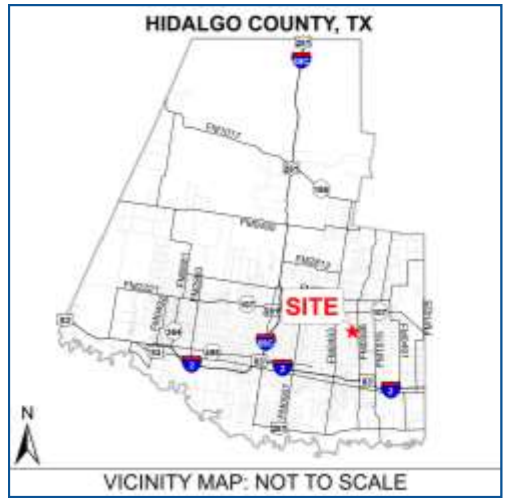
"Filling the Gap"

Colonia: Olivarez No. 10, Hidalgo County

Basin: North Floodway

Category: A1

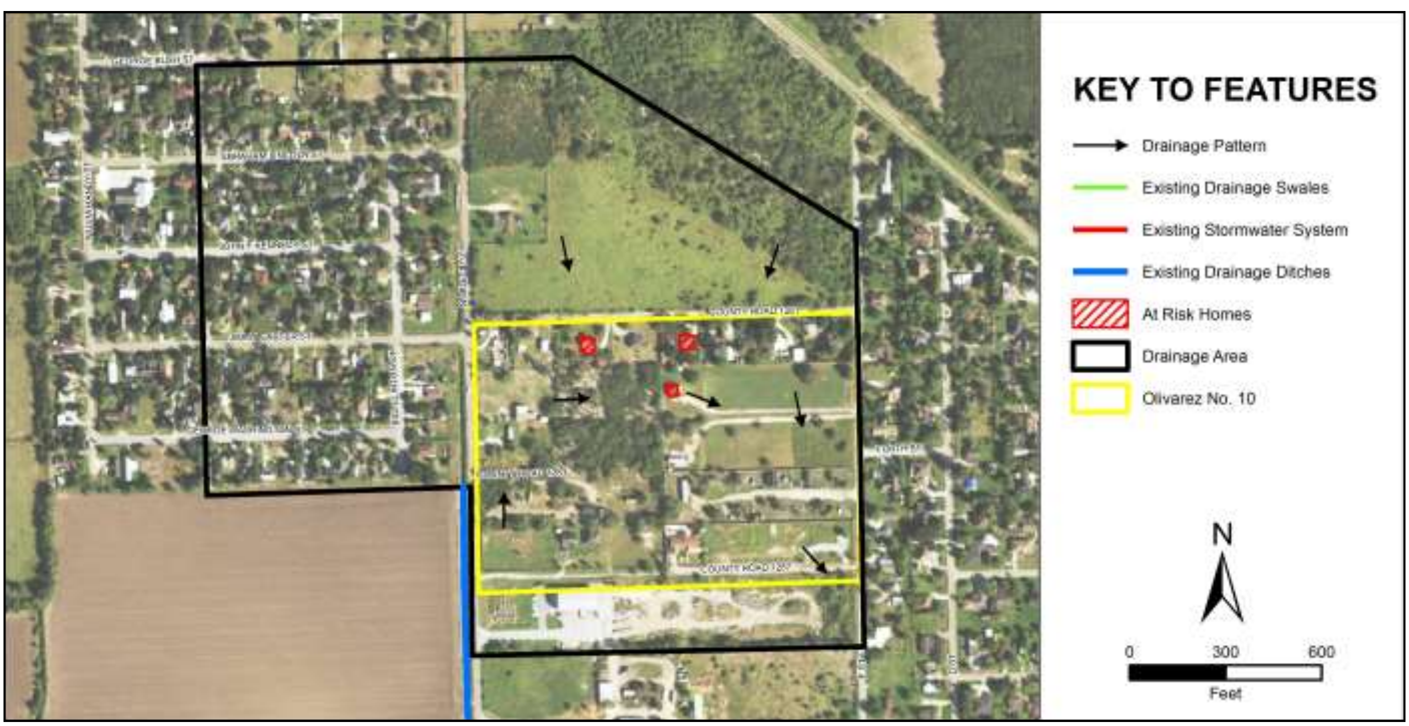
Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the Olivarez No. 10 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 23-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Olivarez No. 10 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Olivarez No. 10, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install roadside swales
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 44 linear feet of 18-inch diameter pipe, 250 linear feet of 24-inch diameter pipe, 167 linear feet of 36-inch diameter, 2,200 linear feet of grassy swale, 1,415 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 11.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Olivarez No. 10 Colonia

	IMPROVEMENTS		COST
1	PAVING IMPROVEMENTS	$	3,716.67
2	DRAINAGE IMPROVEMENTS	$	61,565.00
3	POND EXCAVATION IMPROVEMENTS	$	306,130.00
	Sub-Total =	$	371,411.67
	Engineering (10%)	$	37,141.17
	Contingency (20%)	$	74,282.33
	Total =	$	482,835.17

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2.3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Olivarez No. 10, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	3	0	3
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$710,559	$482,835	1.47
Elevate Structures	$710,559	$390,600	1.82
Acquisition/Supplemental Housing/Demolition	$914,535	$487,775	1.87

Colonia: Olivarez No. 10, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

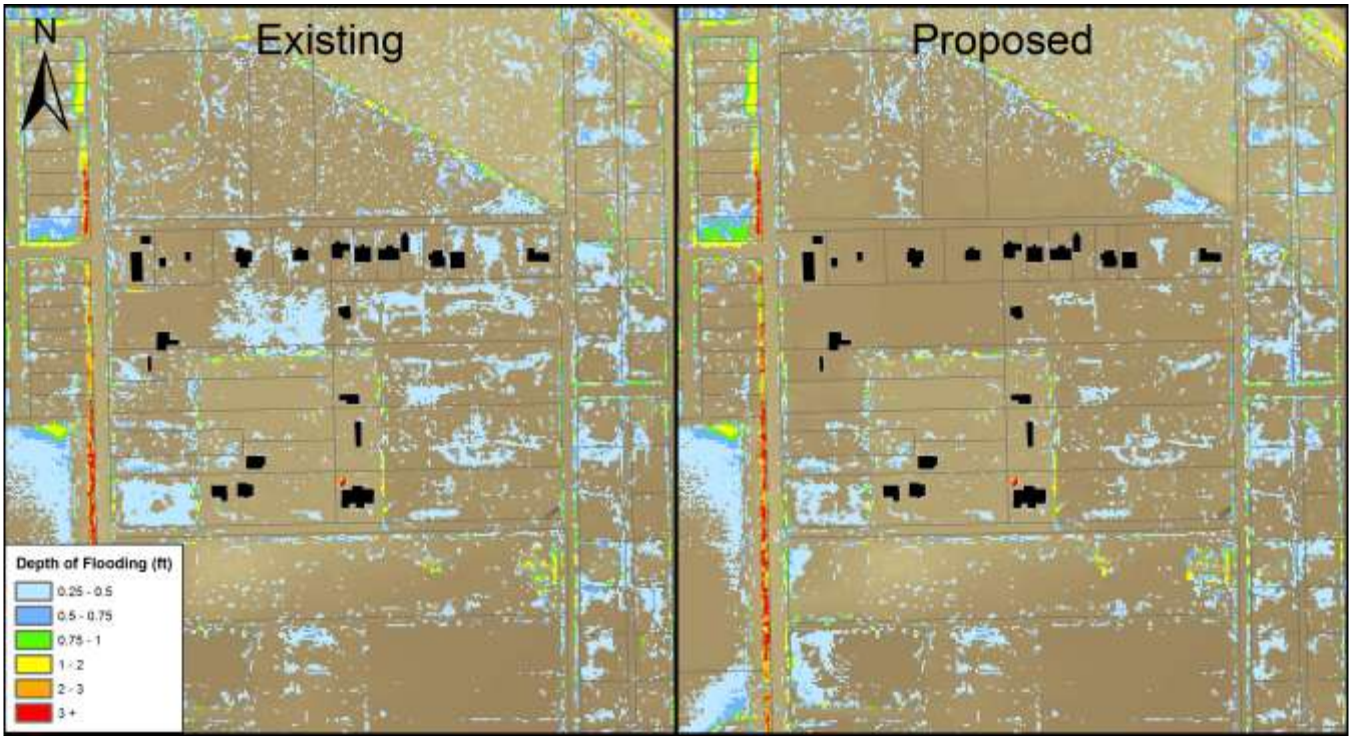


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	21	18	3
Inundated Roadway (LF)	130	110	20

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 10, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

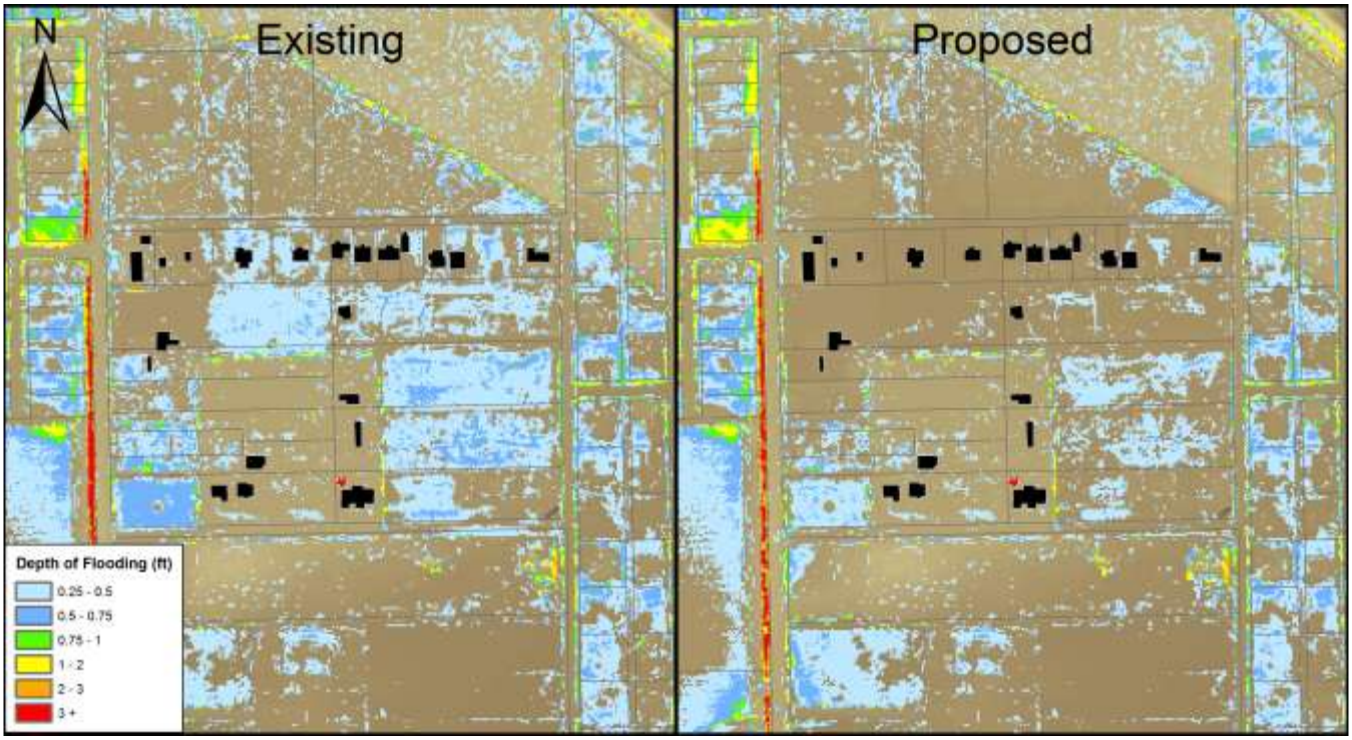


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	21	21	0
Inundated Roadway (LF)	485	155	330

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 10, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

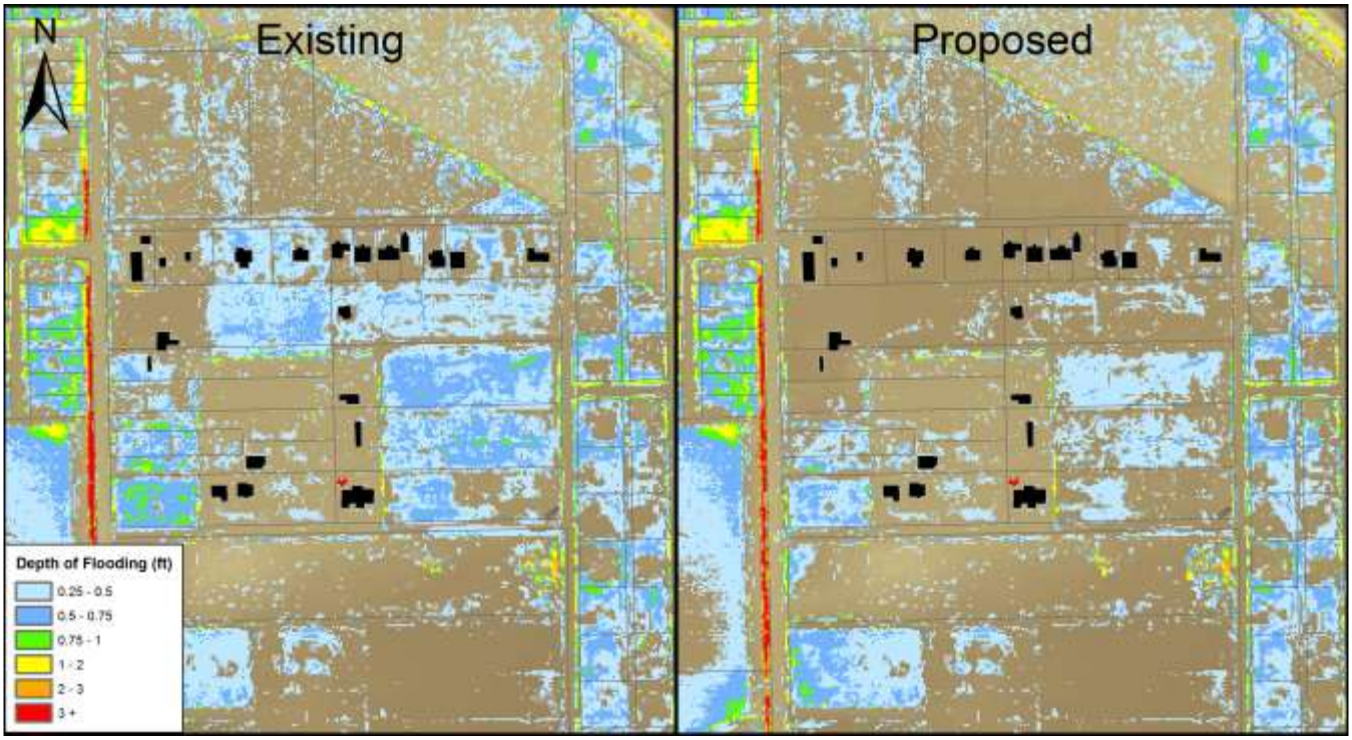


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	21	21	0
Inundated Roadway (LF)	845	285	560

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 10, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

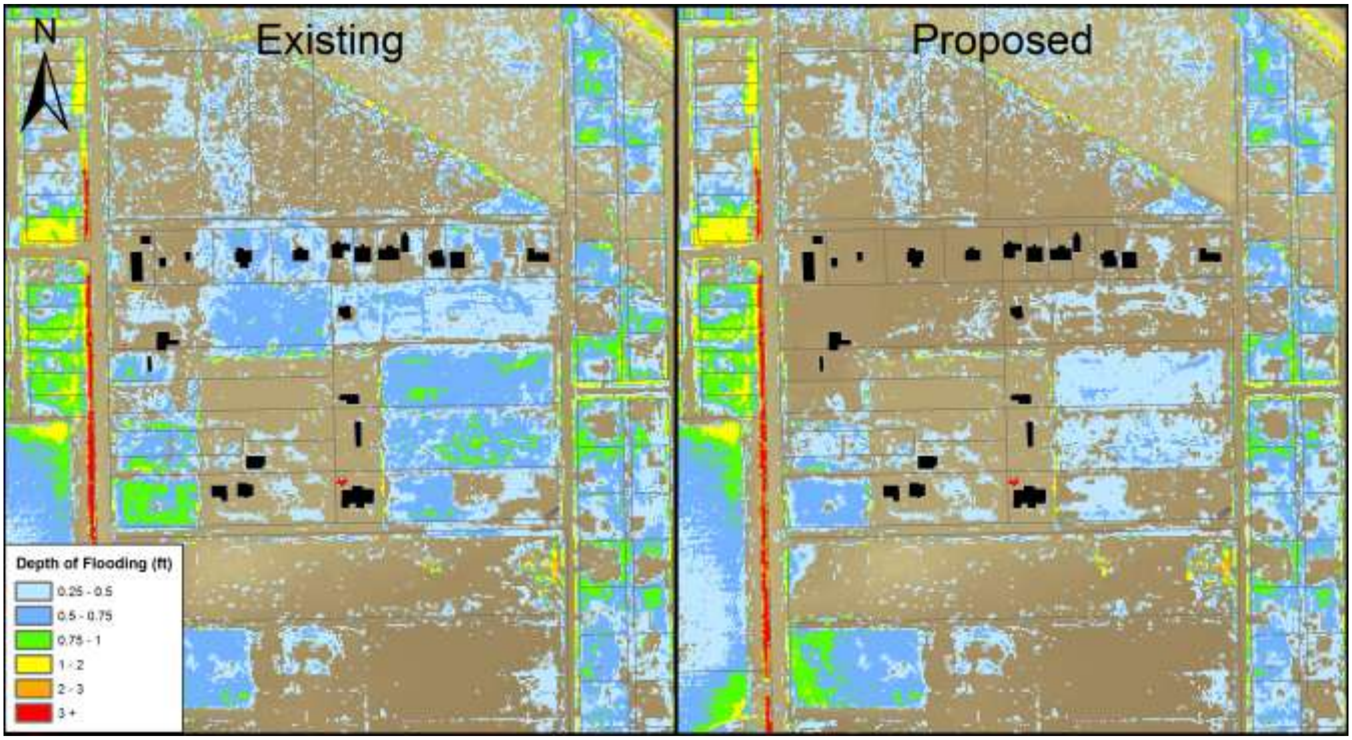


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	21	21	0
Inundated Roadway (LF)	1135	620	515

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figures:

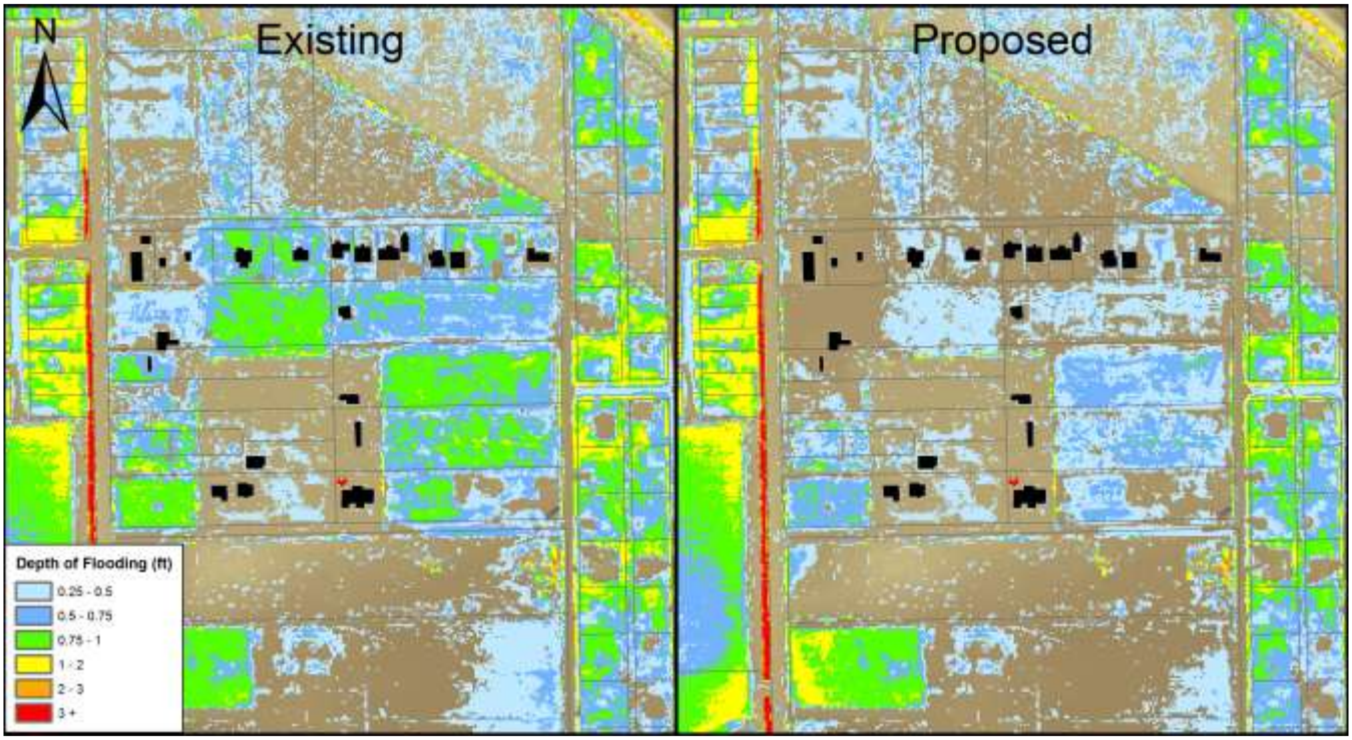


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	21	21	0
Inundated Roadway (LF)	1645	865	780

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Olivarez No.10
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Olivarez No. 10
- Drainage Area

N

0 75 150 300
Feet

"Filling the Gap"

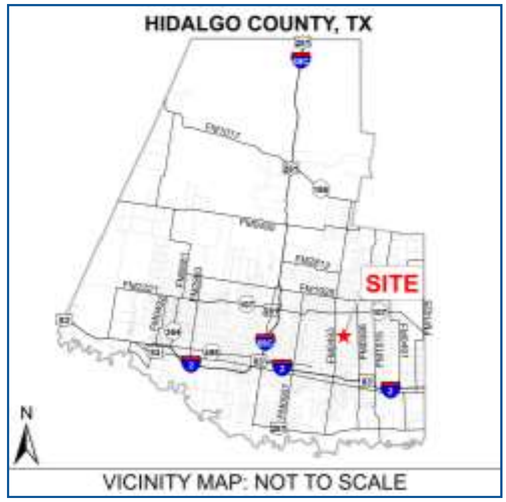
Colonia: Olivarez No. 6, Hidalgo County

Basin: North Floodway

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Olivarez No. 3 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 19-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Olivarez No. 6 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Olivarez No. 6, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install an area inlet
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 835 linear feet of 36-inch diameter pipe, 1,200 linear feet of grassy swale, 2,930 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 27.0 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Olivarez No. 6 Colonia		
	IMPROVEMENTS	COST	
1	PAVING IMPROVEMENTS	$	9,133.33
2	DRAINAGE IMPROVEMENTS	$	127,845.00
3	POND EXCAVATION IMPROVEMENTS	$	704,220.00
	Sub-Total =	$	841,198.33
	Engineering (10%)	$	84,119.83
	Contingency (20%)	$	168,239.67
	Total =	$	1,093,557.83
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4.2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	7	2	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,930,704	$1,093,558	1.77
Elevate Structures	$1,930,704	$1,120,500	1.72
Acquisition/Supplemental Housing/Demolition	$2,020,158	$1,021,260	1.98

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

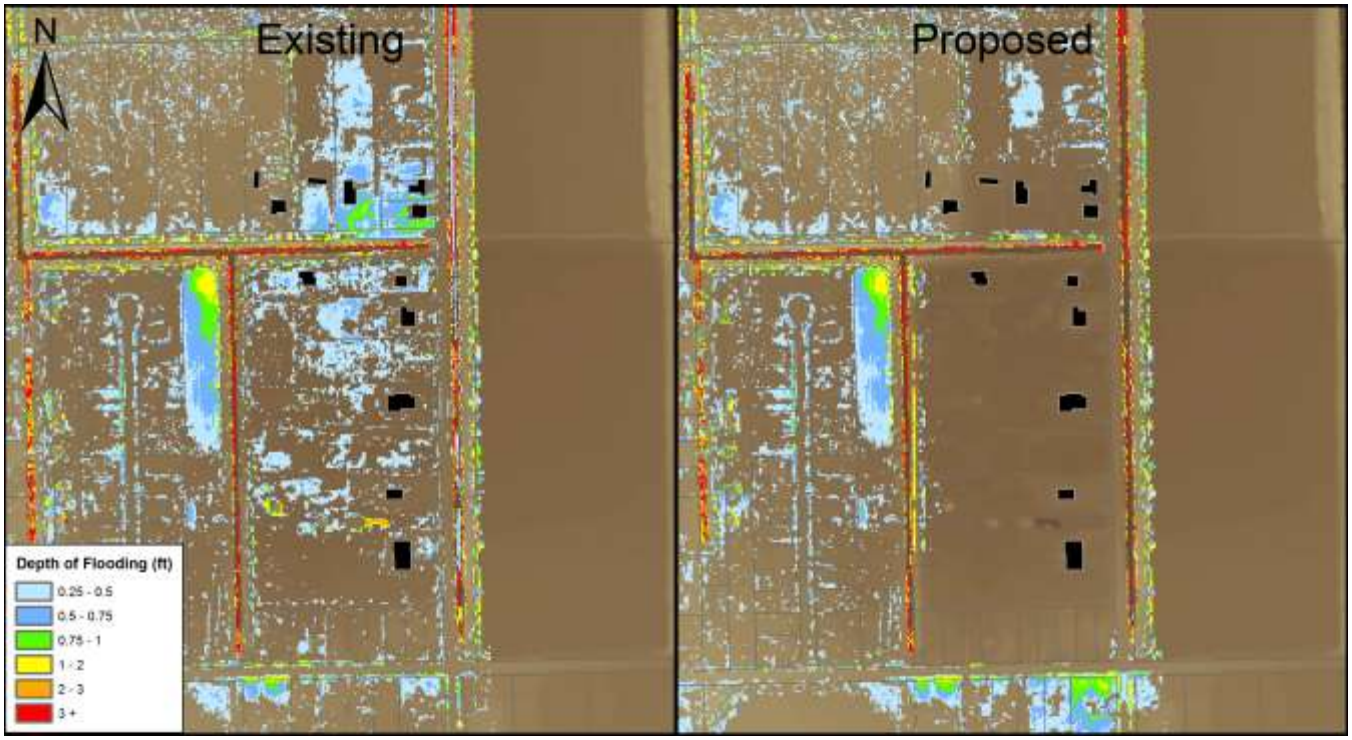


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	13	12	1
Inundated Roadway (LF)	410	205	205

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

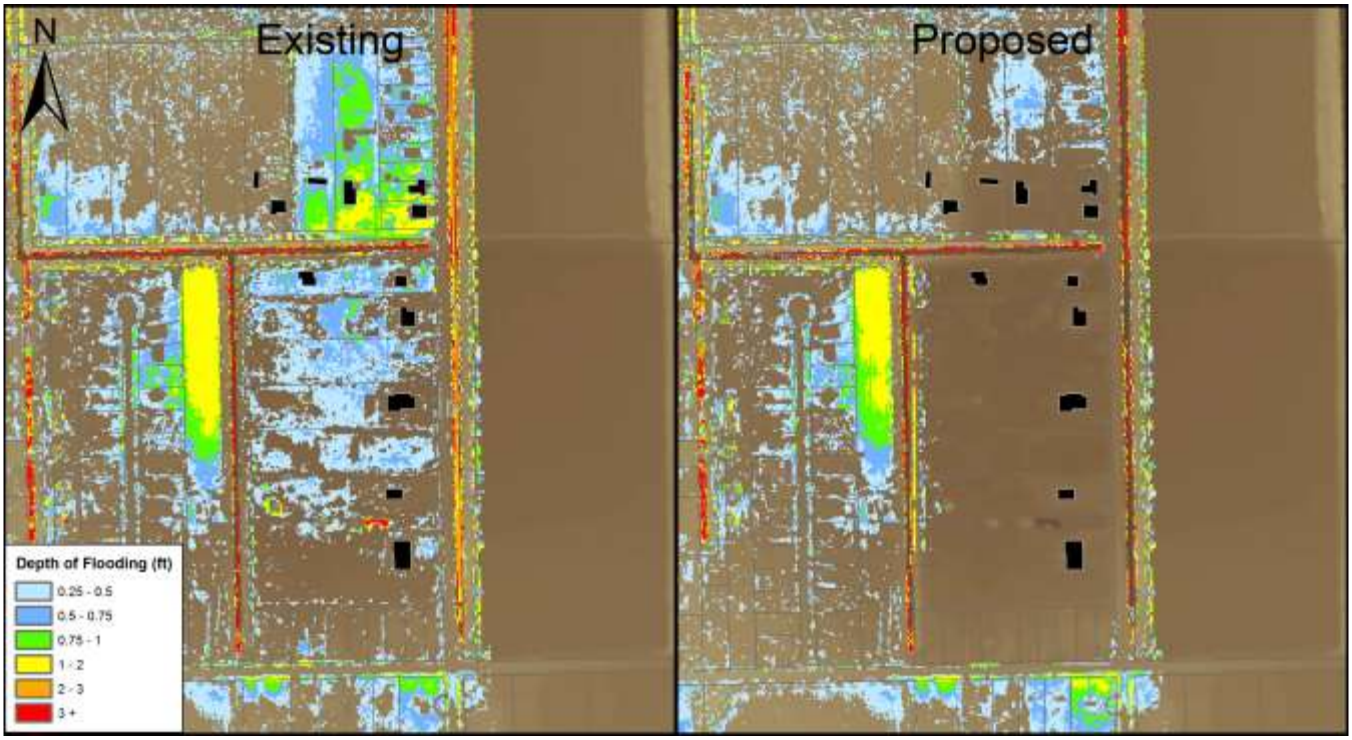


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	13	12	1
Inundated Roadway (LF)	520	310	210

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

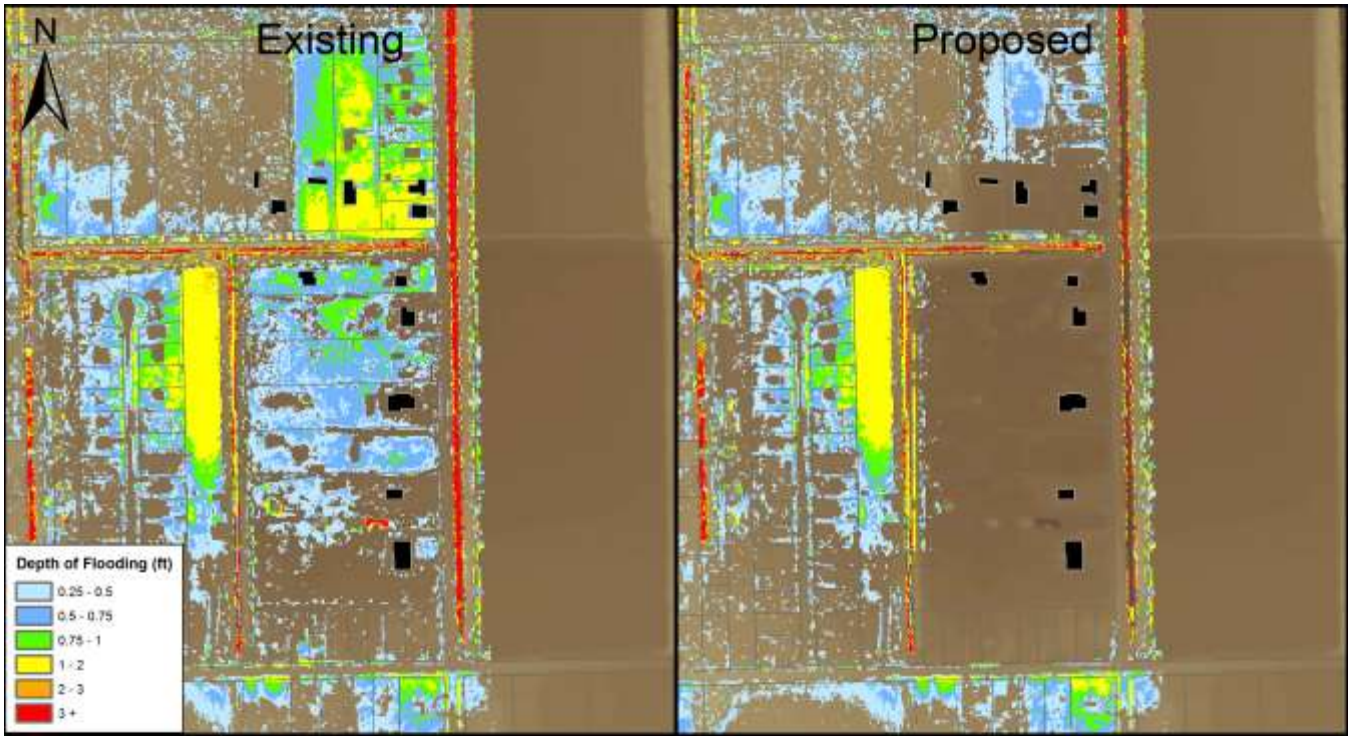


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	13	12	1
Inundated Roadway (LF)	540	140	400

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

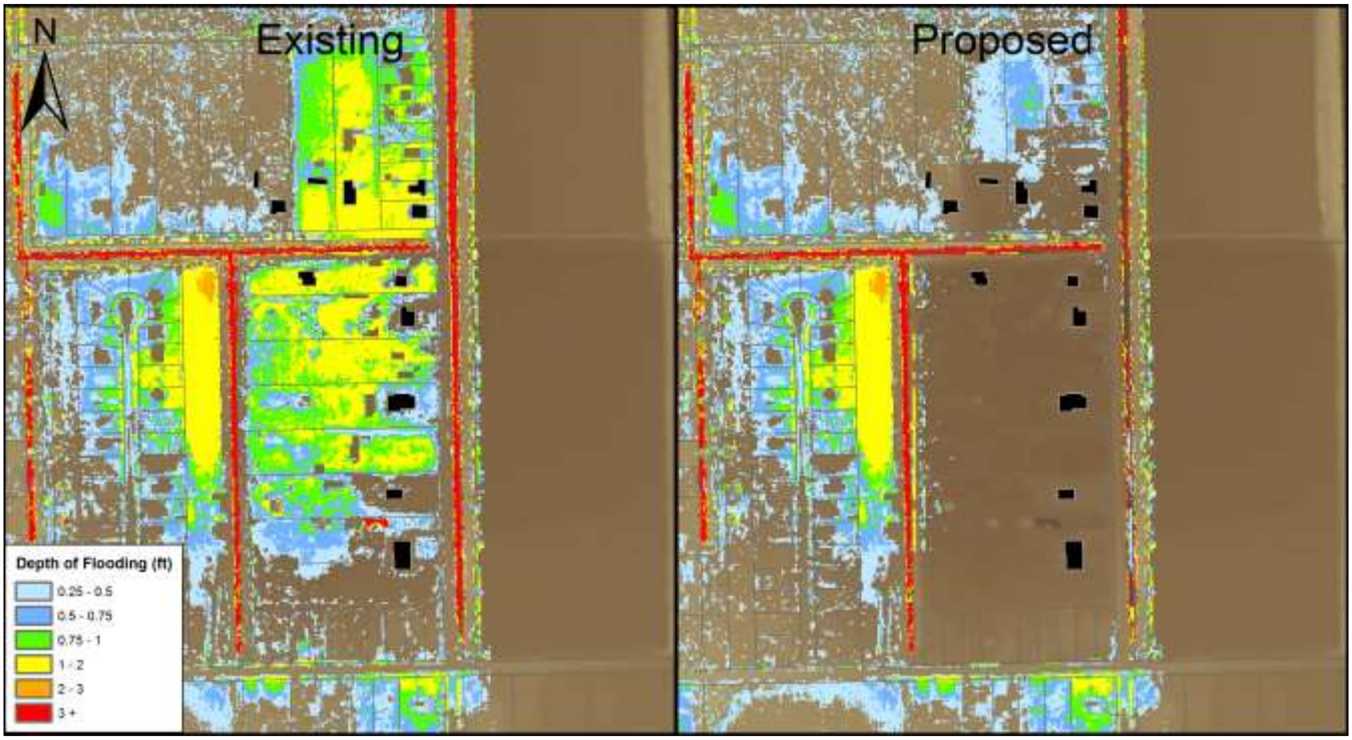


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	13	12	1
Inundated Roadway (LF)	670	190	480

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 6, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

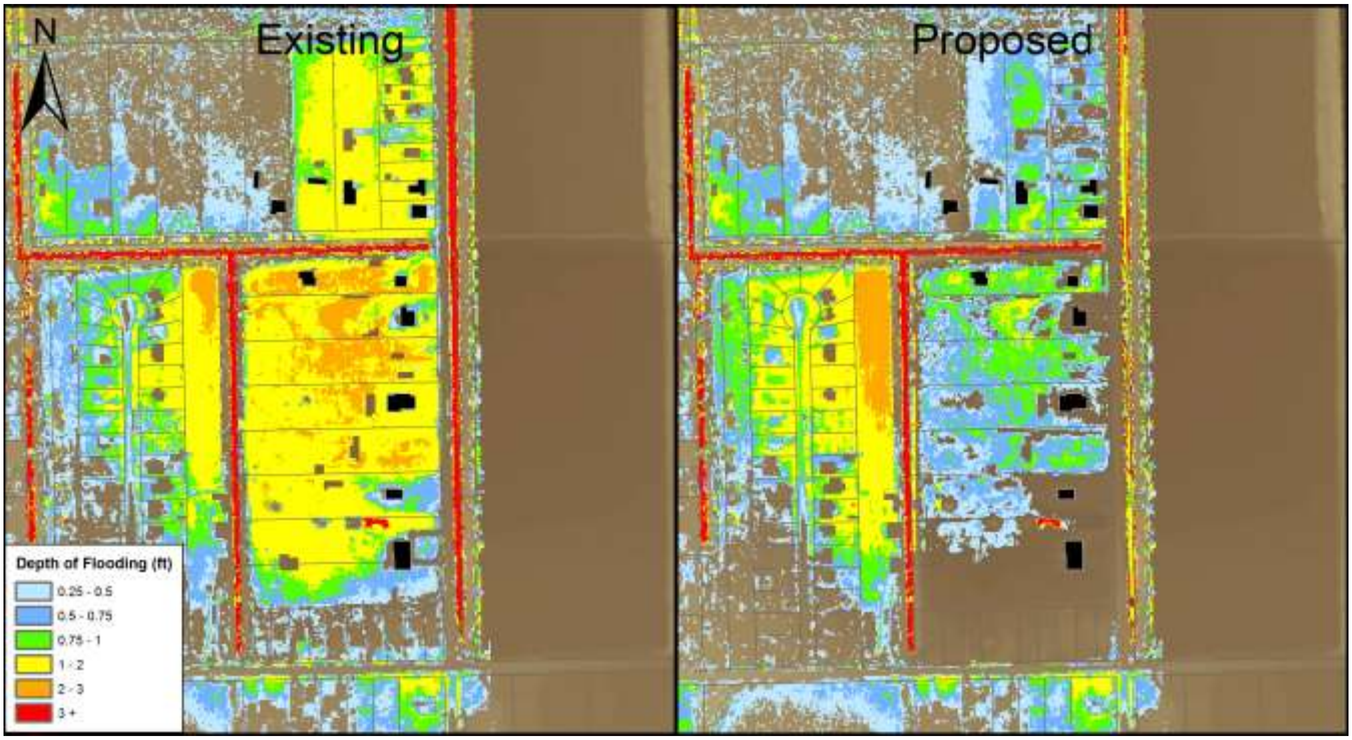


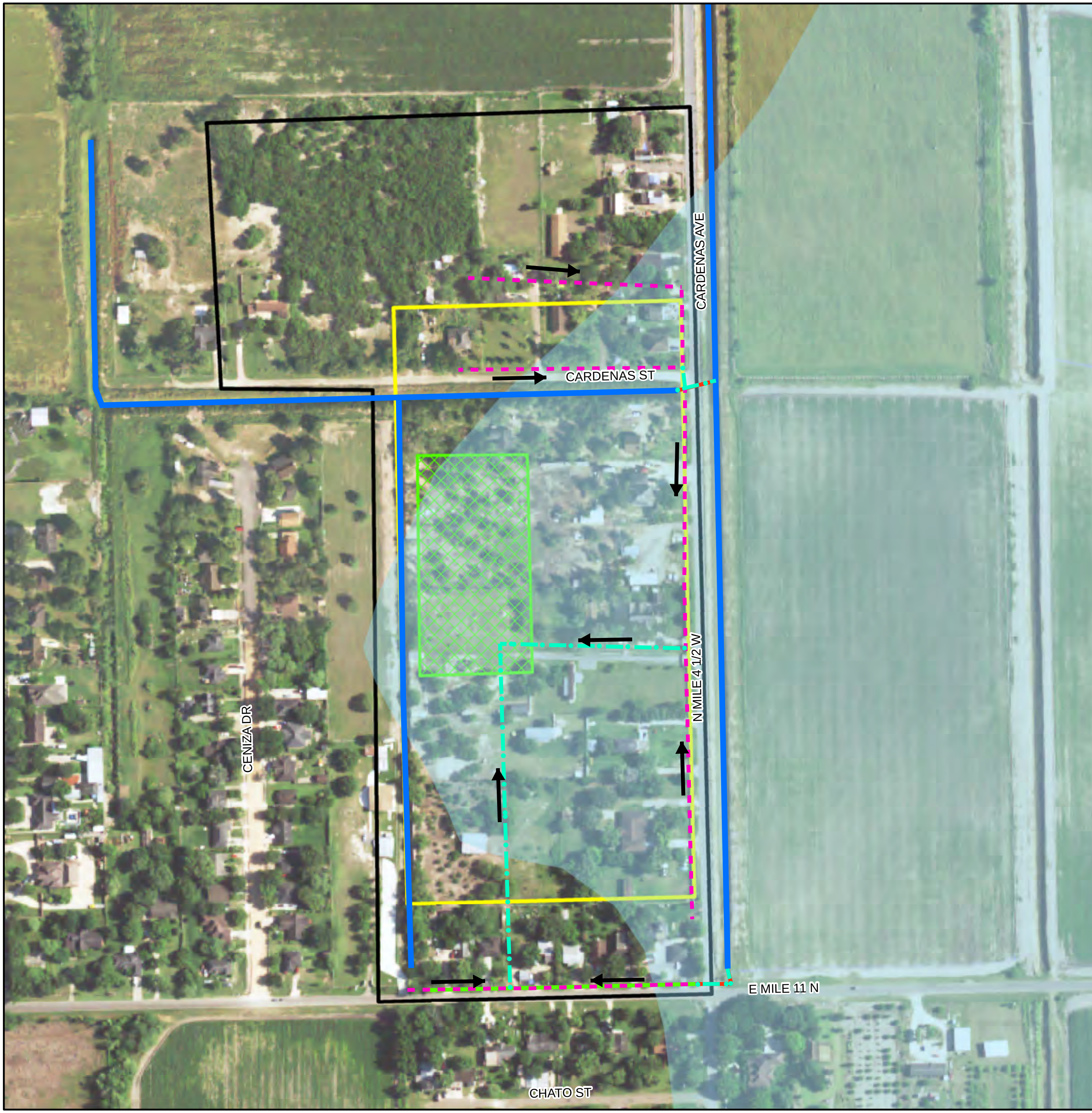
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	2	5
Inundated Lots	13	12	1
Inundated Roadway (LF)	670	390	280

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Olivarez No.6
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Olivarez No. 6
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

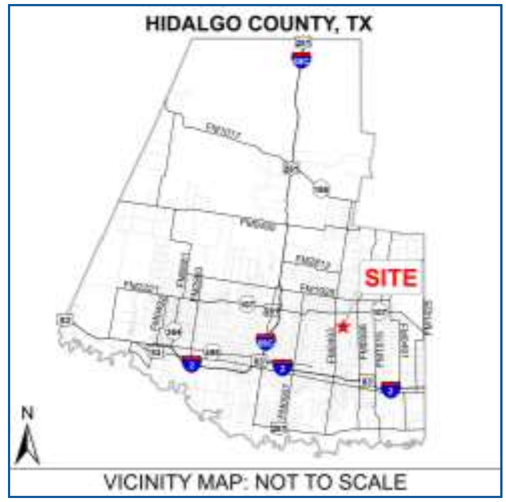
Colonia: Olivarez No. 17, Hidalgo County

Basin: North Floodway

Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Olivarez No. 17 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 21-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Olivarez No. 17 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Olivarez No. 17, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install new underground drainage system with a retention pond
    - Install roadside swales
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 210 linear feet of 18-inch diameter pipe, 1,700 linear feet of grassy swale, 710 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 8.8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Olivarez No. 17 Colonia		
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	8,666.67
2	**DRAINAGE IMPROVEMENTS**	$	55,925.00
3	**POND EXCAVATION IMPROVEMENTS**	$	236,434.00
	Sub-Total =	**$**	**301,025.67**
	Engineering (10%)	$	30,102.57
	Contingency (20%)	$	60,205.13
	Total =	**$**	**391,333.37**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.9 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Olivarez No. 17, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	3	2	1

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$958,403	$391,333	2.45
Elevate Structures	$958,403	$639,300	1.50
Acquisition/Supplemental Housing/Demolition	$1,220,705	$460,320	2.65

Colonia: Olivarez No. 17, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

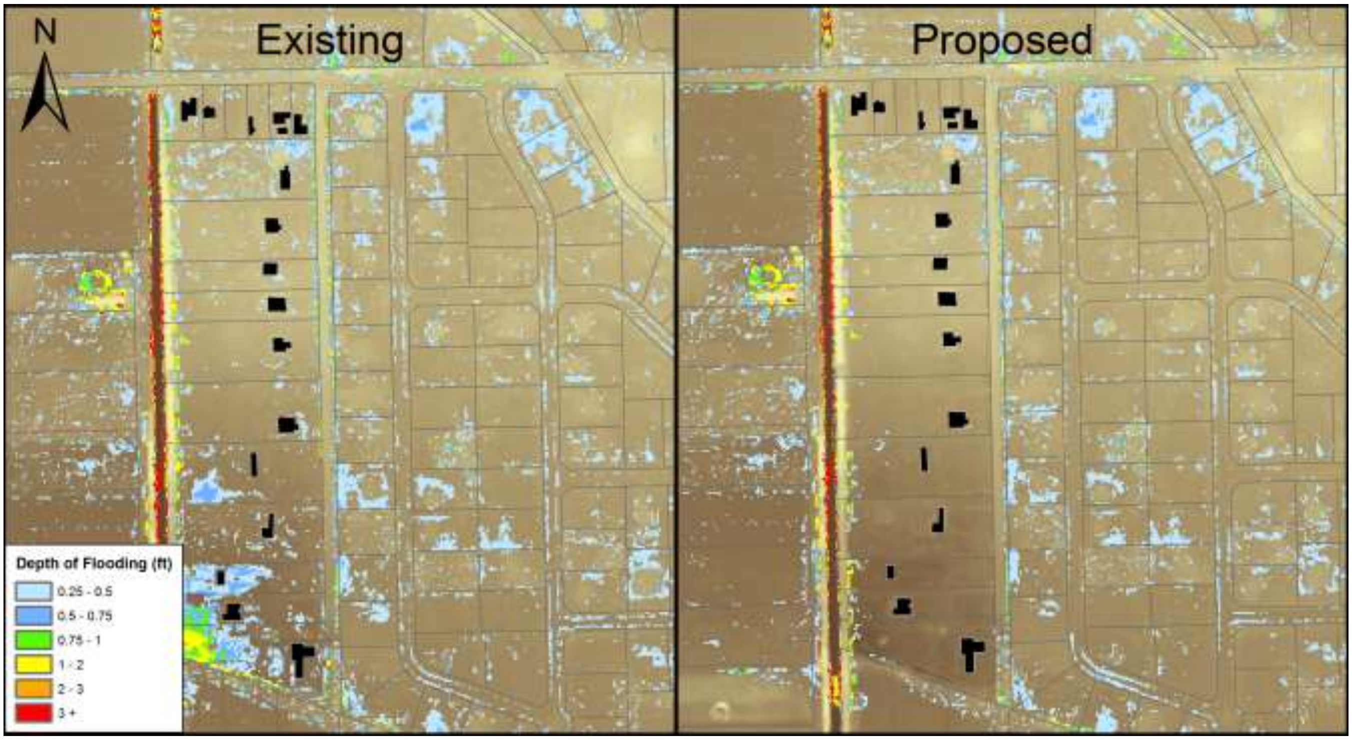


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	18	14	4
Inundated Roadway (LF)	30	0	30

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 17, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

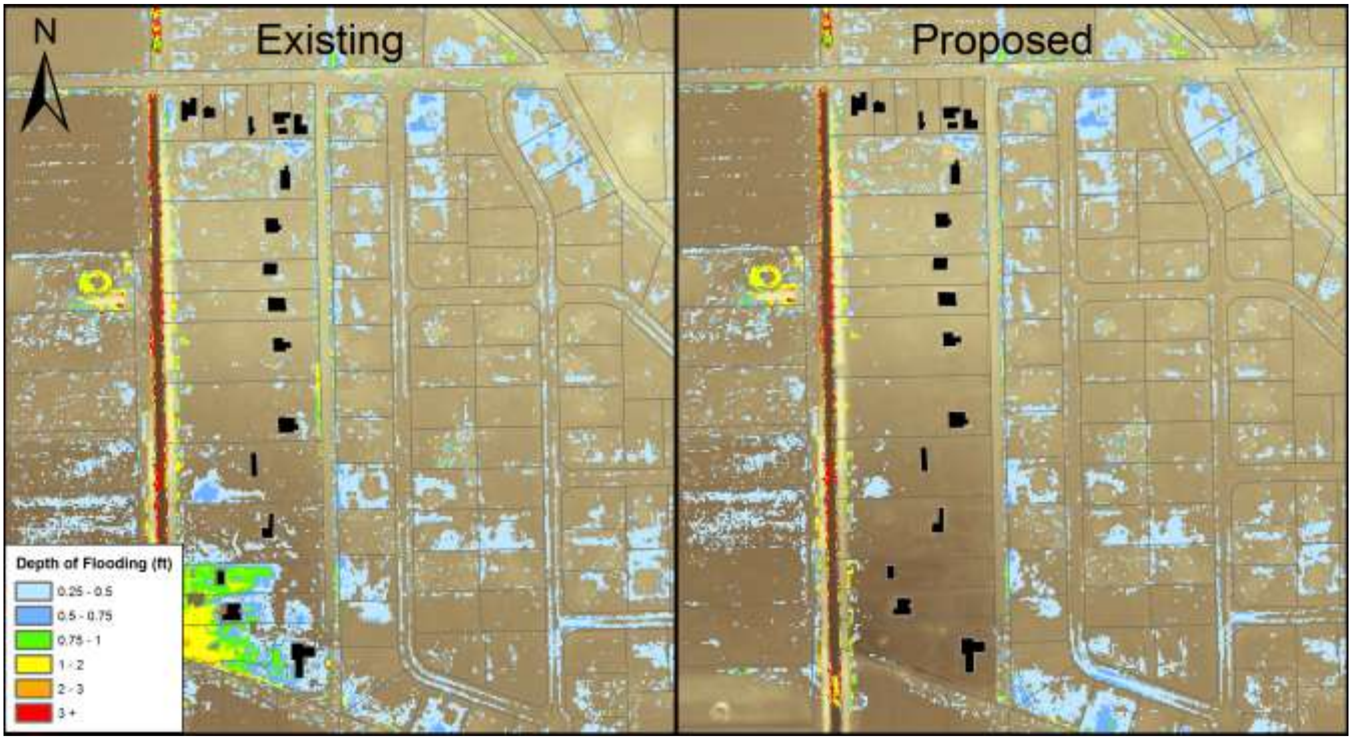


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	18	16	2
Inundated Roadway (LF)	135	0	135

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 17, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

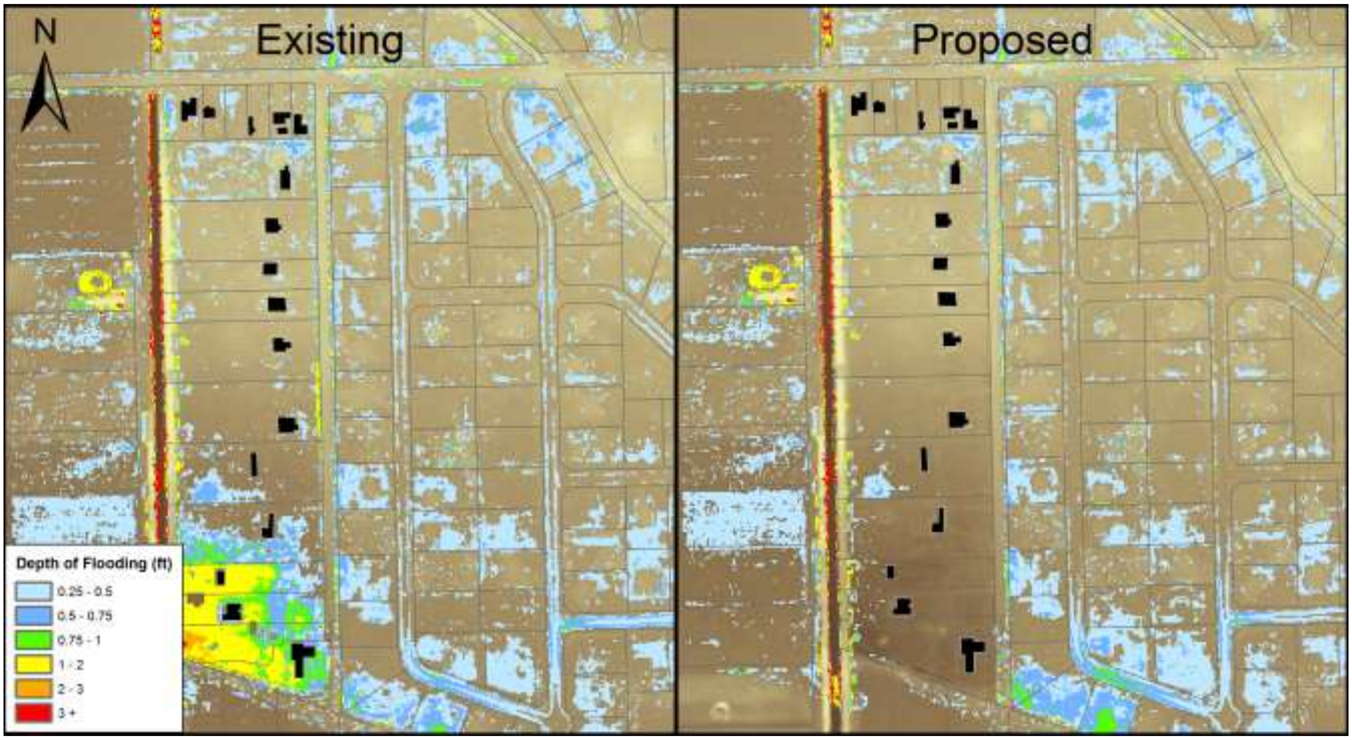


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	18	16	2
Inundated Roadway (LF)	160	120	40

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figures:

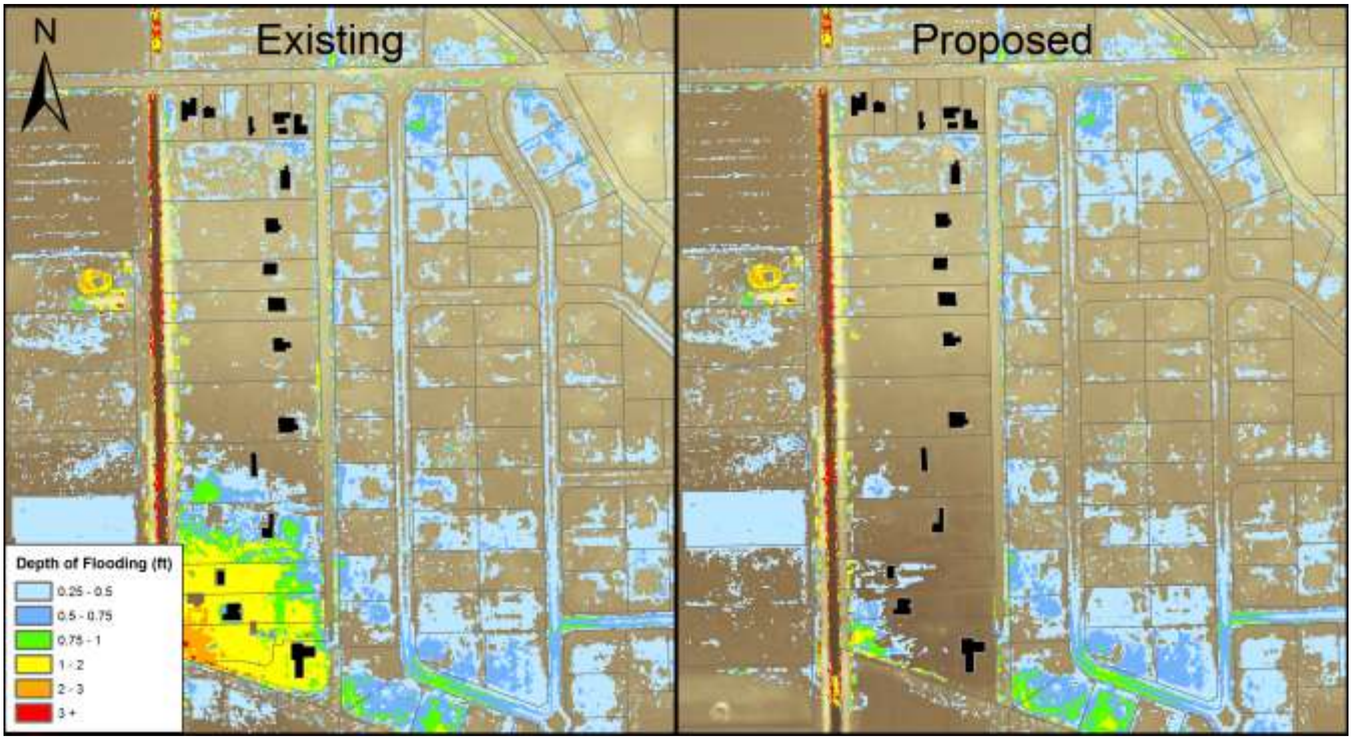


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	18	18	0
Inundated Roadway (LF)	210	140	70

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Olivarez No. 17, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

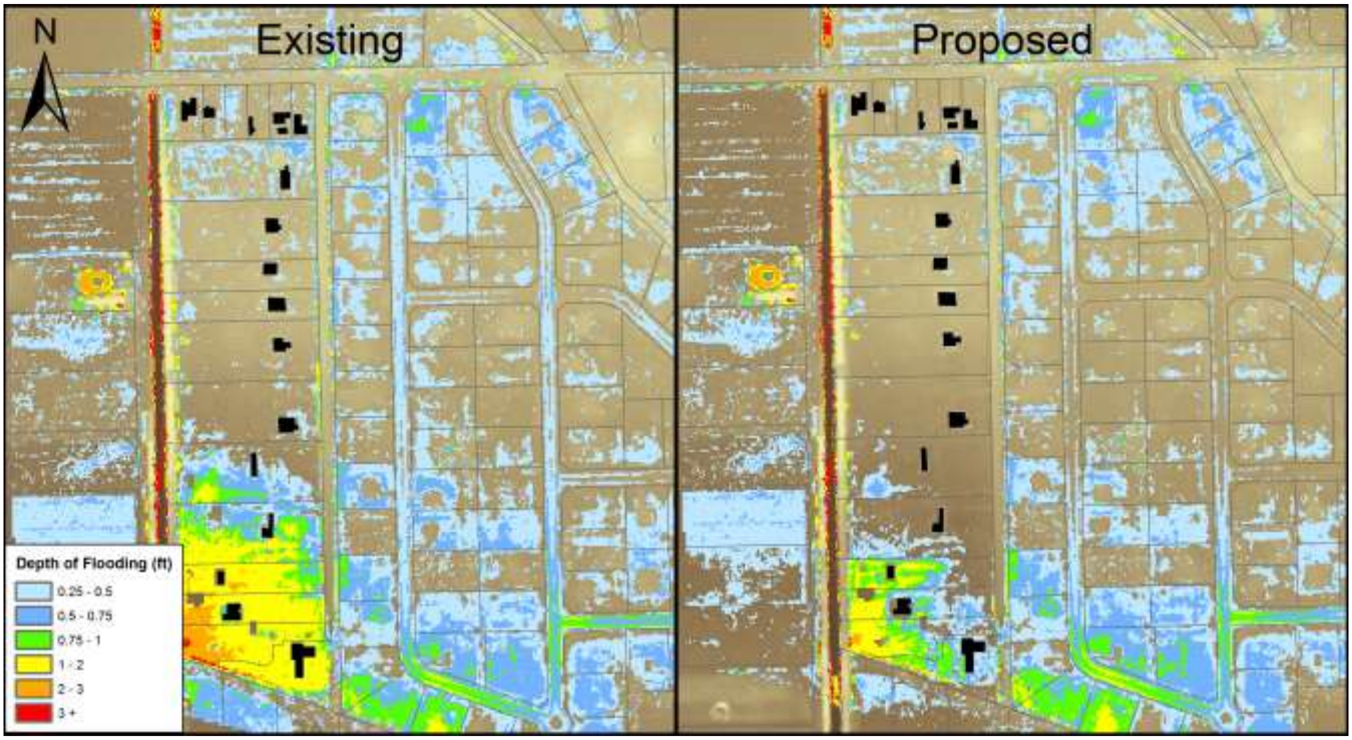
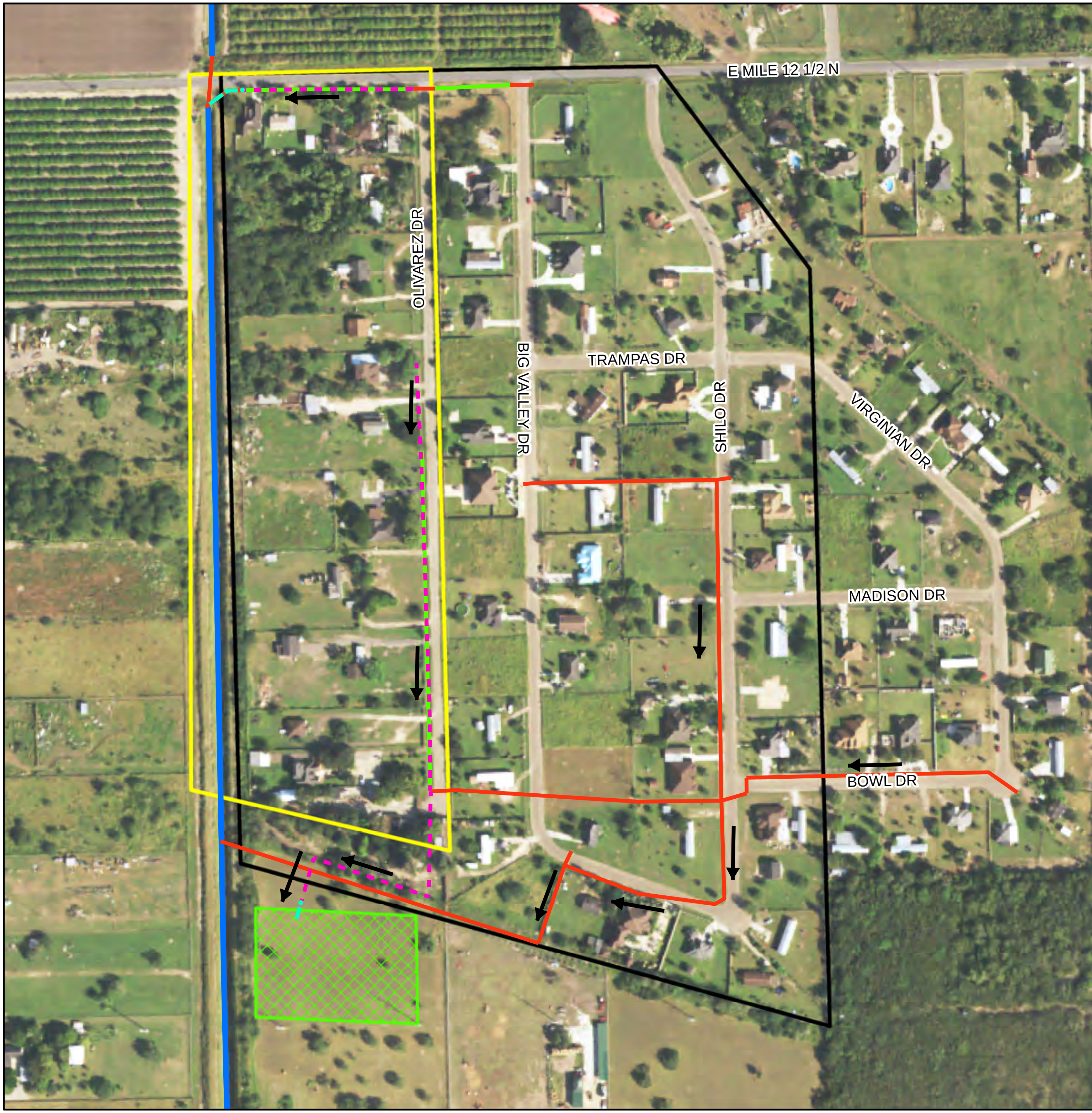


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	2	1
Inundated Lots	18	18	0
Inundated Roadway (LF)	350	185	165

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Olivarez No.17
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Olivarez No. 17
- Proposed Retention Pond
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

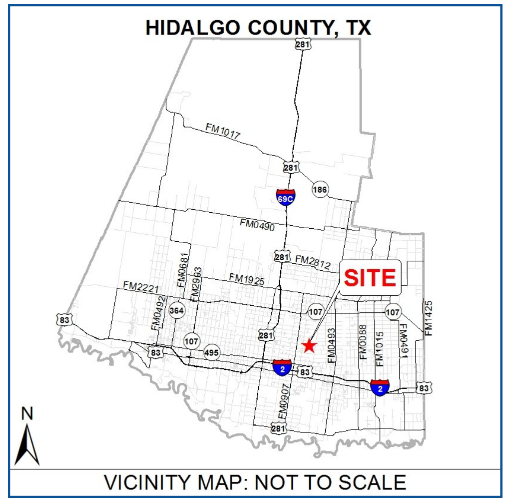
Colonia: Owassa Rd/Tower Rd, Hidalgo County

Basin: North Main Drain

Category: A1

Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia Owassa Rd/Tower Rd storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



VICINITY MAP: NOT TO SCALE

Areas of Risk:

Owassa Rd/Tower Rd consists of approximately 19.7 acres of fully developed residential land. The existing drainage system consists of swales and culvers that appear to have no outfall. It is unclear whether the existing drainage ditch services the colonia. The existing drainage pattern indicates runoff flows toward the east. Based on the existing conditions 2D model results a couple of structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Improve existing culverts and swales to allow maximum conveyance toward a new retention pond.
    - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 2,340 linear feet of 24-inch diameter pipe, 130 linear feet of 36-inch diameter pipe, and twelve curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 5.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
OWASSA RD\TOWER RD

	IMPROVEMENTS	COST
1	Paving Improvements	$409,192.67
2	Drainage Improvements	$172,630.00
3	Pond Excavation Improvements	$145,329.55
	Sub-Total =	**$727,152.22**
	Engineering Fees (10%) =	**$72,715.22**
	Contingency (20%) =	**$145,430.44**
	Total =	**$945,297.89**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	1	0	1
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,175,619.00	$945,297.89	1.24
Elevate Structures	$1,175,619.00	$279,900.00	4.20
Acquisition/Supplemental Housing / Demolition	$1,224,644.00	$345,110.90	3.55

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

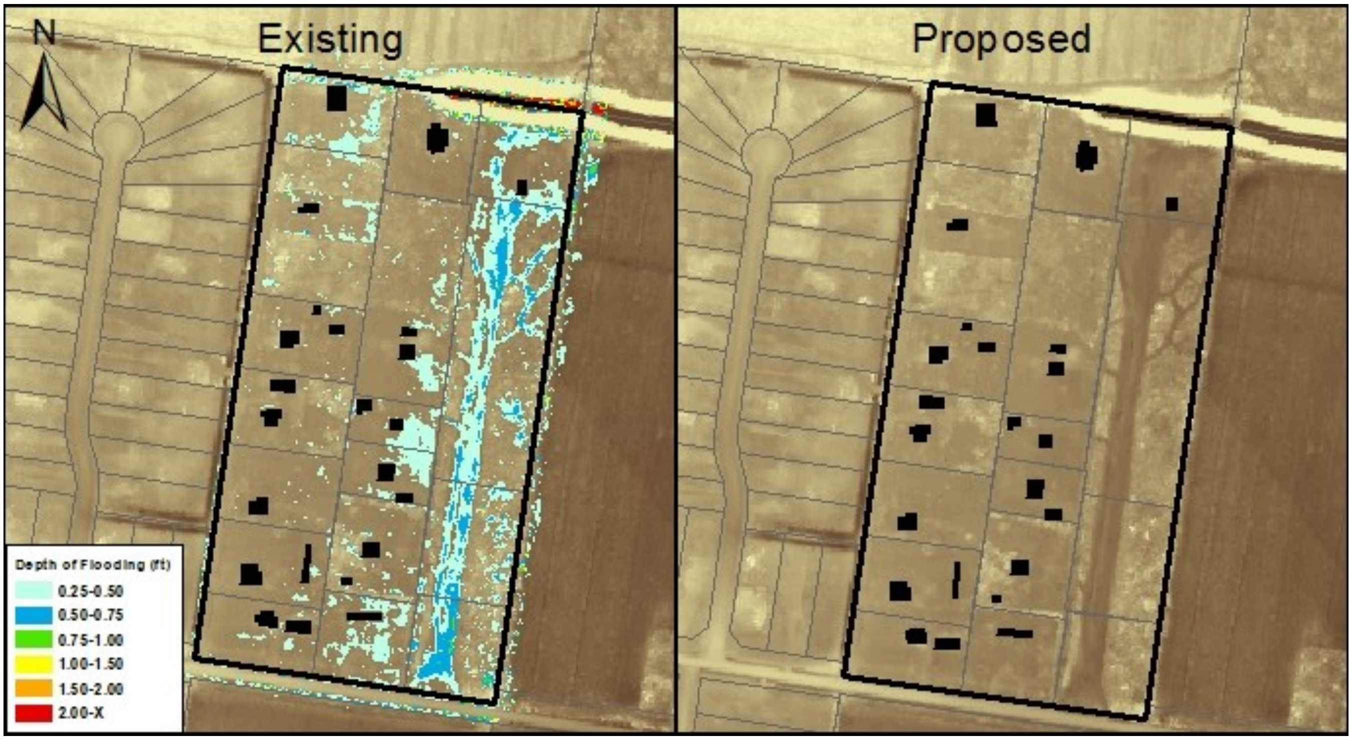


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	17	0	17
Inundated Roadway (LF)	431	0	431

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

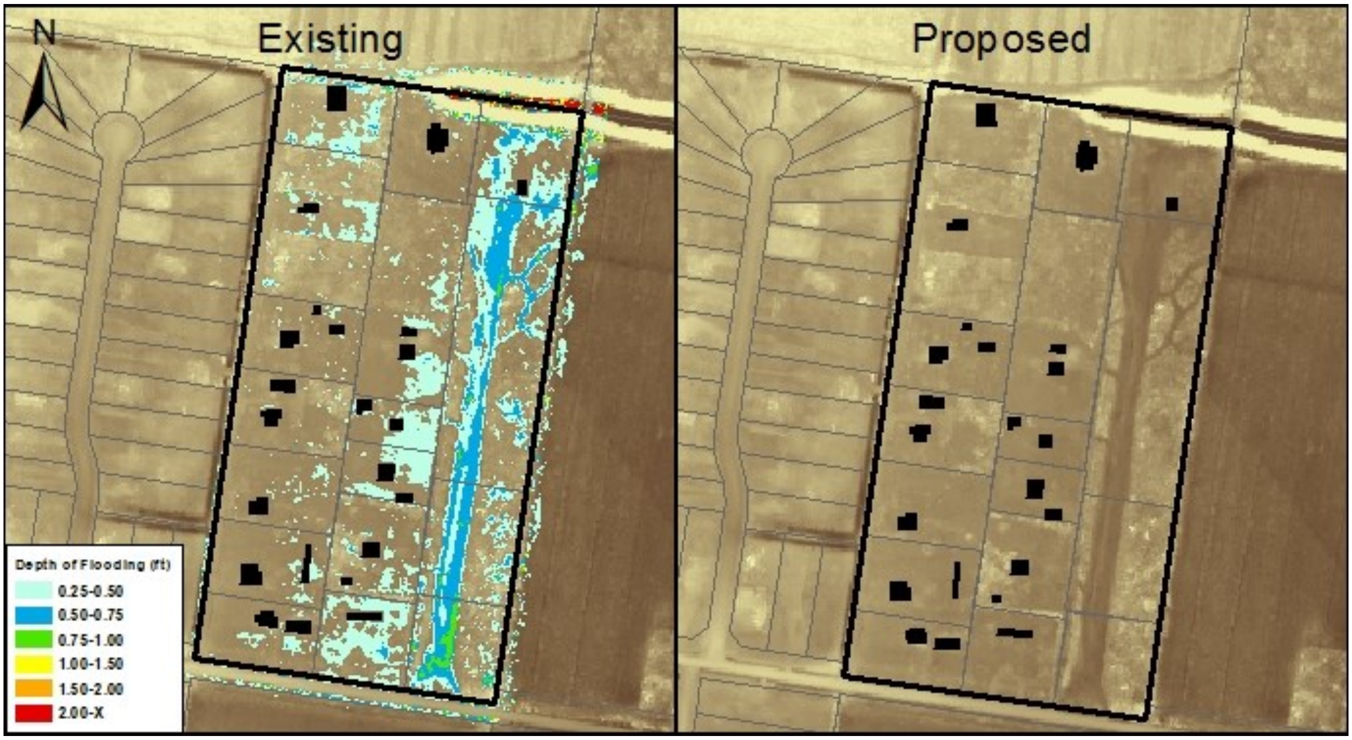


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	17	0	17
Inundated Roadway (LF)	559	0	559

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

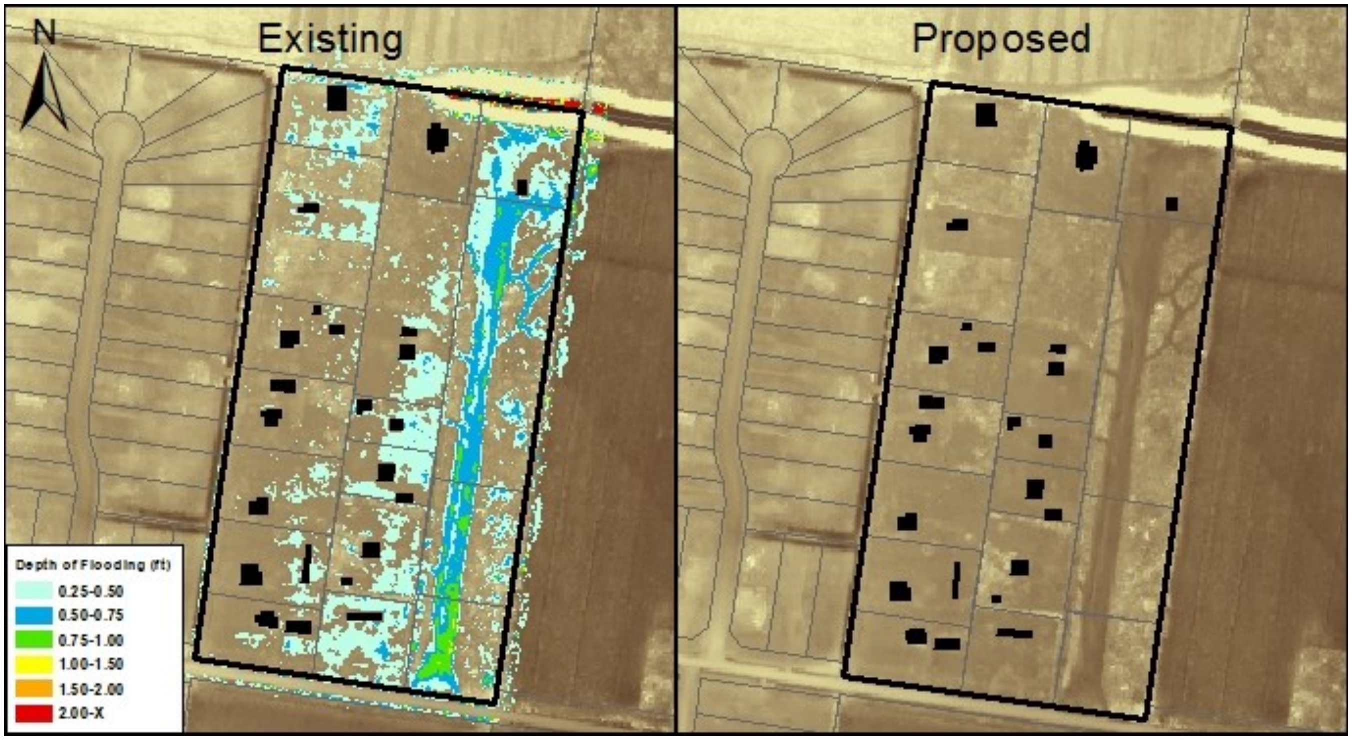


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	17	0	17
Inundated Roadway (LF)	566	0	566

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

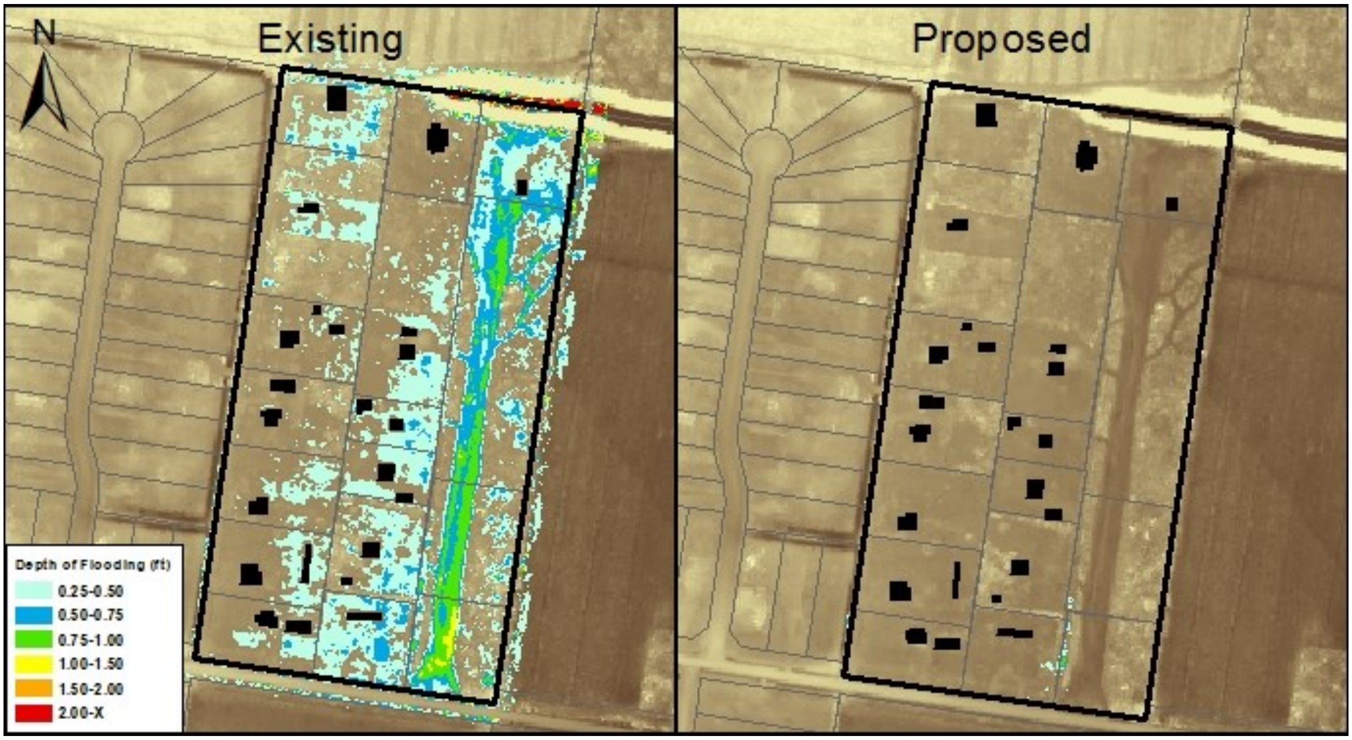


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	17	14	3
Inundated Roadway (LF)	835	125	710

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Owassa Rd/Tower Rd, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

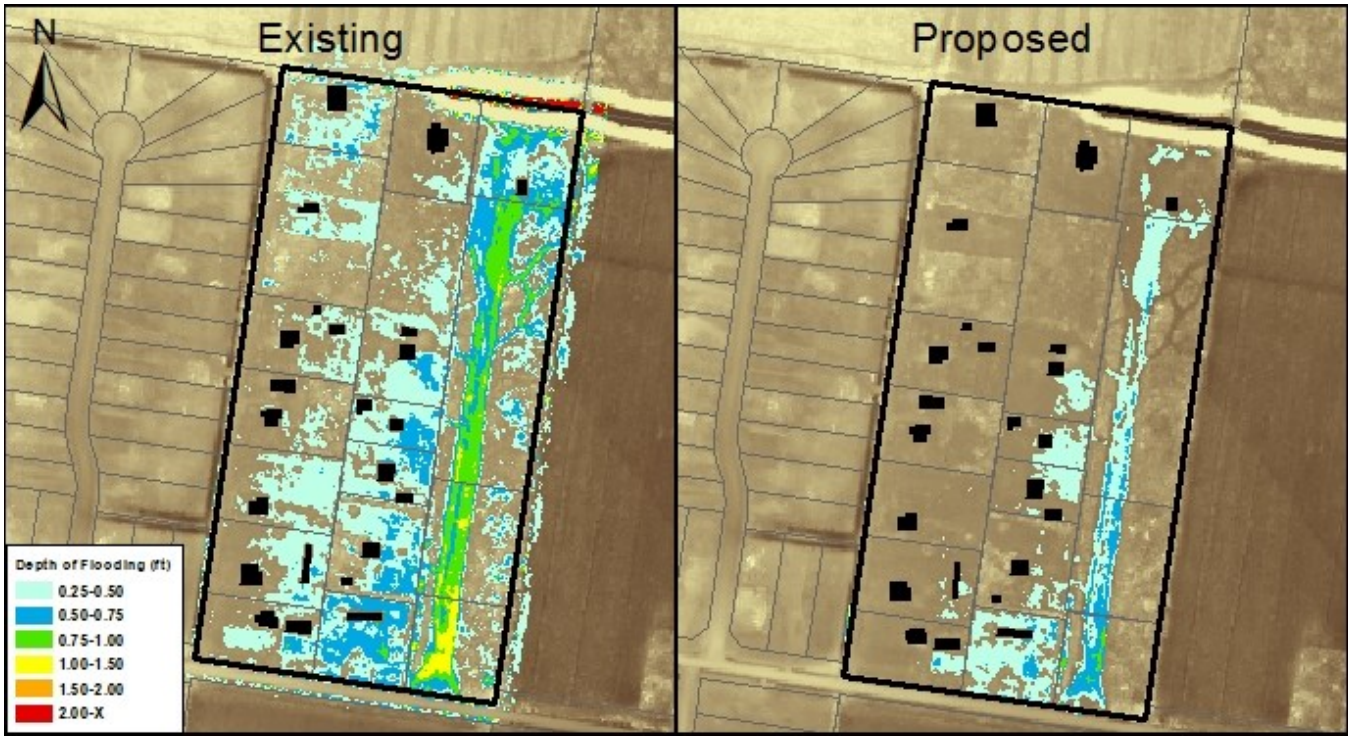


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	17	12	5
Inundated Roadway (LF)	898	278	620

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Owassa Rd/Tower Rd
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- OWASSA RD/TOWER RD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W
E
S

0 120 240 360
Feet

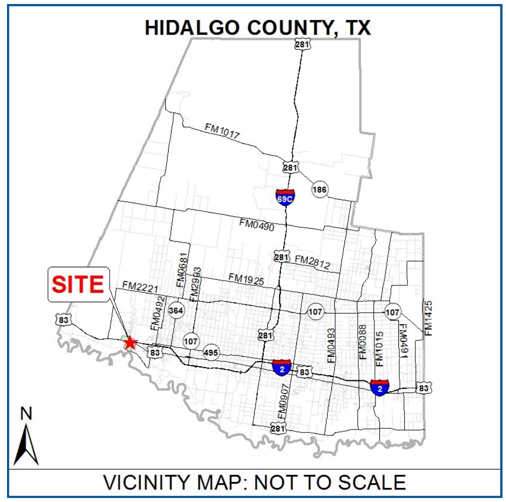
STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Colonia: Peñitas, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

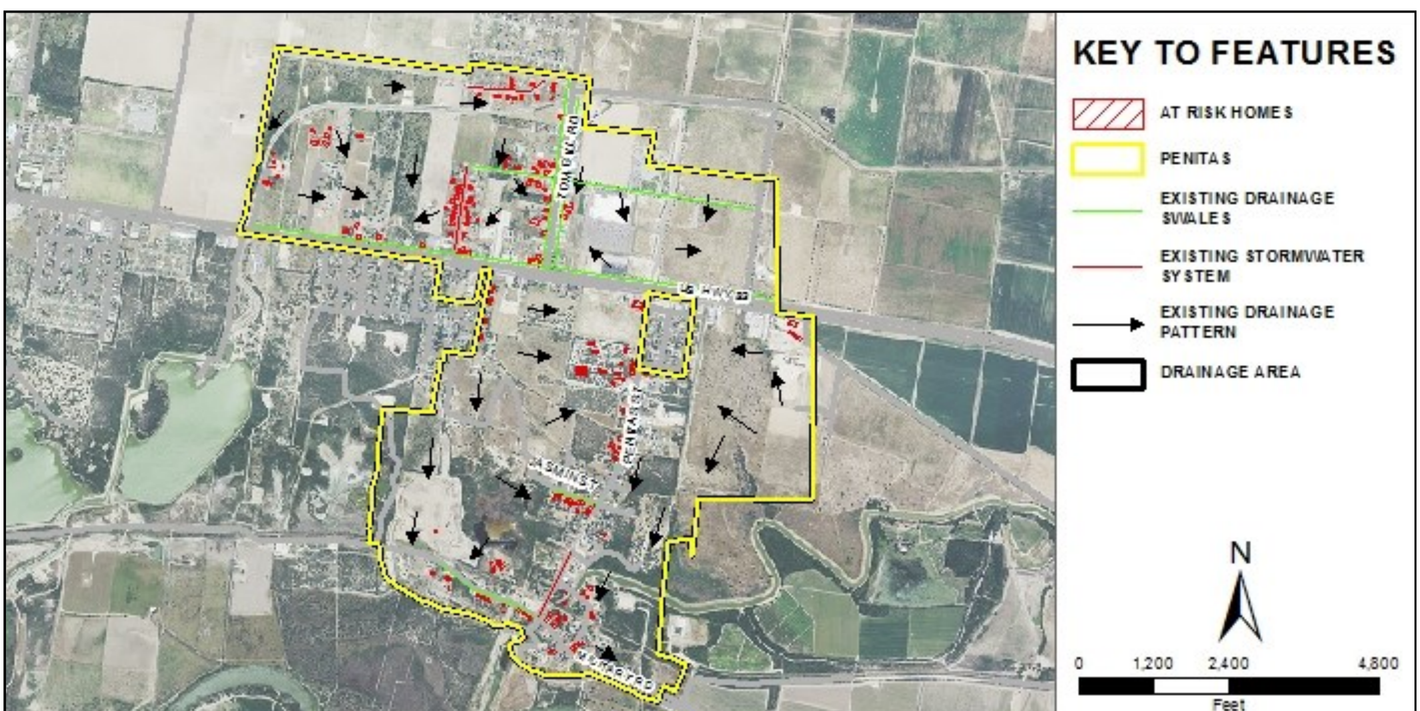
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Penitas storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Penitas consists of approximately 1,239.4 acres of fully developed residential land. The existing drainage system varies within this colonia. Some areas only have swales and culverts whereas other areas have curb inlets with an underground drainage system. The final outfall for these systems was not observed. For the most part the existing drainage pattern indicates runoff flows toward the south. The southern portion of Penitas is under the 100-Yr floodplain, this colonia should be evaluated for risk of flooding due to regional storm events. Based on the existing conditions 2D model results several structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Peñitas, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install more underground drainage systems with retention ponds.
    - Improve existing culverts and swales to allow maximum conveyance toward new retention ponds.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing various underground drainage systems with retention facilities. The colonia was broken down into three areas, north Penitas, southwest Penitas, southeast Penitas.

The new system for north Penitas consists of 1,000 linear feet of 18-inch diameter pipe, 4,450 linear feet of 30-inch diameter pipe, 2,640 linear feet of 36-inch diameter pipe, 1,650 linear feet of 42-inch diameter pipe, 660 linear feet of 48-inch diameter pipe, 320 linear feet of 54-inch diameter pipe, 2,350 linear feet of 60-inch diameter pipe, and fifty two curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 74.4 acre-feet.

The new system for southwest Penitas consists of 2,580 linear feet of 18-inch diameter, 3,160 linear feet of 24-inch diameter pipe, 2,140 linear feet of 30-inch diameter pipe, 1,410 linear feet of 36-inch diameter pipe, 1,280 linear feet of 42-inch diameter pipe, and sixty six curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 26.9 acre-feet.

The new system for southeast Penitas consists of 2,260 linear feet of 18-inch diameter pipe, 4,250 linear feet of 24-inch diameter pipe, 730 linear feet of 30-inch diameter pipe, 340 linear feet of 36-inch diameter pipe, and forty two curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 18.9 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project:

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
NORTH PENITAS

	IMPROVEMENTS	COST
1	Paving Improvements	$1,544,990.00
2	Drainage Improvements	$1,556,920.00
3	Pond Excavation Improvements	$2,004,545.45
	Sub-Total =	**$5,106,455.45**
	Engineering Fees (10%) =	**$510,645.55**
	Contingency (20%) =	**$1,021,291.09**
	Total =	**$6,638,392.09**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 14 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
SOUTHWEST PENITAS

	IMPROVEMENTS	COST
1	Paving Improvements	$1,070,100.00
2	Drainage Improvements	$938,390.00
3	Pond Excavation Improvements	$726,647.73
	Sub-Total =	**$2,735,137.73**
	Engineering Fees (10%) =	**$273,513.77**
	Contingency (20%) =	**$547,027.55**
	Total =	**$3,555,679.05**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
SOUTHEAST PENITAS

	IMPROVEMENTS	COST
1	Paving Improvements	$1,654,368.33
2	Drainage Improvements	$637,940.00
3	Pond Excavation Improvements	$509,488.64
	Sub-Total =	**$2,801,796.97**
	Engineering Fees (10%) =	**$280,179.70**
	Contingency (20%) =	**$560,359.39**
	Total =	**$3,642,336.06**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Peñitas, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	15	0	15
20% (5-year)	39	8	31
10% (10-year)	56	11	45
4% (25-year)	70	16	54
1% (100-year)	92	36	56

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$20,096,680.00	$6,638,392.09	3.03
Elevate Structures	$20,096,680.00	$8,812,462.50	2.28
Acquisition/Supplemental Housing / Demolition	$20,939,939.00	$11,290,379.50	1.85

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$7,335,625.00	$3,555,679.05	2.06
Elevate Structures	$7,335,625.00	$3,251,625.00	2.26
Acquisition/Supplemental Housing / Demolition	$7,654,534.00	$3,389,851.50	2.26

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$3,943,382.00	$3,642,336.06	1.08
Elevate Structures	$3,943,382.00	$1,719,600.00	2.29
Acquisition/Supplemental Housing / Demolition	$4,113,712.00	$1,667,379.60	2.47

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

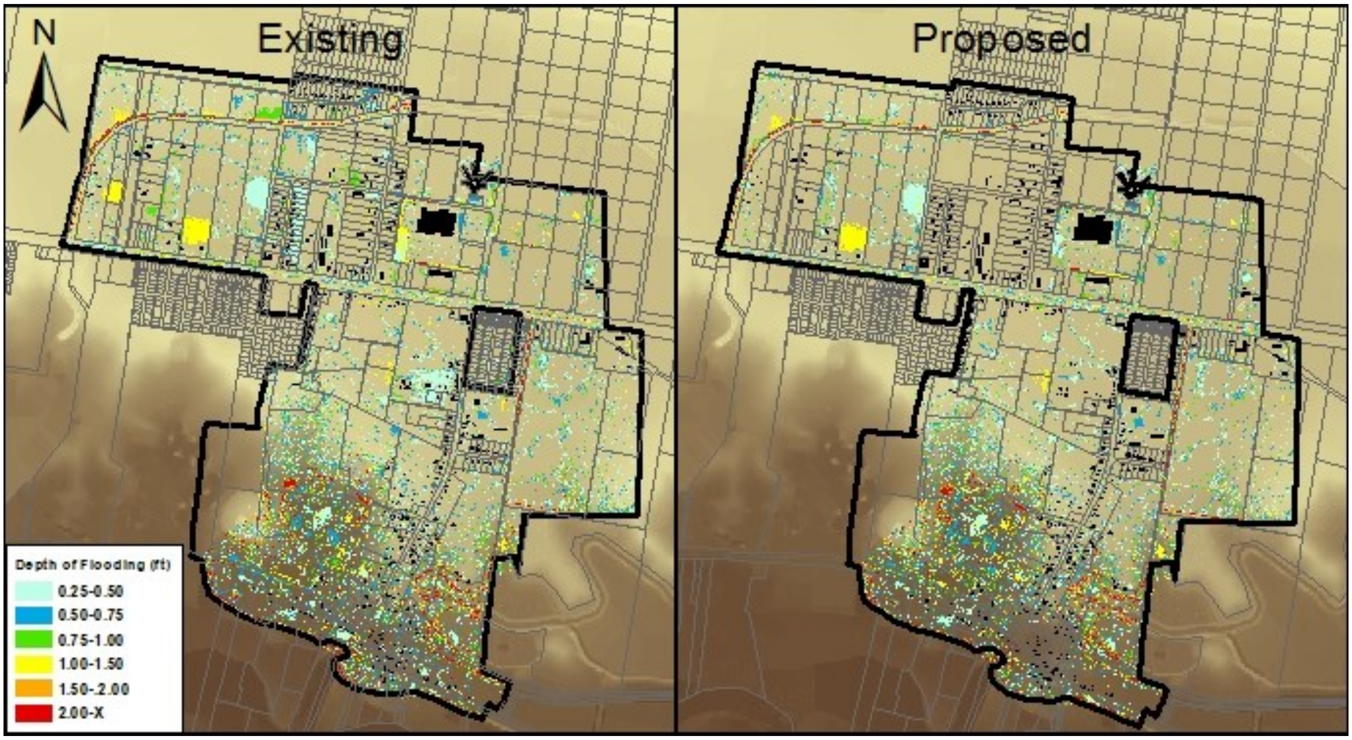


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	15	0	15
Inundated Lots	464	358	106
Inundated Roadway (LF)	2,325	472	1,853

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

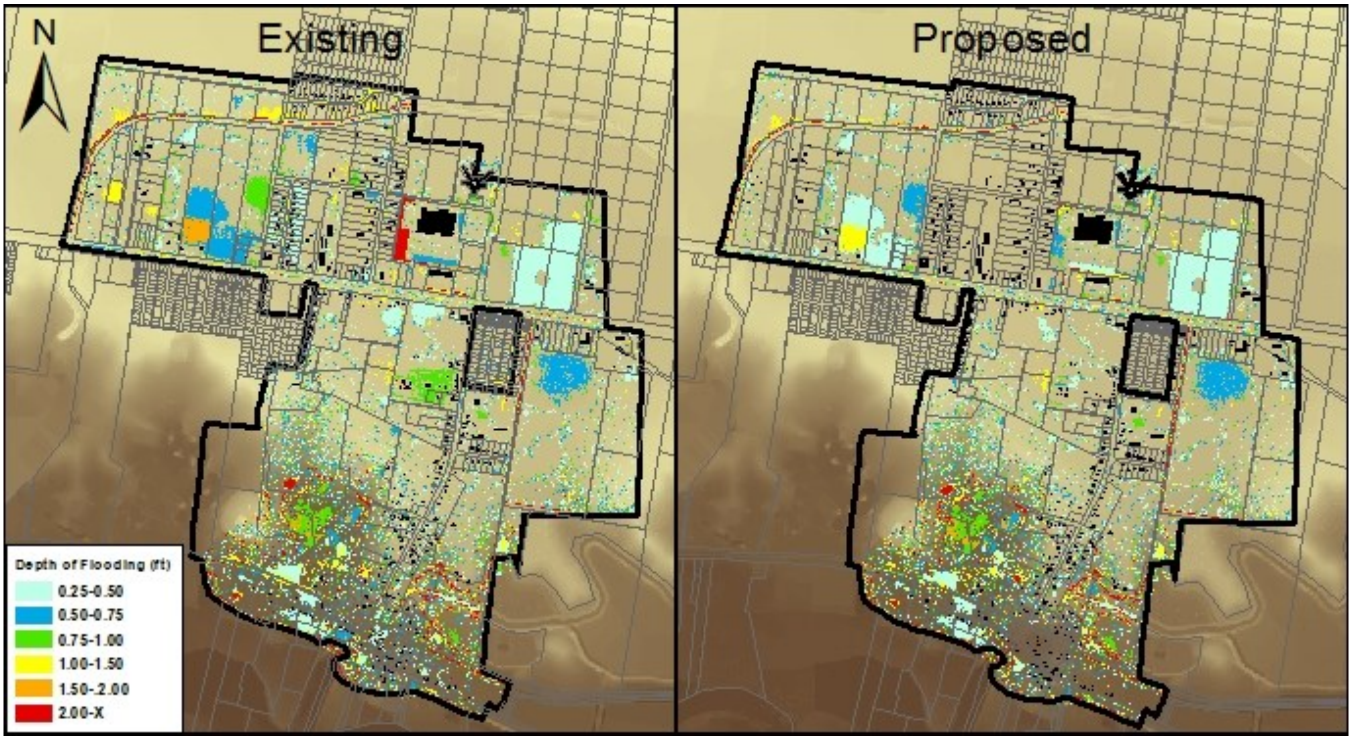


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	39	8	31
Inundated Lots	464	373	91
Inundated Roadway (LF)	3,601	1,492	2,109

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

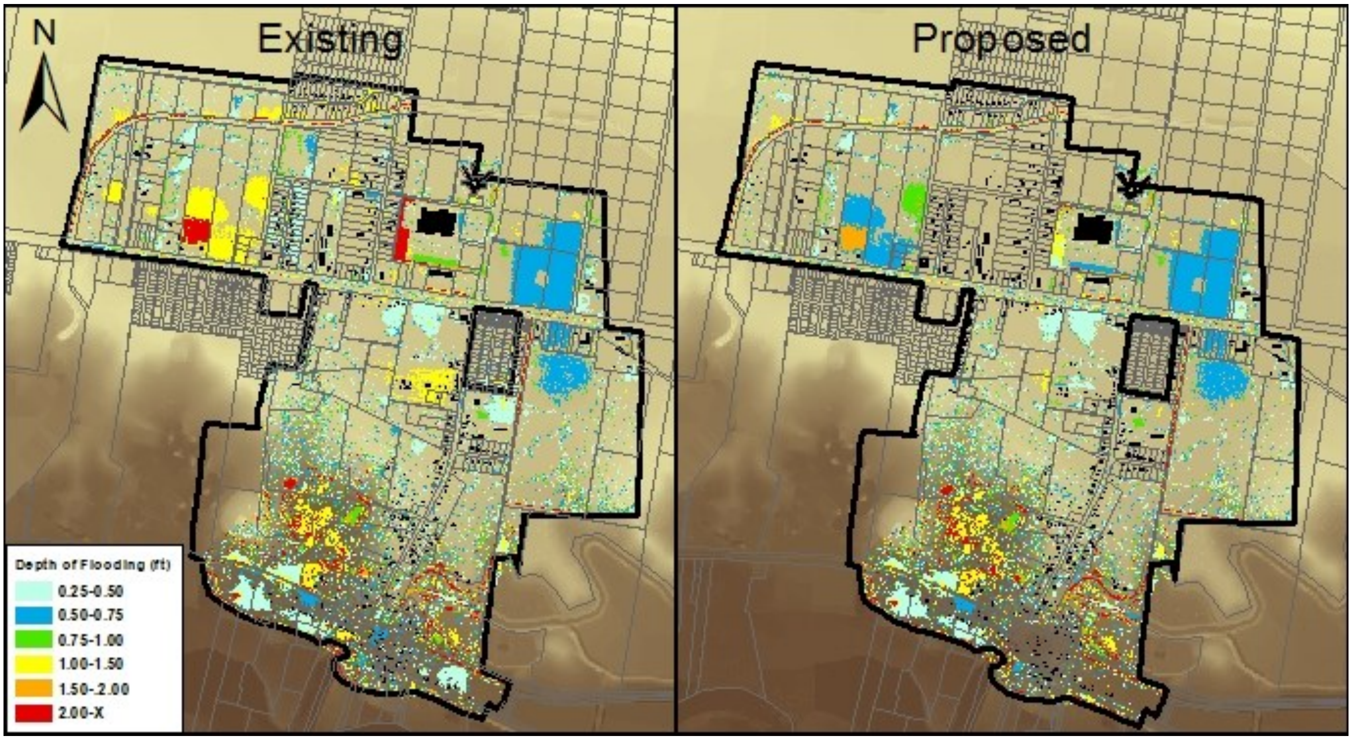


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	56	11	45
Inundated Lots	464	384	80
Inundated Roadway (LF)	3,964	2,329	1,635

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

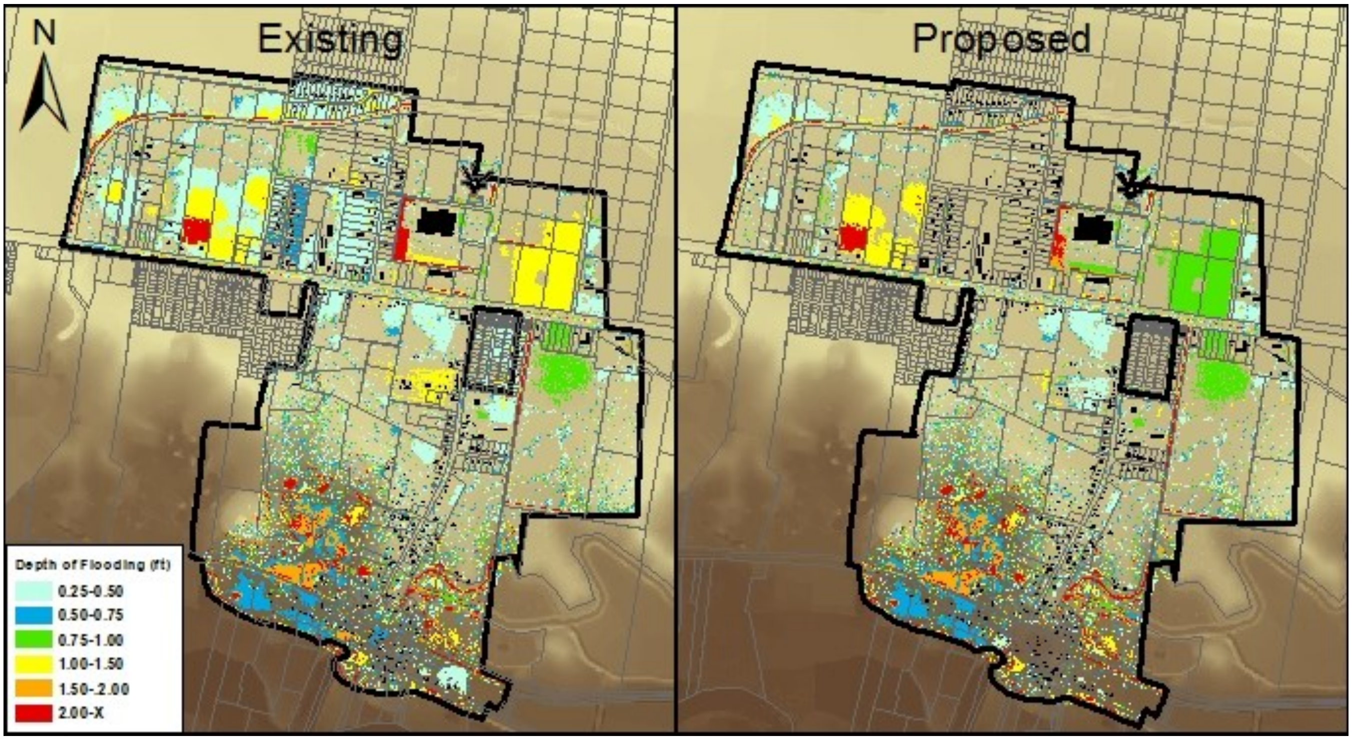


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	70	16	54
Inundated Lots	479	405	74
Inundated Roadway (LF)	5,636	2,972	2,664

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Peñitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

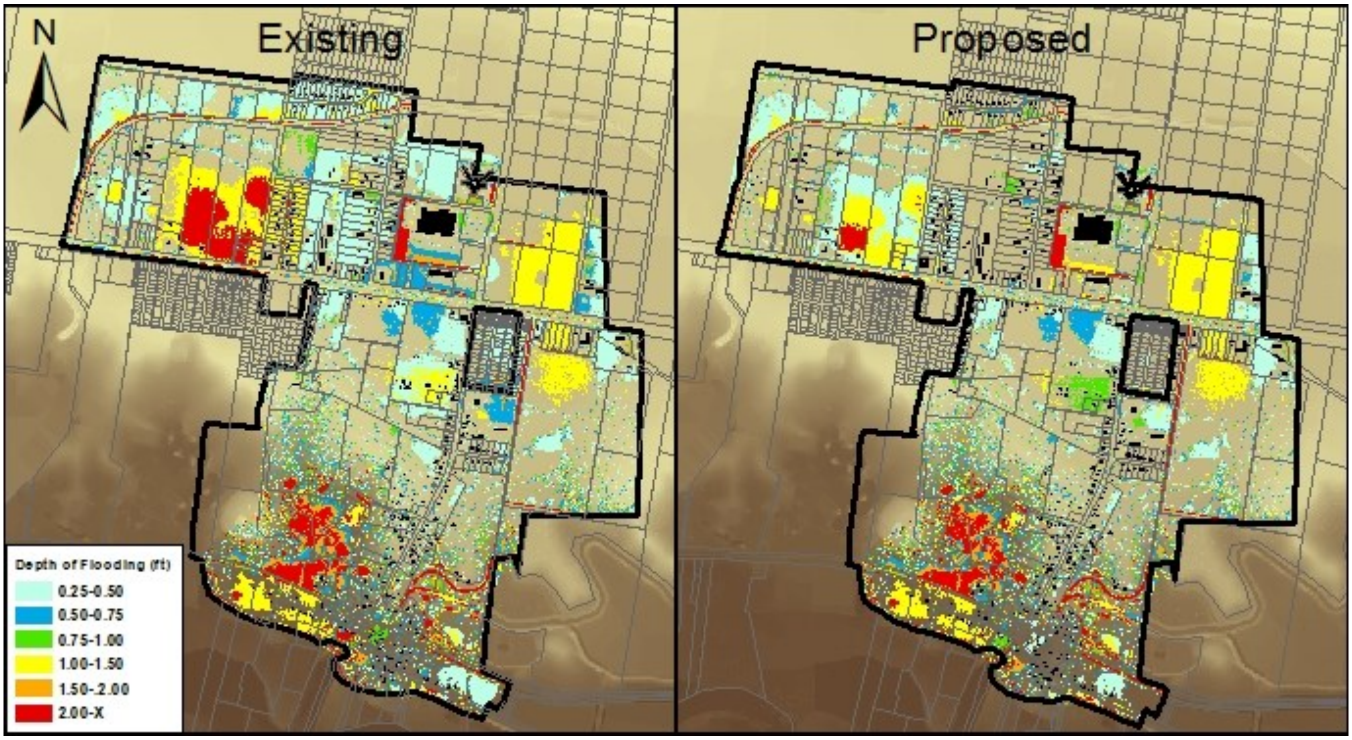


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	92	36	56
Inundated Lots	479	440	39
Inundated Roadway (LF)	6,486	4,375	2,111

Notes:

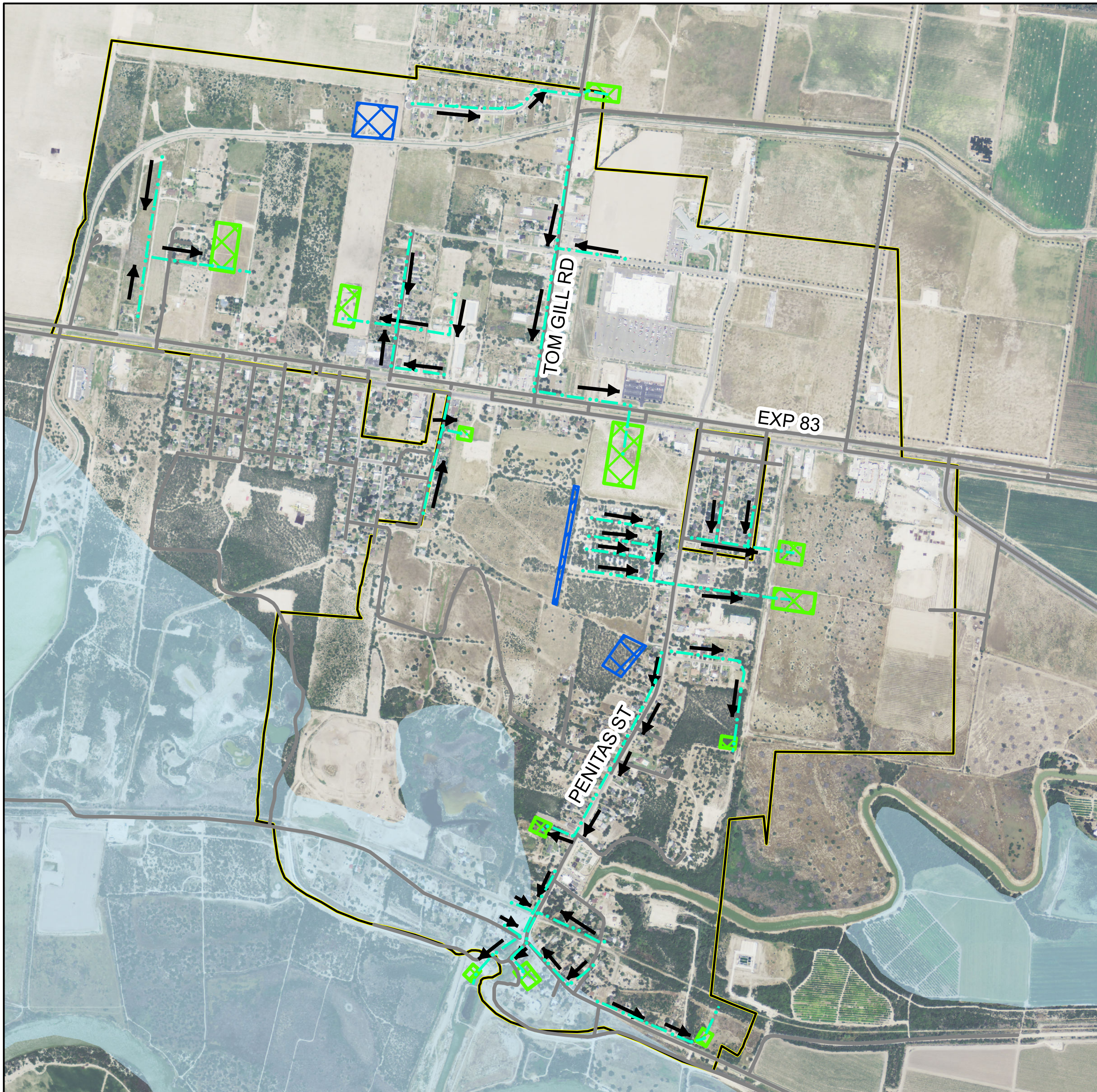
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Penitas
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION



Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- PENITAS
- DRAINAGE AREA
- 25-YR RETENTION POND
- PROPOSED DETENTION POND
- EXISTING FLOODPLAIN

N
W E
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0 870 1,740 2,610
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

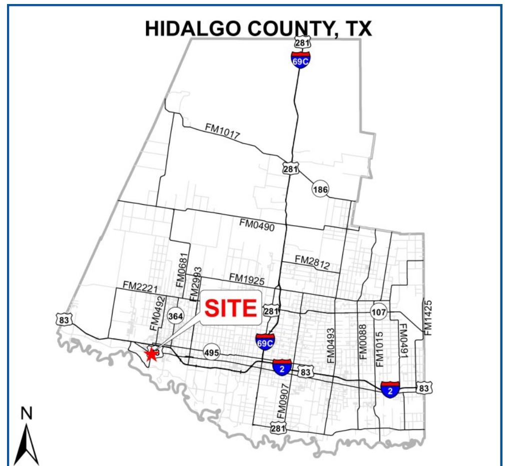
"Filling the Gap"

Colonia: Perezville, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:

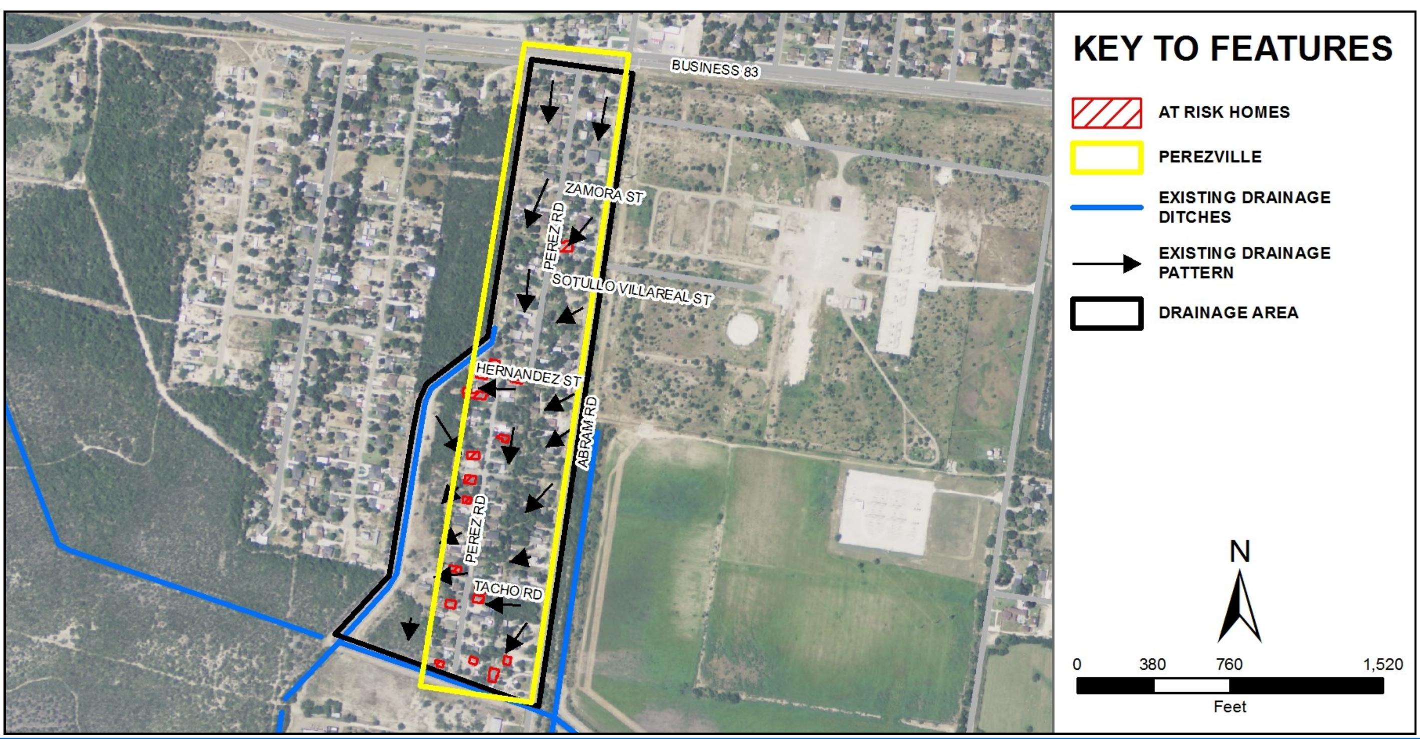


VICINITY MAP: NOT TO SCALE

A 2-dimensional hydrodynamic model of the colonia Perezville storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Perezville consists of approximately 49 acres of fully developed residential land. Currently the colonia does not have a drainage system. There are major drainage ditches along the west, east, and south sides of the colonia. The existing drainage pattern indicates runoff flows toward the southwest corner of the colonia. The results of the existing conditions 2D model indicate that there is considerable ponding within the colonia, resulting in structures at high risk of flooding. This may be attributed to low lots or drainage obstructions. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events that may overflow the existing drainage ditches into the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Perezville, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install an underground drainage system and increase the hydraulic capacity of the existing drainage ditches.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 1,393 linear feet of 18-inch diameter pipe, 910 linear feet of 24-inch diameter pipe, 471 linear feet of 30-inch diameter pipe, 548 linear feet of 36-inch diameter pipe, 1,352 linear feet of 42-inch diameter pipe, and 42 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 19.8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
PEREZVILLE		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$752,347.33
2	Drainage Improvements	$520,275.00
3	Pond Excavation Improvements	$532,808.18
	Sub-Total =	**$1,805,430.51**
	Engineering Fees (10%) =	**$180,543.05**
	Contingency (20%) =	**$361,086.10**
	Total =	**$2,347,059.66**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 5 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	8	0	8
10% (10-year)	9	0	9
4% (25-year)	12	1	11
1% (100-year)	17	7	10

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,283,341.00	$2,347,059.66	0.97
Elevate Structures	$2,283,341.00	$1,694,700.00	1.35
Acquisition/Supplemental Housing / Demolition	$5,044,234.00	$1,346,169.80	3.75

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

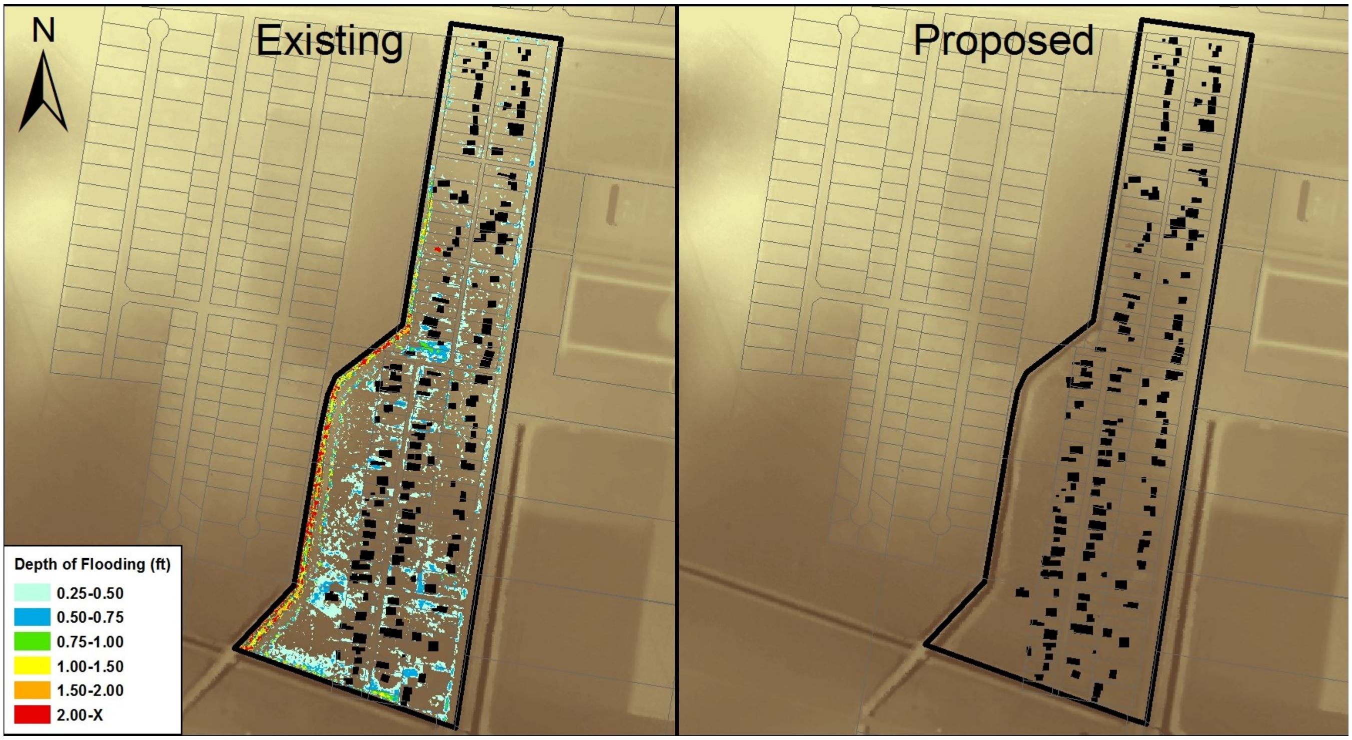


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	125	0	125
Inundated Roadway (LF)	51	0	51

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

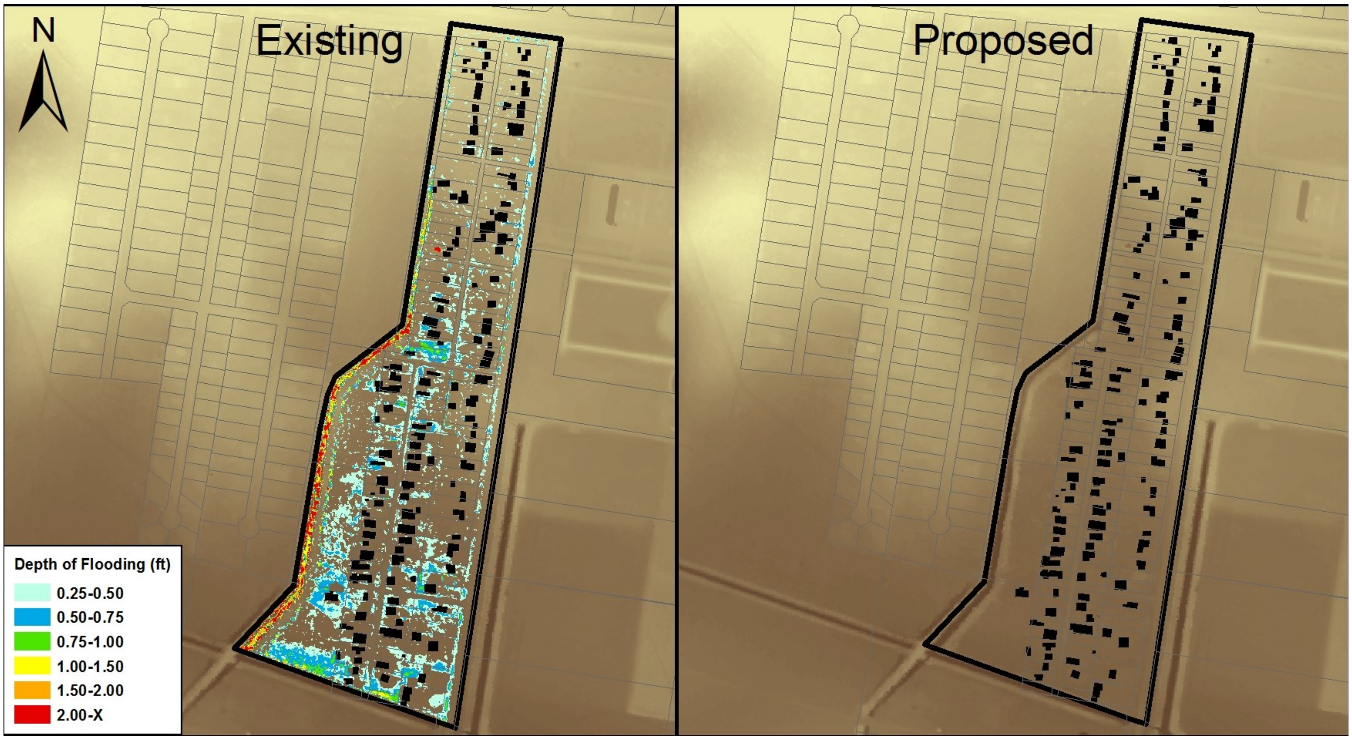


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	125	0	125
Inundated Roadway (LF)	80	0	80

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

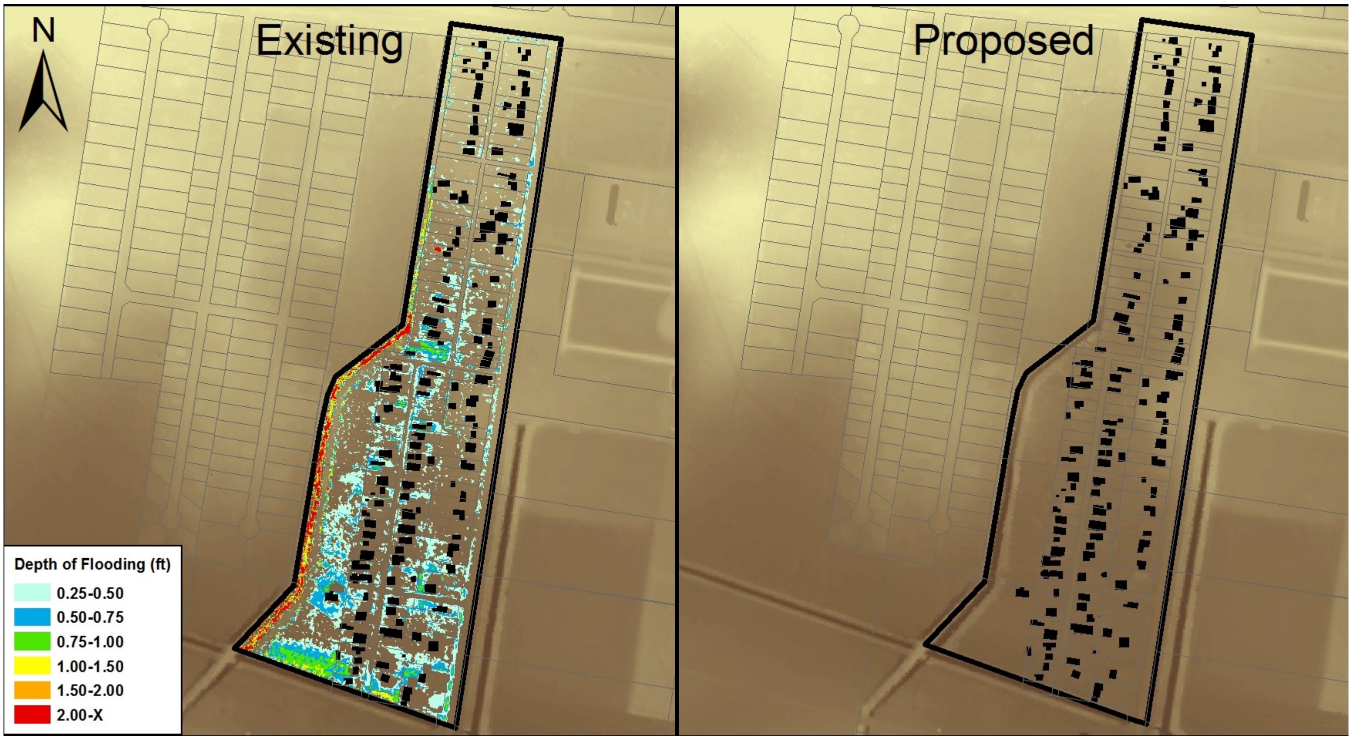


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	0	9
Inundated Lots	125	0	125
Inundated Roadway (LF)	87	0	87

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

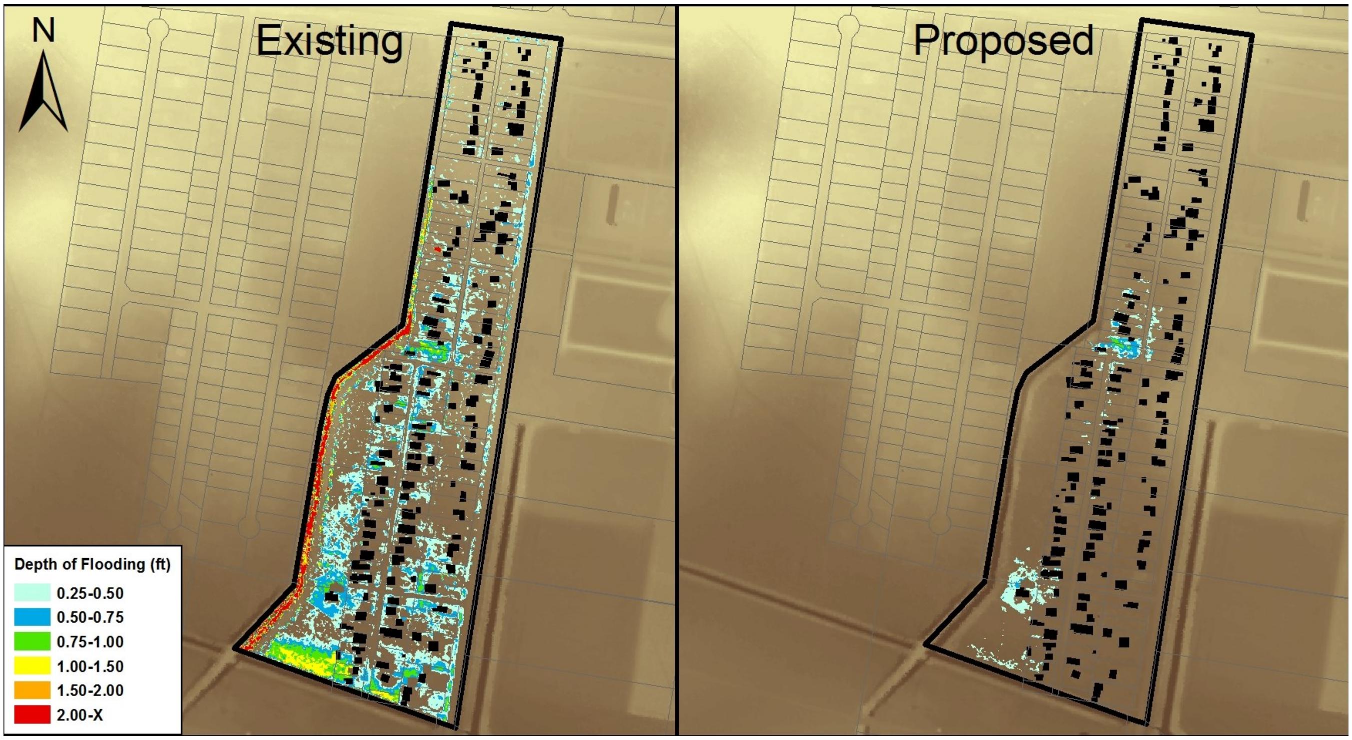


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	1	11
Inundated Lots	125	37	88
Inundated Roadway (LF)	129	0	129

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Perezville, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

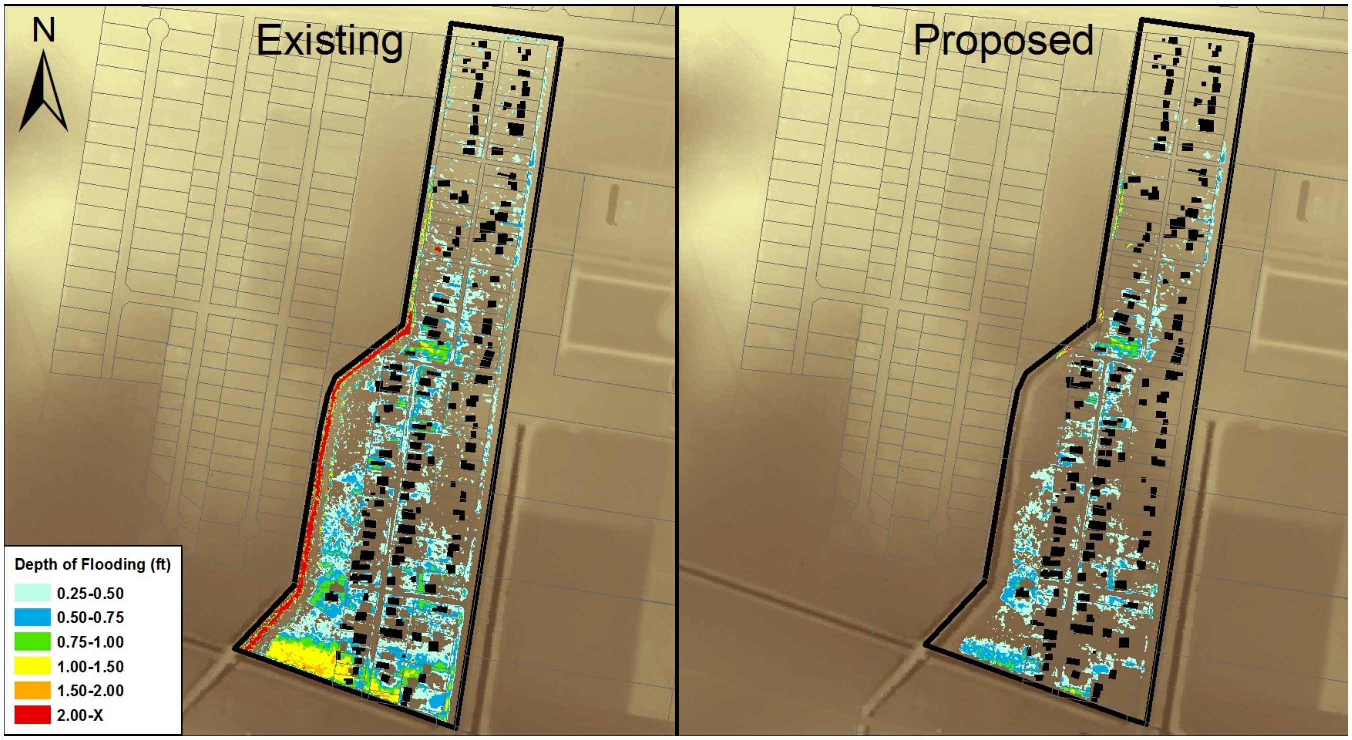


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	17	7	10
Inundated Lots	125	110	15
Inundated Roadway (LF)	431	119	312

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Perezville
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- PEREZVILLE
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N W E S

0 290 580 870
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

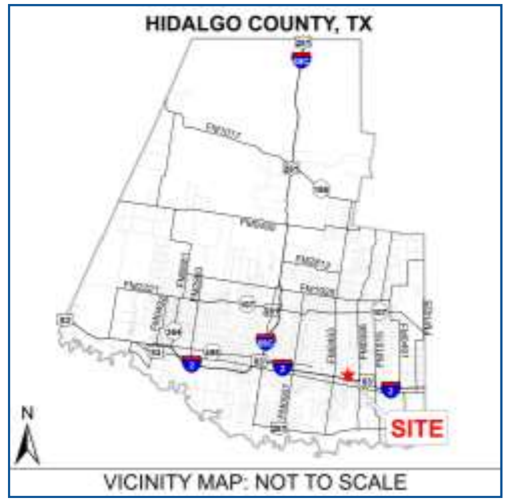
"Filling the Gap"

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the R.C. Babb Subd. No. 3 and 4 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 24-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. R.C. Babb Subd. No. 3 and 4 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install new underground drainage system with a retention pond
    - Install roadside swales
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 135 linear feet of 12-inch diameter pipe, 635 linear feet of 18-inch diameter pipe, 70 linear feet of 24-inch diameter pipe, 300 linear feet of 36-inch diameter pipe, 3,600 linear feet of grassy swale, 2,620 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 6.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
R.C. Babb Subd. No. 3 and 4 Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	23,822.22
2	**DRAINAGE IMPROVEMENTS**	$	110,819.00
3	**POND EXCAVATION IMPROVEMENTS**	$	178,354.00
	Sub-Total =	**$**	**312,995.22**
	Engineering (10%)	$	31,299.52
	Contingency (20%)	$	62,599.04
	Total =	**$**	**406,893.79**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.9 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	3	0	3
1% (100-year)	8	3	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$4,099,349	$406,894	10.07
Elevate Structures	$4,099,349	$824,625	4.97
Acquisition/Supplemental Housing/Demolition	$5,095,343	$929,484	5.48

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	104	96	7
Inundated Roadway (LF)	4260	3570	690

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	104	98	6
Inundated Roadway (LF)	4395	3940	455

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

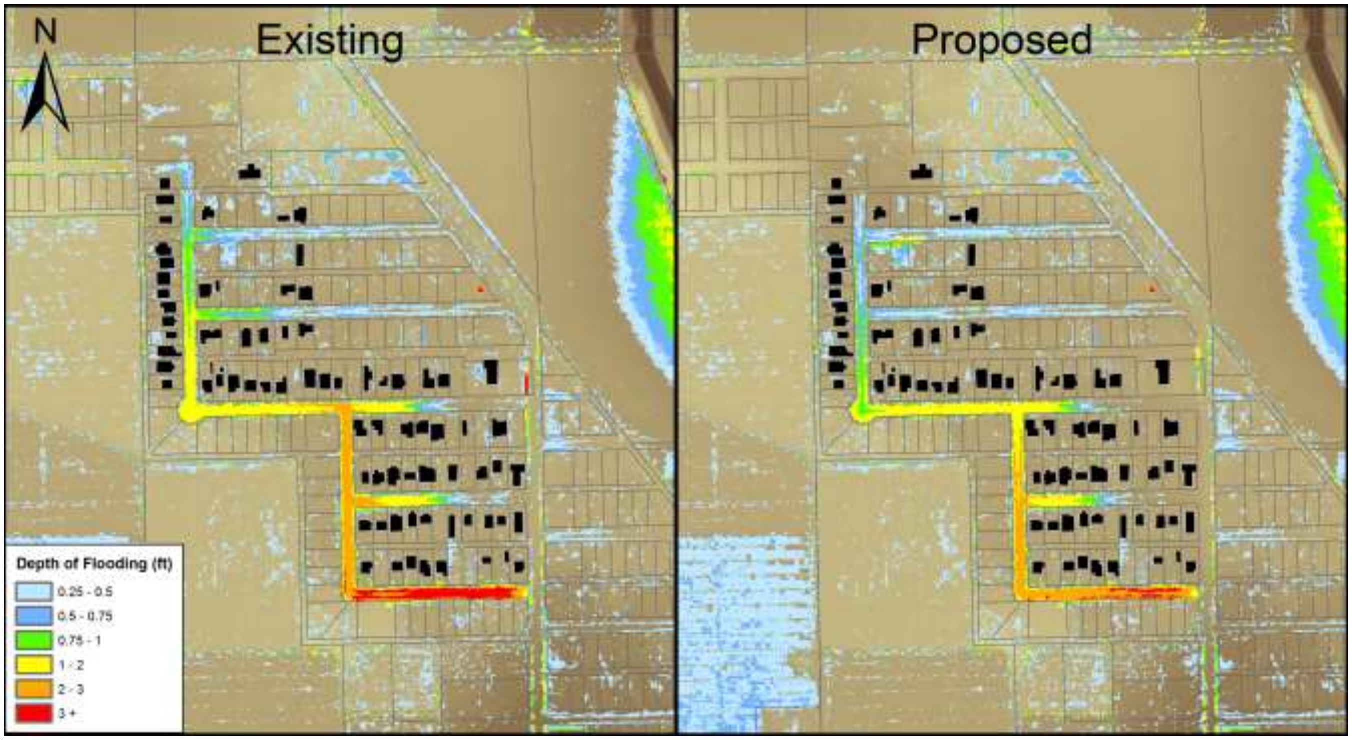


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	104	99	5
Inundated Roadway (LF)	4315	4060	255

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

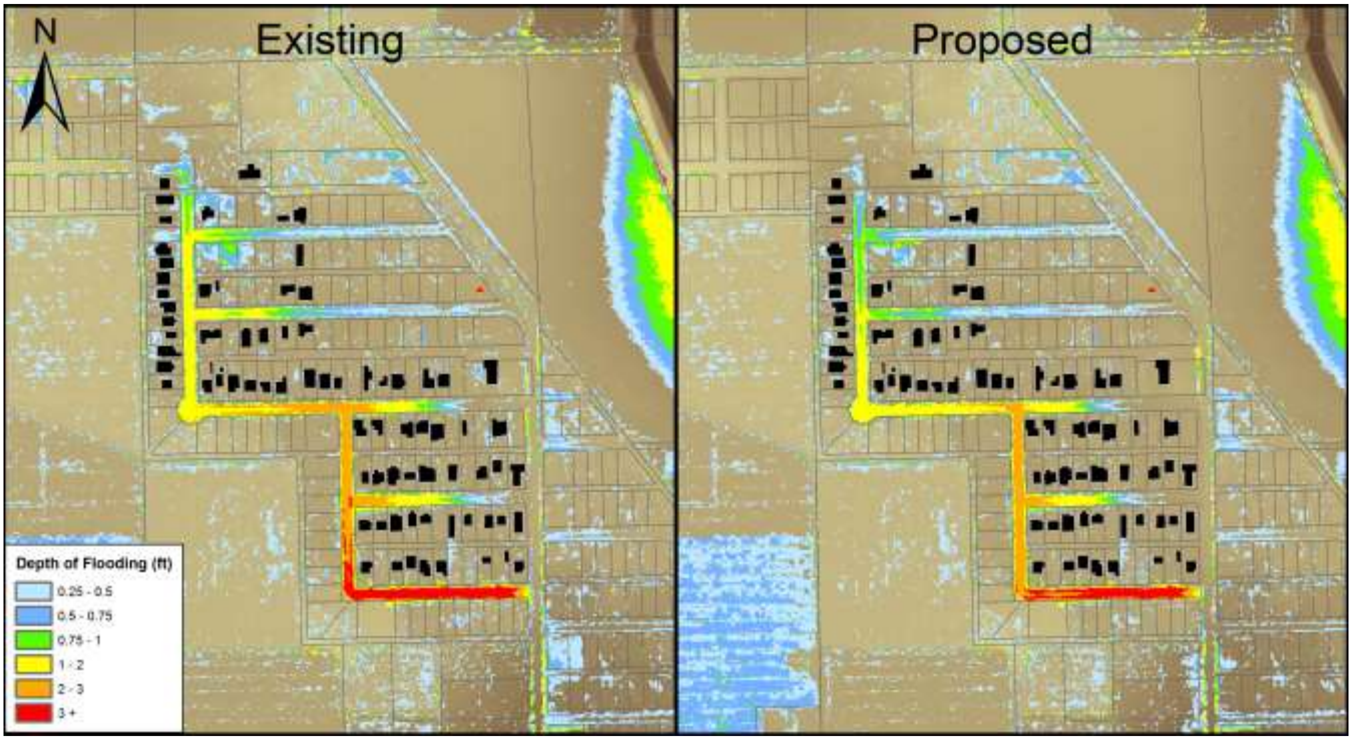


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	104	100	4
Inundated Roadway (LF)	4430	4090	340

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: R.C. Babb No. 3 and 4, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

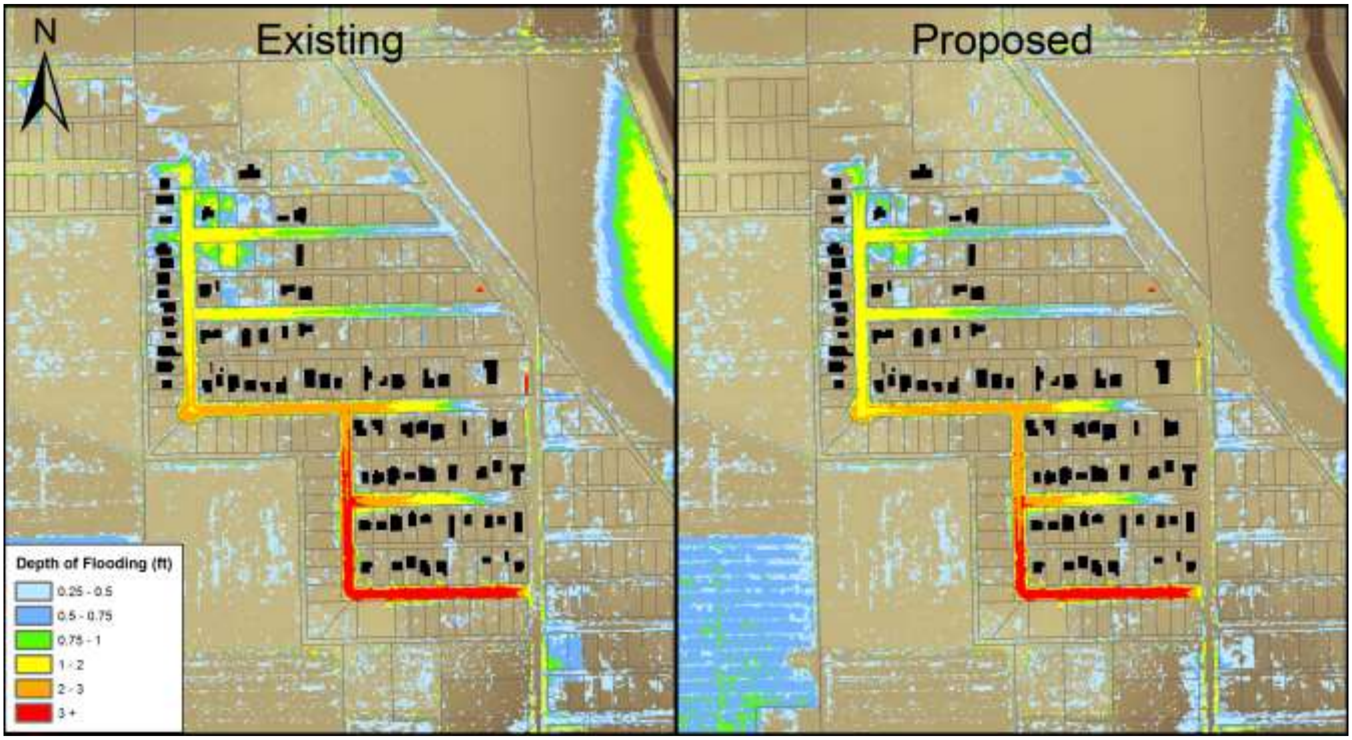


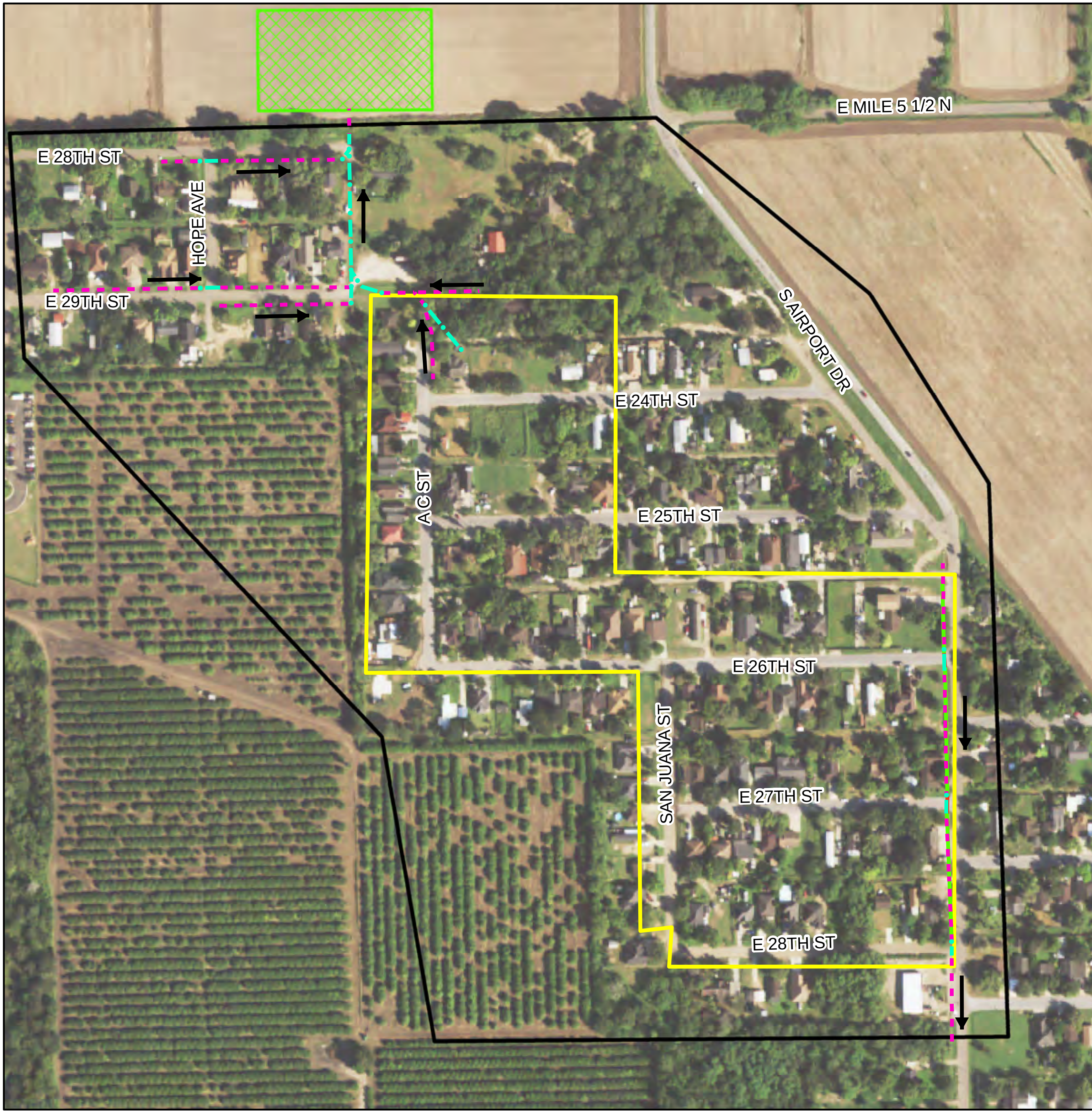
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	3	5
Inundated Lots	104	100	4
Inundated Roadway (LF)	4470	4355	115

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: R.C. Babb Subd. #3 & 4
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- R.C. Babb Subd. No. 3 and 4
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

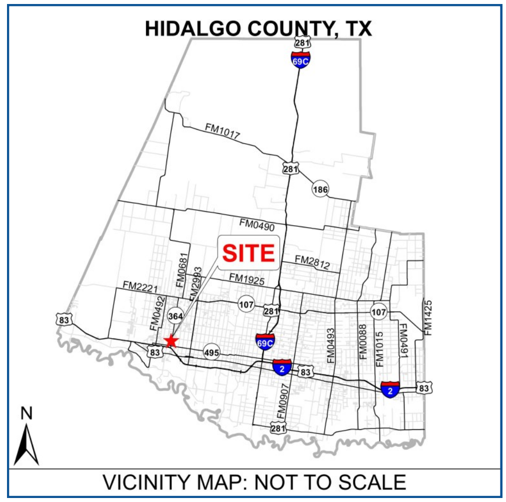
"Filling the Gap"

Colonia: Ramirez Estates, Hidalgo County

Basin: North Main Drain

Category: A1

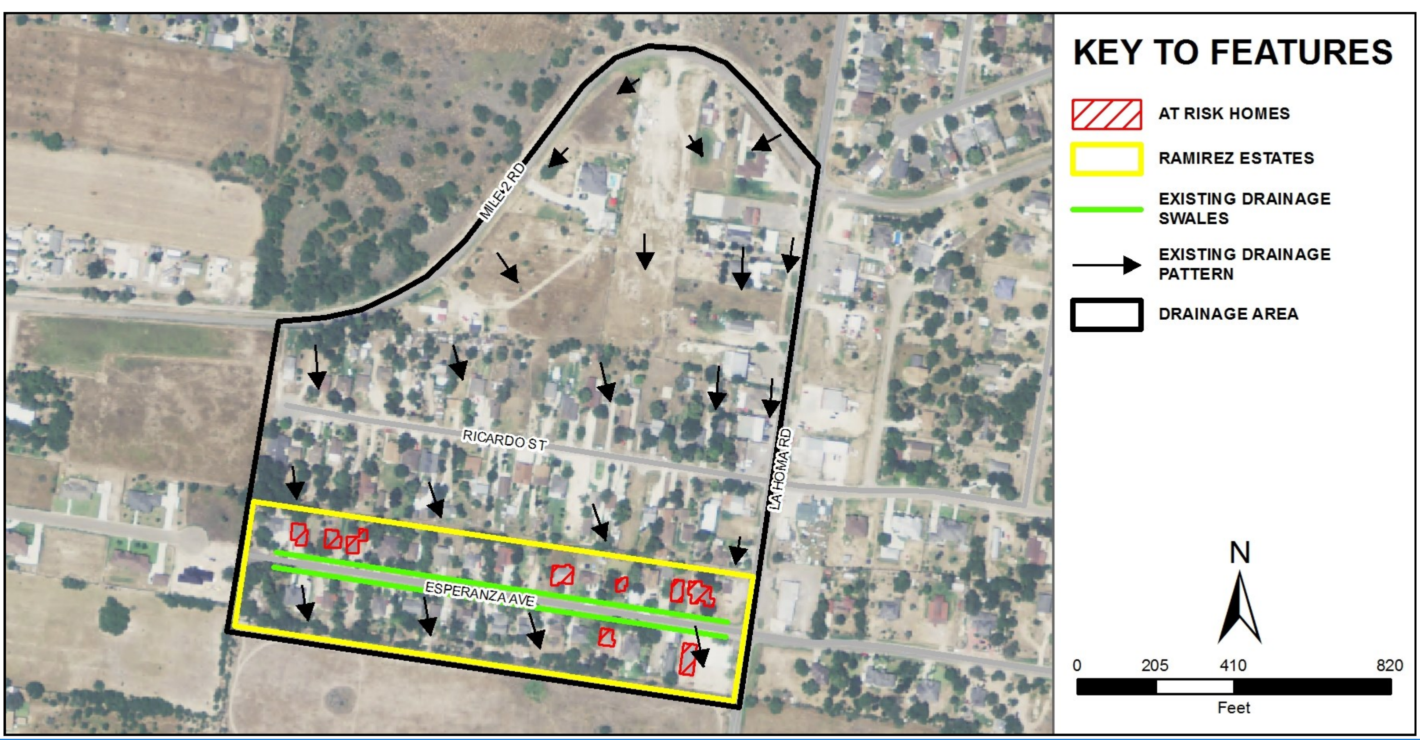
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Ramirez Estates storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Ramirez Estates consists of approximately 10 acres of fully developed residential land with an offsite drainage area of approximately 31 acres of developed residential land. Part of the offsite drainage area includes the colonia "La Homa Road Subdivision". There are existing swales and culverts along Esperanza Avenue but they do not provide adequate drainage for the colonia. The existing drainage pattern indicates that runoff flows south. The results of the existing conditions 2D model indicate that several structures are at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Ramirez Estates, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install an underground drainage system to outfall into the existing drainage ditch located 0.4 miles south (only if adequate capacity is available).

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
Based on Lidar observations and the results of the existing conditions 2D model, it was determined that in order to prevent flooding within the colonia, drainage improvements would be necessary along Ricardo Street as well as Esperanza Avenue. The benefit to cost ratio was calculated for Ramirez Estates, however it should be noted that the suggested improvements would also benefit the colonia La Homa Road Subdivision. The benefits associated with La Homa Road Subdivision were not evaluated in this report. The recommended improvements have been designed to provide drainage protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 532 linear feet of 21-inch diameter pipe, 723 linear feet of 24-inch diameter pipe, 352 linear feet of 27-inch diameter pipe, 621 linear feet of 30-inch diameter pipe , 559 linear feet of 36-inch diameter pipe, 262 linear feet of 42-inch diameter pipe, and 18 curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 14.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
RAMIREZ ESTATES		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$477,592.33
2	Drainage Improvements	$299,571.00
3	Pond Excavation Improvements	$386,994.20
	Sub-Total =	**$1,164,157.54**
	Engineering Fees (10%) =	**$116,415.75**
	Contingency (20%) =	**$232,831.51**
	Total =	**$1,513,404.80**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	6	0	6
4% (25-year)	7	0	7
1% (100-year)	9	0	9

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,465,253.00	$1,513,404.80	0.97
Elevate Structures	$1,465,253.00	$918,150.00	1.60
Acquisition/Supplemental Housing / Demolition	$2,149,709.00	$896,906.10	2.40

Colonia: Ramirez Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

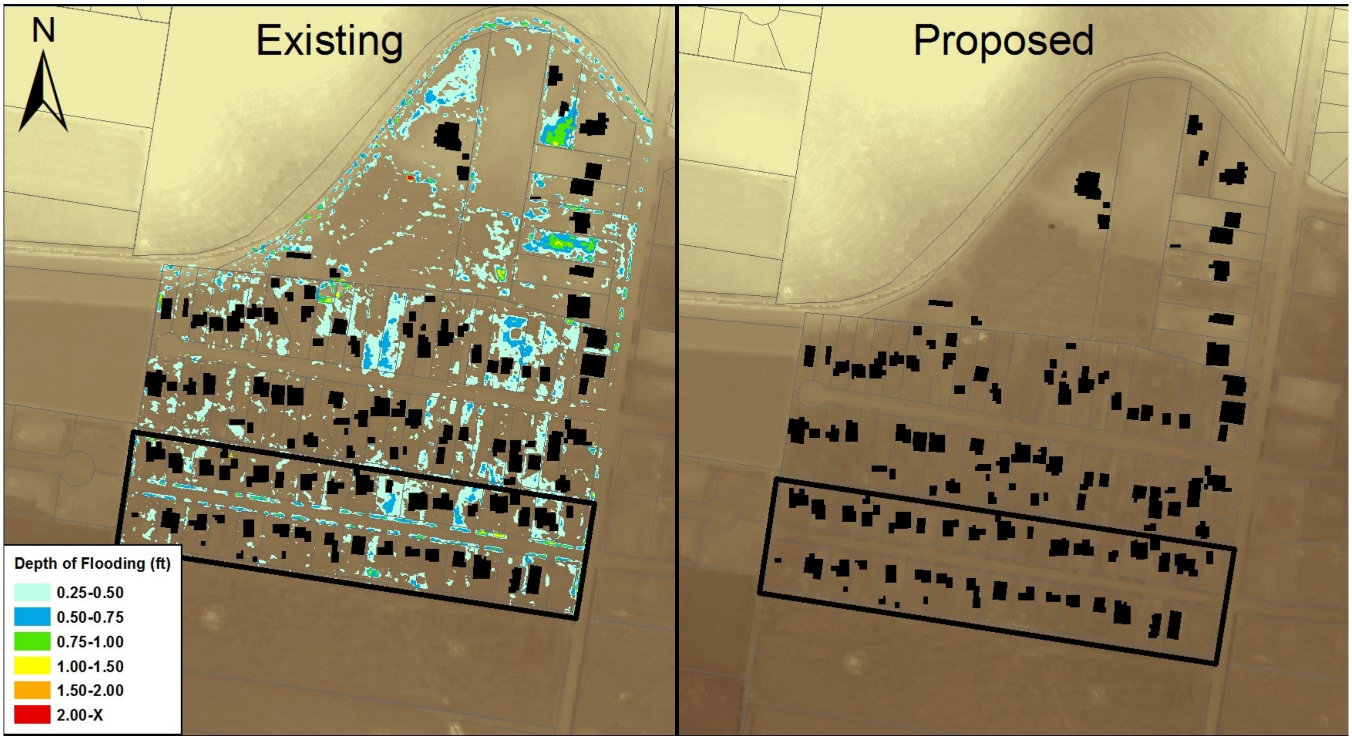


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	0	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ramirez Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

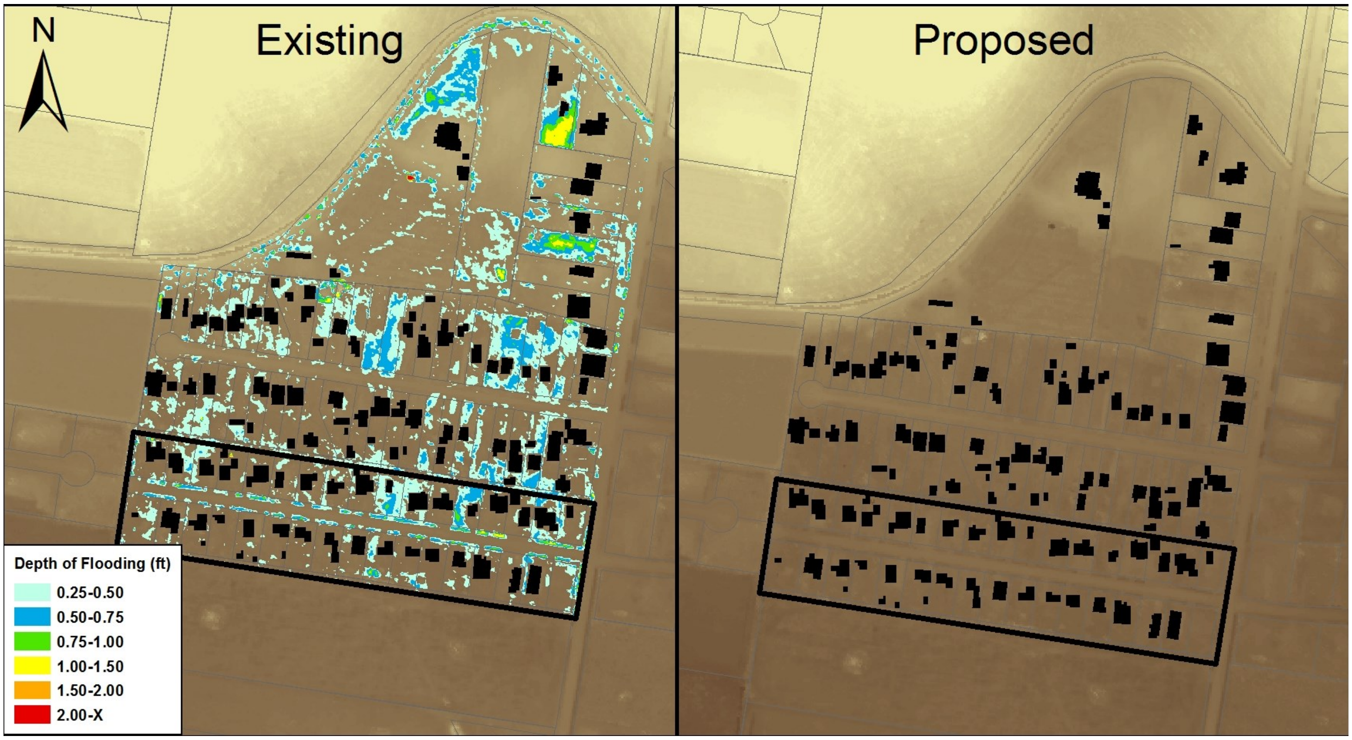


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	34	0	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ramirez Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

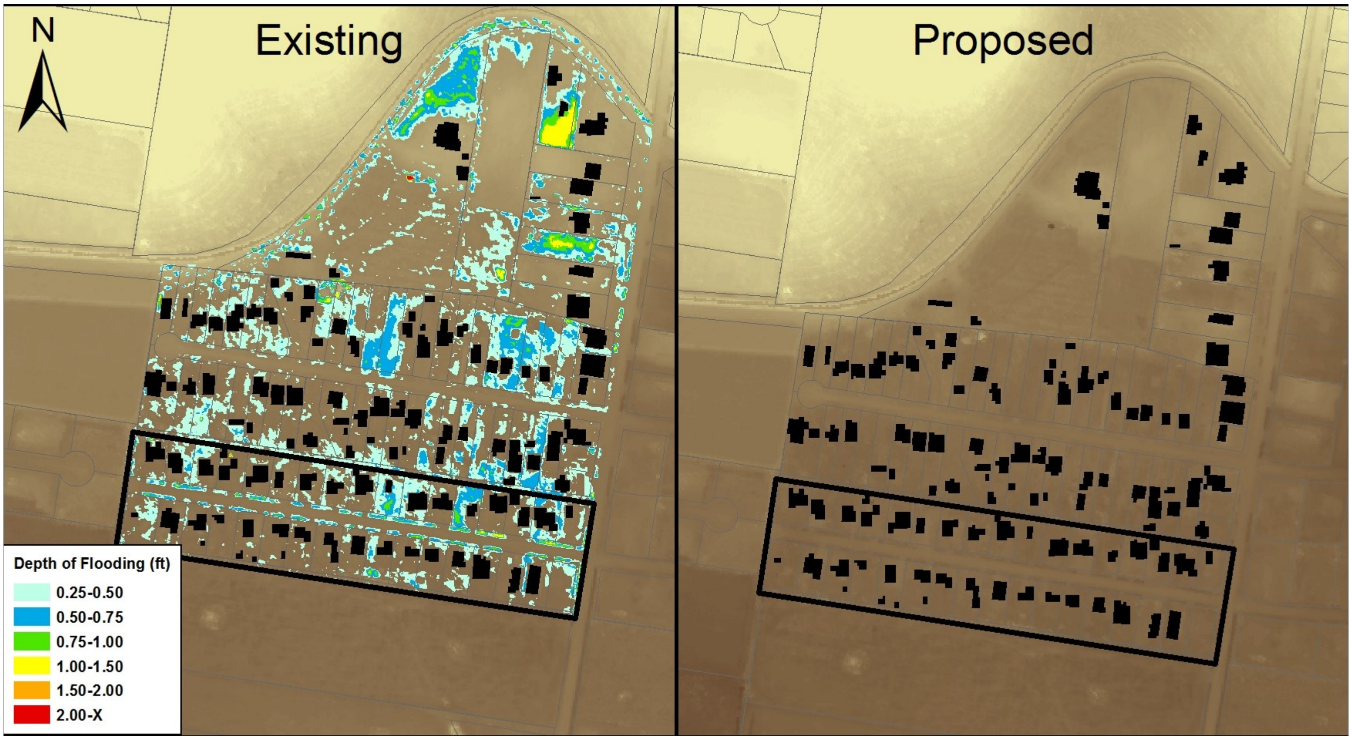


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	34	0	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ramirez Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

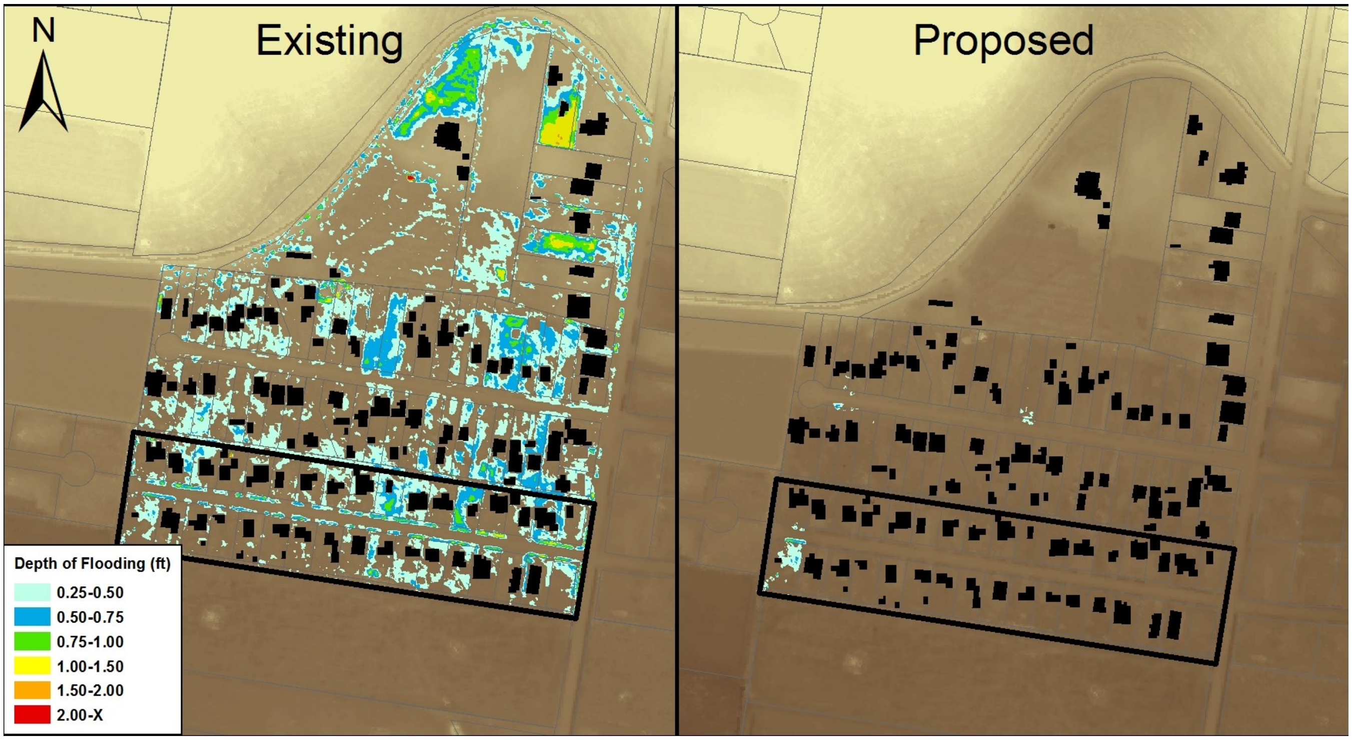


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	34	2	32
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

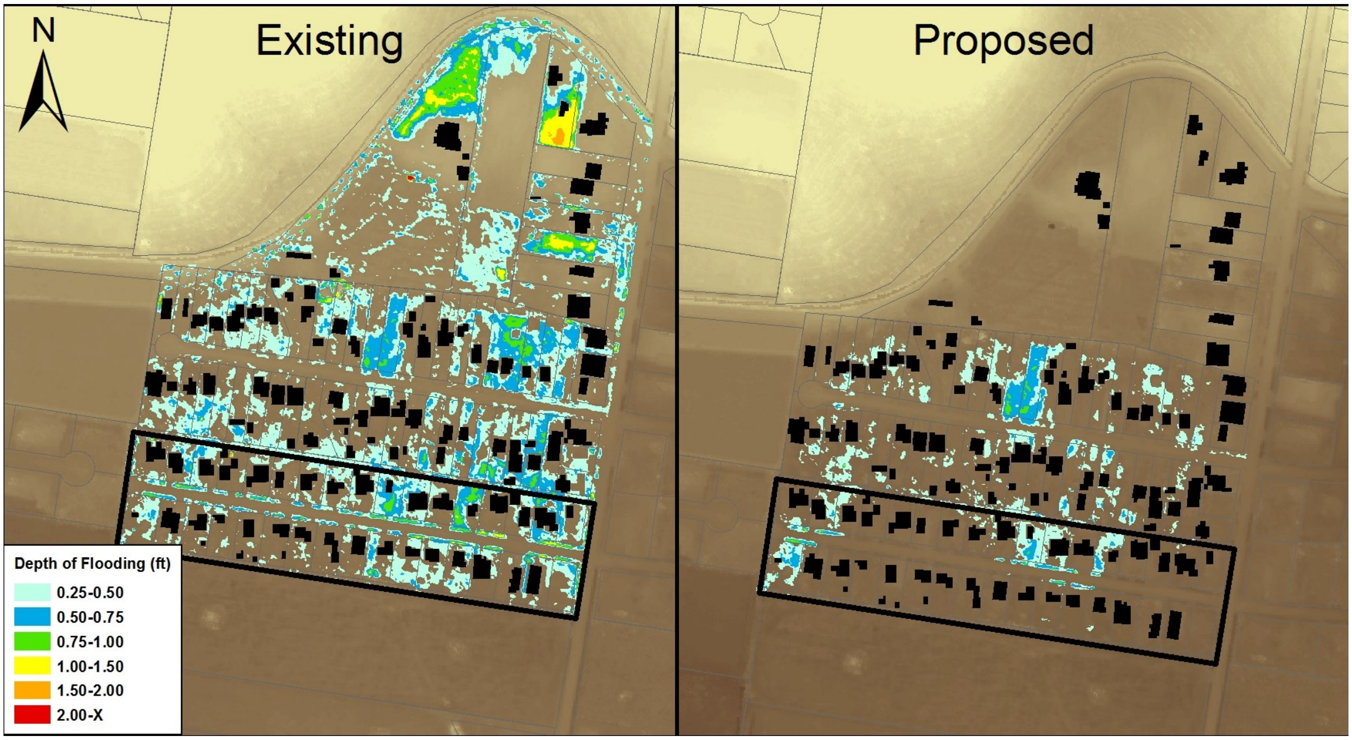
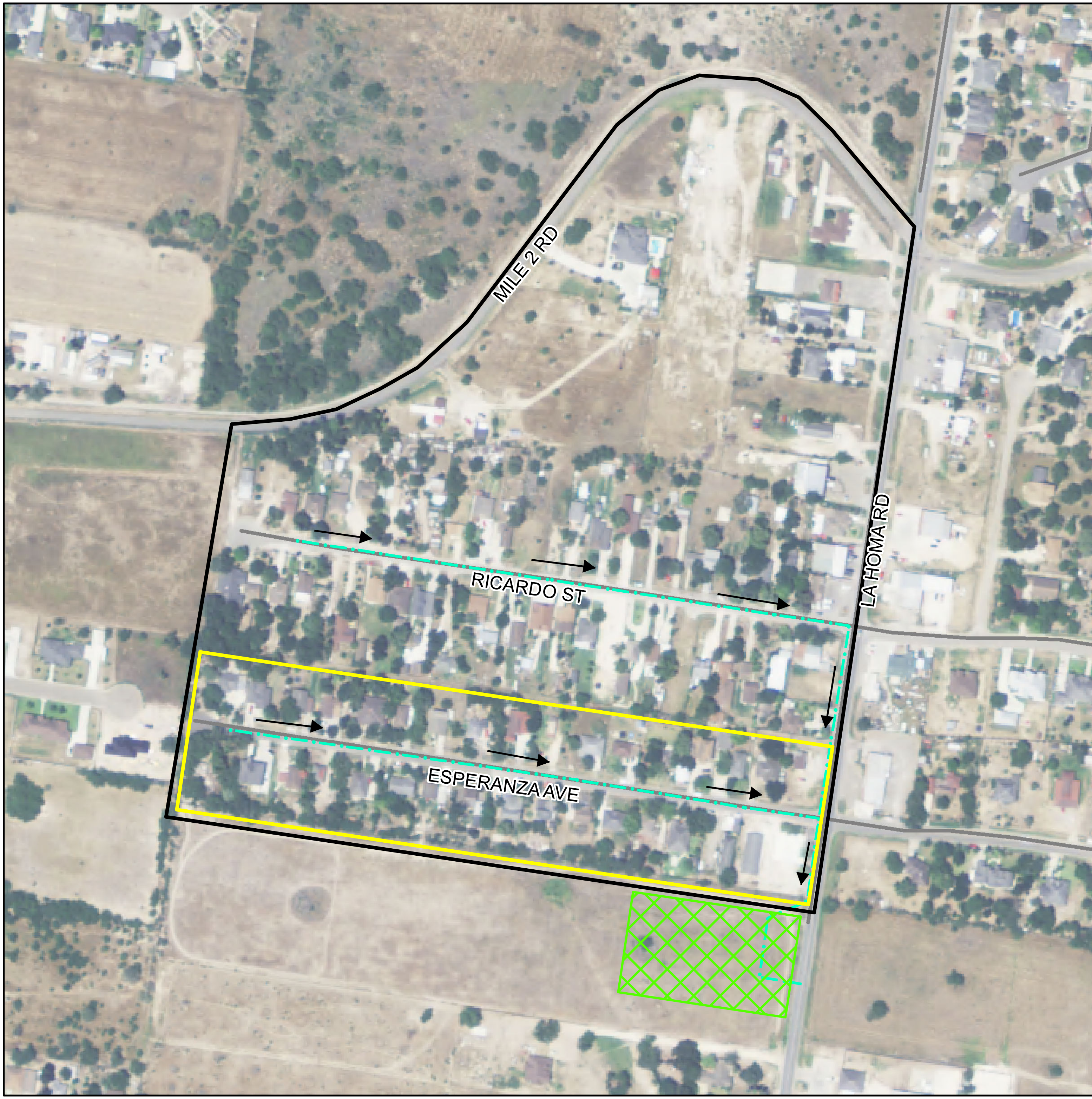


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	0	9
Inundated Lots	34	19	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Ramirez Estates
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- RAMIREZ ESTATES
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 180 360 540
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

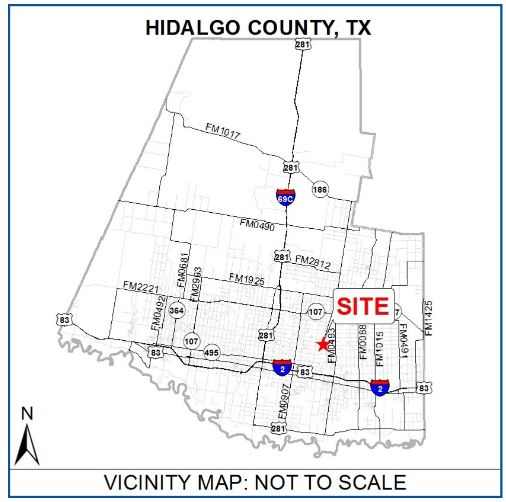
"Filling the Gap"

Colonia: Reina Del Sol Mobile Home Estates, Hidalgo County

Basin: North Main Drain

Category: A1

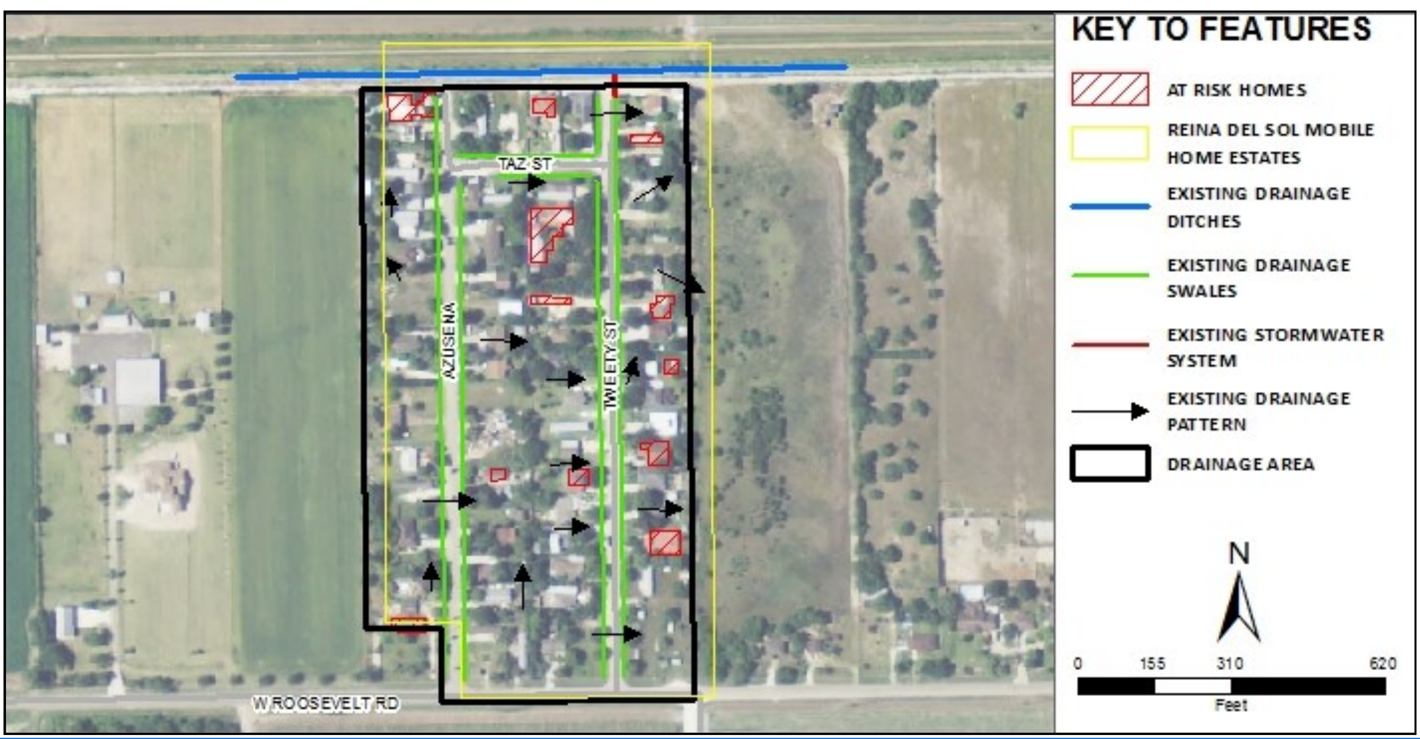
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Reina Del Sol Mobile Home Estates storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Reina Del Sol Mobile Home Estates consists of approximately 18 acres of fully developed residential land. The existing drainage system consists of swales and culverts that convey runoff toward the north, and outfall into an existing drainage ditch via two culverts. The existing drainage pattern indicates runoff flows toward the east. The existing conditions 2D model results show that several structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Reina Del Sol Mobile Home Estates, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Improve existing culverts and swales to allow maximum conveyance toward the existing drainage ditch.
  - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 163 linear feet of 18-inch diameter pipe, 1,490 linear feet of 24-inch diameter pipe, 187 linear feet of 30-inch diameter pipe, 322 linear feet of 36-inch diameter pipe, and thirteen curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4.8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST REINA DEL SOL MOBILE HOME ESTATES		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$464,441.67
2	Drainage Improvements	$201,543.00
3	Pond Excavation Improvements	$130,295.45
	Sub-Total =	**$796,280.12**
	Engineering Fees (10%) =	**$79,628.01**
	Contingency (20%) =	**$159,256.02**
	Total =	**$1,035,164.16**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Reina Del Sol Mobile Home Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	4	0	4
20% (5-year)	6	0	6
10% (10-year)	6	0	6
4% (25-year)	10	0	10
1% (100-year)	13	3	10

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$4,760,308.00	$1,035,164.16	4.60
Elevate Structures	$4,760,308.00	$1,350,375.00	3.53
Acquisition/Supplemental Housing / Demolition	$4,970,522.00	$1,363,873.84	3.64

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	70	0	70
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	70	0	70
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

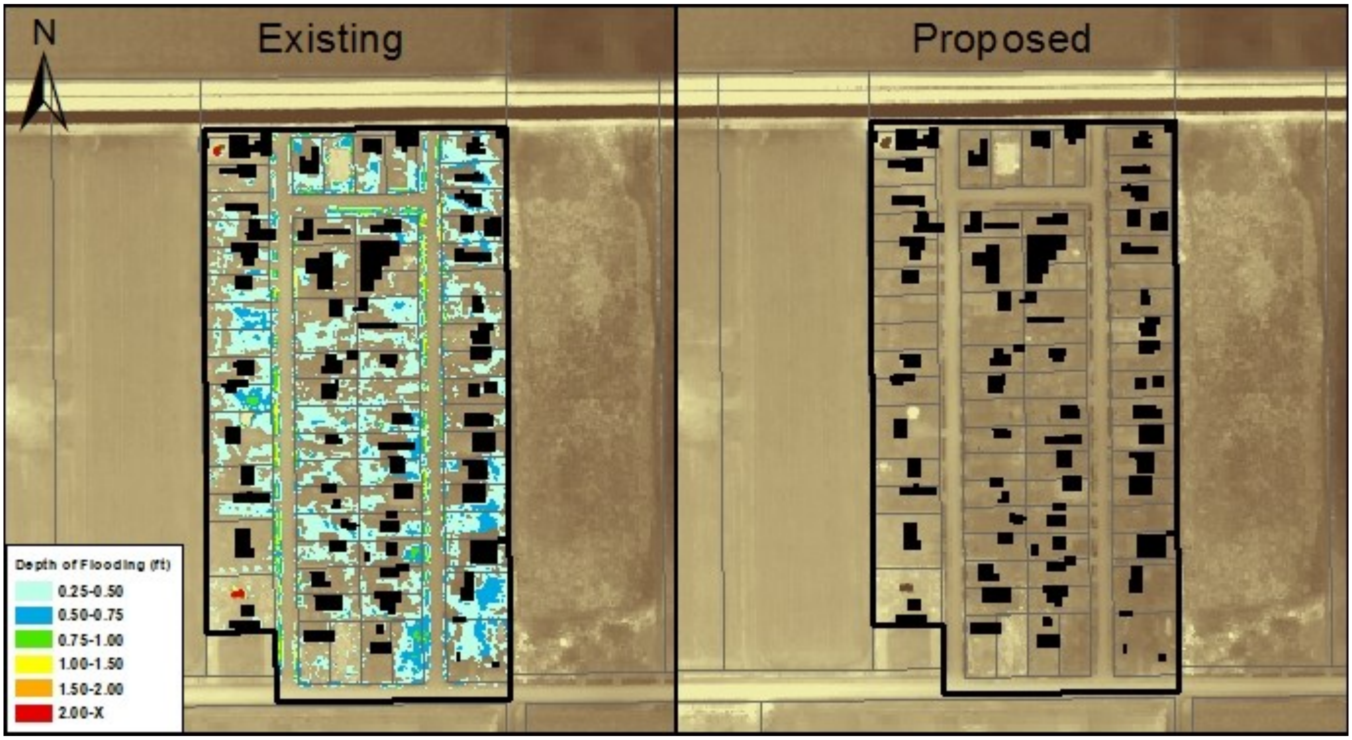


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	70	0	70
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

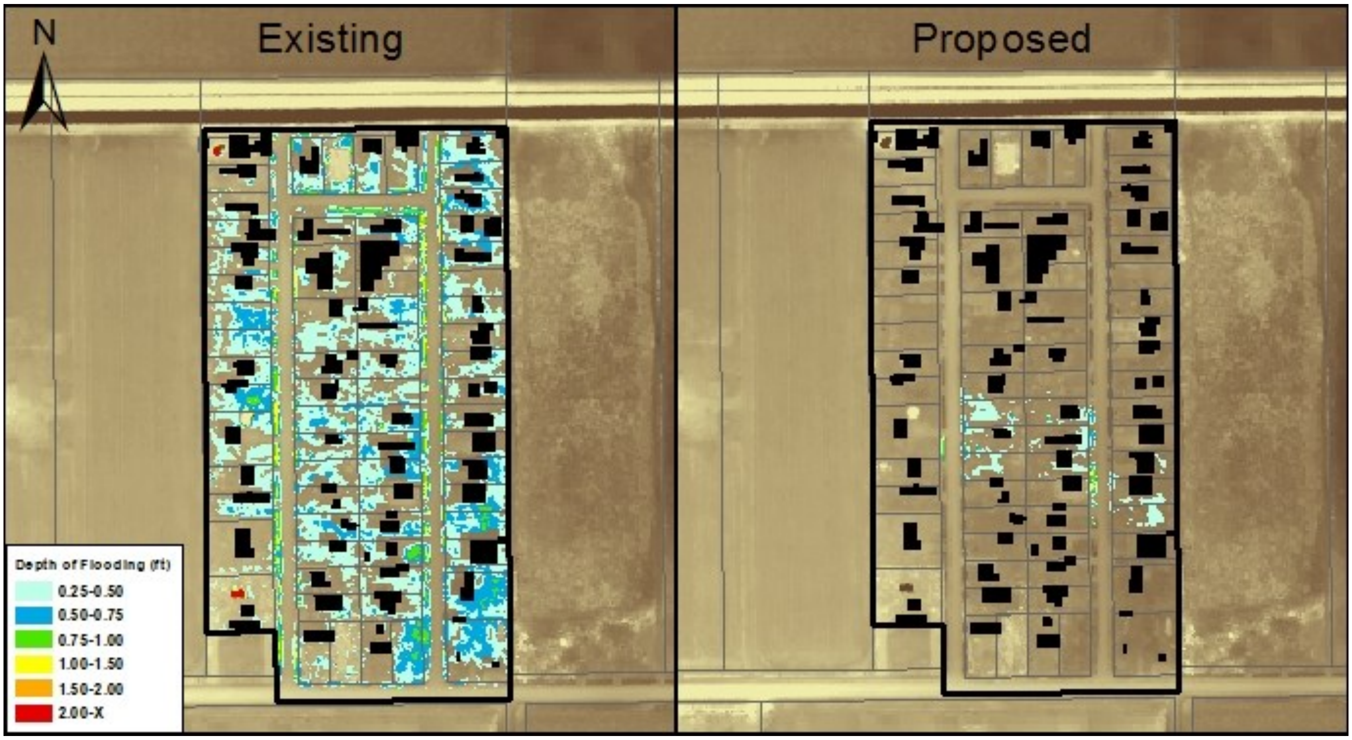


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	10	0	10
Inundated Lots	70	14	56
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

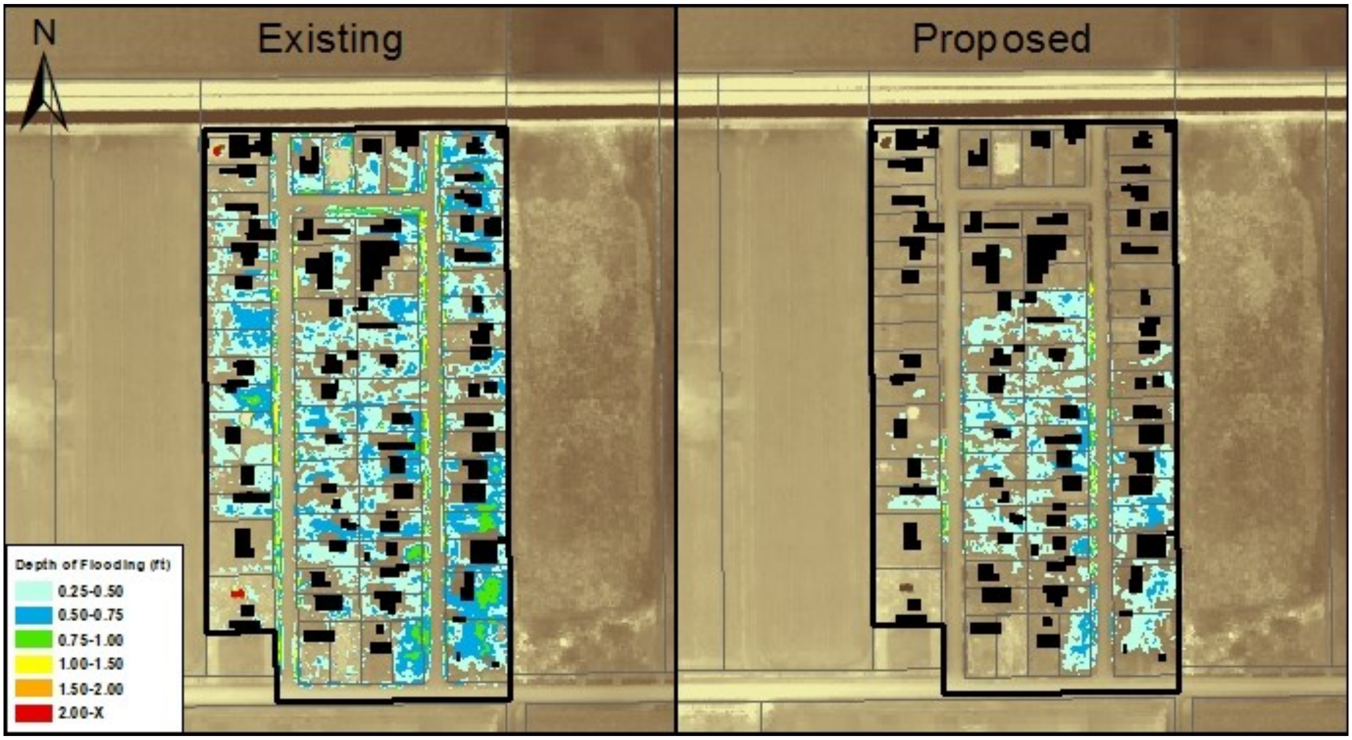
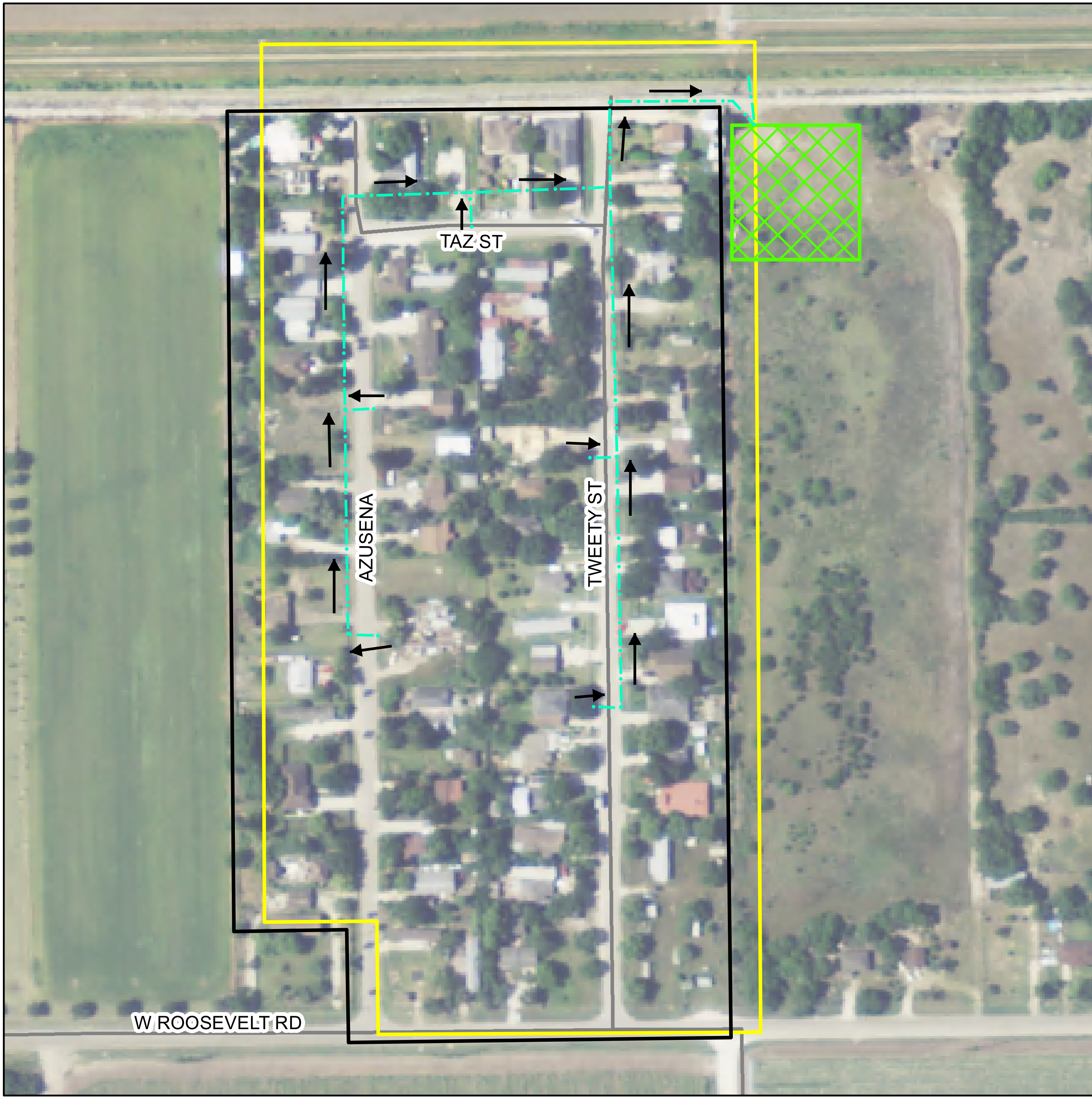


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	13	3	10
Inundated Lots	70	41	29
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Reina Del Sol Mobile Home Estates
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- REINA DEL SOL MOBILE HOME ESTATES
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N W E S

0 110 220 330
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

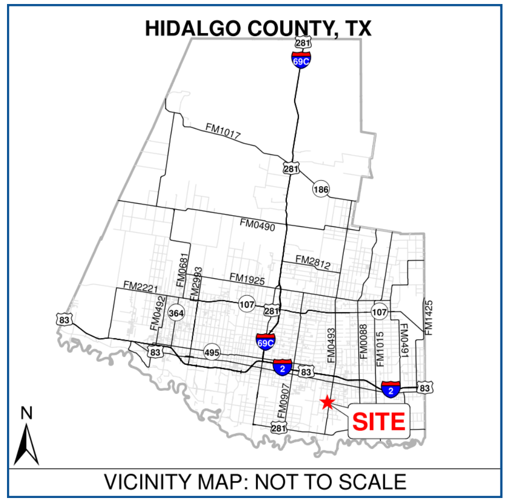
"Filling the Gap"

Colonia: River Road Subd., Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

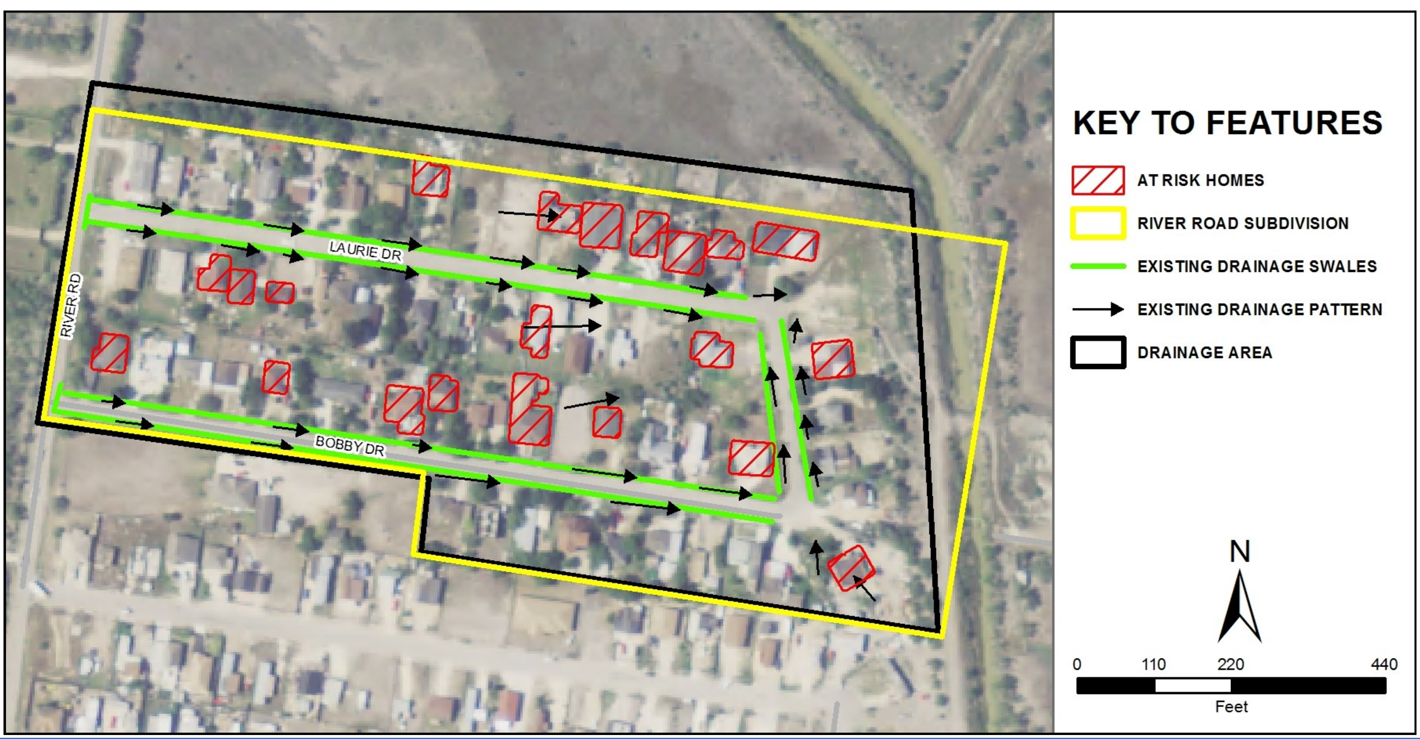
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia River Road Subdivision storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

River Road Subdivision consists of approximately 16 acres. Currently the colonia has swales with culverts along Laurie Drive and Bobby Drive, that outfall into an existing ditch along the east side of the colonia. The model results indicate runoff flows toward the northeast quadrant of the colonia. The results are consistent with site visit observations of high-risk flooding areas. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 10 inches, blue 10 to 12 inches, green 12 to 15 inches, yellow 15 to 18 inches, orange 18 to 24 inches and red more than 24 inches.



Colonia: River Road Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Improve the existing storm system by increasing the outlet pipe or adding multiple outlets.
  - Install an underground drainage system to outfall into the existing drain ditch.
  - Install a new retention pond for the colonia runoff.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharges of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. Based on the results of the existing conditions 2D model, the recommended improvements include installing an underground drainage system and the construction of a retention facility. The new system consists of 1,431 linear feet of 24-inch diameter pipe, 706 linear feet of 30-inch diameter pipe, and 255 linear feet of 36-inch diameter pipe. Fourteen new inlets, and three concrete manholes are also included in the improvements. The proposed retention pond is sized to retain the onsite runoff of up to the 25-Year storm and it entails a facility with an effective storage volume of 10.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST RIVER ROAD		
IMPROVEMENTS		COST
1	Paving Improvements	$423,136.00
2	Drainage Improvements	$245,910.00
3	Pond Excavation Improvements	$284,455.00
	Sub-Total =	**$953,501.00**
	Engineering Fees (10%) =	**$95,350.10**
	Contingency (20%) =	**$190,700.20**
	Total =	**$1,239,551.30**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: River Road Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	2	0	2
1% (100-year)	5	0	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,798,275	$1,239,551	1.45
Elevate Structures	$1,798,275	$479,400	3.75
Acquisition/Supplemental Housing / Demolition	$2,119,772	$391,704	5.41

Colonia: River Road Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

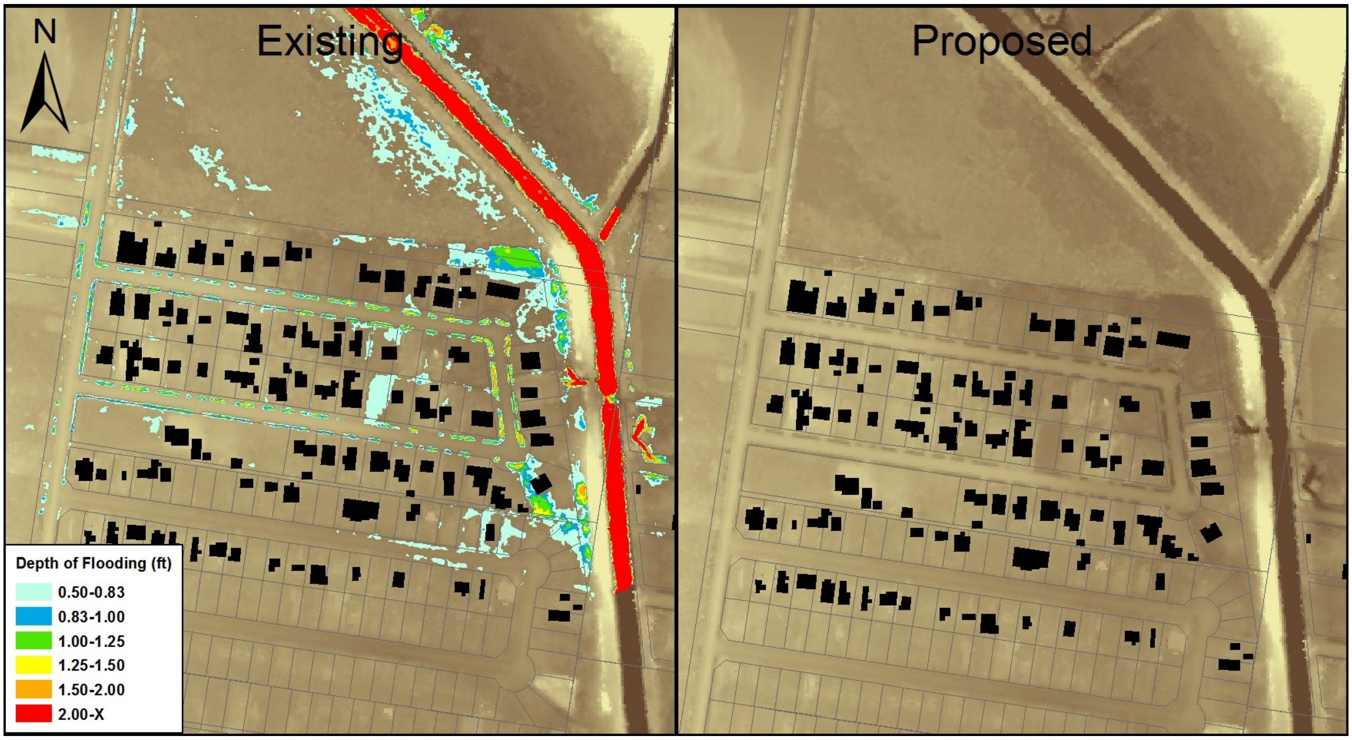


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	47	0	47
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: River Road Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

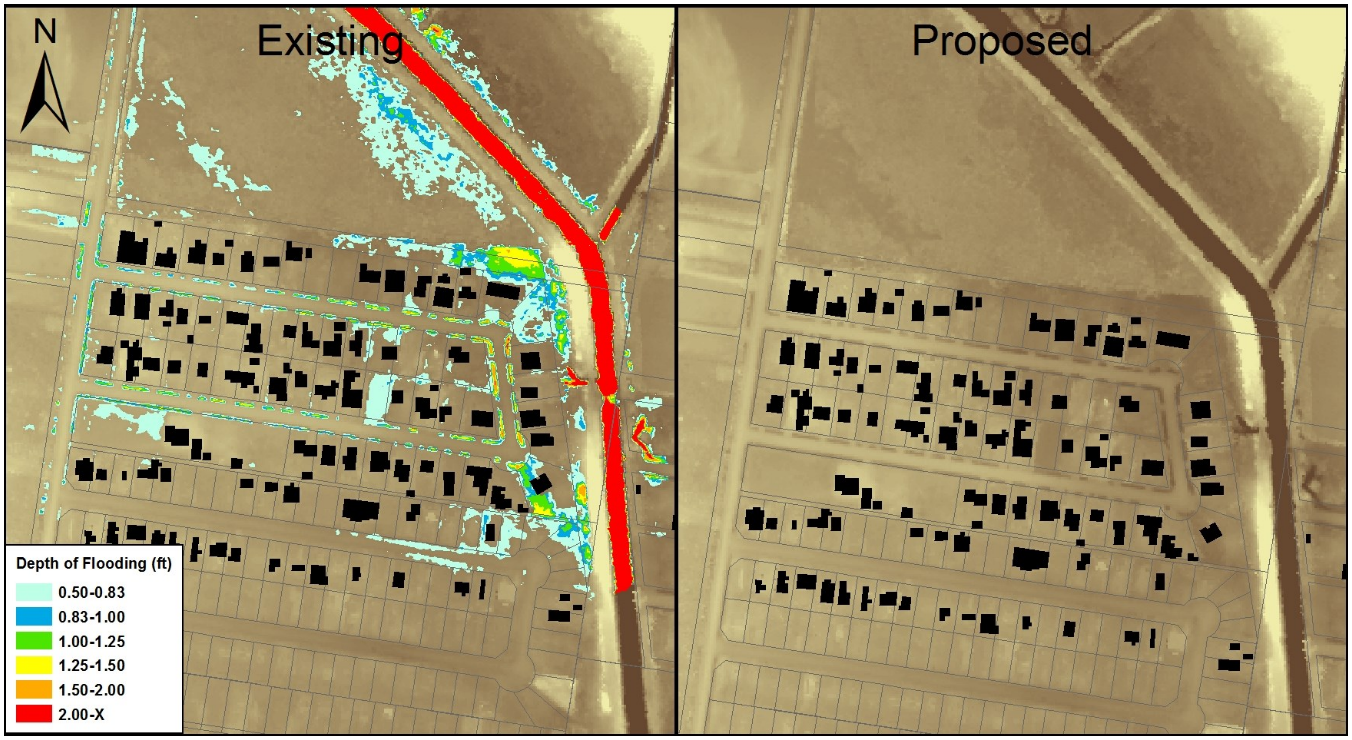


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	49	0	49
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: River Road Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

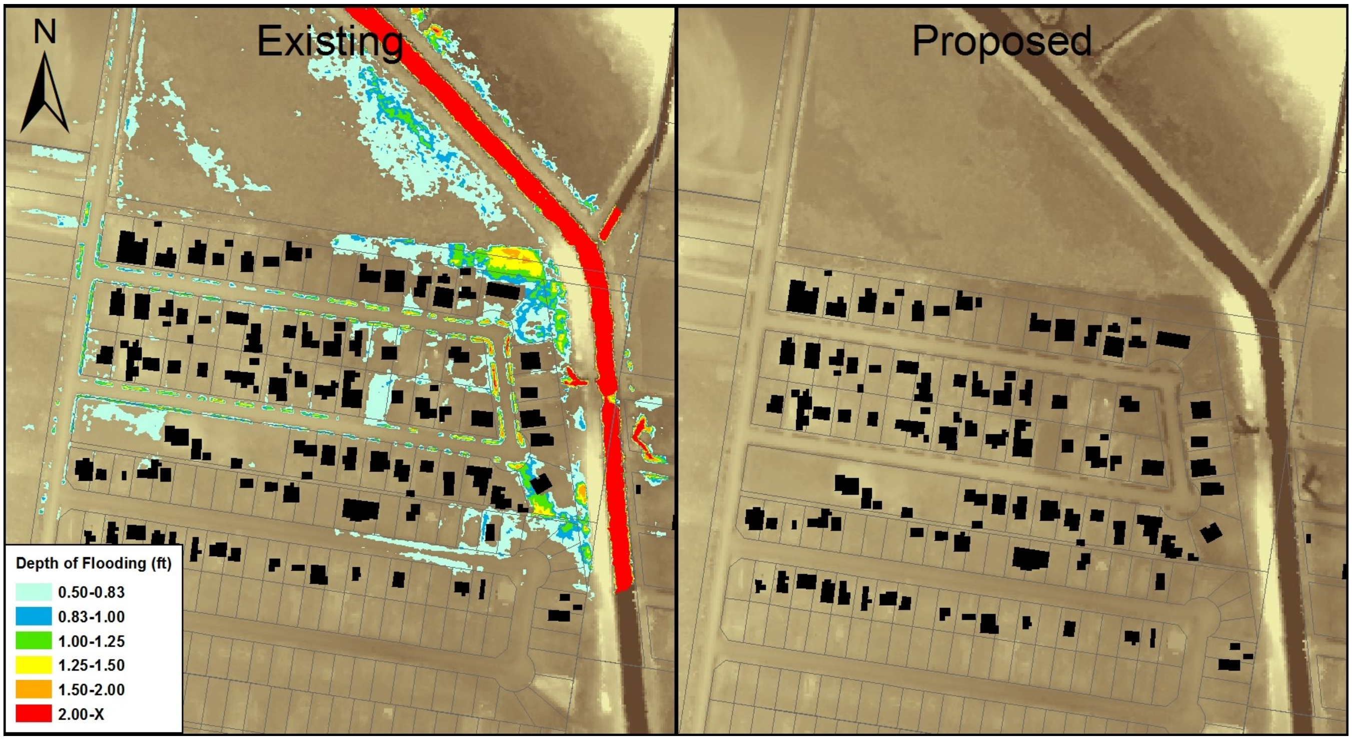


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	50	0	50
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Recommended Mitigation Project cont.:

Project Figures:

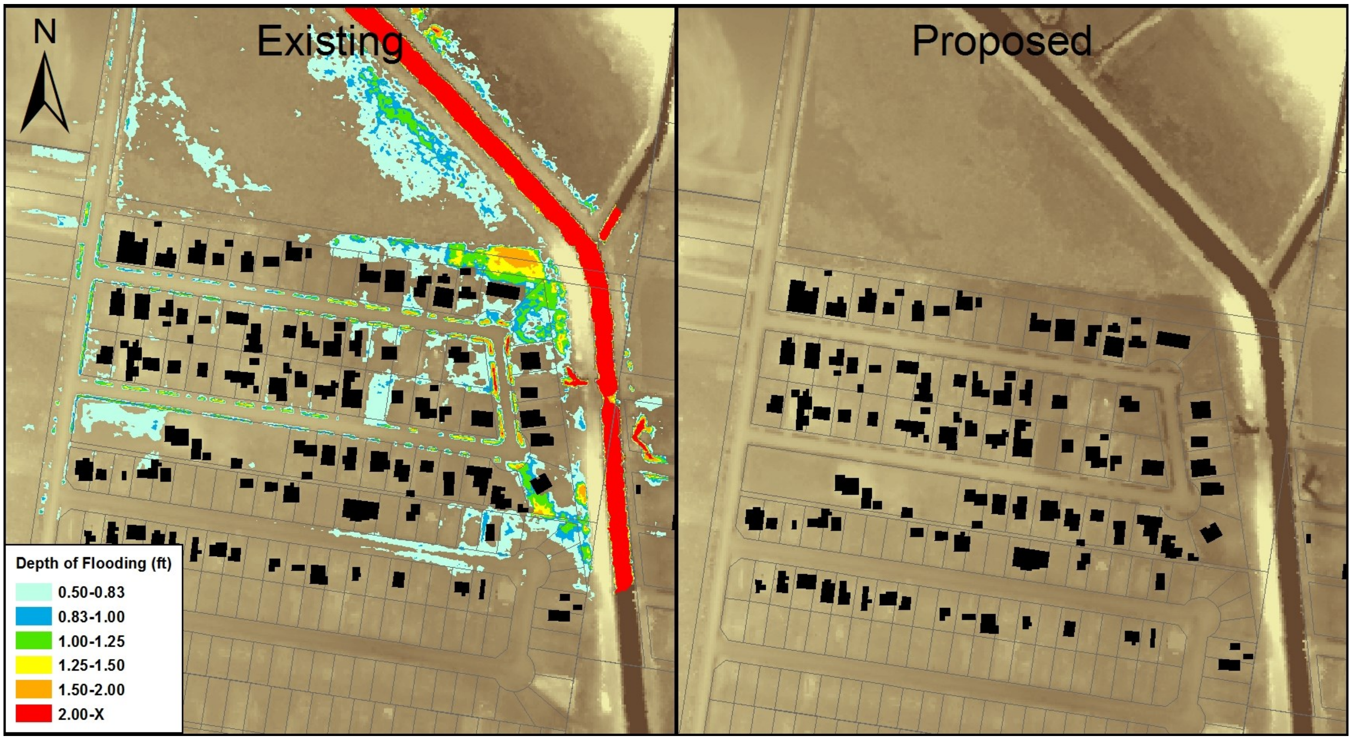


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	53	0	53
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: River Road Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

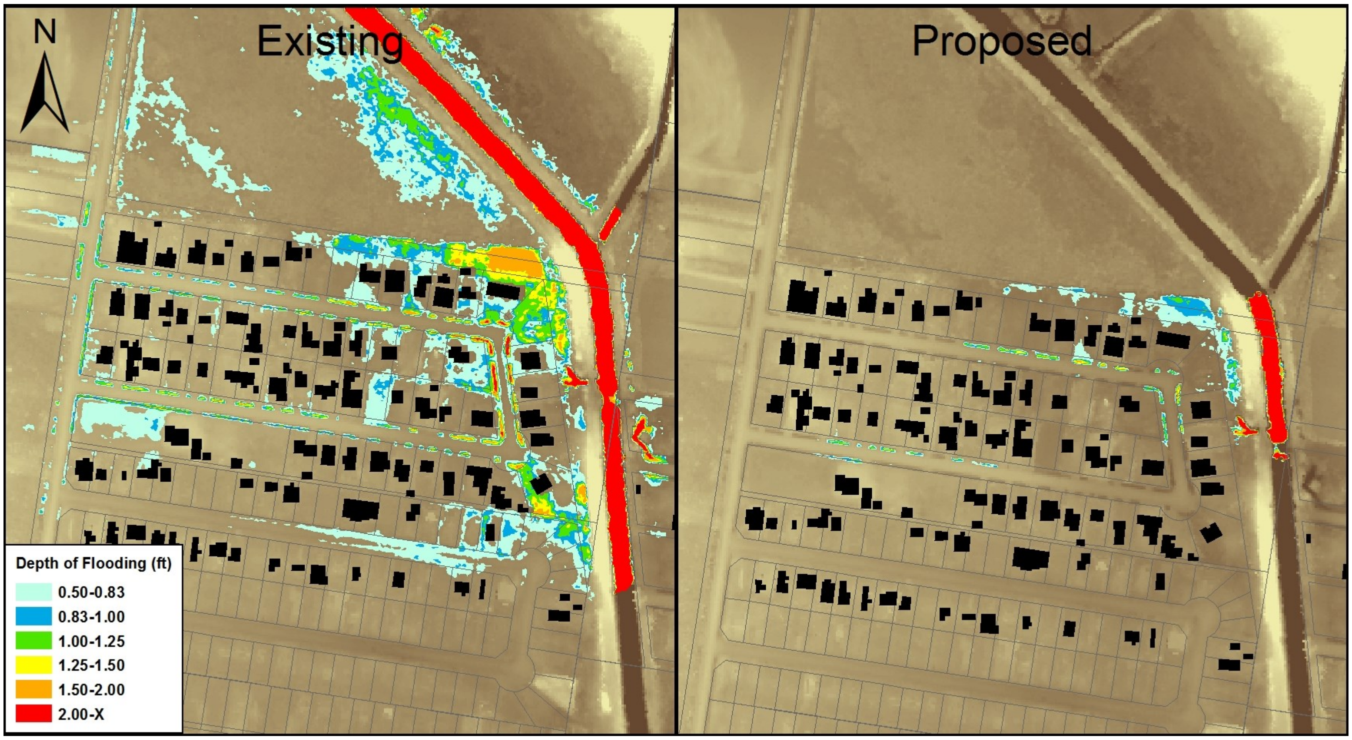
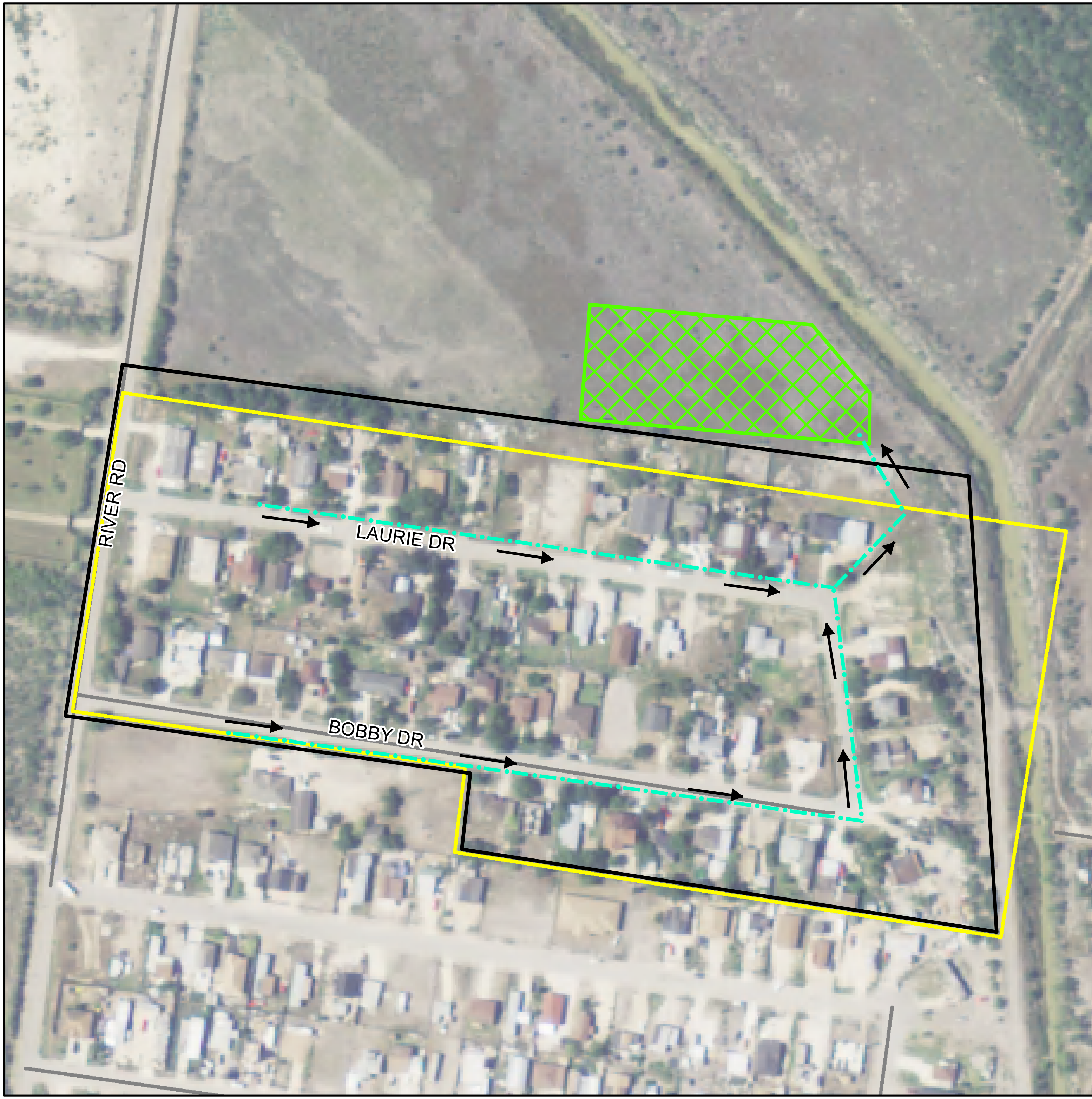


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	0	5
Inundated Lots	54	9	45
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: River Road Subdivision
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- RIVER ROAD SUBD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

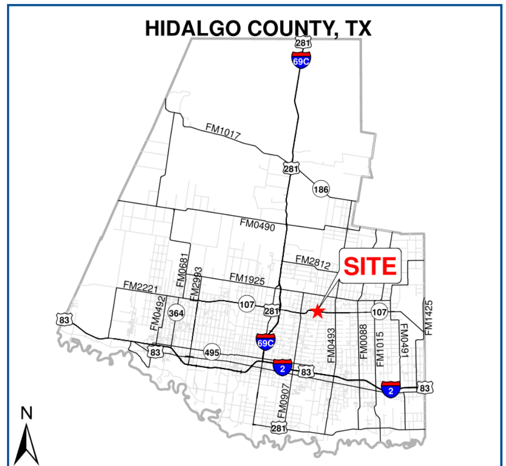
Colonia: Ruthven #1, Hidalgo County

Basin: North Main Drain

Category: A1

Hydrology / Hydraulic Analysis:

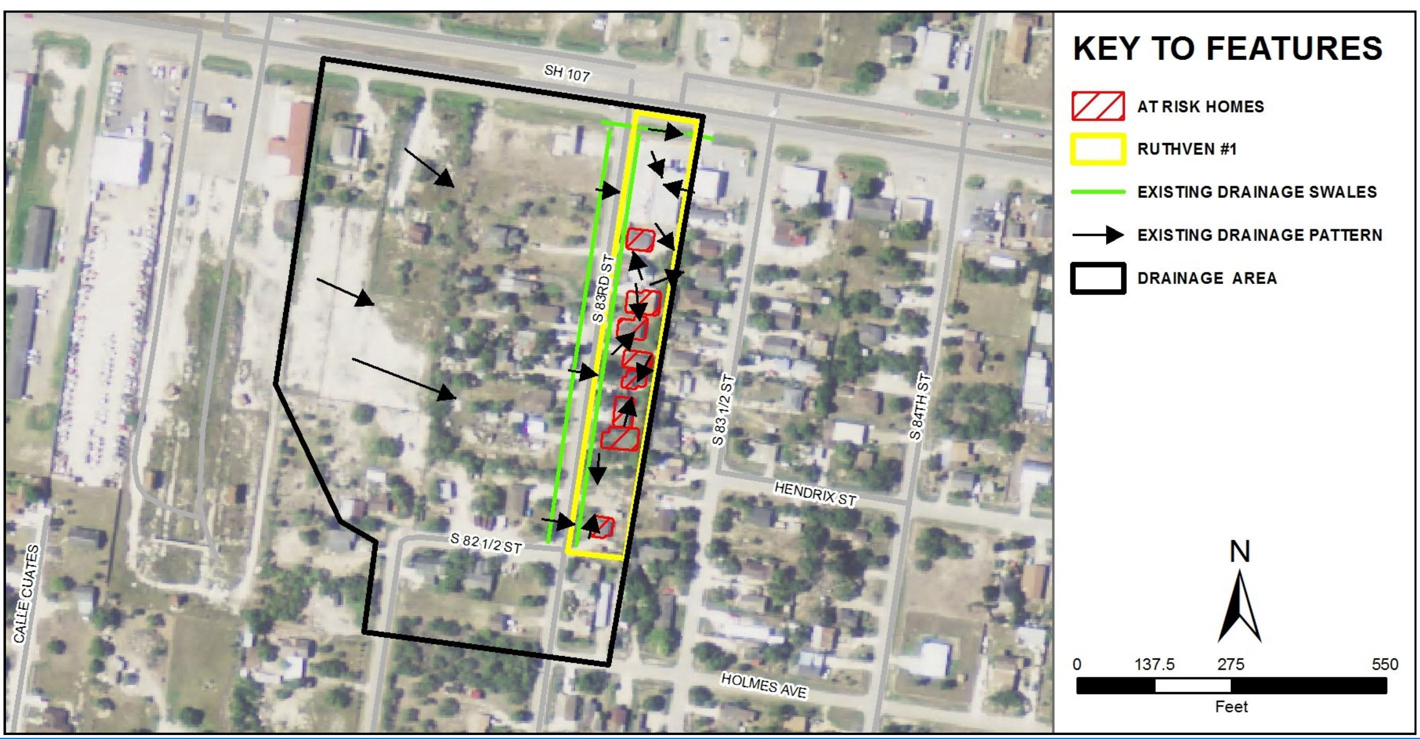
A 2-dimensional hydrodynamic model of the colonia Ruthven #1 storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



VICINITY MAP: NOT TO SCALE

Areas of Risk:

Ruthven #1 consists of approximately 2.2 acres with an offsite drainage basin of approximately 11.9 acres that contributes runoff into the colonia. The colonia currently has a system of swales and culverts that convey runoff toward Highway 107. The model results indicate that some structures within the colonia are at risk of flooding even when subjected to the 10-Year storm and smaller ones. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 10 inches, blue 10 to 12 inches, green 12 to 15 inches, yellow 15 to 22.5 inches, orange 22.5 to 30 inches and red more than 30 inches.



Colonia: Ruthven #1, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a new retention pond.
  - Install an underground drainage system to outfall into the existing drainage ditch.
  - Take a regional design approach to address the offsite drainage basin.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
Based on the results of the existing conditions 2D model, the criteria used to design the new system involves carrying the discharges of the 10-Year storm of the onsite and offsite runoff and retention of both the offsite and onsite runoff of the 25-Year storm. The recommended improvements include installing an underground drainage system and the construction of a retention facility. The new system consists of 100 linear feet of 12-inch diameter pipe, 694 linear feet of 18-inch diameter pipe, 334 linear feet of 24-inch diameter pipe, and 728 linear feet of 30-inch diameter pipe. Ten new inlets and a manhole are also included in the improvements. The proposed retention pond is sized to retain both the onsite and offsite runoff of up to the 25-Year storm and it entails a facility with an effective storage volume of 12.9 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
RUTHVEN #1

	IMPROVEMENTS	COST
1	Paving Improvements	$273,705.00
2	Drainage Improvements	$150,018.00
3	Pond Excavation Improvements	$346,522.50
	Sub-Total =	**$770,245.50**
	Engineering Fees (10%) =	**$77,024.55**
	Contingency (20%) =	**$154,049.10**
	Total =	**$1,001,319.15**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Ruthven #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	2	0	2
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$384,398	$1,001,319	0.38
Elevate Structures	$384,398	$142,500	2.70
Acquisition/Supplemental Housing / Demolition	$397,448	$119,398	3.33

Colonia: Ruthven #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

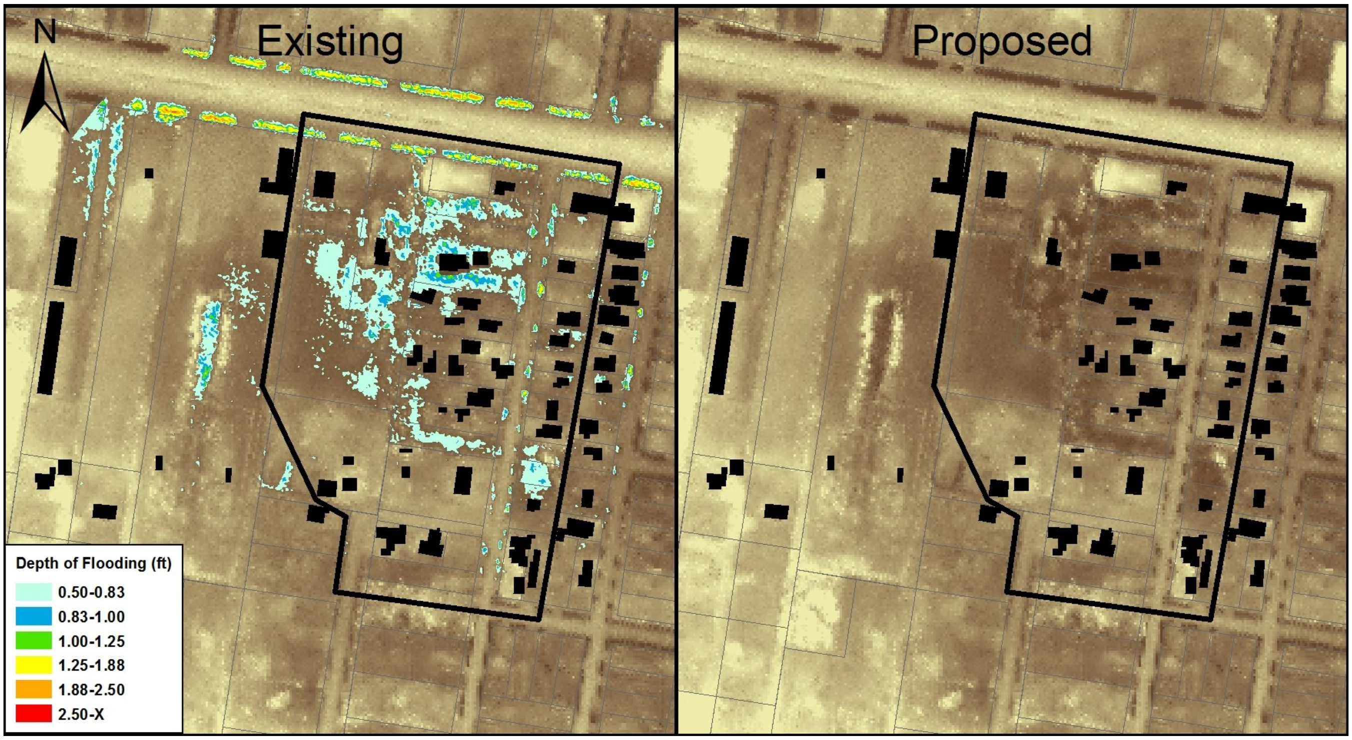


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	13	0	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Ruthven #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

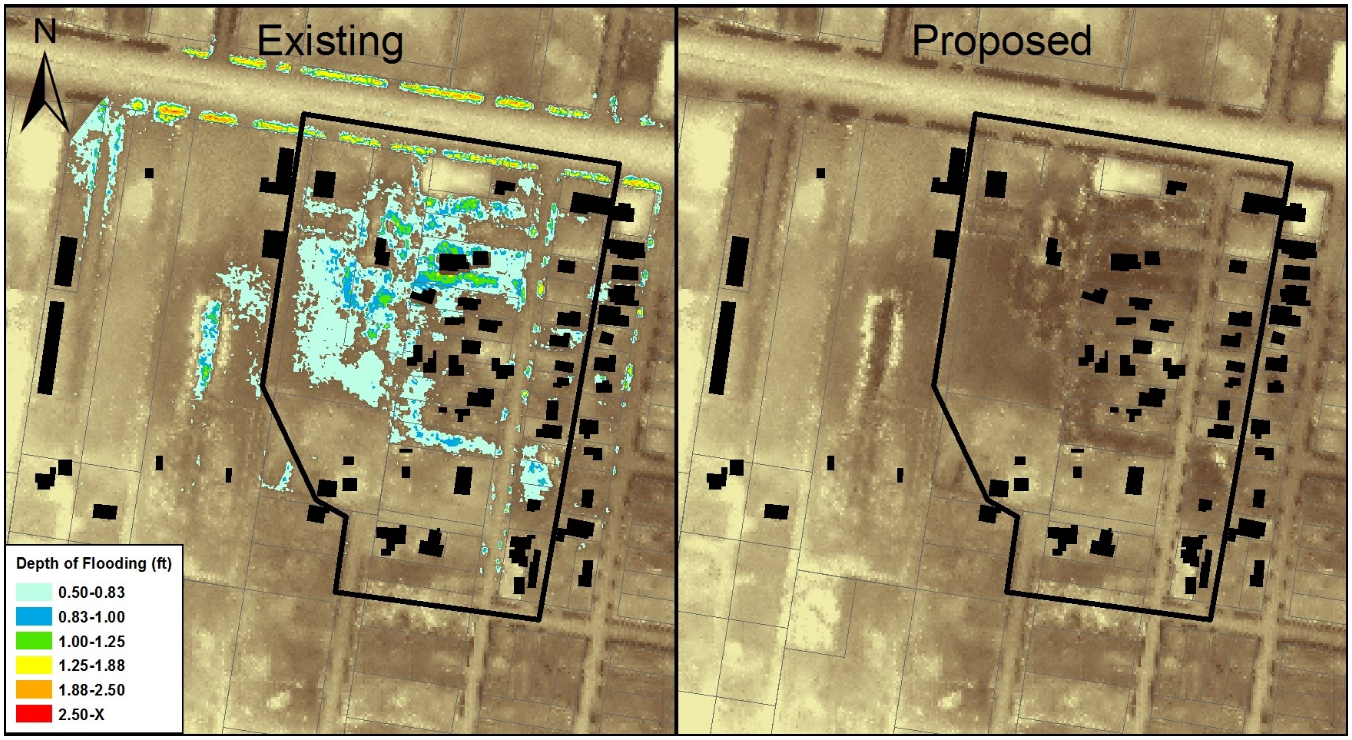


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	13	0	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Ruthven #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

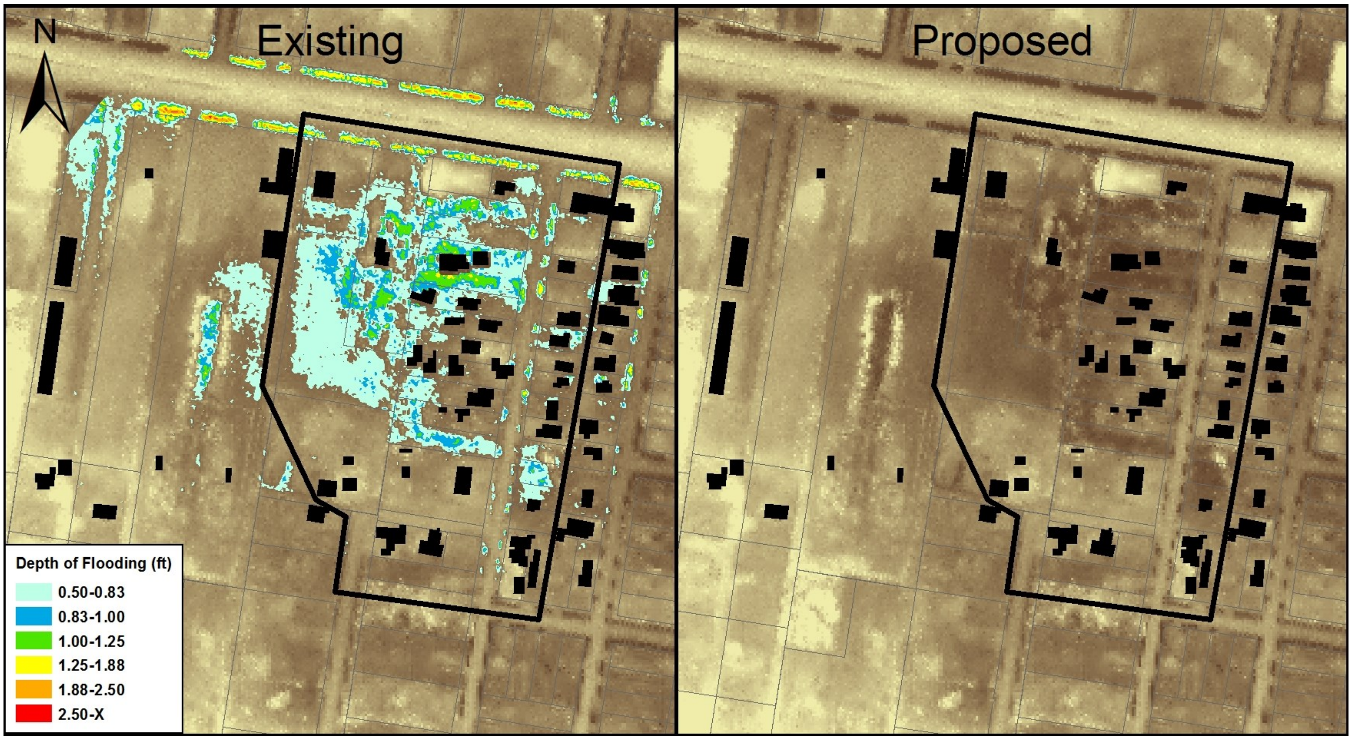


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	13	0	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Recommended Mitigation Project cont.:

Project Figures:

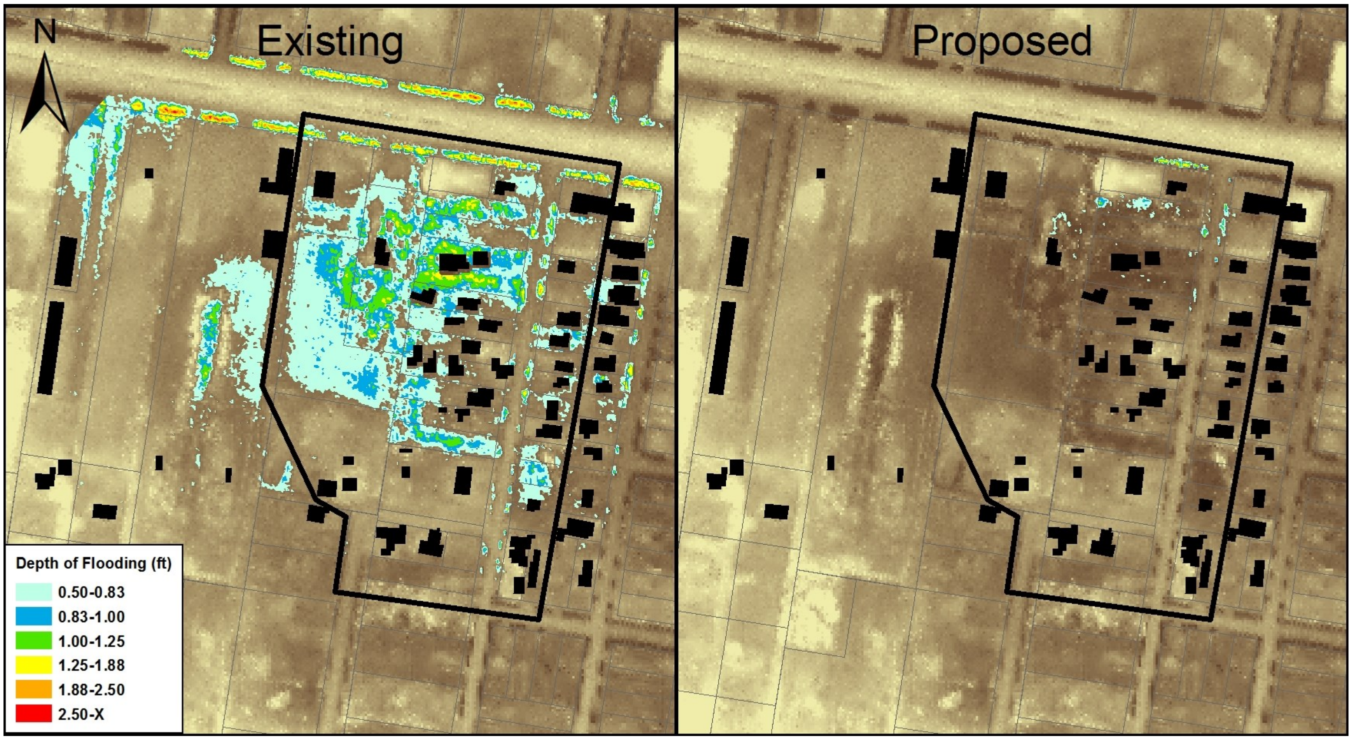


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	14	1	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Ruthven #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

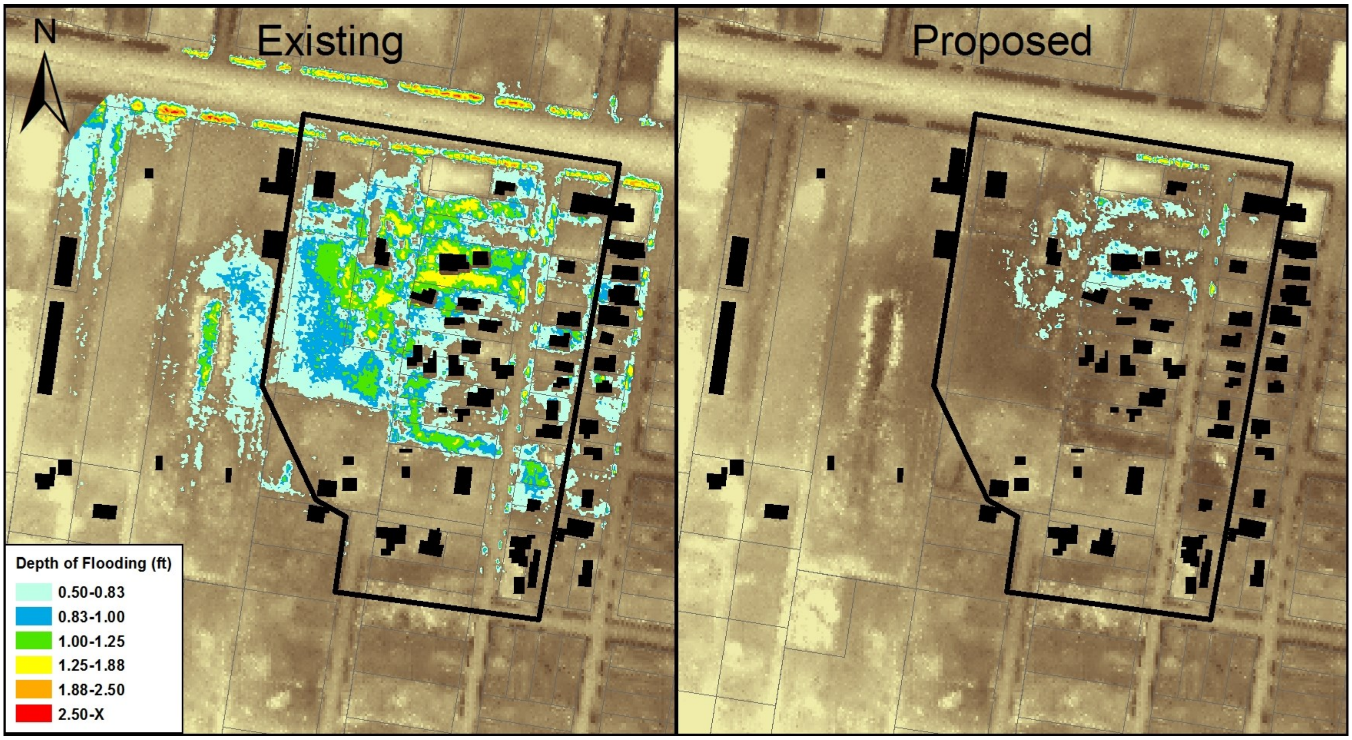


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	14	1	13
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Ruthven #1
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- RUTHVEN #1
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 160 320 480
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

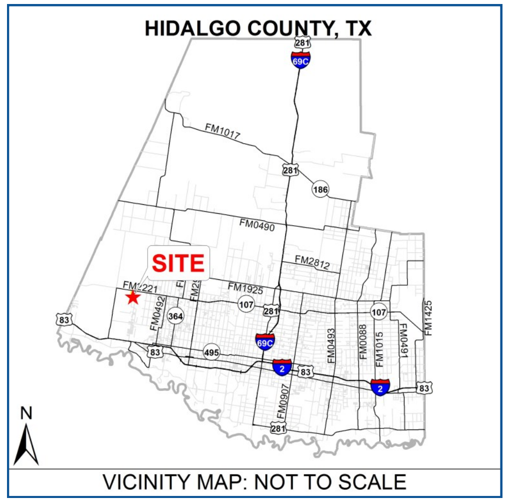
Colonia: Salida Del Sol Estates, Hidalgo County

Basin: North Main Drain

Category: A1

“Filling the Gap”

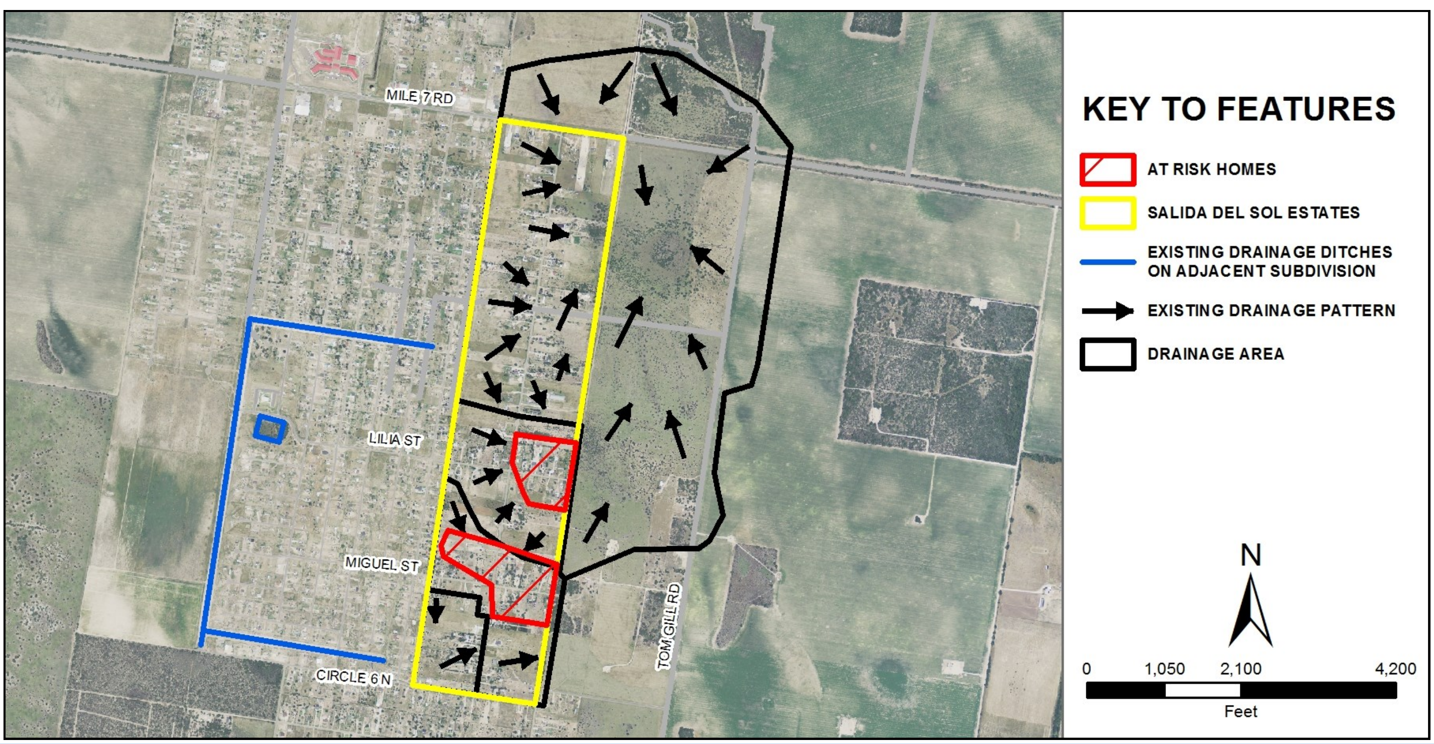
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the drainage pattern of the colonia and surrounding area was created using the software program InfoWorks-SD. The model integrates hydrologic and hydraulic modeling and simulates the relationship between rainfall and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

The colonia known as Salida Del Sol Estates consist of approximately 310 acres and the drainage basin that causes the ponding on the northeast corner of the subdivision consists of approximately 667 acres. Some high-risk flooding areas along the southeast end of Miguel Street and the northeast portion of Lilia Street were observed. As runoff travels to low areas it ponds and potentially overflows to other areas of the colonia. The model computed flood depths that are consistent with comments from residents that indicate experience with flooding depths of up to 4-feet. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps of the areas where structures appear to be at risk of flooding for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 18 inches, blue 18 to 30 inches, green 30 to 42 inches, yellow 42 to 54 inches, orange 54 to 66 inches and red more than 66 inches.



Colonia: Salida Del Sol Estates, Hidalgo County

Potential Solutions:

- The following are alternatives for drainage improvements for Salida Del Sol Estates Subdivision:
    - Install an underground drainage system with outfalls to a proposed ditch along the east boundary of the colonia.
    - Improve existing roadside swales.
    - Address localized high risk areas and convey runoff to a ditch that will outfall to an existing retention area.
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Purchase of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
Based on the results of the existing conditions model, it was determined that the structures currently at risk of being flooded are only found in the lower part of the colonia. The recommended system improvements are only for the lower part of the colonia and have been designed to provide protection from flooding for the 10-Yr storm. The model identifies the benefits obtained by the proposed drainage improvements. For the upper part of the colonia, it is recommended that new regulations be implemented for minimum required finished floor elevations. The improvements recommended are aimed at removing structures at risk of flooding from the 6-inch inundation map, and consist of installing a new underground system with grate inlets, pipes, and a drainage ditch on the east side of the colonia to carry the runoff northeast where the lower parts of the terrain are located. The new system consists of 3,470 linear feet of 24-inch diameter pipe, 2,610 linear feet of 30-inch diameter pipe, 2,650 linear feet of 36-inch diameter pipe, 540 linear feet of 42-inch diameter pipe and 2,400 linear feet of 48-inch diameter pipe. The improvements also include 3,230 linear feet of a 10 feet deep trapezoidal drain ditch and 31 grate inlets.
The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.
Potential Challenges:
The potential challenges would be the acquisition of land for the proposed drainage ditch and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.
Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST SALIDA DEL SOL ESTATES		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$13,000.00
2	Drainage Improvements	$1,030,000.00
3	Pond Excavation Improvements	$791,000.00
	Sub-Total =	**$1,834,000.00**
	Engineering Fees (10%) =	**$183,400.00**
	Contingency (20%) =	**$366,800.00**
	Total =	**$2,384,200.00**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 10 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	5	0	5

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefits representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$549,478	$2,384,200	0.23
Elevate Structures	$549,478	$348,150	1.58
Acquisition/Supplemental Housing / Demolition	$568,133	$346,918	1.64

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

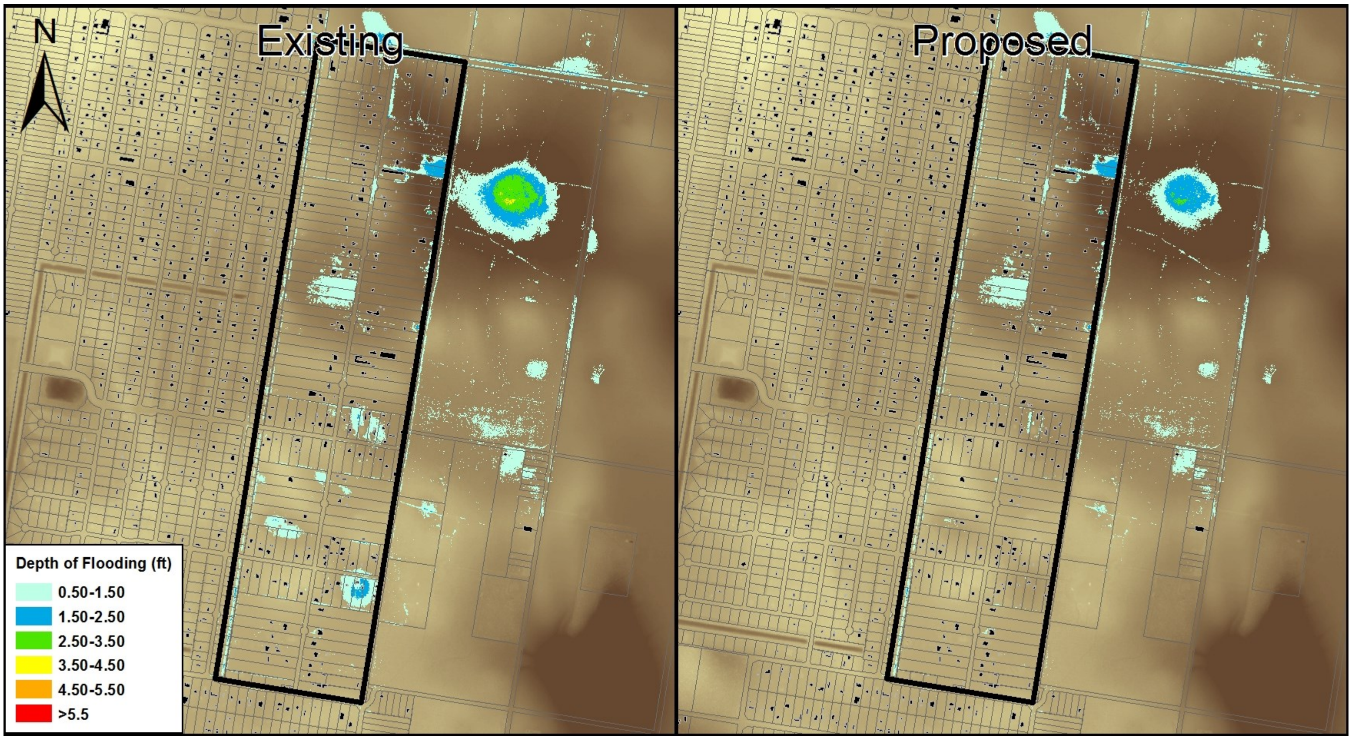


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	178	144	34
Inundated Roadway (LF)	215	215	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

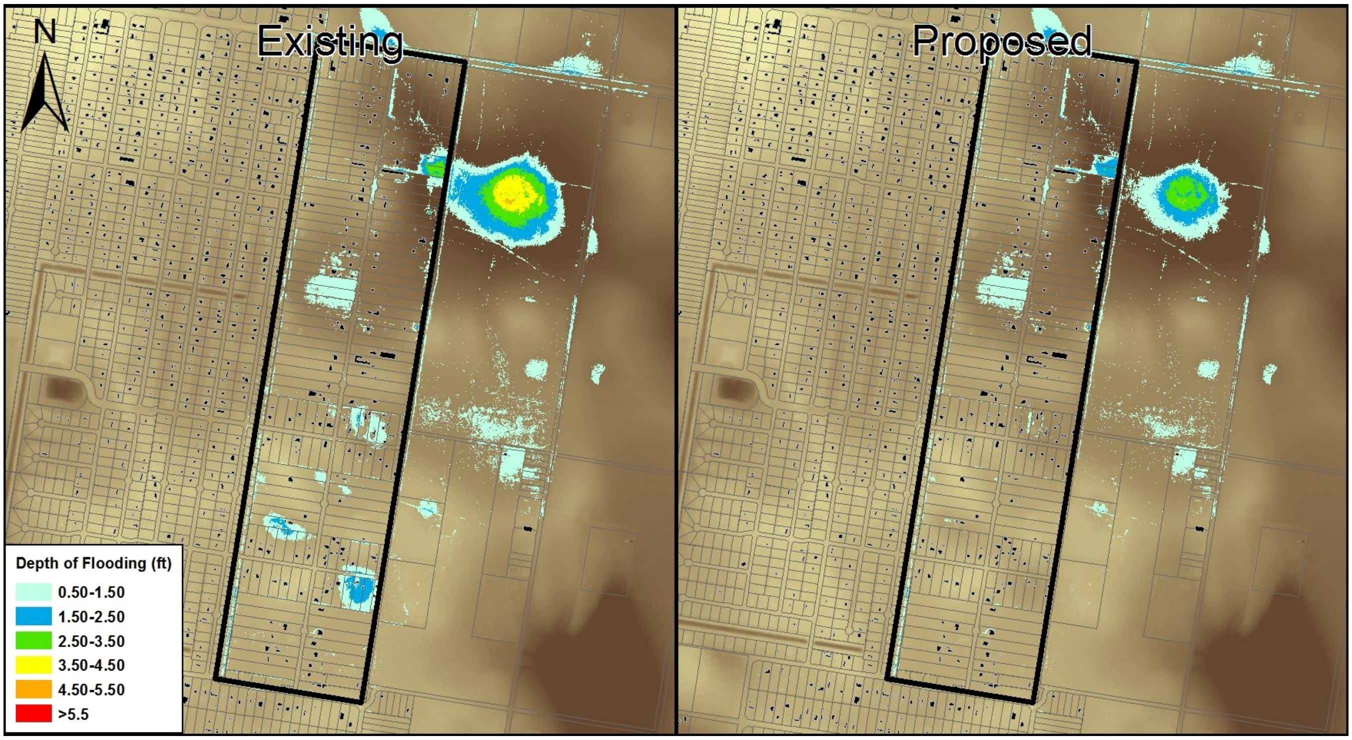


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	187	149	38
Inundated Roadway (LF)	434	215	219

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

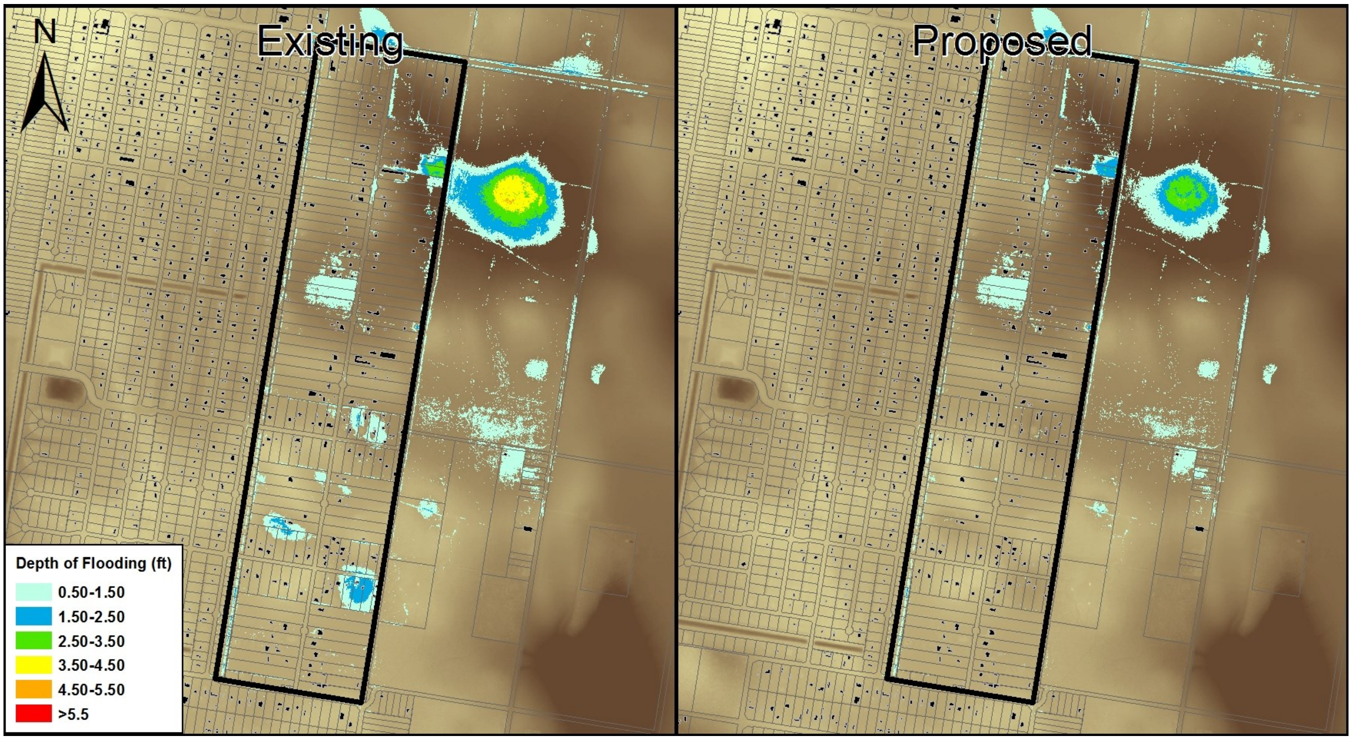


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	188	152	36
Inundated Roadway (LF)	436	215	221

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

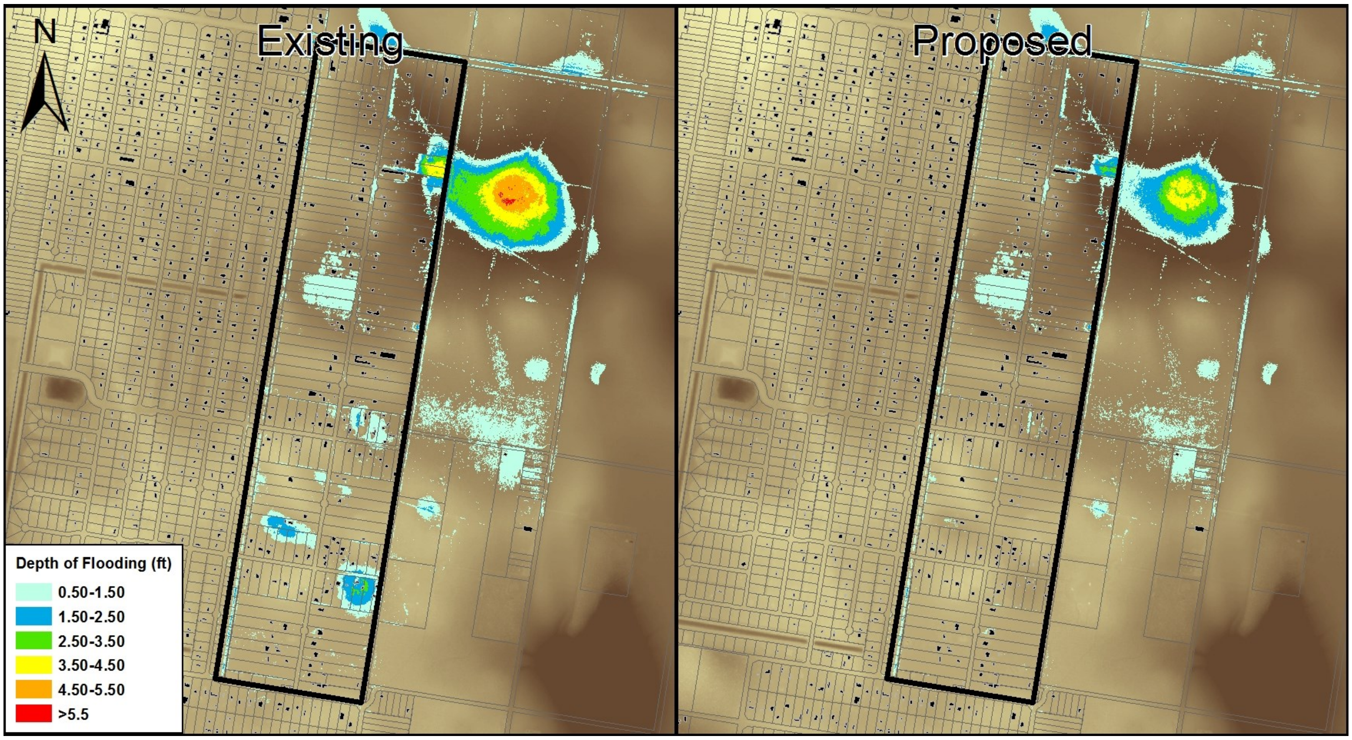


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	189	153	36
Inundated Roadway (LF)	530	218	312

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.

Colonia: Salida Del Sol Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

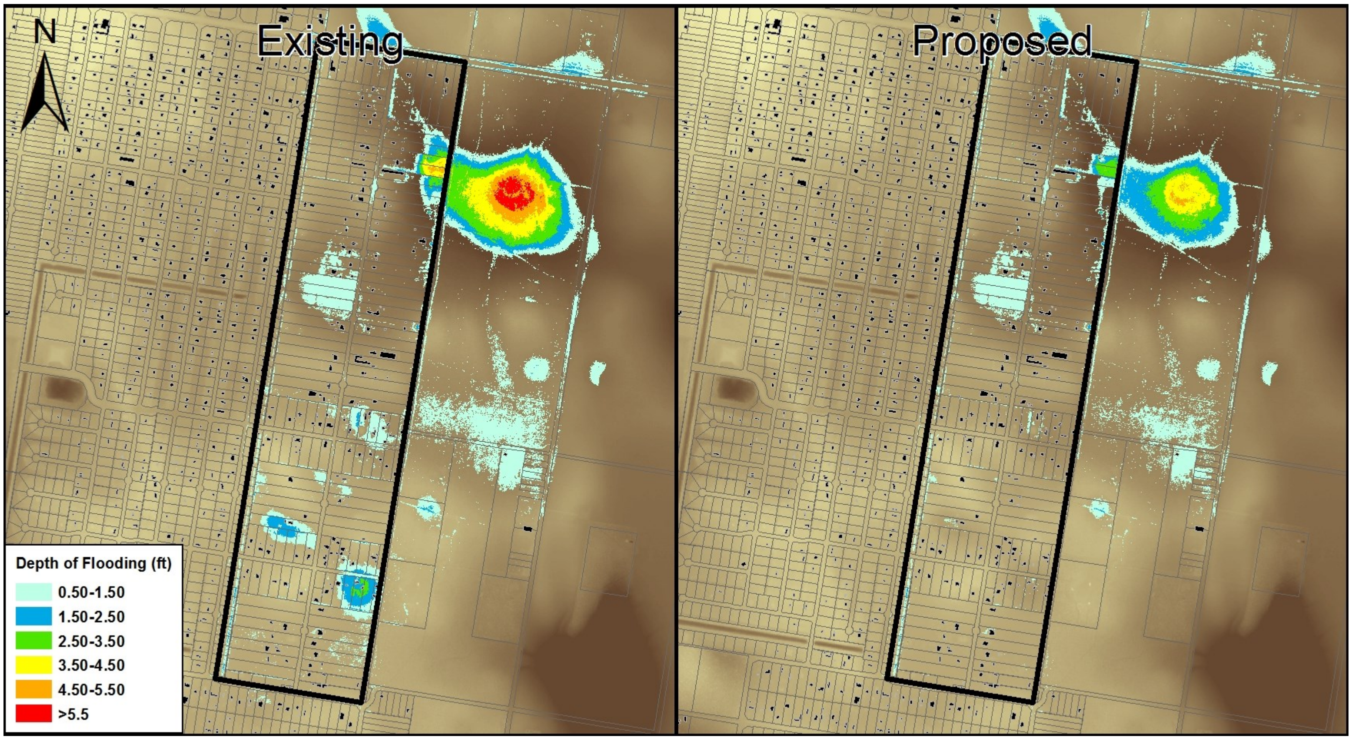
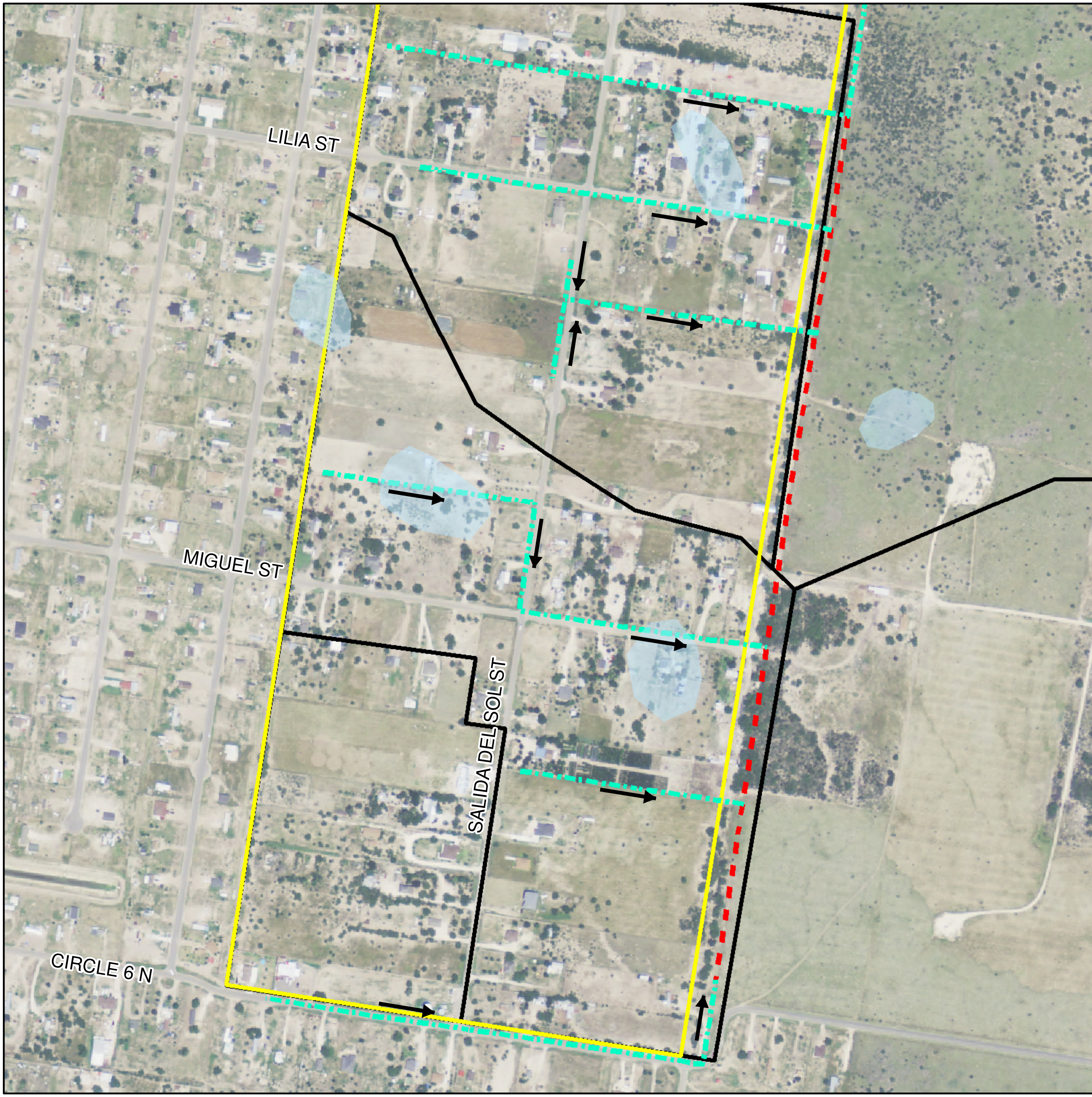


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	0	5
Inundated Lots	189	155	34
Inundated Roadway (LF)	745	220	525

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than six inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than six inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Salida Del Sol Estates
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED DRAINAGE SYSTEM
- PROPOSED DITCH
- SALIDA DEL SOL ESTATES
- EXISTING FLOODPLAIN
- DRAINAGE AREA
- PROPOSED DRAINAGE FLOW

N
W E
S

0 320 640 960
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

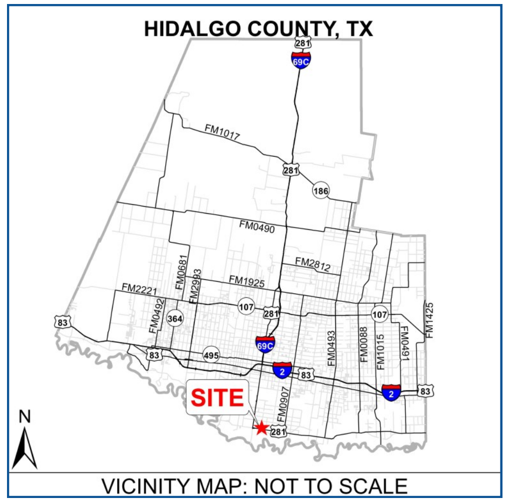
"Filling the Gap"

Colonia: South Fork Subd., Hidalgo County

Basin: North Main Drain

Category: A1

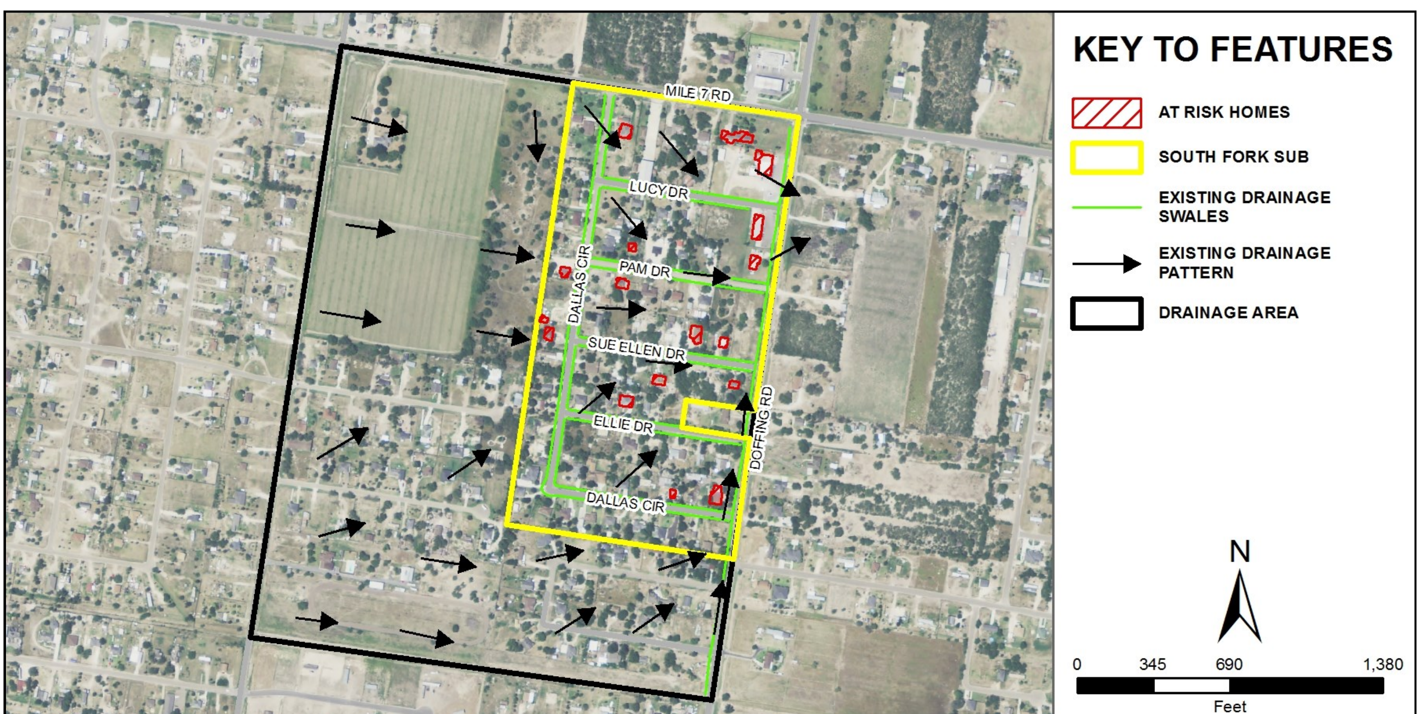
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia South Fork Subd. storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

South Fork Subdivision consist of approximately 47 acres of fully developed residential land with an offsite drainage area of approximately 82 acres of developed residential land and agricultural land. The existing swales are very small, shallow, and eroded, therefore they do not provide adequate drainage; additionally, not all driveways have culverts to allow flow throughout the colonia. The existing drainage pattern indicates runoff flows toward the east. The results of the existing conditions 2D model indicate that there is considerable ponding within the colonia, resulting in several structures at high risk of flooding. This may be attributed to low lots or drainage obstructions. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: South Fork Subd., Hidalgo County

Potential Solutions:

- The following are alternatives for drainage solutions (including non structural alternatives) for this colonia:
    - Install an underground drainage system with a retention pond.
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

Based on Lidar observations, and the results of the existing conditions 2D model, it was determined that in order to prevent flooding within the colonia drainage improvements would also be necessary along Austin Circle as well as the streets within the colonia. The recommended improvements have been designed to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 1,775 linear feet of 21-inch diameter pipe, 742 linear feet of 24-inch diameter pipe, 881 linear feet of 30-inch diameter pipe, 2,480 linear feet of 36-inch diameter pipe, 303 linear feet of 42-inch diameter pipe, 332 linear feet of 48-inch diameter pipe, 338 linear feet of 54-inch diameter pipe, 1,163 linear feet of 60-inch diameter pipe, and 46 curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 42.3 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of drainage easements land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
SOUTH FORK SUBD.		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$1,287,696.67
2	Drainage Improvements	$956,343.00
3	Pond Excavation Improvements	$1,140,519.55
	Sub-Total =	**$3,384,559.22**
	Engineering Fees (10%) =	**$338,455.92**
	Contingency (20%) =	**$676,911.84**
	Total =	**$4,399,926.99**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 6 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: South Fork Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	7	0	7
10% (10-year)	8	0	8
4% (25-year)	13	3	10
1% (100-year)	17	10	7

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$3,454,362.00	$4,399,926.99	0.79
Elevate Structures	$3,454,362.00	$2,445,525.00	1.41
Acquisition/Supplemental Housing / Demolition	$6,391,368.00	$2,687,932.30	2.38

Colonia: South Fork Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

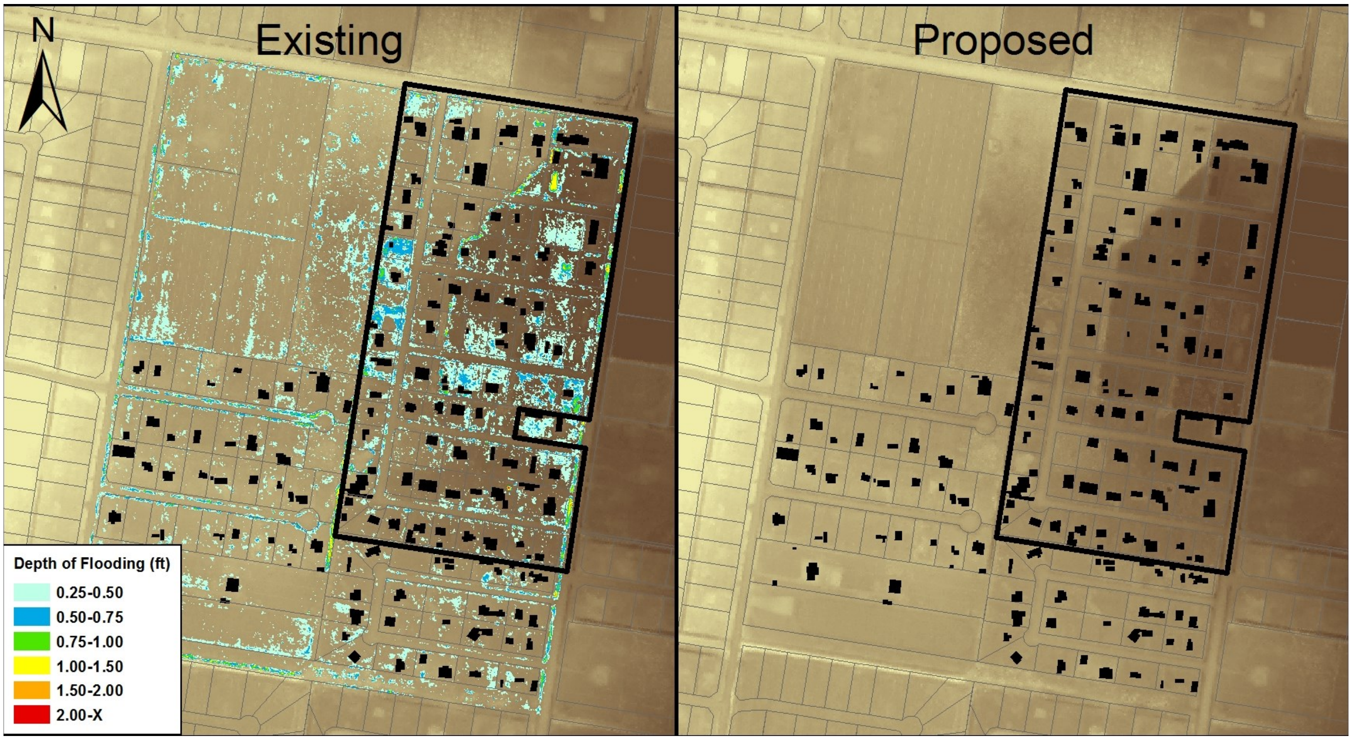


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	86	0	86
Inundated Roadway (LF)	41	0	41

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: South Fork Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

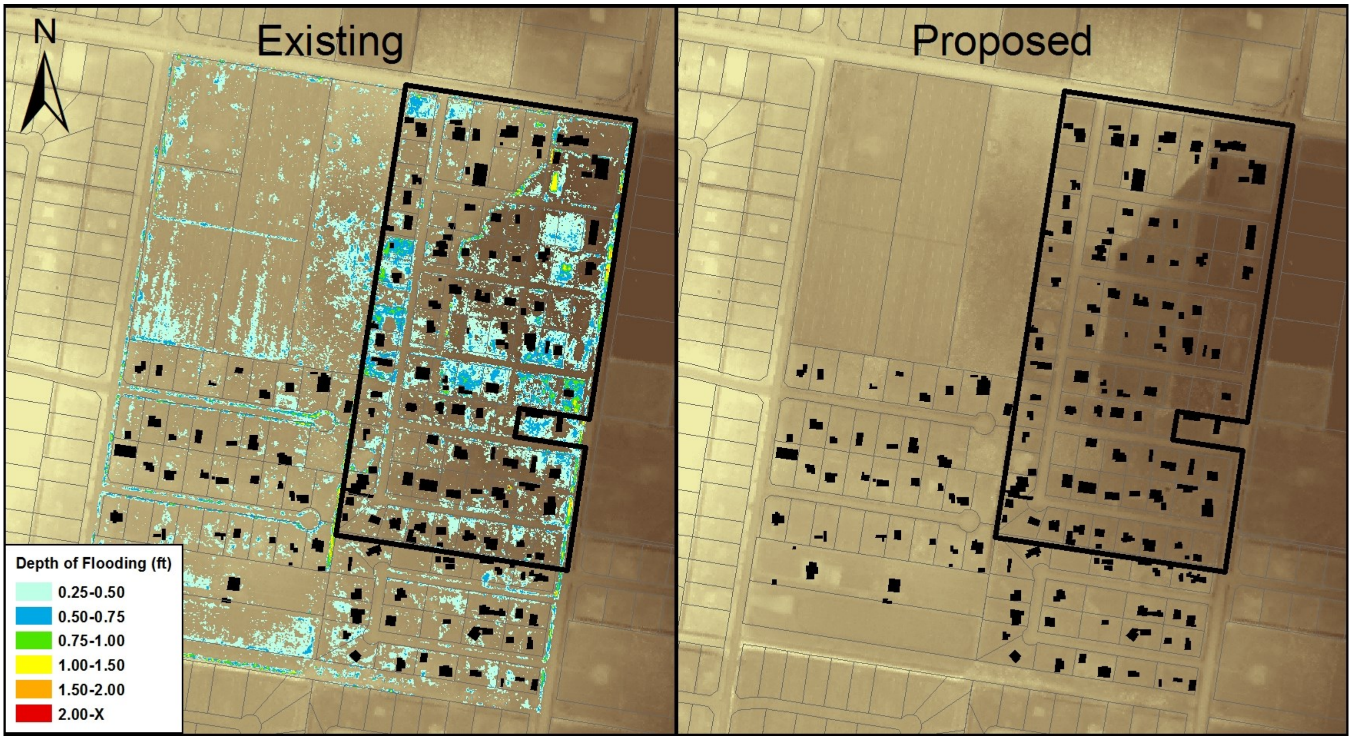


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	86	0	86
Inundated Roadway (LF)	129	0	129

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

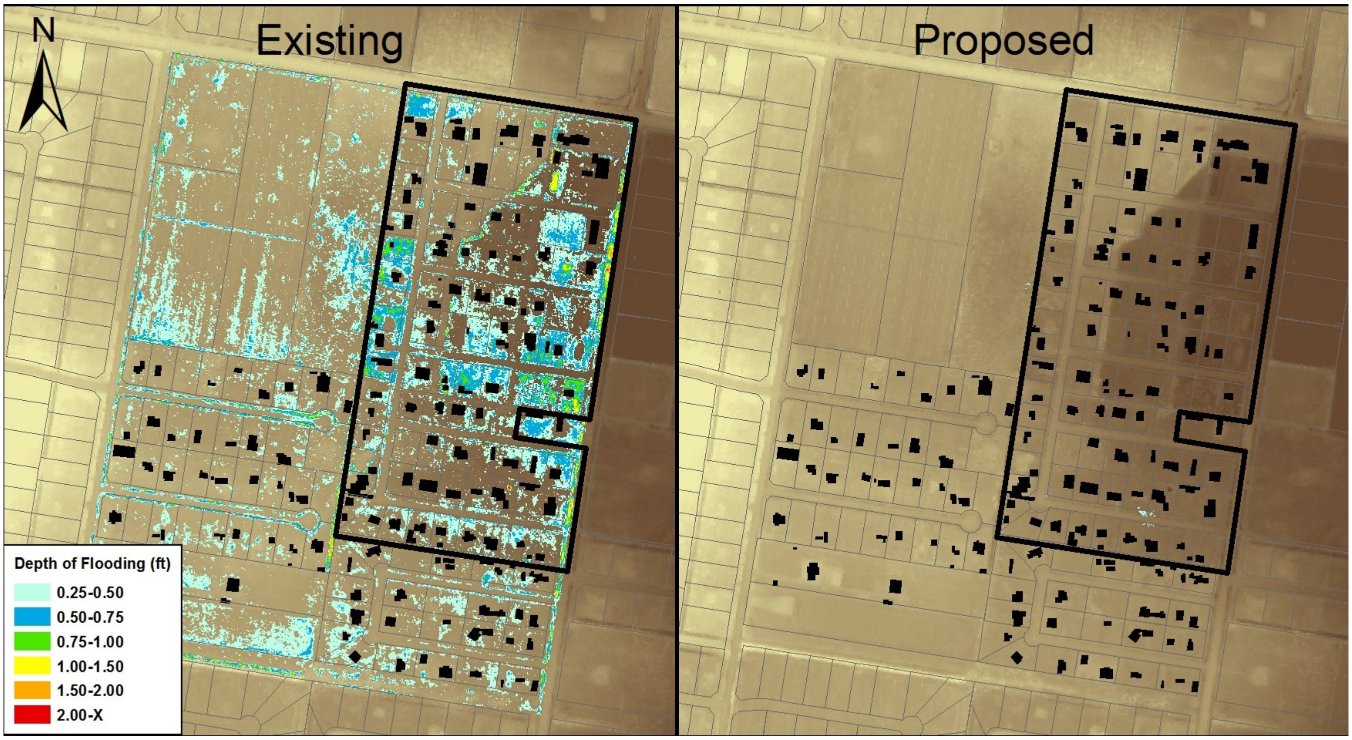


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	86	3	83
Inundated Roadway (LF)	177	0	177

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: South Fork Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

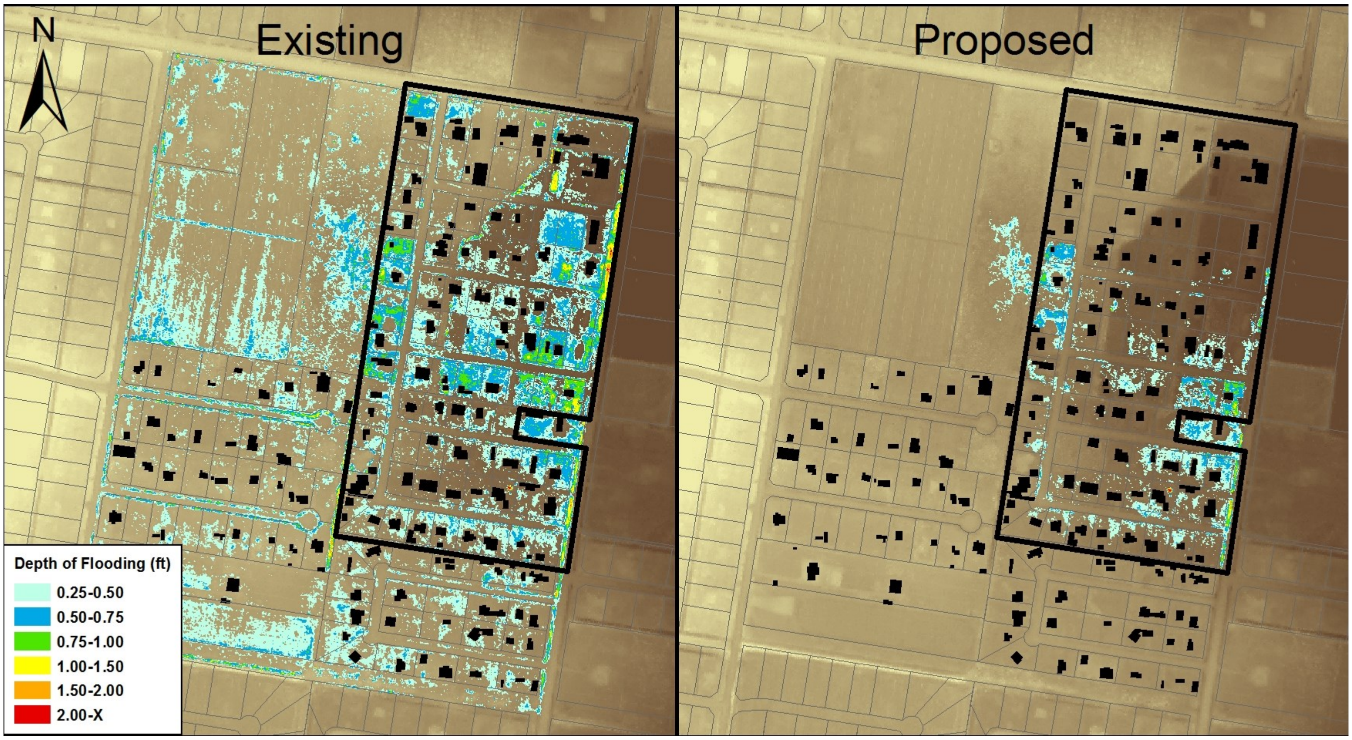


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	13	3	10
Inundated Lots	86	56	30
Inundated Roadway (LF)	276	71	205

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: South Fork Subd., Hidalgo County

“Filling the Gap”

Recommended Mitigation Project cont.:

Project Figures:

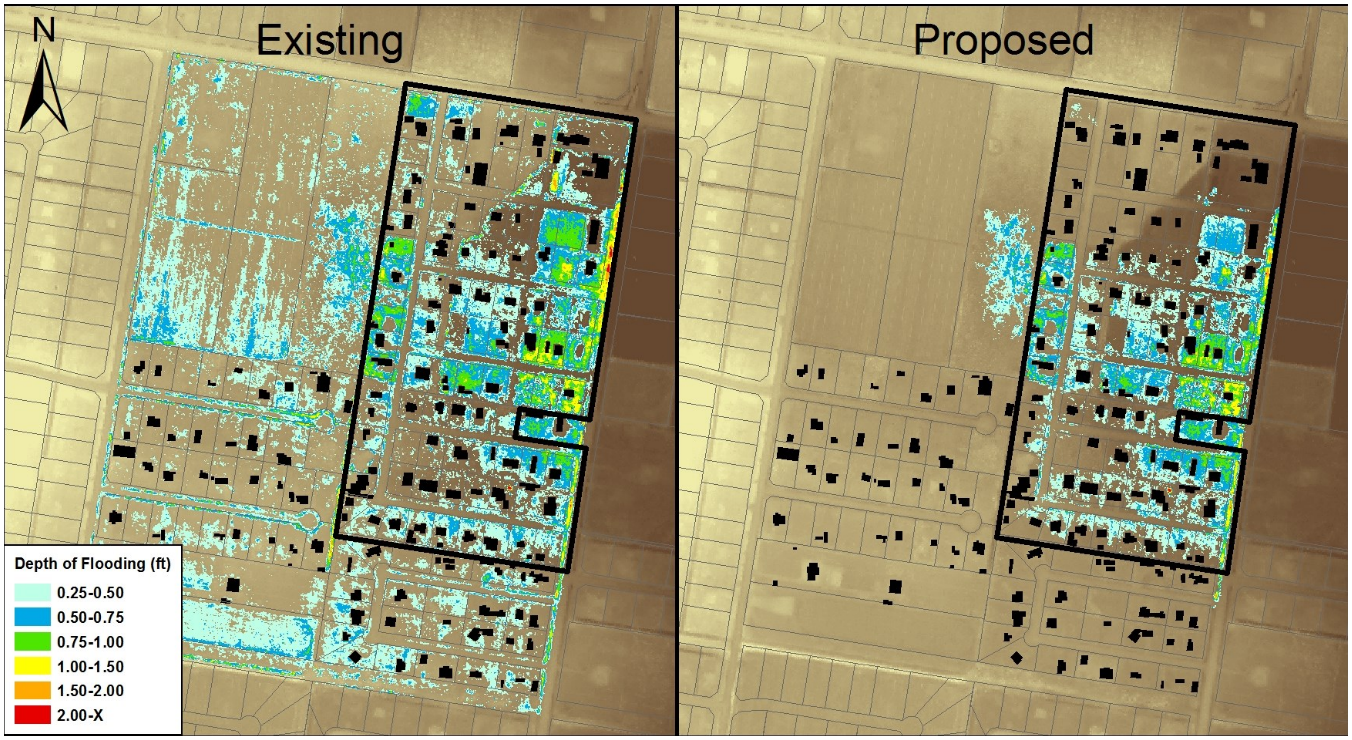


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	17	10	7
Inundated Lots	86	71	15
Inundated Roadway (LF)	1348	202	1146

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: South-Fork Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- SOUTH FORK SUBD.
- 25-YR RETENTION POND
- DRAINAGE AREA
- EXISTING FLOODPLAIN

N W E S

0 300 600 900
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

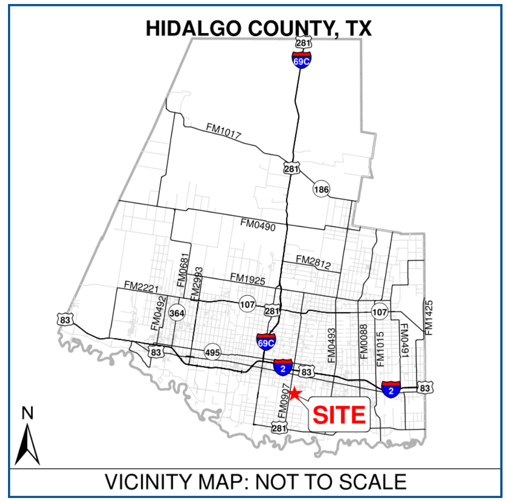
"Filling the Gap"

Colonia: Southside Village, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Southside Village storm drainage system was built using the software program InfoWorks SD. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Southside Village consists of approximately 10.3 acres and currently does not have a drainage system. Culverts were observed at each intersection of Bethany Street and seemingly drain south toward an empty field. The model results indicate that there are high-risk flooding areas throughout the colonia. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 4 to 6 inches, blue 6 to 7.5 inches, green 7.5 to 9 inches, yellow 9 to 11 inches, orange 11 to 28 inches and red more than 28 inches.

Colonia: Southside Village, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Improve the existing roadside swales and install a new retention pond.
    - Install a new underground drainage system with a retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Purchase of flood prone structures
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharges of the 10-Year storm of the onsite runoff and retention of onsite runoff of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 546 linear feet of 24-inch diameter pipe, 321 linear feet of 30-inch diameter pipe, six curb inlets, and three concrete manholes. The improvements include a proposed retention pond with an effective storage volume of 4.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST SOUTHSIDE VILLAGE		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$357,024.00
2	Drainage Improvements	$117,632.00
3	Pond Excavation Improvements	$122,660.00
	Sub-Total =	**$597,316.00**
	Engineering Fees (10%) =	**$59,731.60**
	Contingency (20%) =	**$119,463.20**
	Total =	**$776,510.80**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Southside Village, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	6	2	4
20% (5-year)	8	2	6
10% (10-year)	8	2	6
4% (25-year)	8	2	6
1% (100-year)	8	2	6

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$4,444,409	$776,511	5.72
Elevate Structures	$4,444,409	$627,150	7.09
Acquisition/Supplemental Housing / Demolition	$4,595,288	$621,464	7.39

Colonia: Southside Village, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

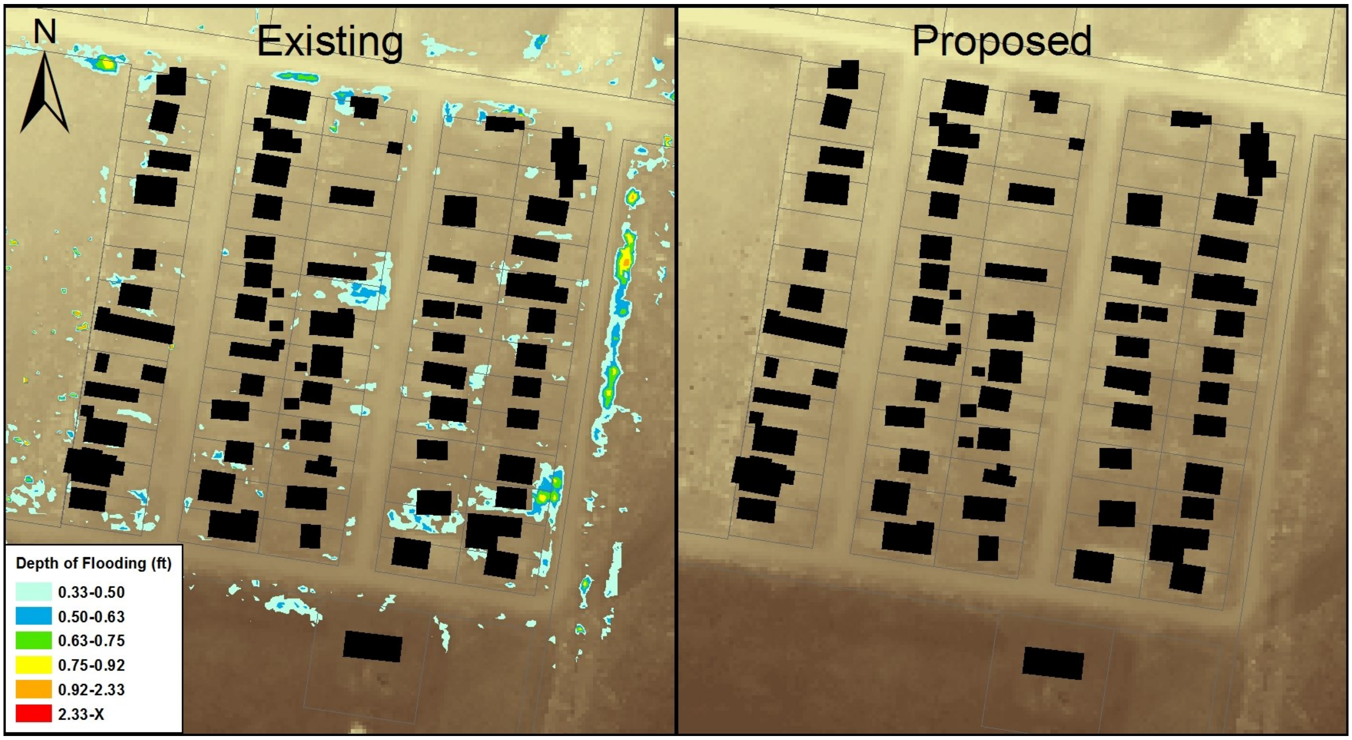


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	2	4
Inundated Lots	56	0	56
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than four inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than four inches.

Colonia: Southside Village, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

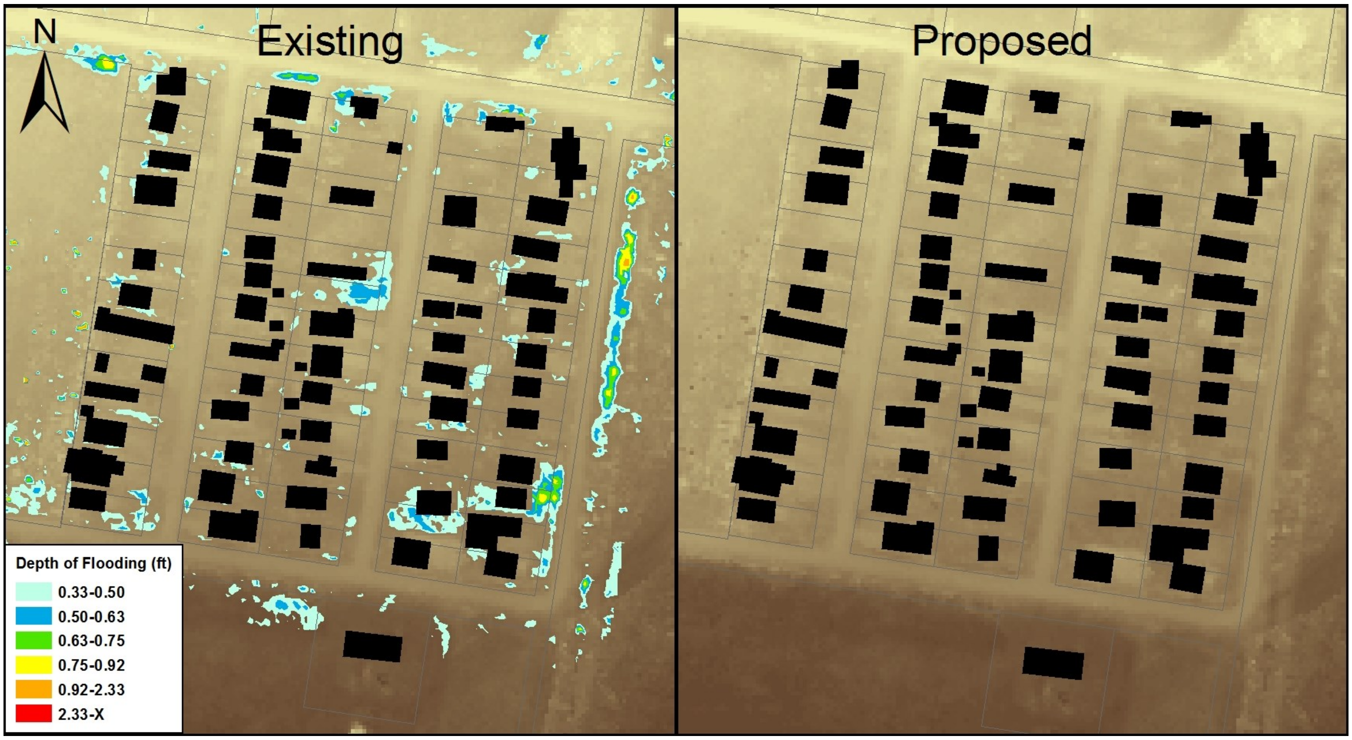


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	2	6
Inundated Lots	58	0	58
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than four inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than four inches.

Colonia: Southside Village, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

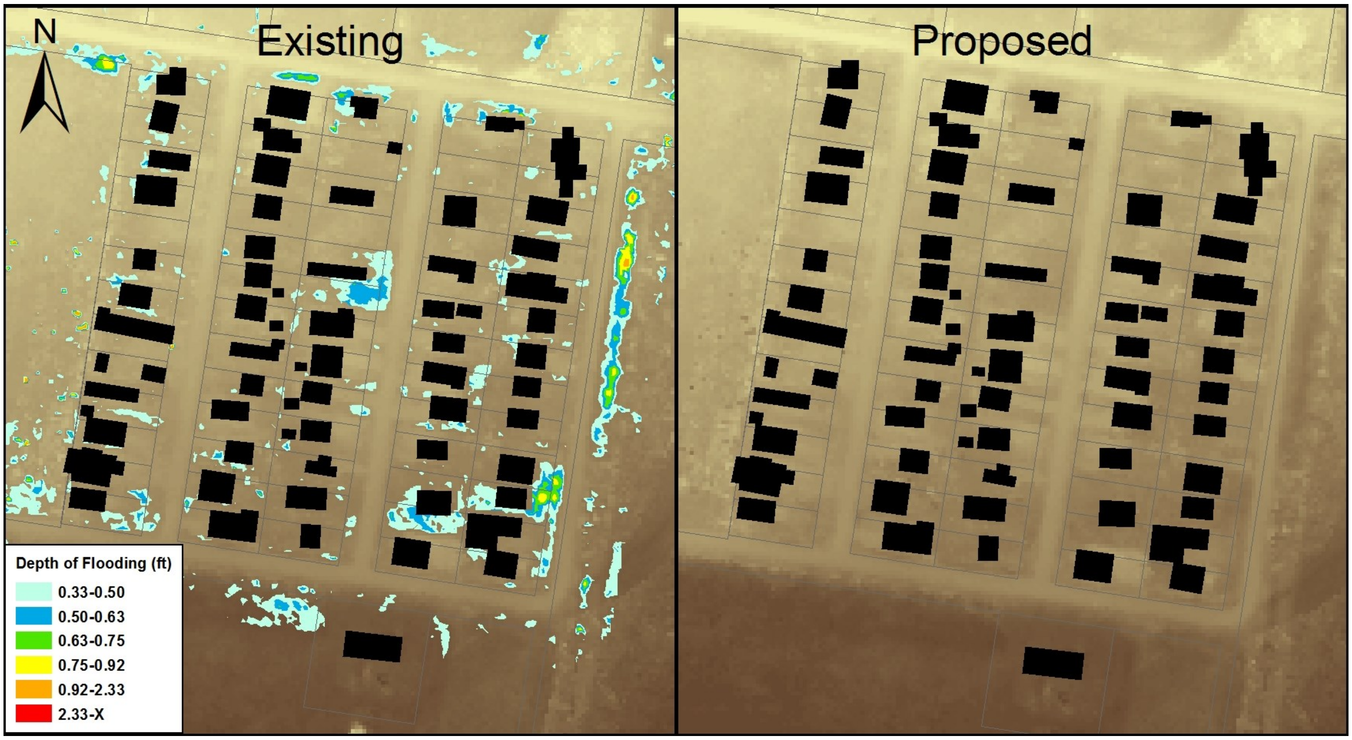


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	2	6
Inundated Lots	58	0	58
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than four inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than four inches.

Colonia: Southside Village, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

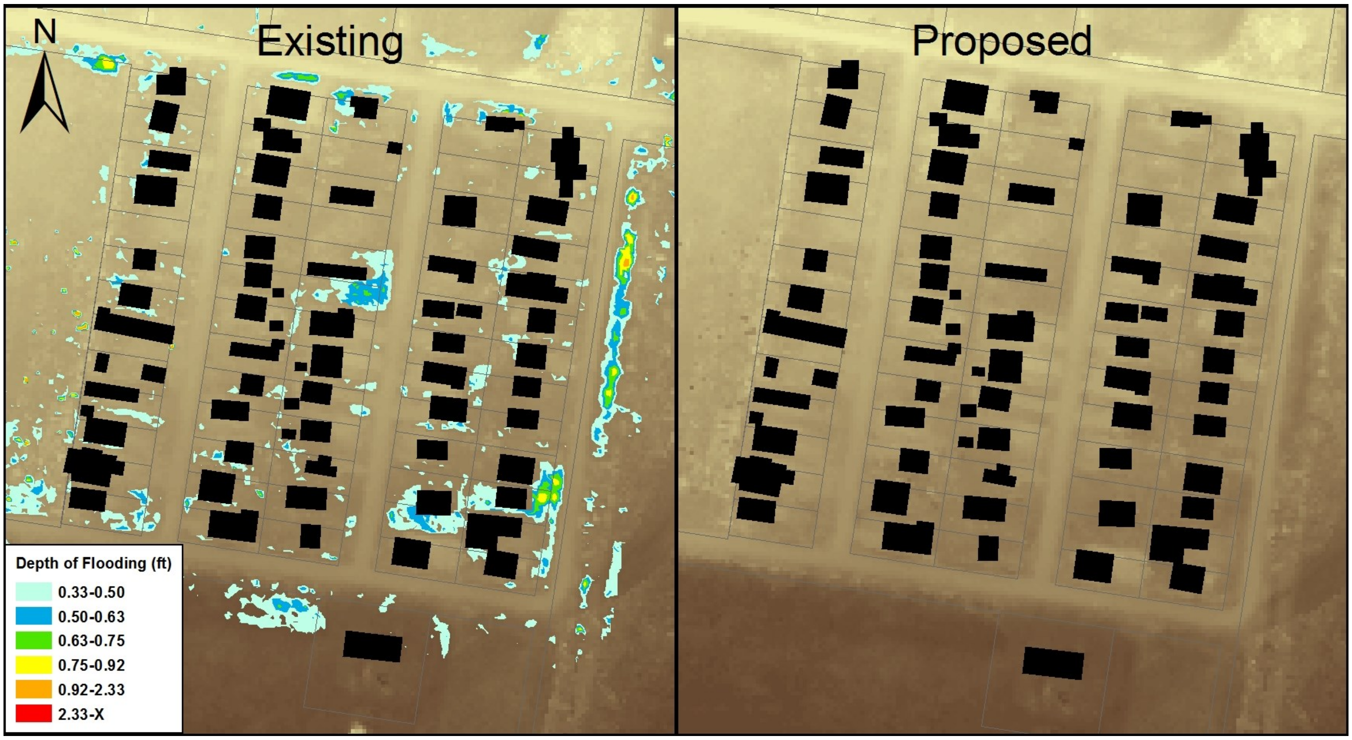


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	2	6
Inundated Lots	62	0	62
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than four inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than four inches.

Colonia: Southside Village, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

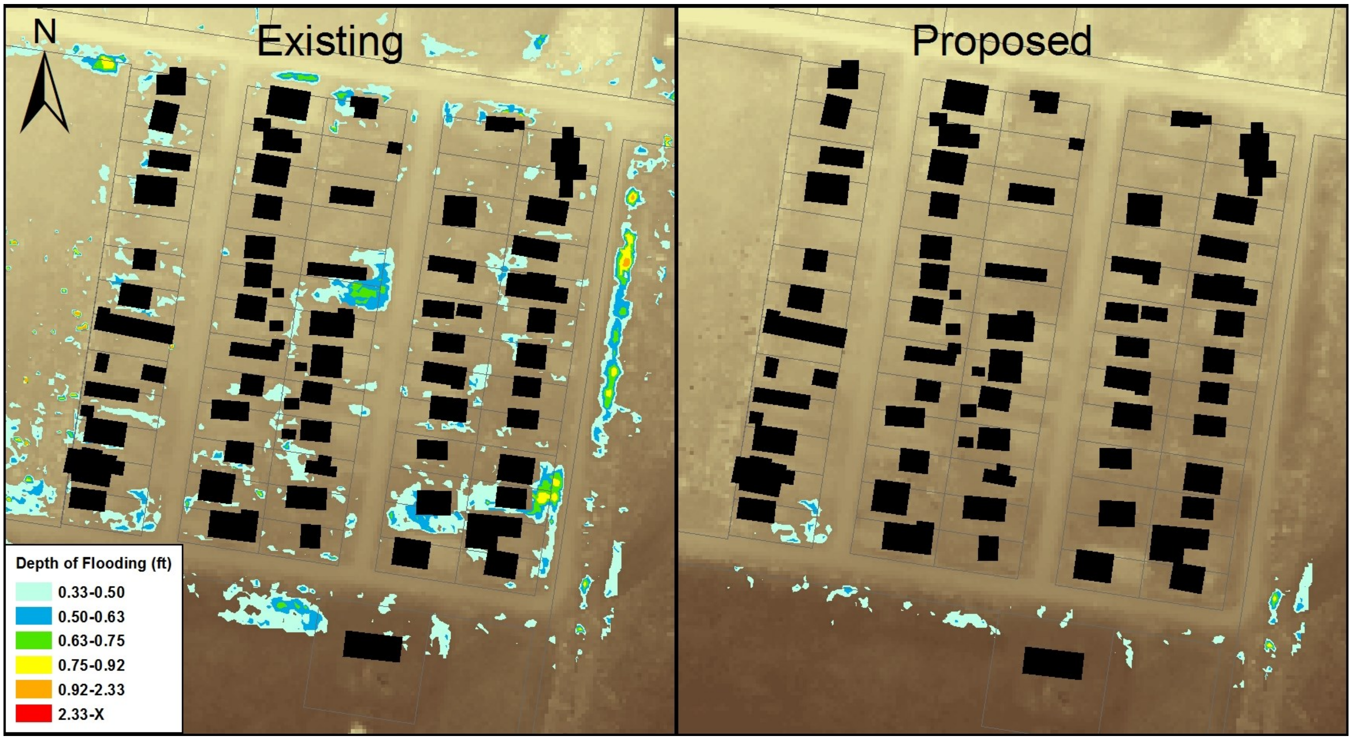


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	2	6
Inundated Lots	64	2	62
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than four inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than four inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Southside Village
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- SOUTHSIDE VILLAGE
- 25-YR RETENTION POND
- DRAINAGE AREA
- EXISTING FLOODPLAIN

N W E S

0 80 160 240
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

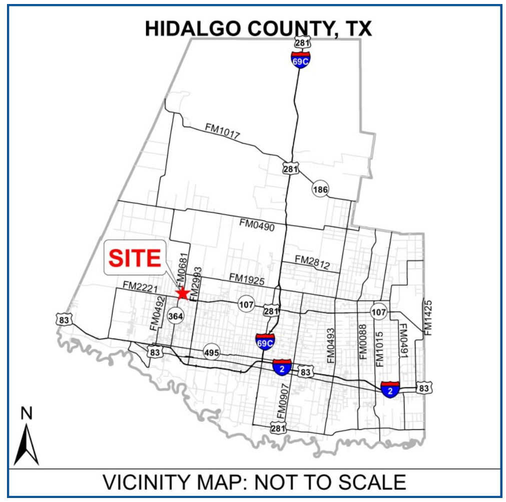
Colonia: Sun Valley Estates, Hidalgo County

Basin: North Main Drain

Category: A1

“Filling the Gap”

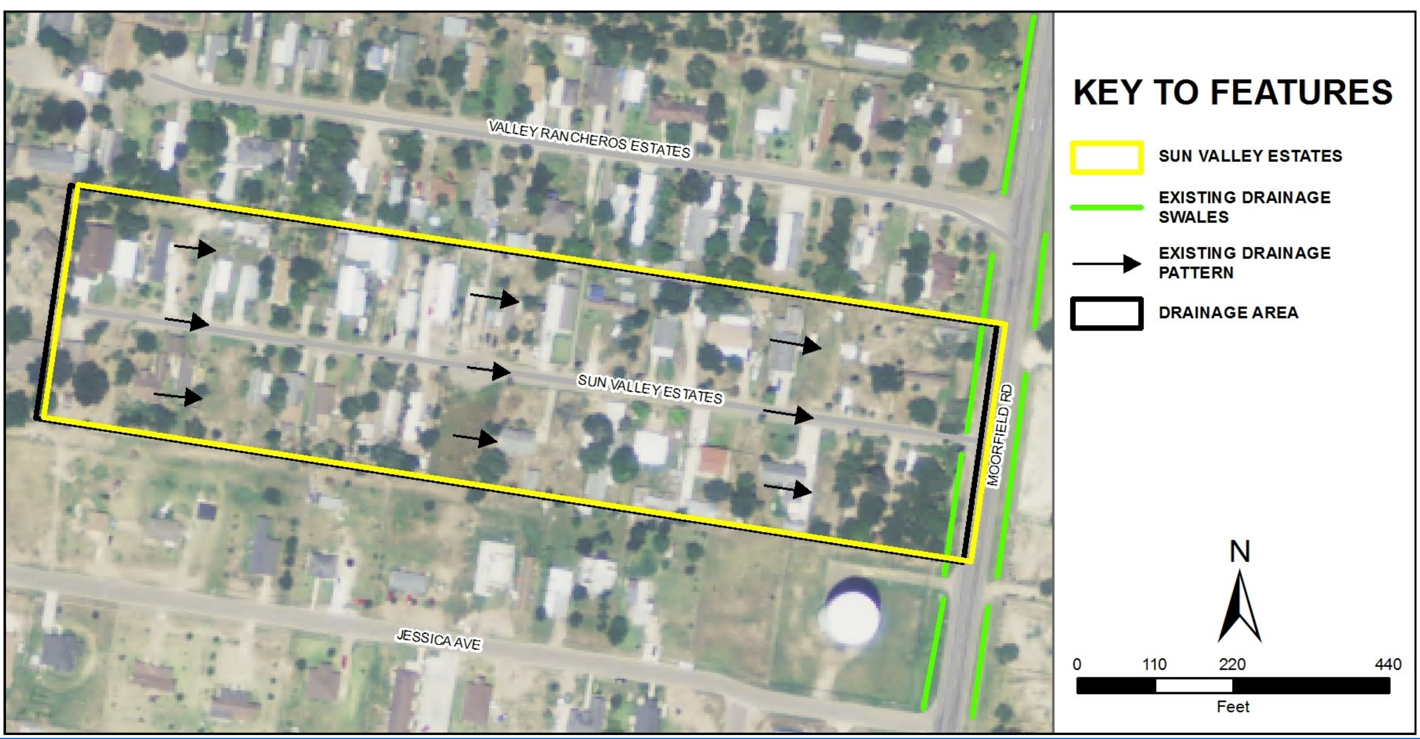
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Sun Valley Estates storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Sun Valley Estates consists of approximately 10 acres of fully developed residential land. Currently the colonia does not have a drainage system and runoff flows toward the east. The model results indicate that the properties along the center of the colonia are at risk of flooding, mostly due to the lots being low or having drainage obstructions. The majority of homes in this colonia are elevated mobile homes and may not be affected by ponding on low lots. Based on the model results and estimated finish floor elevations for the structures it was determined that no structure is at high risk of flooding from a localized storm event. It was also found that the northeast properties may experience risk of flooding if the swales on Moorfield Road become blocked. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 4.5 inches, blue 4.5 to 6 inches, green 6 to 9 inches, yellow 9 to 12 inches, orange 12 to 17 inches, and red more than 17inches.



Colonia: Sun Valley Estates, Hidalgo County

“Filling the Gap”

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install roadside swales with culverts to convey runoff to Moorefield Road.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

The recommended improvements have been designed to the Hidalgo County standards for new subdivisions and to provide protection from flooding for a 10-Year storm. The recommended system includes installing an underground drainage system with a retention facility. The new system consists of 242 linear feet of 18-inch diameter pipe, 1,083 linear feet of 24-inch diameter pipe, and 10 curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 3.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
SUN VALLEY ESTATES		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$207,485.00
2	Drainage Improvements	$116,209.00
3	Pond Excavation Improvements	$86,240.06
	Sub-Total =	**$409,934.06**
	Engineering Fees (10%) =	**$40,993.41**
	Contingency (20%) =	**$81,986.81**
	Total =	**$532,914.28**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Sun Valley Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$532,914.28	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Sun Valley Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

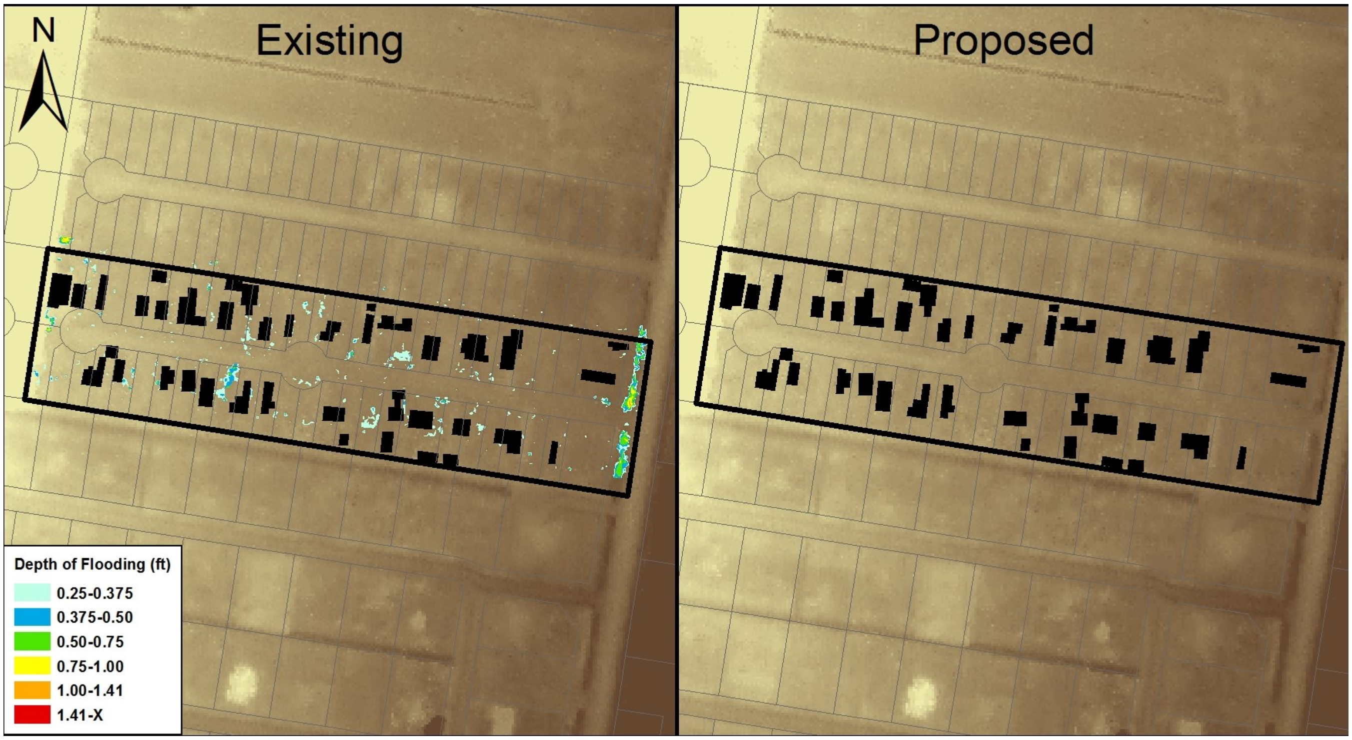


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	51	0	51
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Sun Valley Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

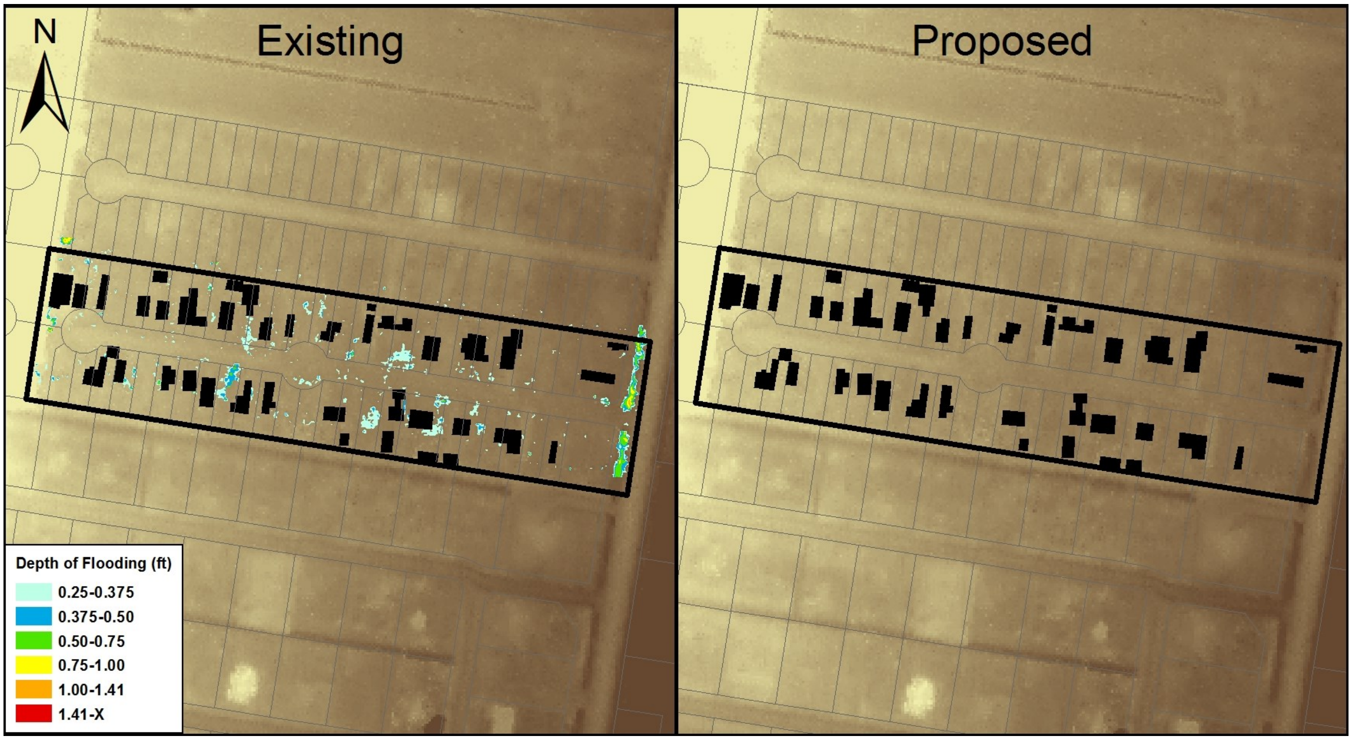


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	52	0	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

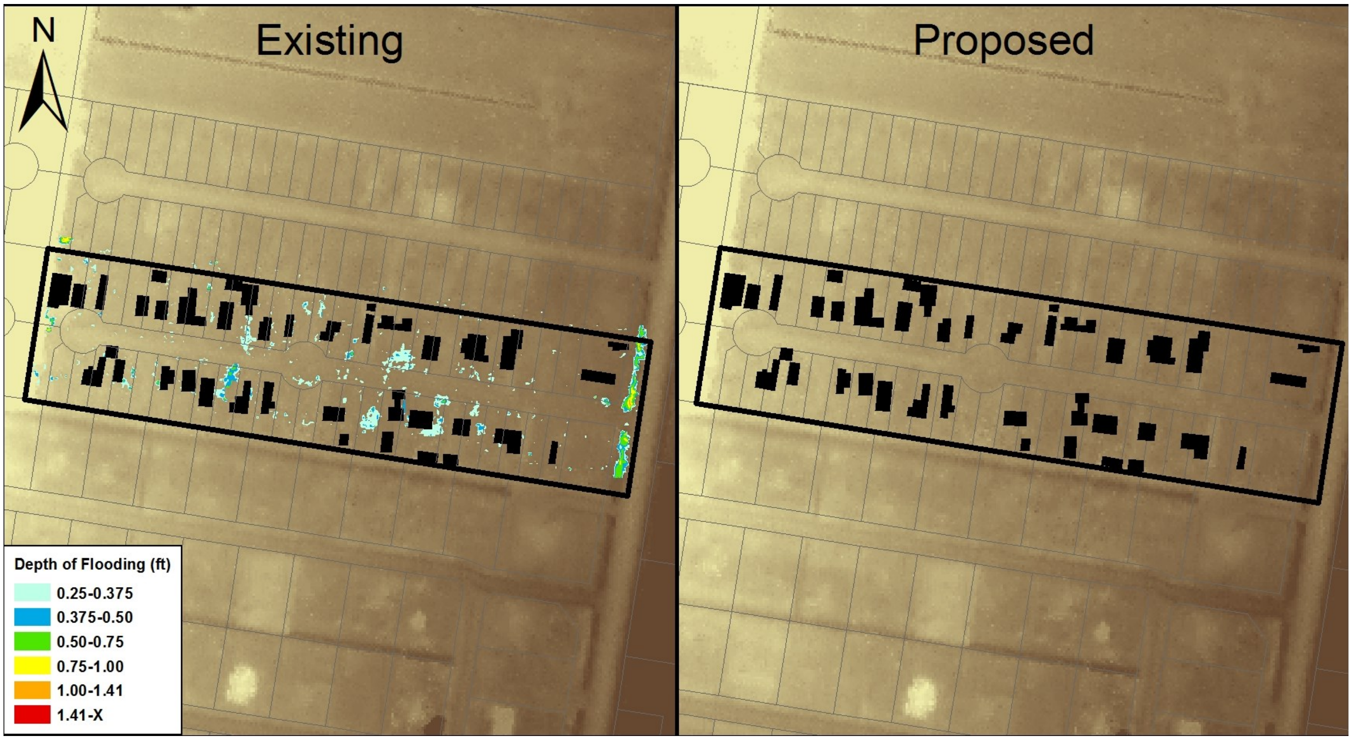


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	52	0	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

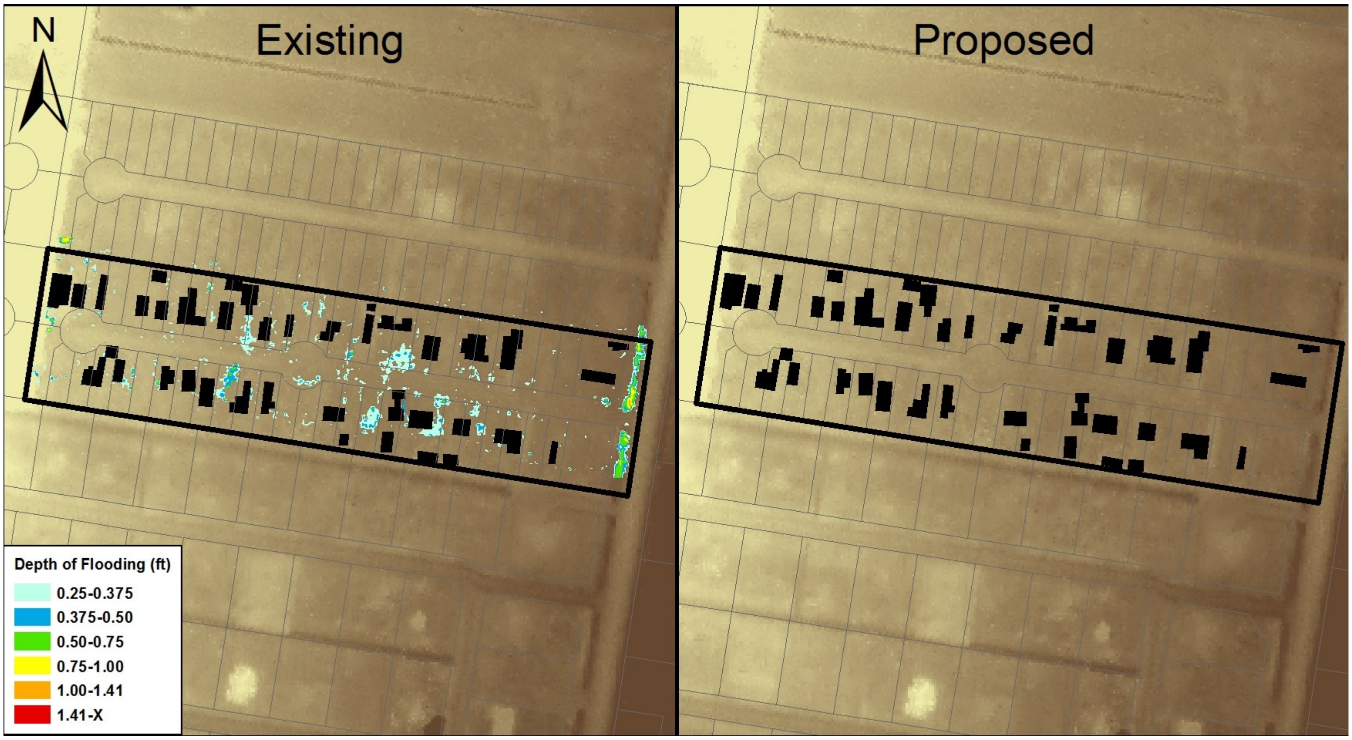


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	52	0	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Sun Valley Estates, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

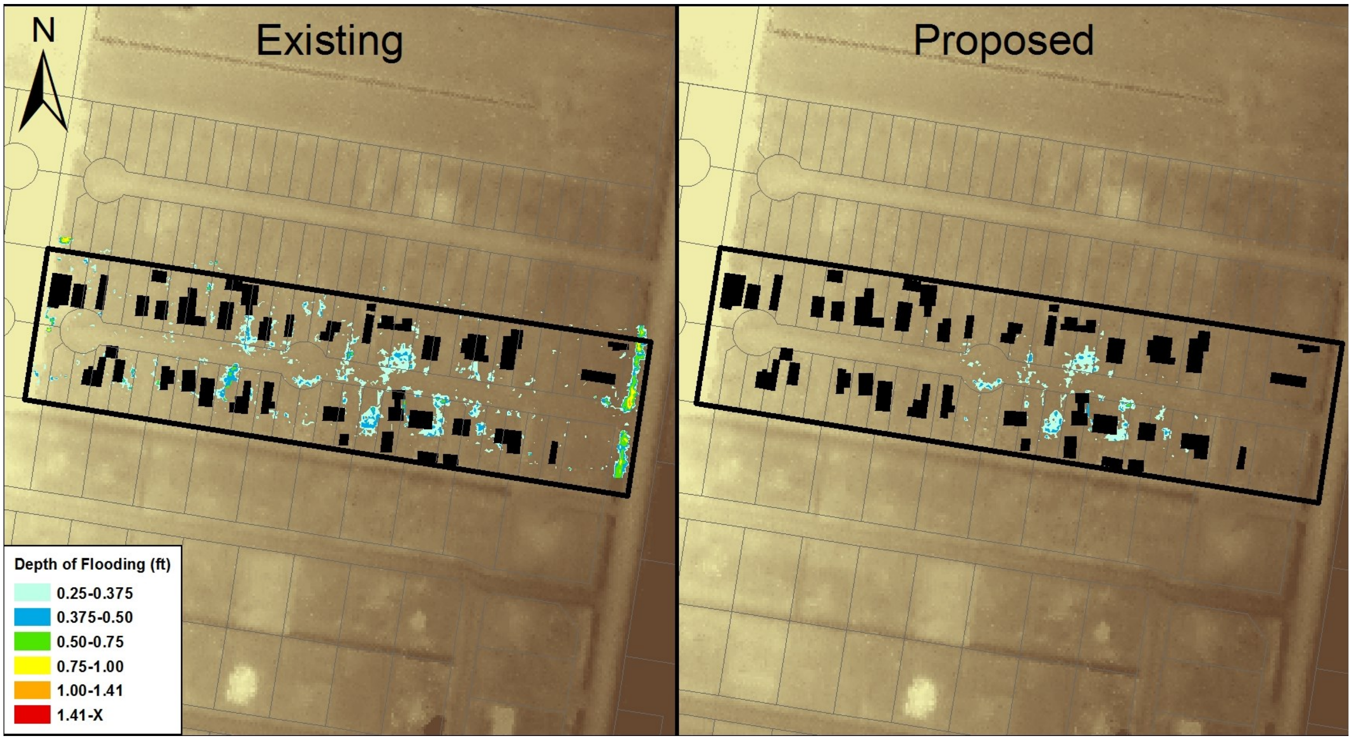
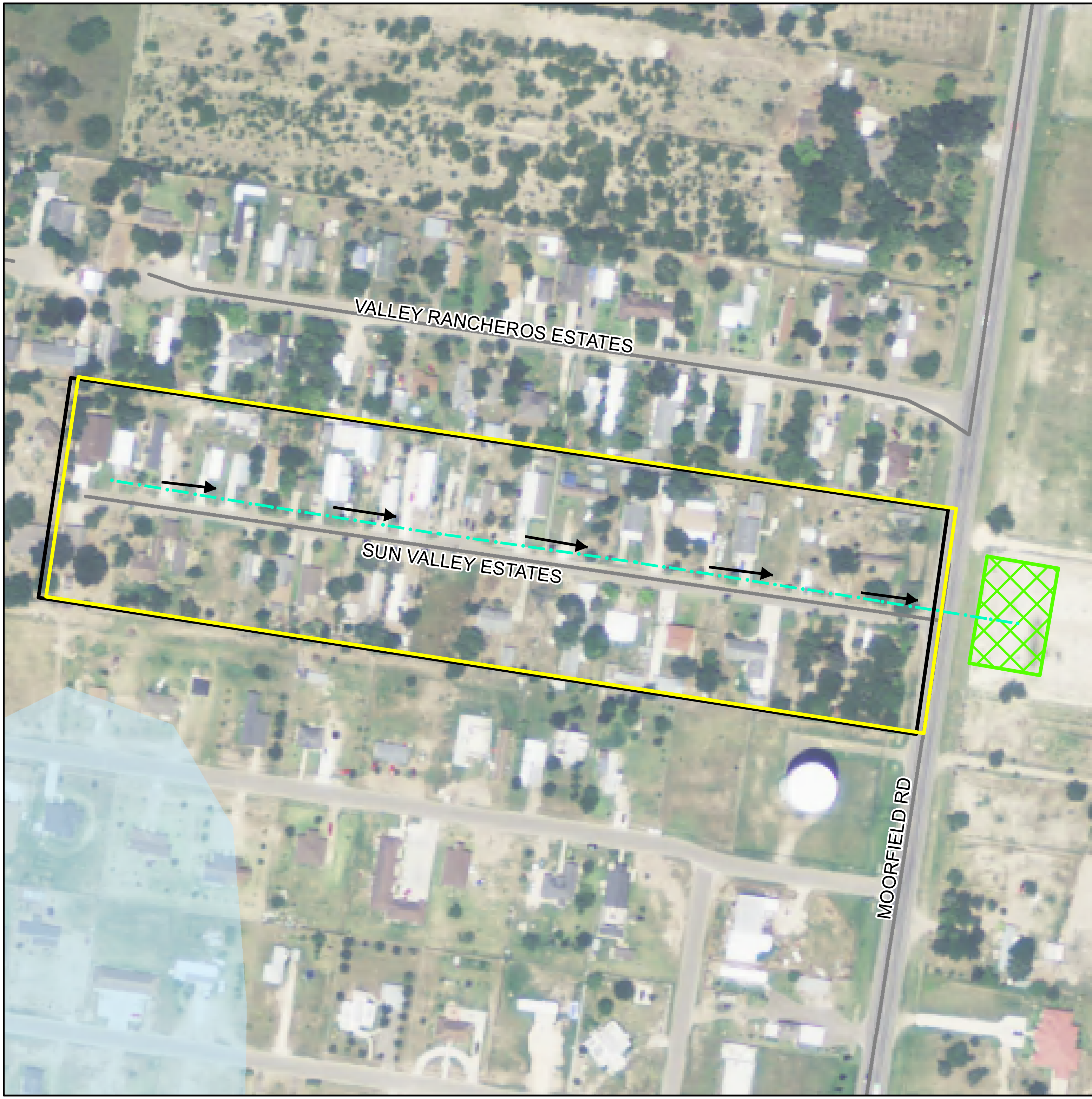


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	52	25	29
Inundated Roadway (LF)	18	0	18

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Sun Valley Estates
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- SUN VALLEY ESTATES
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 130 260 390
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

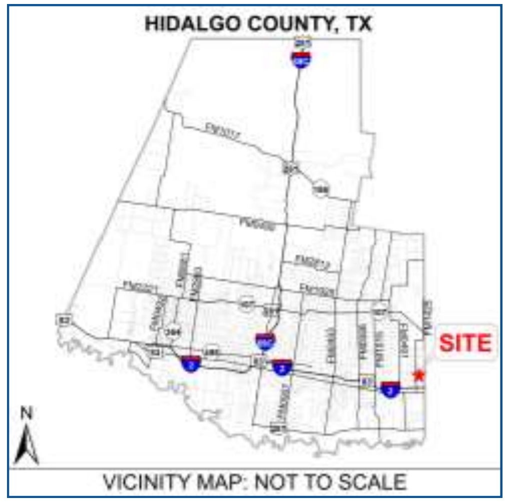
"Filling the Gap"

Colonia: V&C, Hidalgo County

Basin: North Floodway

Category: A1

Hydrology / Hydraulic Analysis:



A two-dimensional hydrodynamic model of the V&C colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 20-acre colonia are generally to the south and west. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. V&C experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: V&C, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install new underground drainage system with a retention pond
    - Install roadside swales
    - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 725 linear feet of 18-inch diameter pipe, 80 linear feet of 24-inch diameter pipe, 240 linear feet of 36-inch diameter pipe, 10 linear feet of 48-inch diameter pipe, 2,500 linear feet of grassy swale, 7,650 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 19.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
V&C Colonia

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	48,961.11
2	**DRAINAGE IMPROVEMENTS**	$	180,480.00
3	**POND EXCAVATION IMPROVEMENTS**	$	514,250.00
	Sub-Total =	$	**743,691.11**
	Engineering (10%)	$	74,369.11
	Contingency (20%)	$	148,738.22
	Total =	**$**	**966,798.44**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	4	0	4
1% (100-year)	8	0	8

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$923,933	$966,798	0.96
Elevate Structures	$923,933	$519,300	1.78
Acquisition/Supplemental Housing/Demolition	$973,526	$546,818	1.78

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

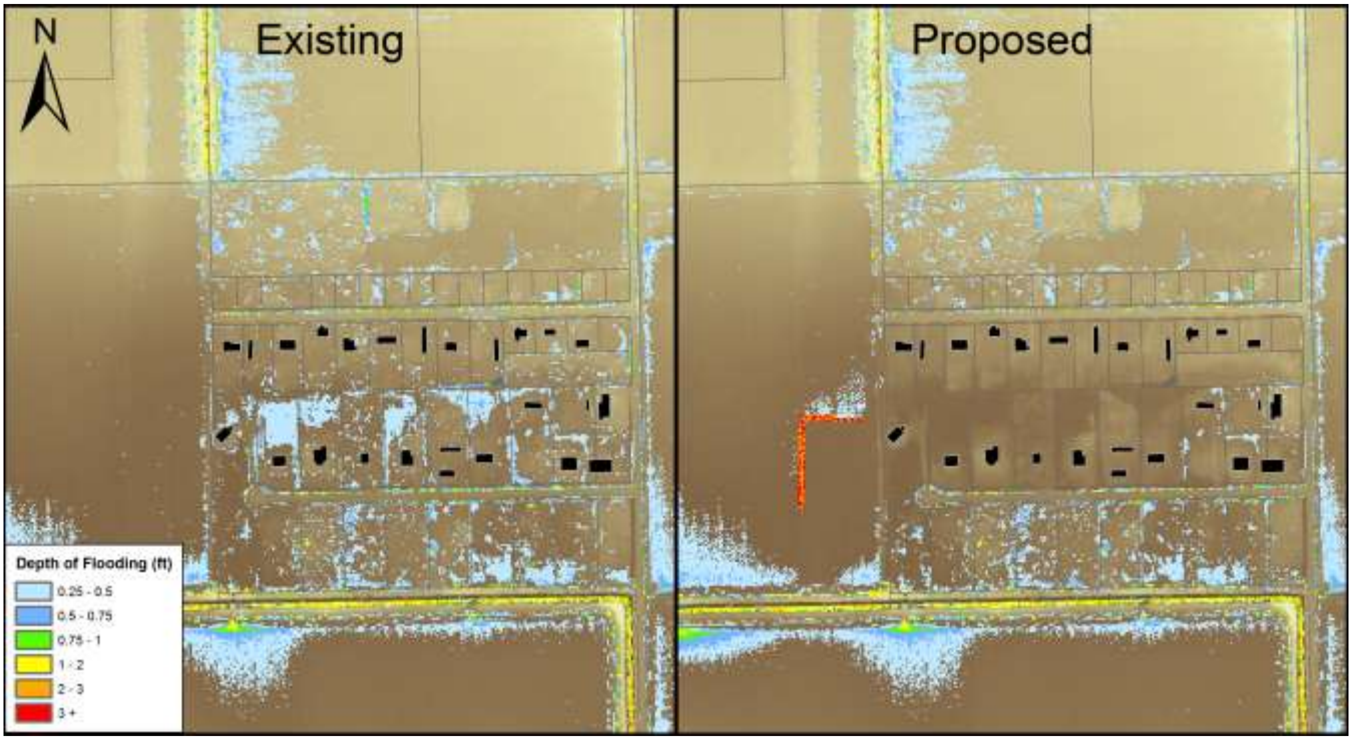


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	24	17	7
Inundated Roadway (LF)	20	5	15

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

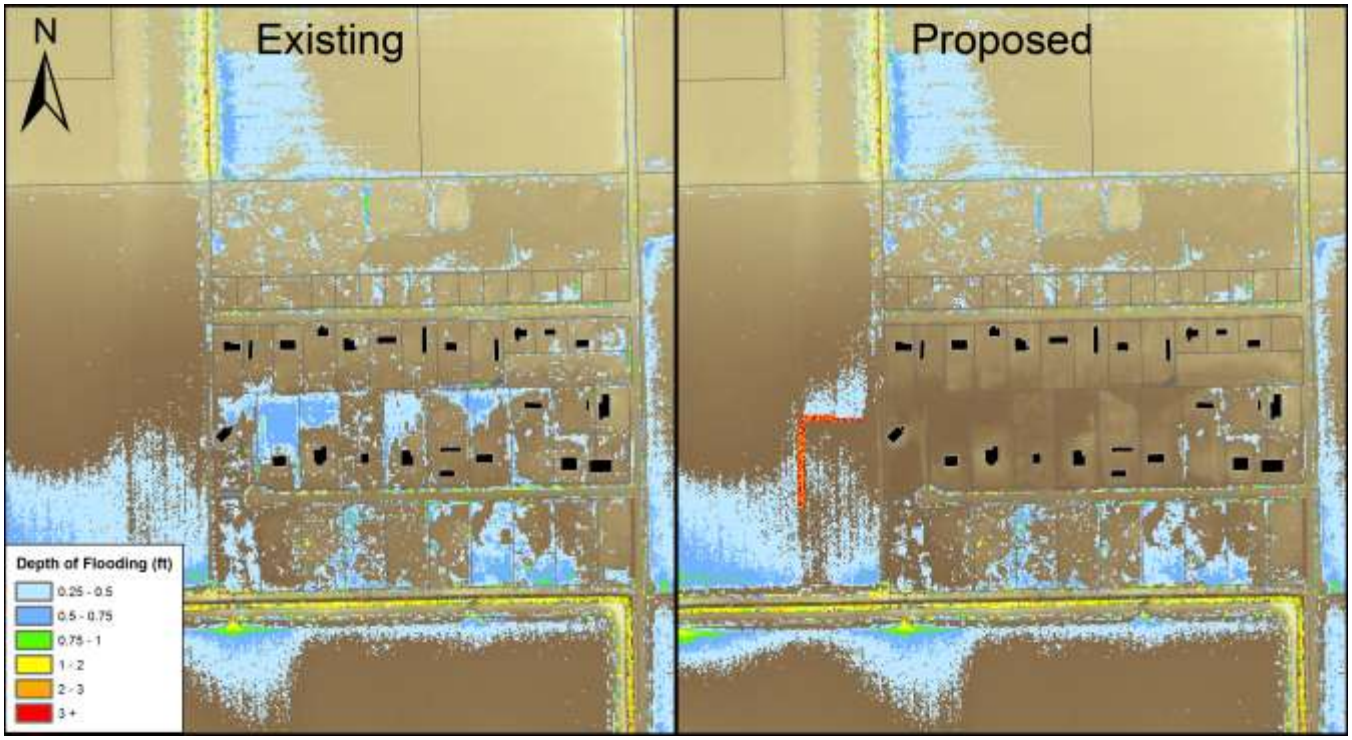


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	24	17	7
Inundated Roadway (LF)	20	5	15

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

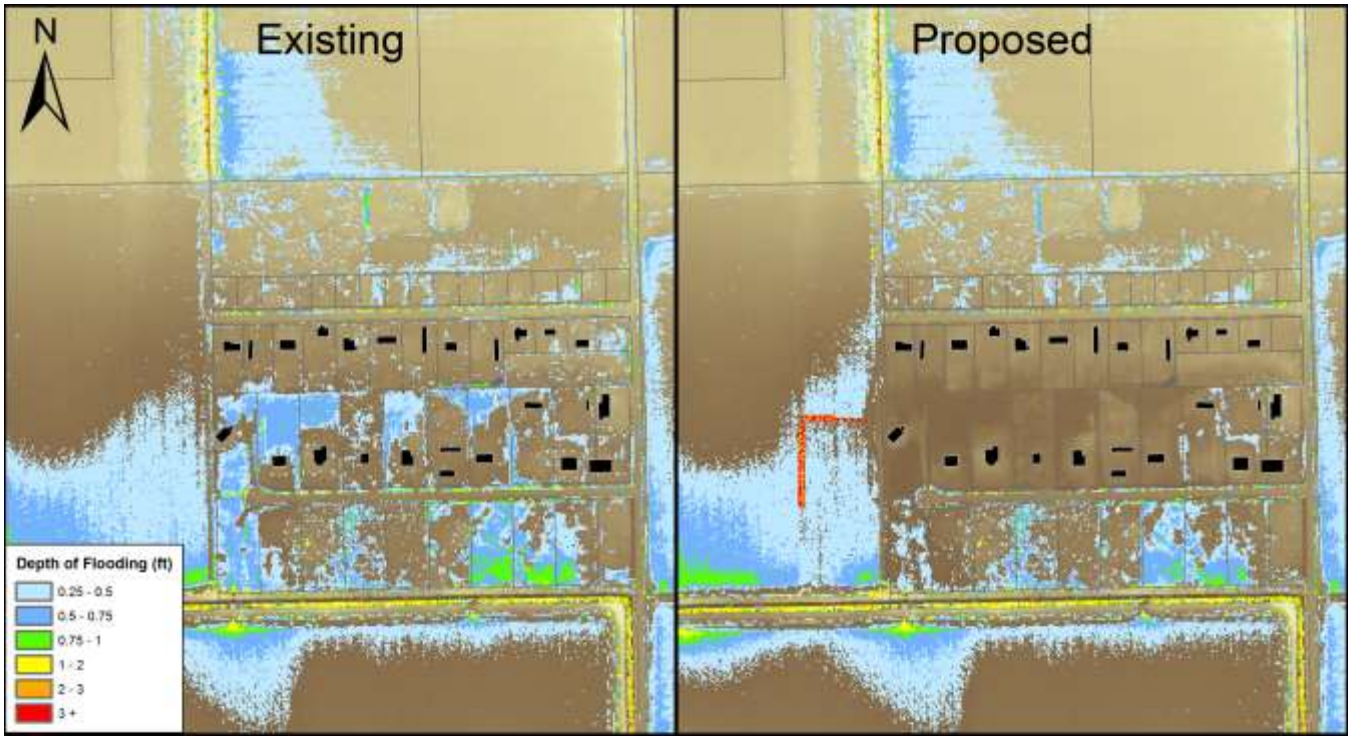


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	24	17	7
Inundated Roadway (LF)	20	5	15

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

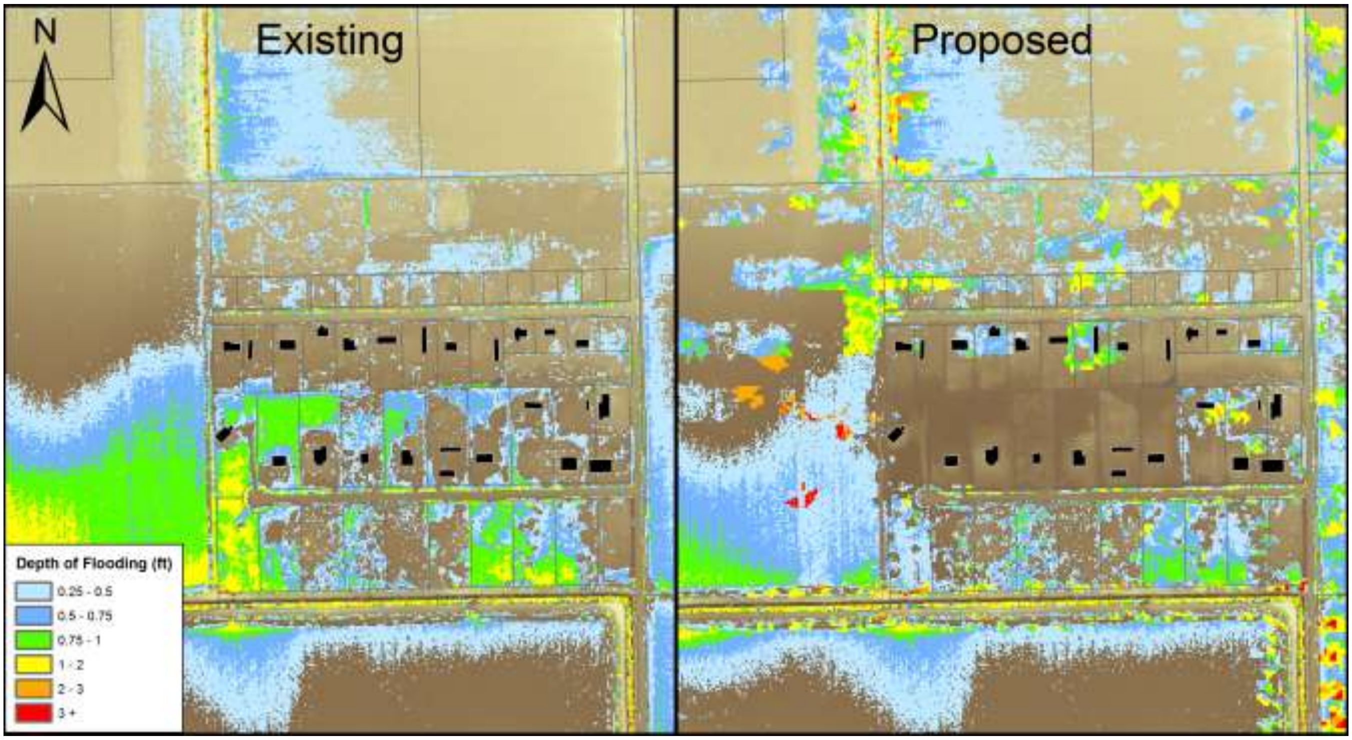


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	24	3	21
Inundated Roadway (LF)	90	65	25

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: V&C, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

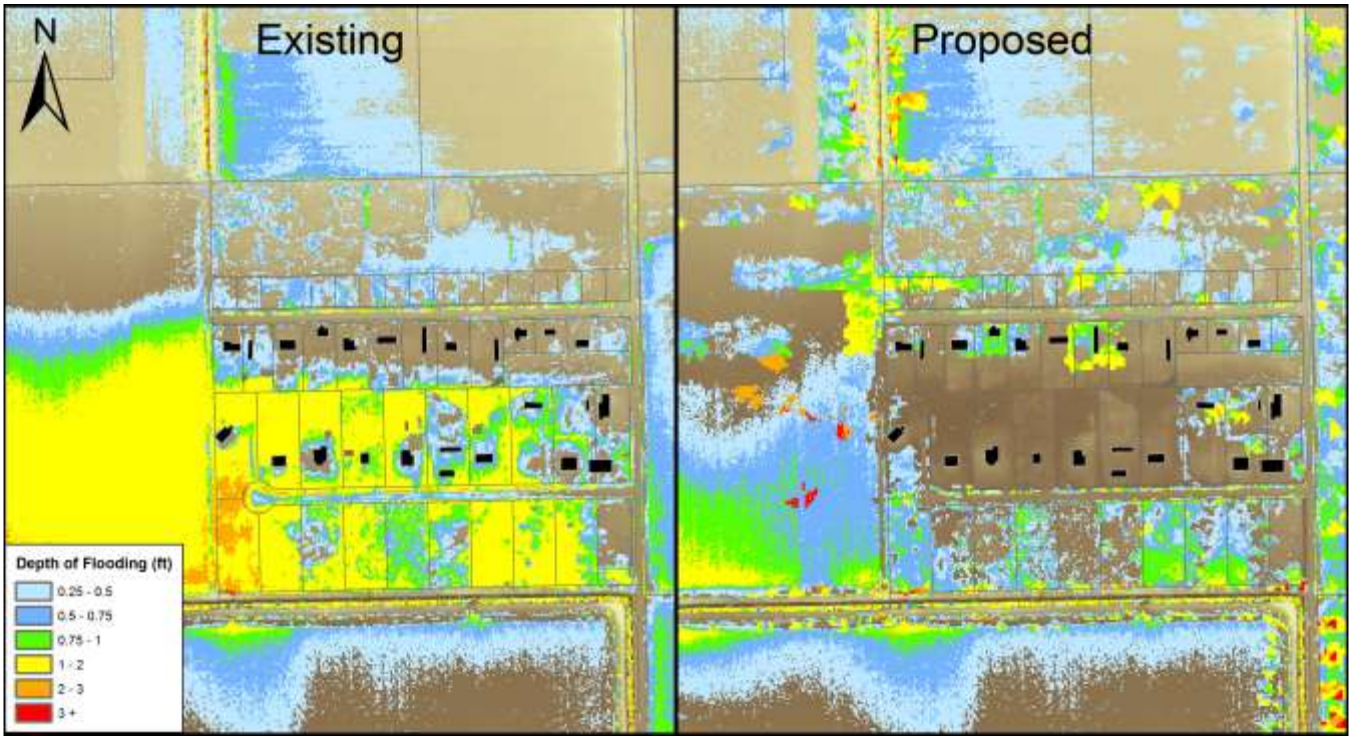


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	24	1	23
Inundated Roadway (LF)	980	85	895

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: V&C
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- V&C boundary
- Proposed Retention Pond
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

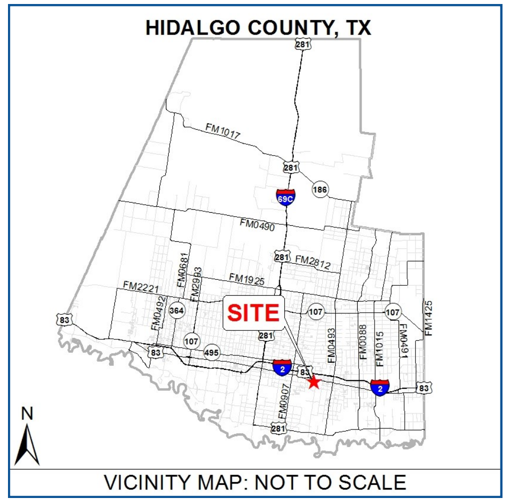
"Filling the Gap"

Colonia: Val Verde Grove, Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Val Verde Grove storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Val Verde Grove consists of approximately 19.6 acres of fully developed residential land. The colonia currently does not have a drainage system. The existing drainage pattern indicates runoff flows toward the north. Based on the existing conditions 2D model results and estimated finished floor elevations for the structures, it was determined that no structure is at high risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.

Colonia: Val Verde Grove, Hidalgo County

"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install culverts and swales with a retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 2,992 linear feet of 24-inch diameter pipe, 148 linear feet of 30-inch diameter pipe, 193 linear feet of 36-inch diameter pipe, and twelve curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 5.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
VAL VERDE GROVE

	IMPROVEMENTS	COST
1	Paving Improvements	$505,820.00
2	Drainage Improvements	$238,953.00
3	Pond Excavation Improvements	$145,329.55
	Sub-Total =	**$890,102.55**
	Engineering Fees (10%) =	**$89,010.26**
	Contingency (20%) =	**$178,020.51**
	Total =	**$1,157,133.32**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Val Verde Grove, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$1,157,133.32	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Val Verde Grove, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

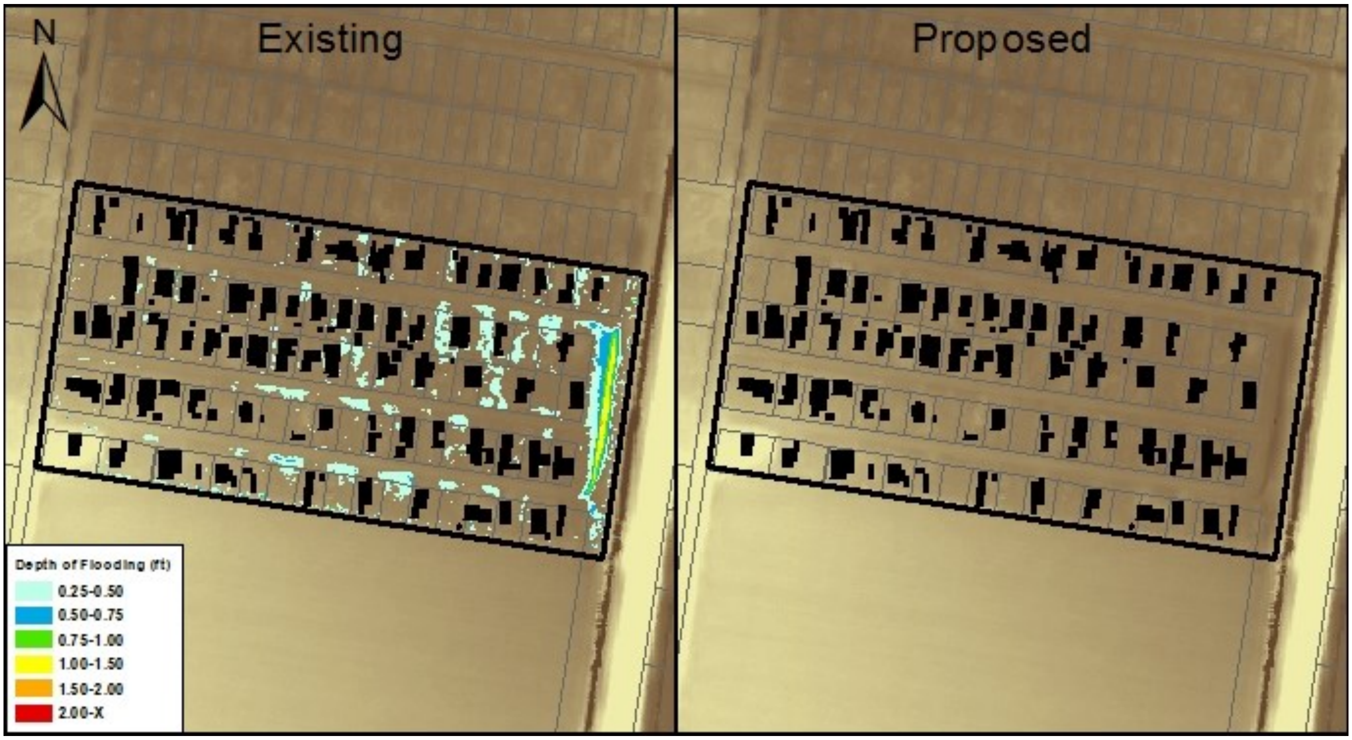


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	80	0	80
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Grove, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

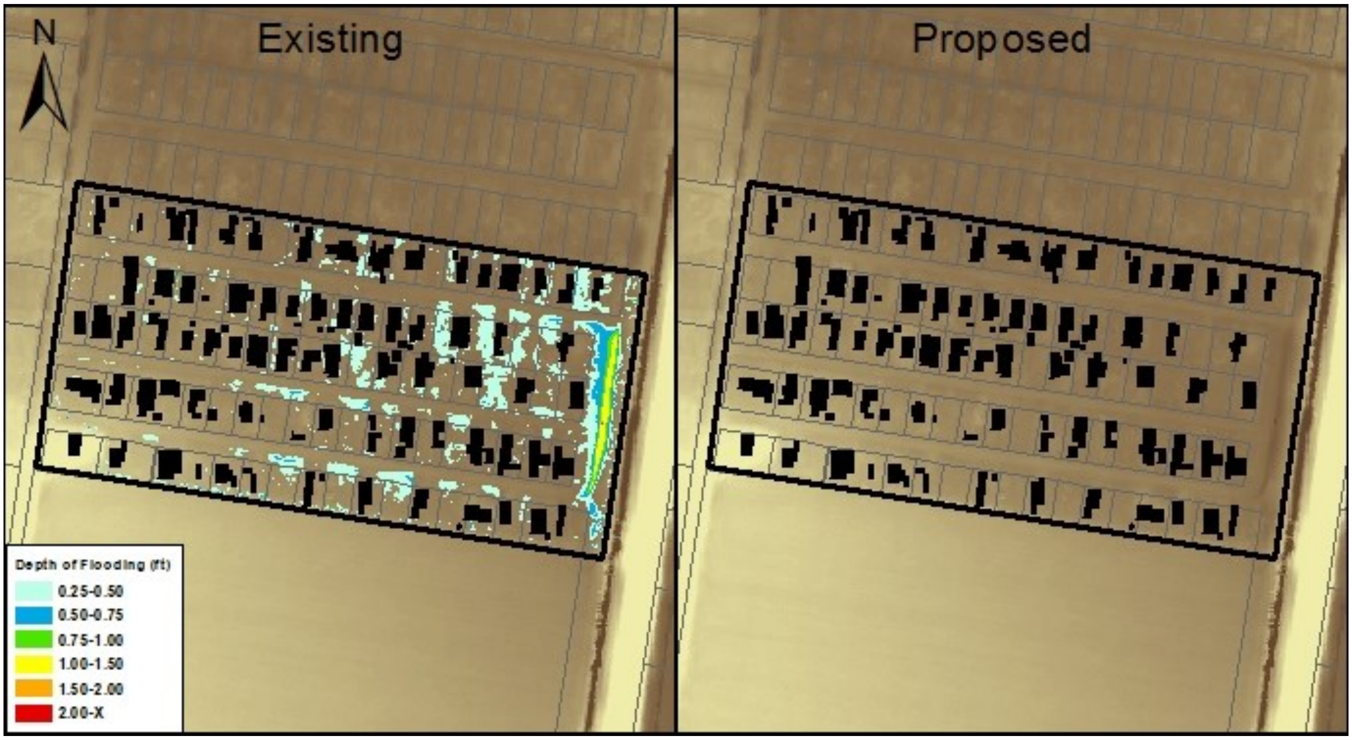


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	82	0	82
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Grove, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

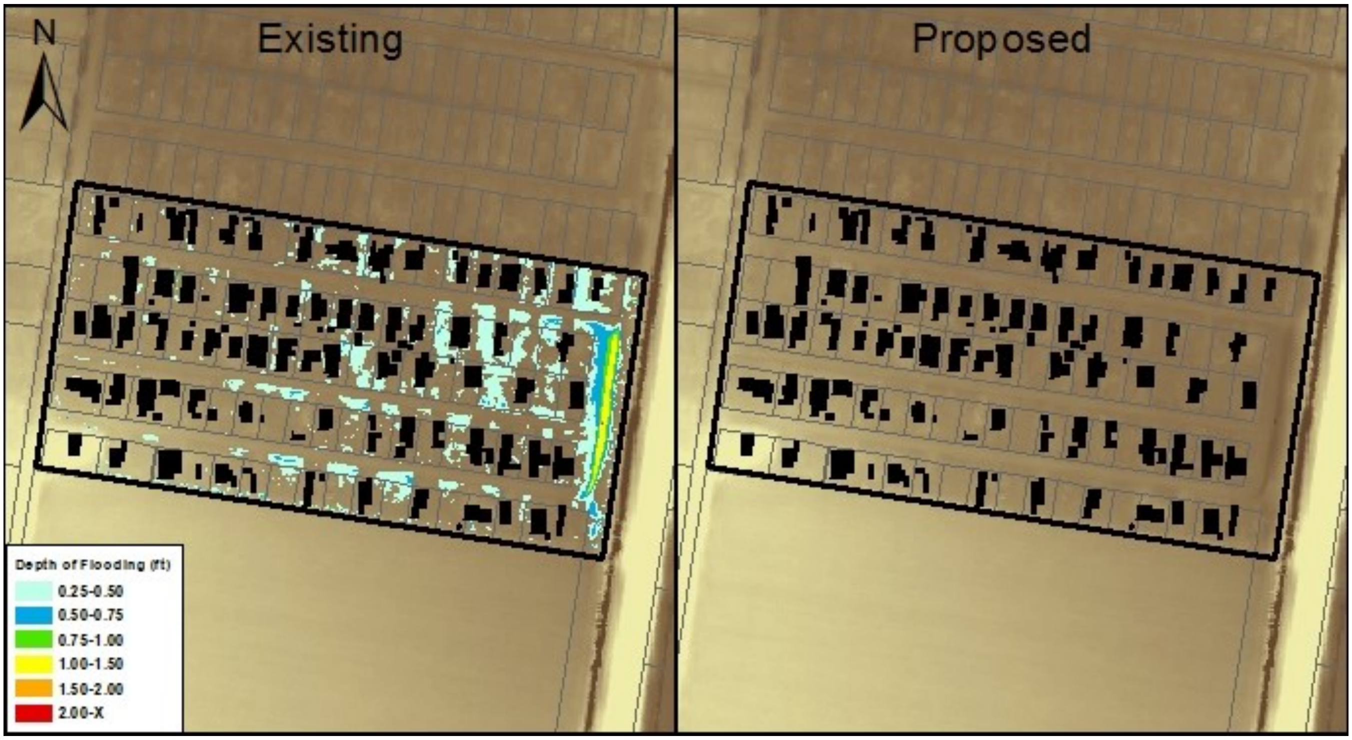


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	82	0	82
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Grove, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

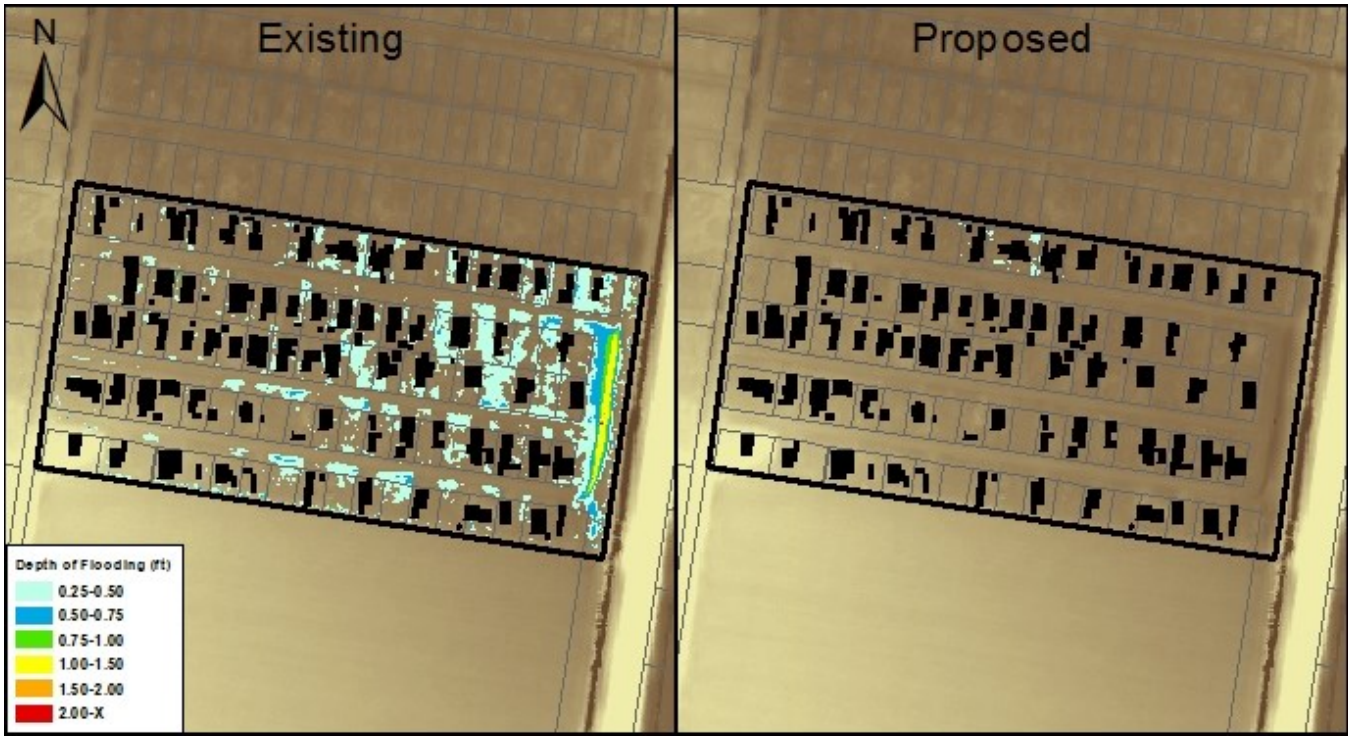


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	83	7	76
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Grove, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

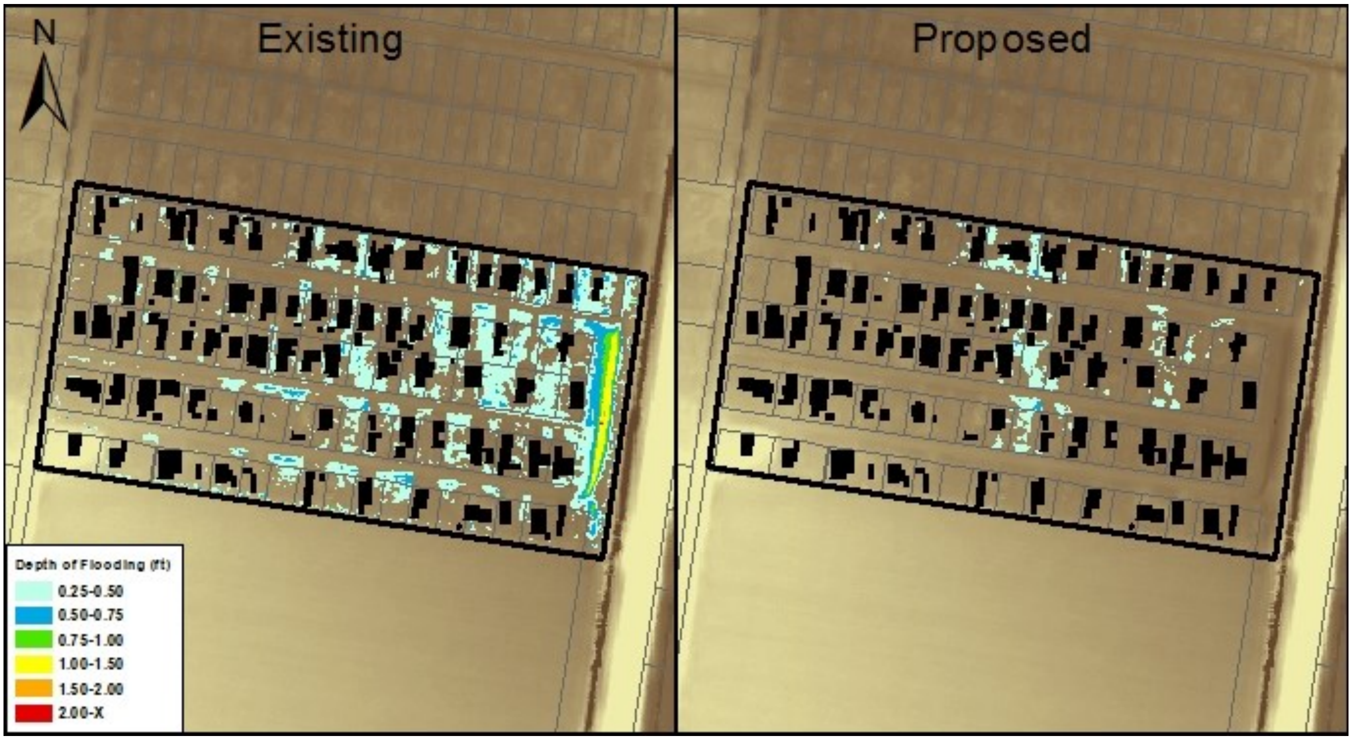


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	85	33	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Val Verde Grove
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- VAL VERDE GROVE
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W
E
S

0 110 220 330
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

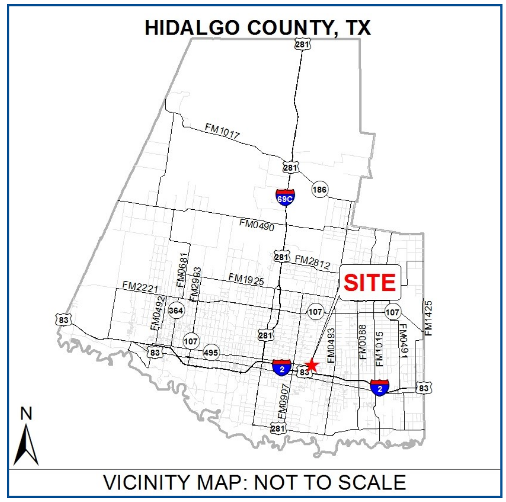
"Filling the Gap"

Colonia: Val Verde North Subd., Hidalgo County

Basin: North Main Drain

Category: B1

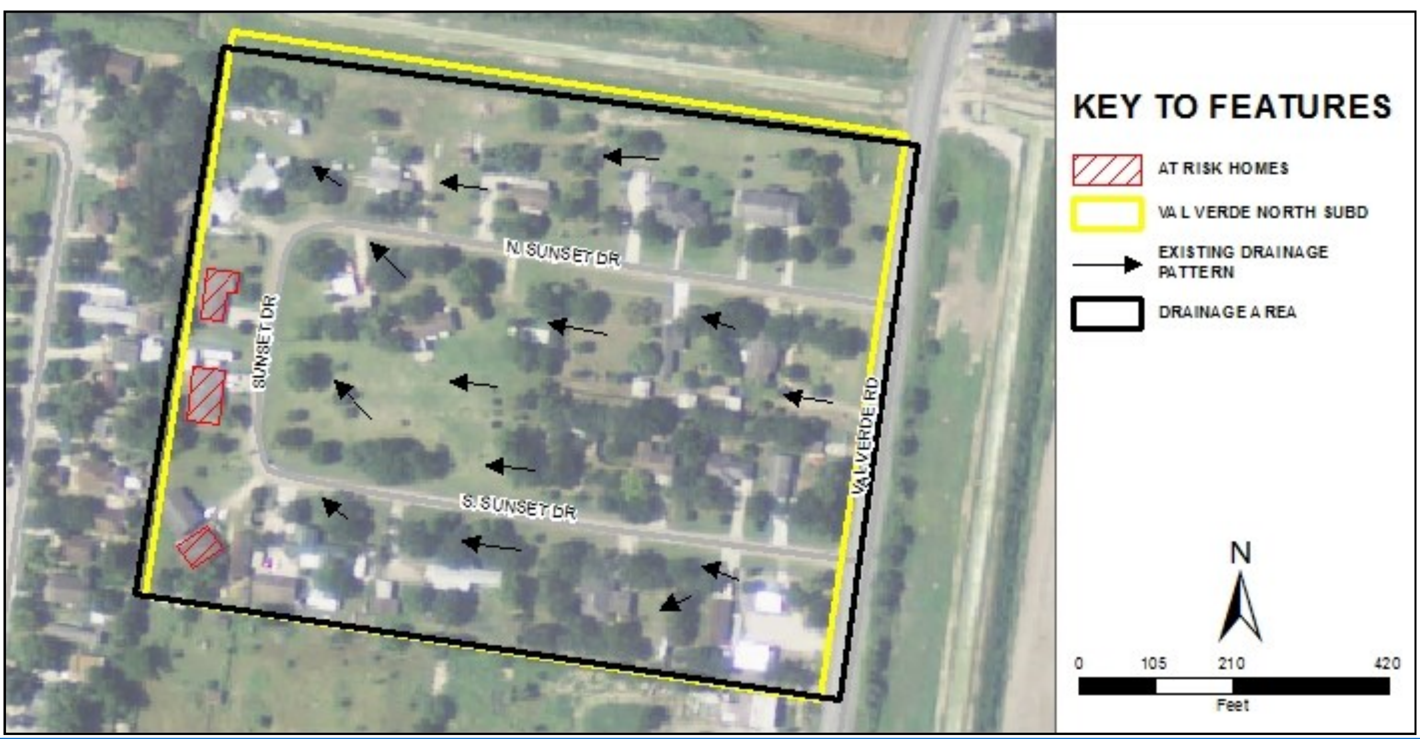
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Val Verde North Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Val Verde North Subd. consists of approximately 17 acres of fully developed residential land. The colonia currently does not have a drainage system. The existing drainage pattern indicates runoff flows toward the west. Based on the existing conditions 2D model results, structures along the west side of the colonia appear to be at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Val Verde North Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system to outfall into the existing drainage ditch.
  - Install an underground drainage system with a retention pond.
  - Install swales and culverts to outfall into the existing drainage ditch.
  - Install swales and culverts with a retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 205 linear feet of 18-inch diameter pipe, 1,504 linear feet of 24-inch diameter pipe, 228 linear feet of 30-inch diameter pipe, and twelve curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST VAL VERDE NORTH SUBD.		
IMPROVEMENTS		**COST**
1	Paving Improvements	$328,016.67
2	Drainage Improvements	$172,868.00
3	Pond Excavation Improvements	$136,977.27
	Sub-Total =	**$637,861.94**
	Engineering Fees (10%) =	**$63,786.19**
	Contingency (20%) =	**$127,572.39**
	Total =	**$829,220.52**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.	

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	1	0	1
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$616,217.00	$829,220.52	0.74
Elevate Structures	$616,217.00	$303,000.00	2.03
Acquisition/Supplemental Housing / Demolition	$646,250.00	$377,423.70	1.71

Colonia: Val Verde North Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

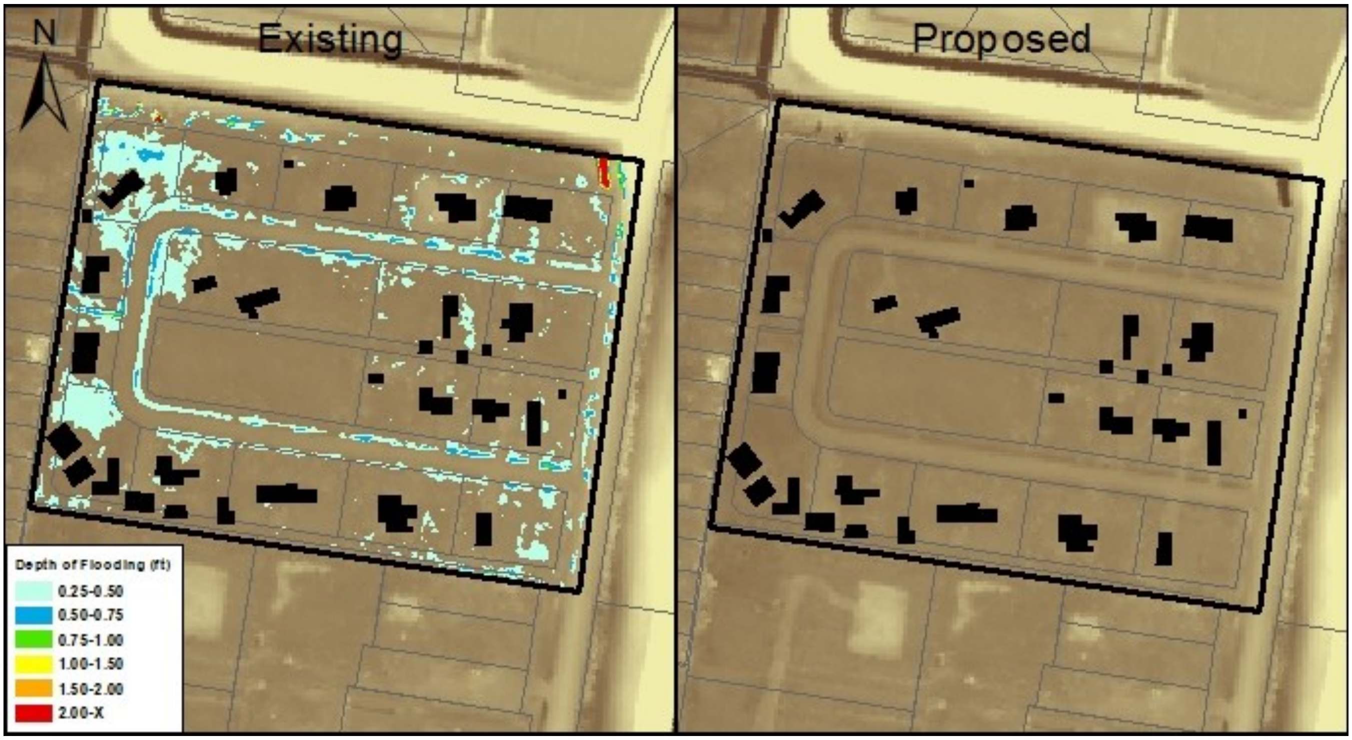


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	18	0	18
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde North Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

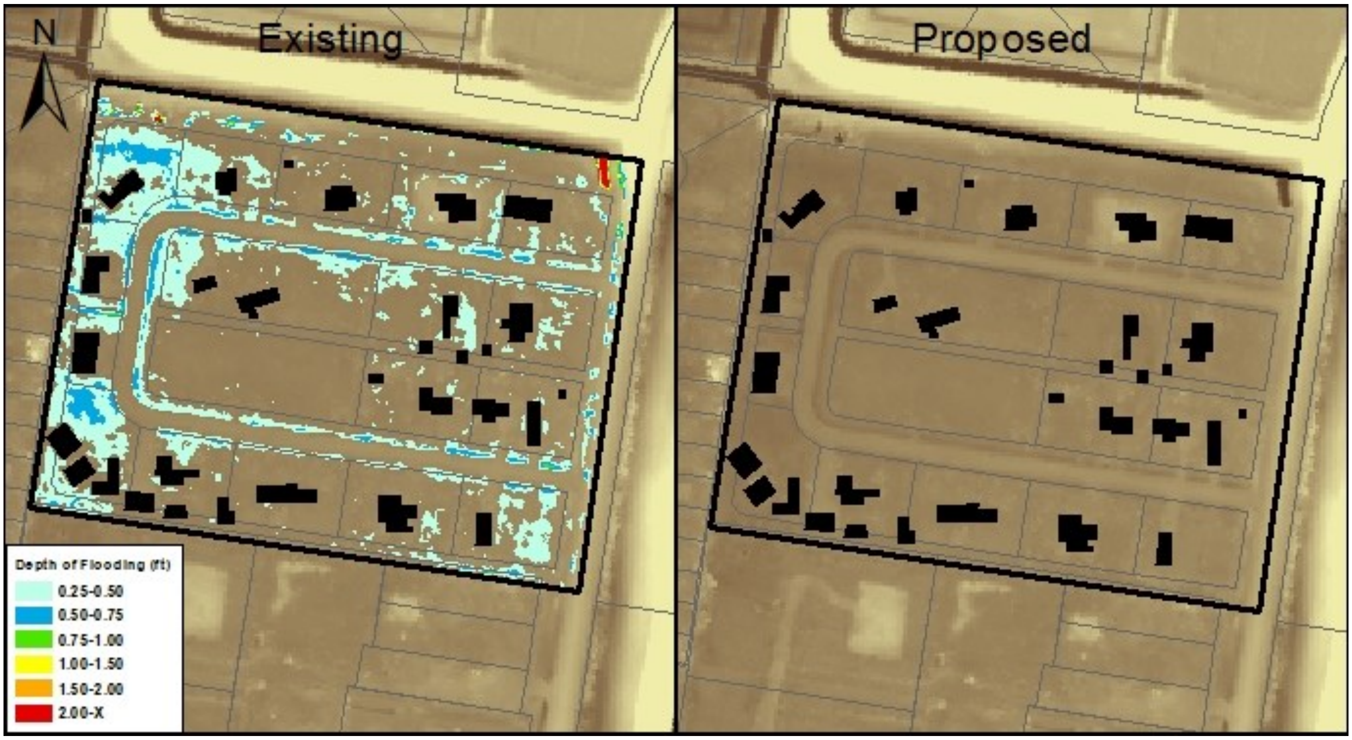


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	18	0	18
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde North Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

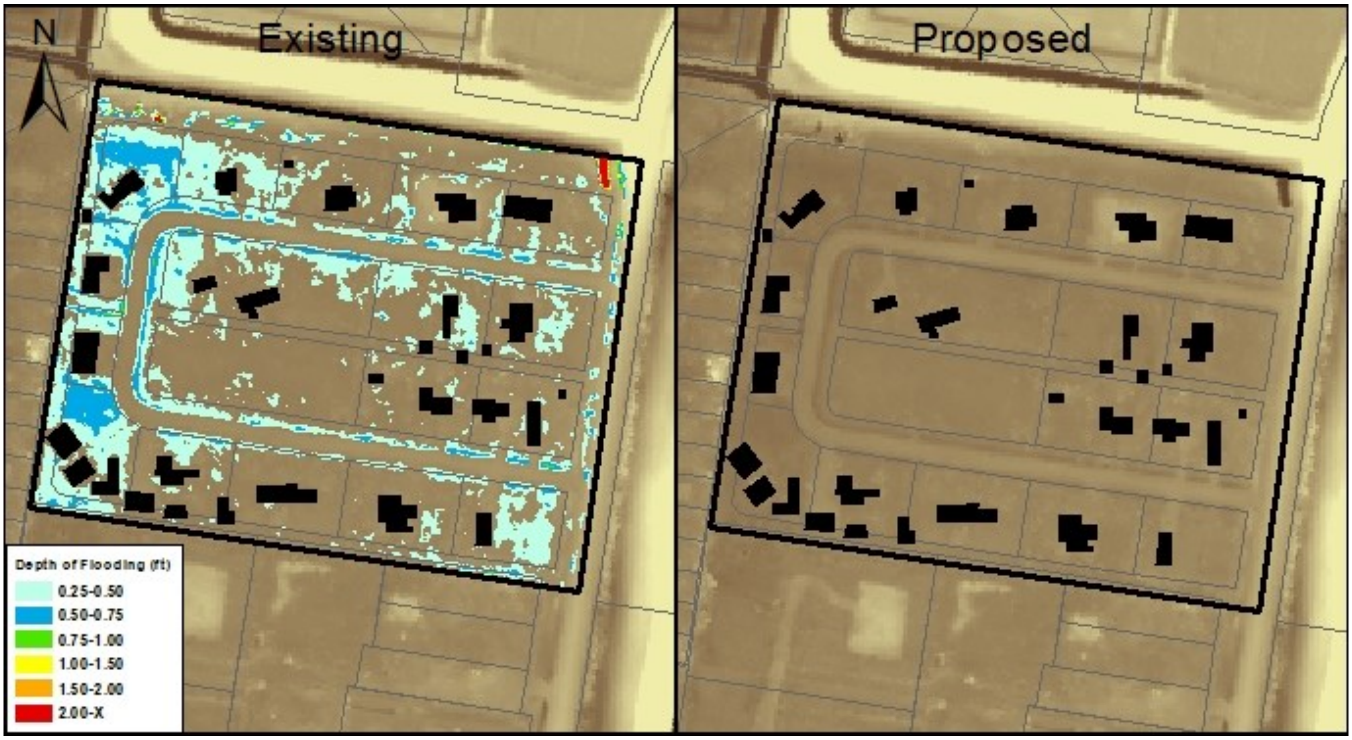


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	18	0	18
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

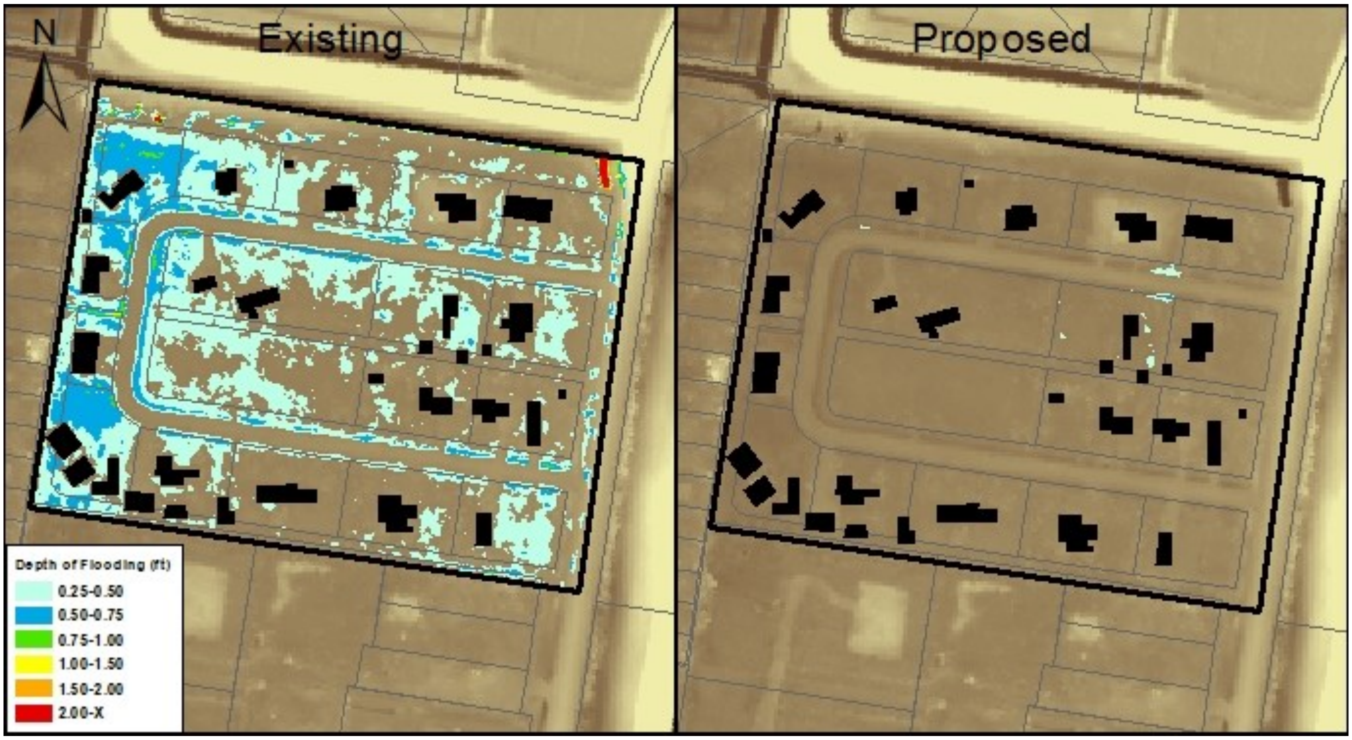


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	18	2	16
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

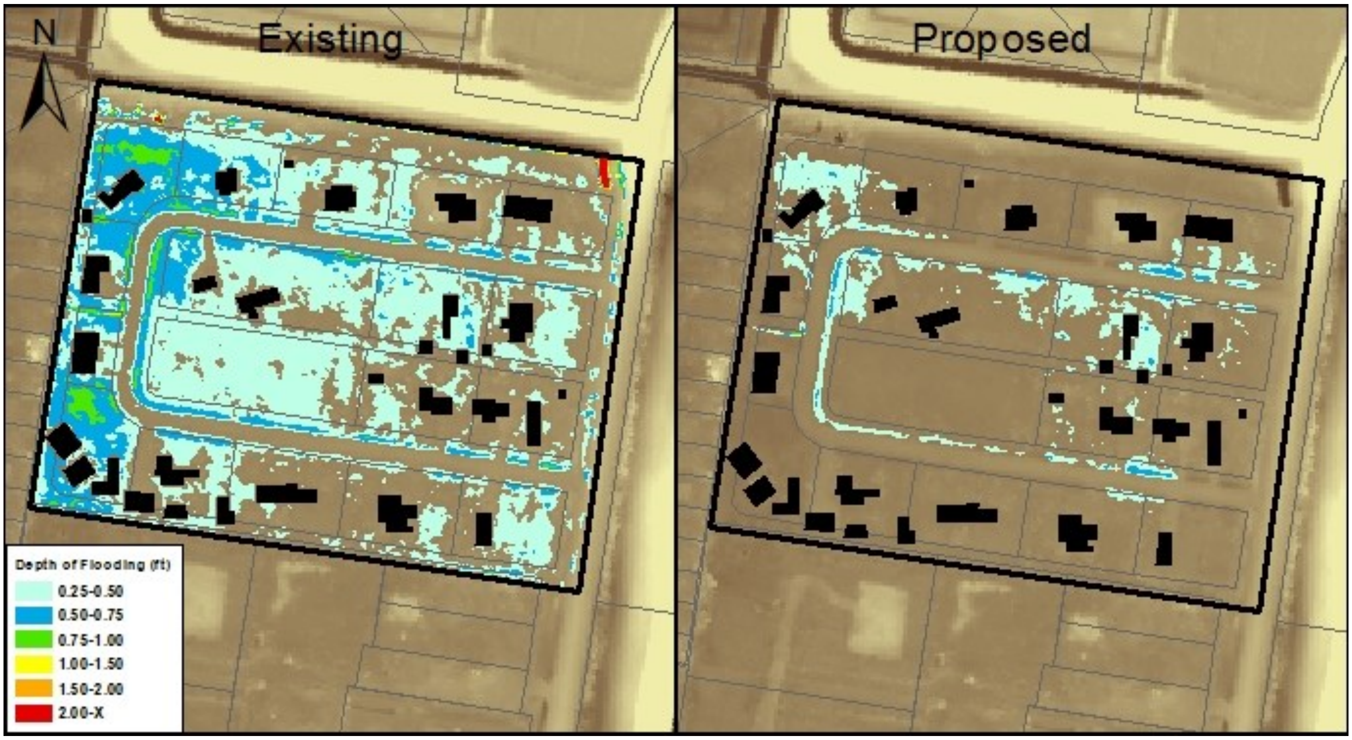
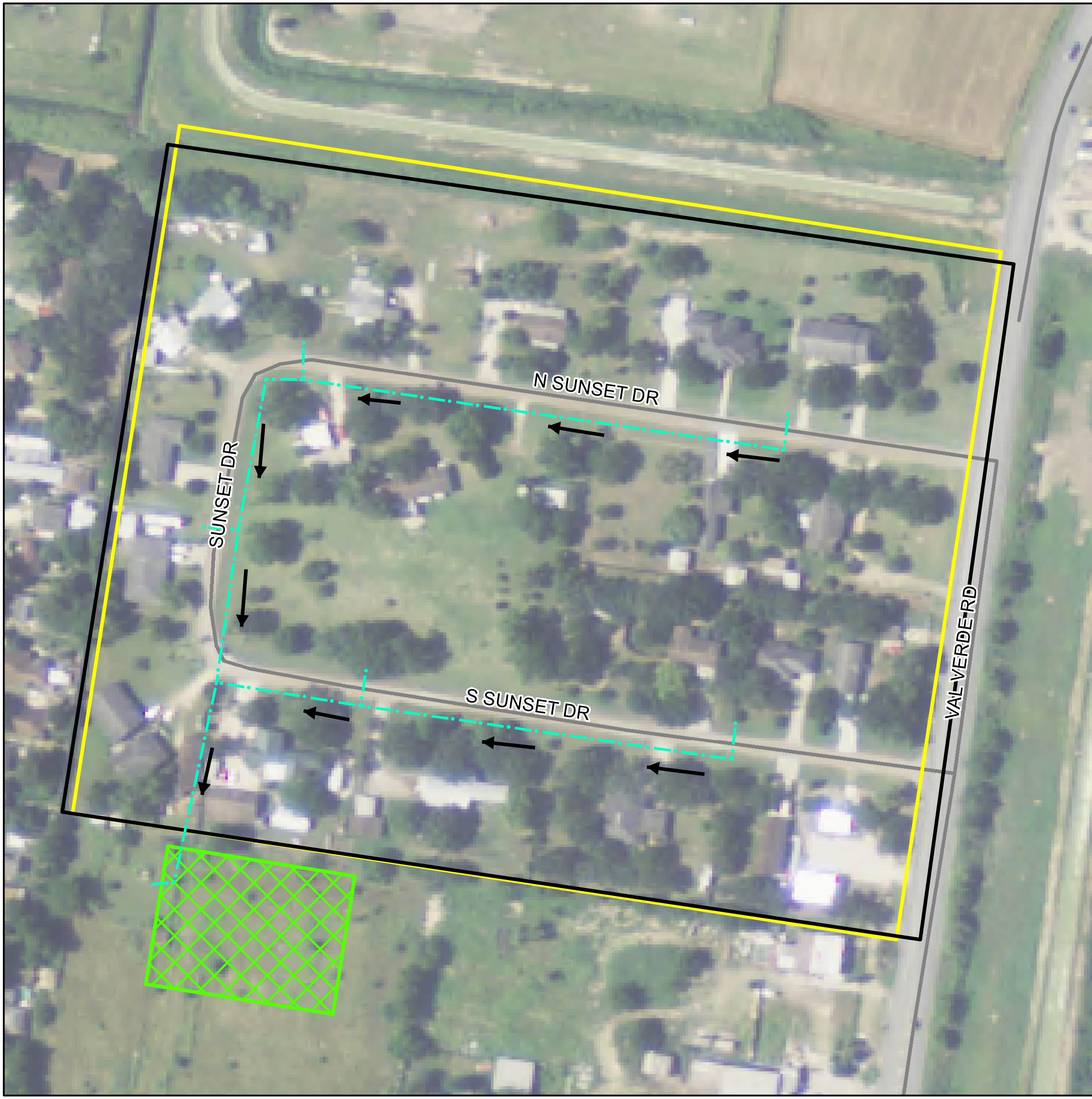


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	18	14	4
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

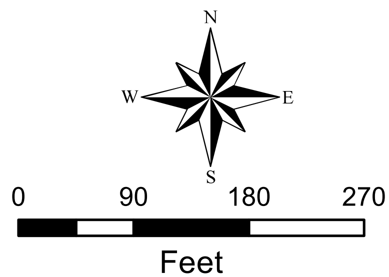
Colonia: Val Verde North Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- VAL VERDE NORTH SUBD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

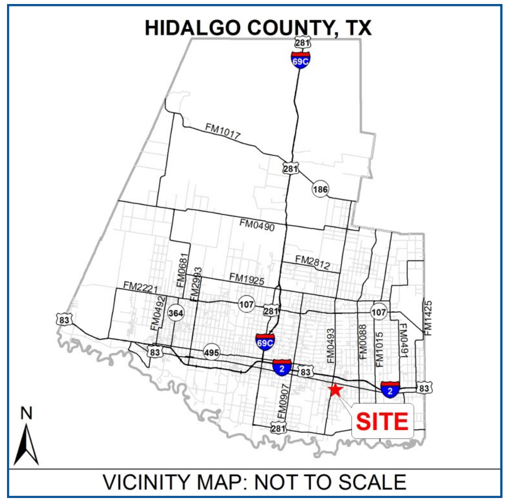
"Filling the Gap"

Colonia: Victoria Belen, Hidalgo County

Basin: North Main Drain

Category: A1

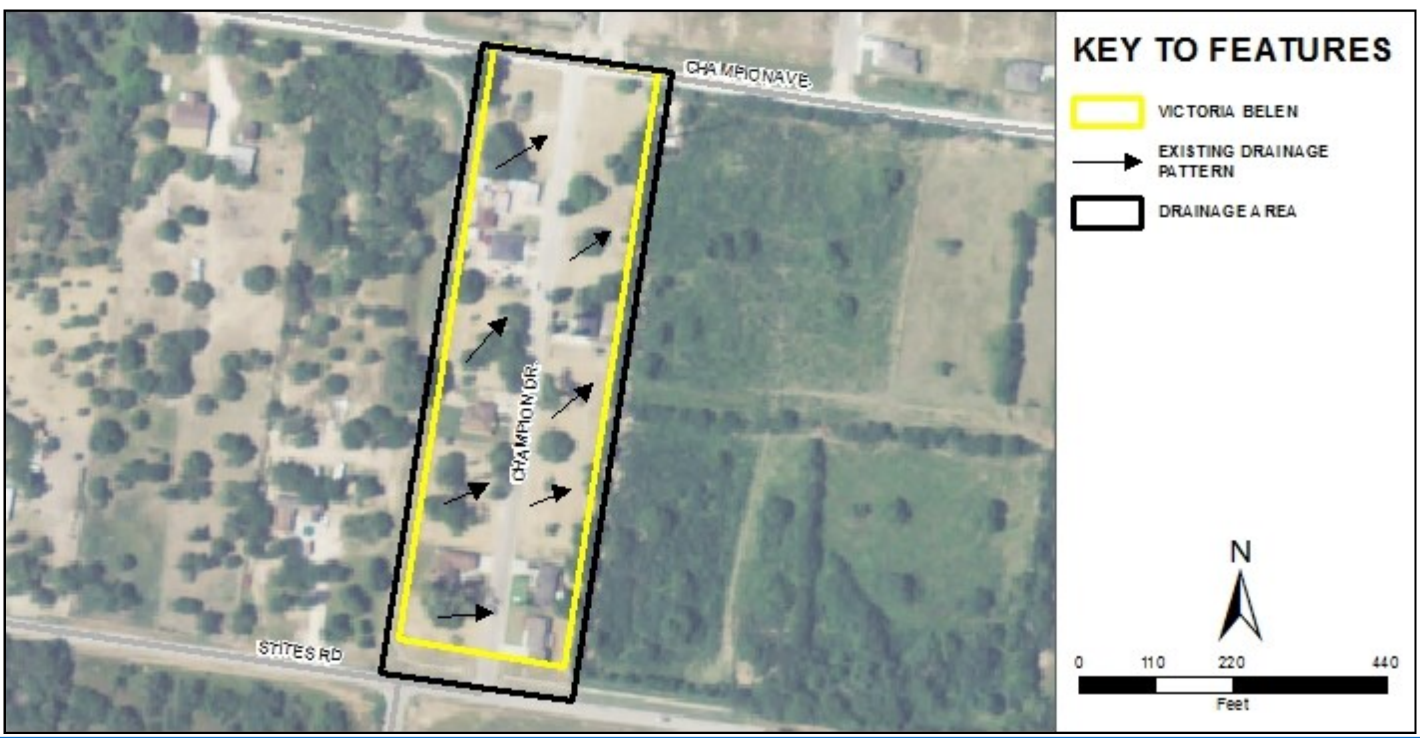
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Victoria Belen storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Victoria Belen consists of approximately 6 acres of partially developed residential land. The colonia currently does not have a drainage system. There is an existing abandoned irrigation canal that runs parallel to Champion Dr. along the west side of the colonia. It turns east along the north side of Stites Rd and runs for approximately 470 feet. The existing drainage pattern seems to indicate runoff flows toward the northeast. Based on the existing conditions 2D model results and estimated finished floor elevations for the structures, it was determined that no structure is at high risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Victoria Belen, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install an underground drainage system with a pump and use the abandoned irrigation canal as detention.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 512 linear feet of 18-inch diameter pipe, 400 linear feet of 24-inch diameter pipe, and four curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 1.97 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
VICTORIA BELEN

	IMPROVEMENTS	COST
1	Paving Improvements	$146,508.33
2	Drainage Improvements	$66,680.00
3	Pond Excavation Improvements	$53,454.55
	Sub-Total =	**$266,642.88**
	Engineering Fees (10%) =	**$26,664.29**
	Contingency (20%) =	**$53,328.58**
	Total =	**$346,635.74**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Victoria Belen, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$346,635.74	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Victoria Belen, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

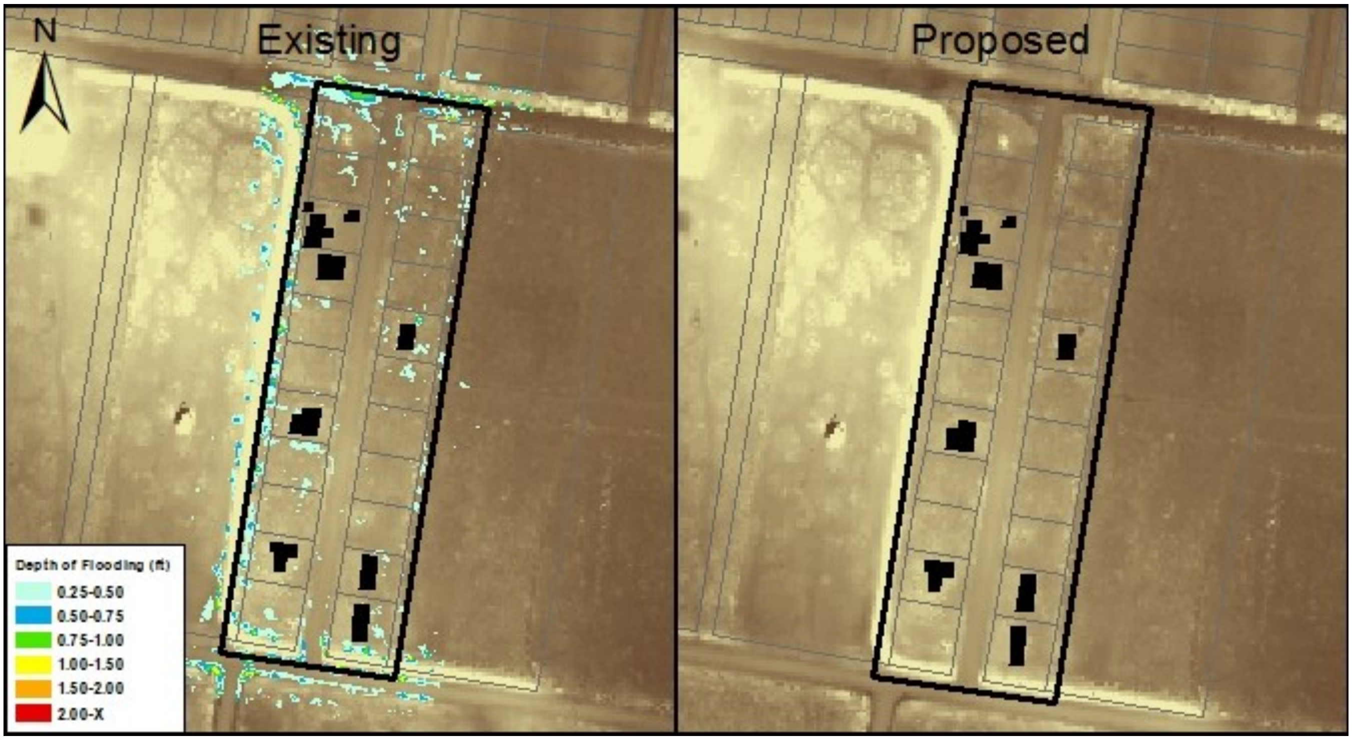


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	0	22
Inundated Roadway (LF)	158	0	158

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Victoria Belen, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

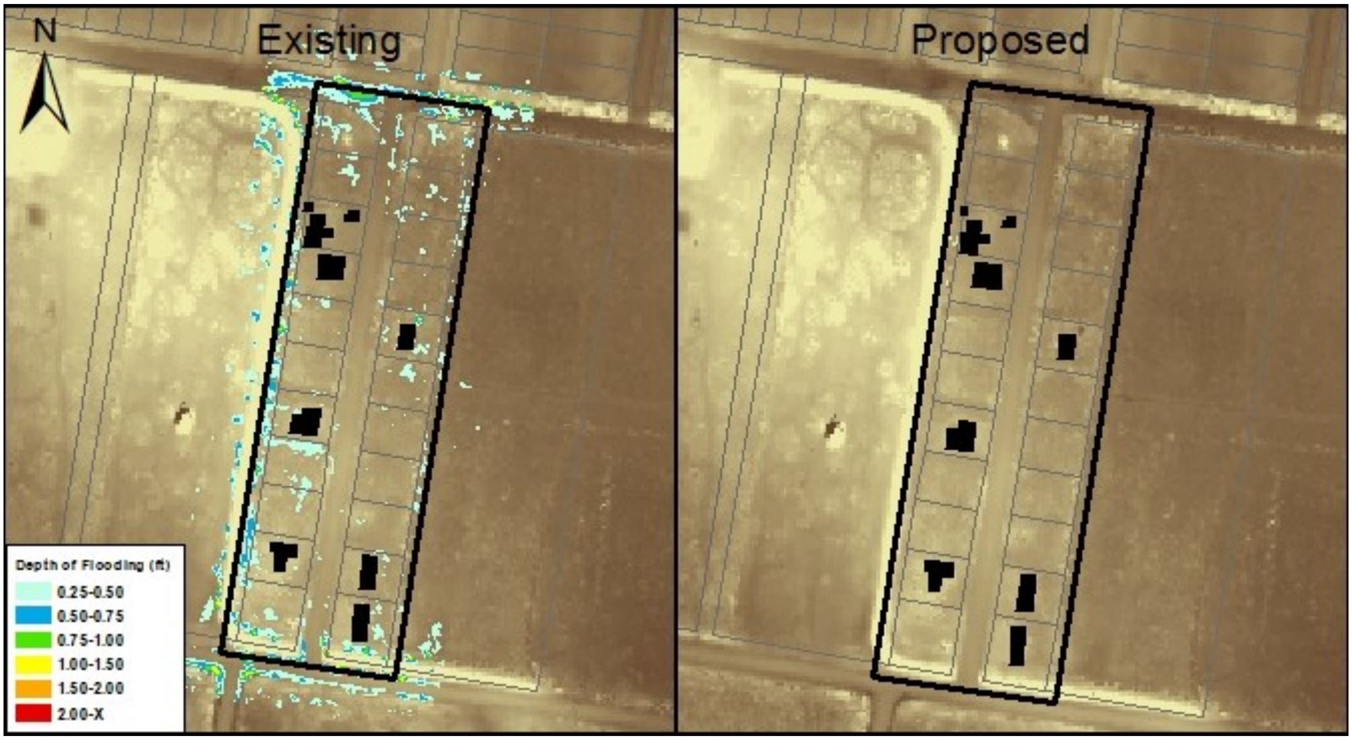


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	0	22
Inundated Roadway (LF)	292	0	292

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Victoria Belen, Hidalgo County

“Filling the Gap”

Recommended Mitigation Project cont.:

Project Figures:

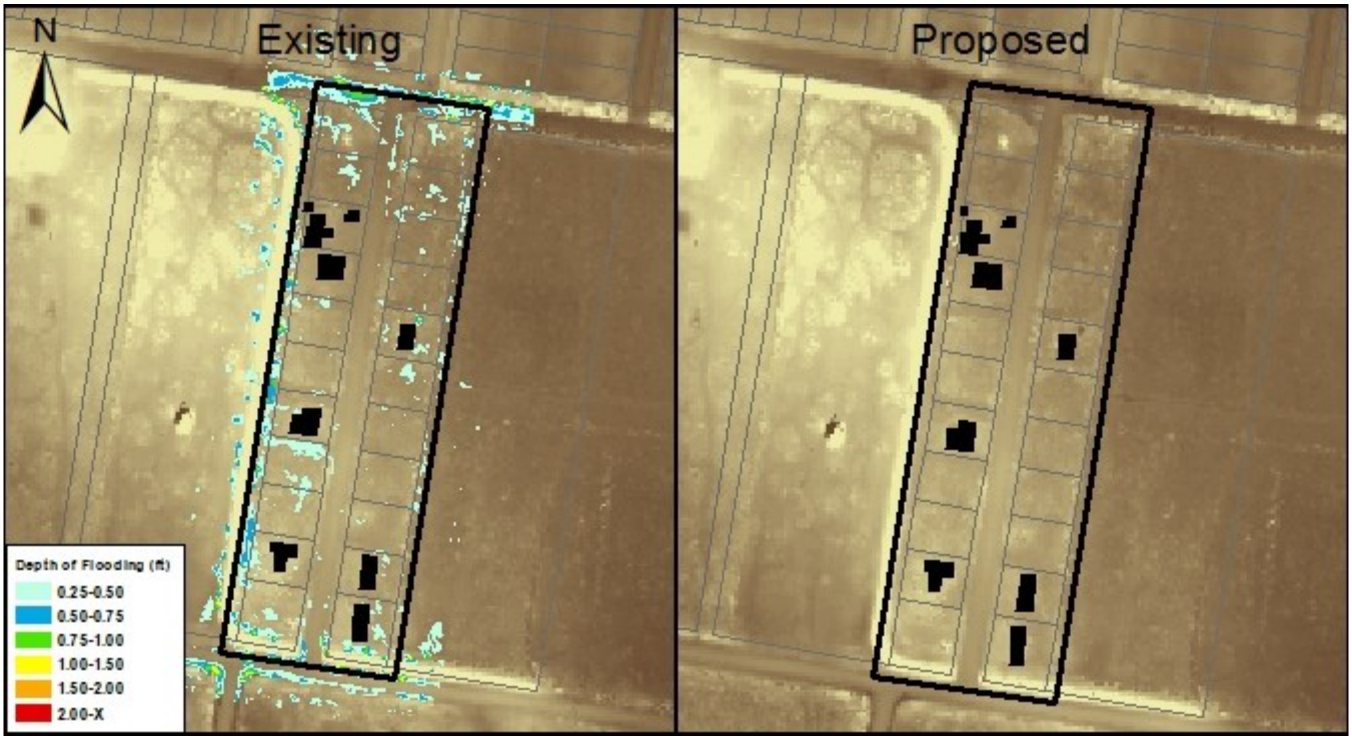


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	0	22
Inundated Roadway (LF)	293	0	293

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Victoria Belen, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

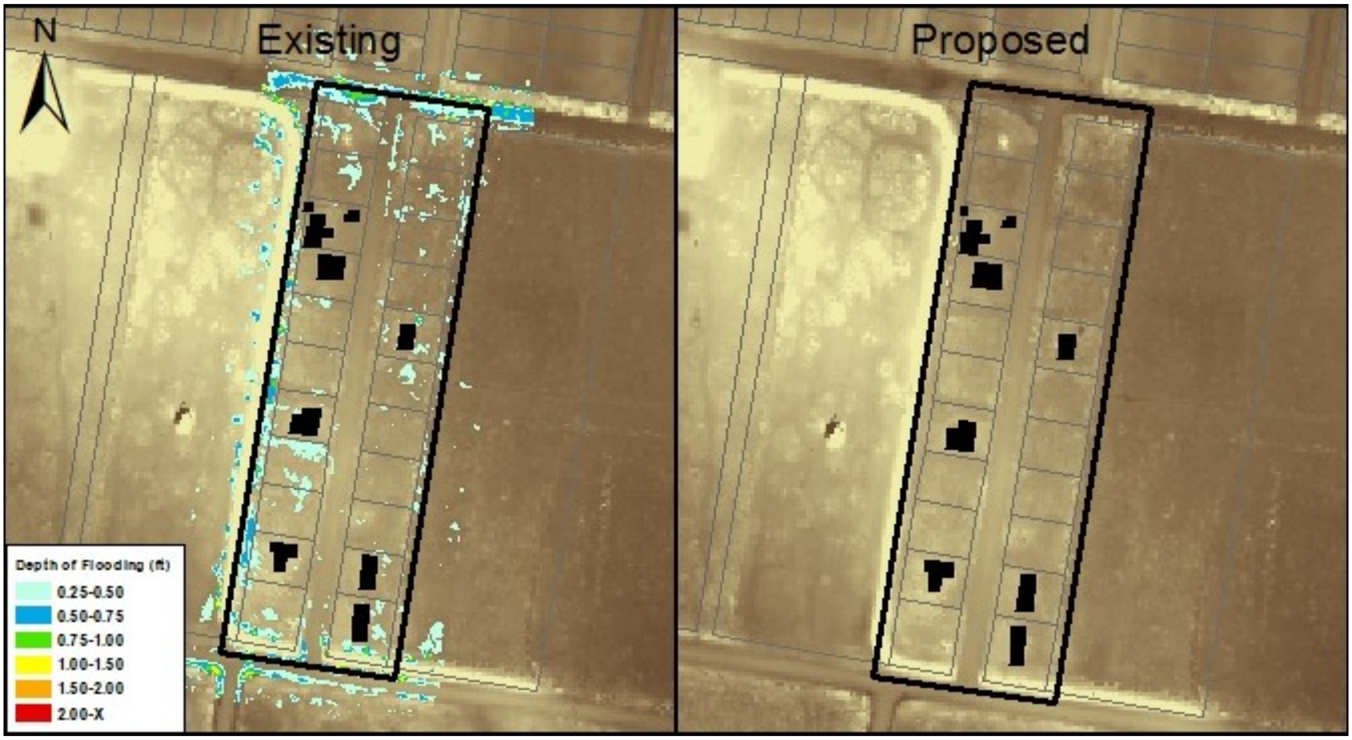


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	0	22
Inundated Roadway (LF)	384	0	384

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Victoria Belen, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

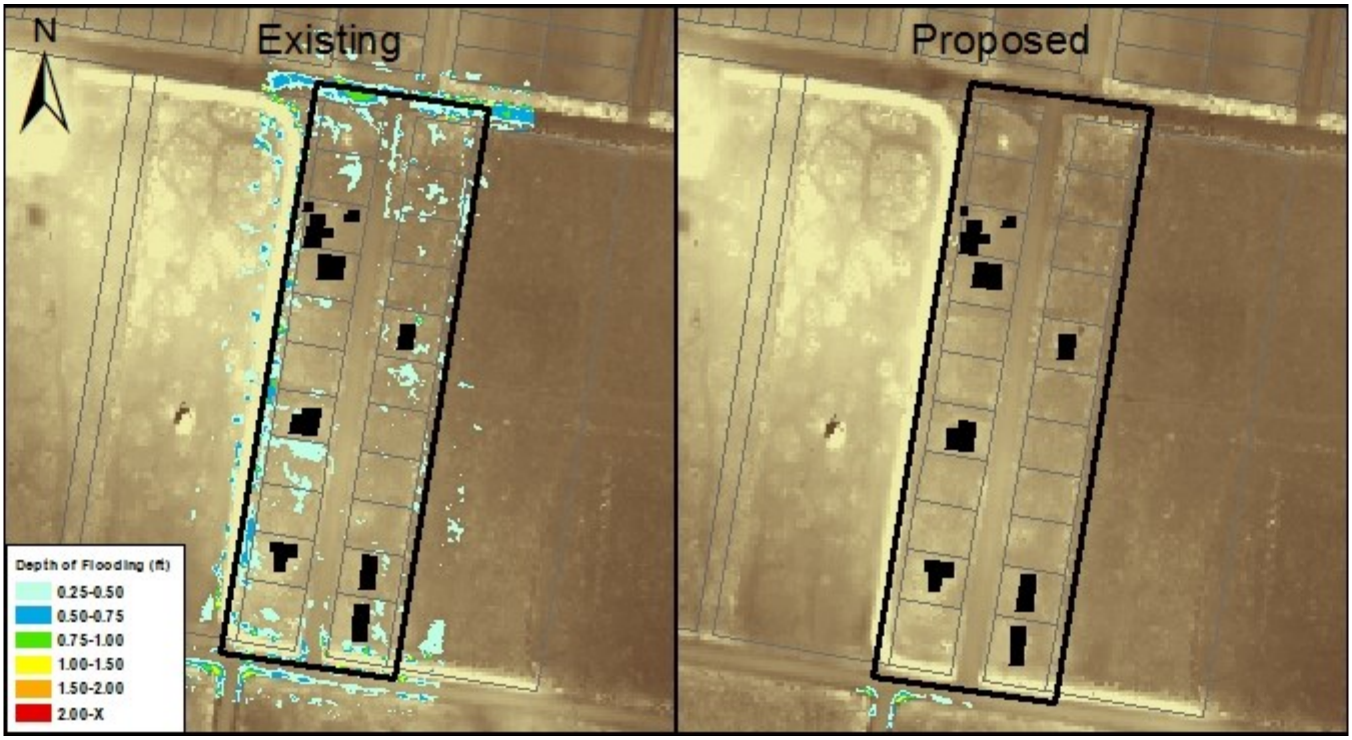


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	22	0	22
Inundated Roadway (LF)	399	0	399

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Victoria Belen
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- VICTORIA BELEN
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N W E S

0 80 160 240
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

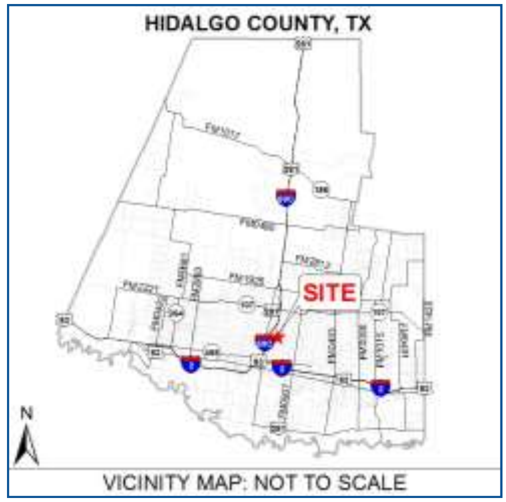
Colonia: Cotter and Welch Tract, Hidalgo County

Basin: North Main Drain

Category: A1

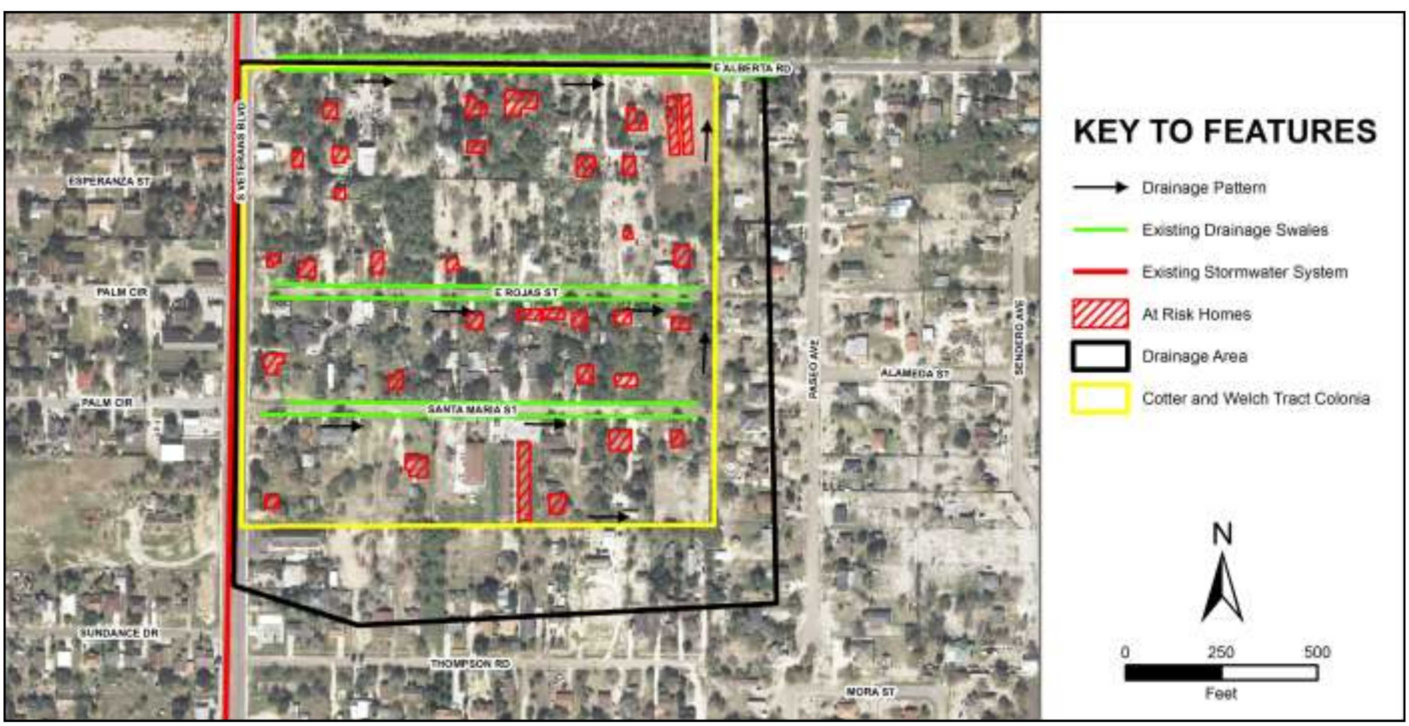
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Cotter Tract and Welch Tract colonias were built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within these gross 34-acre colonias are generally to the north and east. The existing drainage system consists of roadside swales that are generally undersized and restricted by sediment and vegetation. Cotter Tract and Welch Tract both experience residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Cotter and Welch Tract, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Improve the roadside drainage system with a retention pond to mitigate off-site impacts
  - Improve and/or install adequately sized driveway culverts
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

Due to the location and densely populated nature of both the Cotter Tract and Welch Tract colonias, the two areas were combined for this study to create one solution.

To reduce local flooding potential, the recommended project includes improvements to the roadside drainage system with a retention facility. The improvements include 740 linear feet of 18-inch diameter pipe, 320 linear feet of 24-inch diameter pipe, 30 linear feet of 36-inch diameter pipe, 225 linear feet of 48-inch diameter pipe, 6,600 linear feet of grassy swale, 1,780 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 19.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, the densely populated area, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Cotter Tract and Welch Tract

	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	59,550.00
2	**DRAINAGE IMPROVEMENTS**	$	111,380.56
3	**POND EXCAVATION IMPROVEMENTS**	$	516,670.00
	Sub-Total =	$	**687,600.56**
	Engineering (10%)	$	68,760.06
	Contingency (20%)	$	137,520.11
	Total =	$	**893,880.72**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3.5 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	14	0	14
20% (5-year)	18	0	18
10% (10-year)	21	0	21
4% (25-year)	24	0	24
1% (100-year)	34	8	26

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$15,103,516	$893,880	16.90
Elevate Structures	$15,103,516	$3,737,400	4.04
Acquisition/Supplemental Housing/Demolition	$15,881,187	$4,200,663	3.78

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

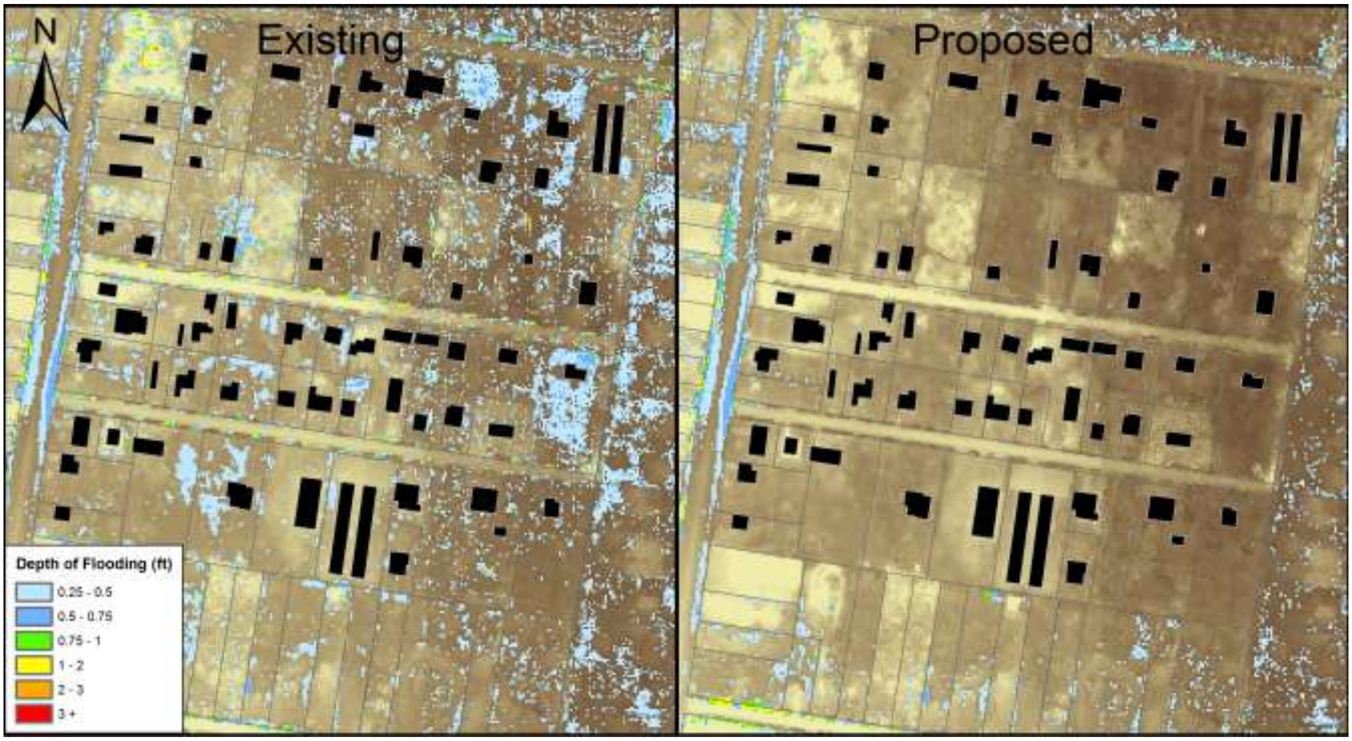


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	14	0	14
Inundated Lots	58	11	47
Inundated Roadway (LF)	70	65	5

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

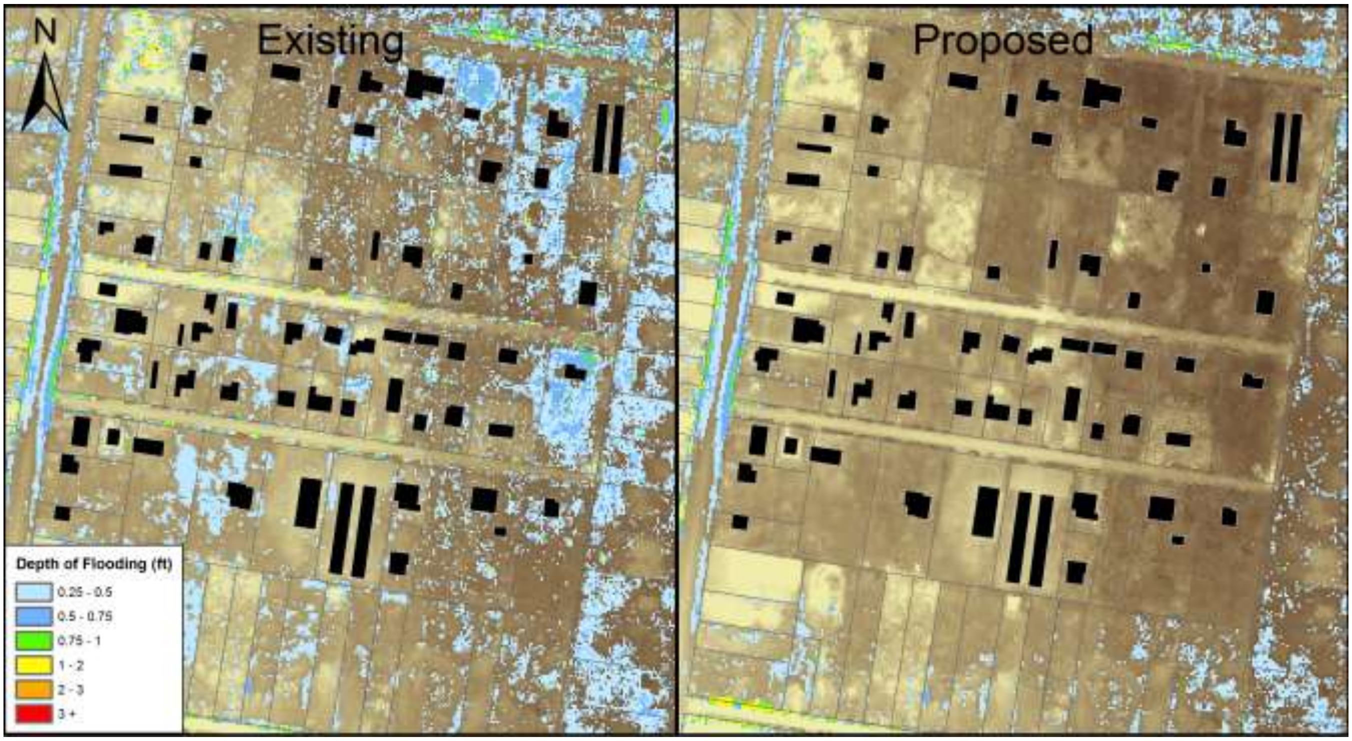


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	18	0	18
Inundated Lots	58	11	47
Inundated Roadway (LF)	100	85	15

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

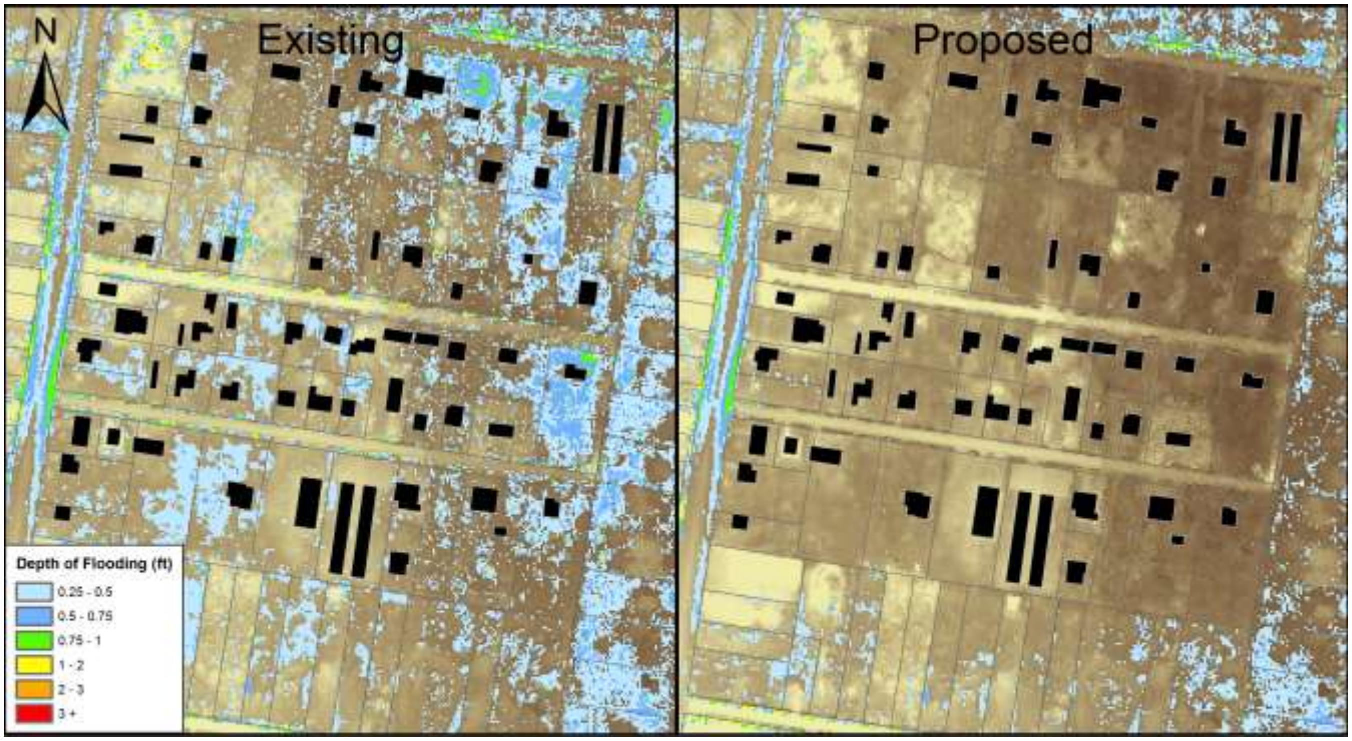


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	21	0	21
Inundated Lots	58	13	45
Inundated Roadway (LF)	180	130	50

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	24	0	24
Inundated Lots	58	15	43
Inundated Roadway (LF)	340	180	160

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Cotter and Welch Tract, Hidalgo County

Recommended Mitigation Project cont.:

Project Figure:

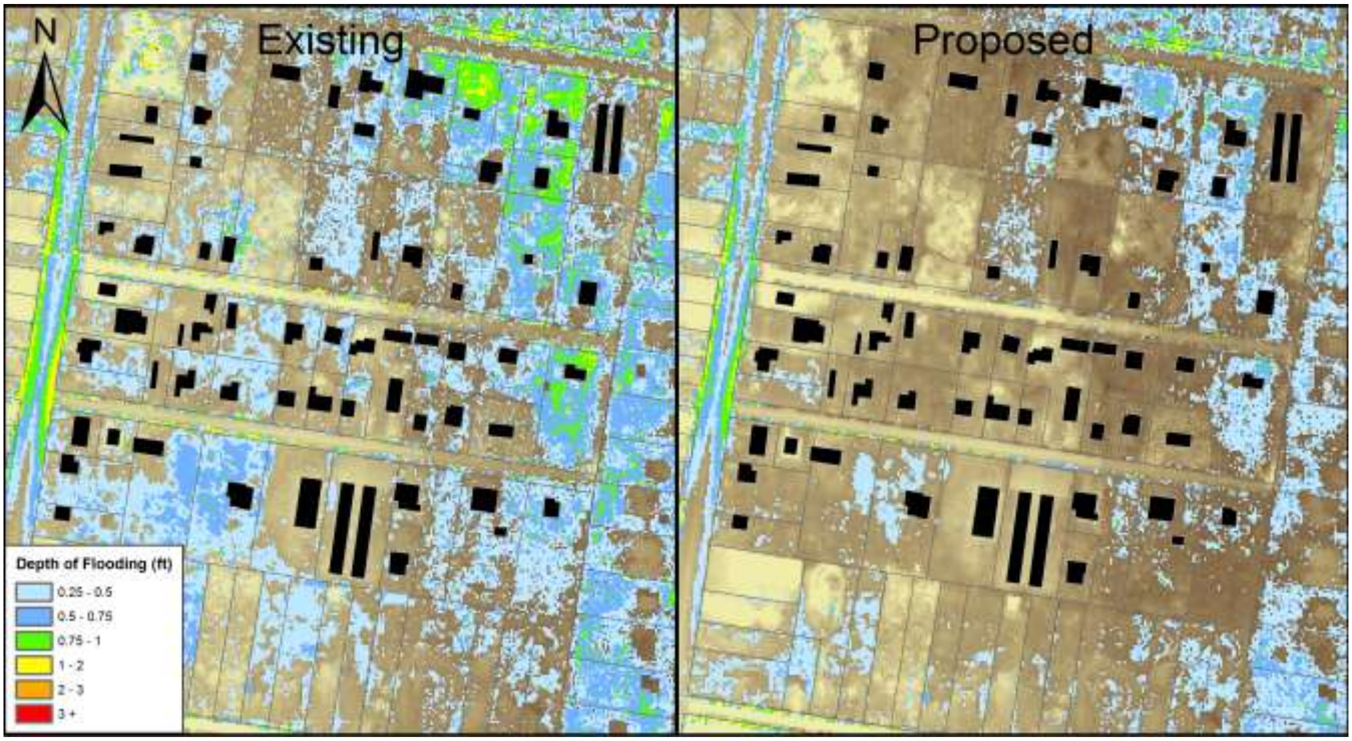
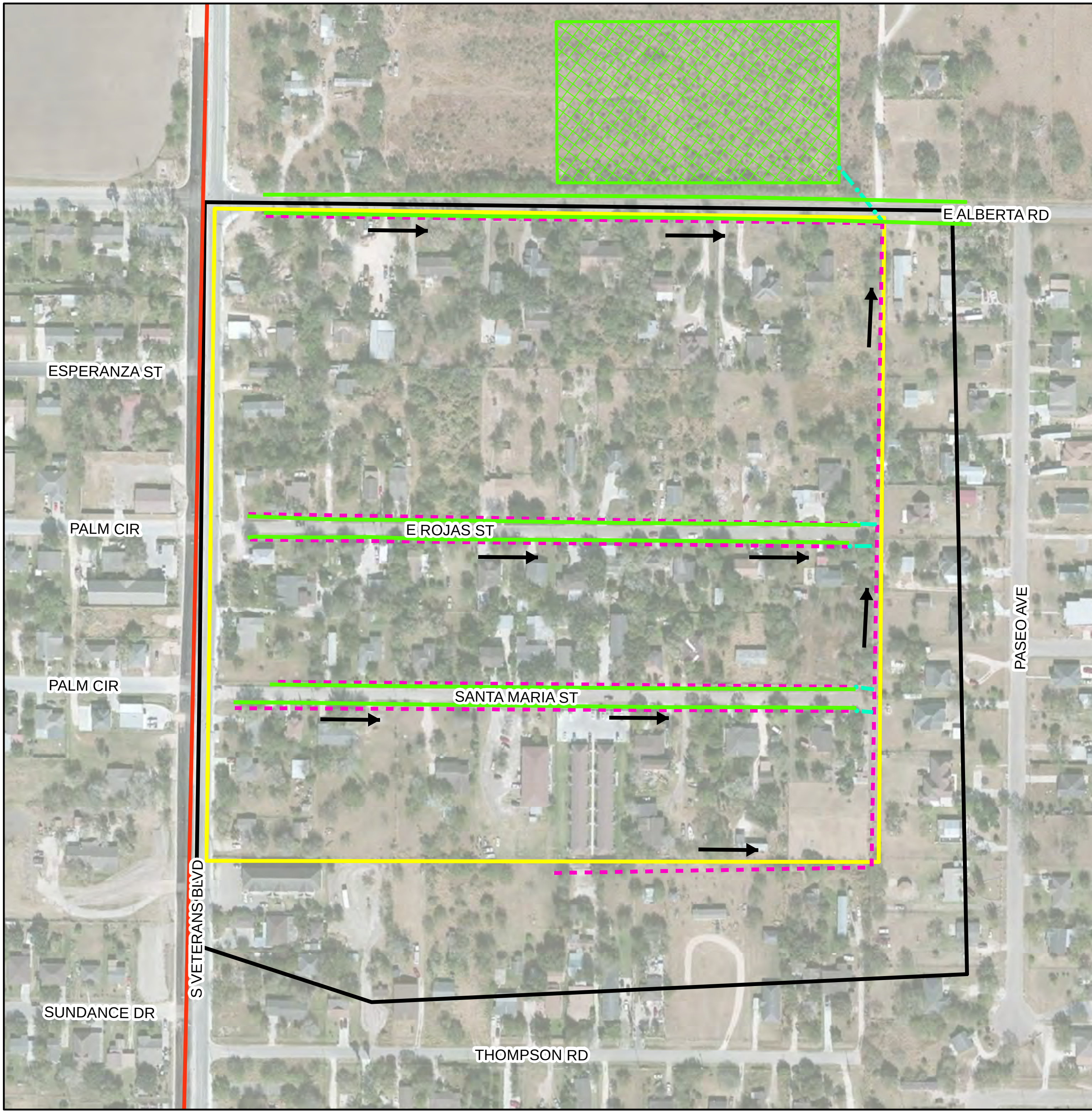


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	34	8	26
Inundated Lots	58	39	19
Inundated Roadway (LF)	635	395	240

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Cotter & Welch Tract
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Existing Stormwater System
- Existing Drainage Swales
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Floodplain
- Proposed Retention Pond
- Cotter Welch Tract Boundary
- Drainage Area

N

0 62.5 125 250
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Lasara, Willacy County

Basin: Raymondville Drain

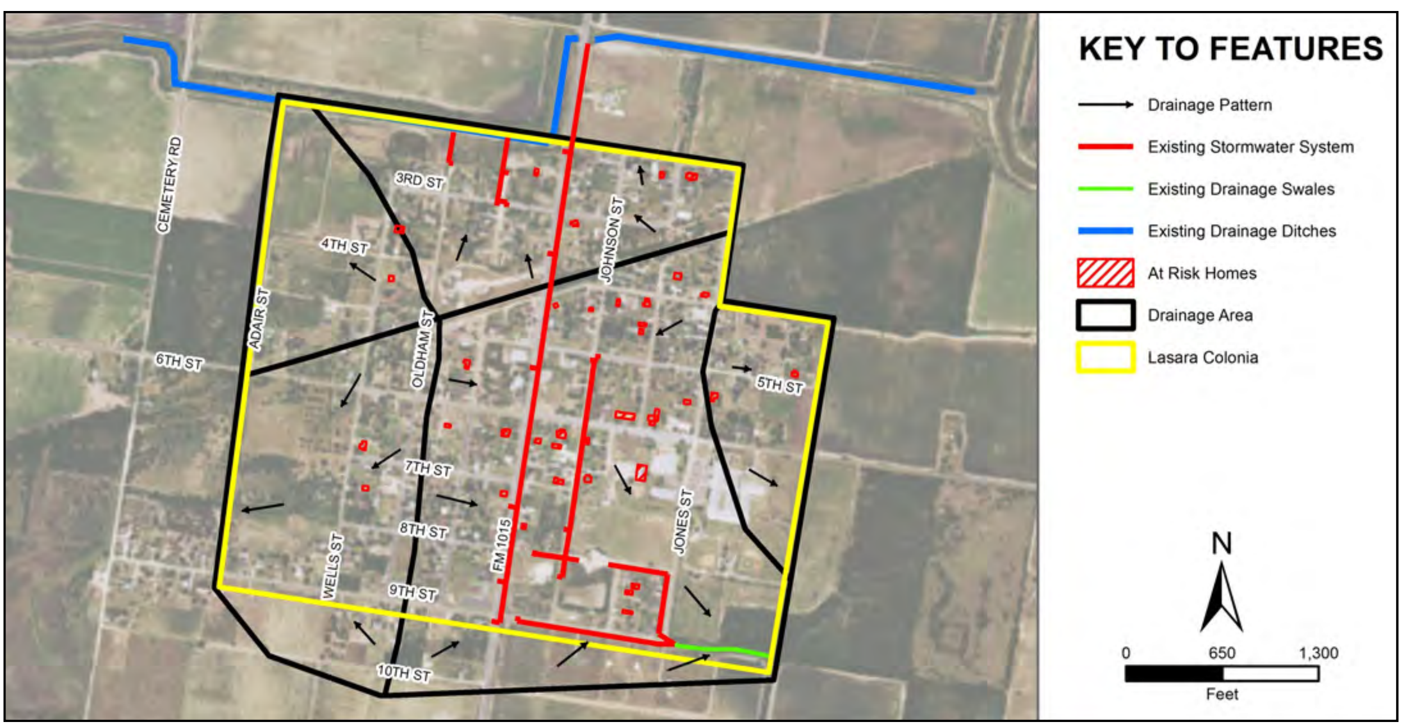
Category: A1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Lasara colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Drainage patterns within this 275-acre colonia are generally from the two high points on the east and west sides of the colonia to the low-lying area along FM 1015 bisecting the area north to south. The existing drainage system includes an underground stormwater system along FM 1015 as well as two smaller underground systems in the northwest corner of the colonia. These systems currently discharge to the regional ditch north of the colonia. At the time of this analysis, a county drainage improvement project has been partially constructed in the southeastern portion of the colonia; however, construction plans were not available. High-risk areas include low-lying areas along FM 1015 and other areas throughout the colonia where the drainage infrastructure is undersized or non-existent. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Lasara, Willacy County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
    - Install/improve underground drainage system with three retention ponds to eliminate off-site impacts
    - Install grassy swales within residential lots to convey runoff to drainage systems
- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone properties
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes improvements to the underground drainage system with retention facilities in the north, southwest, and southeast portions of the colonia. The improvements include 165 linear feet of 30-inch diameter pipe, 1,350 feet of 36-inch diameter pipe, 560 feet of 42-inch diameter pipe, 680 feet of 48-inch diameter pipe, pavement and curb/gutter for 2,800 linear feet of roadway, 6 curb inlets, four 60-inch manholes, and 11,000 feet of grassy swales. The proposed retention ponds are sized to retain onsite runoff up to the 25-year storm with a total effective storage area of 62 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged. The proposed improvements should be re-evaluated once the ongoing drainage improvement construction project is complete or plans are available.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Lasara Colonia		
	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	**$**	**559,027.78**
2	**DRAINAGE IMPROVEMENTS**	**$**	**396,625.00**
3	**POND EXCAVATION IMPROVEMENTS**	**$**	**1,609,300.00**
	Sub-Total =	**$**	**2,564,952.78**
	Engineering (10%)	$	256,495.28
	Contingency (20%)	$	512,990.56
	Total =	**$**	**3,334,438.61**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 9.0 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Lasara, Willacy County

Recommended Mitigation Project cont.:

Project Benefits:
The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	19	10	9
20% (5-year)	23	10	13
10% (10-year)	26	11	15
4% (25-year)	31	14	17
1% (100-year)	36	24	12

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$11,248,574	$3,334,439	3.37
Elevate Structures	$11,248,574	$3,091,200	3.64
Acquisition/Supplemental Housing/Demolition	$13,196,752	$2,557,263	5.16

Recommended Mitigation Project cont.:

Project Figures:

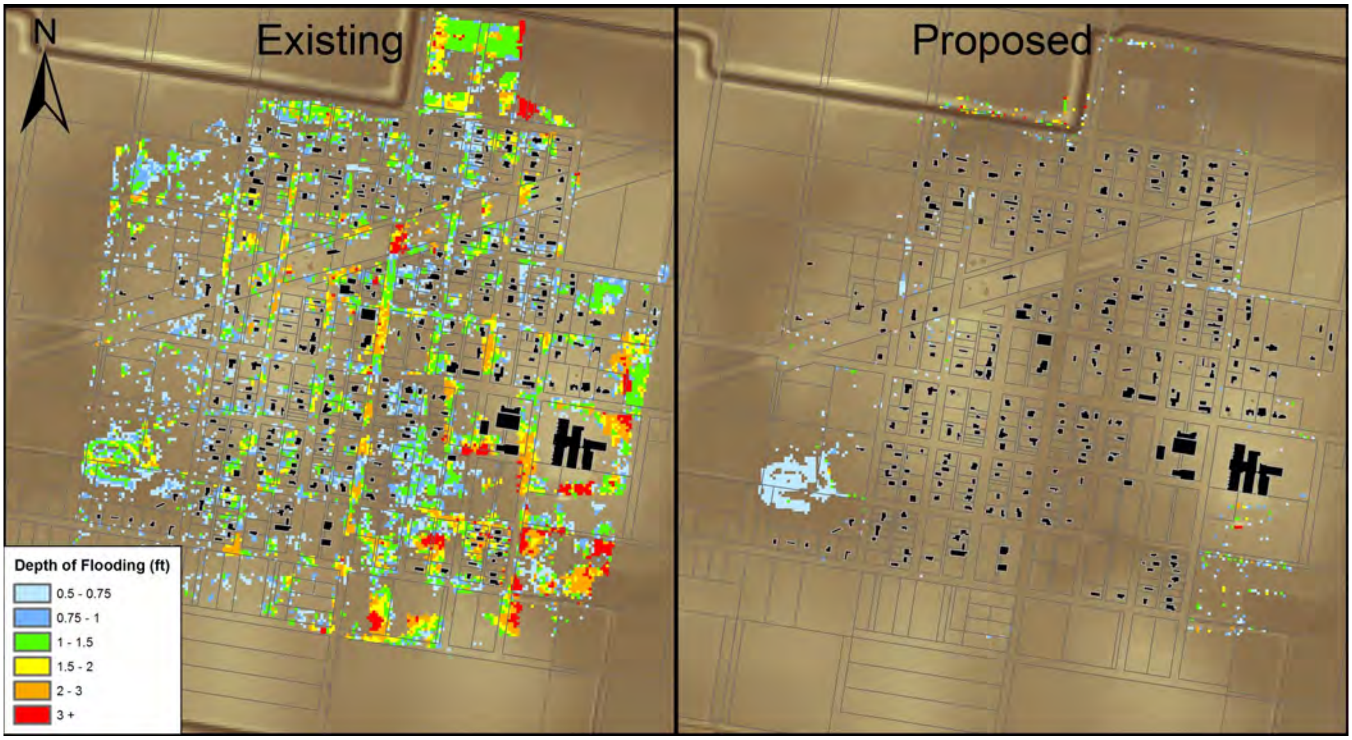


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	19	9	10
Inundated Lots	856	40	816
Inundated Roadway (LF)	16705	1040	15665

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lasara, Willacy County

Recommended Mitigation Project cont.:

Project Figures:

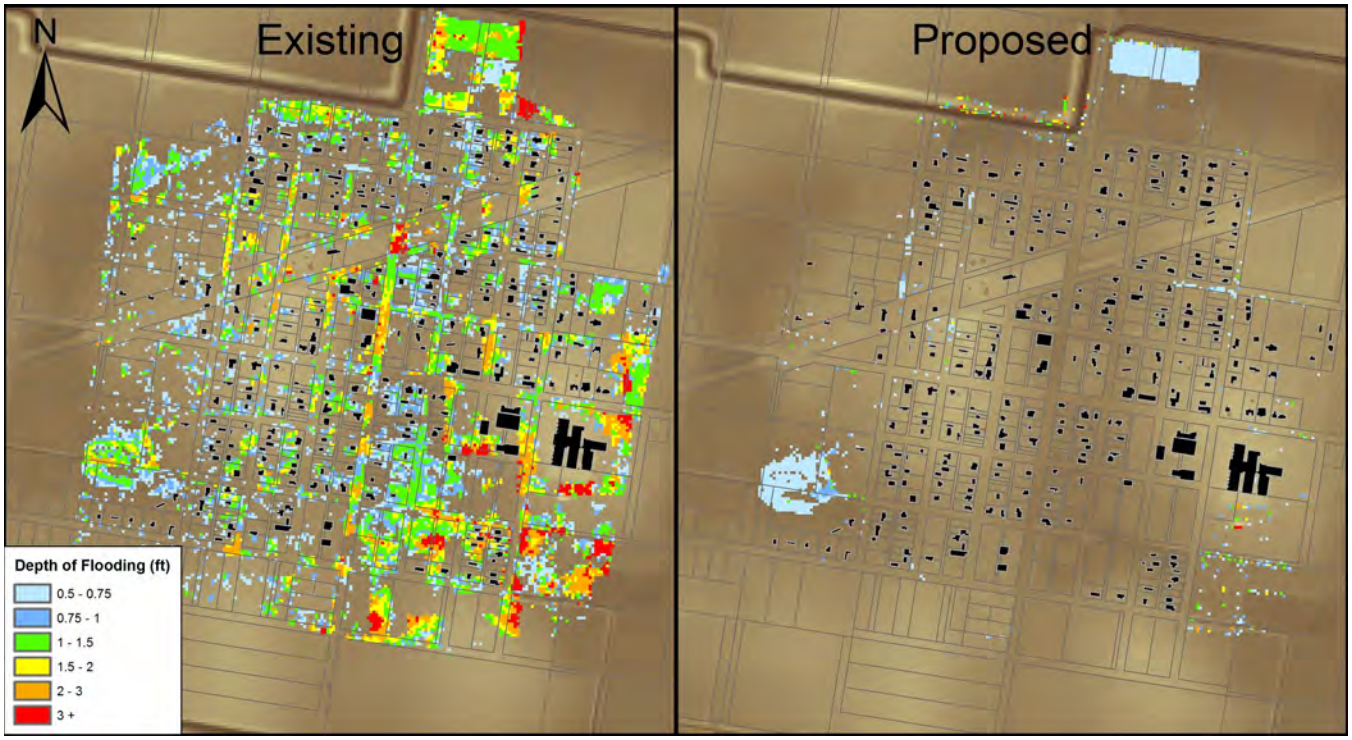


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	23	10	13
Inundated Lots	858	40	818
Inundated Roadway (LF)	17840	1215	16625

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lasara, Willacy County

Recommended Mitigation Project cont.:

Project Figures:

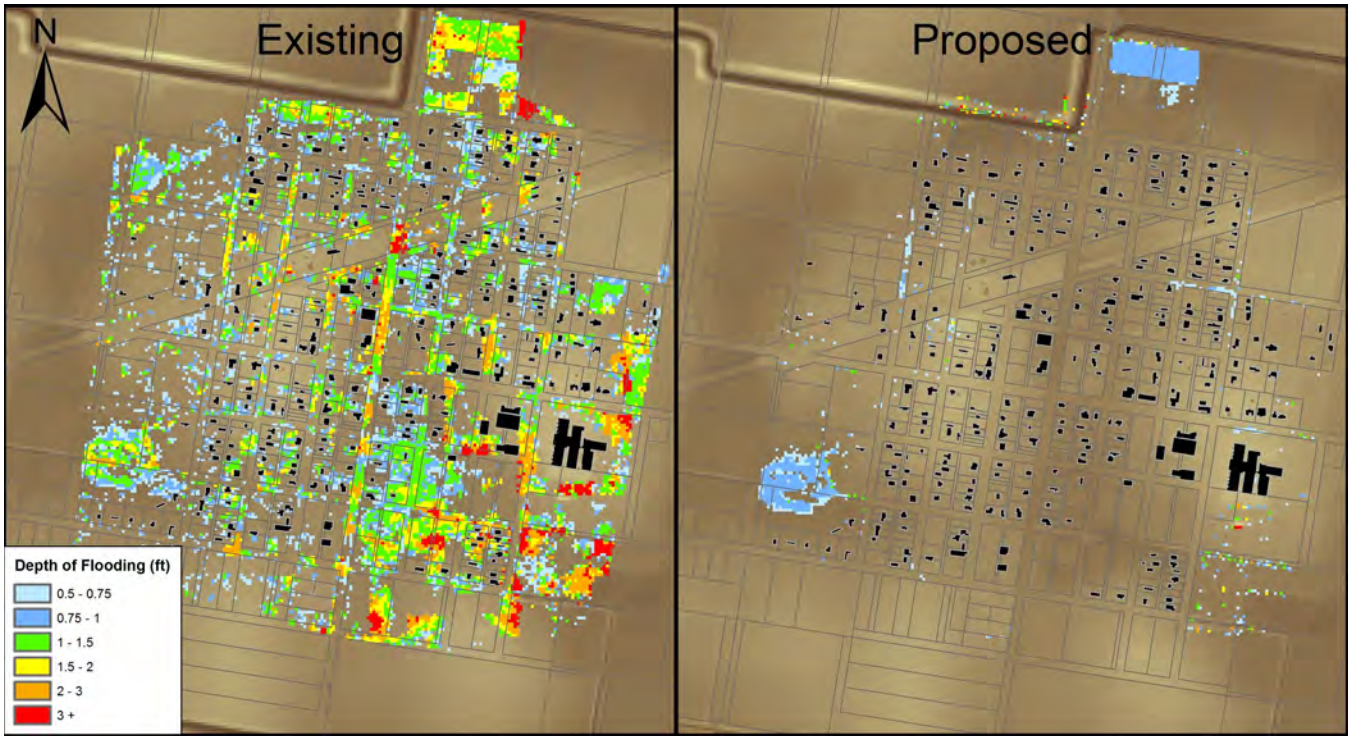


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	26	11	15
Inundated Lots	858	40	818
Inundated Roadway (LF)	18990	1715	18495

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lasara, Willacy County

Recommended Mitigation Project cont.:

Project Figures:

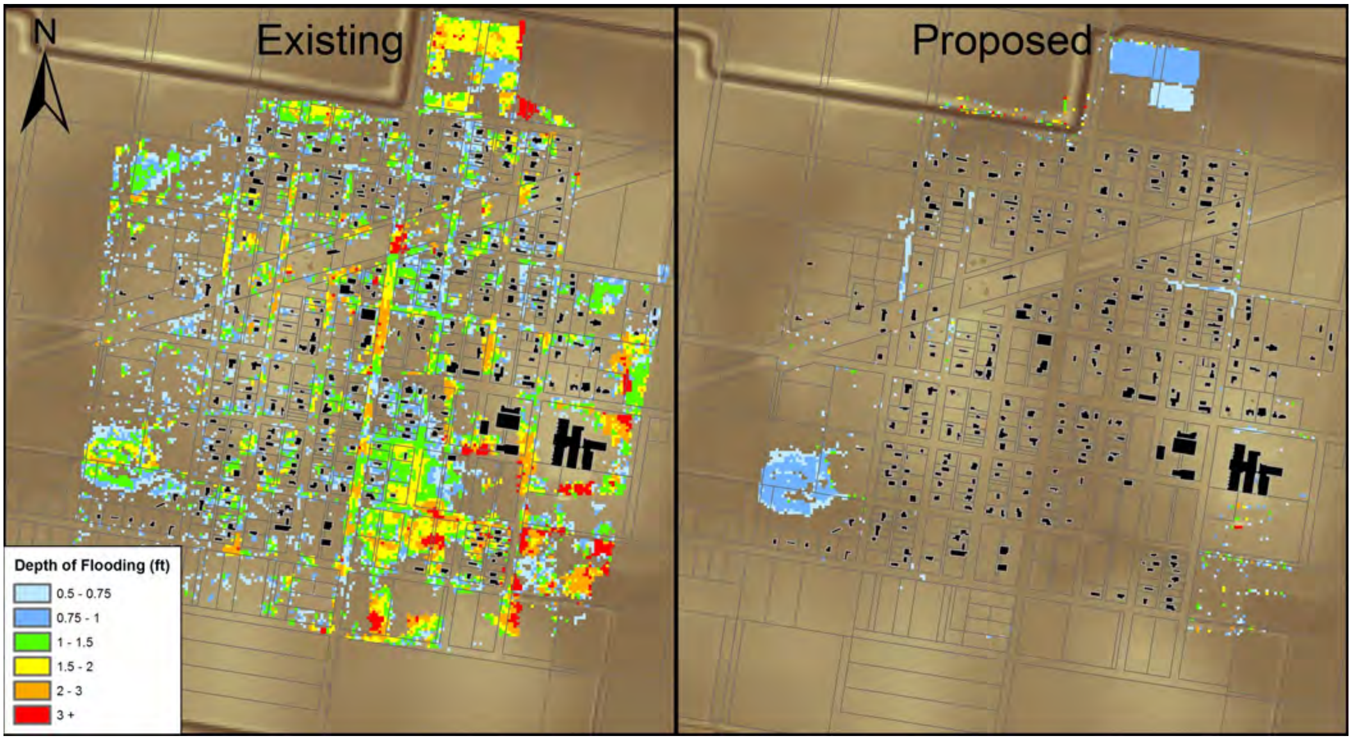


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	31	14	17
Inundated Lots	859	49	810
Inundated Roadway (LF)	20210	1715	18495

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Lasara, Willacy County

Recommended Mitigation Project cont.:

Project Figures:

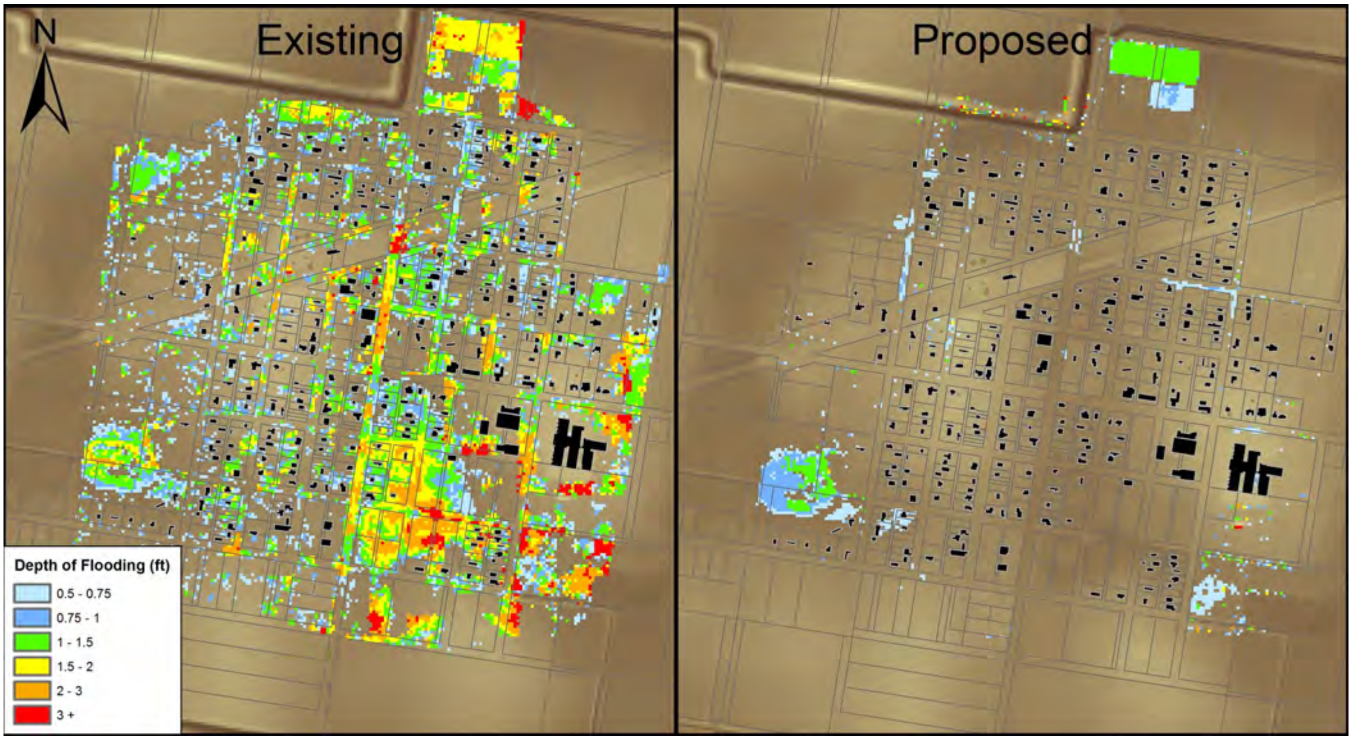


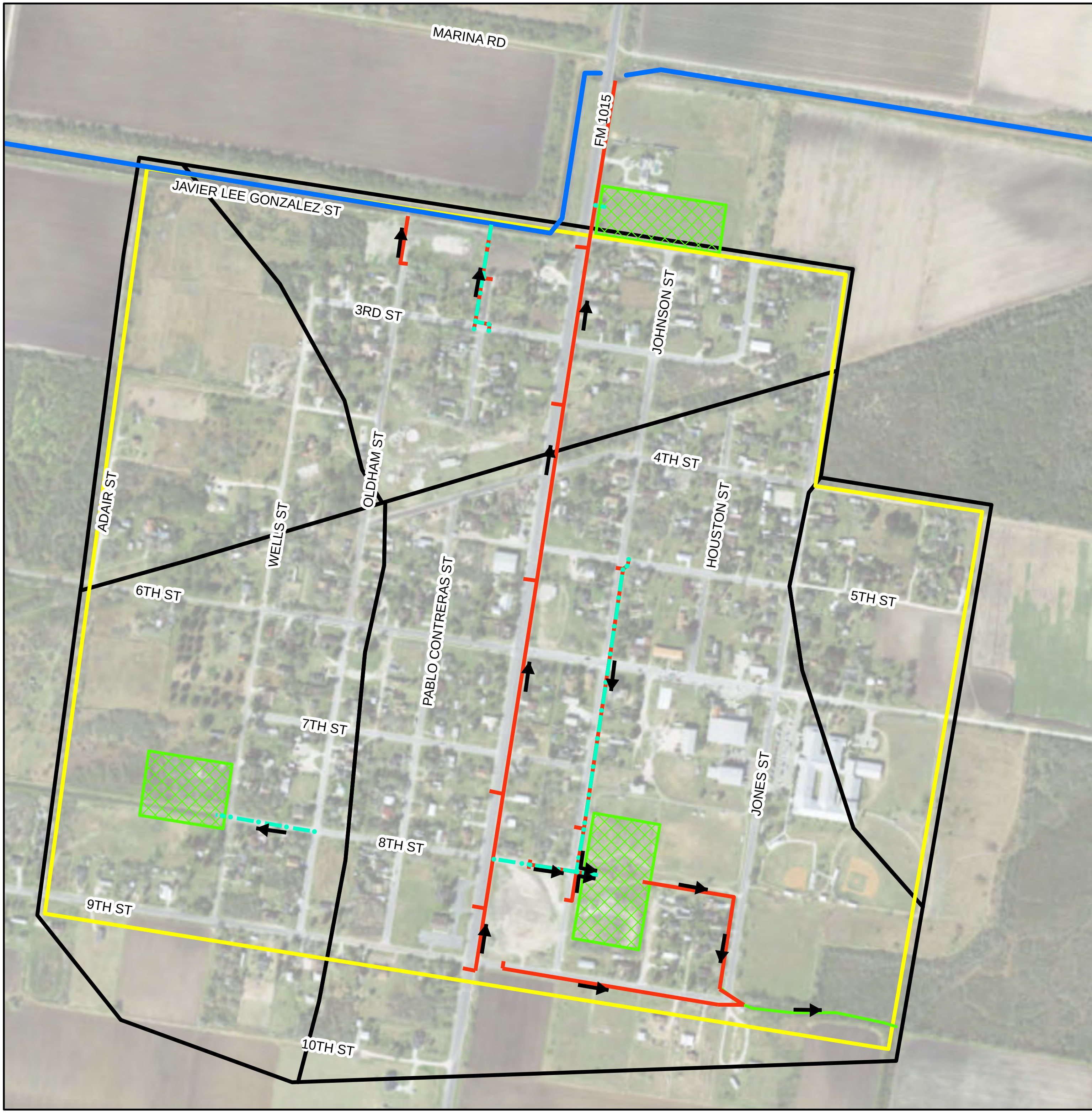
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	36	24	12
Inundated Lots	860	59	801
Inundated Roadway (LF)	21135	2065	19070

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Lasara
County: Willacy County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Existing Stormwater System
- Existing Drainage Swales
- Existing Drainage Ditches
- Lasara Colonia
- Proposed Retention Pond
- Drainage Area

N
W E
S

0 300 600 1,200
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

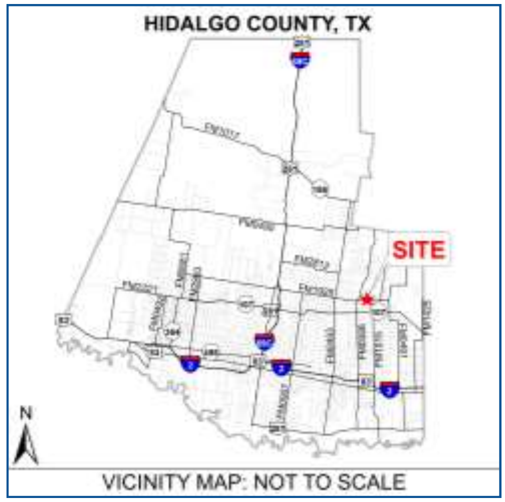
Colonia: Bar No. 3, Hidalgo County

Basin: North Floodway

Category: B1

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Bar No. 3 colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 29-acre colonia are generally to the south and west. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Bar No. 3 experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Bar No. 3, Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install roadside swales
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 495 linear feet of 18-inch diameter pipe, 100 linear feet of 24-inch diameter pipe, 195 linear feet of 30-inch diameter pipe, 190 linear feet of 36-inch diameter pipe, 2,600 linear feet of grassy swale, 3,165 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 1.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Bar No. 3

	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	490,053.89
2	**DRAINAGE IMPROVEMENTS**	$	223,540.00
3	**POND EXCAVATION IMPROVEMENTS**	$	209,330.00
	Sub-Total =	**$**	**922,923.89**
	Engineering (10%)	$	92,292.39
	Contingency (20%)	$	184,584.78
	Total =	**$**	**1,199,801.06**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	6	0	6
20% (5-year)	10	0	10
10% (10-year)	10	0	10
4% (25-year)	11	0	11
1% (100-year)	12	1	11

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$7,026,109	$1,199,801	5.86
Elevate Structures	$7,026,109	1,528,125	4.60
Acquisition/Supplemental Housing/Demolition	$7,257,018	$1,231,792	5.89

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

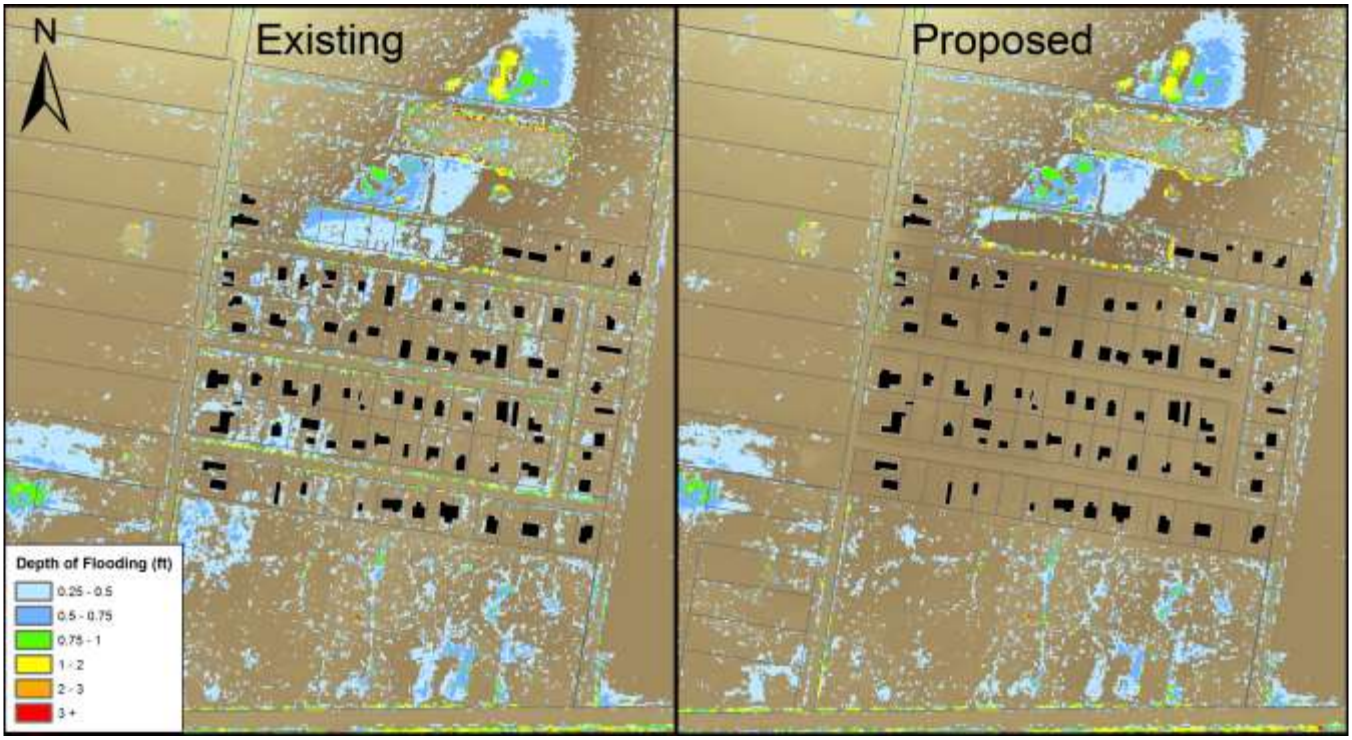


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	96	49	57
Inundated Roadway (LF)	17	0	17

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

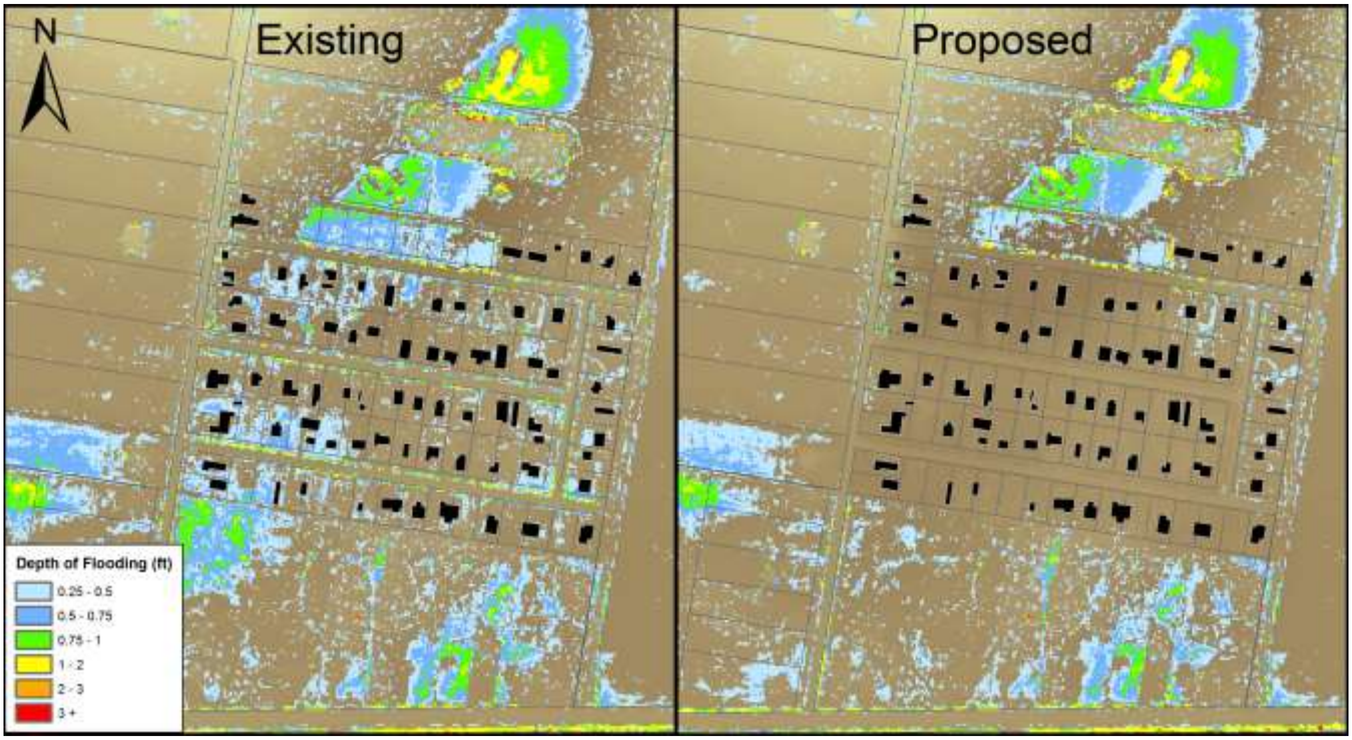


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	10	0	10
Inundated Lots	96	41	55
Inundated Roadway (LF)	17	0	17

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

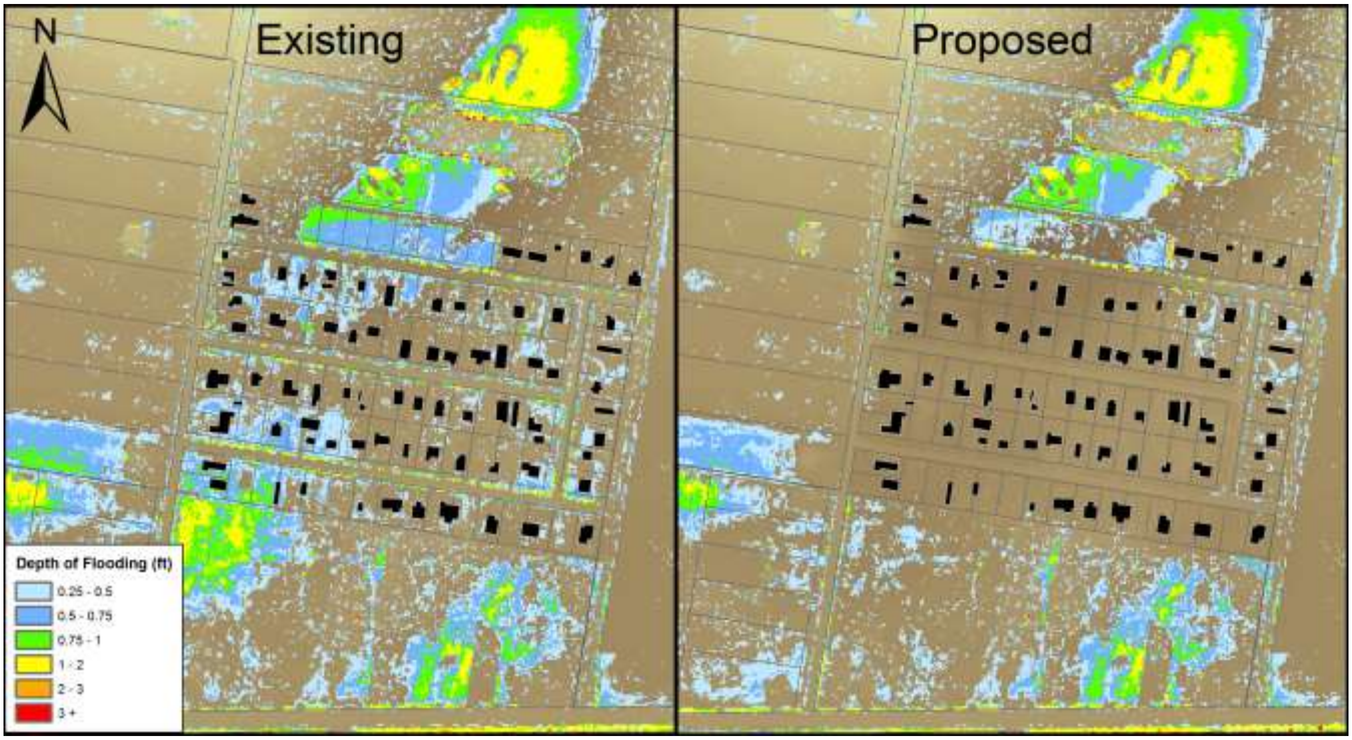


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	96	51	45
Inundated Roadway (LF)	17	0	17

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

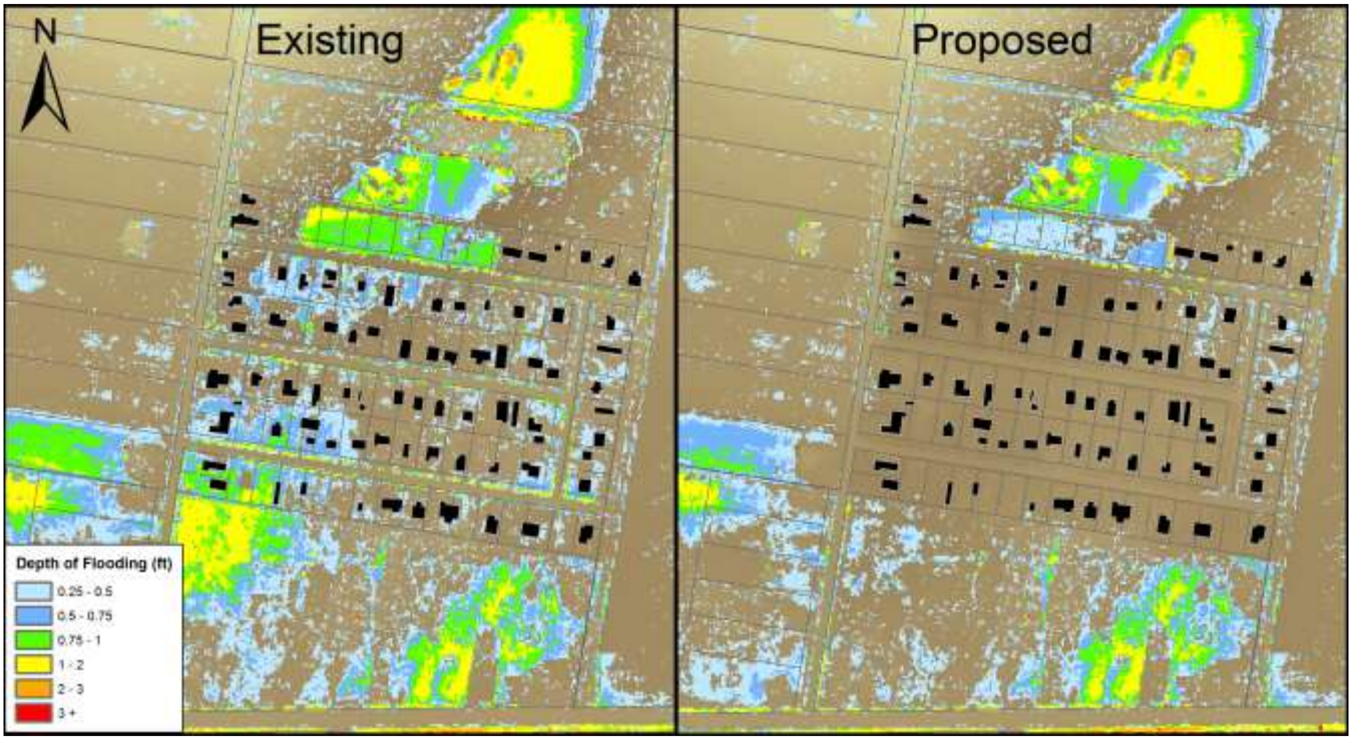


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	96	55	41
Inundated Roadway (LF)	17	0	17

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Bar No. 3, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

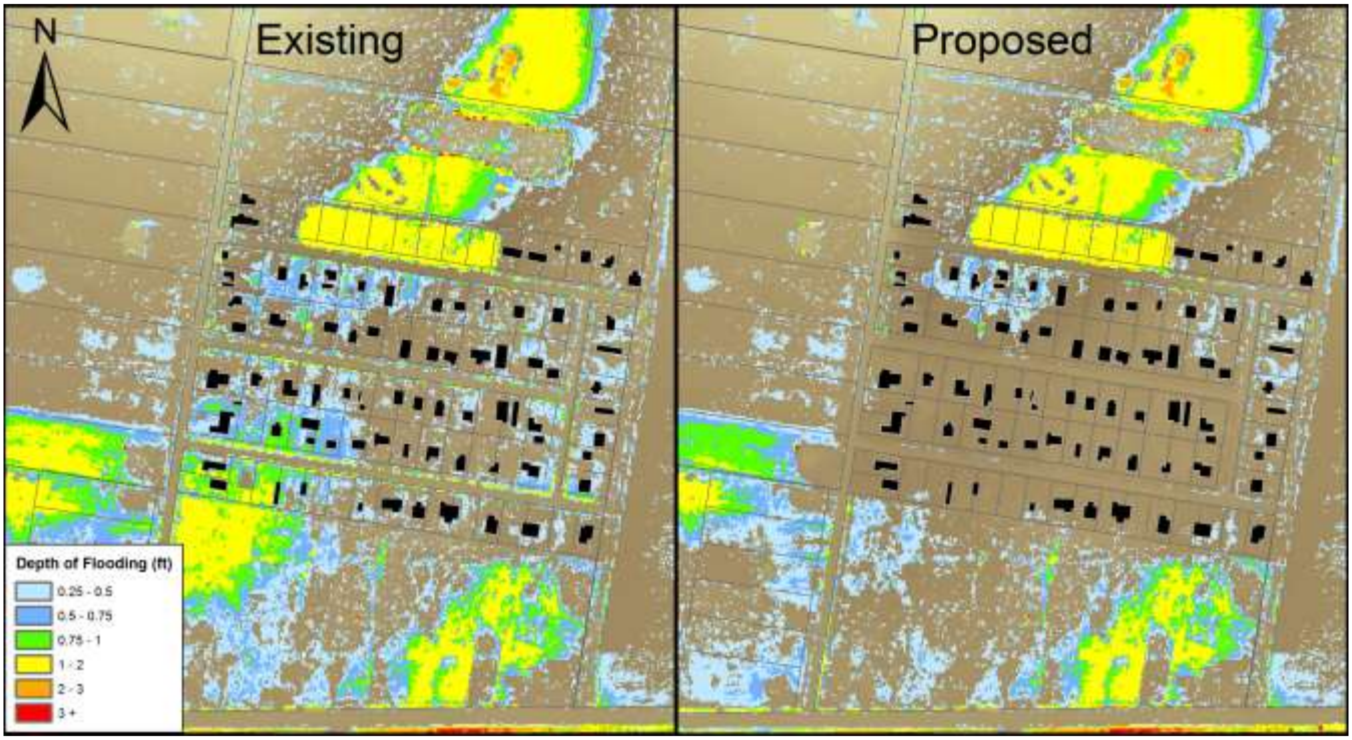


Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	1	11
Inundated Lots	96	61	35
Inundated Roadway (LF)	17	0	17

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Bar No. 3
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Bar No. 3
- Drainage Area

N

0 75 150 300
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

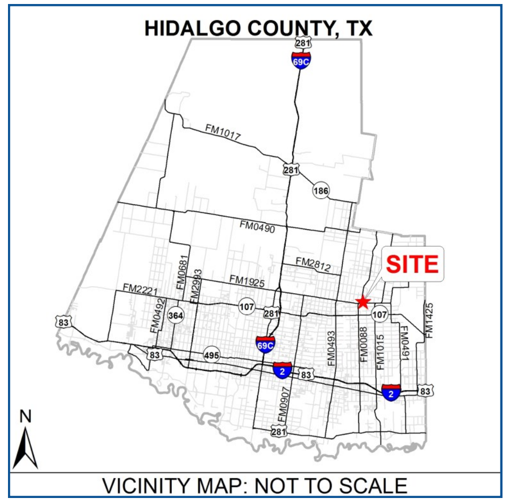
"Filling the Gap"

Colonia: **Bernal Heights #1, Hidalgo County**

Basin: North Floodway

Category: B1

Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Bernal Heights #1 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Bernal Heights #1 consists of approximately 7 acres of fully developed residential land. The existing drainage system consist of culverts and swales along Bernal Drive. The swales appear to convey stormwater toward the north, however there isn't an outfall. Monte Cristo Road also has swales along the north side of the roadway. The existing drainage pattern indicates runoff flows toward the northeast. Based on the existing conditions 2D model results, structures along the east and north sides of the colonia appear to be at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.

Colonia: Bernal Heights #1, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Regrade swales to convey stromwater toward the existing swales along Monte Cristo Road.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 365 linear feet of 18-inch diameter pipe, 413 linear feet of 21-inch diameter pipe, 63 linear feet of 24-inch diameter pipe, and three curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 2.7 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
BERNAL HEIGHTS #1

IMPROVEMENTS		COST
1	Paving Improvements	$159,716.67
2	Drainage Improvements	$60,568.00
3	Pond Excavation Improvements	$75,170.45
	Sub-Total =	**$295,455.12**
	Engineering Fees (10%) =	**$29,545.51**
	Contingency (20%) =	**$59,091.02**
	Total =	**$384,091.66**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Bernal Heights #1, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	3	0	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$509,450.00	$384,091.66	1.33
Elevate Structures	$509,450.00	$211,500.00	2.41
Acquisition/Supplemental Housing / Demolition	$535,858.00	$282,770.70	1.90

Colonia: Bernal Heights #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

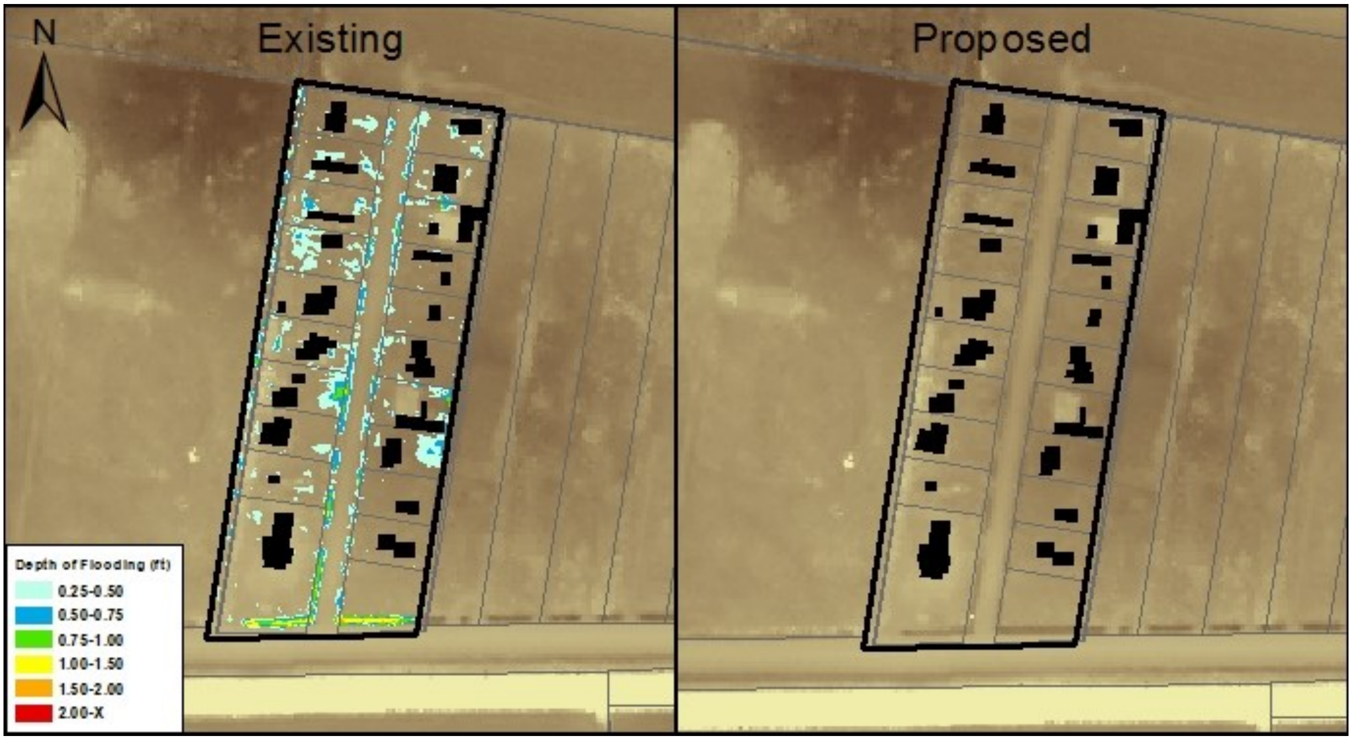


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	21	0	21
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Bernal Heights #1, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

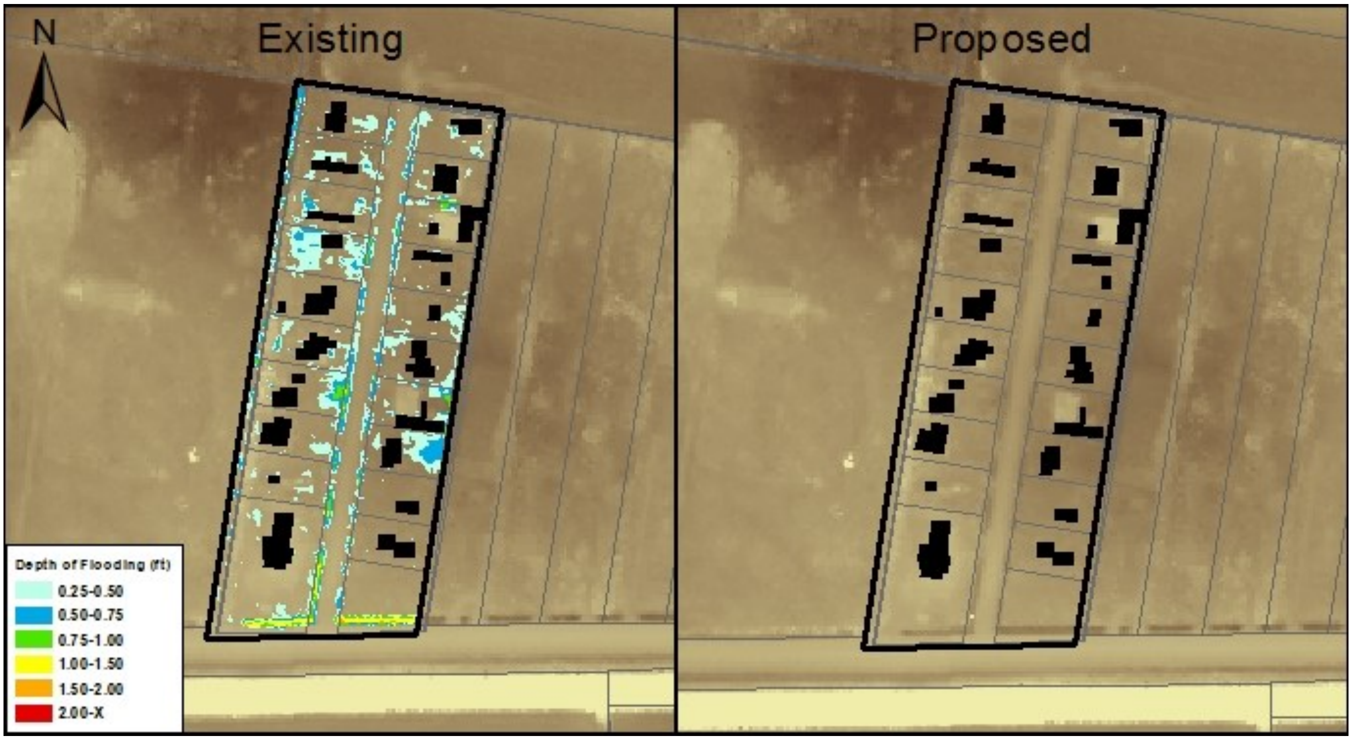


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	21	0	21
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

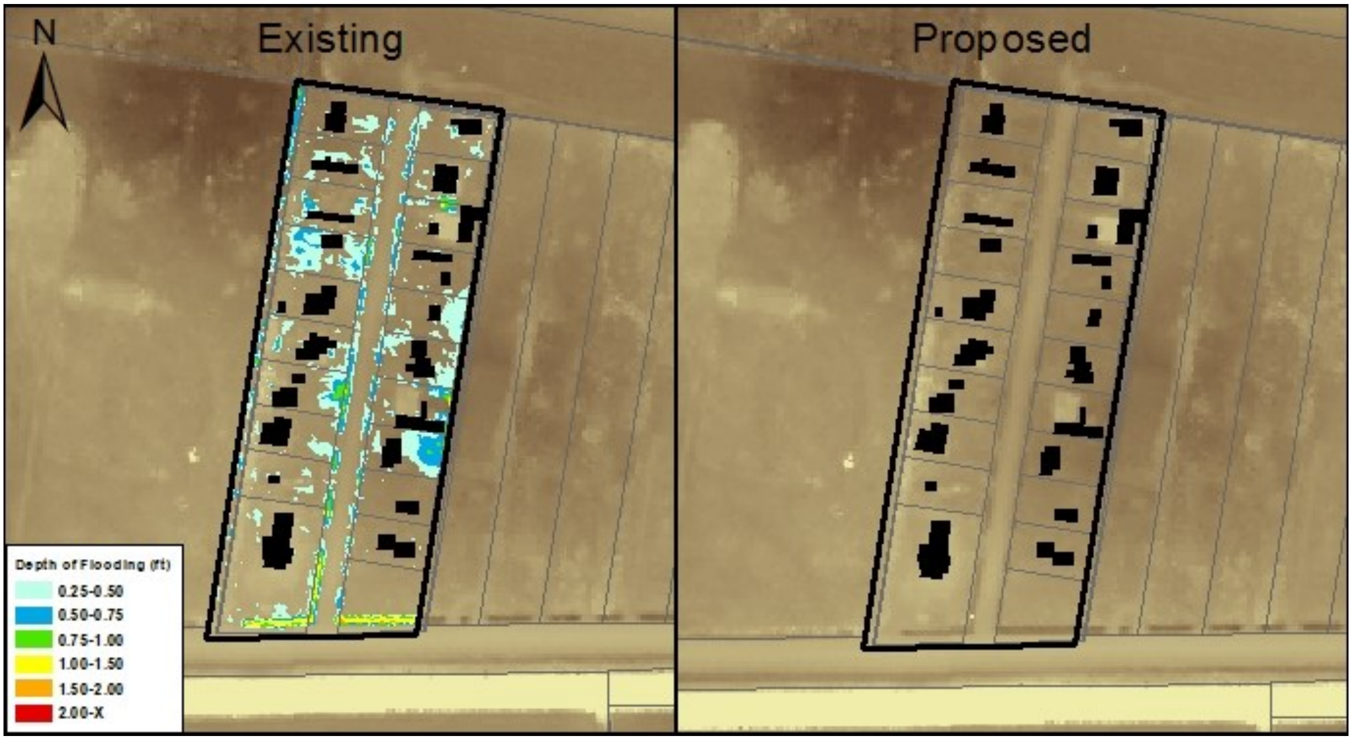


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	21	0	21
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

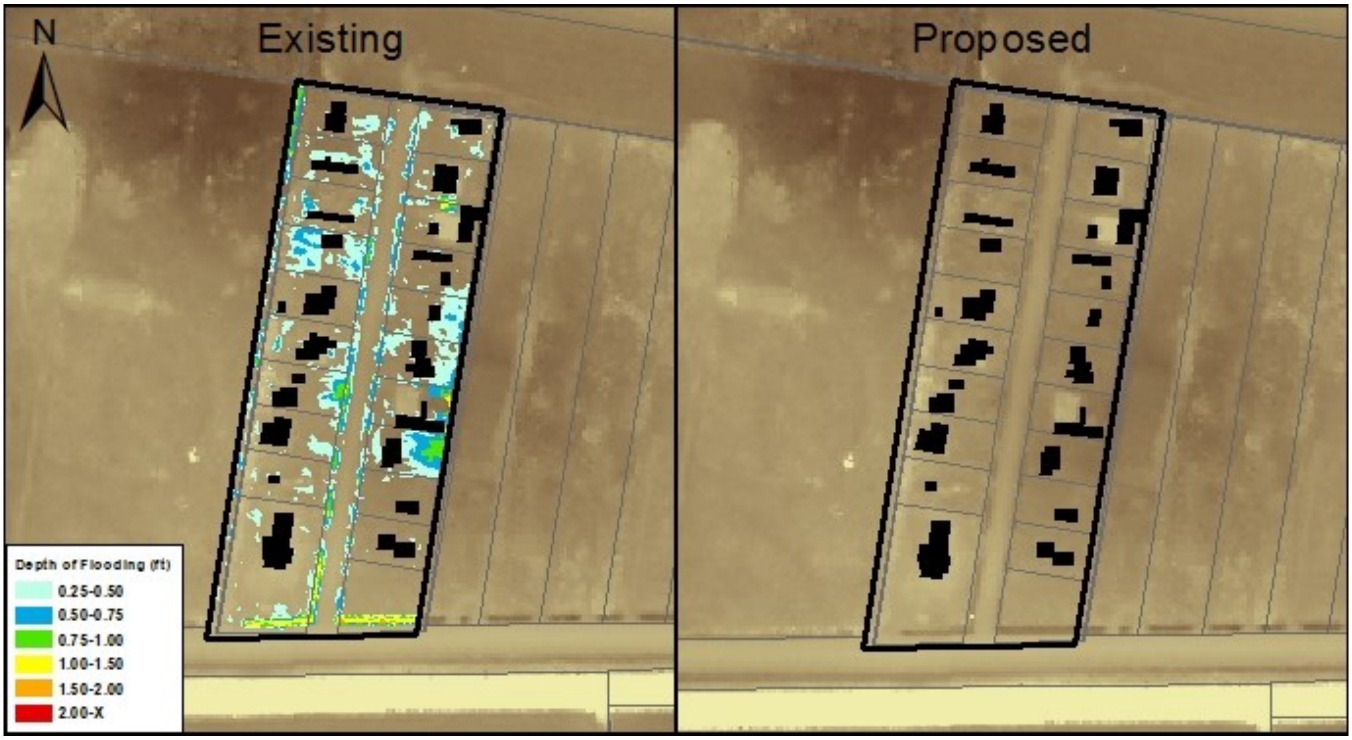


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	21	0	21
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

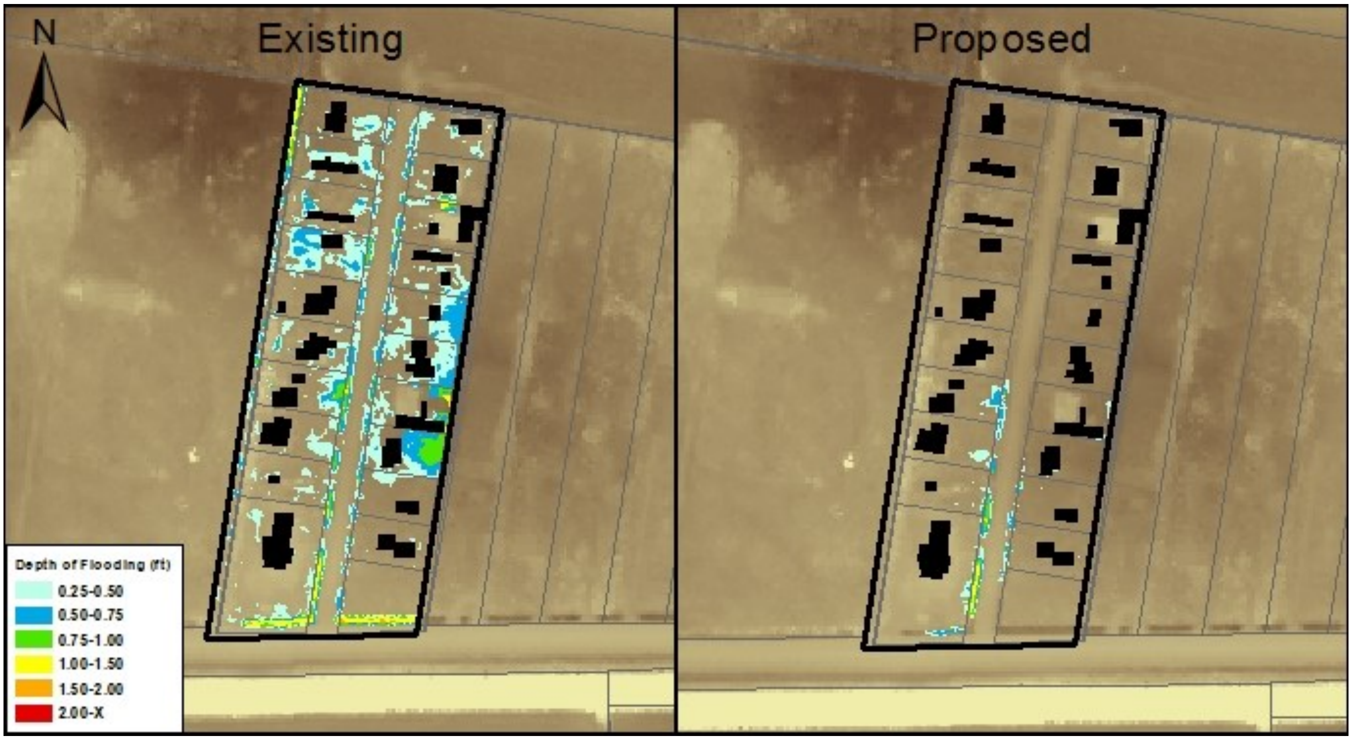
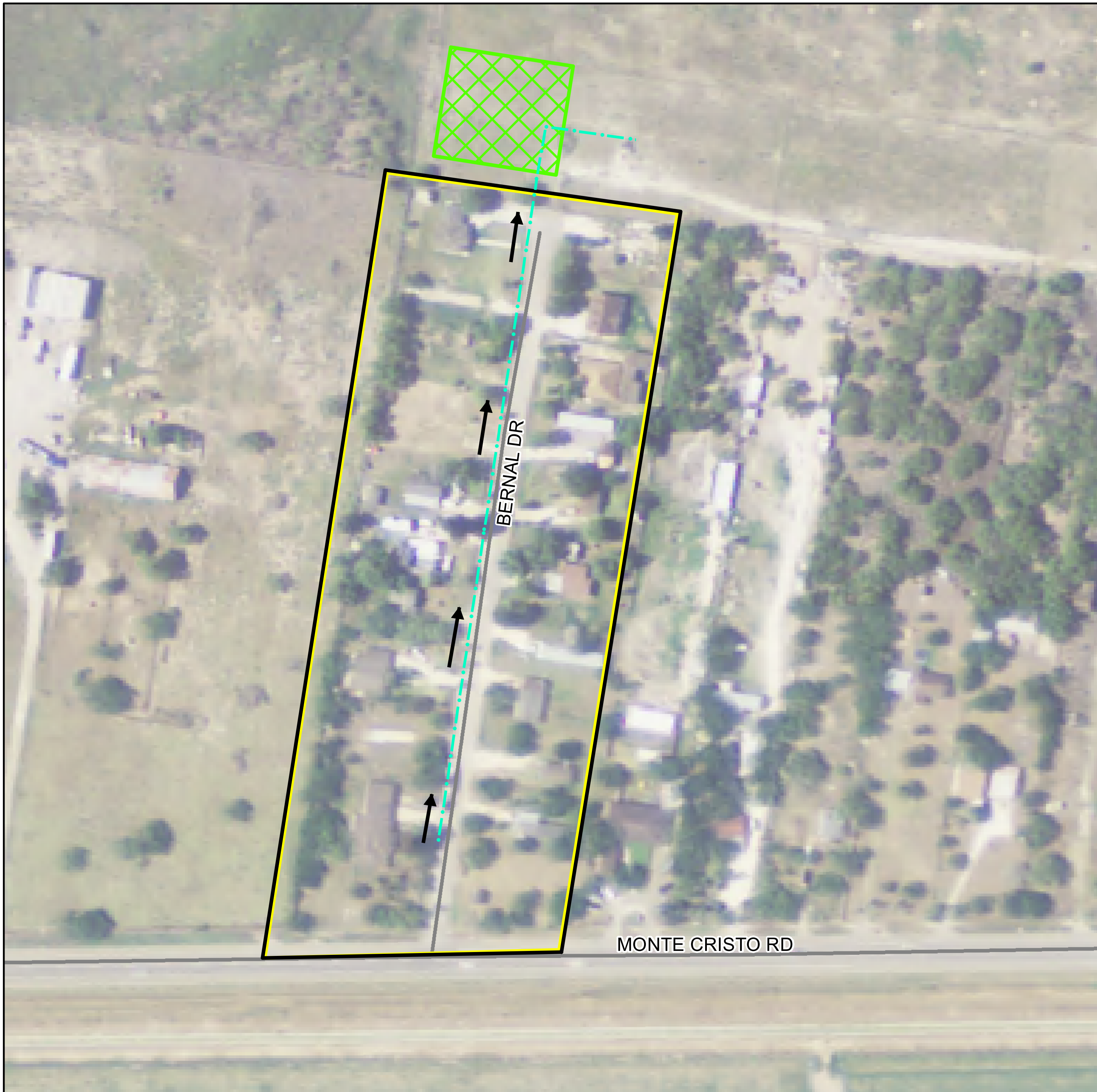


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	21	9	12
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

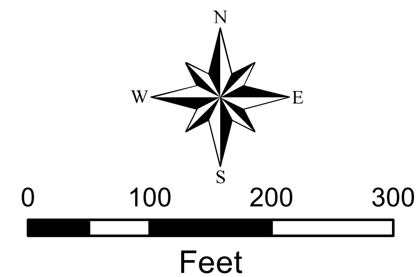
Colonia: Bernal Heights #1
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- BERNAL HEIGHTS #1
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

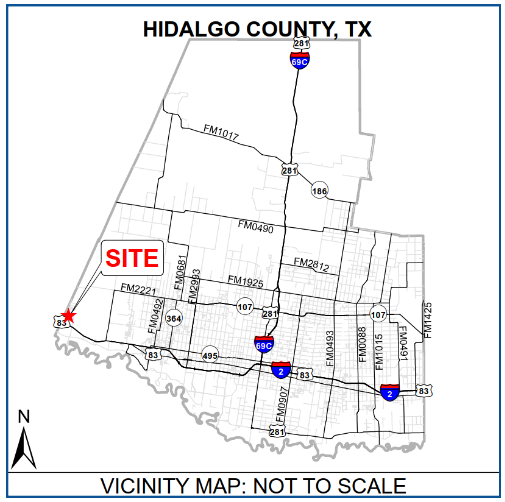
Colonia: Blue Star Enterprises #2, Hidalgo County

Basin: Rio Grande

Category: B1

Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia Blue Star Enterprises #2 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Blue Star Enterprises #2 consists of approximately 20 acres of fully developed residential land with an offsite drainage area of approximately 12 acres of agricultural land. Currently there are swales and culverts along the streets within the colonia; However, the swales do not have an outlet and therefore do not provide adequate drainage for the colonia. The existing drainage pattern indicates runoff flows toward the south end of the colonia. Structures located along the southern portion of the colonia are at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.

Colonia: Blue Star Enterprises #2, Hidalgo County

"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Improve roadside swales and culverts to convey runoff to a retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite and offsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 1,011 linear feet of 18-inch diameter pipe, 1,666 linear feet of 24-inch diameter pipe, 914 linear feet of 30-inch diameter pipe, 402 linear feet of 36-inch diameter pipe, and fifteen curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 11.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments in the colonia.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
BLUE STAR ENTERPRISES #2		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$568,692.67
2	Drainage Improvements	$254,130.00
3	Pond Excavation Improvements	$307,230.00
	Sub-Total =	**$1,130,052.67**
	Engineering Fees (10%) =	**$113,005.27**
	Contingency (20%) =	**$226,010.53**
	Total =	**$1,469,068.47**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	7	0	7
10% (10-year)	8	0	8
4% (25-year)	9	0	9
1% (100-year)	15	3	12

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,307,816.00	$1,469,068.47	1.57
Elevate Structures	$2,307,816.00	$1,599,900.00	1.44
Acquisition/Supplemental Housing / Demolition	$5,246,751.00	$1,567,434.20	3.35

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

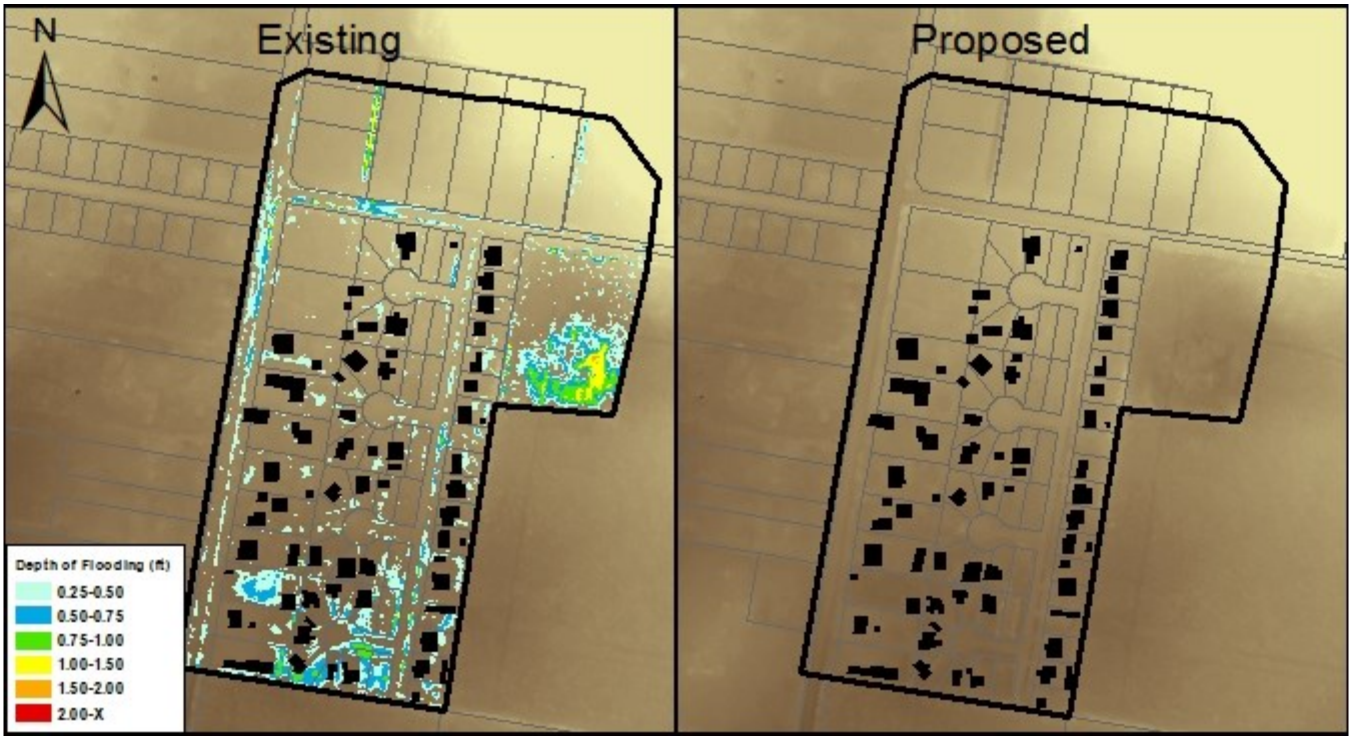


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	67	0	67
Inundated Roadway (LF)	279	0	279

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

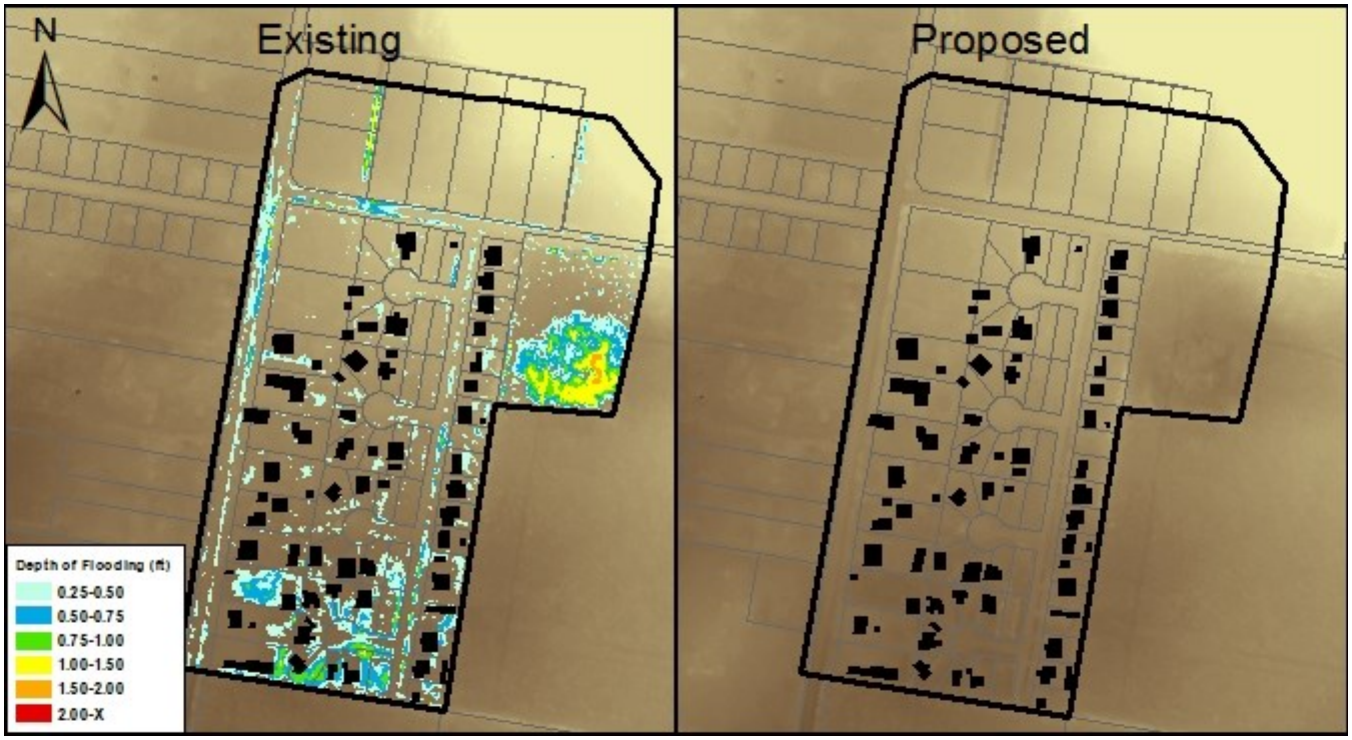


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

25% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	67	0	67
Inundated Roadway (LF)	403	0	403

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

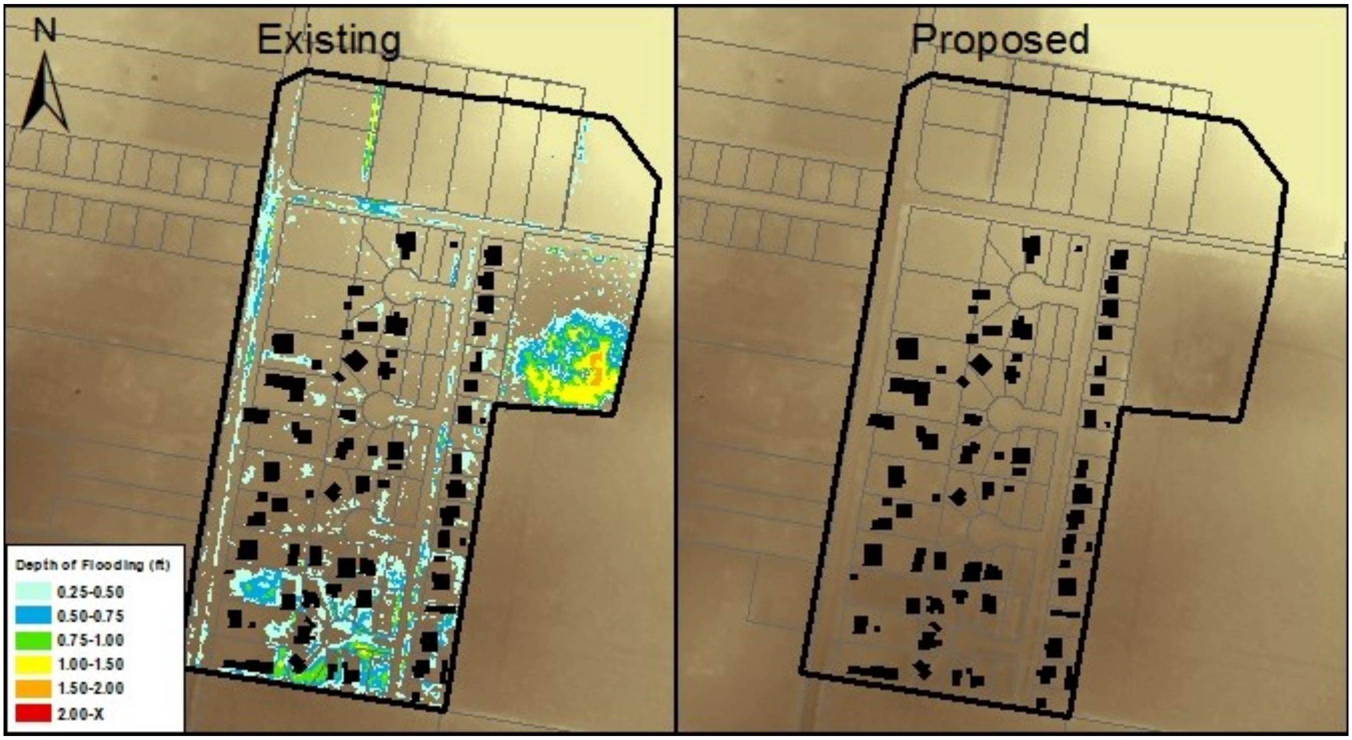


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	67	0	67
Inundated Roadway (LF)	430	0	430

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

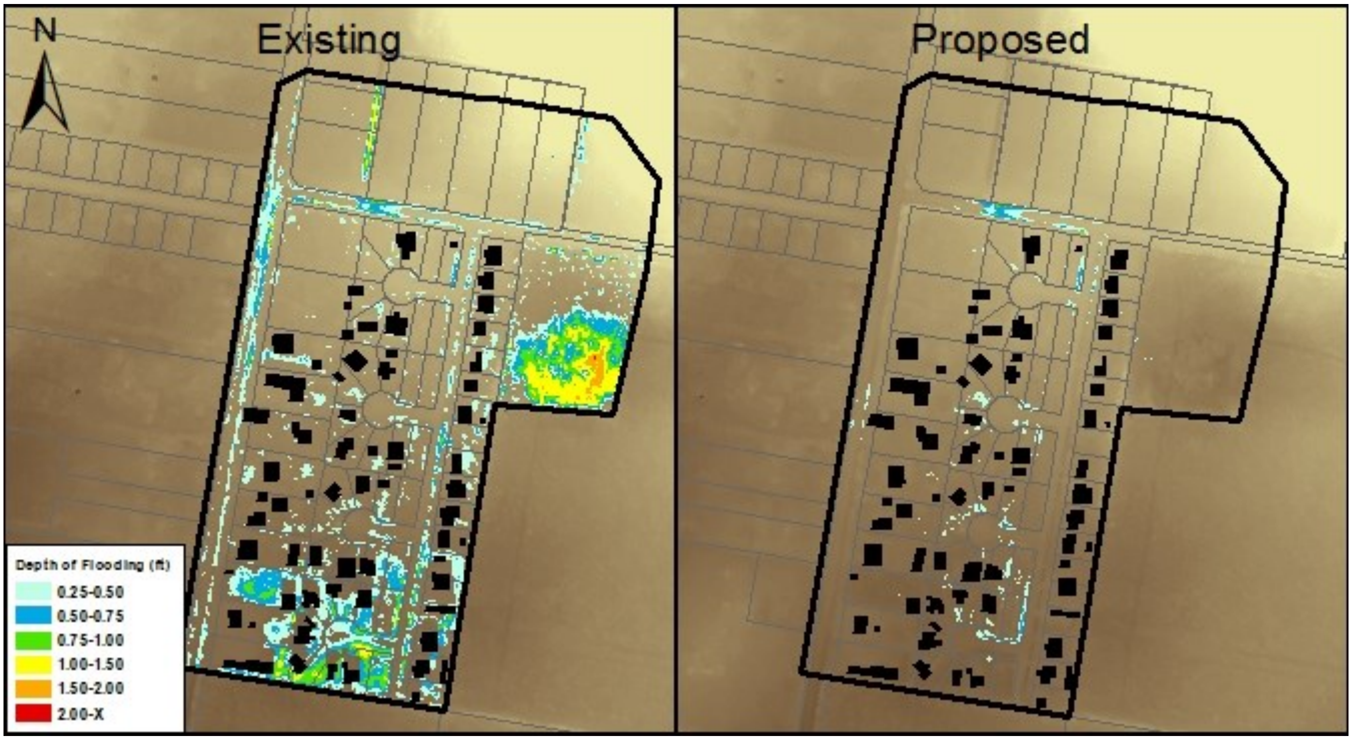


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	0	9
Inundated Lots	67	38	29
Inundated Roadway (LF)	508	95	413

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Blue Star Enterprises #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

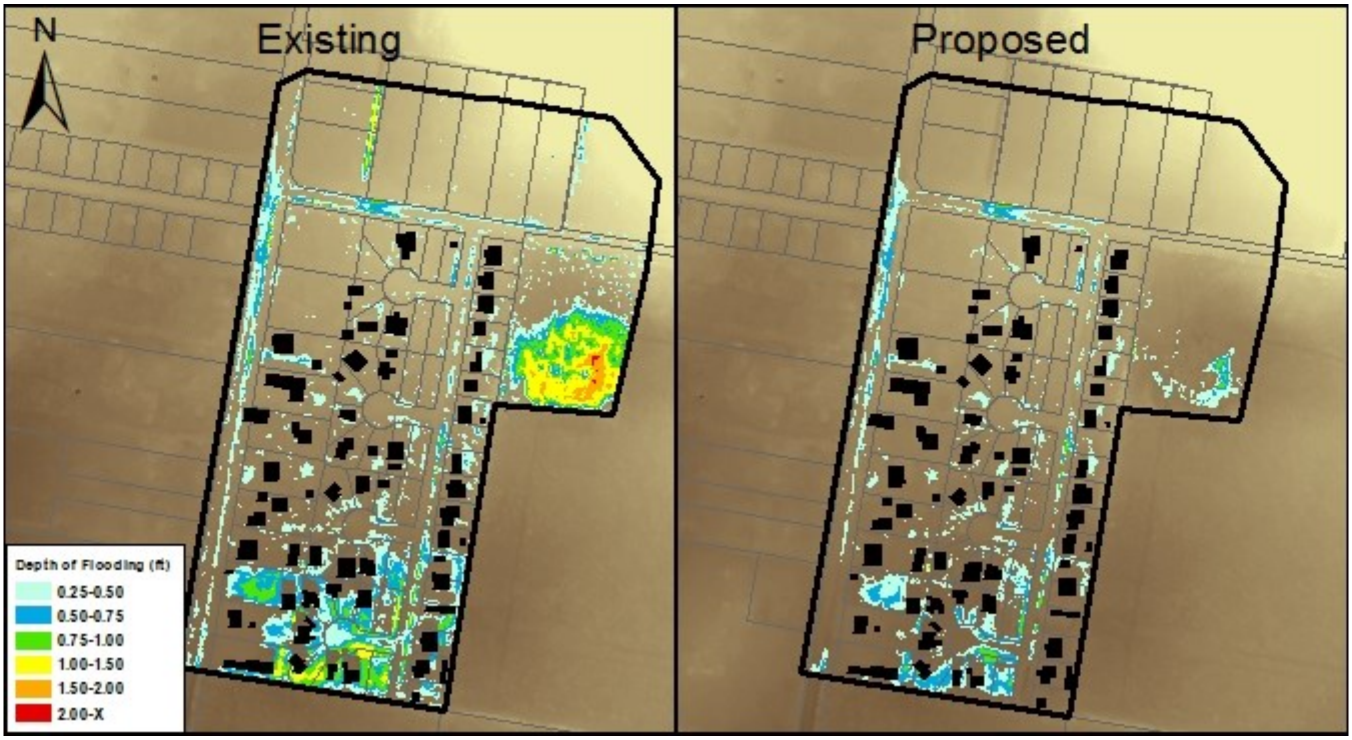
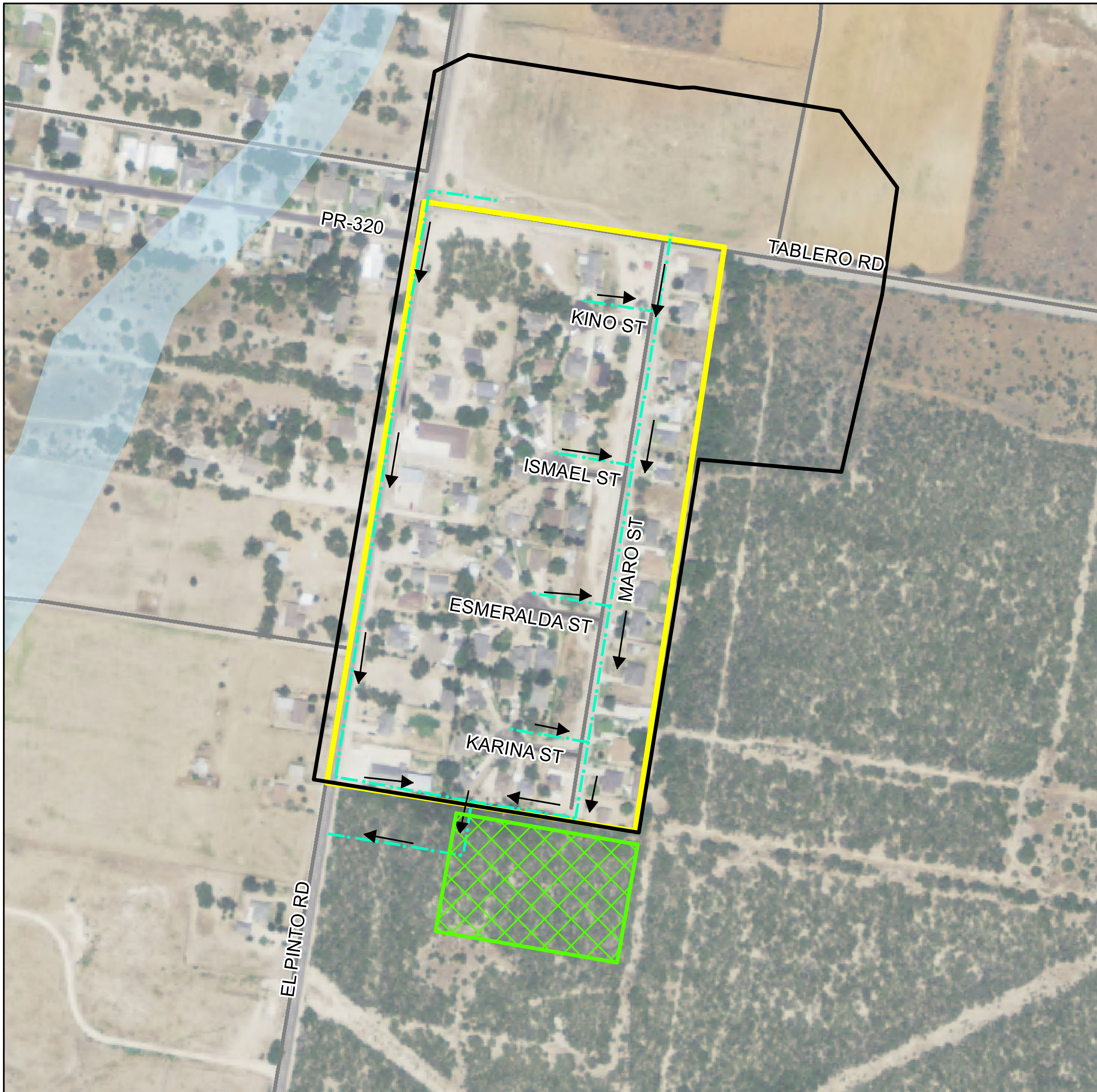


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	15	3	12
Inundated Lots	67	59	8
Inundated Roadway (LF)	645	444	201

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Blue Star Enterprises #2
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- BLUE STAR ENTERPRISES #2
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N W E S

0 190 380 570

Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

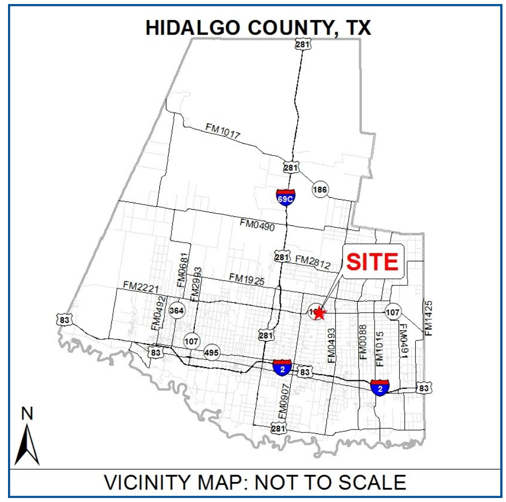
"Filling the Gap"

Colonia: Colonia Tijerina, Hidalgo County

Basin: North Main Drain

Category: B1

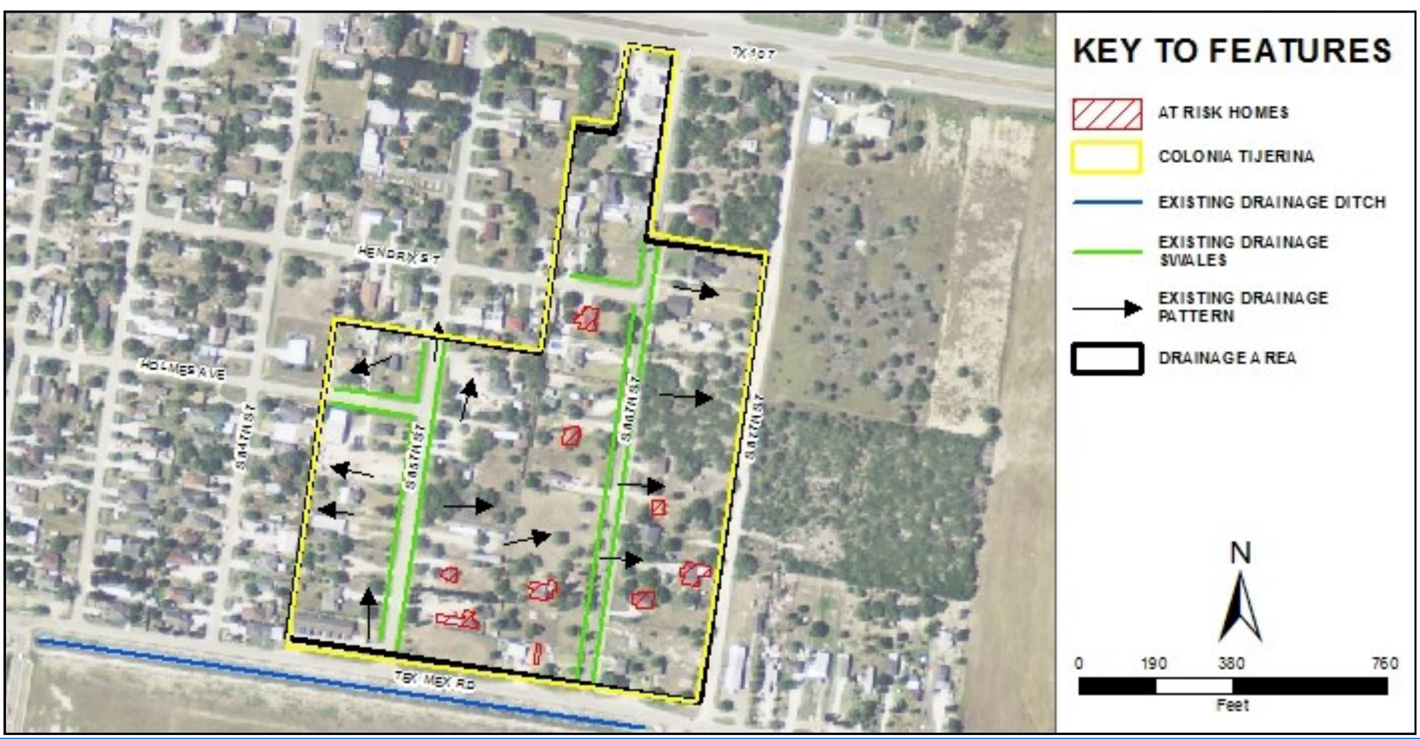
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of Colonia Tijerina's storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Colonia Tijerina consists of approximately 24.3 acres of fully developed residential land. The existing drainage system consists of swales and culvers that appear to outfall into an existing drainage ditch. The existing drainage pattern indicates runoff flows toward the east and west. Based on the existing conditions 2D model results several structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Colonia Tijerina, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Improve existing culverts and swales to allow maximum conveyance toward the existing drainage ditch.
  - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 178 linear feet of 18-inch diameter pipe, 493 linear feet of 24-inch diameter pipe, 1,474 linear feet of 30-inch diameter pipe, 298 linear feet of 36-inch diameter pipe, and nine curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 6.2 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
COLONIA TIJERINA

IMPROVEMENTS		COST
1	Paving Improvements	$653,714.00
2	Drainage Improvements	$232,660.00
3	Pond Excavation Improvements	$168,715.91
	Sub-Total =	**$1,055,089.91**
	Engineering Fees (10%) =	**$105,508.99**
	Contingency (20%) =	**$211,017.98**
	Total =	**$1,371,616.88**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Colonia Tijerina, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	2	0	2
10% (10-year)	3	0	3
4% (25-year)	6	0	6
1% (100-year)	9	0	9

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,751,576.00	$1,371,616.88	1.28
Elevate Structures	$1,751,576.00	$848,775.00	2.06
Acquisition/Supplemental Housing / Demolition	$1,838,380.00	$967,160.70	1.90

Colonia: Colonia Tijerina, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

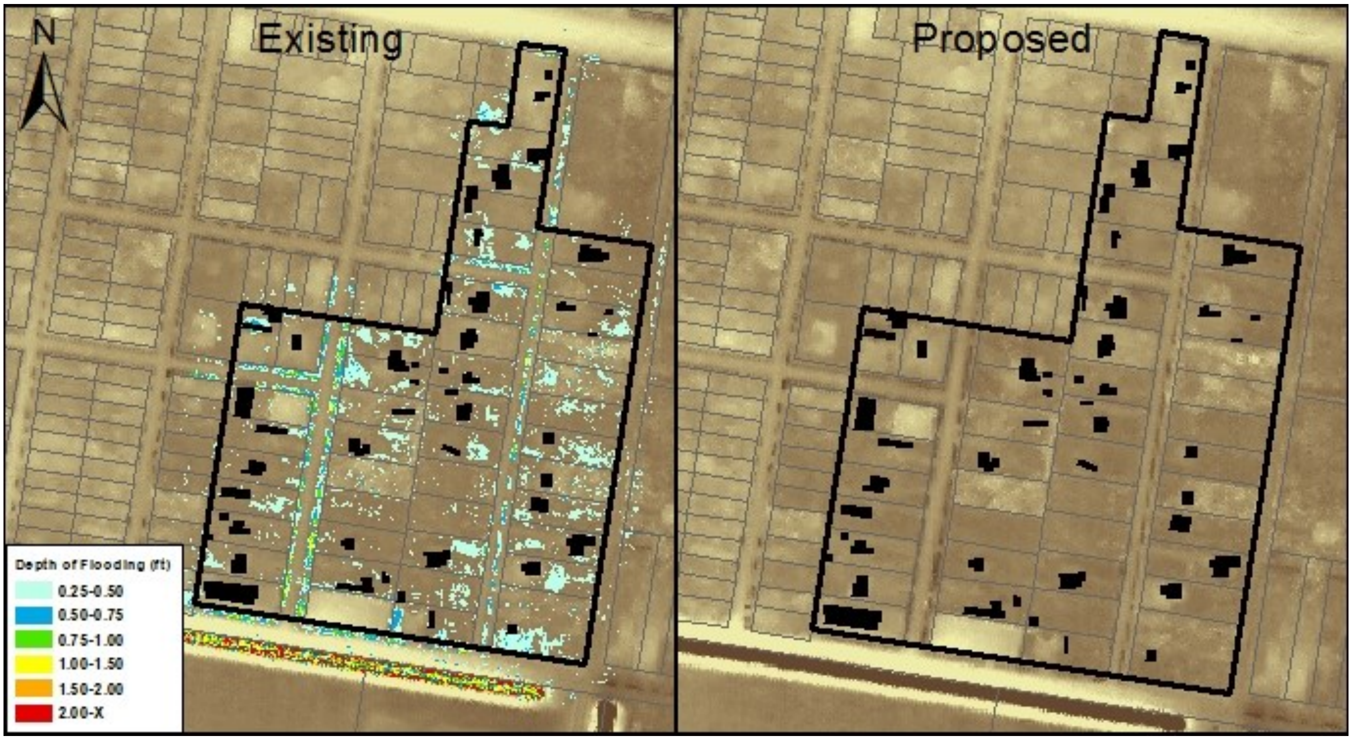


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	45	0	45
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Colonia Tijerina, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

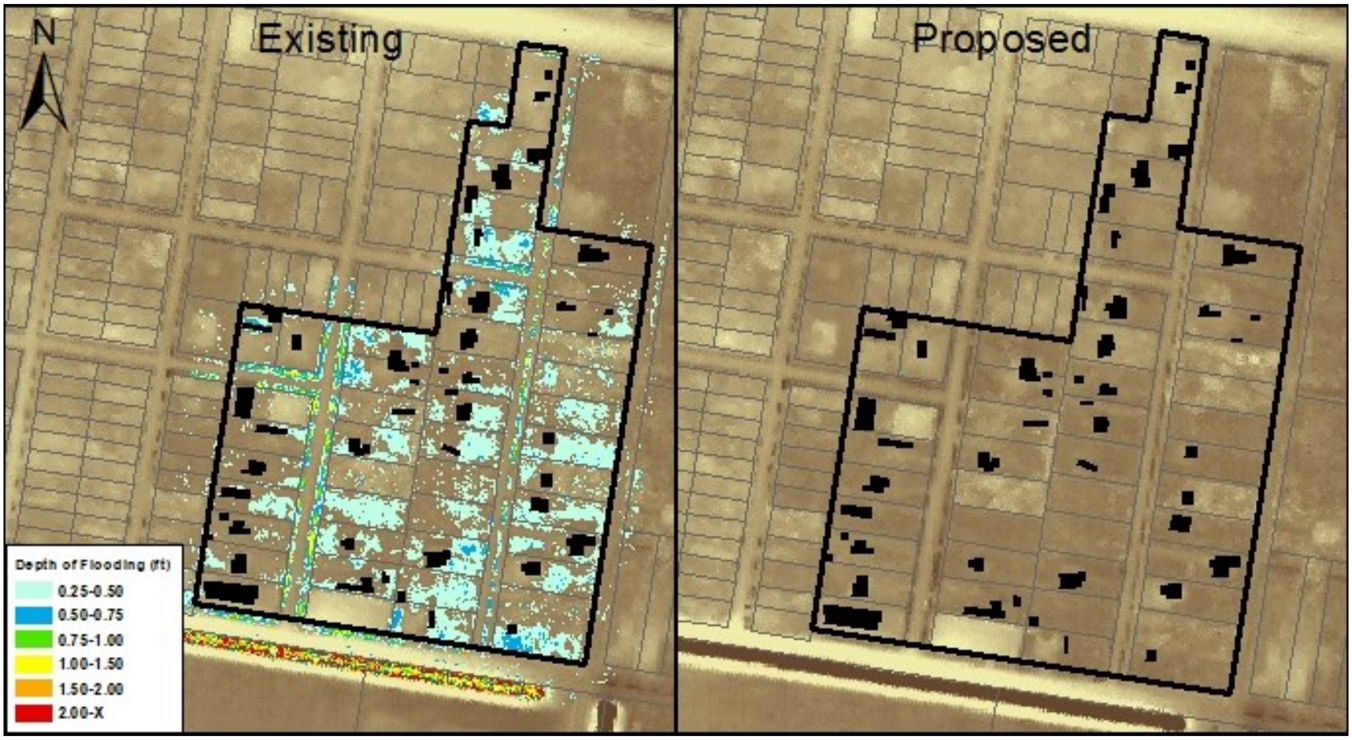


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	45	0	45
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Recommended Mitigation Project cont.:

Project Figures:

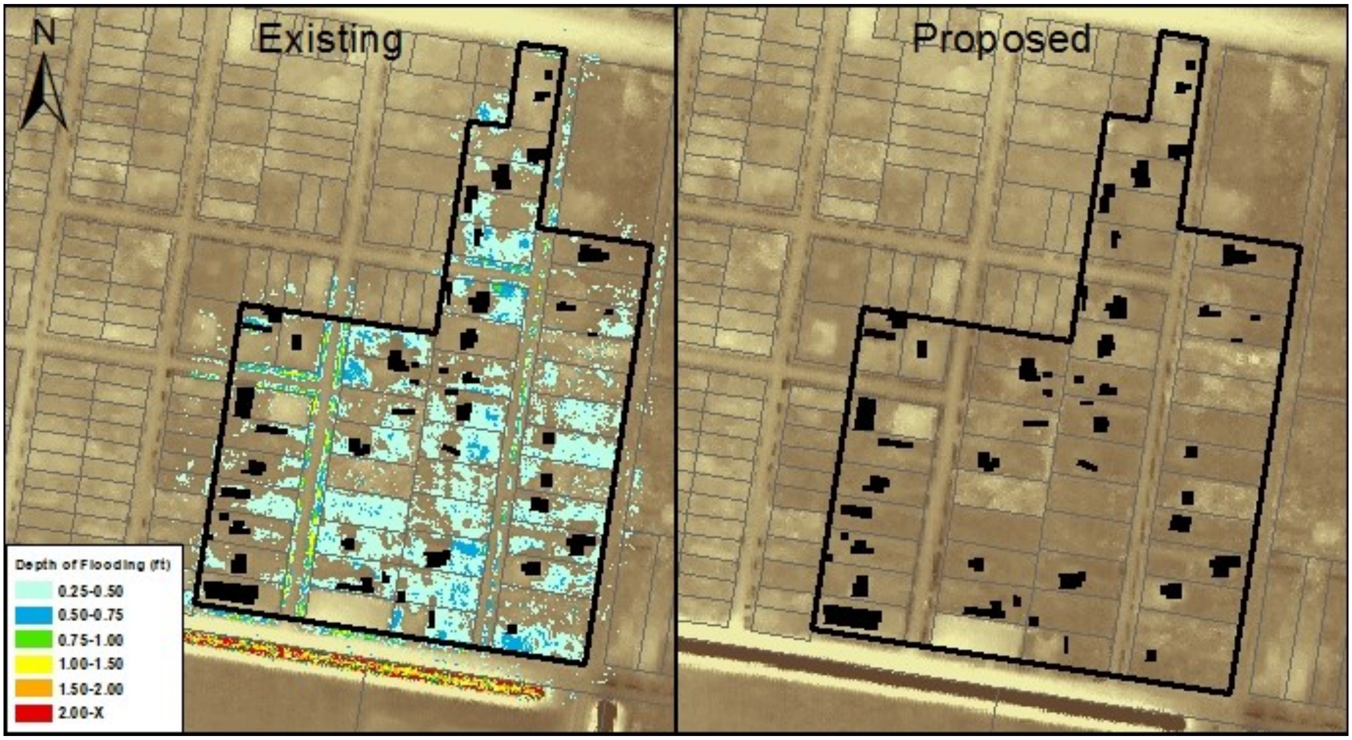


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	45	0	45
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Colonia Tijerina, Hidalgo County

“Filling the Gap”

Recommended Mitigation Project cont.:

Project Figures:

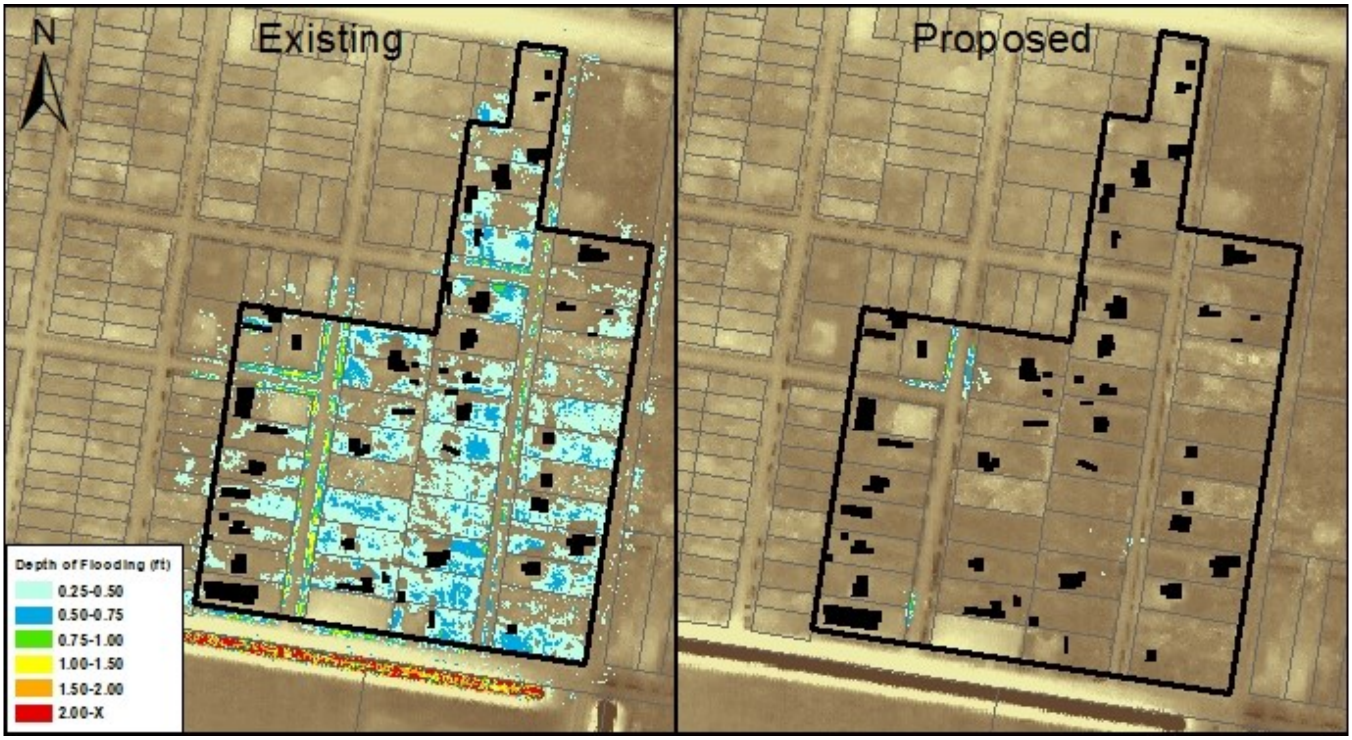


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	45	7	38
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Colonia Tijerina, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

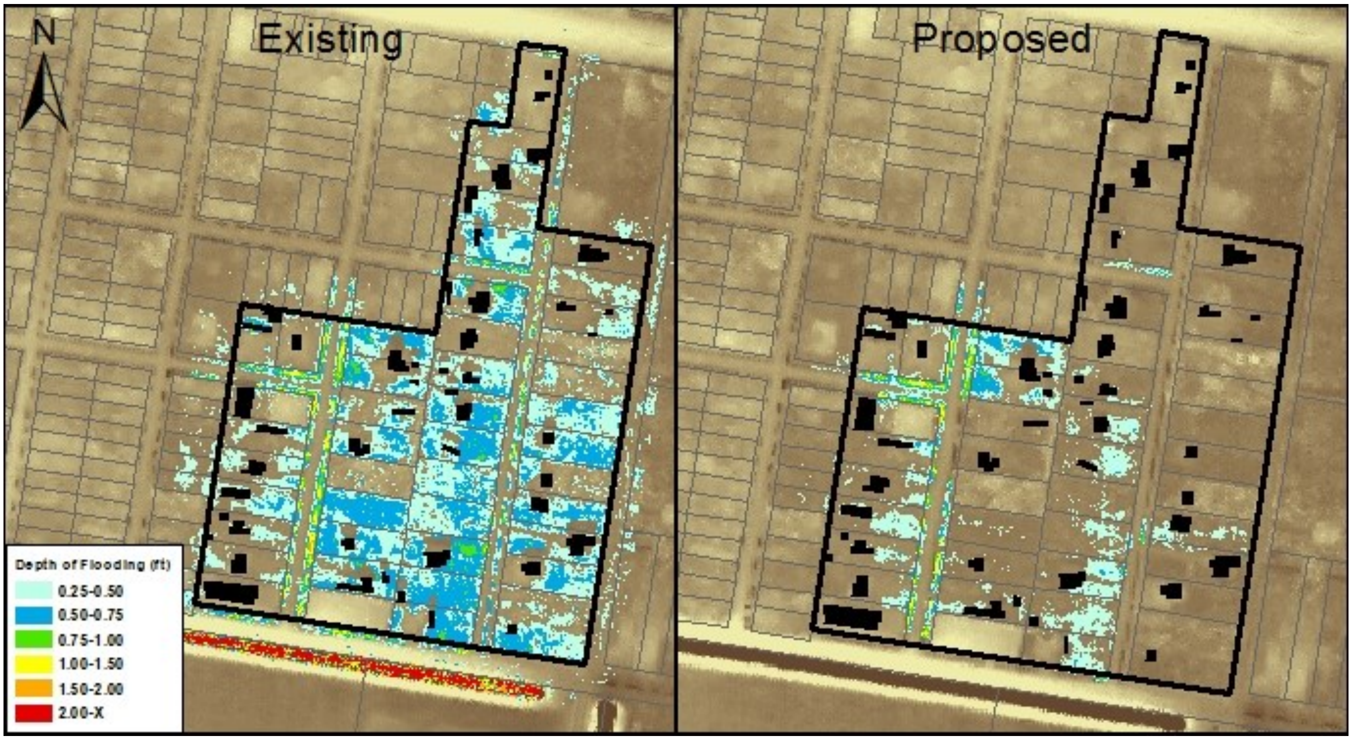


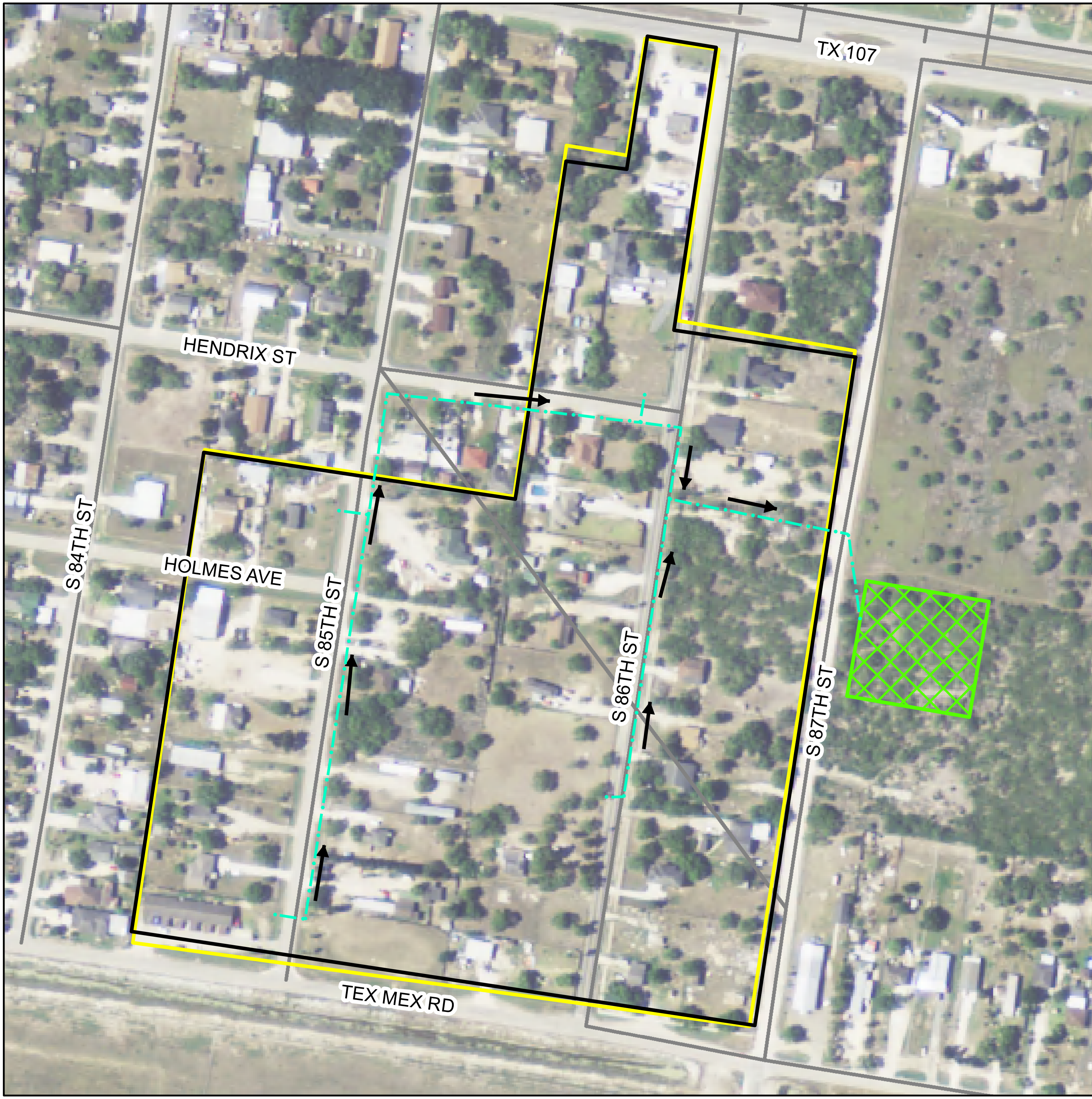
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	0	9
Inundated Lots	45	26	19
Inundated Roadway (LF)	58	58	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

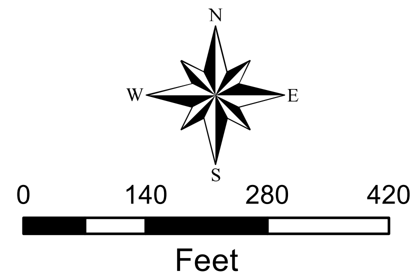
Colonia: Colonia Tijerina
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- COLONIA TIJERINA
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

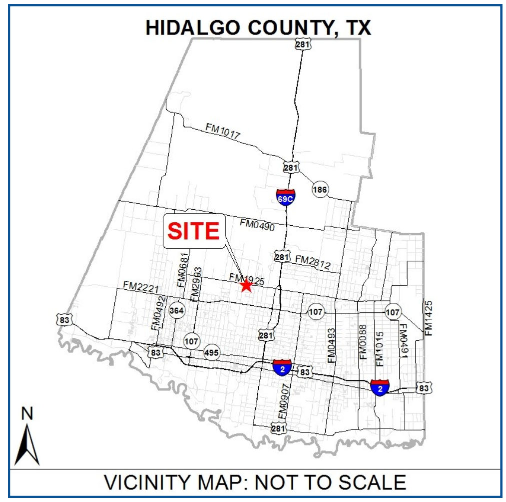
"Filling the Gap"

Colonia: Hoehn Drive Subd., Hidalgo County

Basin: North Main Drain

Category: B1

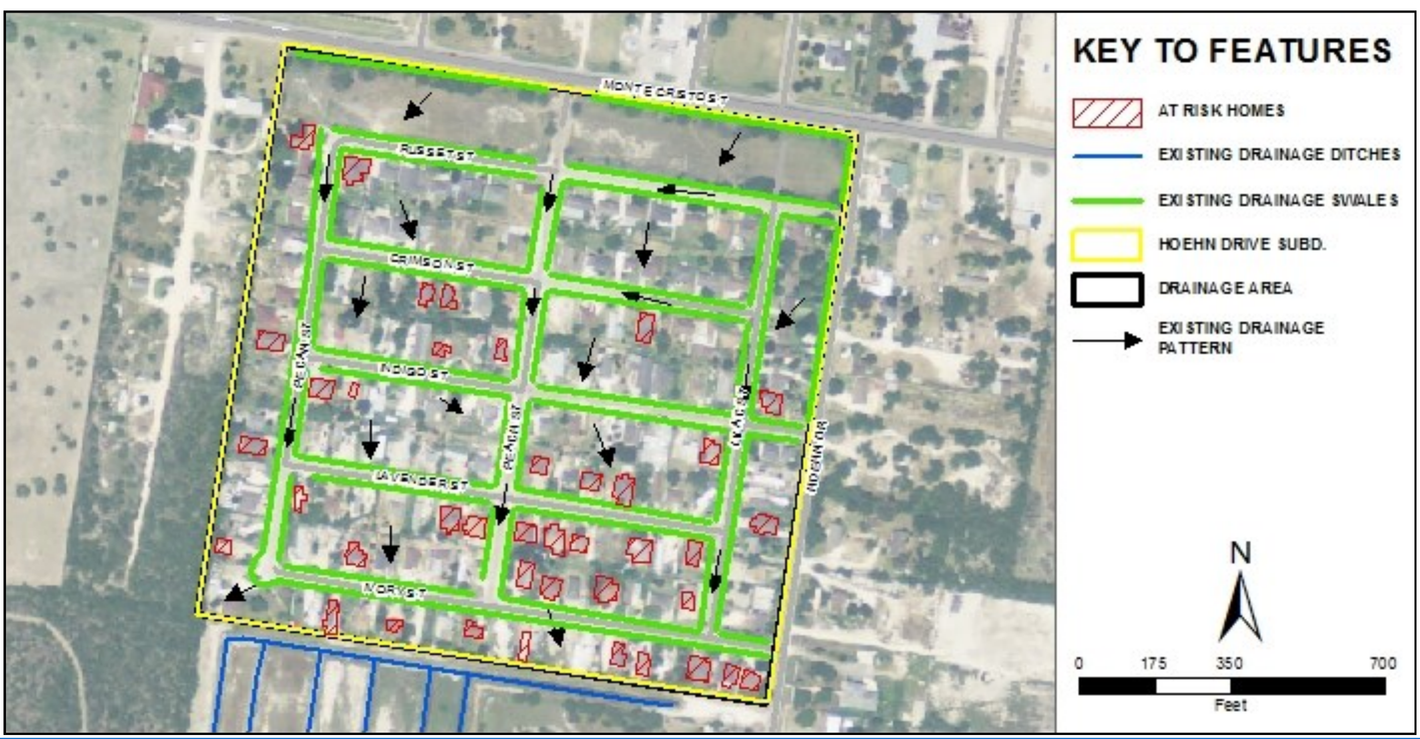
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Hoehn Drive Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Hoehn Drive Subd. consists of approximately 39.8 acres of fully developed residential land. The existing drainage system consists of swales and culverts that drain south to an existing detention pond, via two 30-inch diameter pipes. The detention pond is drained by a stormwater pump station. The existing drainage pattern indicates runoff flows toward Peach Street then south. Based on the existing conditions 2D model results several structures are at risk of flooding from a localized storm event. However, since half of the colonia is under the 100-Yr floodplain, it should be evaluated for risk of flooding due to regional storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Hoehn Drive Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - ∗ Install an underground drainage system with a retention pond.
    - ∗ Improve existing culverts and swales to allow maximum conveyance toward the existing drainage ditch.
    - ∗ Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
    - ∗ Elevate structures
    - ∗ Buyout of flood prone structures
    - ∗ Land use zoning change
    - ∗ Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 2,990 linear feet of 24-inch diameter pipe, 1,070 linear feet of 30-inch diameter pipe, 580 linear feet of 36-inch diameter pipe, 500 linear feet of 42-inch diameter pipe, 510 linear feet of 48-inch diameter pipe, and eighteen curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 9.3 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
HOEHN DRIVE

	IMPROVEMENTS	COST
1	Paving Improvements	$1,437,383.33
2	Drainage Improvements	$494,220.00
3	Pond Excavation Improvements	$251,069.32
	Sub-Total =	**$2,182,672.65**
	Engineering Fees (10%) =	**$218,267.27**
	Contingency (20%) =	**$436,534.53**
	Total =	**$2,837,474.45**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	25	0	25
20% (5-year)	38	0	38
10% (10-year)	39	0	39
4% (25-year)	41	8	33
1% (100-year)	43	30	13

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$16,002,965.00	$2,837,474.45	5.64
Elevate Structures	$16,002,965.00	$3,983,550.00	4.02
Acquisition/Supplemental Housing / Demolition	$16,667,757.00	$4,004,581.50	4.16

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	25	0	25
Inundated Lots	166	0	166
Inundated Roadway (LF)	1,022	0	1,022

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	38	0	38
Inundated Lots	166	0	166
Inundated Roadway (LF)	2,361	0	2,361

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	39	0	39
Inundated Lots	166	0	166
Inundated Roadway (LF)	2,471	0	2,471

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

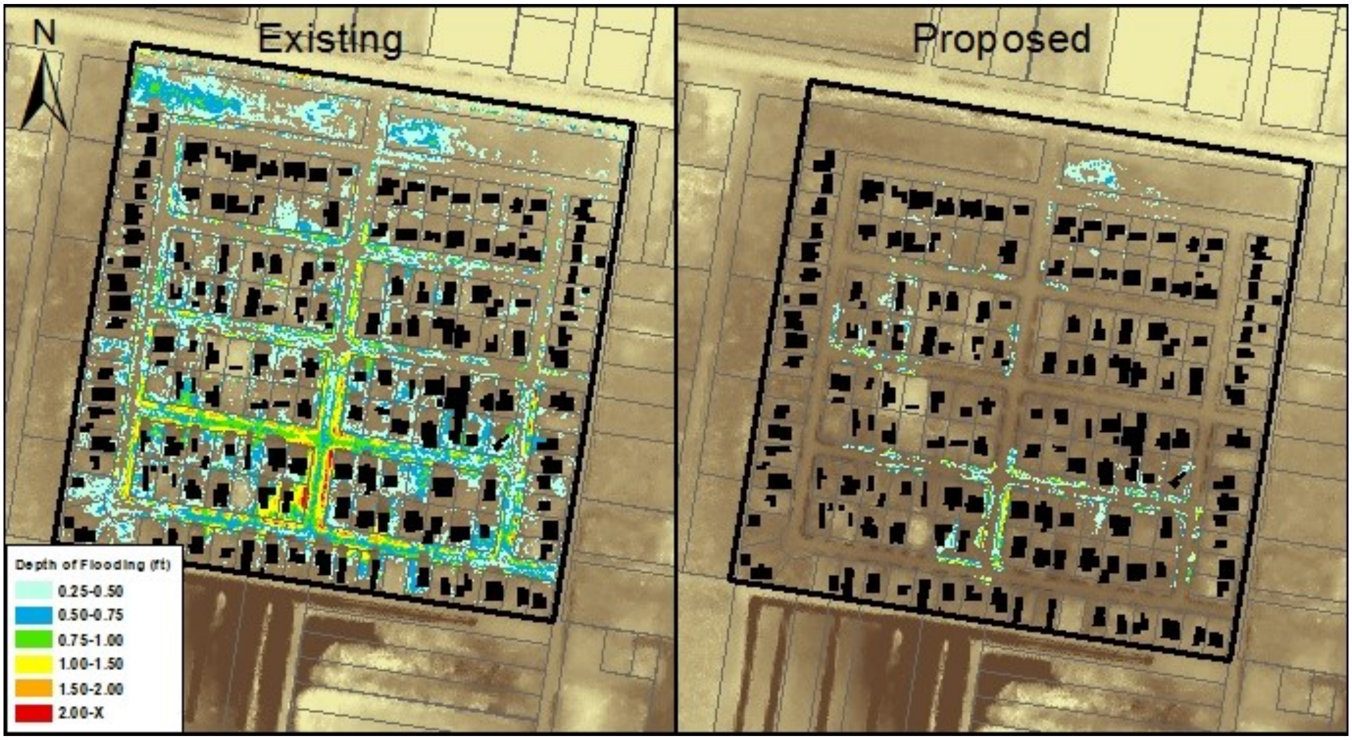


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	41	8	33
Inundated Lots	166	54	112
Inundated Roadway (LF)	3,135	0	3,135

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Hoehn Drive Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

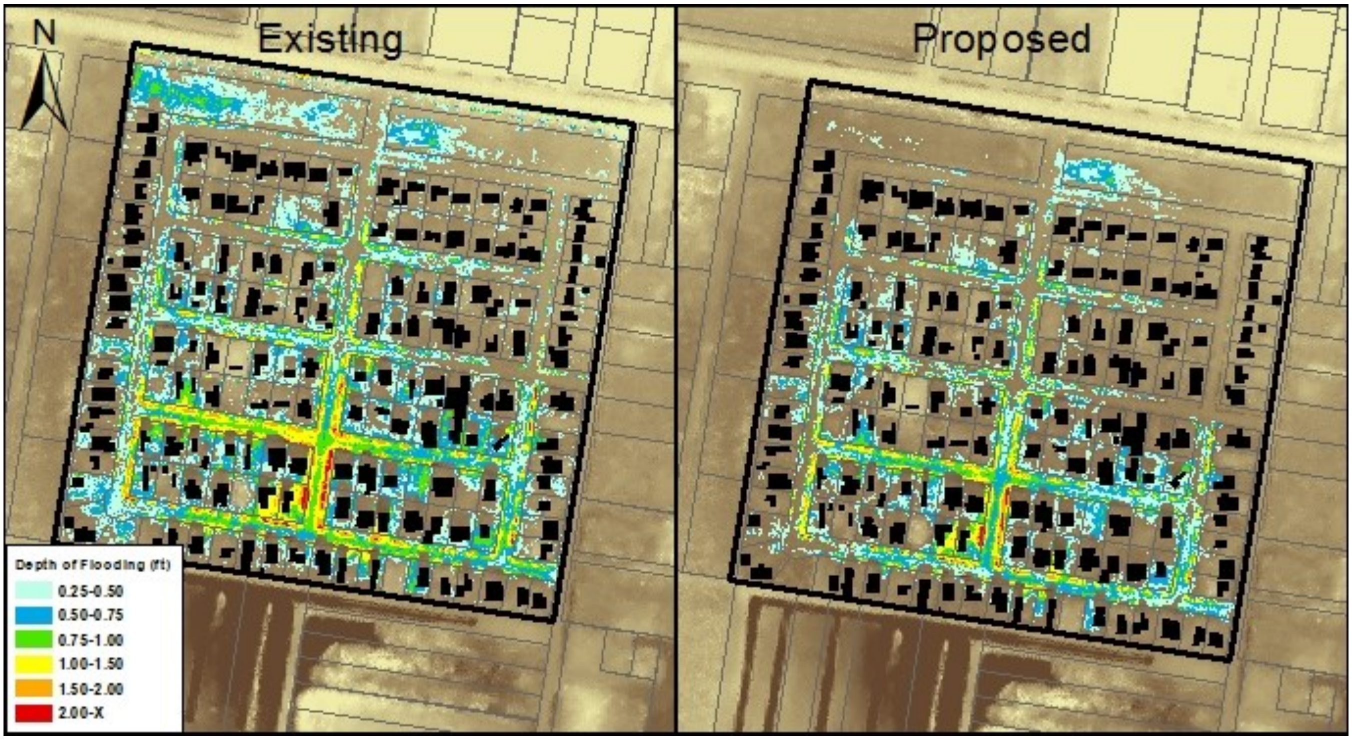


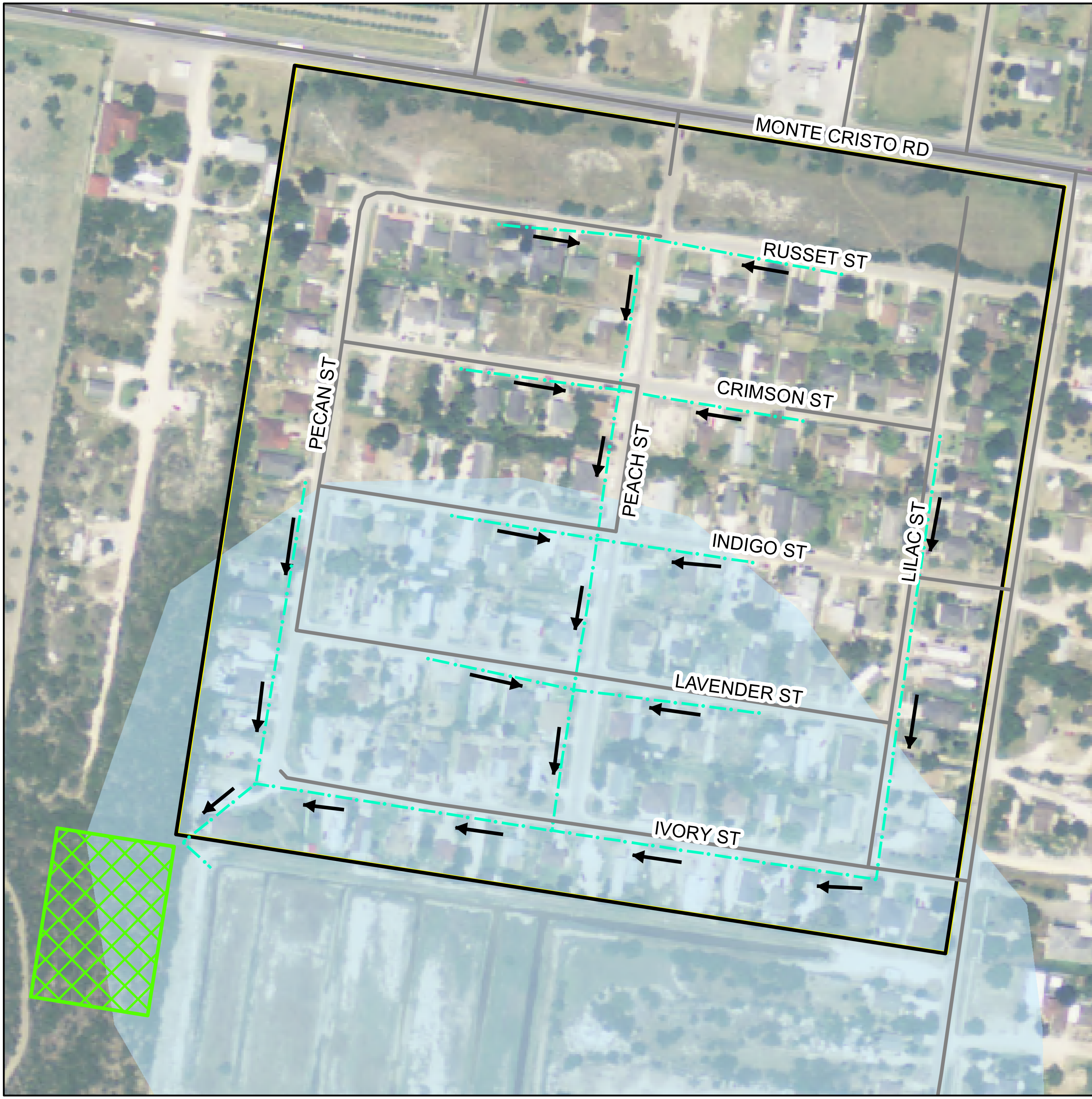
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	43	30	13
Inundated Lots	166	137	29
Inundated Roadway (LF)	4,000	2721	1,279

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Hoehn Drive Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- HOEHN DRIVE SUBD.
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N
W E
S

0 150 300 450
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

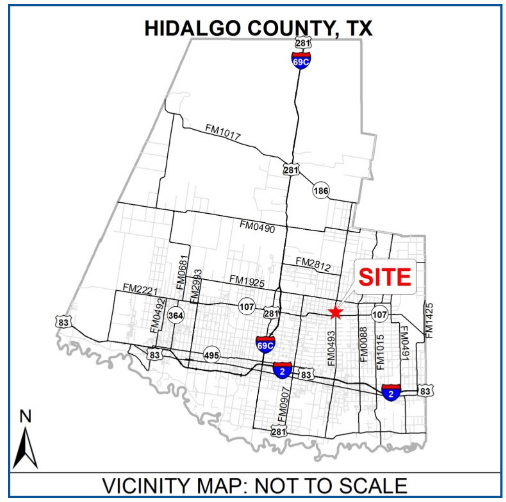
Colonia: Imperial Subd., Hidalgo County

Basin: North Main Drain

Category: B1

"Filling the Gap"

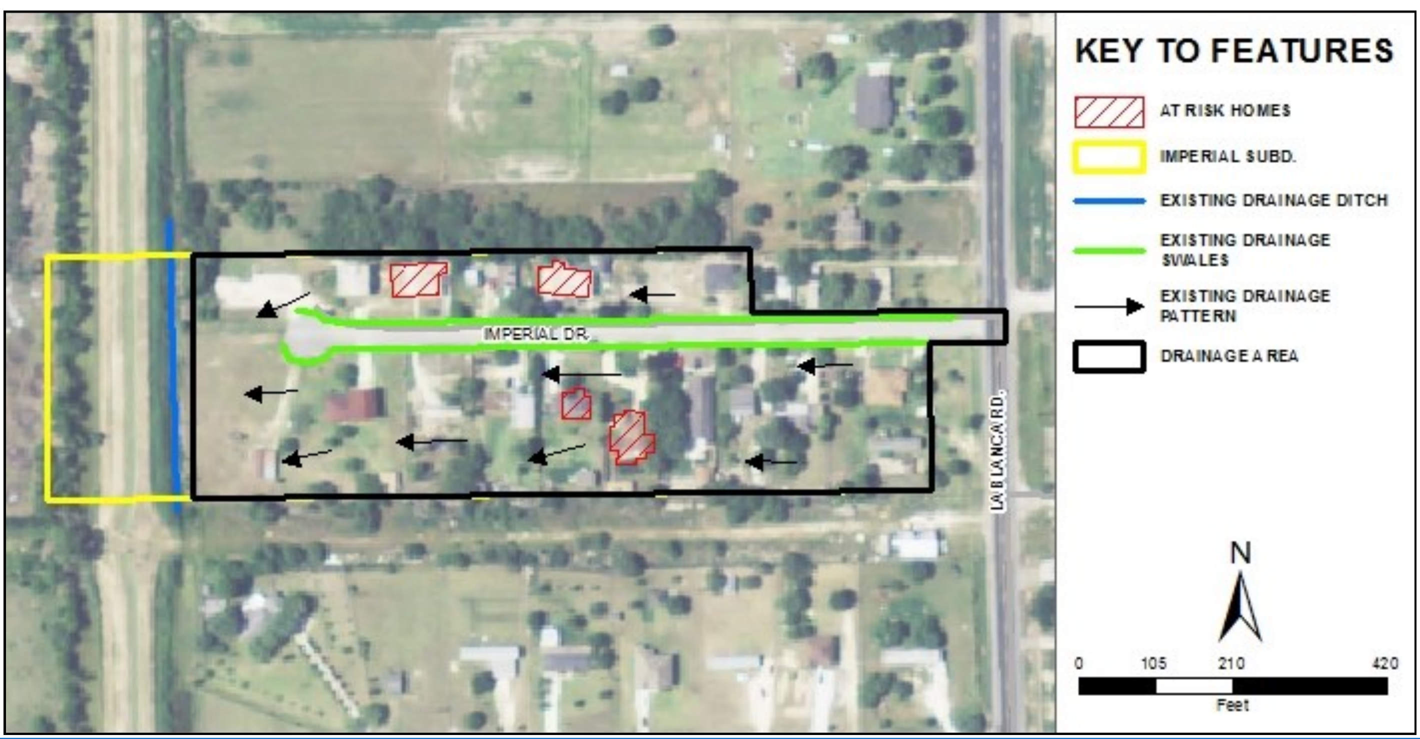
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Imperial Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Imperial Subd. consists of approximately 7 acres of fully developed residential land. Imperial Drive has swales and culvers along both north and south sides; and existing outlet was not observed. The existing drainage pattern indicates runoff flows toward the west. Based on the existing conditions 2D model results, structures on both the north and south sides of Imperial Drive appear to be at risk of flooding. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Imperial Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install a direct outfall from the roadside swales into the existing drainage ditch.
    - Install an underground drainage system and outfall into the existing drainage ditch.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 868 linear feet of 21-inch diameter pipe, 296 linear feet of 24-inch diameter pipe, and five curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 3.19 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
IMPERIAL SUBD.

IMPROVEMENTS		COST
1	Paving Improvements	$169,686.67
2	Drainage Improvements	$82,552.00
3	Pond Excavation Improvements	$86,863.64
	Sub-Total =	**$339,102.30**
	Engineering Fees (10%) =	**$33,910.23**
	Contingency (20%) =	**$67,820.46**
	Total =	**$440,832.99**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Imperial Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	2	0	2
10% (10-year)	2	0	2
4% (25-year)	3	0	3
1% (100-year)	4	0	4

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,330,882.00	$440,832.99	5.29
Elevate Structures	$2,330,882.00	$544,800.00	4.28
Acquisition/Supplemental Housing / Demolition	$2,419,125.00	$410,529.50	5.89

Colonia: Imperial Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

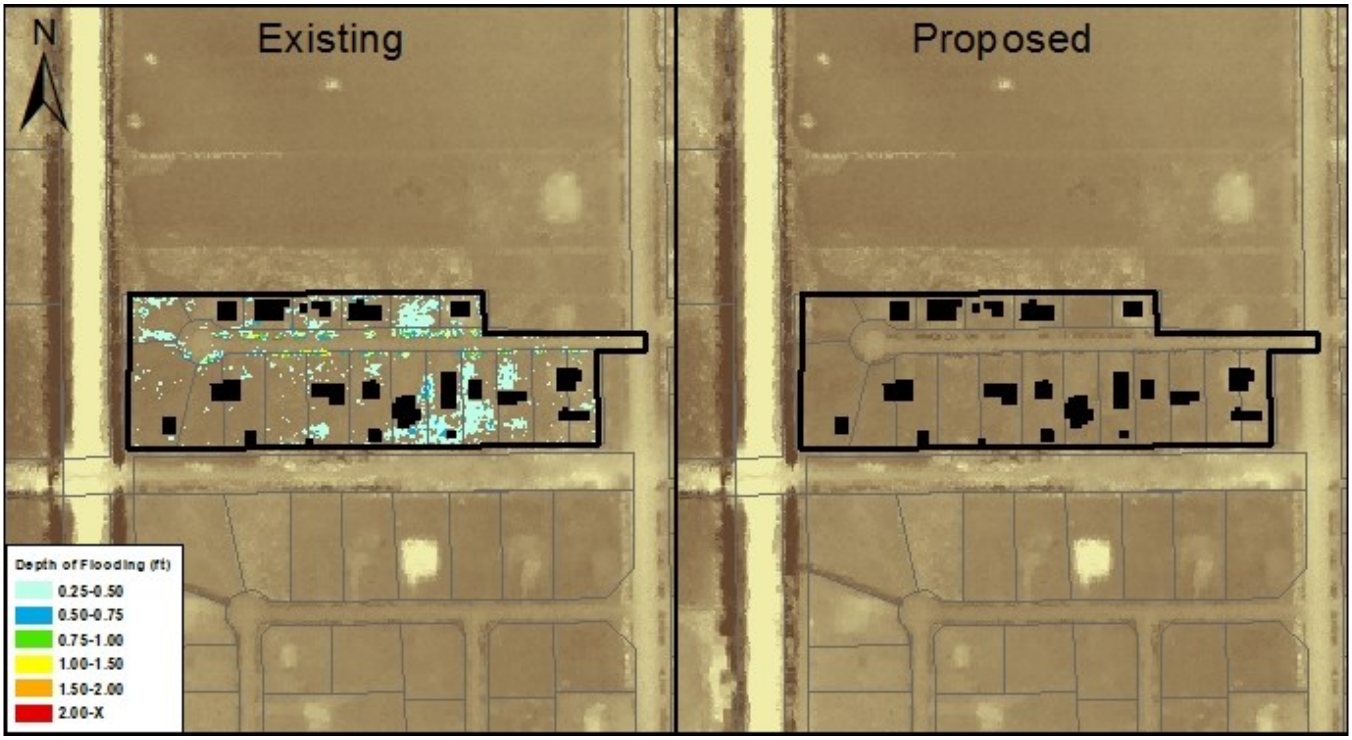


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	0	19
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Imperial Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

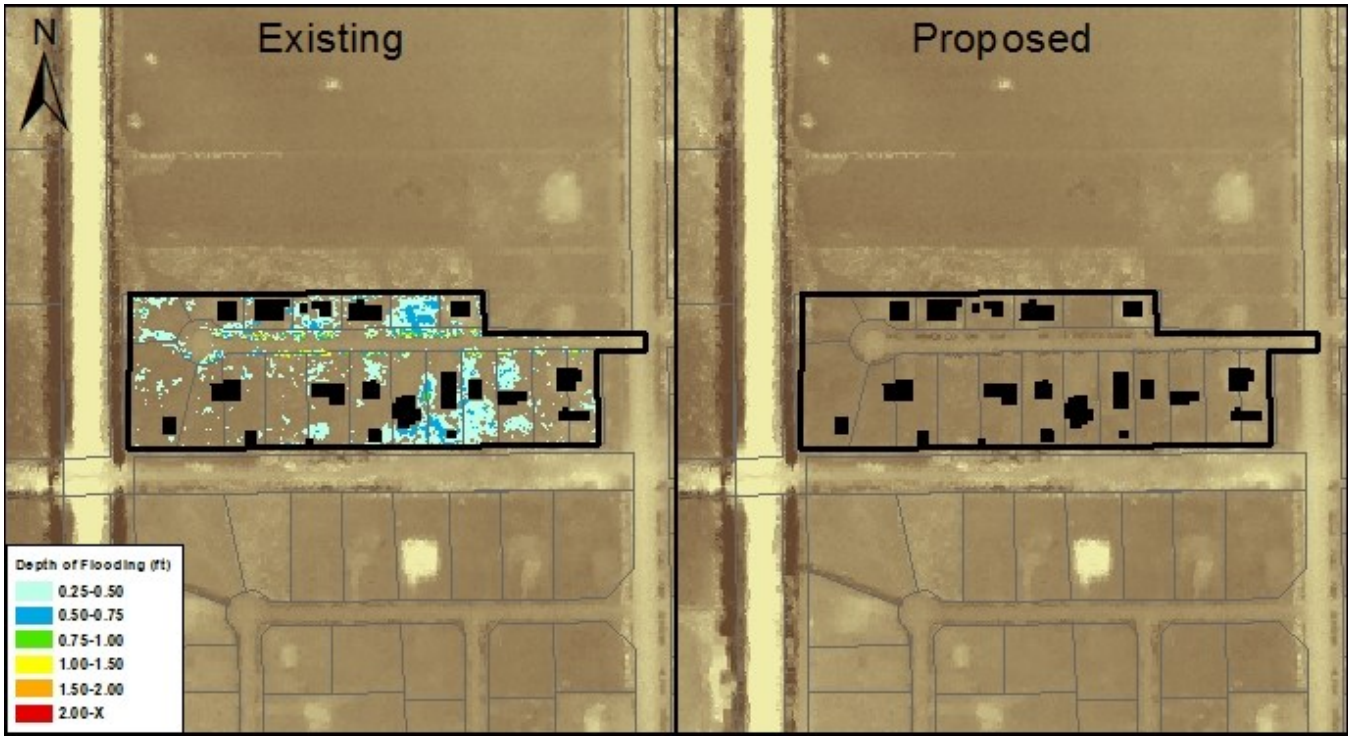


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	0	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Imperial Subd., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

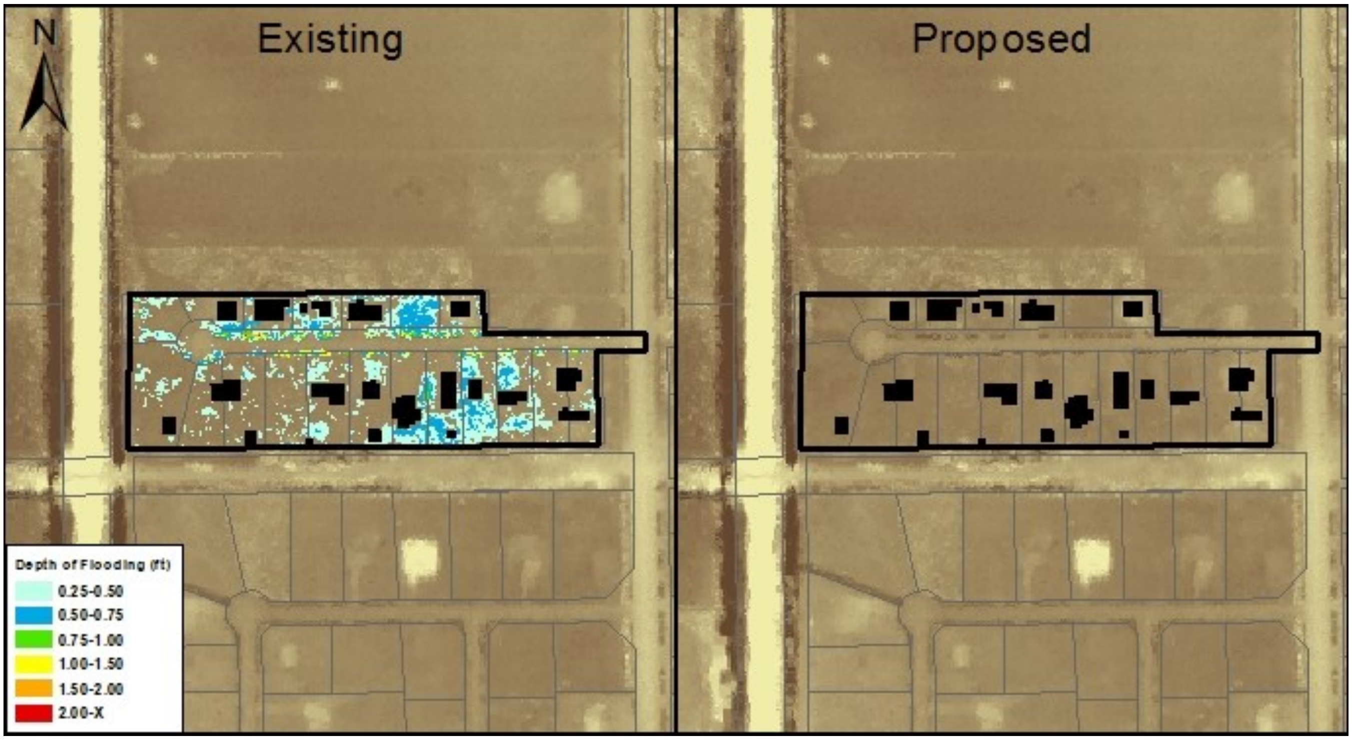


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	19	0	19
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Imperial Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

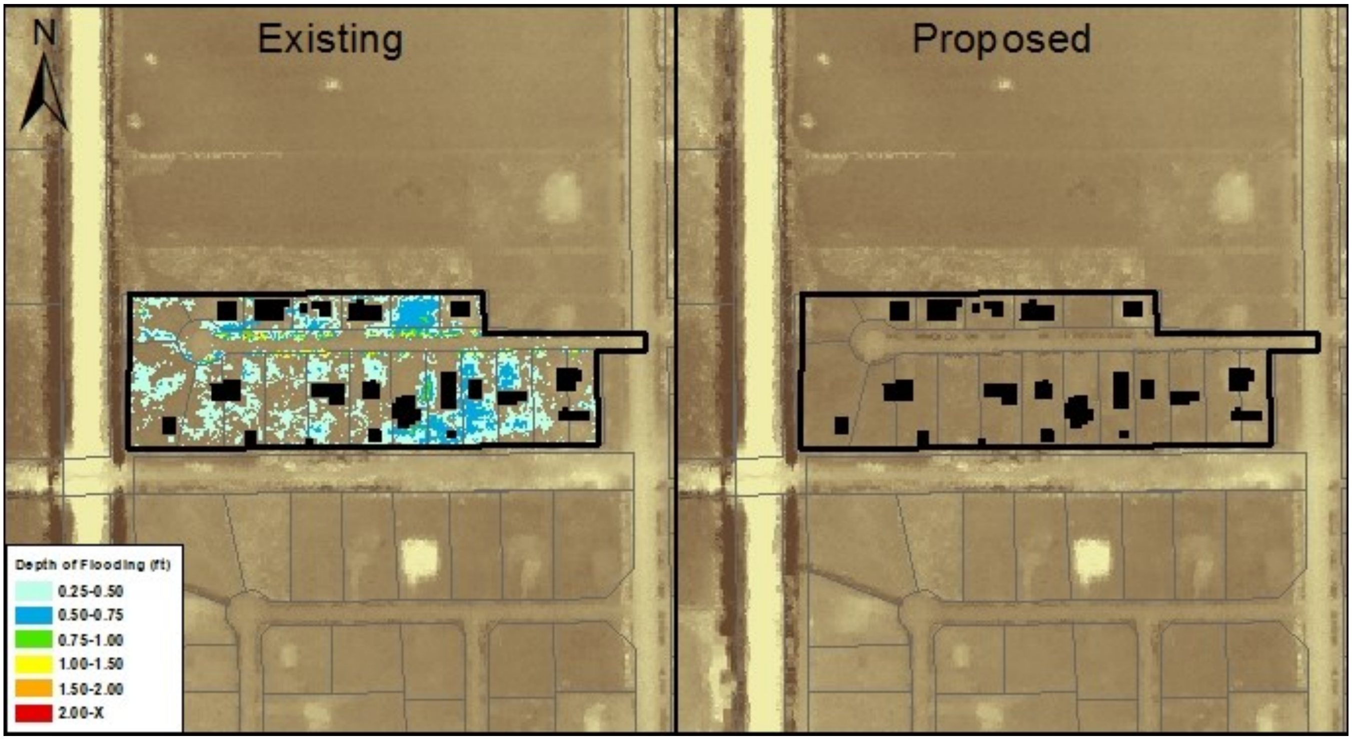


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	19	0	19
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Imperial Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

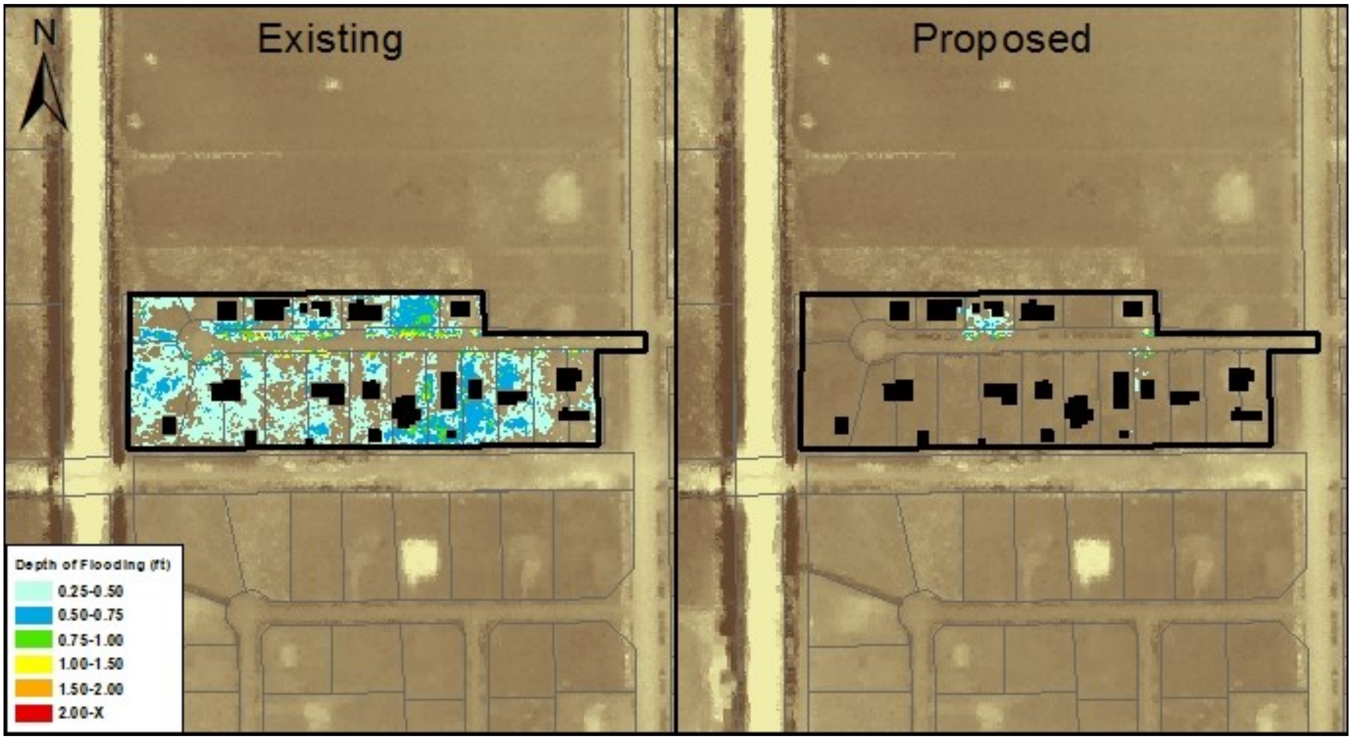


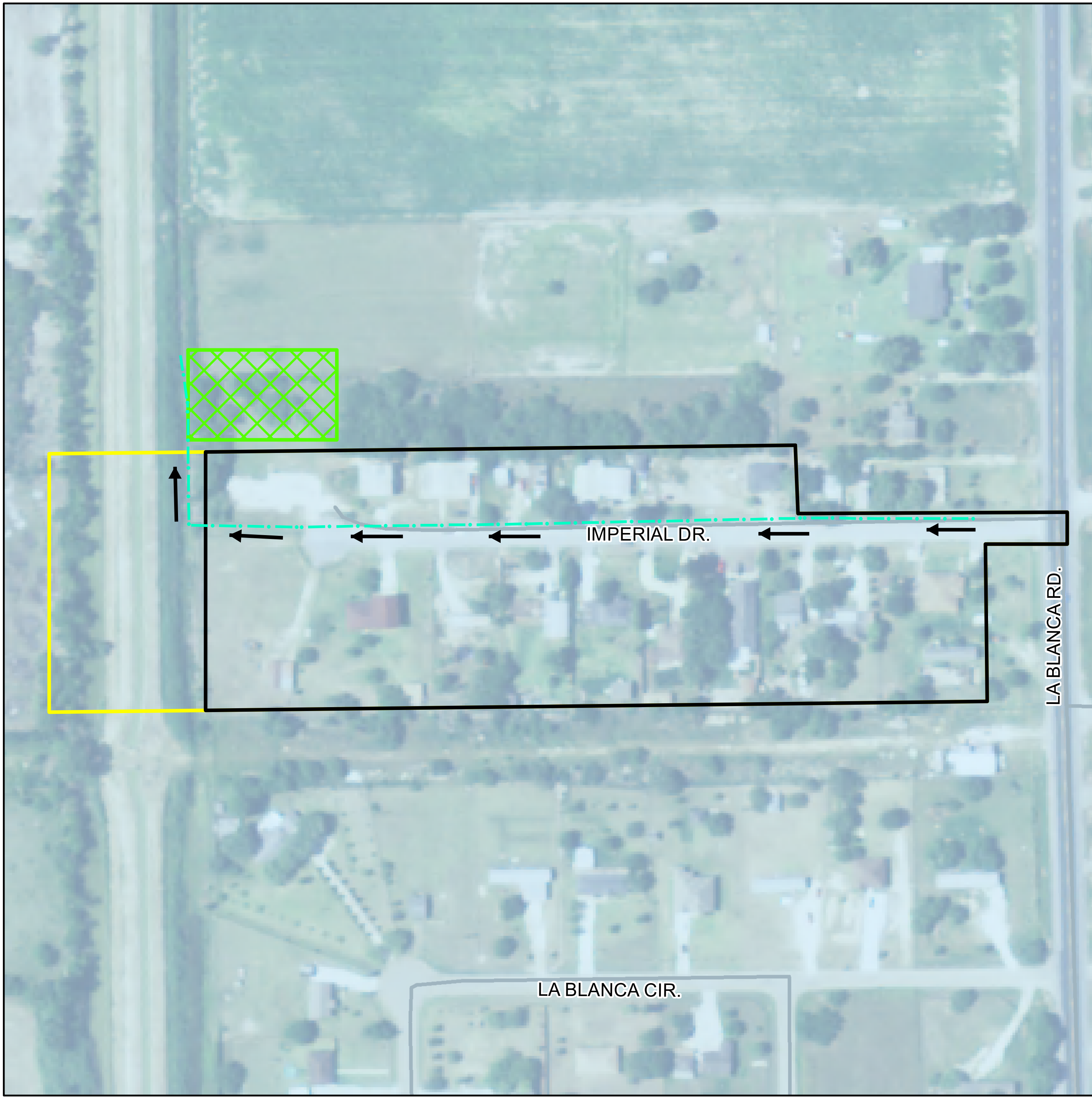
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	19	4	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Imperial Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- IMPERIAL SUBD.
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

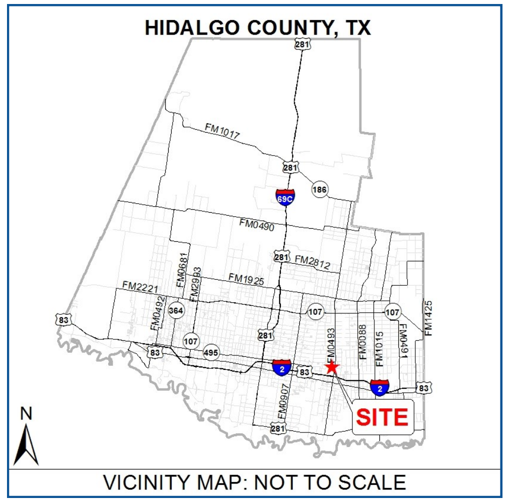
Colonia: La Blanca Heights, Hidalgo County

Basin: North Main Drain

Category: B1

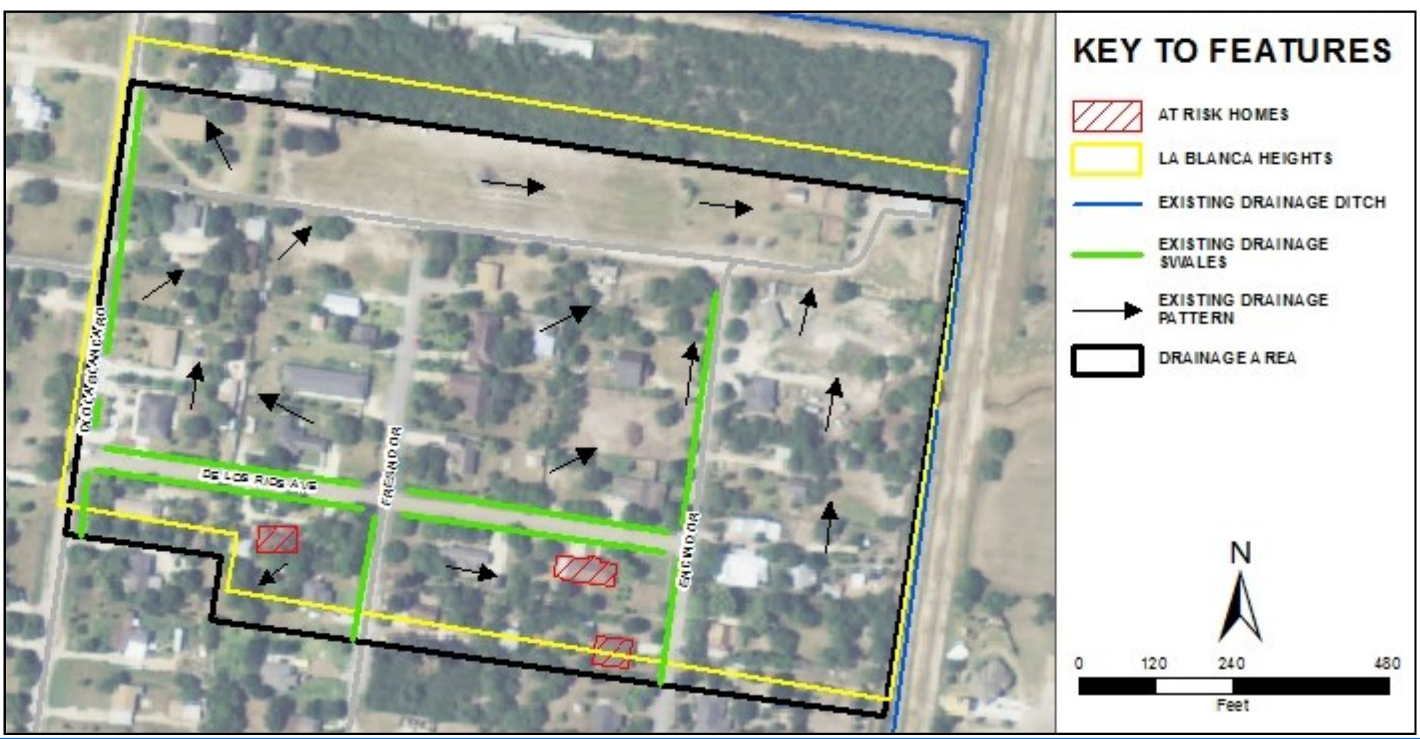
Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia La Blanca Heights storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

La Blanca Heights consists of approximately 23.6 acres of fully developed residential land. The existing drainage system consists of swales and culvers with no apparent outfall. The existing drainage pattern indicates runoff flows toward the northeast. Based on the existing conditions 2D model results several structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: La Blanca Heights, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Improve existing culverts and swales and connect an outfall into the existing drainage ditch.
  - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 490 linear feet of 24-inch diameter pipe, 480 linear feet of 30-inch diameter pipe, 5,560 linear feet of 36-inch diameter pipe, 500 linear feet of 42-inch diameter pipe, and eleven curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 6.1 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
LA BLANCA HEIGHTS

	IMPROVEMENTS	COST
1	Paving Improvements	$408,893.33
2	Drainage Improvements	$599,550.00
3	Pond Excavation Improvements	$163,704.55
	Sub-Total =	**$1,172,147.88**
	Engineering Fees (10%) =	**$117,214.79**
	Contingency (20%) =	**$234,429.58**
	Total =	**$1,523,792.24**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: La Blanca Heights, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	3	0	3
1% (100-year)	9	0	9

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$791,342.00	$1,523,792.24	0.52
Elevate Structures	$791,342.00	$367,875.00	2.15
Acquisition/Supplemental Housing / Demolition	$827,320.00	$381,014.30	2.17

Colonia: La Blanca Heights, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

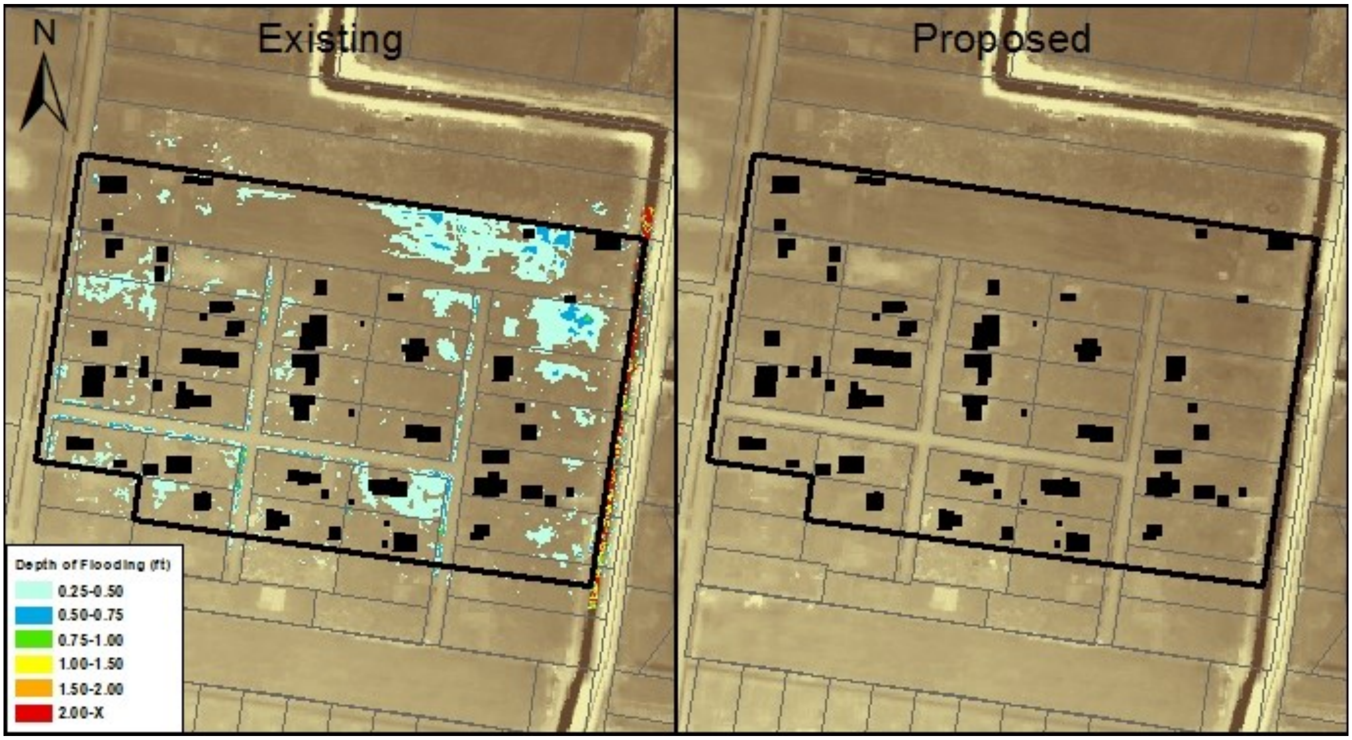


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	31	0	31
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: La Blanca Heights, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

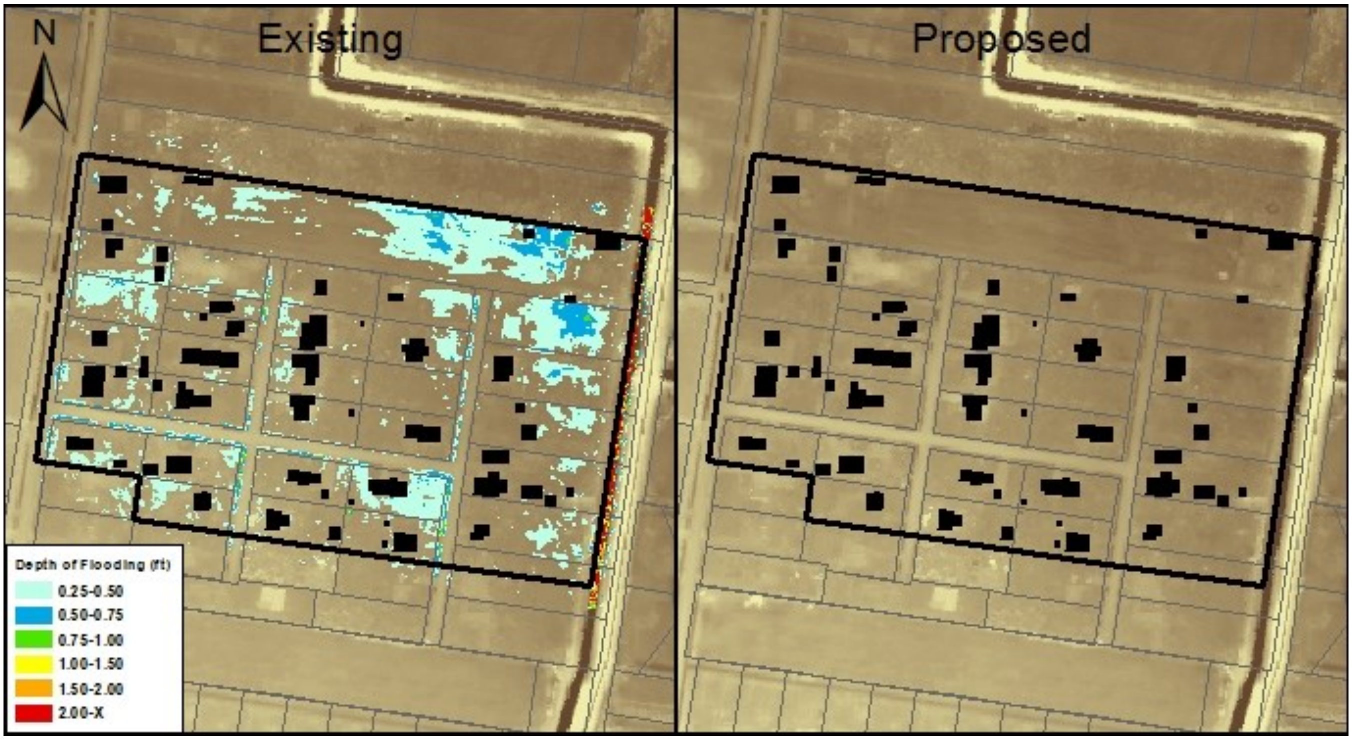


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	31	0	31
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: La Blanca Heights, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

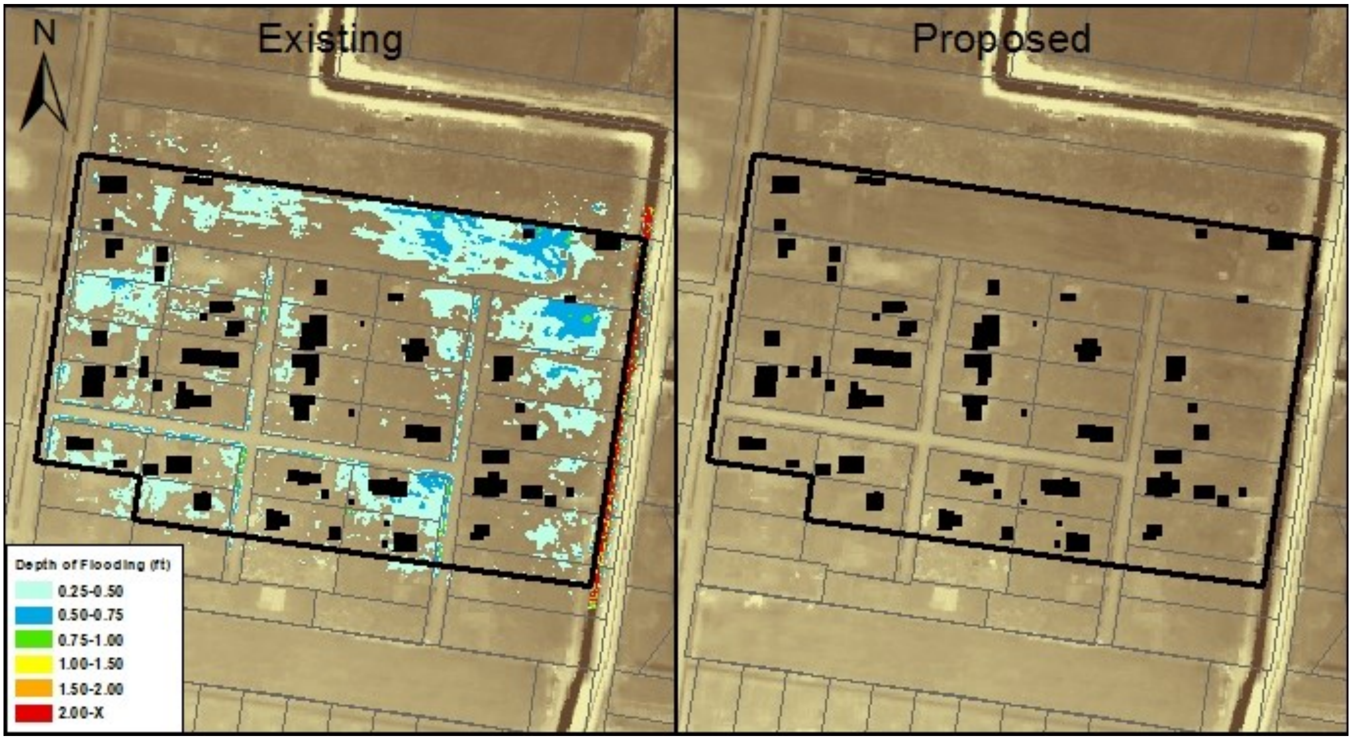


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	31	0	31
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: La Blanca Heights, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

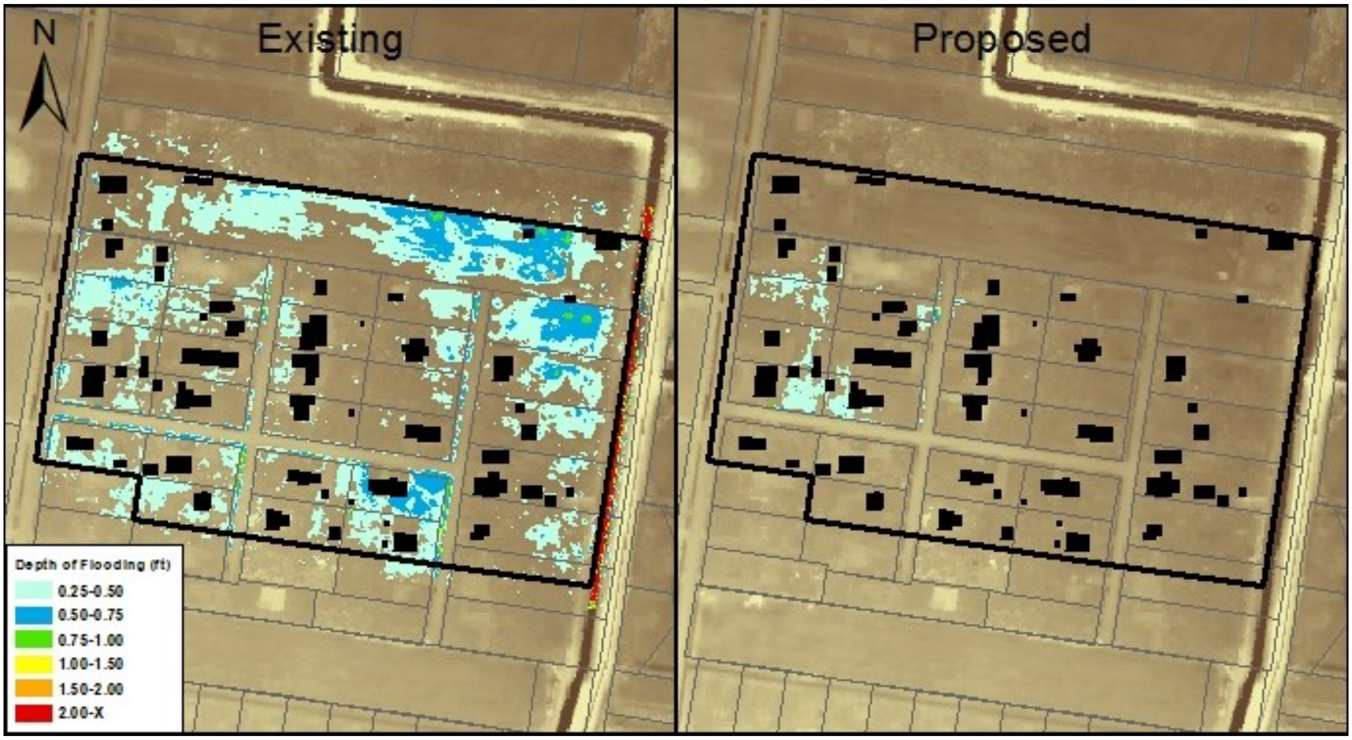


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	31	11	20
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: La Blanca Heights, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

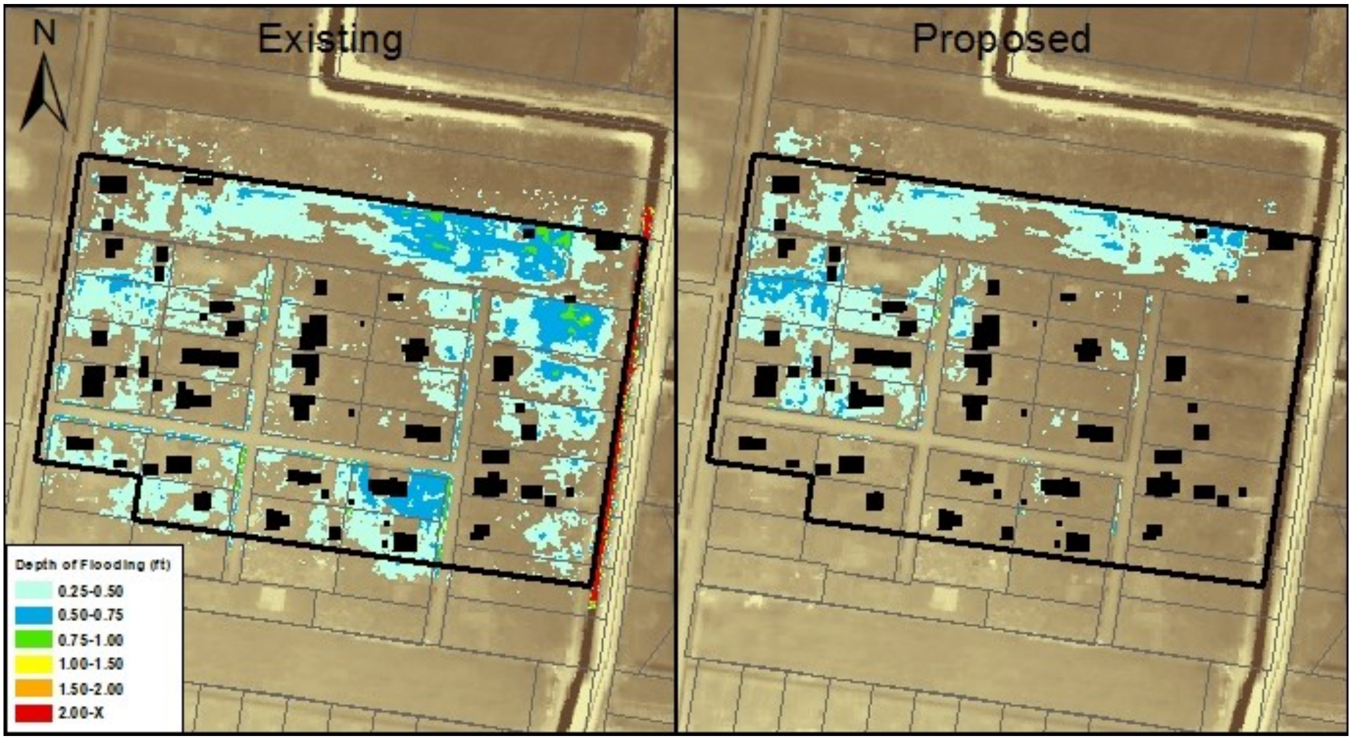
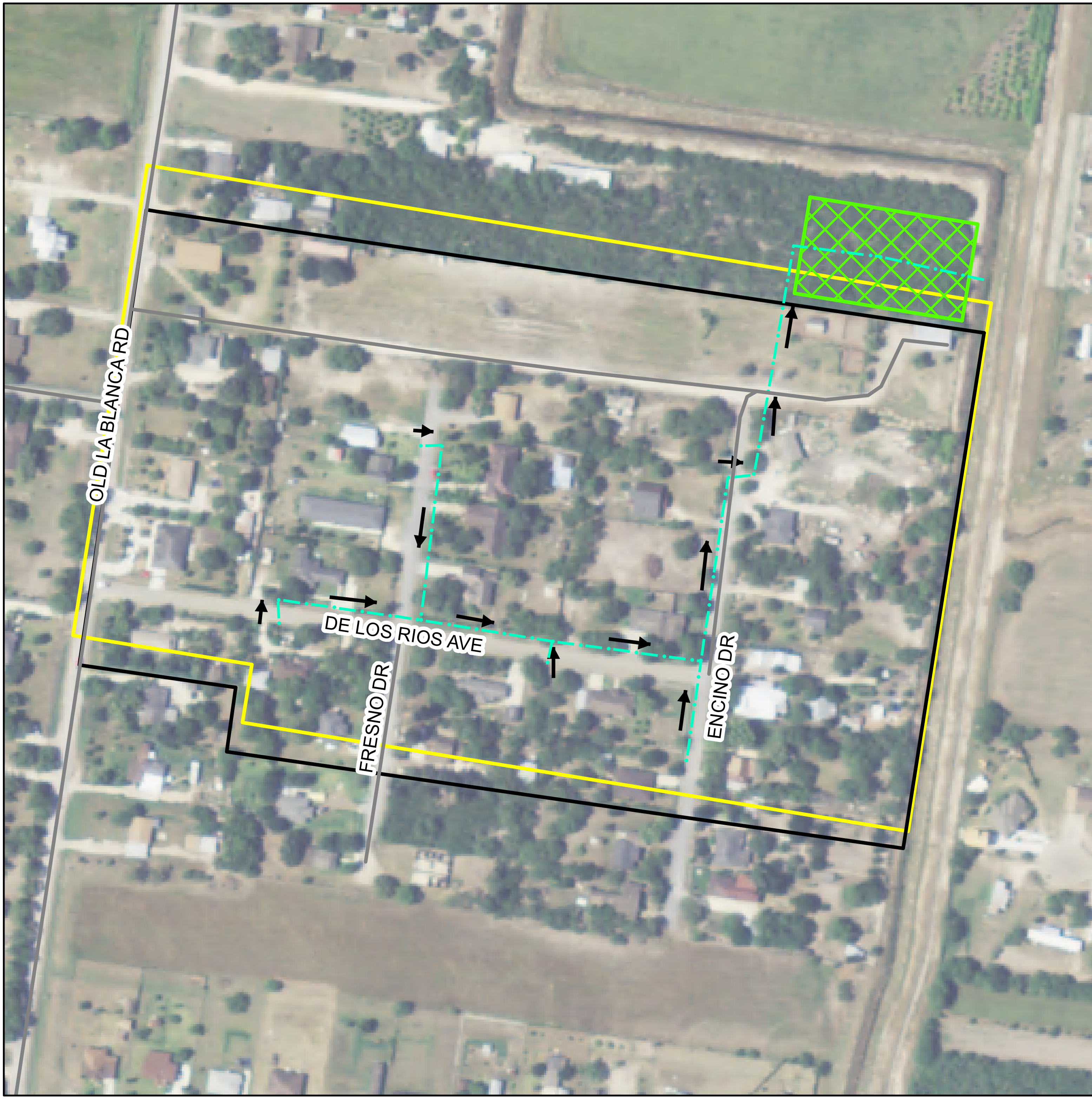


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	9	0	9
Inundated Lots	31	22	9
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: La Blanca Heights
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- LA BLANCA HEIGHTS
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

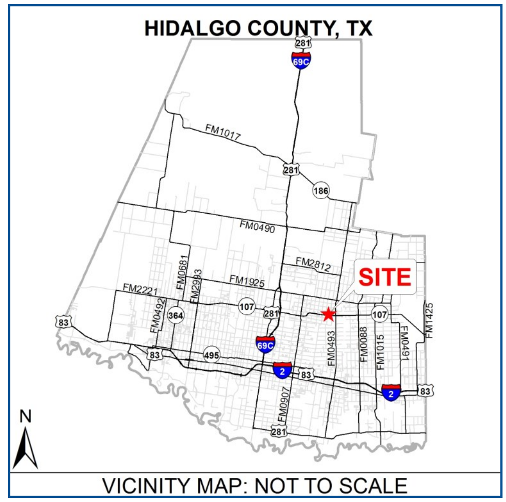
Colonia: Rankin Subd., Hidalgo County

Basin: North Main Drain

Category: B1

“Filling the Gap”

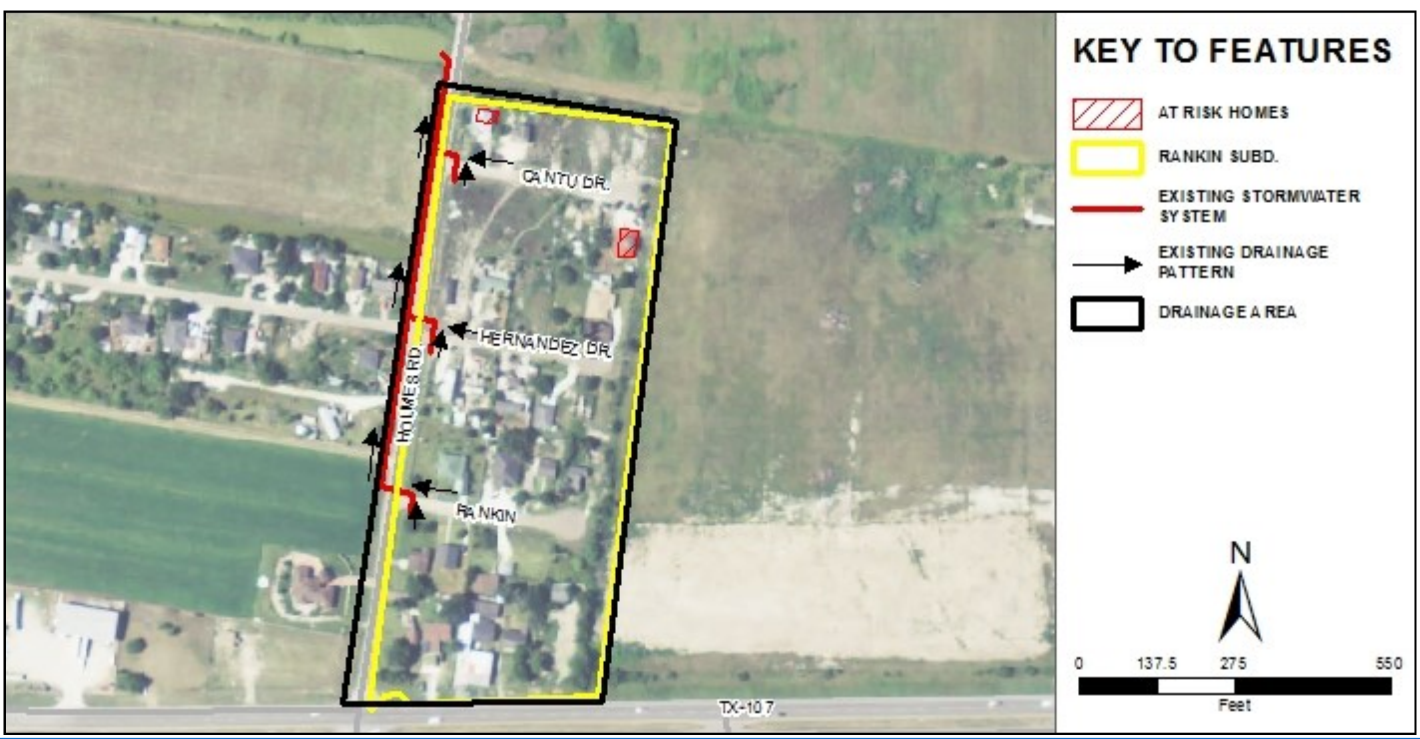
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Rankin Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Rankin Subd. consists of approximately 10.6 acres of fully developed residential land. The existing drainage system consists of curb and gutter along the streets with an underground drainage system. From LIDAR observations it appears runoff flows toward the north. The existing conditions 2D model results indicate that structures at the north end of the colonia appear to be at risk of flooding. The model conditions were ran with a worst case scenario of a full drainage ditch at the outfall. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Rankin Subd., Hidalgo County

"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install additional underground drainage with a new retention pond.
  - Install additional underground drainage to outfall into the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 978 linear feet of 18-inch diameter pipe, 100 linear feet of 36-inch diameter pipe, and six curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
RANKIN SUBD

IMPROVEMENTS		COST
1	Paving Improvements	$326,261.67
2	Drainage Improvements	$132,820.00
3	Pond Excavation Improvements	$121,943.18
	Sub-Total =	**$581,024.85**
	Engineering Fees (10%) =	**$58,102.48**
	Contingency (20%) =	**$116,204.97**
	Total =	**$755,332.30**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.	

Colonia: Rankin Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	1	0	1
20% (5-year)	1	0	1
10% (10-year)	1	0	1
4% (25-year)	2	0	2
1% (100-year)	2	0	2

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$414,285.00	$755,332.30	0.55
Elevate Structures	$414,285.00	$175,950.00	2.35
Acquisition/Supplemental Housing / Demolition	$434,425.00	$253,398.10	1.71

Colonia: Rankin Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

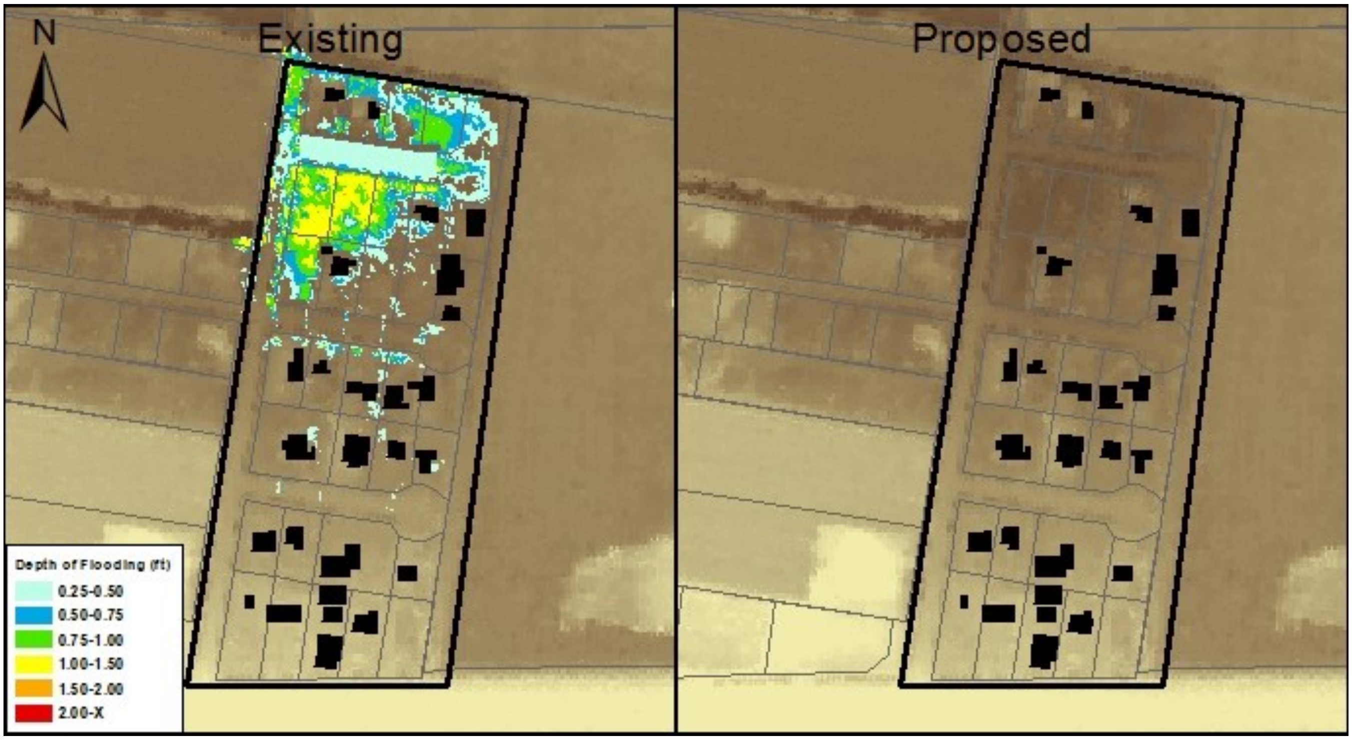


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	23	0	23
Inundated Roadway (LF)	669	0	669

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Rankin Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

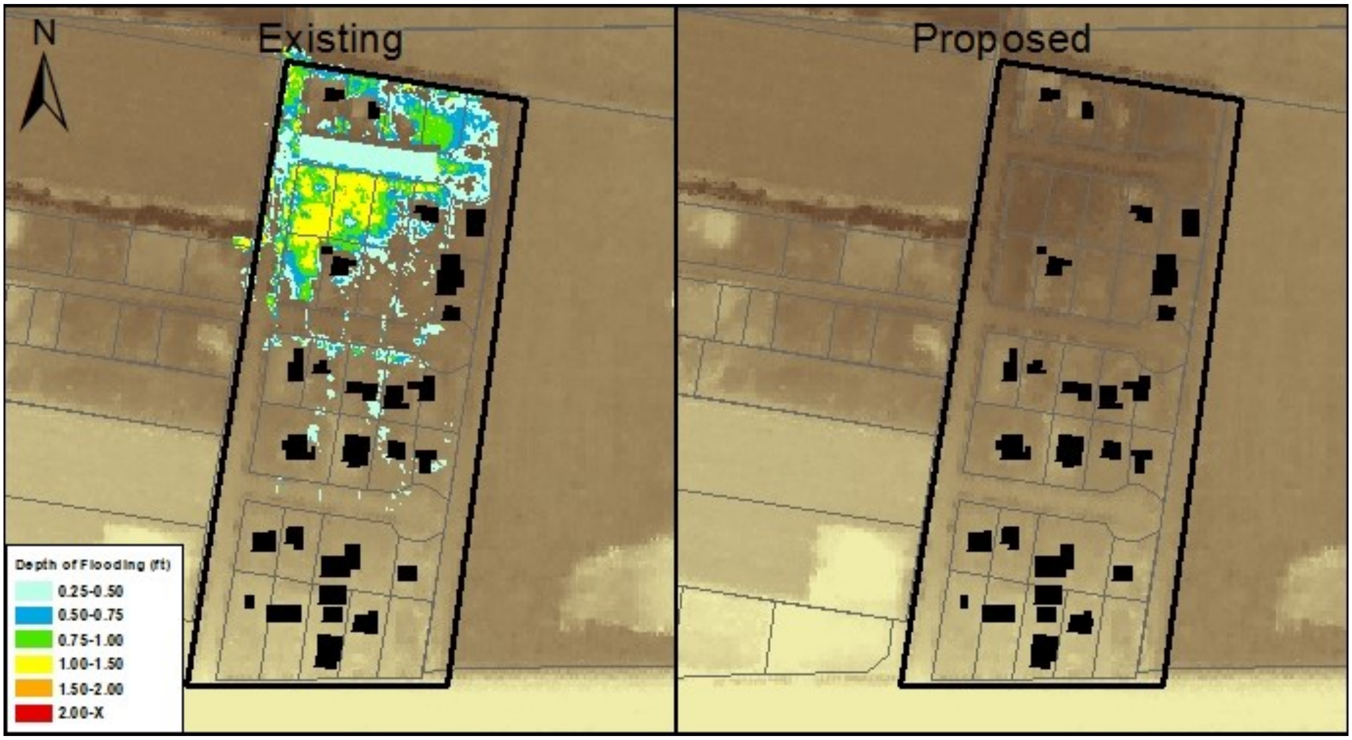


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	23	0	23
Inundated Roadway (LF)	669	0	669

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Rankin Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

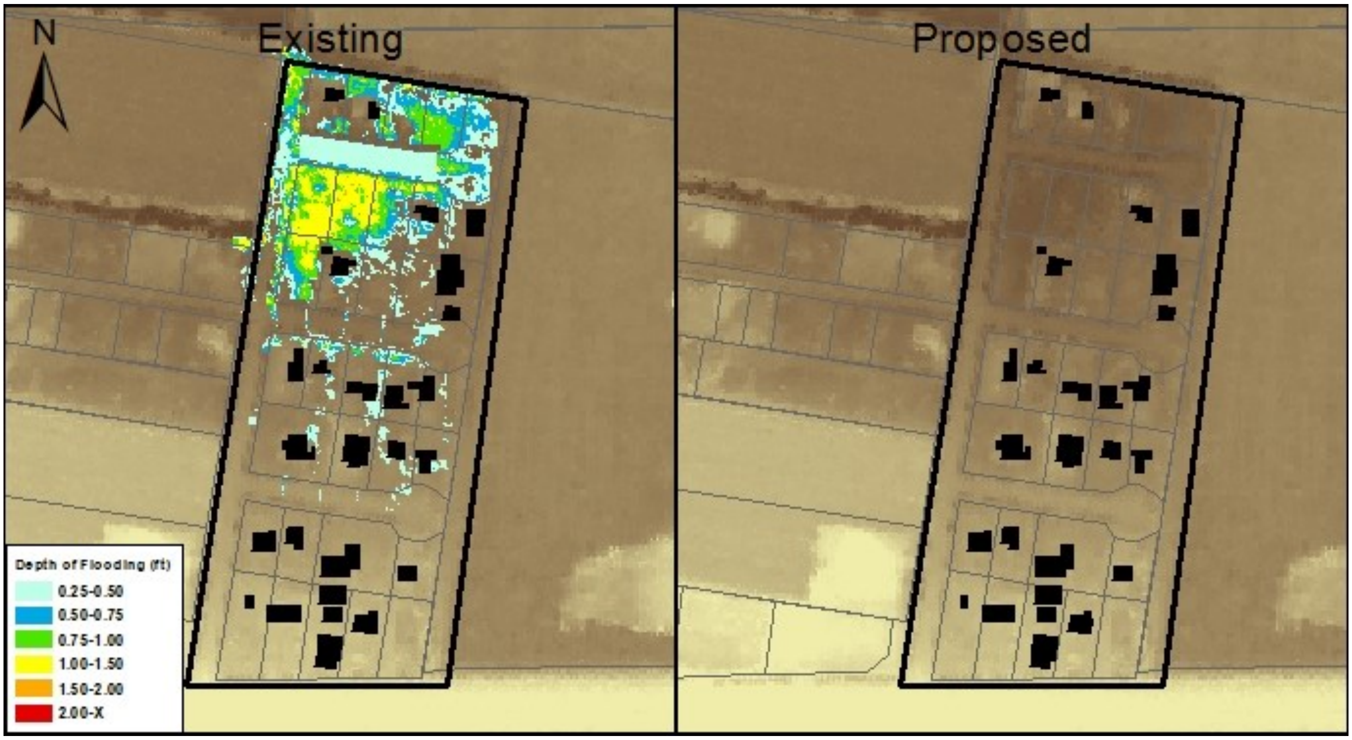


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	1	0	1
Inundated Lots	23	0	23
Inundated Roadway (LF)	669	0	669

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Rankin Subd., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

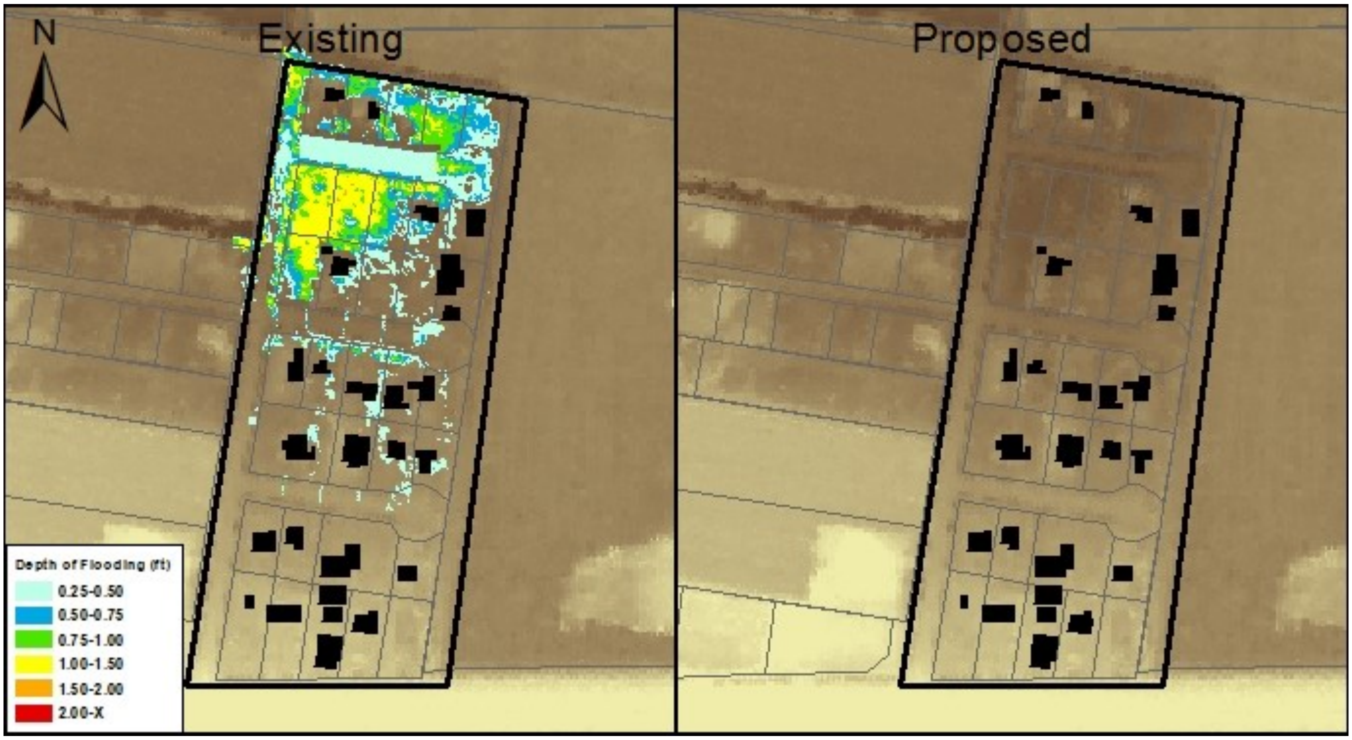


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	24	0	24
Inundated Roadway (LF)	669	0	669

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Rankin Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

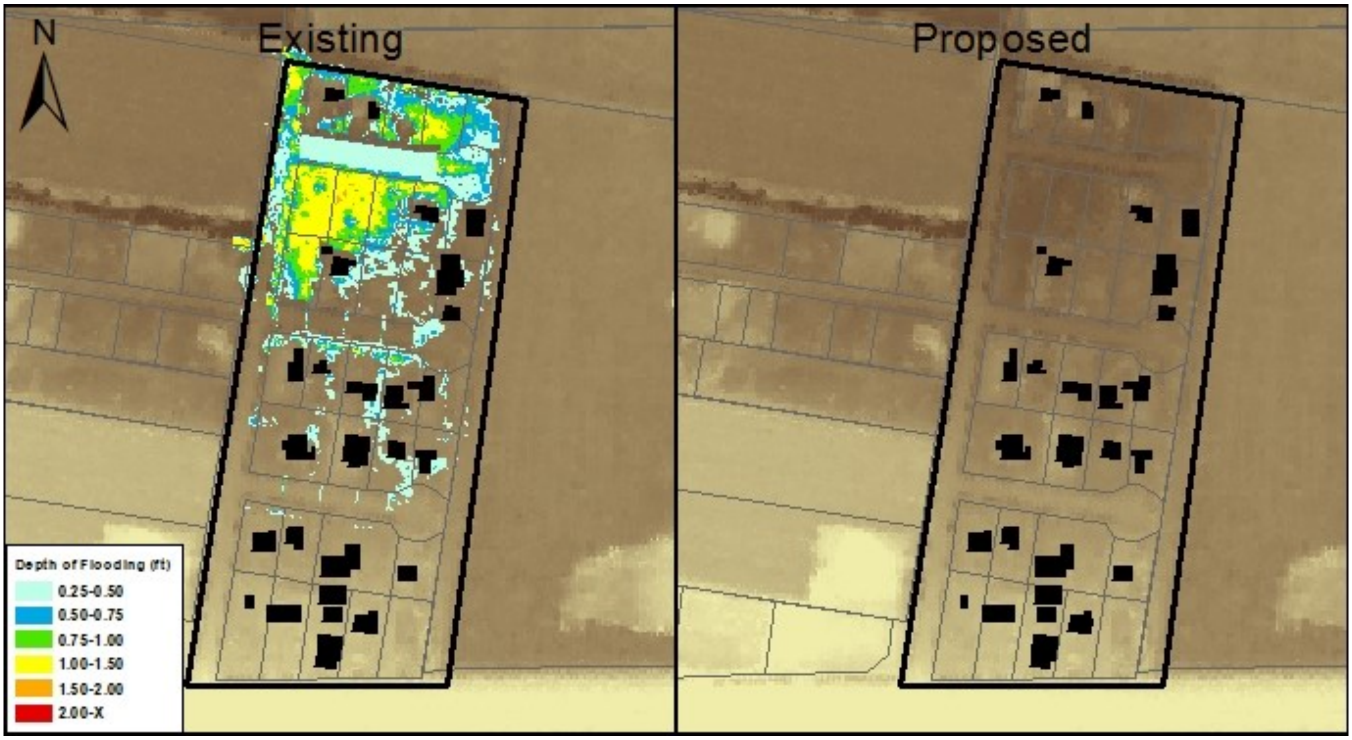


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	27	0	27
Inundated Roadway (LF)	675	0	675

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Rankin Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- RANKIN SUBD.
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

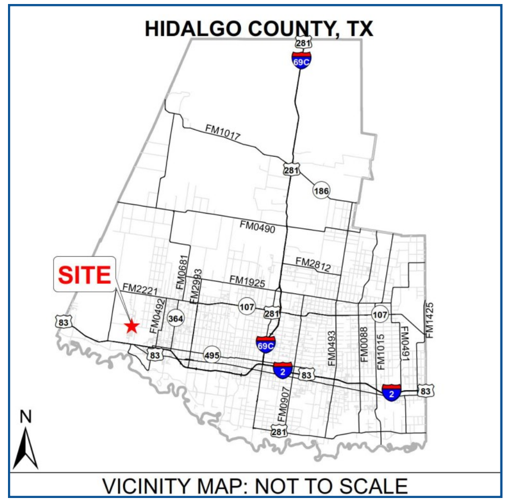
Colonia: Reina Subd., Hidalgo County

Basin: Rio Grande

Category: B1

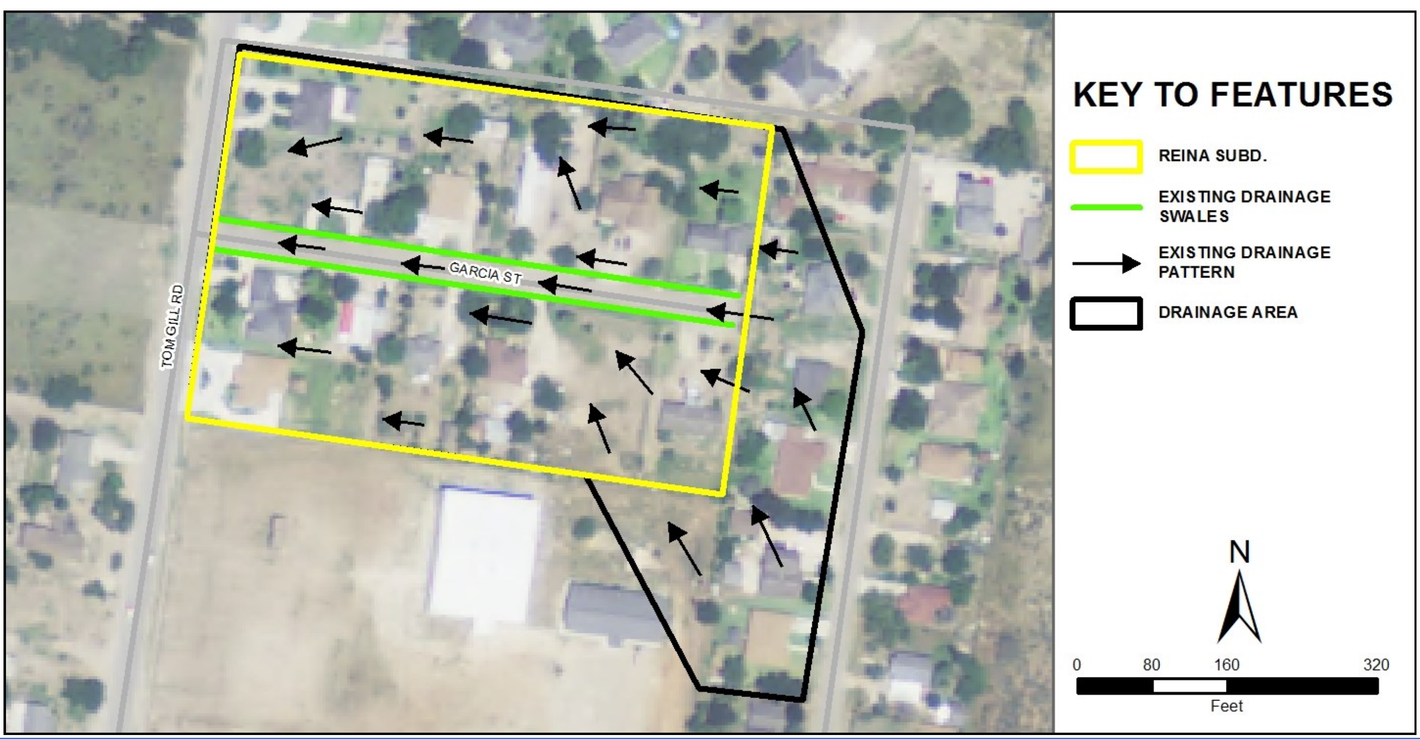
Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia Reina Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Reina Subd. consists of approximately 5.2 acres of fully developed residential land with an offsite drainage area of approximately 1.8 acres of fully developed residential land. Currently the colonia only appears to have roadside swales that are too shallow and eroded to provide adequate drainage. The existing drainage pattern indicates runoff flows west toward Tom Gill Road. Based on the existing conditions 2D model results and estimated finished floor elevations for the structures, it was determined that no structure is at high risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Reina Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Install roadside swales with culverts to convey runoff to a retention pond.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:

The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite and offsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 552 linear feet of 18-inch diameter pipe, 60 linear feet of 24-inch diameter pipe, four curb inlets, and a manhole. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 2.7 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
REINA SUBD.		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$126,406.33
2	Drainage Improvements	$49,660.00
3	Pond Excavation Improvements	$72,597.95
	Sub-Total =	**$248,664.28**
	Engineering Fees (10%) =	**$24,866.43**
	Contingency (20%) =	**$49,732.86**
	Total =	**$323,263.56**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$323,263.56	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

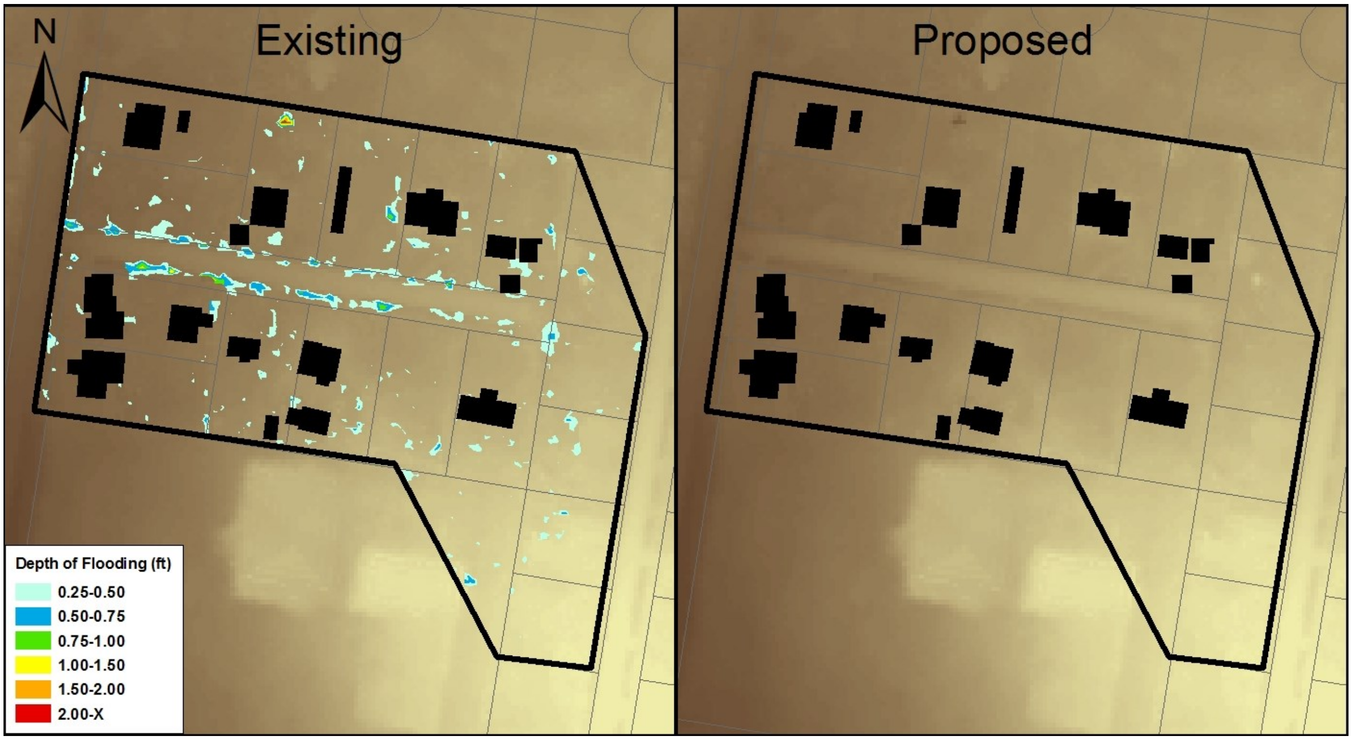


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	12	0	12
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

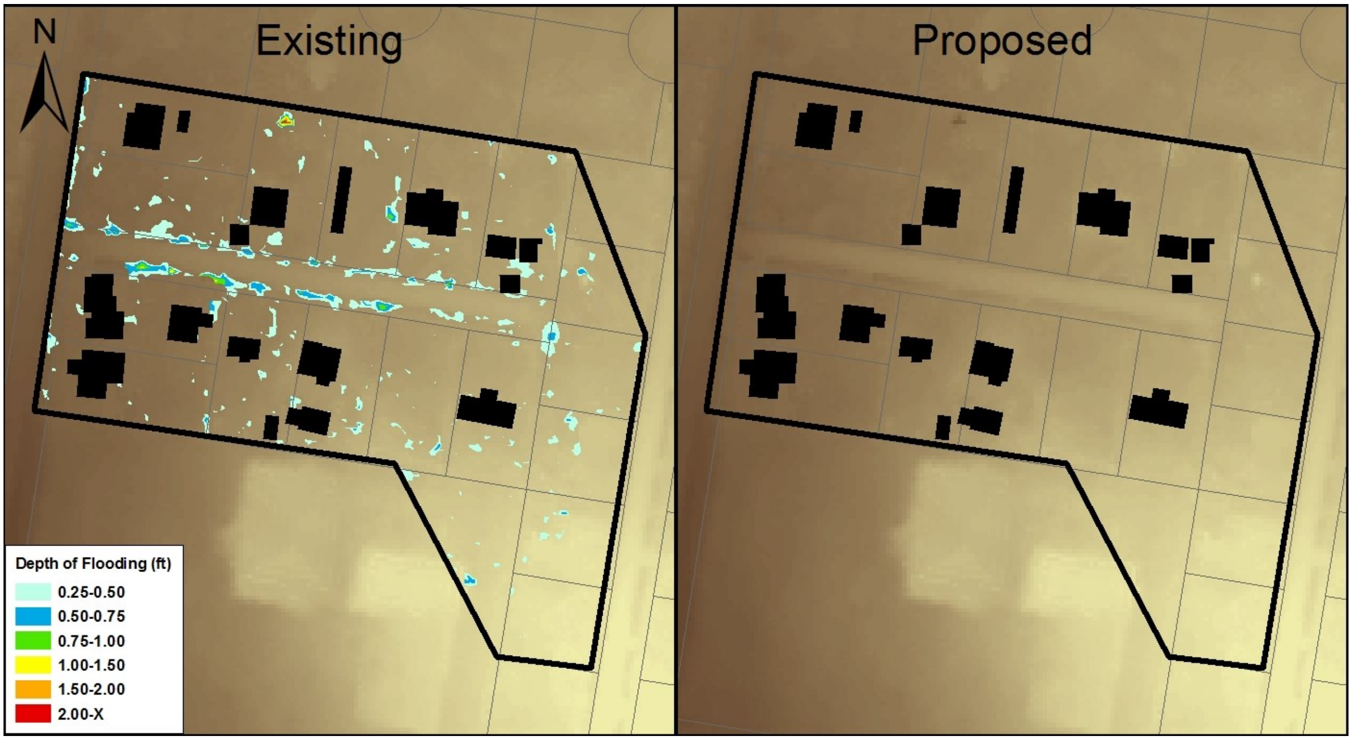


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	12	0	12
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

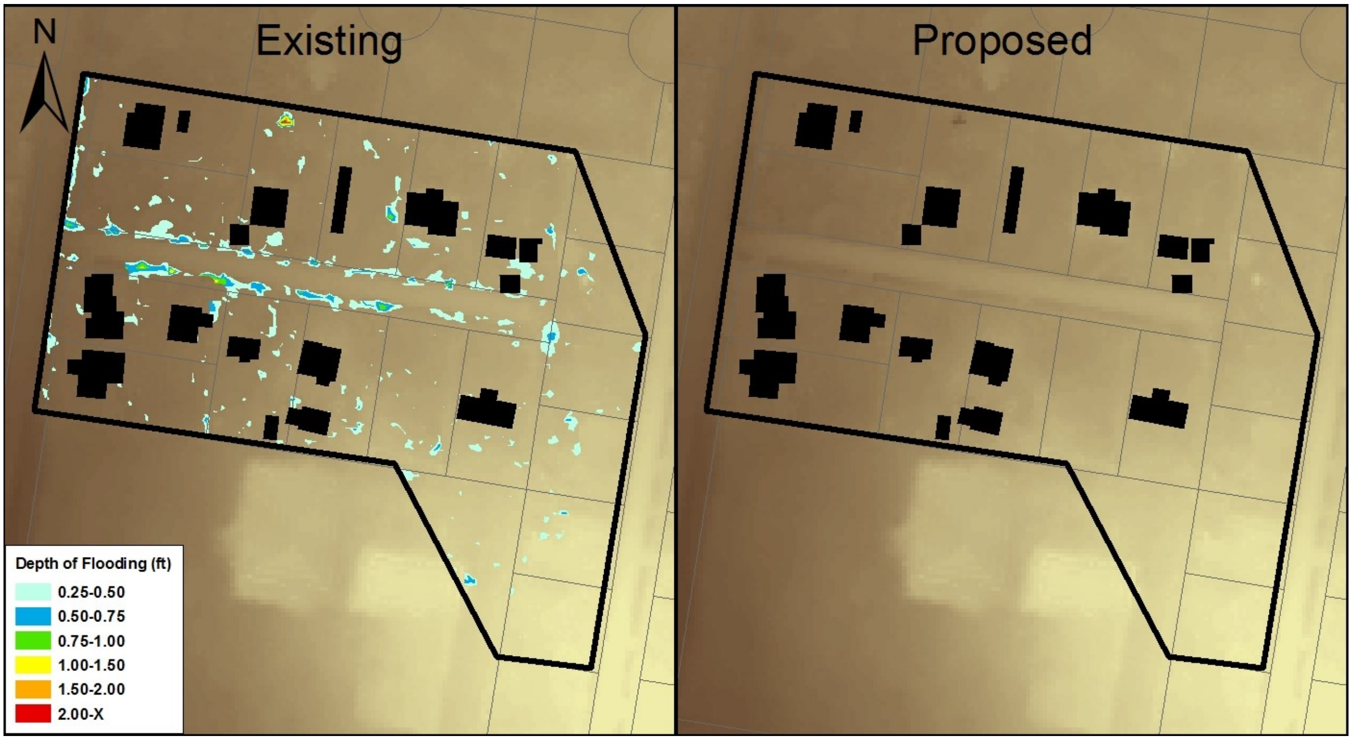


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	12	0	12
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

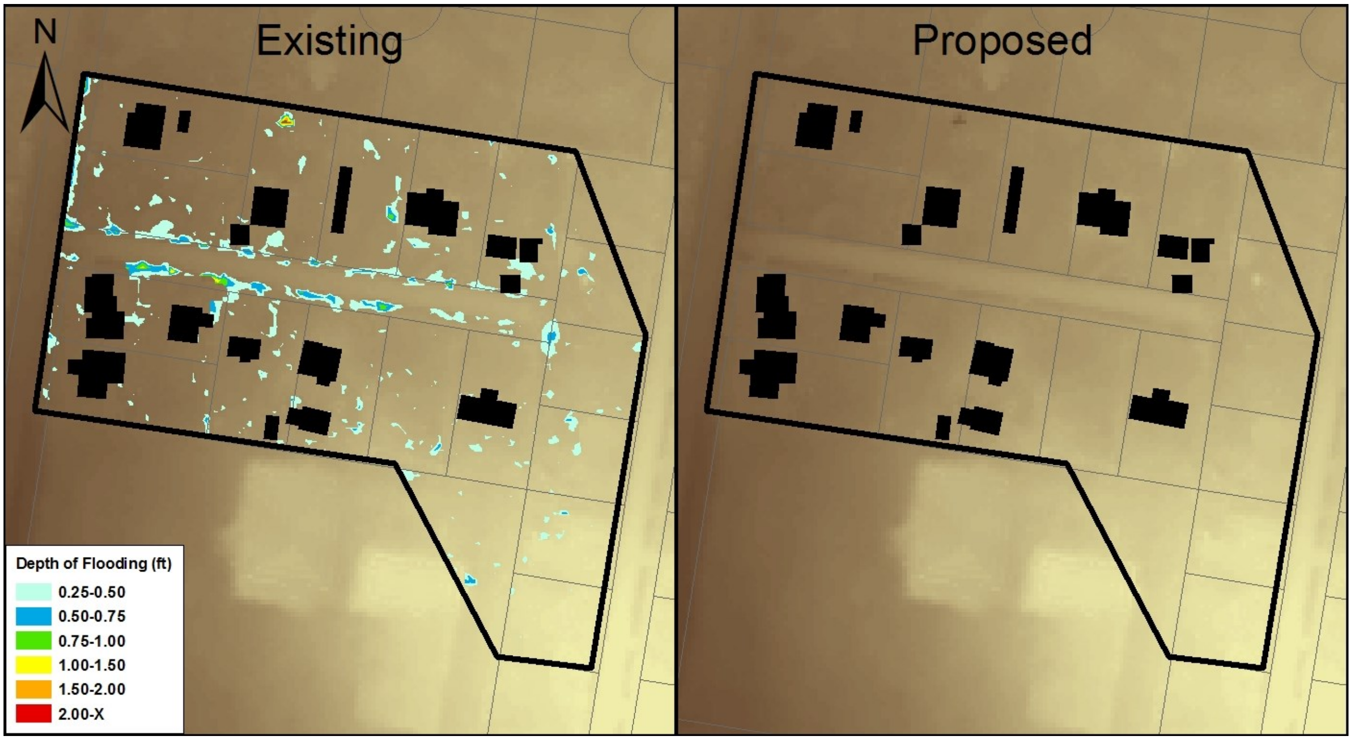


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	12	0	12
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Reina Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

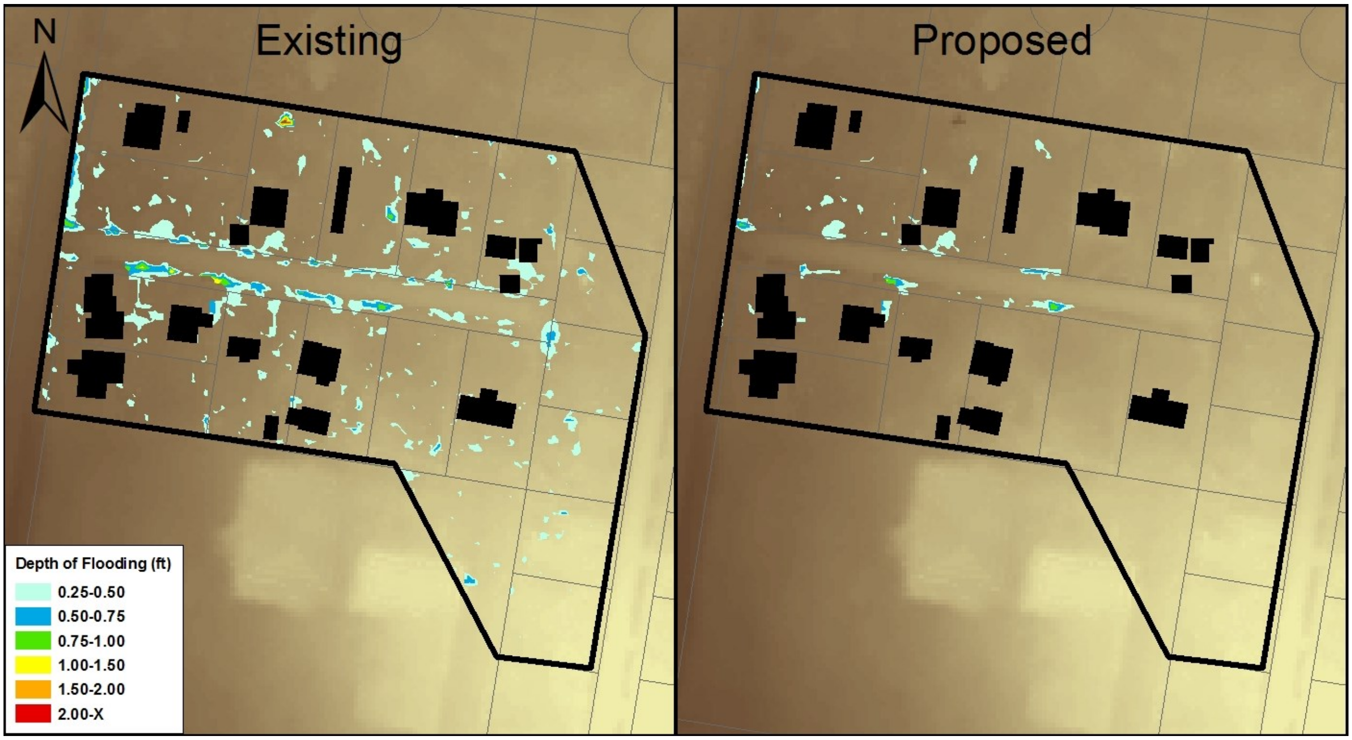
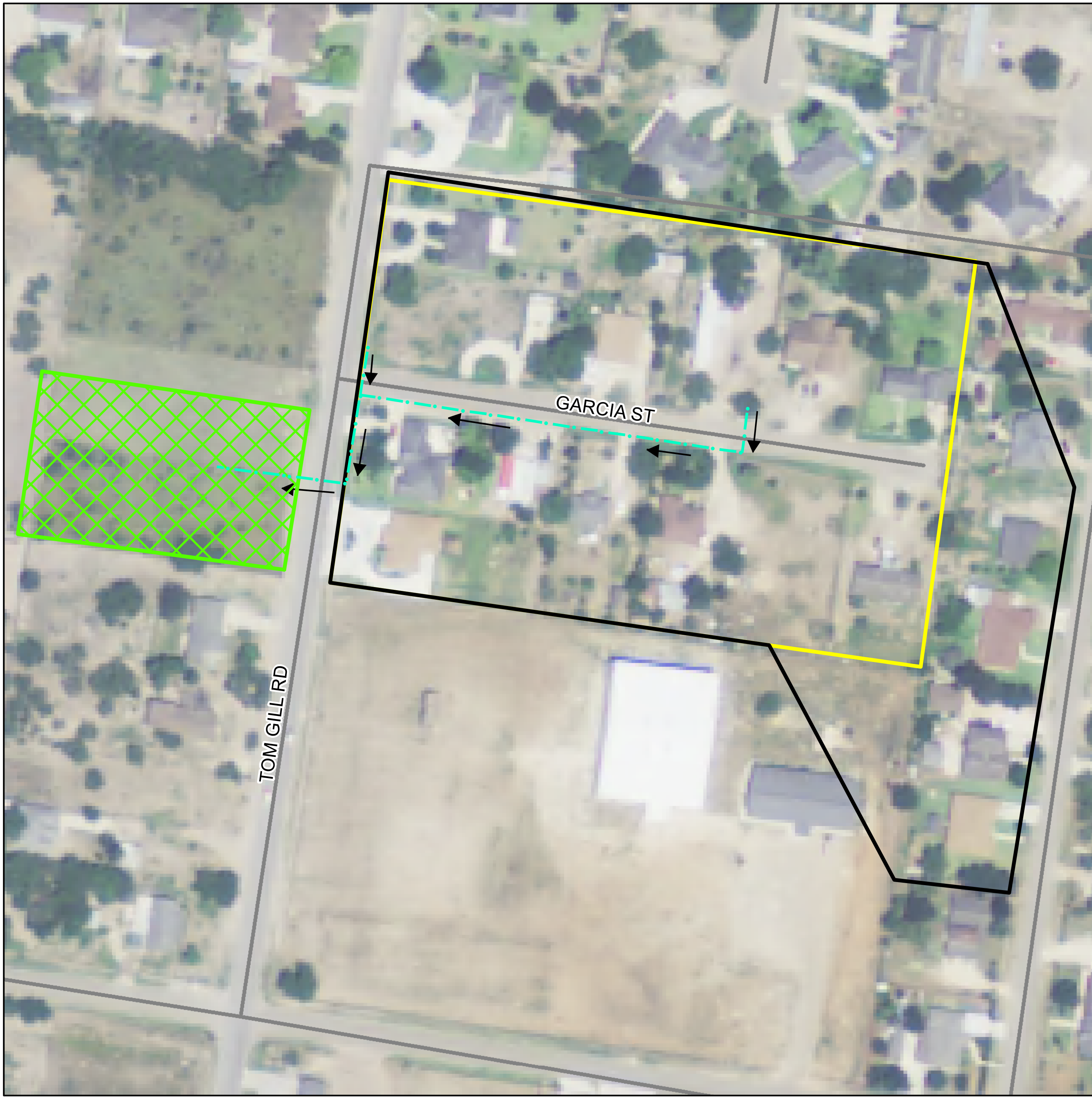


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	12	6	6
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

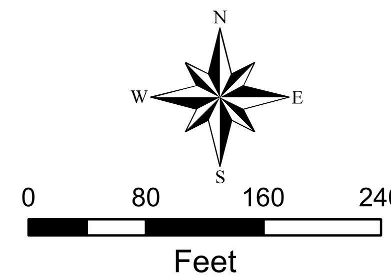
Colonia: Reina Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

STREETS
PROPOSED STORMWATER SYSTEM
PROPOSED DRAINAGE FLOW
REINA SUBD
DRAINAGE AREA
25-YR RETENTION POND
EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Ruthven Subd. #2, Hidalgo County

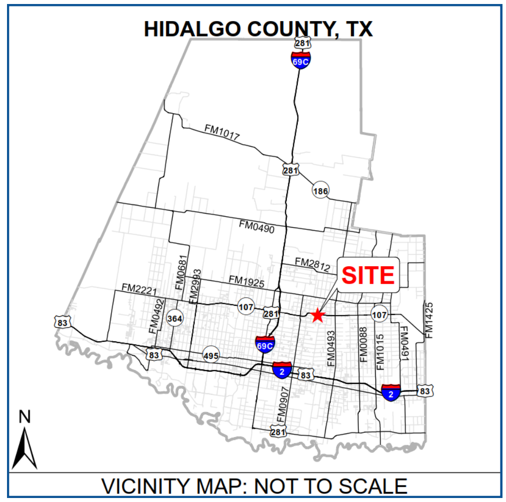
Basin: North Main Drain

Category: B1

"Filling the Gap"

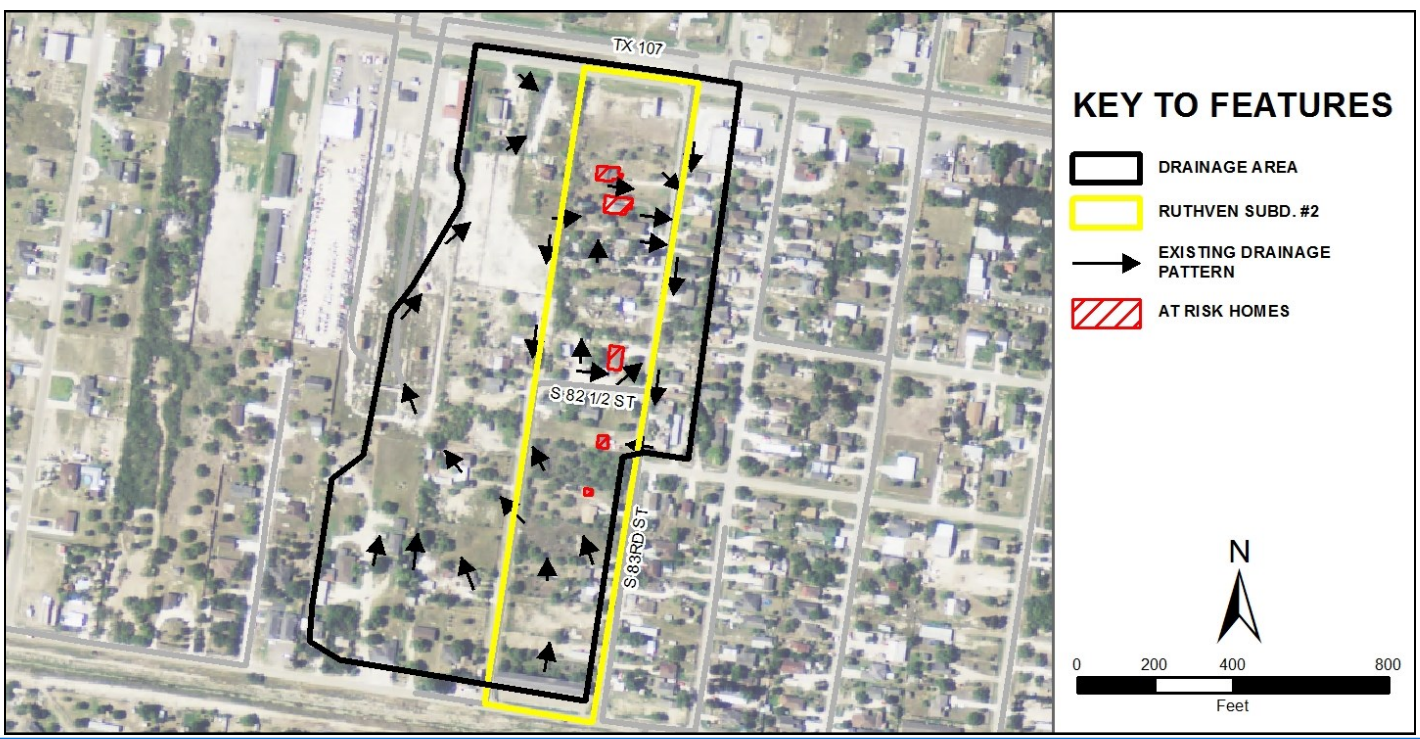
Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia Ruthven Subd. #2 storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Ruthven Subd. #2 consists of approximately 11 acres of fully developed residential land with an offsite drainage area of approximately 16 acres of fully developed residential land. The existing drainage system consist of culverts and swales, however most of the swales and culverts are partially or completely filled. The existing drainage pattern indicates runoff flows northwest through the south portion of the colonia and back east at the north end of the colonia. Based on the existing conditions 2D model results, structures along the north side of the colonia appear to be at risk of flooding. It should be noted that providing drainage improvements to this colonia would also benefit Ruthven #1, however the benefit to cost ratio was only calculated for this colonia. A regional design approach should be evaluated for these two colonias. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Ruthven Subd. #2, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install an underground drainage system to outfall into the existing drainage ditch.
  - Take a regional design approach to address the offsite drainage basin.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite and offsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 164 linear feet of 18-inch diameter pipe, 811 linear feet of 24-inch diameter pipe, 431 linear feet of 30-inch diameter pipe, 215 linear feet of 42-inch diameter pipe, and seven curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 11.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST		
RUTHVEN SUBD. #2		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$176,545.00
2	Drainage Improvements	$135,280.00
3	Pond Excavation Improvements	$307,764.55
	Sub-Total =	**$619,589.55**
	Engineering Fees (10%) =	**$61,958.96**
	Contingency (20%) =	**$123,917.91**
	Total =	**$805,466.42**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost w ere developed using bid tabulations from projects w ithin the Rio Grande Valley. The unit prices w ere taken from projects that w ere bid in the years 2014-2015.	

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	2	0	2
20% (5-year)	3	0	3
10% (10-year)	4	0	4
4% (25-year)	4	0	4
1% (100-year)	5	2	3

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,626,735.00	$805,466.42	3.26
Elevate Structures	$2,626,735.00	$438,000.00	6.00
Acquisition/Supplemental Housing / Demolition	$2,731,096.00	$528,604.10	5.17

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

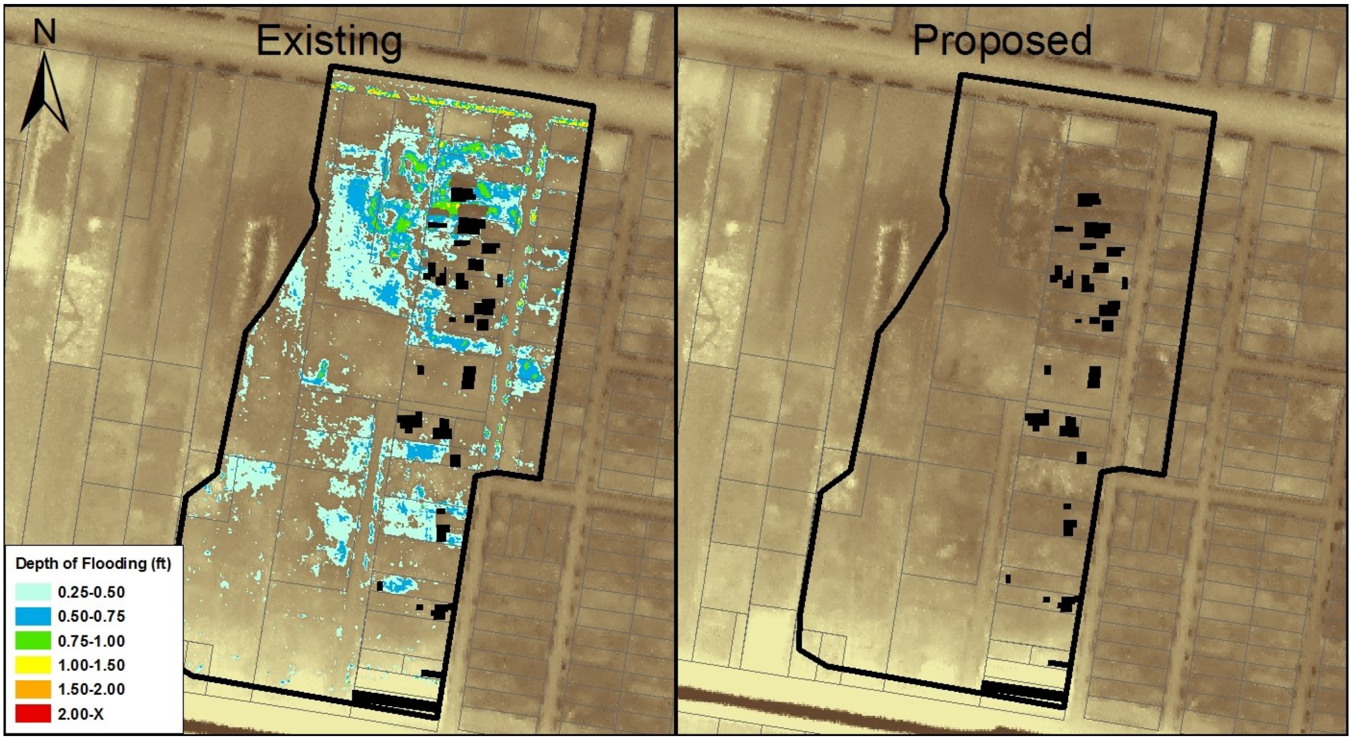


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	2	0	2
Inundated Lots	26	0	26
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

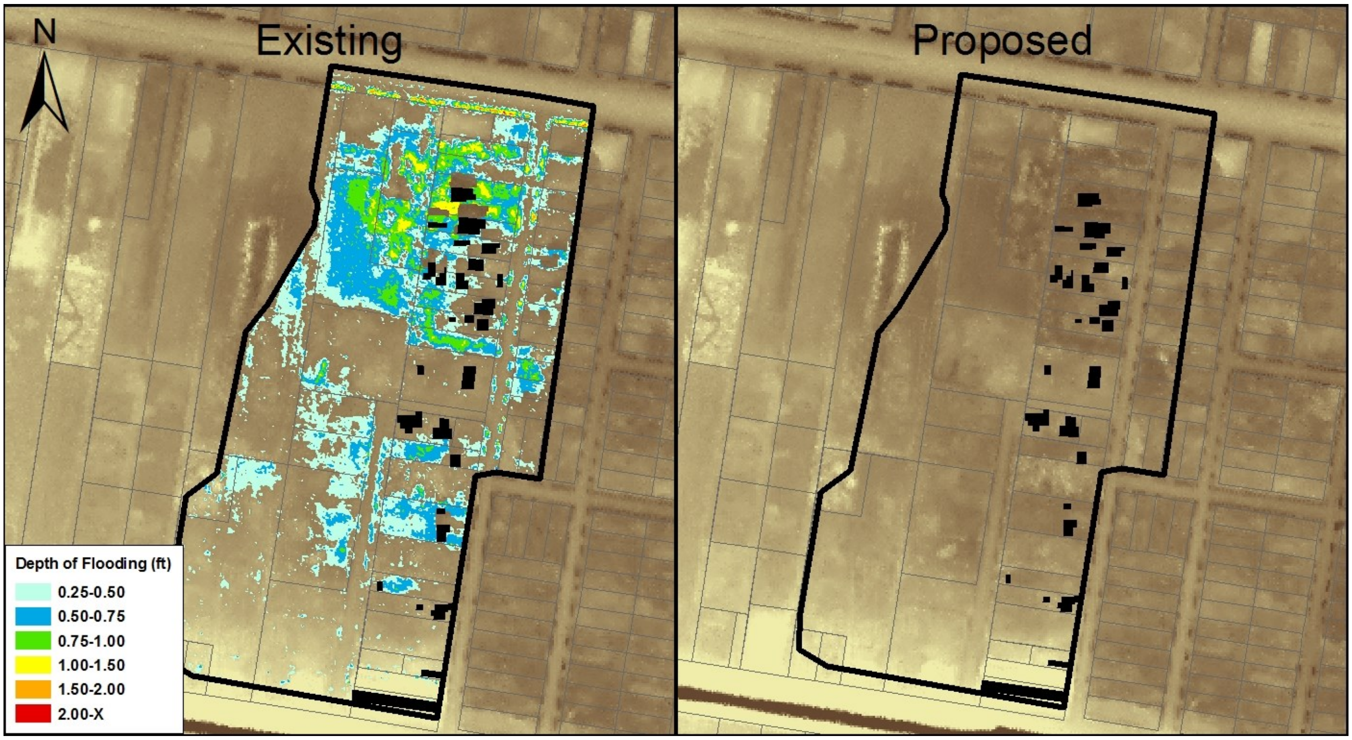


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	26	0	26
Inundated Roadway (LF)	10	0	10

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

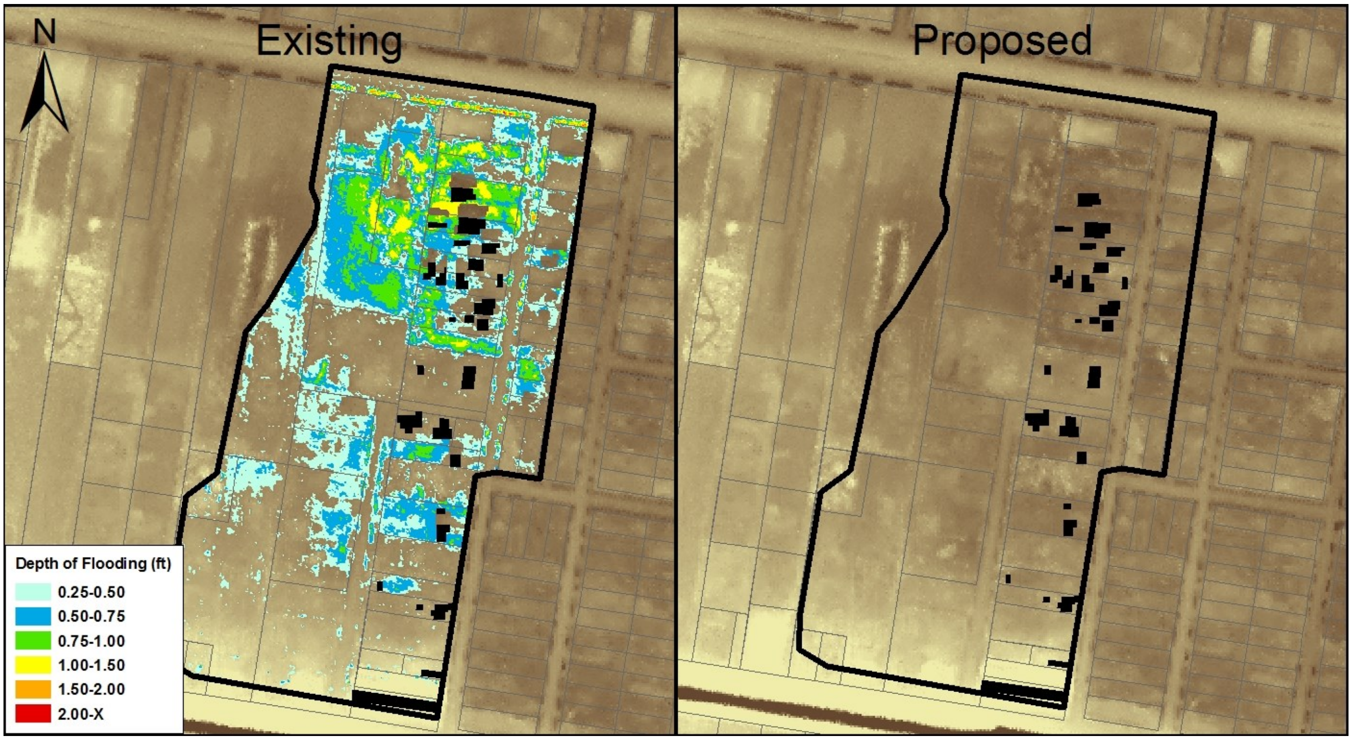


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	26	0	26
Inundated Roadway (LF)	92	0	92

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

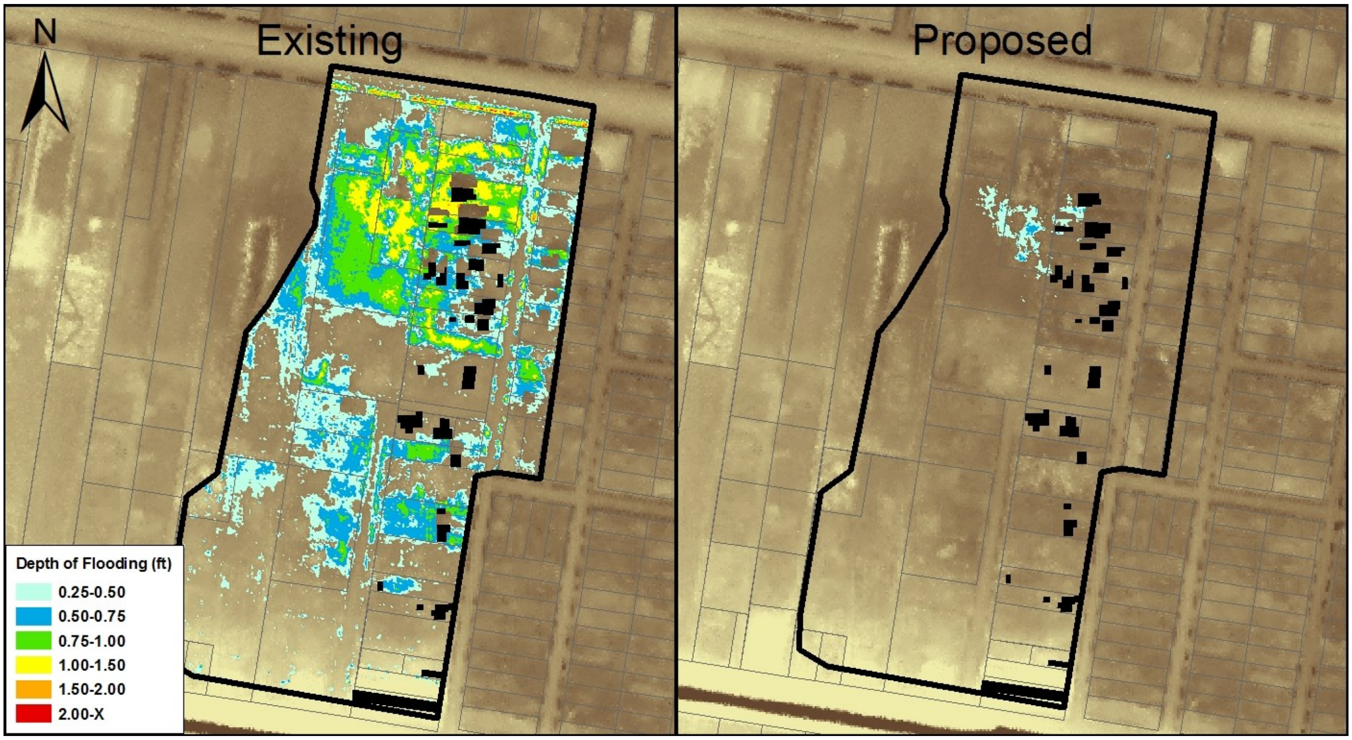


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	26	6	20
Inundated Roadway (LF)	270	0	270

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Ruthven Subd. #2, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

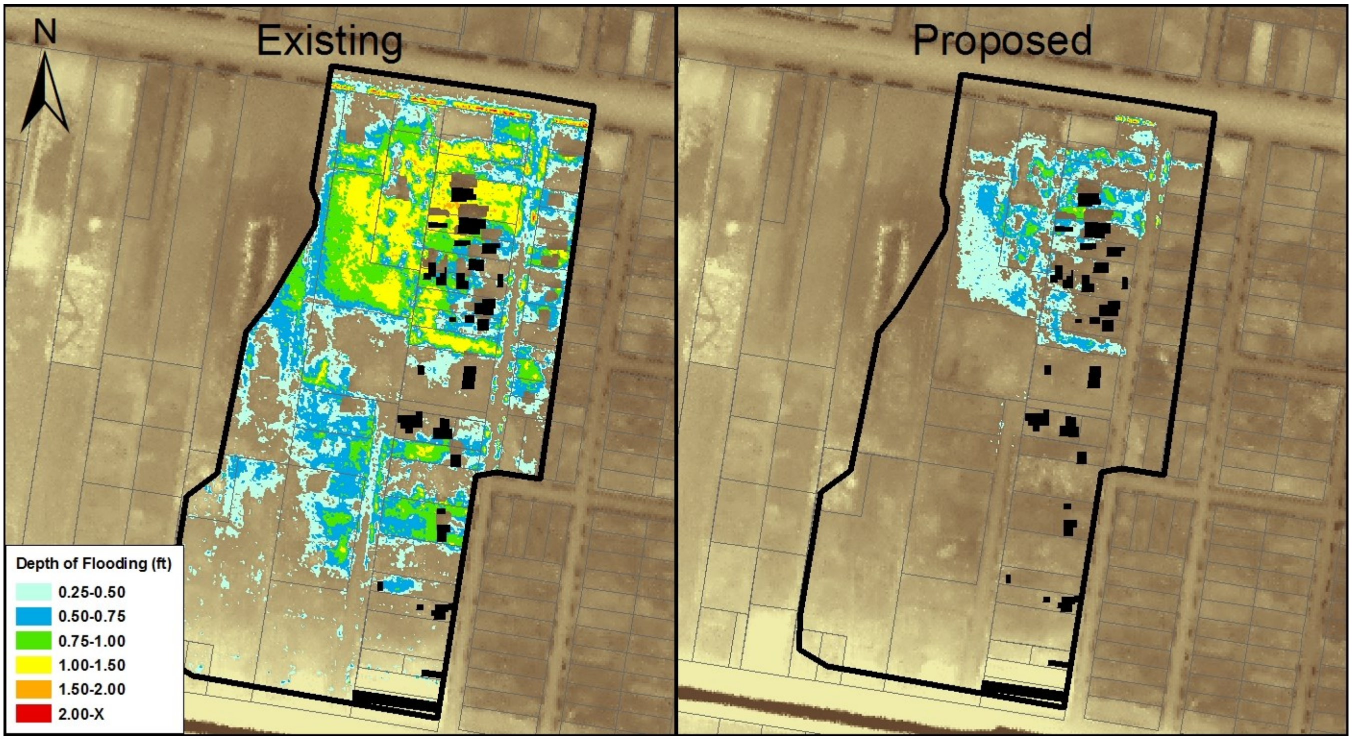
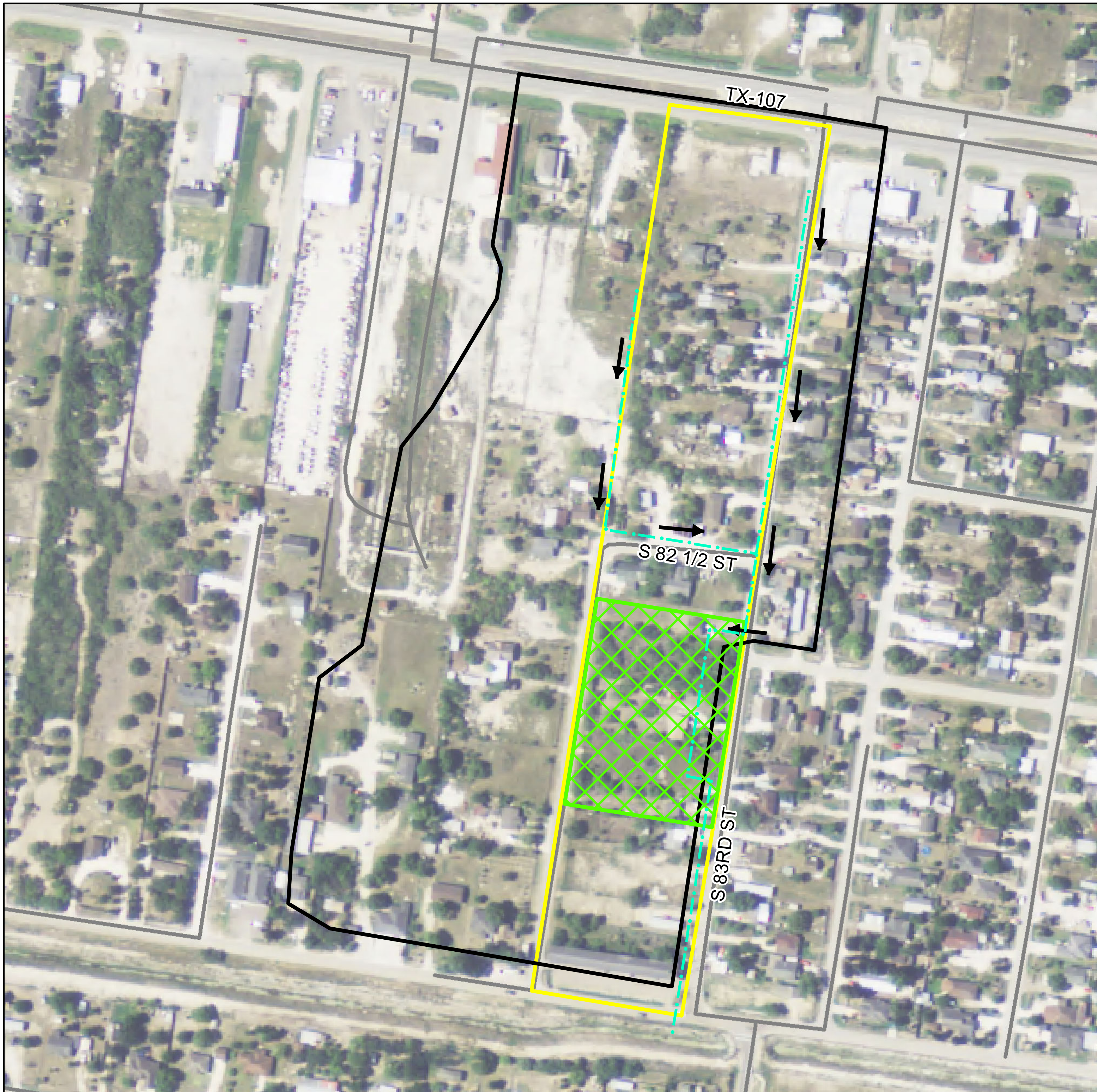


Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	5	2	3
Inundated Lots	26	12	14
Inundated Roadway (LF)	334	0	334

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Ruthven Subd. #2
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- RUTHVEN SUBD. #2
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

N E S W

0 160 320 480
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

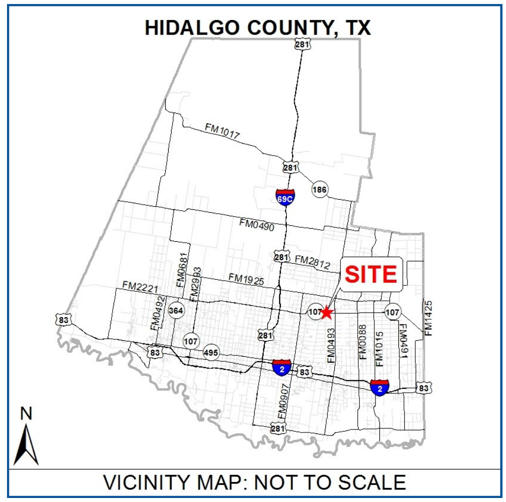
"Filling the Gap"

Colonia: Southern Breeze Subd., Hidalgo County

Basin: North Main Drain

Category: B1

Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Southern Breeze Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Southern Breeze Subd. consists of approximately 16 acres of fully developed residential land. The existing drainage system consists of swales and culvers that do not appear to have an outfall. The existing drainage pattern indicates runoff flows toward the northeast corner of the colonia. The existing conditions 2D model results indicate some structures are at risk of flooding from a localized storm event. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.

Colonia: Southern Breeze Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Replace plugged culverts to allow maximum conveyance toward a new retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 2,236 linear feet of 24-inch diameter pipe, 172 linear feet of 30-inch diameter pipe, and twelve curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
SOUTHERN BREEZE SUBD

	IMPROVEMENTS	COST
1	Paving Improvements	$671,773.33
2	Drainage Improvements	$222,952.00
3	Pond Excavation Improvements	$108,579.55
	Sub-Total =	**$1,003,304.88**
	Engineering Fees (10%) =	**$100,330.49**
	Contingency (20%) =	**$200,660.98**
	Total =	**$1,304,296.34**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Southern Breeze Subd., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	8	0	8
20% (5-year)	12	0	12
10% (10-year)	13	0	13
4% (25-year)	13	0	13
1% (100-year)	13	4	9

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$5,201,847.00	$1,304,296.34	3.99
Elevate Structures	$5,201,847.00	$1,088,475.00	4.78
Acquisition/Supplemental Housing / Demolition	$5,417,935.00	$1,279,441.80	4.23

Colonia: Southern Breeze Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

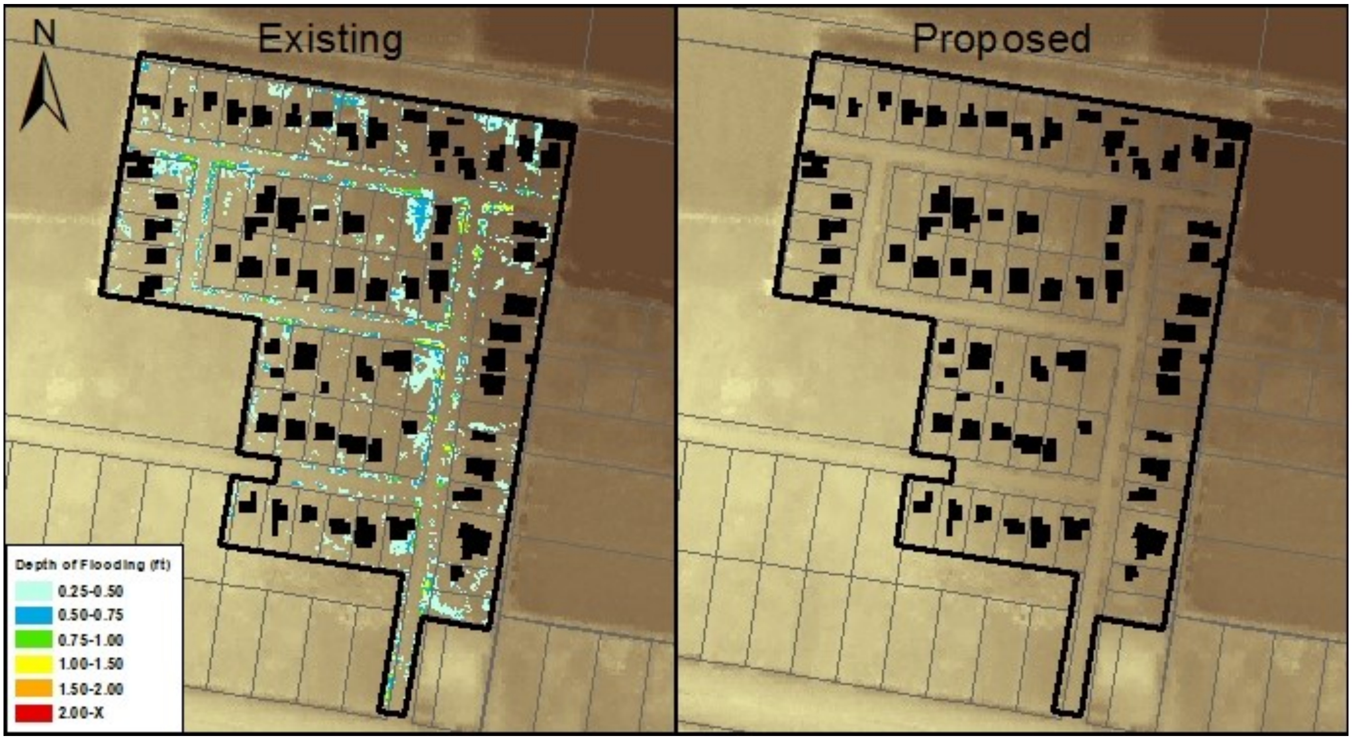


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	68	0	68
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Southern Breeze Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

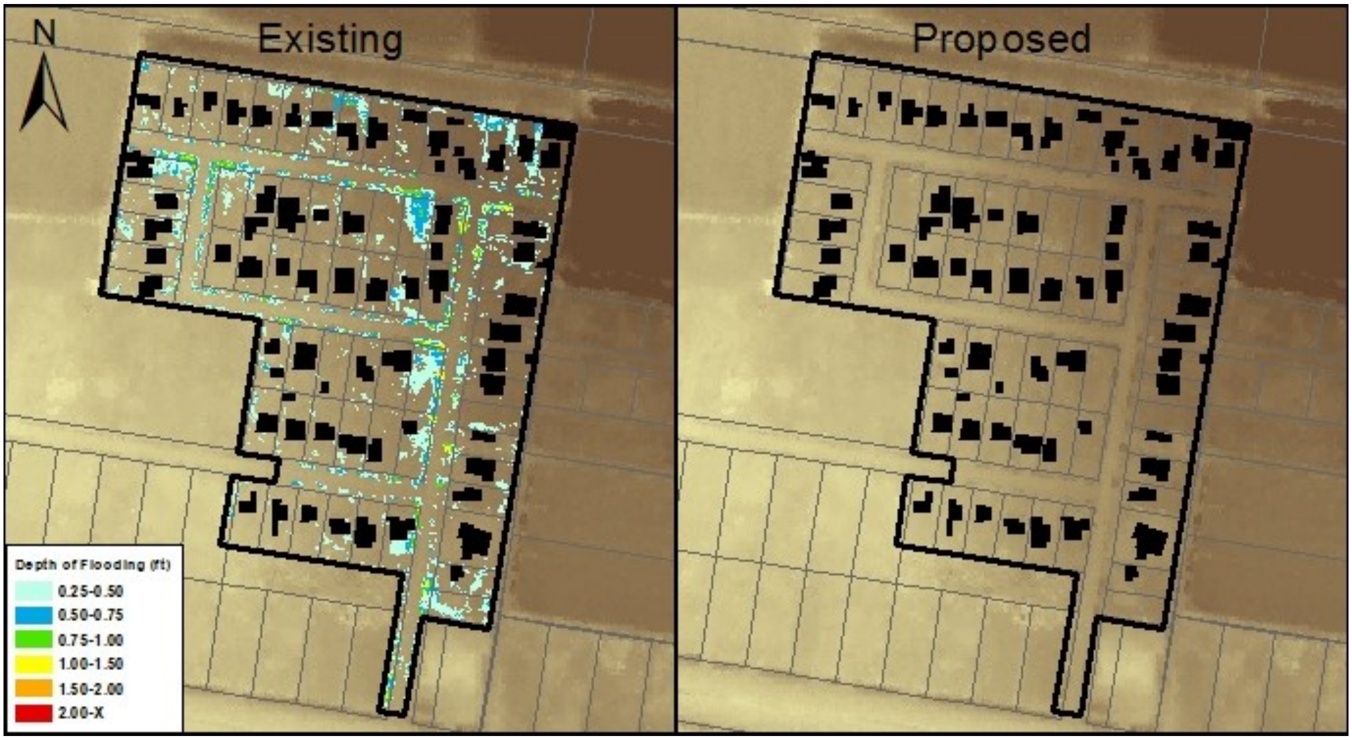


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	0	12
Inundated Lots	68	0	68
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Southern Breeze Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

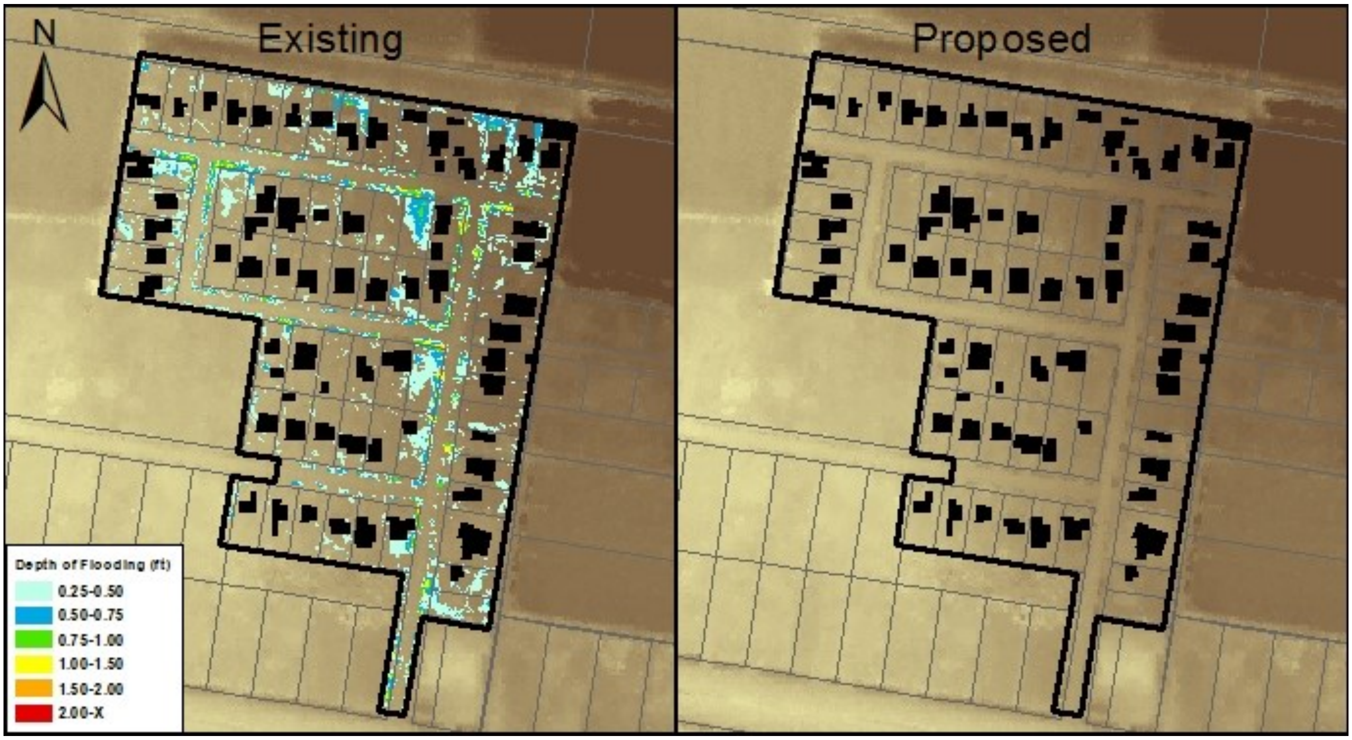


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	13	0	13
Inundated Lots	68	0	68
Inundated Roadway (LF)	0	0	0

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Southern Breeze Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

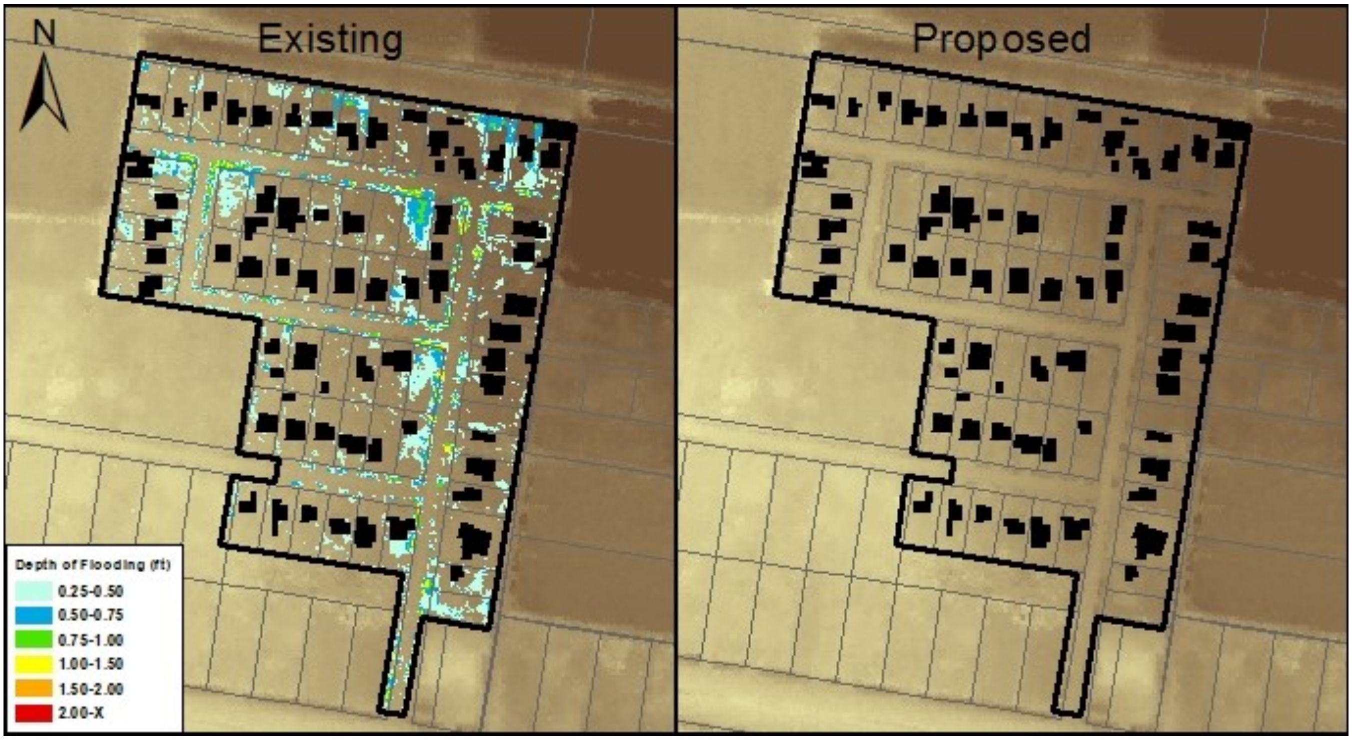


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	13	0	13
Inundated Lots	68	0	68
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Southern Breeze Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

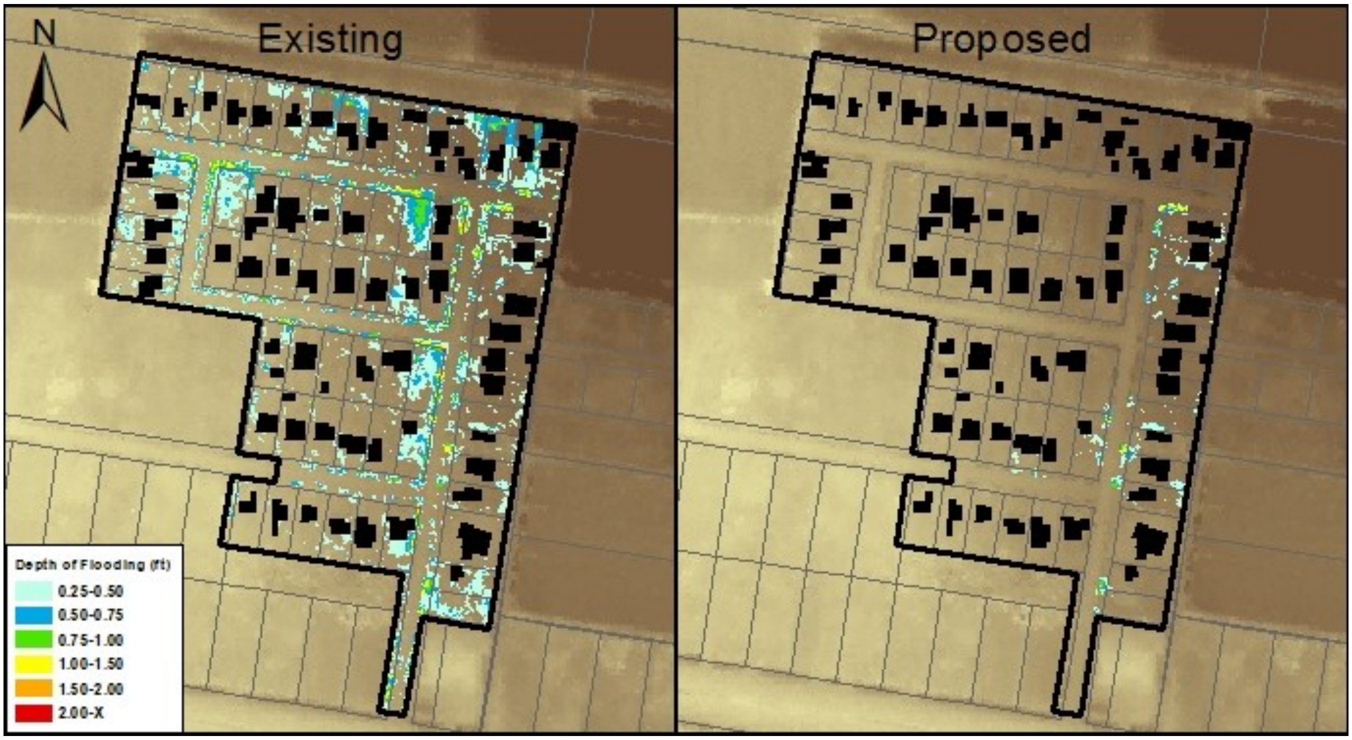


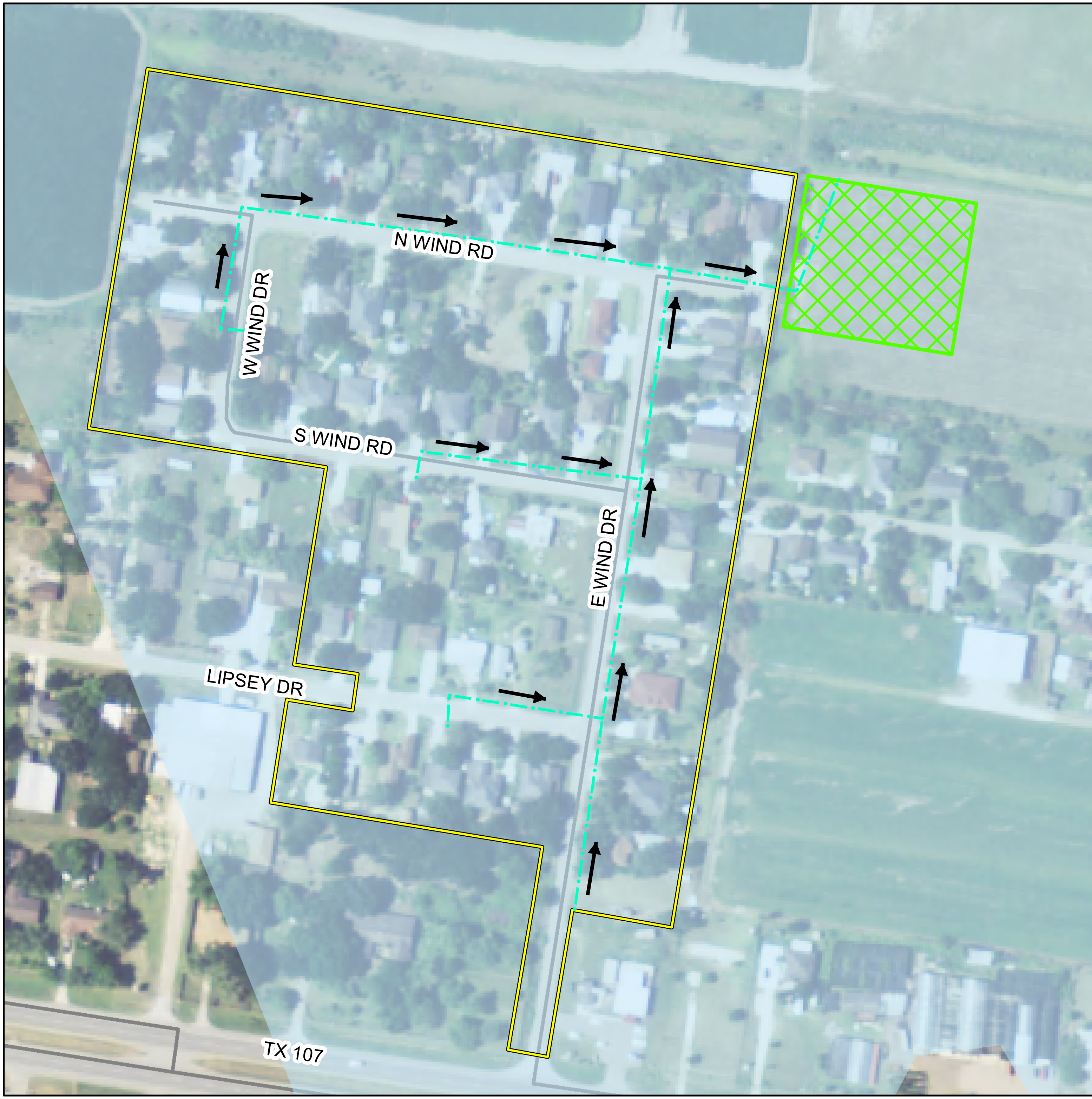
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	13	4	9
Inundated Lots	68	16	52
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

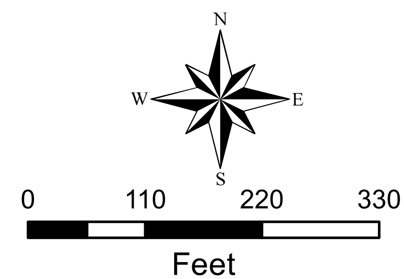
Colonia: Southern Breeze Subd
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- SOUTHERN BREEZE SUBD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

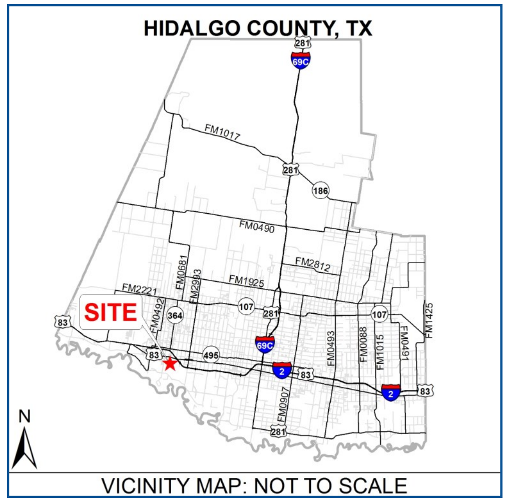
Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Basin: Upper Arroyo Colorado

Category: B1

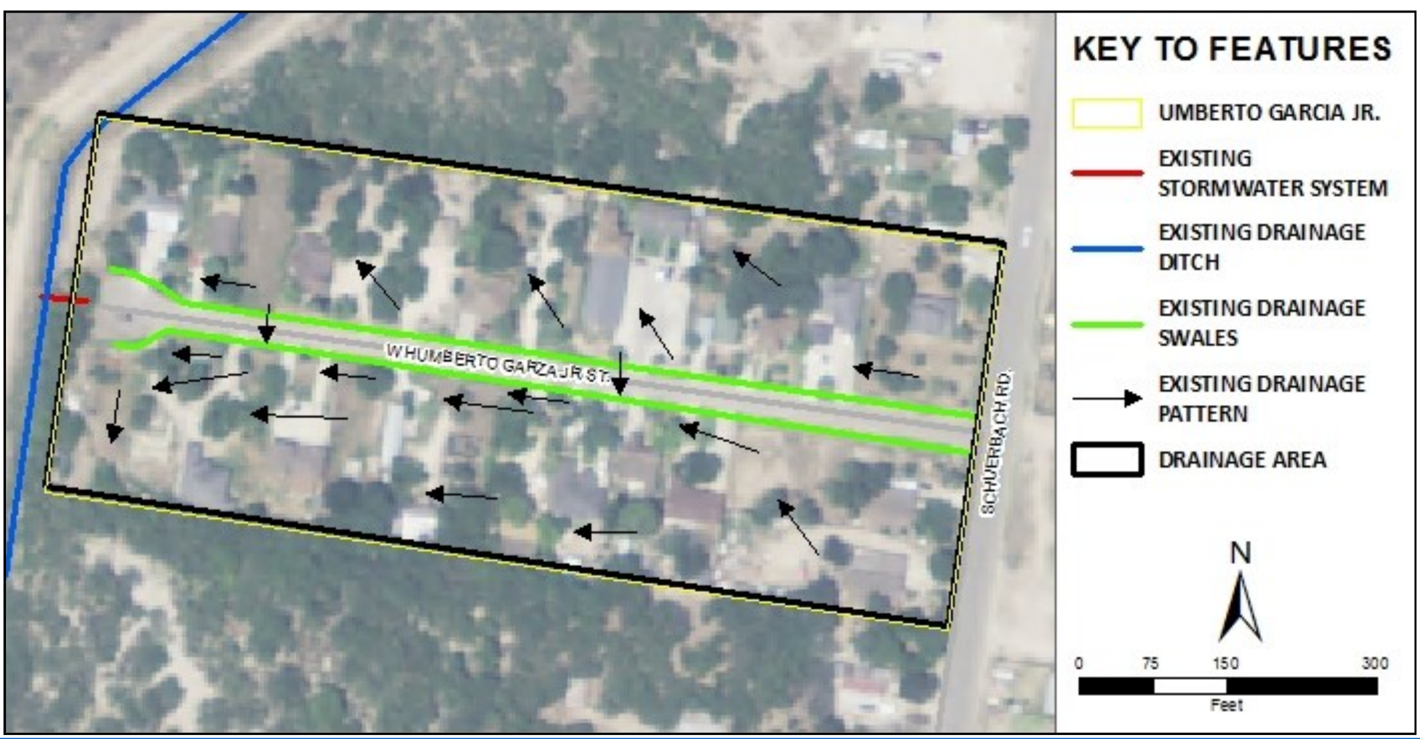
Hydrology / Hydraulic Analysis:

A 2-dimensional hydrodynamic model of the colonia Umberto Garcia Jr. Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Umberto Garcia Jr. Subd. consists of approximately 8 acres of fully developed residential land. The existing drainage system consists of swales and culverts that outfall into an existing drainage ditch via a 36-inch diameter pipe at the west end of the colonia. The existing drainage pattern indicates runoff flows toward the west. Based on the existing conditions 2D model results and estimated finished floor elevations for the structures, it was determined that no structure is at high risk of flooding from a localized storm event. However, this colonia should also be evaluated for risk of flooding due to regional storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Umberto Garcia Jr. Subd., Hidalgo County

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Regrade swales to allow maximum conveyance toward the outfall pipe.
  - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 80 linear feet of 18-inch diameter pipe, 620 linear feet of 24-inch diameter pipe, and five curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 3.5 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in less overall ponding and the street is at lower risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST UMBERTO GARCIA JR		
	IMPROVEMENTS	**COST**
1	Paving Improvements	$158,425.00
2	Drainage Improvements	$62,360.00
3	Pond Excavation Improvements	$95,215.91
	Sub-Total =	**$316,000.91**
	Engineering Fees (10%) =	**$31,600.09**
	Contingency (20%) =	**$63,200.18**
	Total =	**$410,801.18**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	0	0	0
10% (10-year)	0	0	0
4% (25-year)	0	0	0
1% (100-year)	0	0	0

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project. Based on this analysis, flooding within this colonia is limited to streets and properties with no inundation of structures, and therefore, a benefit-cost ratio is not able to be computed. The recommended mitigation project is intended to minimize localized flooding in streets and properties within the colonia.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$0	$410,801.18	N/A
Elevate Structures	$0	N/A	N/A
Acquisition/Supplemental Housing / Demolition	$0	N/A	N/A

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Figures:

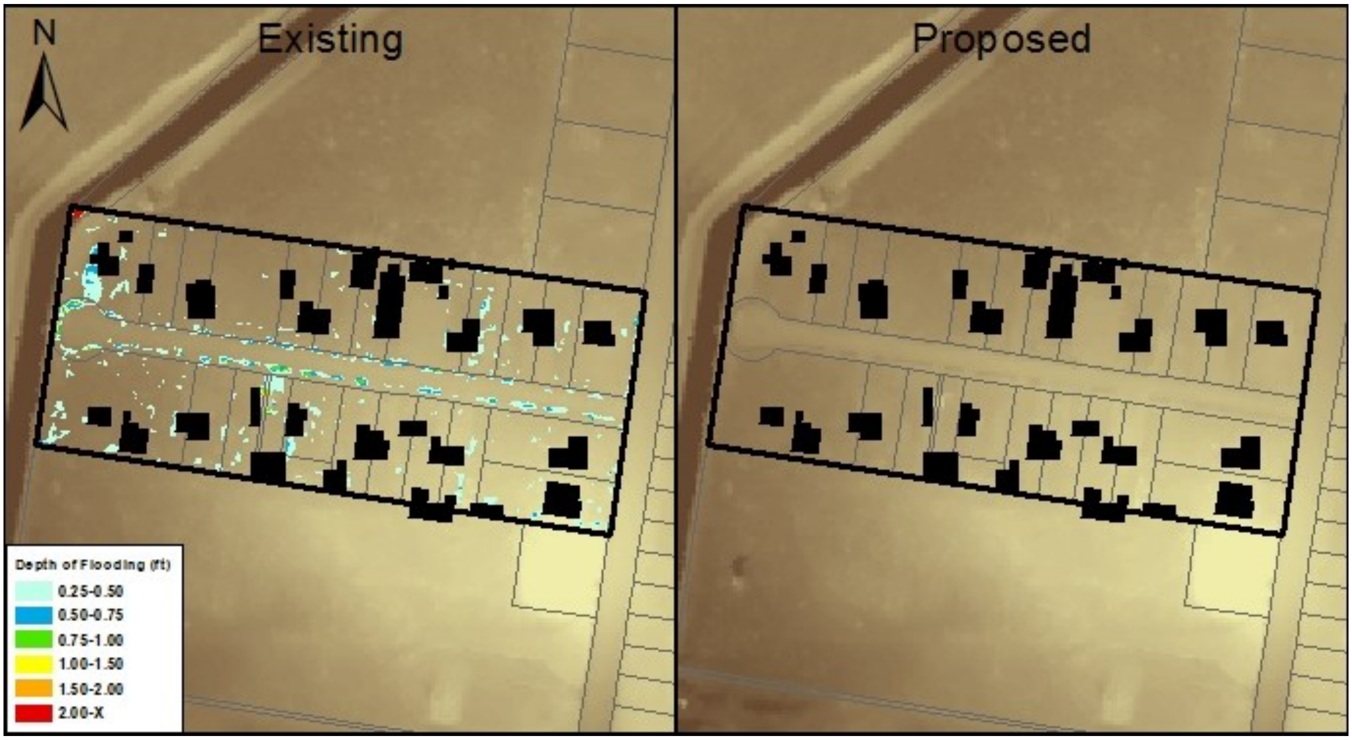


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	23	0	23
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

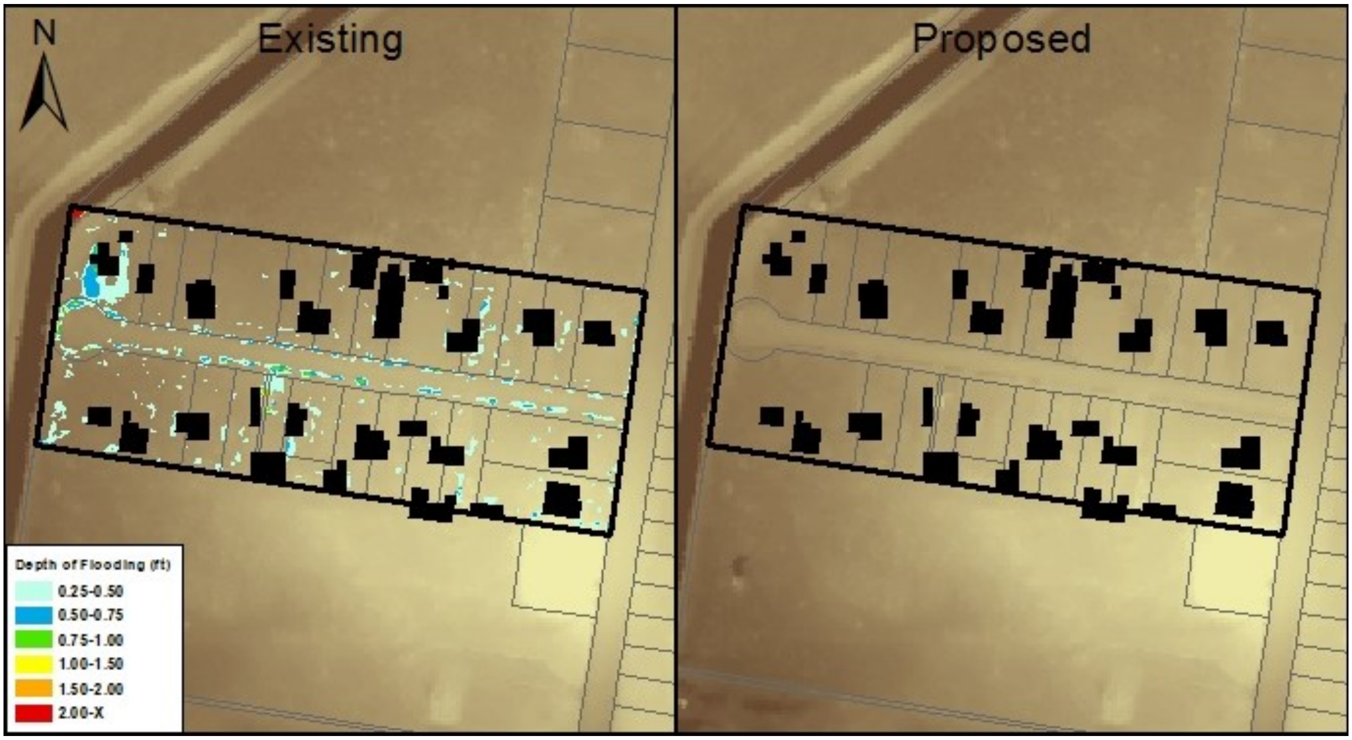


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	23	0	23
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

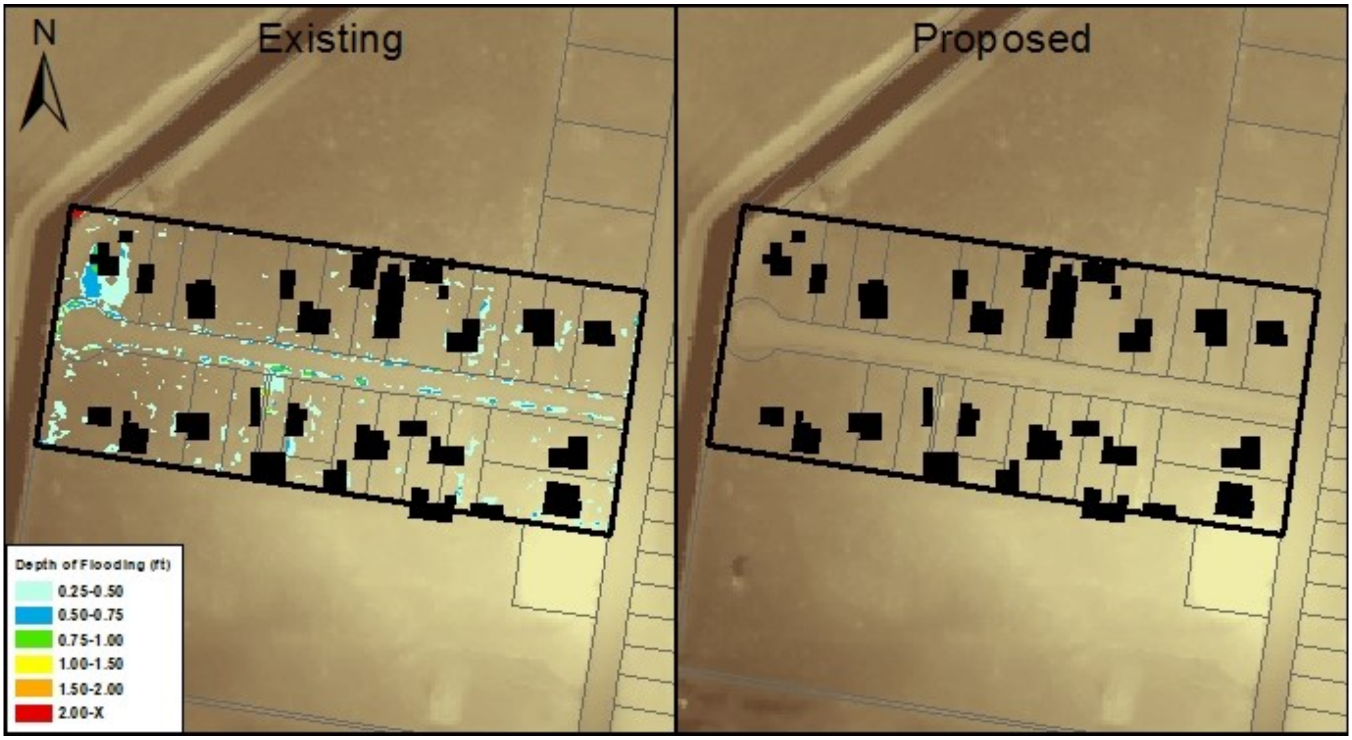


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	23	0	23
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

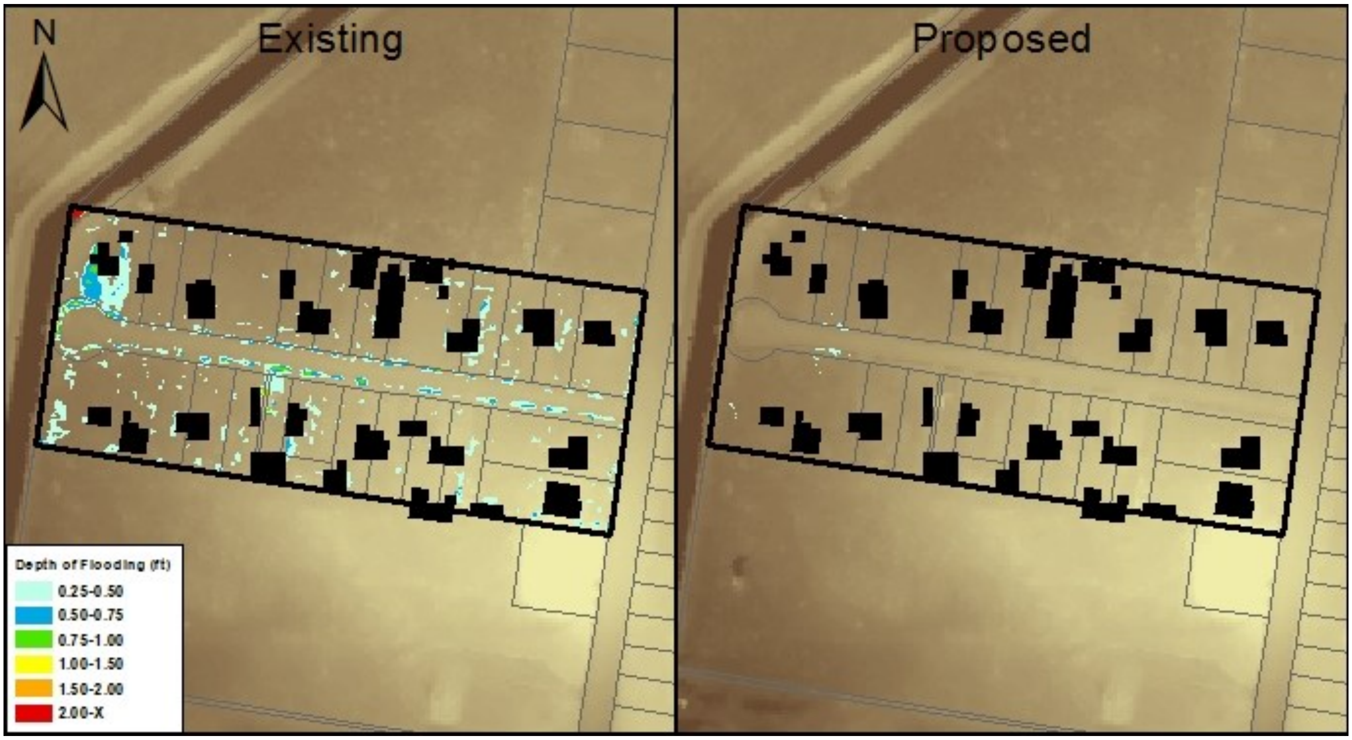


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	23	3	20
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Umberto Garcia Jr. Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

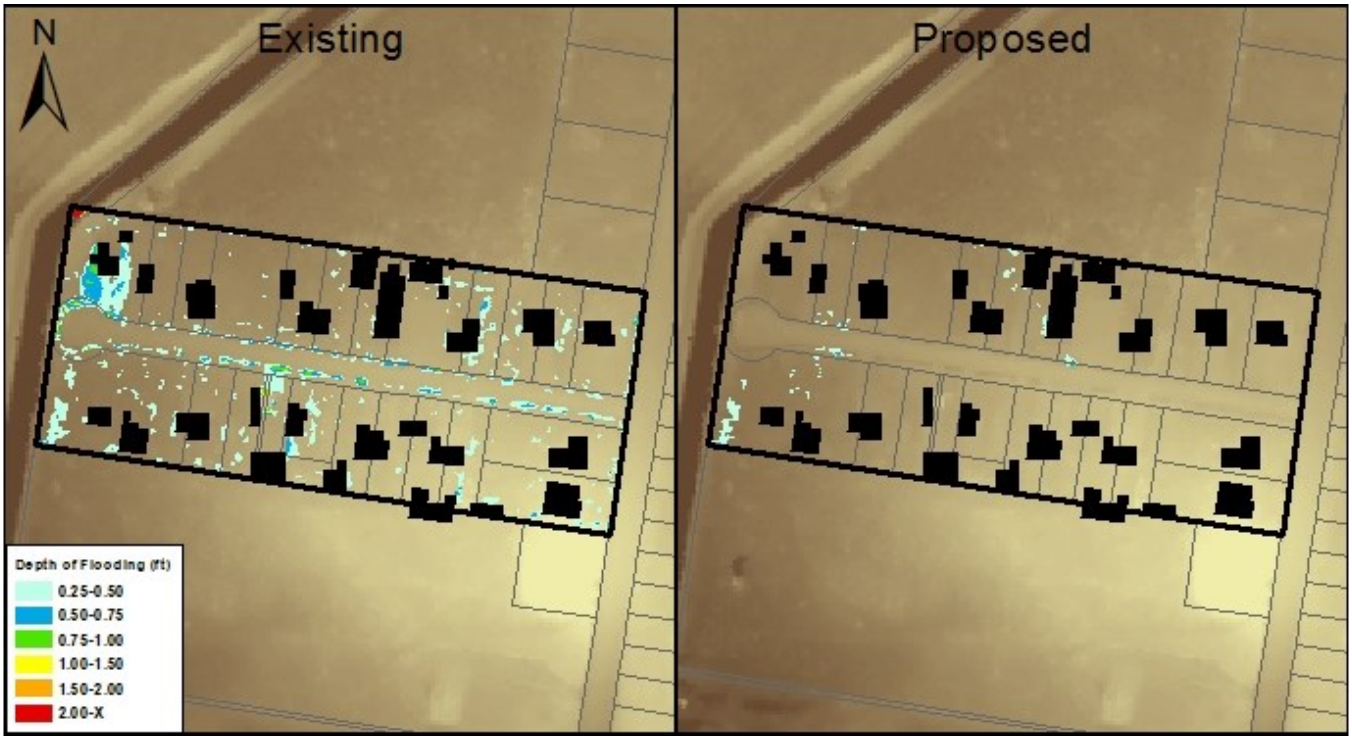


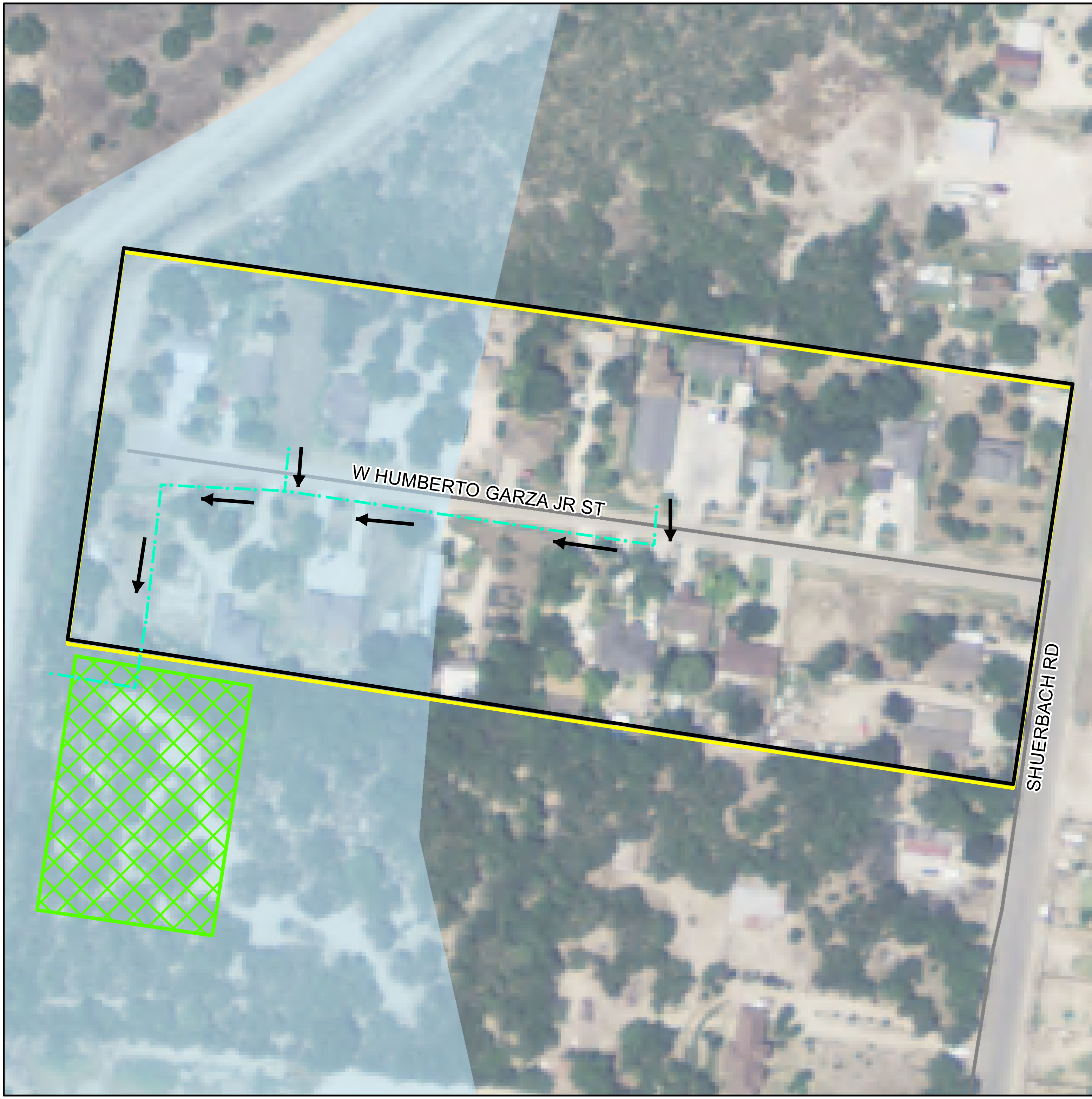
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	23	8	15
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

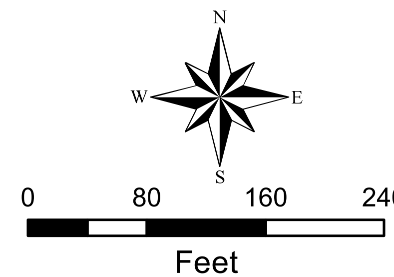
Colonia: Umberto Garcia Jr.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- UMBERTO GARCIA JR.
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

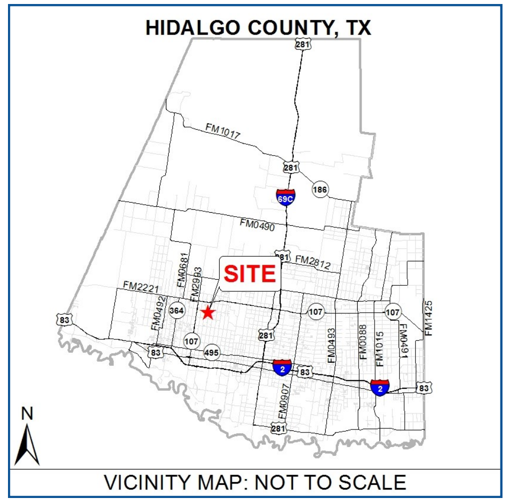
"Filling the Gap"

Colonia: Val Verde Acres, Hidalgo County

Basin: North Main Drain

Category: B1

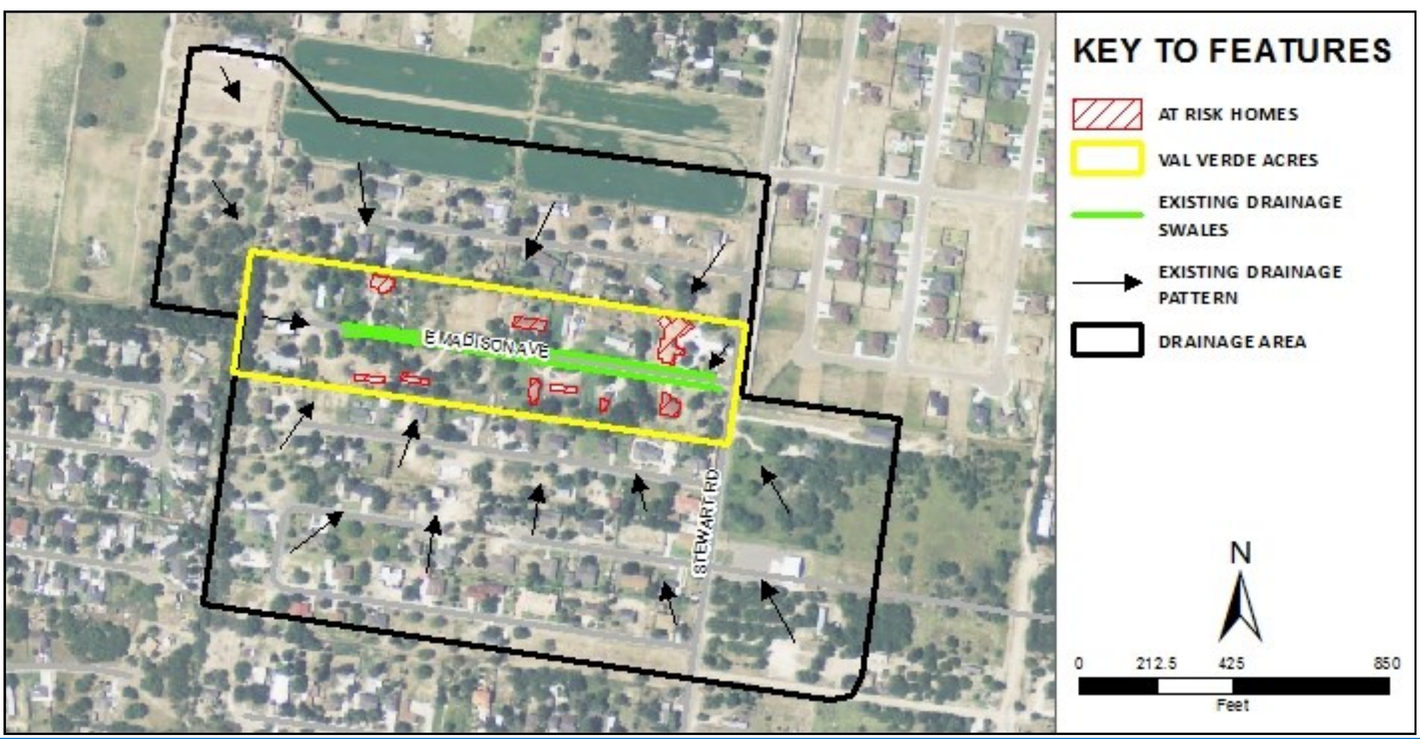
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Val Verde Acres storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Val Verde Acres consists of approximately 10.5 acres of fully developed residential land with an offsite drainage area of approximately 45 acres of fully developed residential land. The existing drainage system consists of swales and culverts with no outfall. The existing drainage pattern indicates runoff flows toward the center of Val Verde Acres. Based on the existing conditions 2D model results several structures are at risk of flooding. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Val Verde Acres, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install an underground drainage system with a lift station to a retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 391 linear feet of 36-inch diameter pipe, 392 linear feet of 42-inch diameter pipe, 685 linear feet of 48-inch diameter pipe, and nine curb inlets. The proposed retention pond is sized to retain onsite and offsite runoff of up to the 25-Year storm with an effective storage volume of 20 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land and buying out existing structures for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
VAL VERDE ACRES

	IMPROVEMENTS	COST
1	Paving Improvements	$204,045.00
2	Drainage Improvements	$181,171.00
3	Pond Excavation Improvements	$542,897.73
	Sub-Total =	**$928,113.73**
	Engineering Fees (10%) =	**$92,811.37**
	Contingency (20%) =	**$185,622.75**
	Total =	**$1,206,547.85**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 4 acre. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Val Verde Acres, Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	0	0	0
20% (5-year)	4	0	4
10% (10-year)	6	0	6
4% (25-year)	6	0	6
1% (100-year)	10	2	8

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$1,737,464.00	$1,206,547.85	1.44
Elevate Structures	$1,737,464.00	$1,122,150.00	1.55
Acquisition/Supplemental Housing / Demolition	$1,823,792.00	$1,212,921.80	1.50

Colonia: Val Verde Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

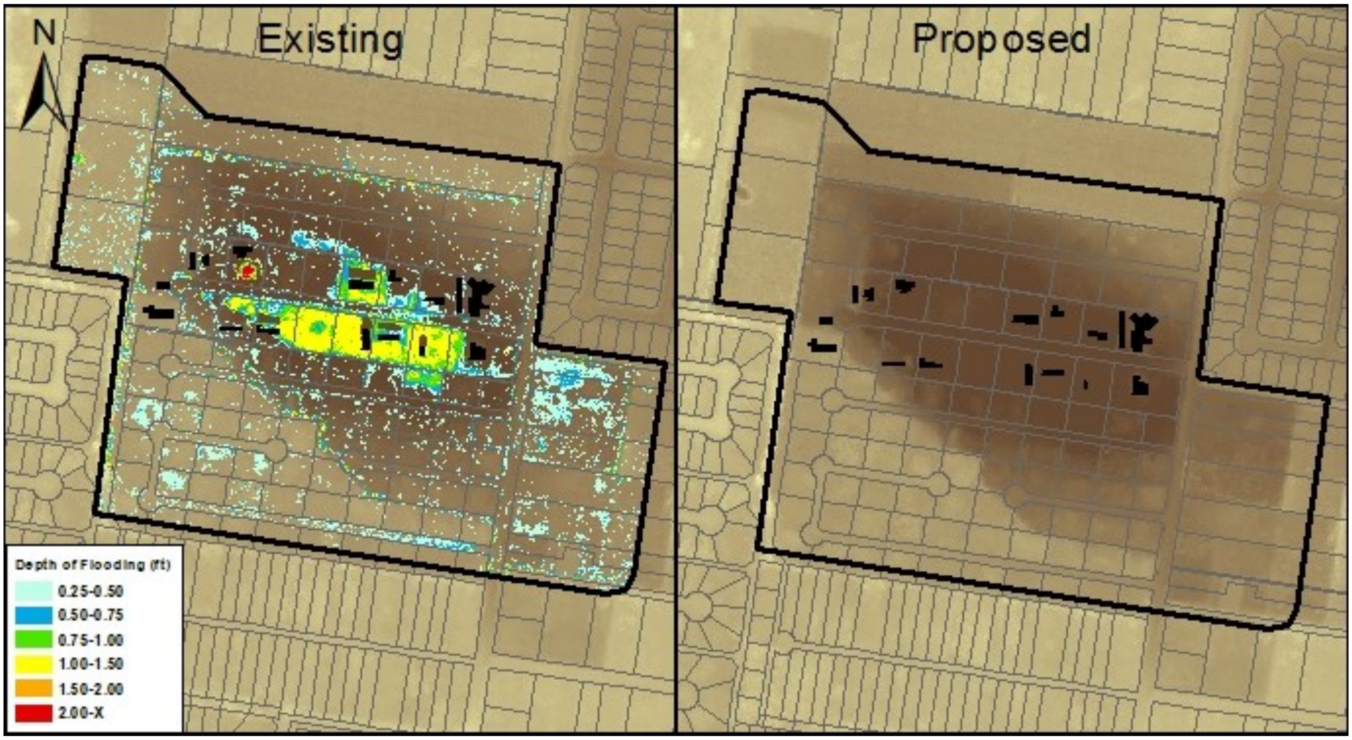


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	0	0	0
Inundated Lots	17	0	17
Inundated Roadway (LF)	128	0	128

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

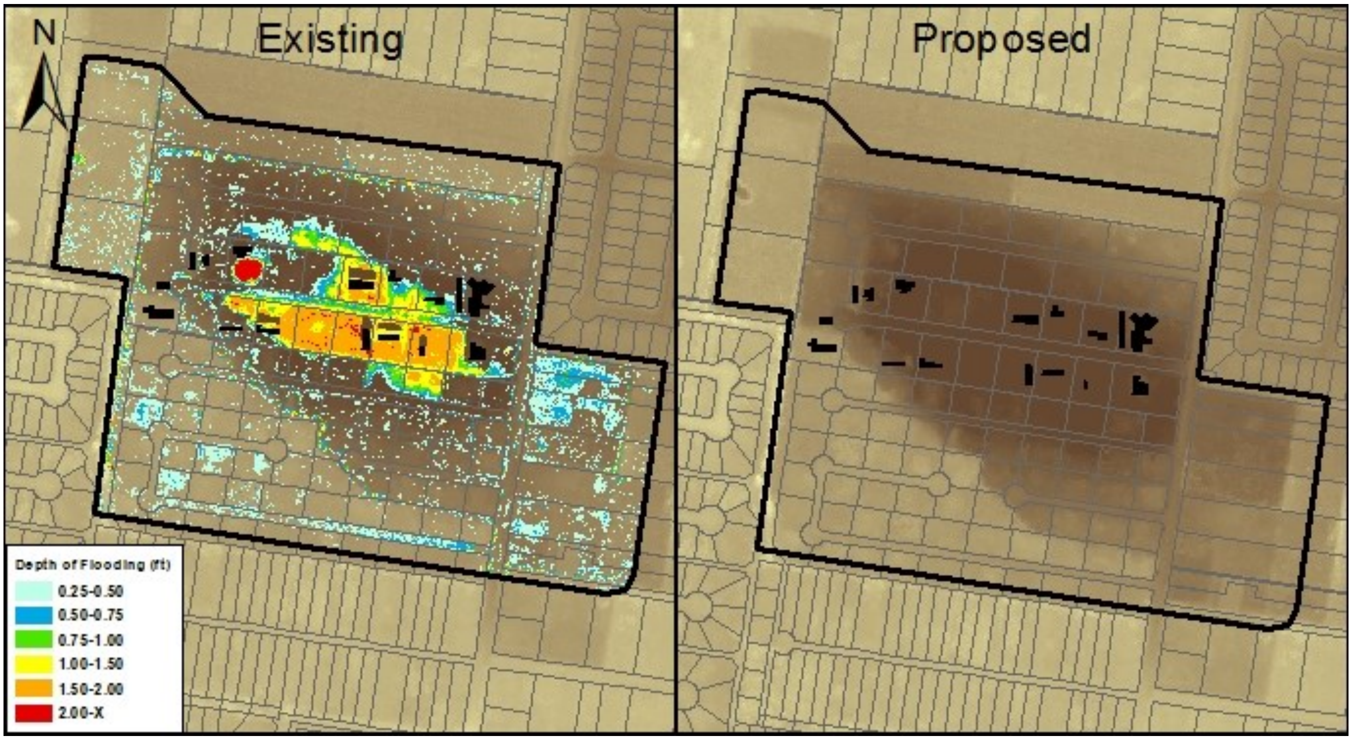


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	17	0	17
Inundated Roadway (LF)	682	0	682

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

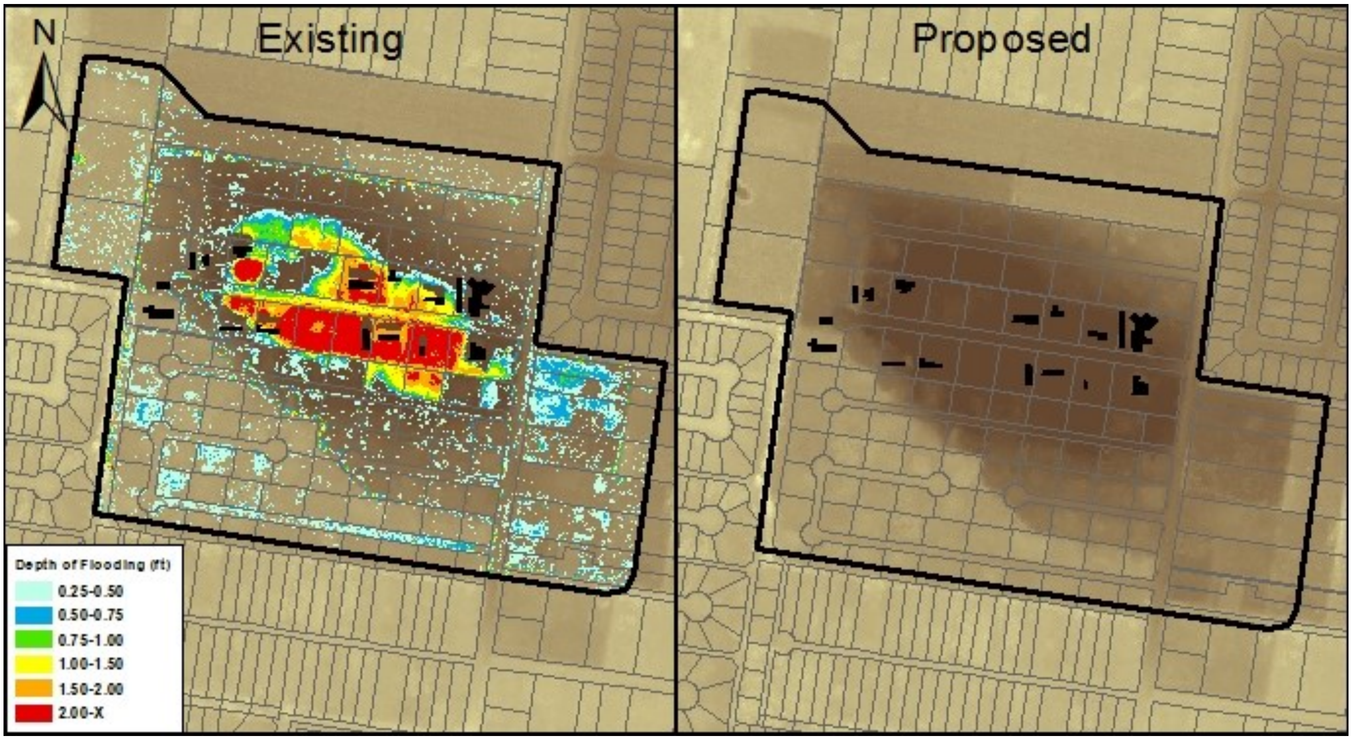


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	17	0	17
Inundated Roadway (LF)	840	0	840

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

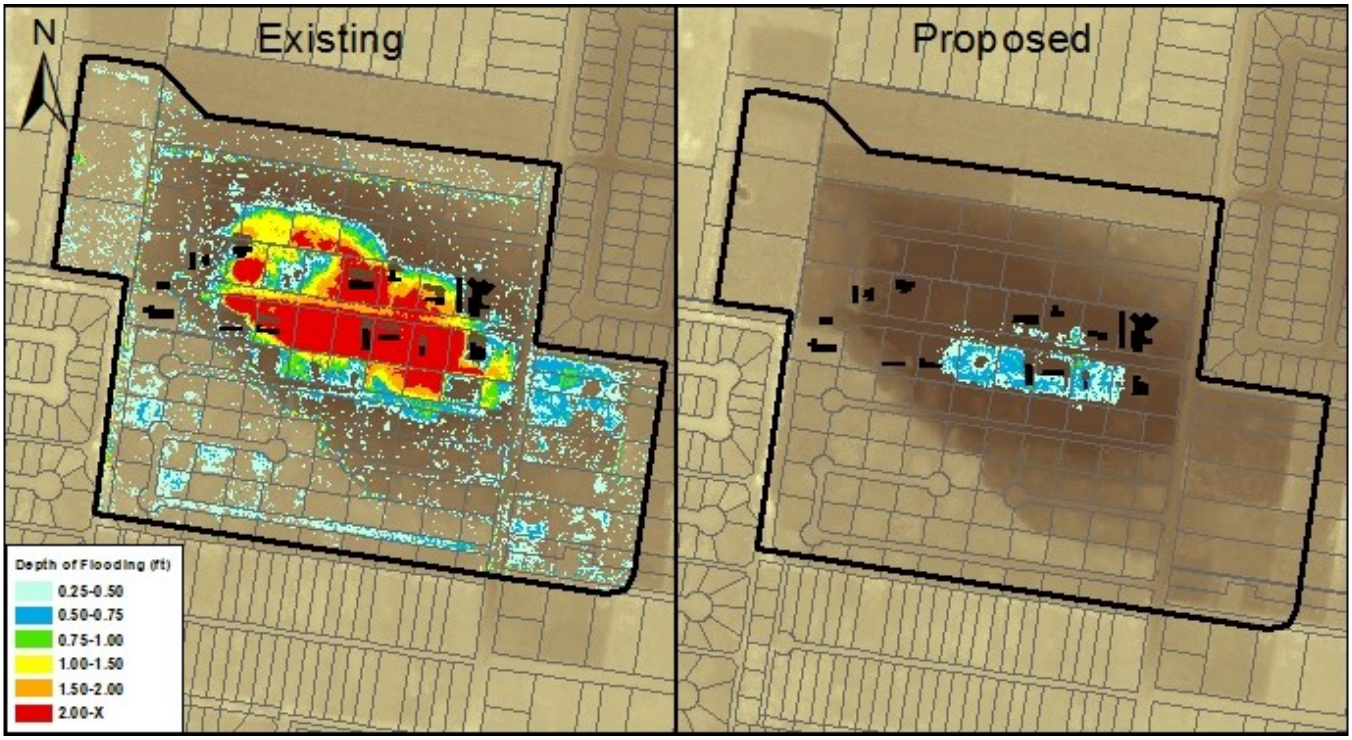


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	6	0	6
Inundated Lots	17	11	7
Inundated Roadway (LF)	935	0	935

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Val Verde Acres, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

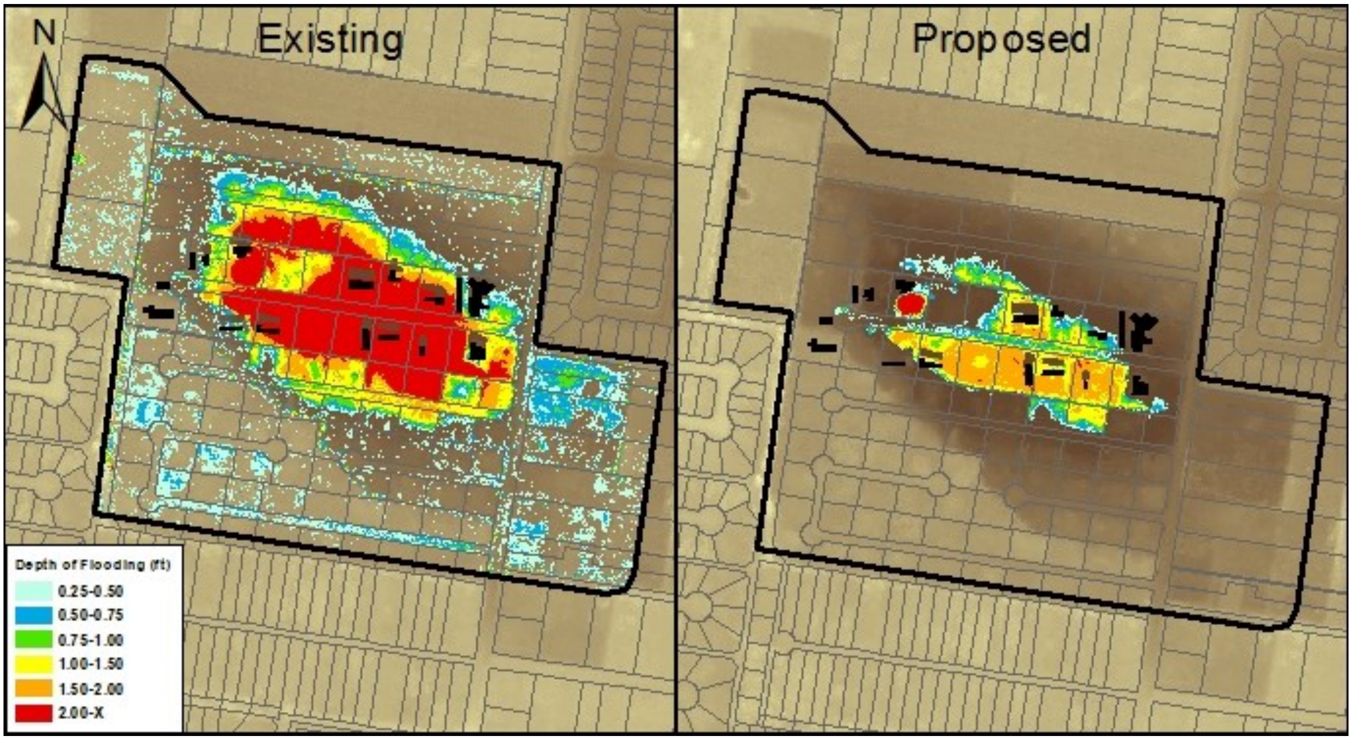


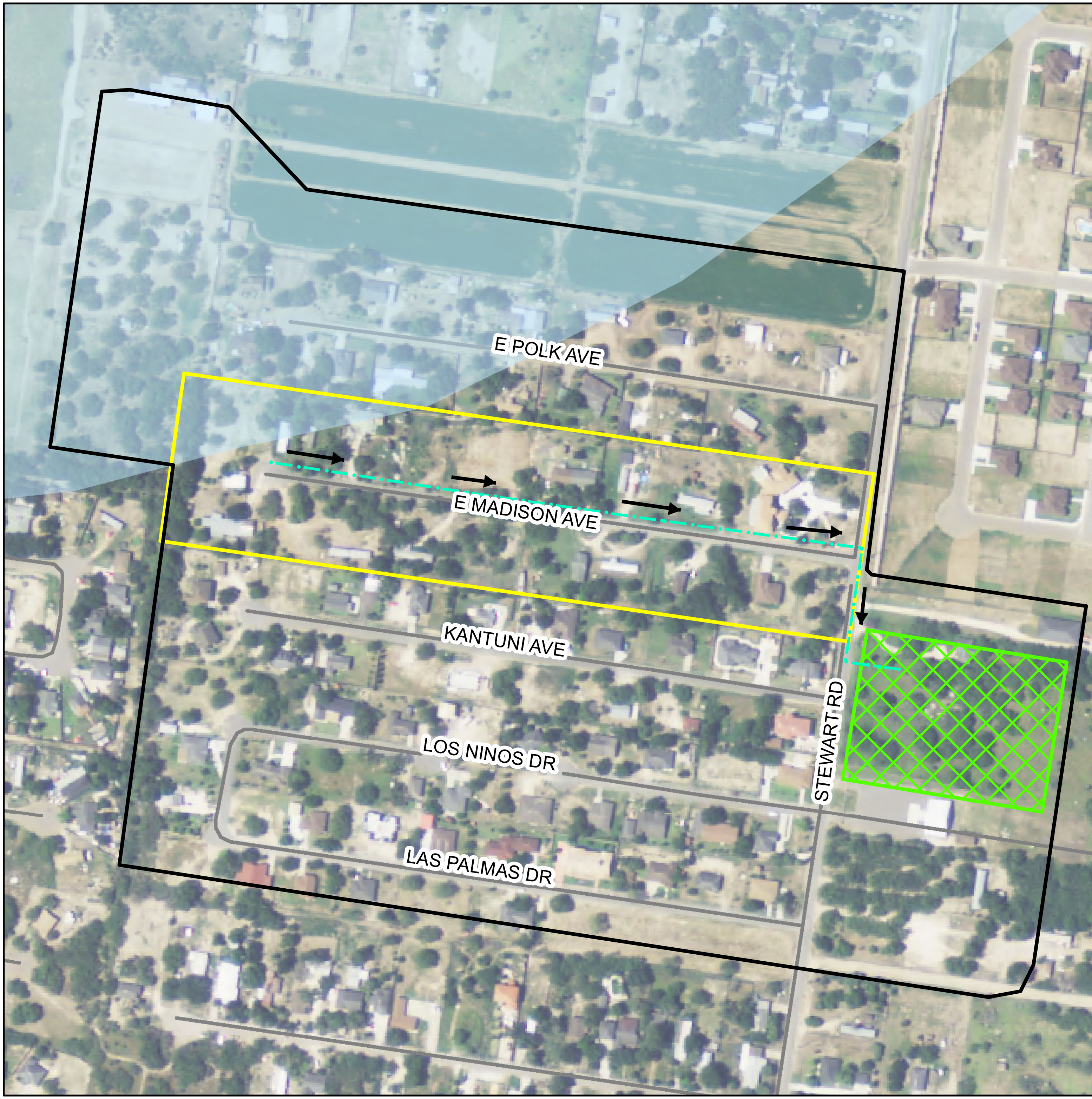
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	10	2	8
Inundated Lots	17	16	1
Inundated Roadway (LF)	1,077	688	389

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

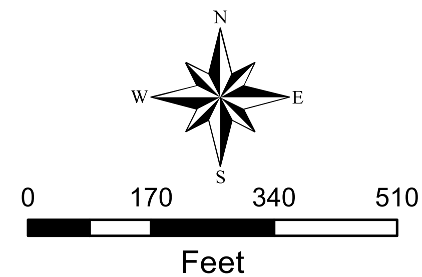
Colonia: Val Verde Acres
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- VAL VERDE ACRES
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN



STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

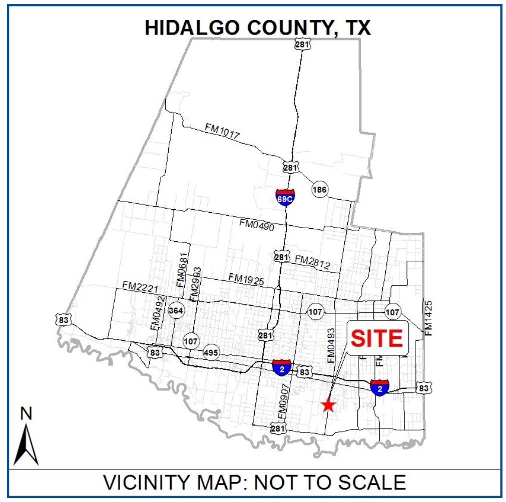
Colonia: Tierra Bella Subd., Hidalgo County

Basin: Upper Arroyo Colorado

Category: A1

"Filling the Gap"

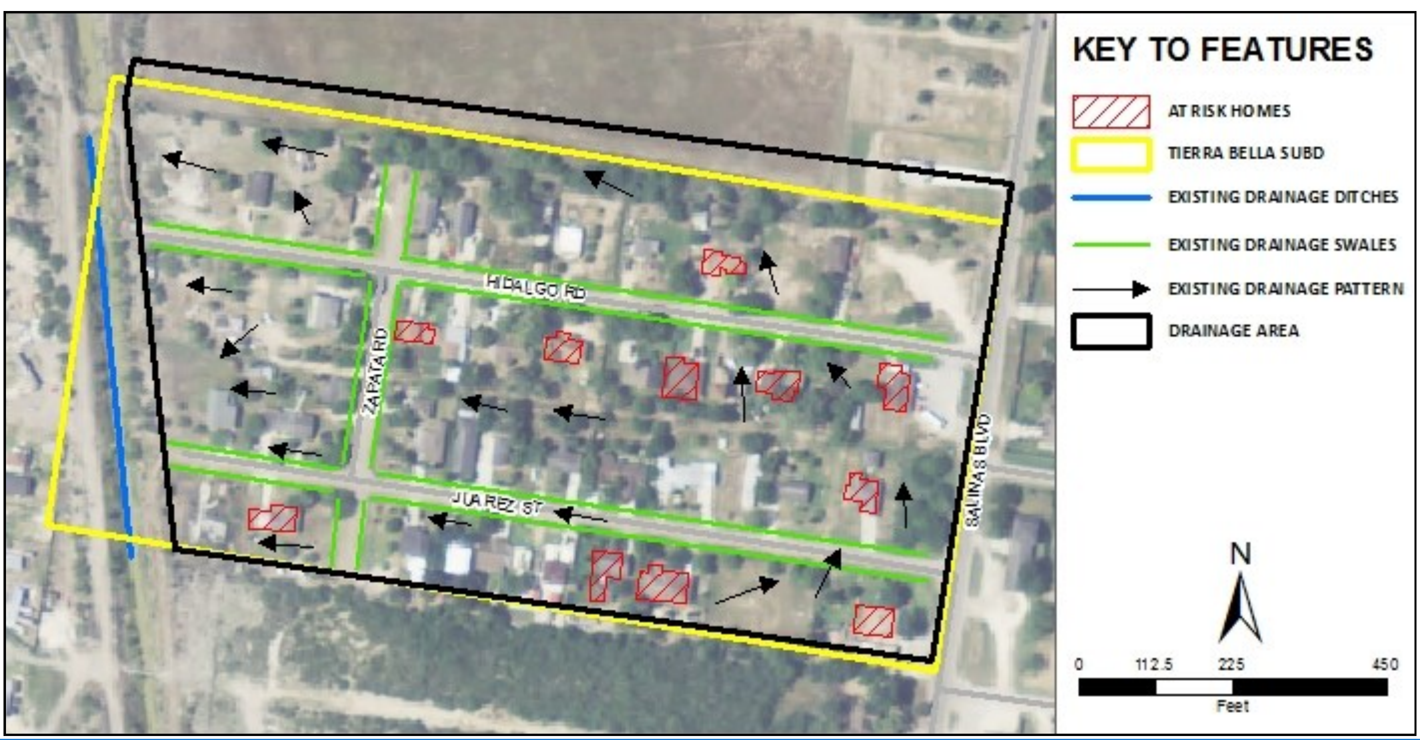
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Tierra Bella Subd. storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Tierra Bella Subd. consists of approximately 19.5 acres of fully developed residential land. The existing drainage system consists of swales and culvers that outfall into an existing drainage ditch. The existing drainage pattern indicates runoff flows toward the west. Based on the existing conditions 2D model results several structures are at risk of flooding from a localized storm event. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Tierra Bella Subd., Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
    - Install an underground drainage system with a retention pond.
    - Improve existing culverts and swales to allow maximum conveyance toward the existing drainage ditch.
    - Install an underground drainage system and outfall to the existing drainage ditch.

- The non structural alternatives for this project are as follows:
    - Elevate structures
    - Buyout of flood prone structures
    - Land use zoning change
    - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 1,920 linear feet of 24-inch diameter pipe, 173 linear feet of 30-inch diameter pipe, 390 linear feet of 36-inch diameter pipe, and nine curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 4.8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
TIERRA BELLA SUBD

	IMPROVEMENTS	COST
1	Paving Improvements	$416,370.00
2	Drainage Improvements	$188,951.00
3	Pond Excavation Improvements	$130,295.45
	Sub-Total =	**$735,616.45**
	Engineering Fees (10%) =	**$73,561.65**
	Contingency (20%) =	**$147,123.29**
	Total =	**$956,301.39**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 2 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Tierra Bella Subd., Hidalgo County

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY
"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	8	0	8
20% (5-year)	11	0	11
10% (10-year)	11	0	11
4% (25-year)	11	0	11
1% (100-year)	11	0	11

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$7,457,332.00	$956,301.39	7.80
Elevate Structures	$7,457,332.00	$1,316,850.00	5.66
Acquisition/Supplemental Housing / Demolition	$7,746,950.00	$1,158,950.90	6.68

Colonia: Tierra Bella Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

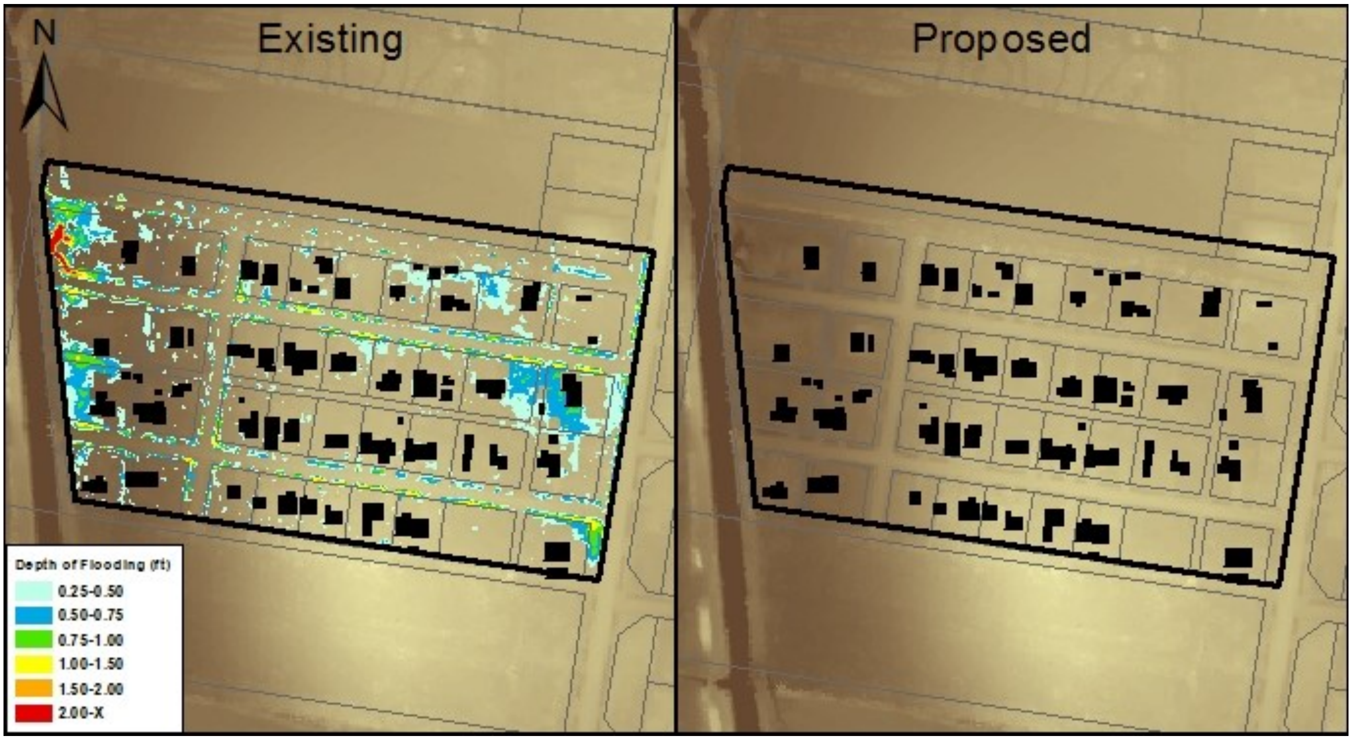


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	36	0	36
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Tierra Bella Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

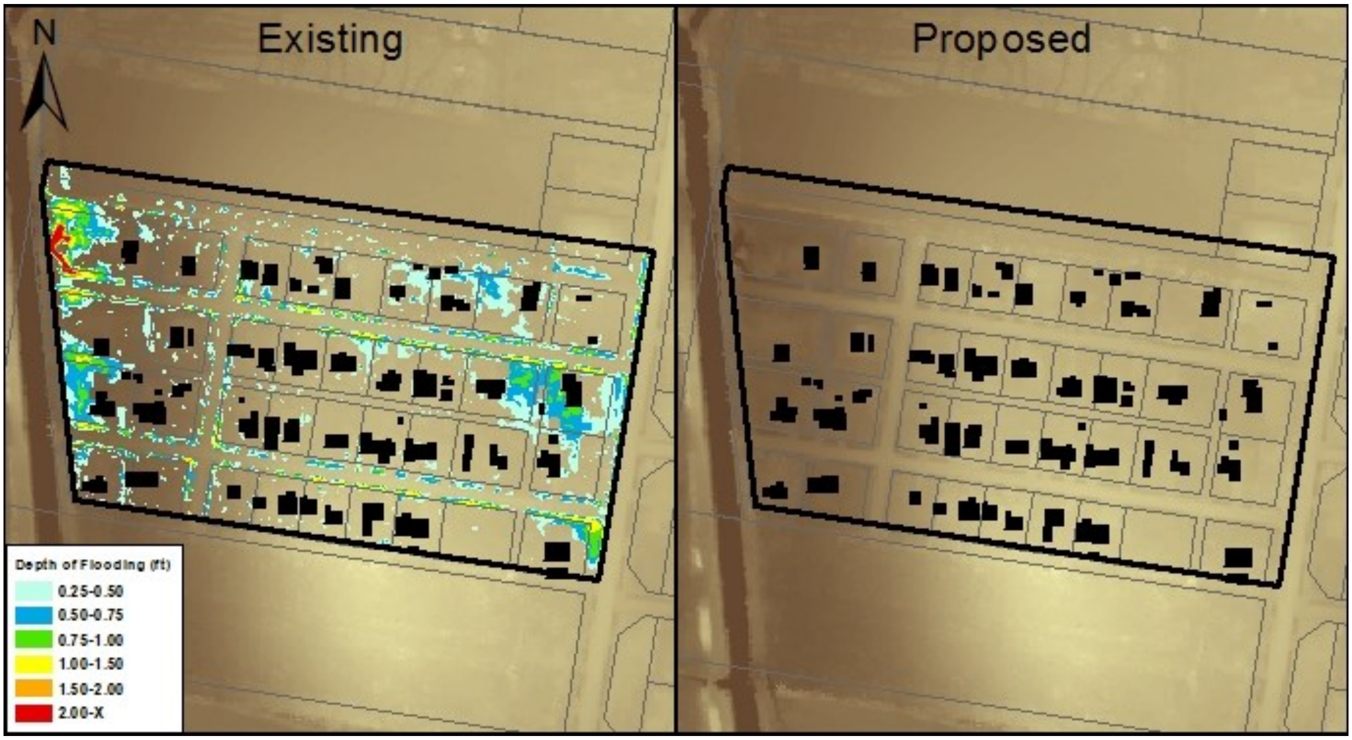


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	36	0	36
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Tierra Bella Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

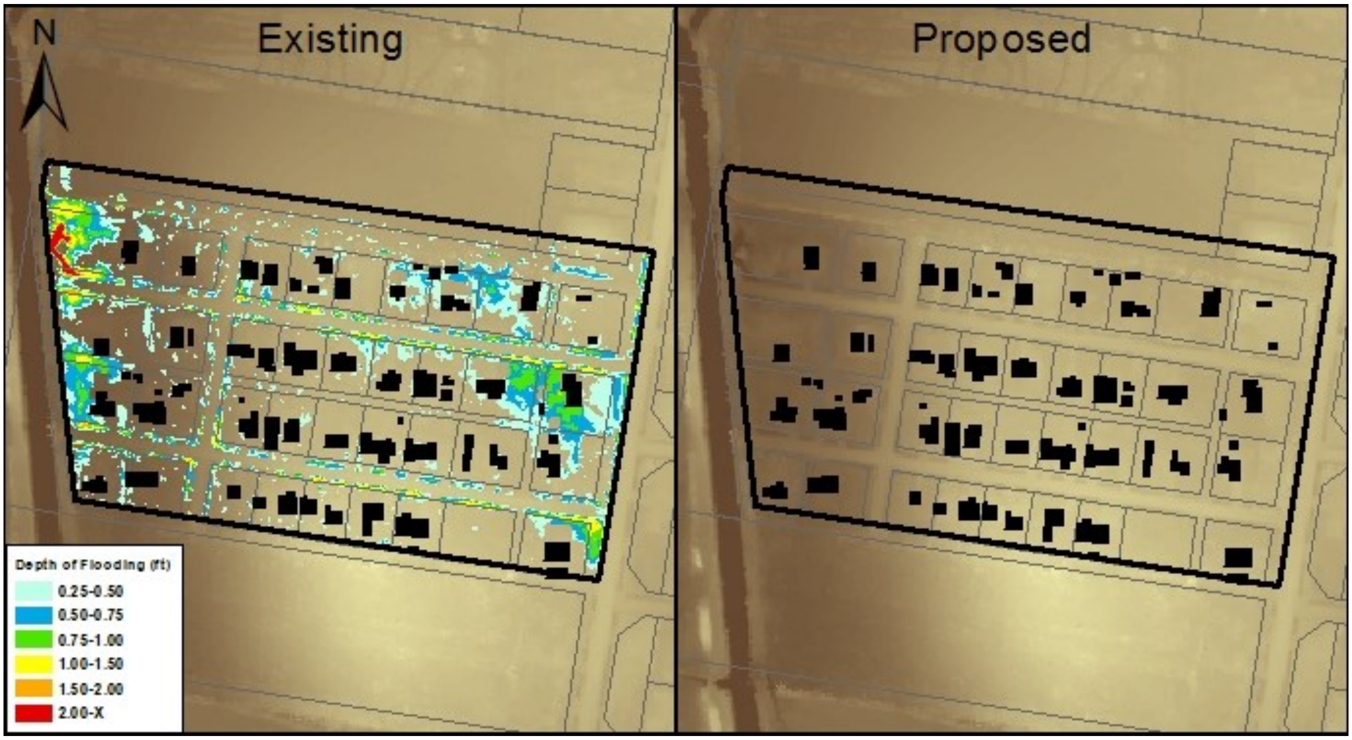


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	36	0	36
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Tierra Bella Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

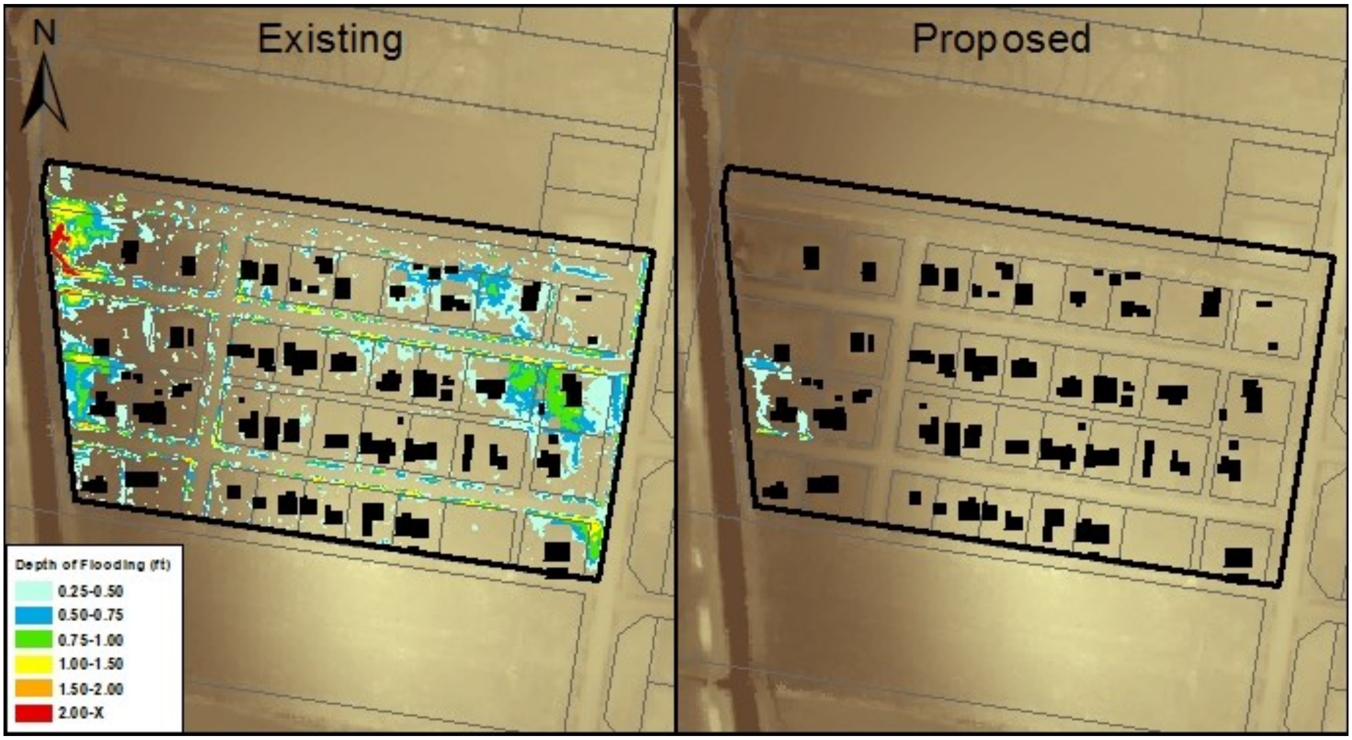


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	36	2	34
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Tierra Bella Subd., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

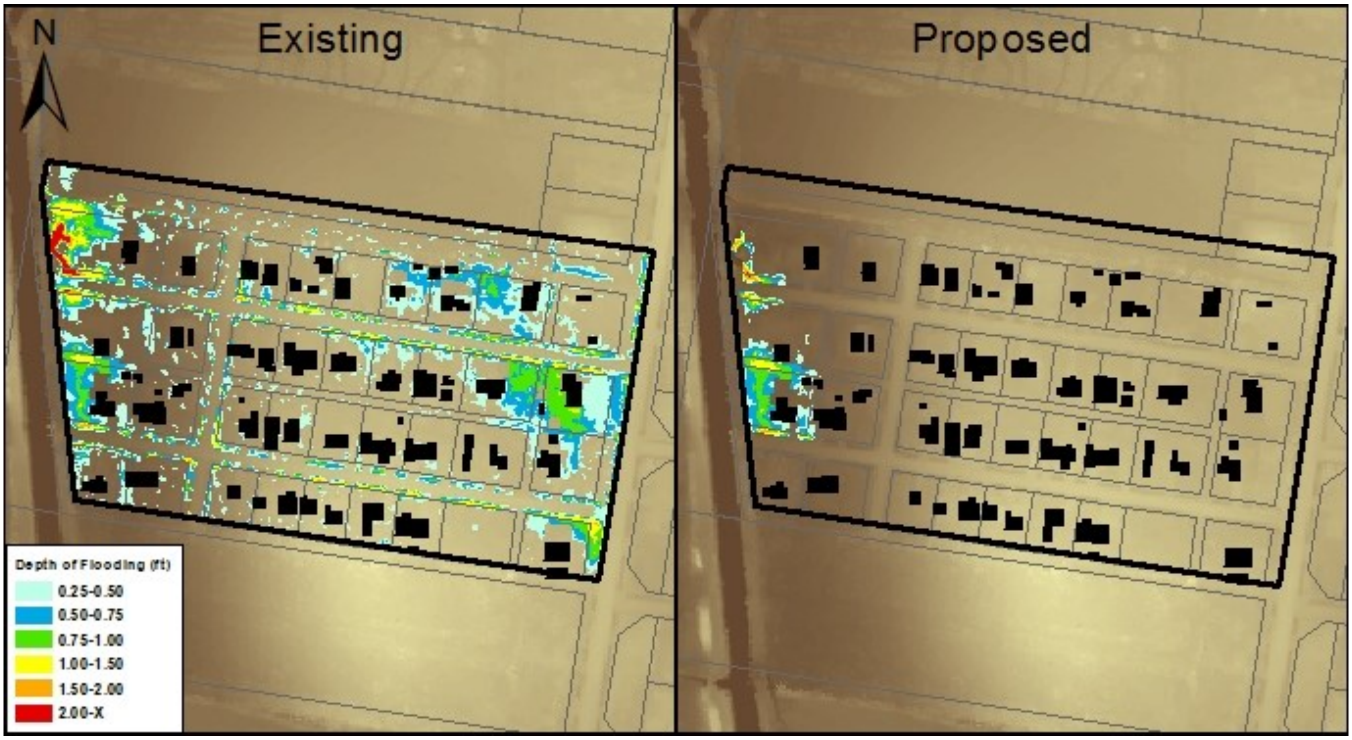


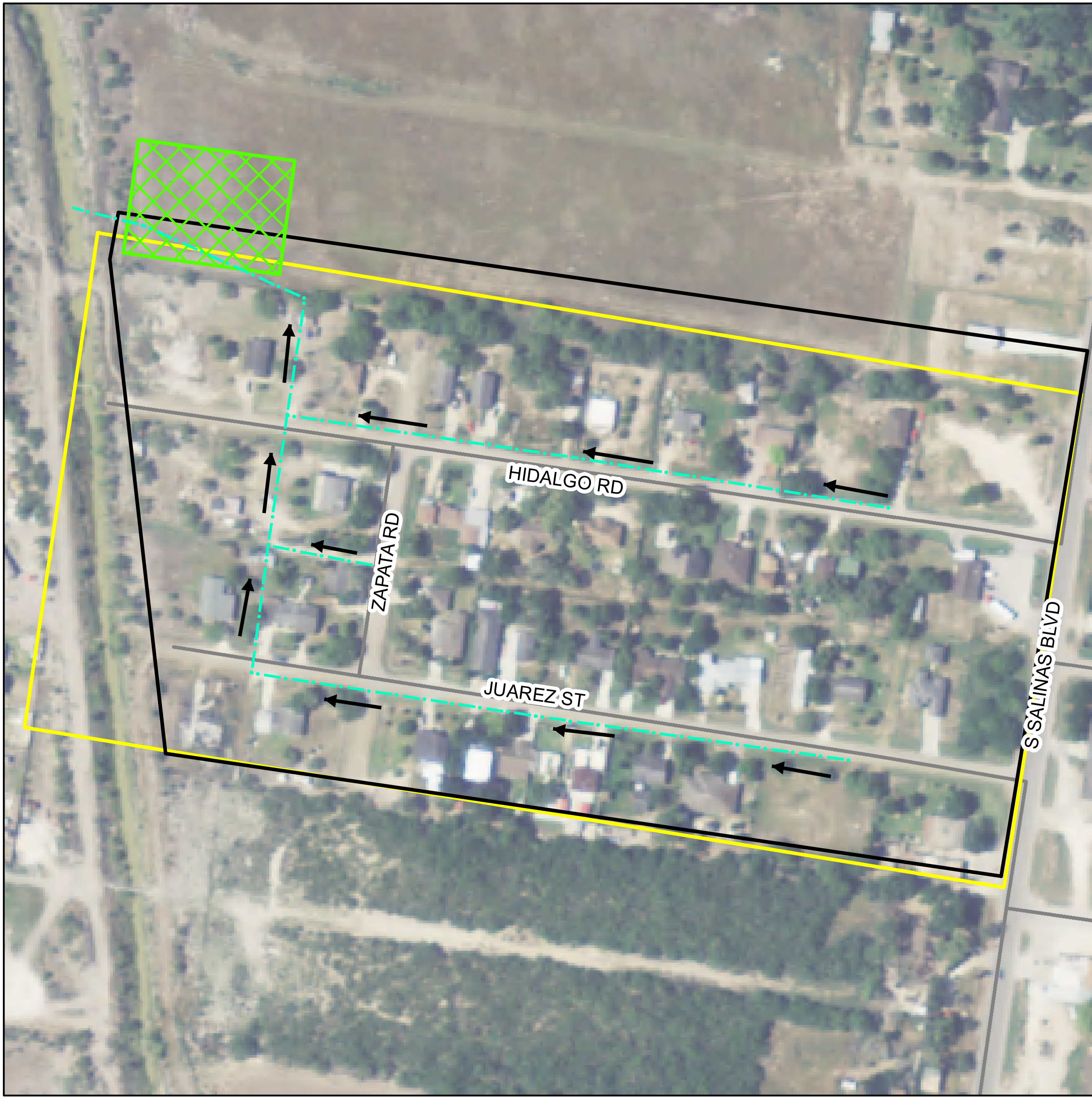
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	11	0	11
Inundated Lots	36	3	33
Inundated Roadway (LF)	0	0	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Tierra Bella Subd.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- TIERRA BELLA SUBD
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Olmito, Cameron County

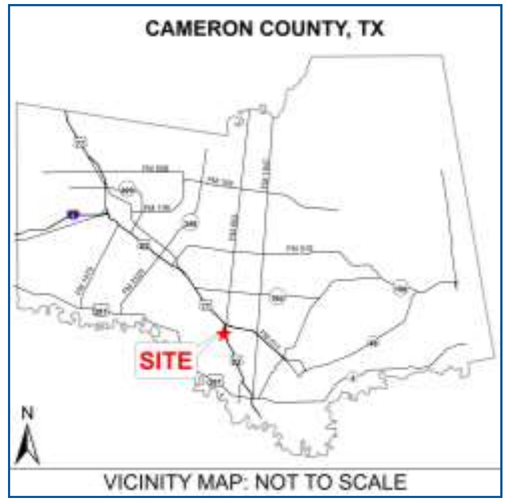
Basin: Brownsville North Main Drain

Category: B1

"Filling the Gap"

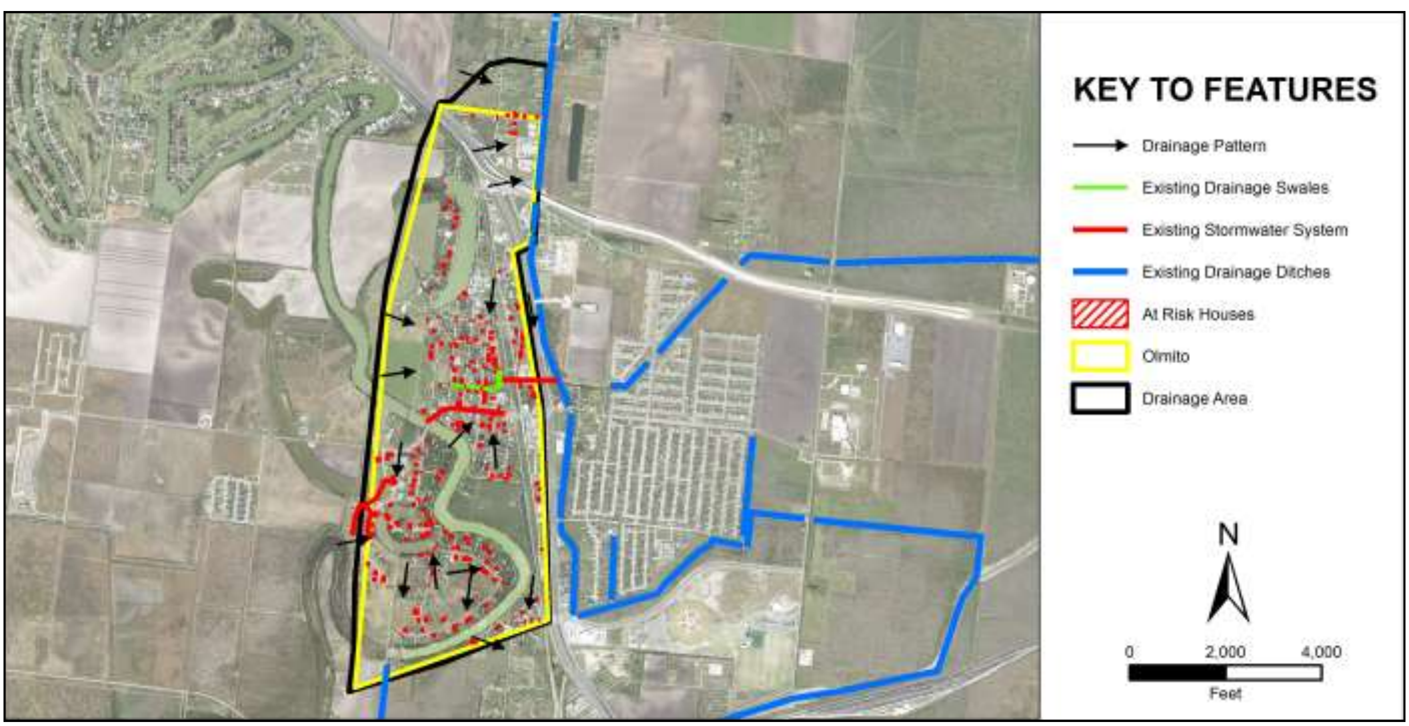
Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Olmito colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 802-acre colonia are generally to the south and east. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Olmito experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 6 to 9 inches, blue 9 to 12 inches, green 1 to 1.5 feet, yellow 1.5 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.



Colonia: Olmito, Cameron County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention ponds
  - Install roadside swales
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 7,005 linear feet of 18-inch diameter pipe, 10,010 linear feet of 24-inch diameter pipe, 5,945 linear feet of 36-inch diameter pipe, 875 linear feet of 48-inch diameter pipe, 45 linear feet of 60-inch diameter pipe, 56,900 linear feet of grassy swale, 1,067,930 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention ponds is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 6.4 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention ponds, excavation of local existing ponds, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

	ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST Olmito Colonia		
	IMPROVEMENTS	COST	
1	**PAVING IMPROVEMENTS**	$	1,244,950.44
2	**DRAINAGE IMPROVEMENTS**	$	22,927,440.00
3	**POND EXCAVATION IMPROVEMENTS**	$	6,111,710.00
	Sub-Total =	**$**	**30,284,100.44**
	Engineering (10%)	$	3,028,410.04
	Contingency (20%)	$	6,056,820.09
	Total =	**$**	**39,369,330.58**
NOTE:	Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 53.3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.		

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	102	31	71
20% (5-year)	116	42	74
10% (10-year)	134	46	88
4% (25-year)	163	53	110
1% (100-year)	192	66	126

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$73,676,981	$39,369,330	1.87
Elevate Structures	$73,676,981	$23,469,900	3.14
Acquisition/Supplemental Housing/Demolition	$188,166,286	$27,564,960	6.83

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	102	31	71
Inundated Lots	1113	751	362
Inundated Roadway (LF)	4100	610	3490

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	116	42	74
Inundated Lots	1128	777	351
Inundated Roadway (LF)	5860	1020	4840

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	134	46	88
Inundated Lots	1136	792	344
Inundated Roadway (LF)	7070	1310	5760

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

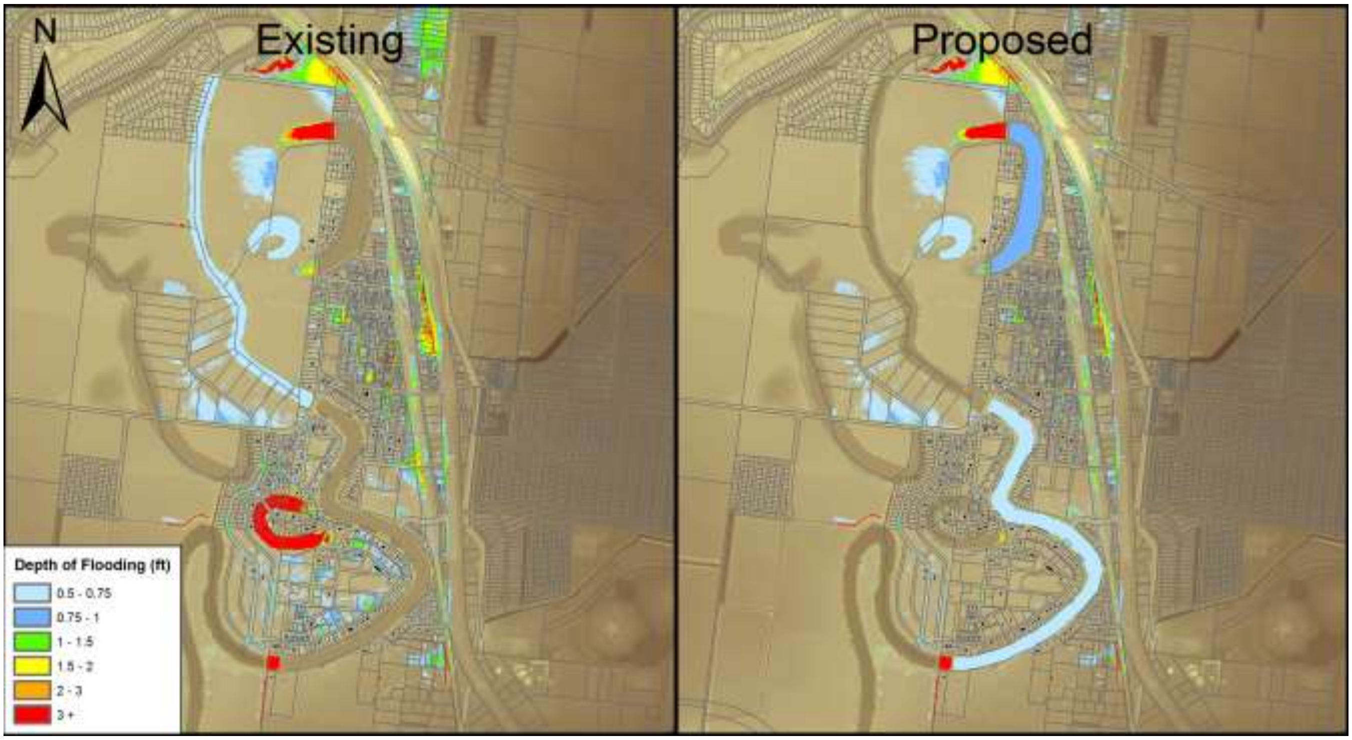


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	163	53	110
Inundated Lots	1149	832	317
Inundated Roadway (LF)	9140	1800	7340

Notes:
1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.

Colonia: Olmito, Cameron County

Recommended Mitigation Project cont.:

Project Figures:

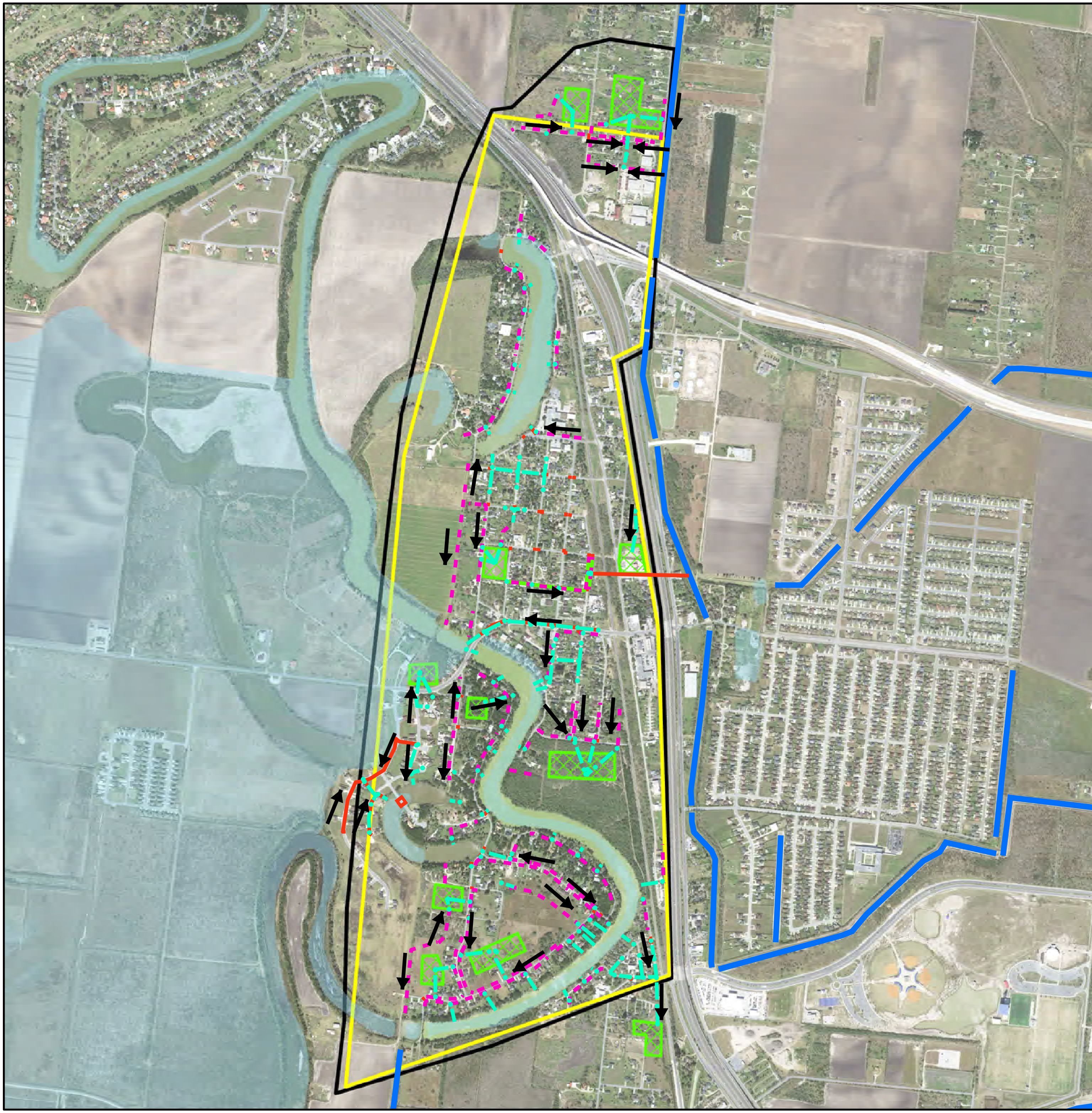
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	192	66	126
Inundated Lots	1162	881	281
Inundated Roadway (LF)	12620	2690	9930

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 6 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 6 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Olmito
County: Cameron County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Olmito
- Proposed Retention Pond
- Drainage Area

N

0 250 500 1,000
Feet

STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

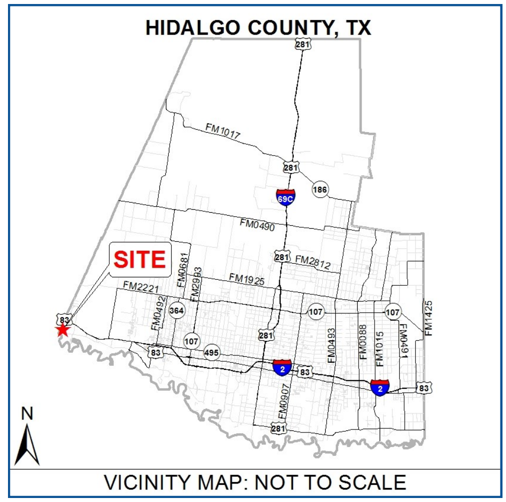
"Filling the Gap"

Colonia: Cuevitas, Hidalgo County

Basin: Rio Grande

Category: B1

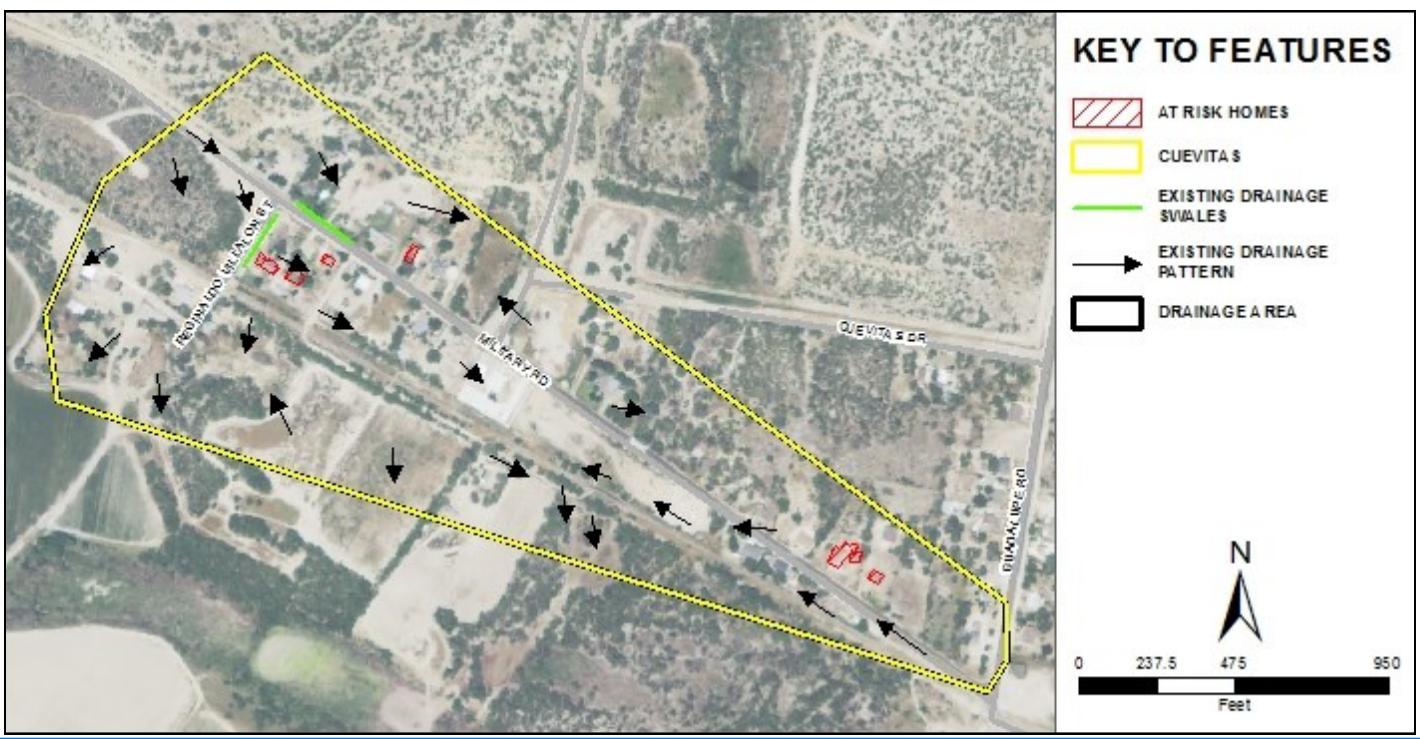
Hydrology / Hydraulic Analysis:



A 2-dimensional hydrodynamic model of the colonia Cuevitas storm drainage system was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the underground storm drain system and the movement of the overland flow using a three dimensional digital terrain model of the existing ground surfaces. This report accurately assesses the adequacy and current capacity of the drainage system and recommends system improvements that will provide protection from flooding for up to the 10-Yr storm. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.

Areas of Risk:

Cuevitas consists of approximately 53.2 acres of fully developed residential land. The existing drainage system consists of only some roadside swales. The existing drainage pattern indicates runoff flows east and west toward some low areas in the colonia. Based on LIDAR observations, this colonia may experience flooding from localized events, but should also be evaluated for risk of flooding due to regional storm events. Figures 1, 2, 3, 4, and 5 illustrate the existing and proposed inundation maps for the 2-, 5-, 10-, 25-, and 100-Year storms respectively. The color coded inundation maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 12 to 18 inches, orange 18 to 24 inches, and red more than 24 inches.



Colonia: Cuevitas, Hidalgo County

Potential Solutions:

- The following are the alternatives for the drainage of this colonia:
  - Install an underground drainage system with a retention pond.
  - Install culverts and swales to drain into a new retention pond.

- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone structures
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:
The criteria used to design the new system involves carrying the discharge of the 10-Year storm of the onsite runoff and retention of the 25-Year storm. The recommended system improvements include installing an underground drainage system with a retention facility. The new system consists of 1,010 linear feet of 30-inch diameter pipe, 1,010 linear feet of 36-inch diameter pipe, 500 linear feet of 42-inch diameter pipe, 1,060 linear feet of 48-inch diameter pipe, and sixteen curb inlets. The proposed retention pond is sized to retain onsite runoff of up to the 25-Year storm with an effective storage volume of 14.8 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation maps for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:
The potential challenges would be the acquisition of land for the proposed retention pond, and possible utility adjustments. While the proposed improvements will reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
CUEVITAS

	IMPROVEMENTS	COST
1	Paving Improvements	$421,055.33
2	Drainage Improvements	$378,340.00
3	Pond Excavation Improvements	$233,863.64
	Sub-Total =	**$1,033,258.97**
	Engineering Fees (10%) =	**$103,325.90**
	Contingency (20%) =	**$206,651.79**
	Total =	**$1,343,236.66**

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 3 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	3	0	3
20% (5-year)	4	0	4
10% (10-year)	7	0	7
4% (25-year)	8	0	8
1% (100-year)	8	0	8

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$2,649,523.00	$1,343,236.66	1.97
Elevate Structures	$2,649,523.00	$698,925.00	3.79
Acquisition/Supplemental Housing / Demolition	$2,763,775.00	$607,831.20	4.55

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

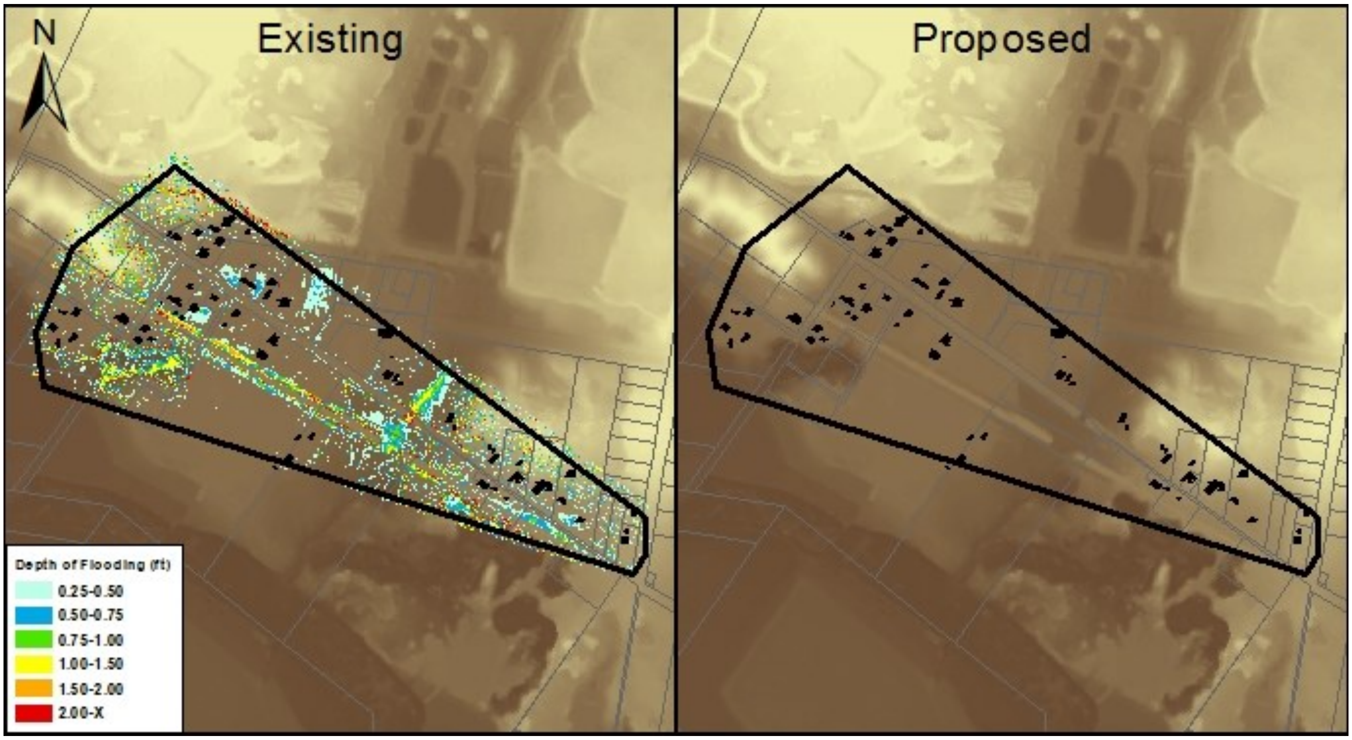


Figure 1: Existing and Proposed Conditions - 2-Yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	3	0	3
Inundated Lots	49	0	49
Inundated Roadway (LF)	107	0	107

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

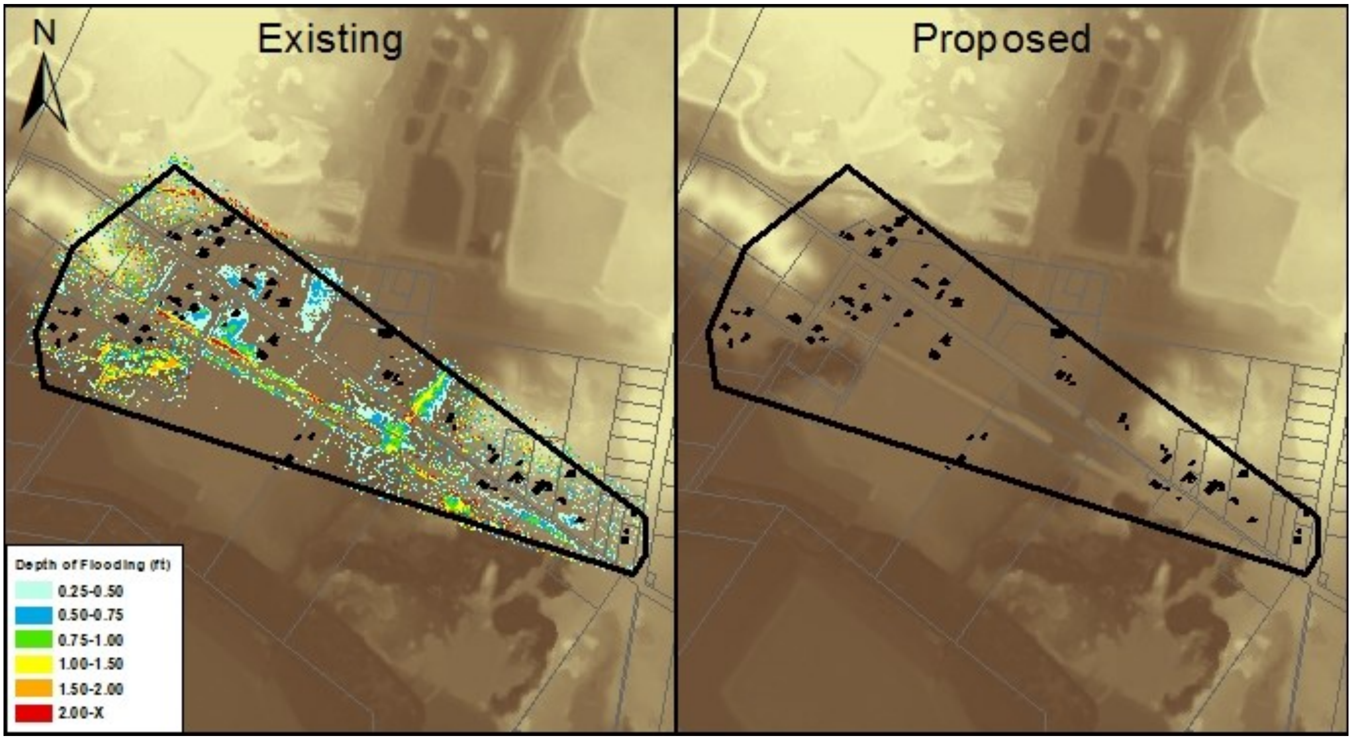


Figure 2: Existing and Proposed Conditions - 5-Yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	49	0	49
Inundated Roadway (LF)	115	0	115

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

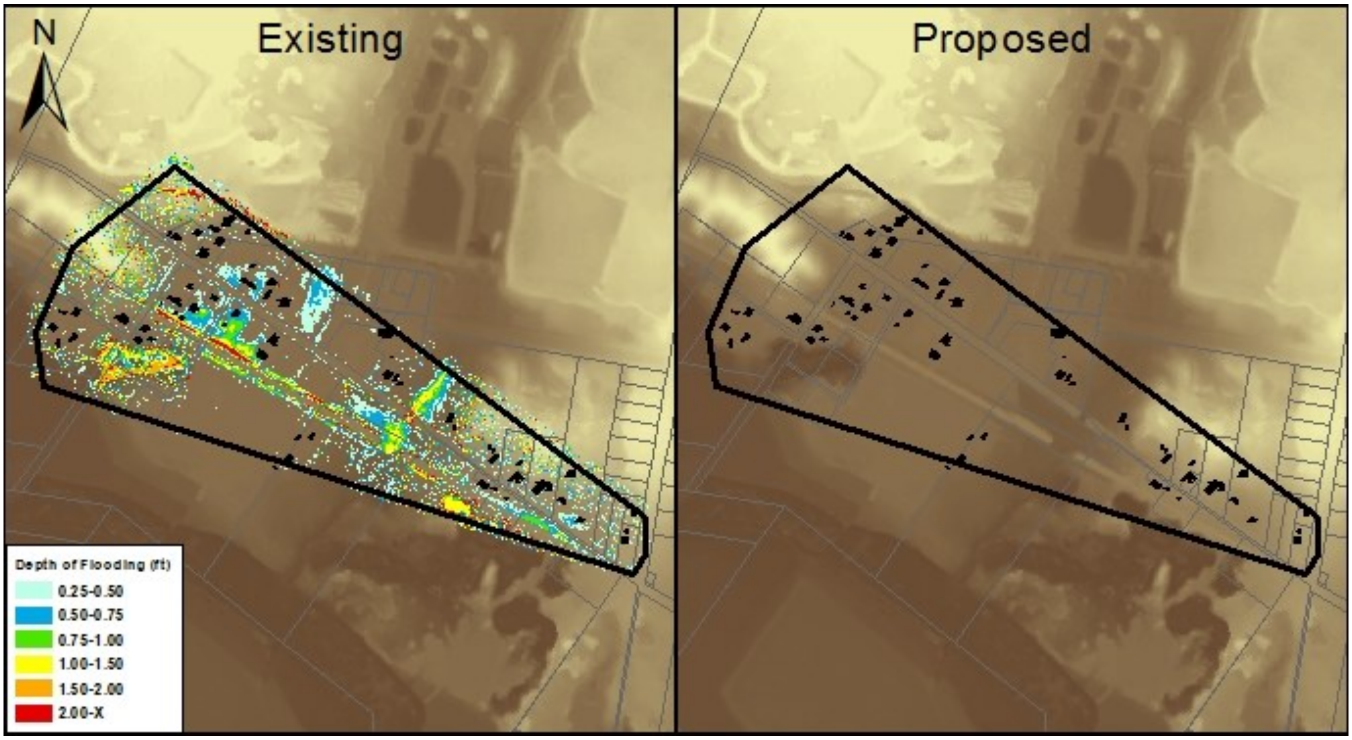


Figure 3: Existing and Proposed Conditions - 10-Yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	49	0	49
Inundated Roadway (LF)	182	0	182

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

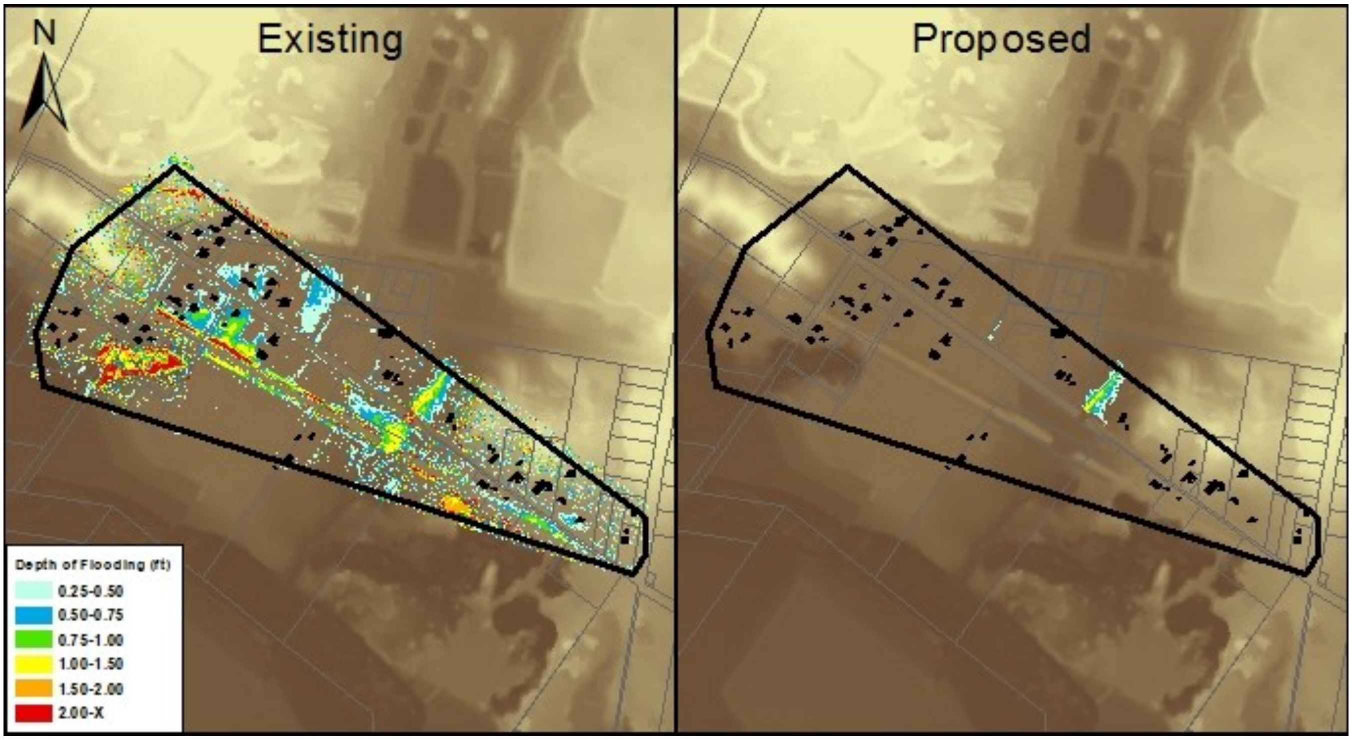


Figure 4: Existing and Proposed Conditions - 25-Yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	49	2	47
Inundated Roadway (LF)	202	0	202

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.

Colonia: Cuevitas, Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

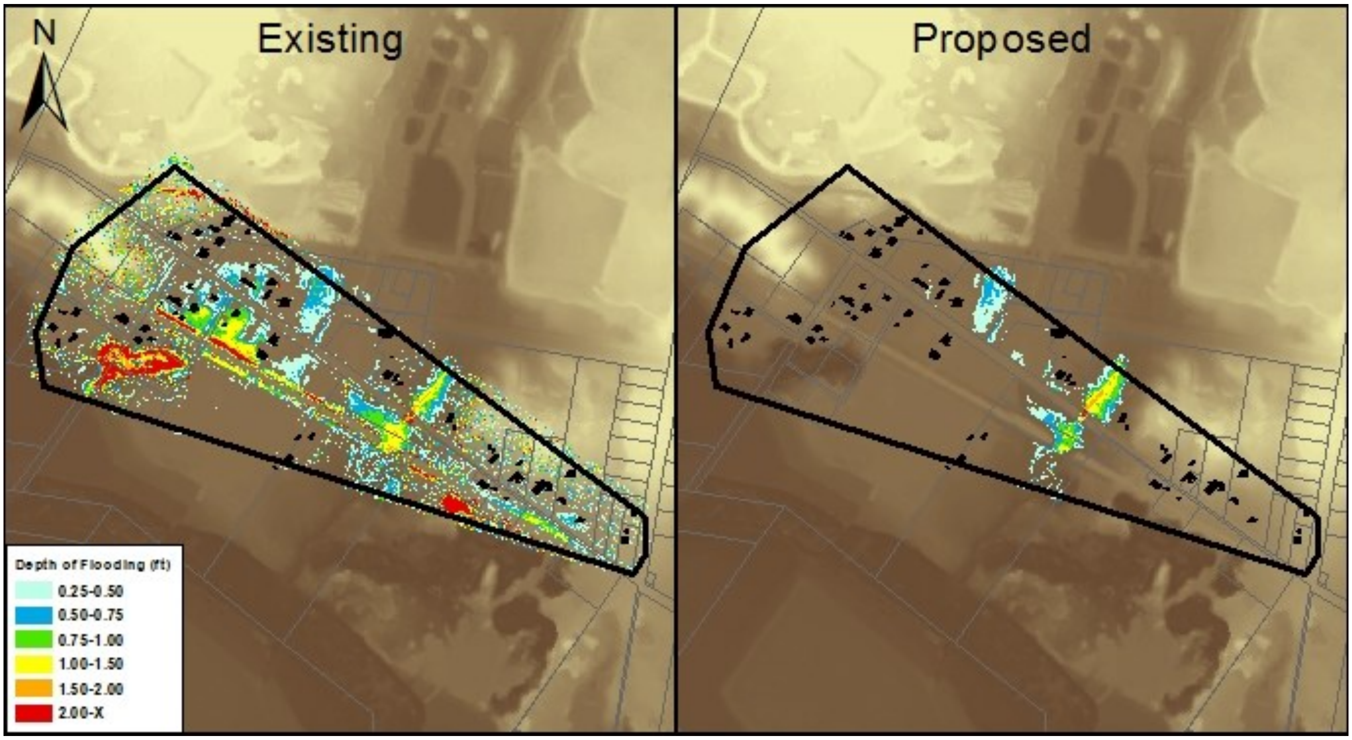


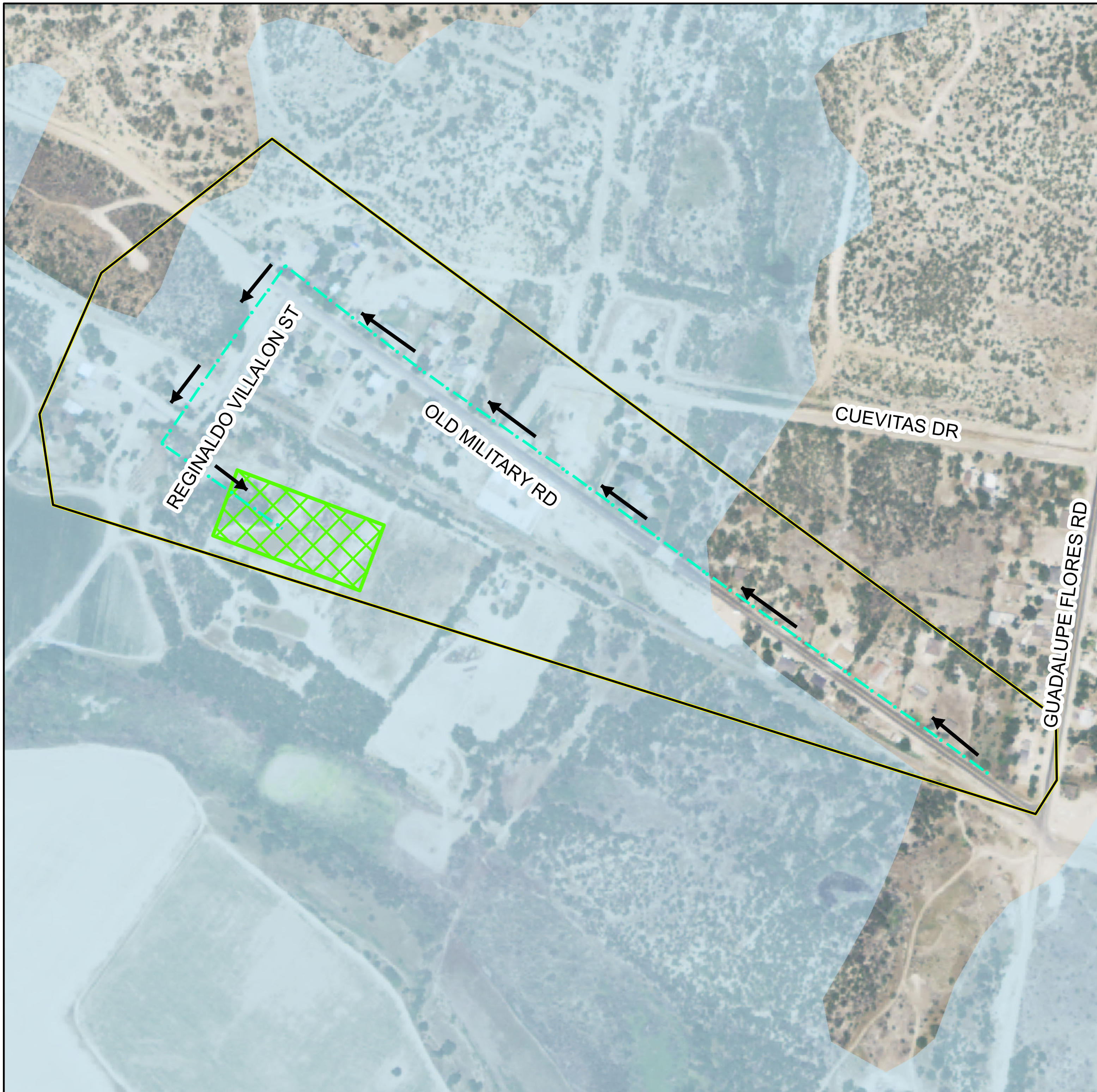
Figure 5: Existing and Proposed Conditions - 100-Yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	49	11	38
Inundated Roadway (LF)	273	25	248

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than three inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than three inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Cuevitas
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- STREETS
- PROPOSED STORMWATER SYSTEM
- PROPOSED DRAINAGE FLOW
- CUEVITAS
- DRAINAGE AREA
- 25-YR RETENTION POND
- EXISTING FLOODPLAIN

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STORMWATER DRAINAGE PLANNING FOR THE COLONIAS OF THE LOWER RIO GRANDE VALLEY

"Filling the Gap"

Colonia: Green Valley Dev., Hidalgo County

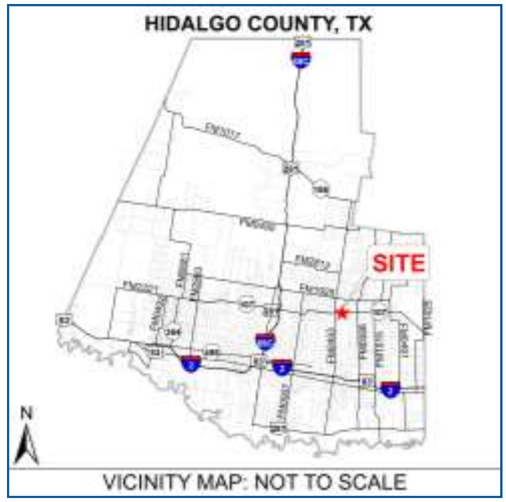
Basin: North Main Drain

Category: B1

"Filling the Gap"

Hydrology / Hydraulic Analysis:

A two-dimensional hydrodynamic model of the Green Valley Development colonia was built using the software program InfoWorks ICM. The model integrates hydrologic and hydraulic modeling and simulates the interactions of the storm drain system and the movement of overland flow using a three-dimensional digital terrain model of the existing ground surface. This report assesses the adequacy and capacity of the existing drainage system and recommends system improvements that will provide protection from flooding for up to the 10-year storm. Rainfall-runoff simulations were conducted for the 2-, 5-, 10-, 25-, and 100-year storm events. Please refer to the Localized Analysis Document for modeling and mapping methodology and assumptions.



Areas of Risk:

Drainage patterns within this 8-acre colonia are generally to the south. The existing drainage system consists of a small stormwater system and roadside swales that are generally undersized and restricted by sediment and vegetation. Green Valley Development experiences residential lot, street, and structure flooding in nearly every rainfall event. Figures 1-5 illustrate the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-year storms, respectively. These maps illustrate the depth of flooding as follows: light blue represents a depth of 3 to 6 inches, blue 6 to 9 inches, green 9 to 12 inches, yellow 1 to 2 feet, orange 2 to 3 feet, and red more than 3 feet.

Colonia: Green Valley Dev., Hidalgo County

Potential Solutions:

- The following structural alternatives are proposed to improve drainage within this colonia:
  - Install new underground drainage system with a retention pond
  - Install roadside swales
  - Install grassy swales between lots
- The non structural alternatives for this project are as follows:
  - Elevate structures
  - Buyout of flood prone properties
  - Land use zoning change
  - Set construction regulations

Recommended Mitigation Project:

Project Description:

To reduce local flooding potential, the recommended project includes minor improvements to the roadside drainage system with a retention facility. The improvements include 495 linear feet of 18-inch diameter pipe, 100 linear feet of 24-inch diameter pipe, 195 linear feet of 30-inch diameter pipe, 190 linear feet of 36-inch diameter pipe, 2,600 linear feet of grassy swale, 3,165 linear feet of roadside ditch grading and excavation, and associated pavement improvements. The proposed retention pond is sized to retain on-site runoff up to the 25-year storm with a total effective storage area of 1.6 acre-feet.

The goal of this study was to size the system to be capable of carrying up to the 10-Year storm runoff with no inundation in the colonia. However, some structures lie within low areas of the colonia and still show risk of flooding. When comparing the 6-inch inundation map for the 25- and 100-Year storms, it is observed that the inundation depths are lower than the existing conditions model, resulting in fewer structures at risk of being flooded once improvements are in place. Figures 1, 2, 3, 4, and 5 show the existing and proposed conditions inundation maps for the 2-, 5-, 10-, 25-, and 100-Yr storms respectively.

Potential Challenges:

The potential challenges would be acquisition of land for the proposed retention pond, potential utility adjustments, and coordination required for improvements on private property. While the proposed improvements reduce local flooding potential, flooding potential due to significant regional storm events will remain unchanged.

Estimate of Probable Cost:

ENGINEER'S STATEMENT OF PROBABLE CONSTRUCTION COST
Green Valley Development Colonia

	IMPROVEMENTS		COST
1	**PAVING IMPROVEMENTS**	$	31,377.78
2	**DRAINAGE IMPROVEMENTS**	$	112,570.00
3	**POND EXCAVATION IMPROVEMENTS**	$	185,372.00
	Sub-Total =	$	329,319.78
	Engineering (10%)	$	32,931.98
	Contingency (20%)	$	65,863.96
	Total =	$	428,115.71

NOTE: Excludes cost of land acquisition for necessary drainage easements and environmental permitting. Land acquisition required for retention pond is approximately 1.6 acres. Unit prices for probable construction cost were developed using bid tabulations from projects within the Rio Grande Valley. The unit prices were taken from projects that were bid in the years 2014-2015.

Colonia: Green Valley Dev., Hidalgo County

"Filling the Gap"

Recommended Mitigation Project cont.:

Project Benefits:

The table below displays the number of structures where water is deemed to be above the estimated finished floor elevation for each flood recurrence interval.

Flood Recurrence Interval	Pre-Project Inundated Structures	Post-Project Inundated Structures	Structures Removed
50% (2-year)	4	0	4
20% (5-year)	7	0	7
10% (10-year)	8	0	8
4% (25-year)	8	0	8
1% (100-year)	12	0	12

The table below displays potential flood mitigation solutions, the associated computed project benefits, and the estimated project cost. Project benefits are computed using FEMA's Flood Module version 5.1. This Flood Module is used to generate project benefit representing a present value of future damages that are estimated to occur over the useful life of the project (in our case, 50 years). A benefit to cost ratio is computed by dividing the project benefits by the estimated cost of the project.

Solution	Avoided Damages	Cost	Benefit-Cost Ratio
Drainage Improvement Project	$6,422,399	$428,115	15.00
Elevate Structures	$6,422,399	$1,402,725	4.58
Acquisition/Supplemental Housing/Demolition	$6,789,814	$1,452,911	4.67

Colonia: Green Valley Dev., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

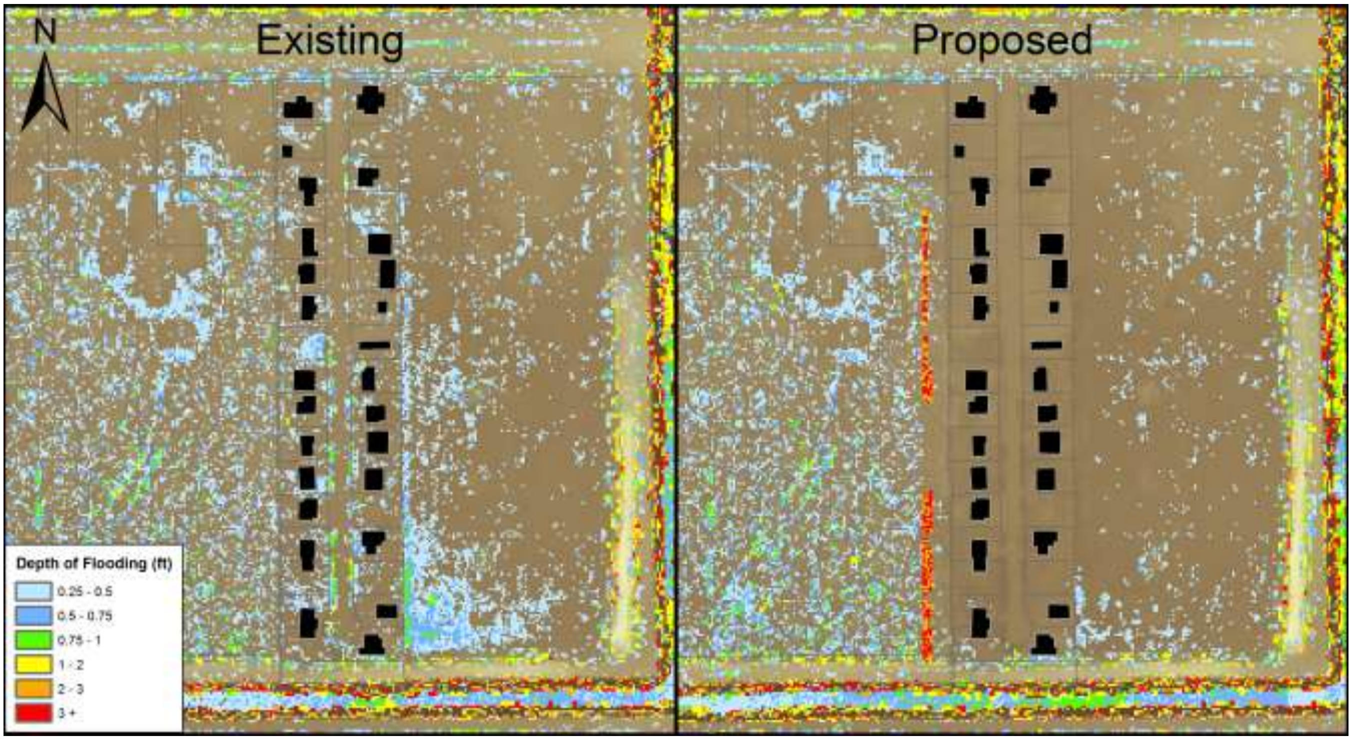


Figure 1: Existing and Proposed Conditions - 2-yr Storm Inundation Map

Project Benefits:

50% (2-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	4	0	4
Inundated Lots	35	9	26
Inundated Roadway (LF)	25	25	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation map above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Green Valley Dev., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

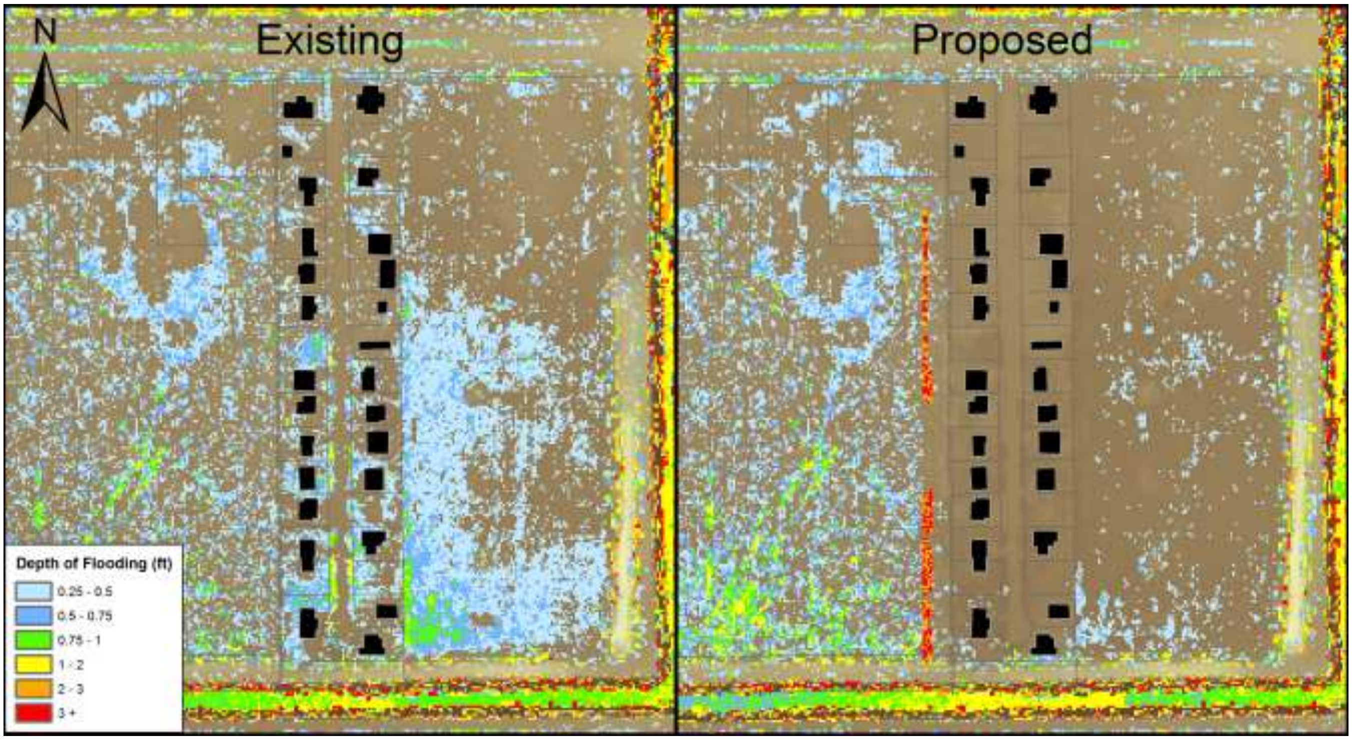


Figure 2: Existing and Proposed Conditions - 5-yr Storm Inundation Map

Project Benefits:

20% (5-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	7	0	7
Inundated Lots	35	11	24
Inundated Roadway (LF)	25	25	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Recommended Mitigation Project cont.:

Project Figures:

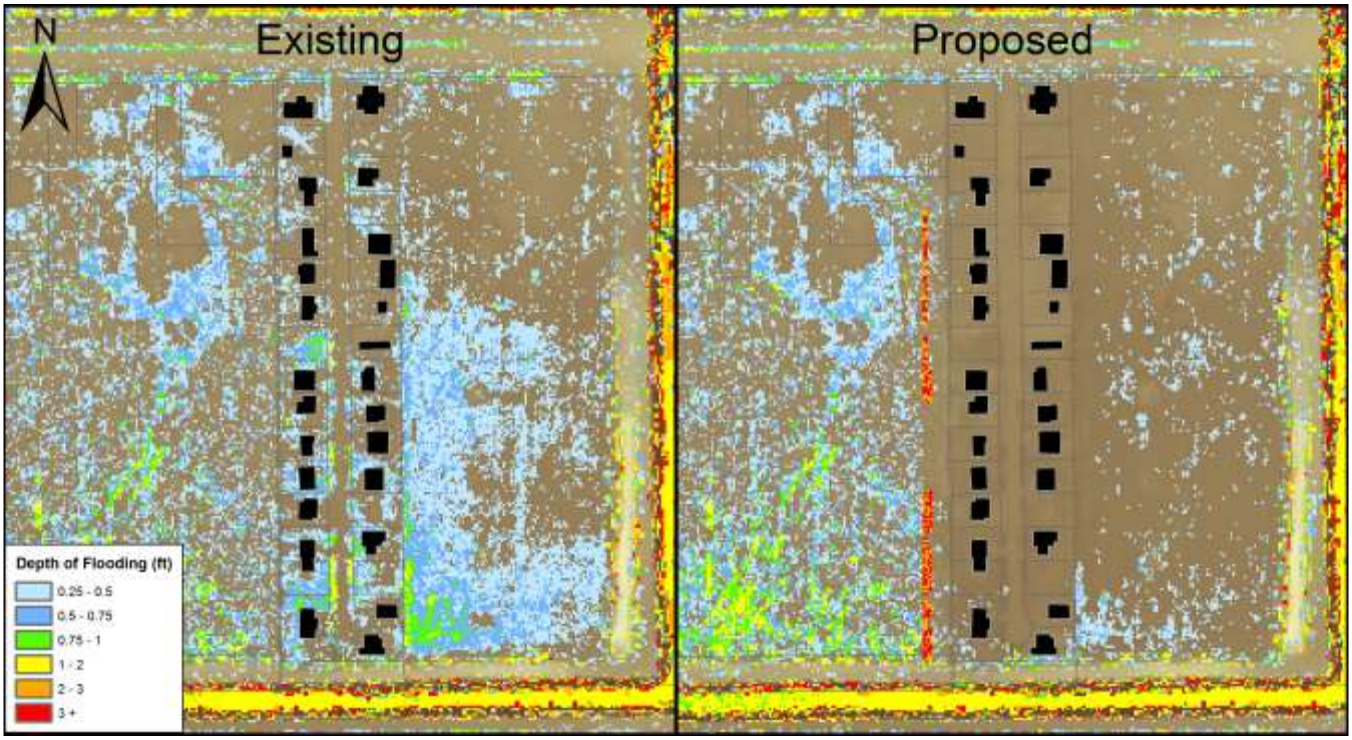


Figure 3: Existing and Proposed Conditions - 10-yr Storm Inundation Map

Project Benefits:

10% (10-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	35	11	24
Inundated Roadway (LF)	25	25	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Green Valley Dev., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

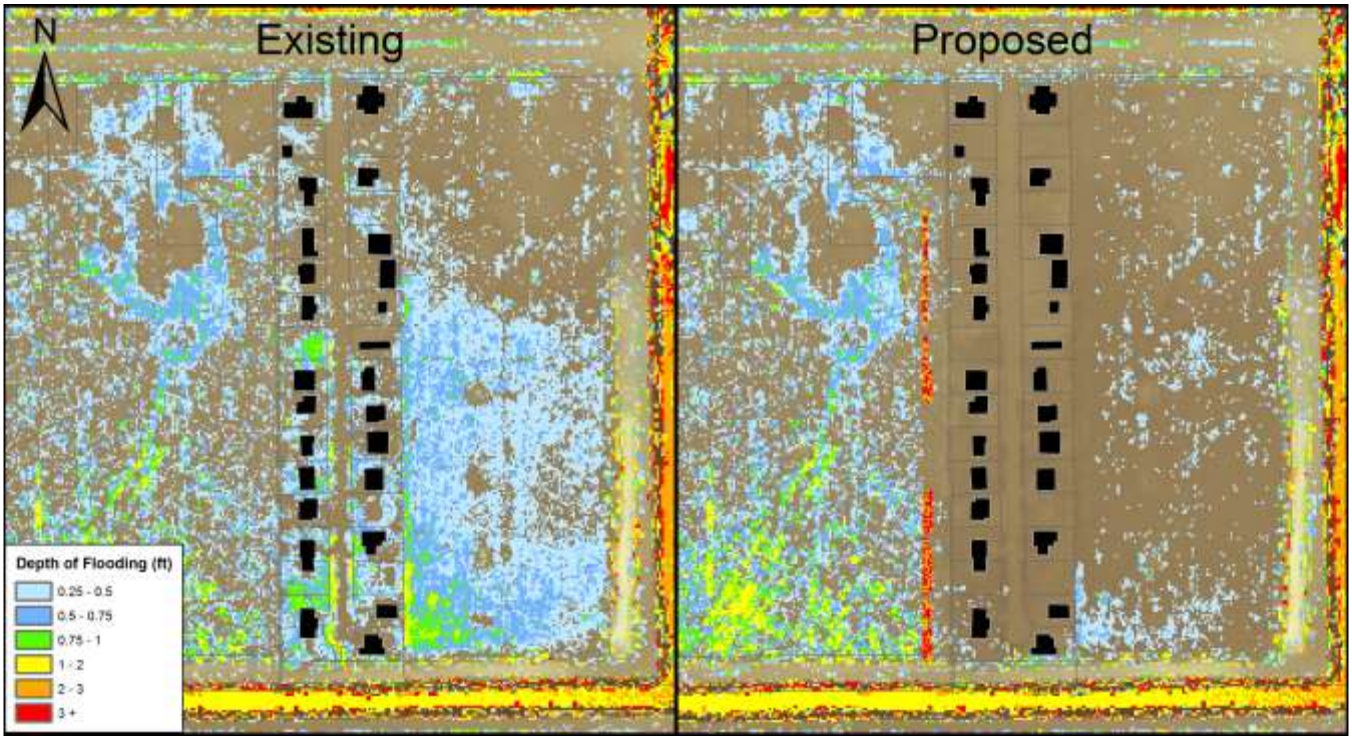


Figure 4: Existing and Proposed Conditions - 25-yr Storm Inundation Map

Project Benefits:

4% (25-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	8	0	8
Inundated Lots	35	13	22
Inundated Roadway (LF)	25	25	0

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.

Colonia: Green Valley Dev., Hidalgo County

Recommended Mitigation Project cont.:

Project Figures:

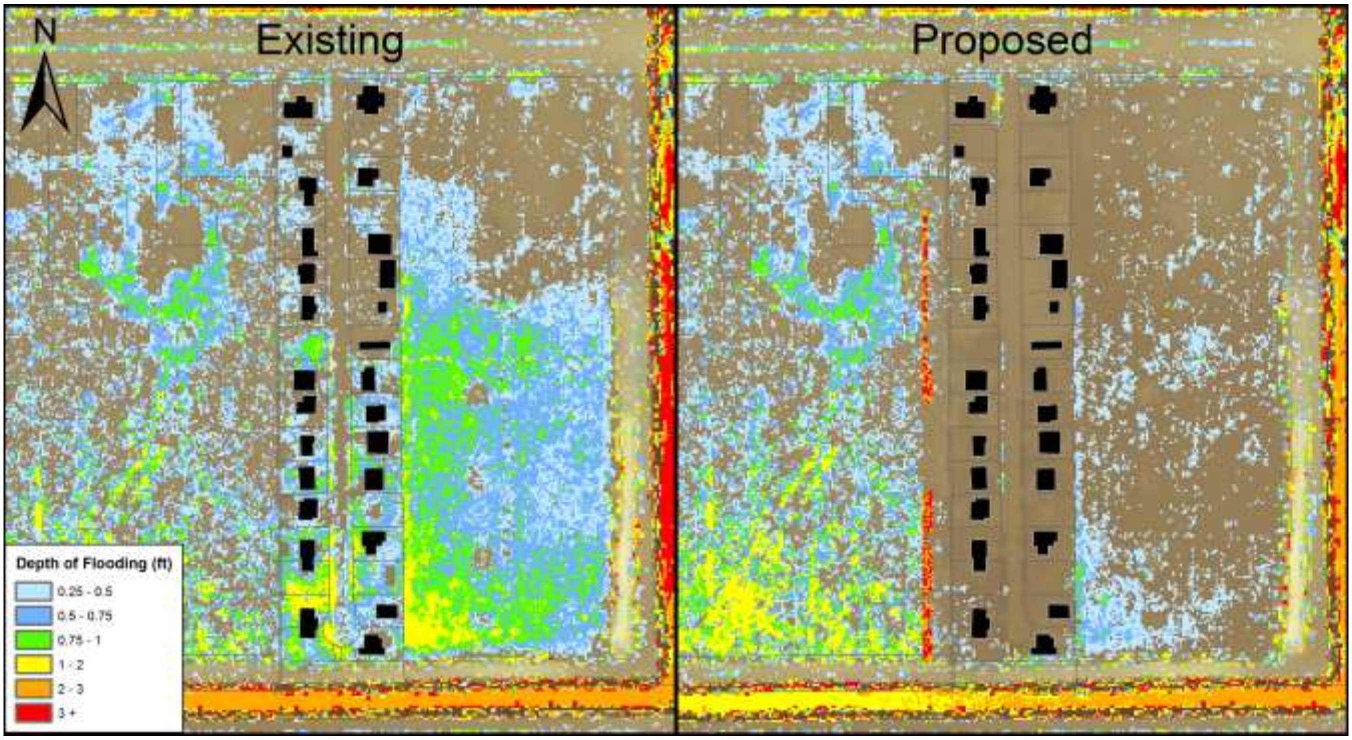


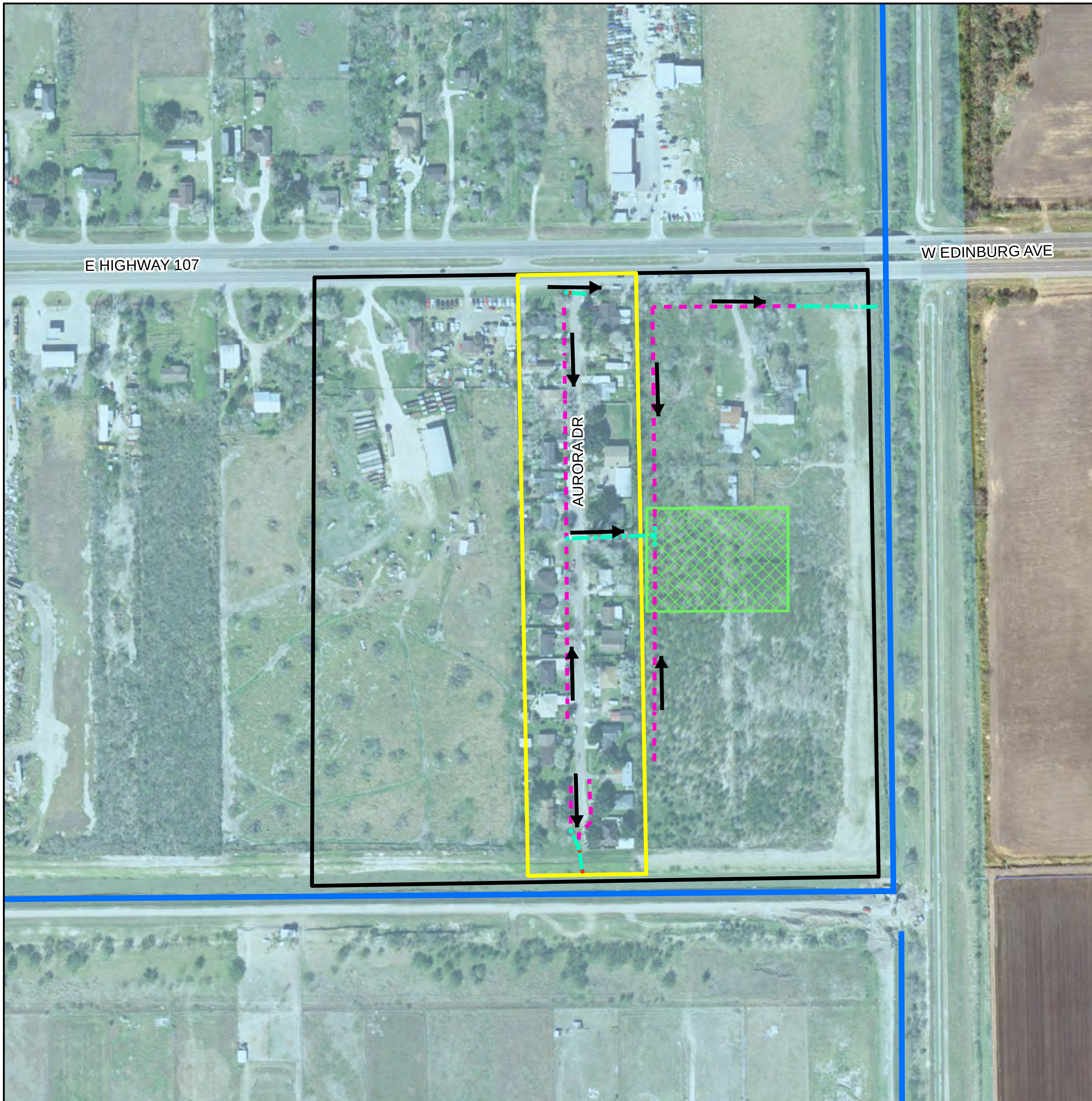
Figure 5: Existing and Proposed Conditions - 100-yr Storm Inundation Map

Project Benefits:

1% (100-Year) Flood Recurrence	Pre-Project	Post-Project	Removed
Inundated Structures	12	0	12
Inundated Lots	35	23	12
Inundated Roadway (LF)	115	25	90

Notes:

1. The number of inundated structures are based strictly on finished floor elevations compared to computed water surface elevations.
2. The inundation maps above only display flooding depths greater than 3 inches.
3. The number of inundated lots are based strictly on the inundation maps above and therefore do not count as inundated if the depth of flooding is less than 3 inches.



Stormwater Drainage Planning for the Colonias of the Lower Rio Grande Valley

Colonia: Green Valley Dev.
County: Hidalgo County

Recommended Conceptual Plan

NOT FOR CONSTRUCTION

Legend

- Proposed Drainage Pattern
- Proposed Stormwater System
- Proposed Drainage Swales
- Existing Drainage Swales
- Existing Stormwater System
- Existing Drainage Ditches
- Existing Floodplain
- Proposed Retention Pond
- Green Valley Development
- Drainage Area

N

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"Filling the Gap"