CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS & ENGINEERING

PRE-ENGINEERING OF STREET AND PAVING IMPROVEMENTS

FOR

GELLHORN DRIVE

(N-2016T-0015)

FROM IH-610 TO IH-10

STATE OF TEXAS
COSTAS K. GEORGHIOU
58255
REGISTERED PROFESSIONAL ENGINEER

11/30/2017

PREPARED BY:

PGAL

F-2742
3131 BRIARPARK
HOUSTON, TEXAS 77042
713.622.1444

NOVEMBER 2017

TABLE OF CONTENTS

Executive Summary

1.0 Summary of Candidate Project

2.0 Summary of Need Area

3.0 Summary of Problems

4.0 Candidate Project
- **4.1 Candidate Project Forms**
- **4.2 Candidate Project Exhibits**

EXHIBIT A – Location Map
EXHIBIT B – Proposed Roadway Layout
EXHIBIT C – Proposed Storm & Utility Layout

APPENDICES

APPENDIX 1 – Planning 1 (Problem Definition)
APPENDIX 2 – Planning 2 (Alternatives)

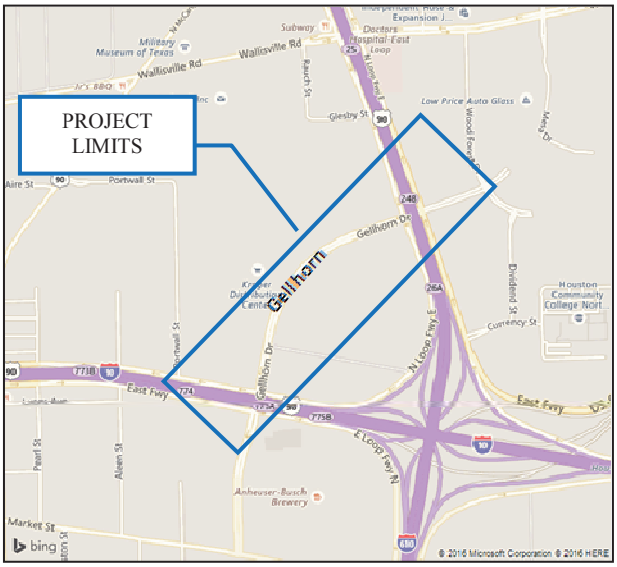
EXECUTIVE SUMMARY

INTRODUCTION

This pre-engineering study has been prepared by PGAL for the City of Houston (City) under the terms of the Contract for Professional Engineering Services for pre-engineering services for Gellhorn Drive from IH-10 to IH-610, N-2016T-0015.

The purpose of the study is to provide assessment of existing conditions, identify the needs, provide alternative solutions and recommendations for street and paving improvements, drainage concepts, water line and sanitary sewer utility improvements, and cost estimates.

The 0.7-mile project is located in northeast Houston (Key Map 495 C & G, Council district B), between IH-10 on the south and IH-610 on the north (See the location map below).



EXISTING CONDITIONS

Gellhorn currently exists as a divided 4-lane major thoroughfare in a 100-foot wide right-of-way (T-4-100). The roadway was built approximately 50 years ago. Development is generally comprised of industrial properties. Horizontal geometry consists of one curve between two tangent sections.

The concrete pavement is generally in very poor condition with major cracks, potholes, and deteriorated asphalt patches. Sidewalks are 4 feet wide and in fair to poor condition and not continuous throughout the study area. There are two major intersections, each with outdated pedestrian features: IH-10 and IH-610.

Metro bus route #11 runs in both directions along Gellhorn, with 4 stops on each side.

NEEDS IDENTIFICATION is evaluated in three major categories; Street and Traffic, Drainage, and Utility Needs (Water and Wastewater).

The pavement condition index (PCI) initially provided by the City of Houston indicates that the existing pavement is in good condition, with an average rating of 80. The average PCI of 80 has been determined to be an anomaly and not representative of the observed conditions. The City of Houston has recommended a PCI of 35 to properly evaluate the study area. Additional deficiencies include outdated signal equipment and wheelchair ramps that do not meet current ADA standards. Metro bus stops provide a proper landing pad, but no contiguous sidewalk.

The preliminary traffic capacity analyses indicate that Gellhorn is within acceptable LOS for 2016 ADT and 2040 ADT, based on existing geometry.

The study area's limits lie in the Hunting Bayou watershed and existing drainage is provided by two storm sewer systems that serve a total area of 56.4 acres. According to record drawings and GIMS the storm sewer systems were built in or around 1967. The storm sewer pipe sizes range from 30 to 48 inches in diameter. The storm sewer systems drain into HCFCD Unit H125-00-00 and H103-00-00. The Comprehensive Drainage Plan (CDP) indicates that both existing systems can convey a 2-year storm event and both are inadequate for the 100-year storm. Most of the southern half of the study area is located within Hunting Bayou's 100-year floodplain. Between both systems, there are no reported cases of structural flooding, repetitive losses, or 311 ROW flooding complaints. Representatives from the Kroger Distribution Center contacted the City of Houston to bring attention to deficiencies of H125-00-00 near their facility.

Existing water and sanitary sewers within the project area were researched utilizing the City of Houston's GIMS website and record drawings. The project area is served by a 12-inch waterline running along Gellhorn Drive. Sanitary sewer lines run along Gellhorn ranging from 8 to 10 inches, while lines ranging from 18 to 24 inches cross Gellhorn. The City of Houston has requested the following utility improvements: remove and replace the 12-inch waterline between IH-10 and IH-610 and to

EXECUTIVE SUMMARY

rehabilitate or remove and replace the 15- and 18-inch sanitary sewer.

CenterPoint Energy (CPE) provided gas and electric utility maps as logged under Center Point Energy ID 1403169794. A 6" HP STL line runs along Gellhorn from IH-10 to IH-610. Street lighting in the project area is provided by cobra-head light fixtures mounted on wooden poles. Overhead power lines run along and cross Gellhorn at several locations. No major pipelines have been identified.

PROPOSED ALTERNATIVES

Two alternative solutions have been developed for Gellhorn Drive. Alternative 1 calls for the reconstruction of Gellhorn as a 4-lane divided boulevard, with 27-foot wide pavement in each direction. It also calls for the construction of a 6-foot sidewalk. Right-of-way acquisition is not required.

Alternative 2 calls for the reconstruction of Gellhorn to include a median and 2 11-foot travel lanes and a 5-foot bike lane with a 3-foot buffer in each direction. It also calls for the construction of a 6-foot sidewalk. Right-of-way acquisition is not required

CANDIDATE PROJECT DEVELOPMENT

The estimated cost of Alternative 1 is approximately $11,906,333. The estimated cost of Alternative 2 is approximately $12,160,029.

RECOMMENDATIONS

Alternative 2, which enhances pedestrian and bicyclist safety, is recommended for implementation. Drainage and utility improvements to meet city requests and criteria are included.

The total project cost of the recommended alternative is $12,160,029. The calculated score of this alternative is 29.88.

Due to a low score and a diminished likelihood that Alternative 2 advances to the design phase, an alternative solution for the City is to seek funding for the reconstruction of the pavement via its N-321039 Roadway Pavement Replacement Program. If funding is obtained from N-321039, it is recommended for the roadway to be reconstructed with a 17-foot median, four 11-foot travel lanes, and two 8-foot off-street shared-use paths. Not including possible limited inlet improvements, the approximate cost of this is $6,782,510.

Recommendations that address the Kroger Distribution Center's concerns over H125-00-00 have also been provided. The estimated cost of these recommendations is $2,060,420.

1.0 Summary of Candidate Project

Name of Project: **Need Area No:**	Gellhorn Drive from IH-10 to IH-610 N-2016T-0015
Project Scope & Description	Reconstruct Gellhorn with medians to include buffered bike lanes; construct 6-foot sidewalks and provide necessary upgrades to storm sewer system and utilities. No right-of-way acquisition is required.
Project Limits	IH-10 to IH-610
Type	Major Thoroughfare (T-4-100)
Council District	B
Key Map No.	495 C & G
Super Neighborhood	Pleasantville Area
Project Length	0.7 miles
Project Cost	$12,160,029

2.0 Summary of Need Area

The project is approximately 0.7 miles long and is located in northeast Houston between IH-10 and IH-610 in the Pleasantville Area super neighborhood.

The roadway was built approximately 50 years ago and currently exists as a four-lane road in a 100-foot right-of-way. The development adjacent to the roadway is mainly comprised of industrial properties.

3.0 Summary of Problems

The pavement is generally in very poor condition with a recorded Pavement Condition Index (PCI) of 78-85. The City of Houston considers the recorded PCI for Gellhorn an anomaly and has recommended a PCI of 35 for scoring and evaluation purposes.

The 4-lane roadway has sufficient capacity for the projected 2040 traffic volumes.

The traffic signals are outdated and pedestrian facilities do not meet current ADA standards.

Drainage; the existing drainage systems are generally adequate to convey the 2-year storm event but the 100-year storm event conveyance requirements are not fully satisfied.

Utilities; waterline and sanitary upgrades have been requested by the City of Houston Planning Group. These upgrades include 3,690 LF of 12-inch waterline and 3,220 LF of proposed 8- and 15-inch sanitary sewer.

4.0 Candidate Project

The candidate project recommended for implementation is Alternative 2, which involves the reconstruction of Gellhorn Drive as a divided boulevard with four 11-foot travel lanes and two 5-foot on-street bike lanes with 3-foot buffers. This alternative maintains the existing roadway configuration and accommodates for the bike facilities planned by the Houston Bike Plan. It requires traffic signal modernization at the intersection of Gellhorn and IH-610 and a traffic signal warrant study will need to be performed at the intersection of Gellhorn and IH-10. Sidewalks are to be reconstructed to be 6 feet wide on both sides of the roadway between IH-10 and IH-610. The Candidate Project also includes drainage upgrades that require the upsizing of storm pipes in one of the two analyzed drainage systems to reduce 100-year event flooding. The Candidate project recommends, but does not include, the cleaning, regrading, and culvert upsizing for ditch H125-00-00 near the Kroger Distribution Center, as detailed in Appendix 1 of Planning 2 (Alternatives). The estimated cost of the recommended work at H125-00-00 is $2,060,420, including contingencies, design fees, and construction fees. Mitigation in the form of in-line detention is recommended due to impacts caused by storm sewer upgrades to the receiving streams; 0.47 ac-ft of storage is provided. Drainage assumptions and methodology can also be found in Appendix 1 of Planning 2 (Alternatives). Waterline and sanitary upgrades have been requested by the City of Houston's utility groups, and

include 3,690 LF of 12-inch waterline improvements and over 3,220 LF of new 8-inch and 15-inch sanitary sewer. The utility recommendations have been implemented into the proposed storm and utility layouts in Exhibit C. There are no recommendations to relocate existing Metro bus stops. During the design phase, consideration should be given to the proper access of bus stops and the adequacy of landing pads.

The Candidate Project Priority Score (CPPS) for this project is 29.88, with a total cost of $12,160,029 and a ReBuild Houston cost of $8,691,164. See the Candidate Project Forms section for Form Y and a detailed cost breakdown. The proposed improvements are depicted in Exhibits B & C.

Due to a low CPPS, the project is unlikely to advance to the design phase. It is recommended that funding to reconstruct the pavement be pursued from the City of Houston's N-321039 Roadway Pavement Replacement Program. The pavement's existing, dire conditions are limiting to the safety and accessibility of drivers and should be a priority for reconstruction. If the project is able to obtain funding from the N-321039 program, it is recommended for the roadway to be rebuilt with a 17-foot median, four 11-foot travel lanes, and two 8-foot off-street shared-use paths. The design engineer should also consider the addition of storm inlets in order to reasonably meet City of Houston storm criteria. Not including possible drainage enhancements, this undertaking would approximately cost $6,782,510.

FY 2018 Candidate Projects ($ Thousands)
Street & Traffic Control Program - Thoroughfares

Candidate Project Summary Information

Need Area:	*N-2016T-0015*	**Alternative No.:**	**2 4 Lanes Reconstruction**
Name:	*GELLHORN*	**Council District:**	**B**
Limits:	*INTERSTATE 10 TO INTERSTATE 610*	**Key Map No.:**	**495 C&G**
Type:	Thoroughfare	**Super Neighborhood:**	**PLEASANTVILLE AREA**
WBS No.:	N-000100-0003-3	**Total No. of Sub-projects:**	**1**
Description:	*Project provides for the design and construction of a 4-Lane Divided concrete with curbs, sidewalks, driveways, street lighting, traffic control and necessary underground utilities. Project includes no crossings.*		
Justification:	*Project will replace (and widen) a street that has been deteriorated beyond economical repair and normal maintenance. It will improve traffic circulation, mobility and drainage in service area. These improvements will upgrade existing roadway to MTFP standards, if applicable.*		

Implementation - Estimated Cost and Duration

	City Funds	Other Entities Funds	Total	Duration
Total Project Cost	$ 12,160	$ -	$ -	
Acquisition	$ -	$ -	$ -	18 Months
Design	$ 2,079	$ -	$ -	24 Months
Construction	$ 7,995	$ -	$ -	24 Months
Contingency	$ 2,086	$ -	$ -	NA
Private Utility Reloc.	$ -	$ -	$ -	Months
Warranty	$ -	$ -	$ -	12 Months

Candidate Project Priority Scores

Infrastructure Categories	Benefit Scores (Total Maximum 100)	
	Maximum	**Actual**
Streets	**75**	**39**
Drainage System	**15**	**4**
Water	**5**	**0**
Wastewater	**5**	**2**
Total	**100**	**45**
	Service Area Benefit score:	45
	Benefitted Population:	8,217
	Rebuild Houston Funds:	$ 8,691
	Candidate Project Priority Score:	**29.88**
	Candidate Project Priority Rank No.:	(To be assigned by the City)

Other Entities & Jurisdictions Coordination

Entities		Coordination For
TxDOT	☑	Intersection work
Metro	☑	Bus stops
HCFCD	☐	
Gulf Coast Railroad District	☐	
Union Pacific Rail Road	☐	
Harris County	☐	
Fort Bend County	☐	
Private Utilities	☑	
CenterPoint		Potential conflicts
AT&T		Potential conflicts
Municipalities	☐	
(Name of municipality)		
(Name of municipality)		
Other	☐	
Other	☐	

Sequencing Requirements (SR) and Other Considerations

SR:	
Permits:	
Other:	

Maintenance - Estimated Cost and Frequency (By the City)

Asset Categories	Estimated Asset Life	Maintenance Items	Cost	Schedule/Frequency
Streets	40-years	Street Sweeping	$ -	4 Times Annually
		Overlay	$ -	N/A
		Pot Hole Patch	$ -	As needed - typically starts year 25
		Panel Repair	$ -	As needed
Storm Drainage	50-years	Point Repair	$ -	
			$ -	
Water	50-years	Point Repair	$ -	
			$ -	
Wastewater	50-years	Point Repair	$ -	
			$ -	

CANDIDATE PROJECT PRIORITY SCORE

Need Area N-2016T-0015 Gellhorn
Alternative 2 (4 Lane Reconstruction)
Firm PGAL
Date 11/30/2017

Infrastructure Category	Weight	SubCategory	Point Range	Formula	Points ub-Category	Total
Streets	75%	Pavement Condition (60%)	0-60	0.60 x (100-35)	39	**39.00**
		Traffic Level of Service (15%)	0-15	Intersections Score	0.00	
Drainage	15%		0-15			**3.90**

Drainage Key

Drainage ID	Drainage Area (acres)	Pre-Project Extreme Event	Pre-Project Design Event	Candidate-Project Extreme Event	Candidate-Project Design Event
H0051	21.97	I	A	A(10)	A (0)
H0052	34.4	PA	A	PA(0)	A(0)

I	Inadequate
A	Adequate
PA	Partially Adequate

AVERAGE *3.90* *0*

Water	5%	WIRP Rank	0-5	**Keymap**	WIRP RANK	**0.47**
				495C	945	0.48
				495G	950	0.45
				AVERAGE		0.47
Wastewater	5%	Sanitary Sewer Overflows or Agreed Order	0-5		1.33	**1.78**
		Point Repair			0	
		Age of Pipe			0.45	
					Service Area Benefit Factor	**45.15**

Benefitted Population	35% Current ADT + 65% Future ADT + Current Metro Ridership			8217
	Current ADT	3702	35% of Current ADT=	1296
	Future ADT	5705	65% of Future ADT=	3708
	Current Metro Ridership	3213	Metro Ridership=	3213

Candidate Project Priority Score = Service Area Benefit Factor x (Benefitted Population/City ReBuild Houston Funds) X Project Center Line Mile

Service Area Benefit Factor =		45.15
Benefitted Population =		8217
City ReBuild Houston Funds=	$	8,691
Project Center Line Miles =		0.70

Candidate Project Priority Score= **29.88**

Pre-Engineering Services Contracts

Total Project Cost Estimate Breakdown (FY18 Dollars)

Need No. N-2016T-0015 GELLHORN ALTERNATIVE 2

1	**410 (Summarized based on FY 18 List of Unit Prices)**		$6,952,561.00
	1.1	Total Unit Price, Paving Items	$4,369,555.00
	1.2	Total Unit Price, Storm Sewer Items	$599,664.00
	1.3	Total Unit Price, Water Items	$879,743.00
	1.4	Total Unit Price, Wastewater Items	$1,103,599.00
2	**Contingency (30% of 410)**		**$2,085,768.30**
3	**Construction Management (15% of 410)**		**$1,042,884.15**
4	**Engineering Fee Estimate (20% of Sum of 410 and Contingency)**		**$1,807,665.86**
5	**Design Management (15% of Engineering Fee Estimate)**		**$271,149.88**
6	**Land Acquisition (Engineer's Best Estimate)**		**$0.00**
	Total Project Cost		**$12,160,029.19**

Note: General Items are prorated in Paving, Storm, Water & Wastewater items.

Pre-Engineering Services Contracts

COH Rebuild Funds

Need No. N-2016T-0015 GELLHORN ALTERNATIVE 2

1	**410 (Summarized based on FY 18 List of Unit Prices)**		$4,969,219.00
	1.1	Total Unit Price, Paving Items	$4,369,555.00
	1.2	Total Unit Price, Storm Sewer Items	$599,664.00
2	**Contingency (30% of 410)**		**$1,490,765.70**
3	**Construction Management (15% of 410)**		**$745,382.85**
4	**Engineering Fee Estimate (20% of Sum of 410 and Contingency)**		**$1,291,996.94**
5	**Design Management (15% of Engineering Fee Estimate)**		**$193,799.54**
6	**Land Acquisition (Engineer's Best Estimate)**		**$0.00**
	Total Project Cost		**$8,691,164.03**

Note: General Items are prorated in Paving & Storm items.

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
PRE-ENGINEERING OF STREET AND PAVING IMPROVEMENTS
N-2016T-0015 GELLHORN (4-LANE OPTION W/17' MEDIAN)
INTERSTATE 10 TO INTERSTATE 610
PRELIMINARY CONSTRUCTION COST ESTIMATE

SUMMARY

SUB-TOTAL PAVING ITEMS	$4,369,555
SUB-TOTAL STORM SEWER ITEMS	$599,664
SUB-TOTAL SANITARY SEWER ITEMS	$1,103,599
SUB-TOTAL WATER LINE ITEMS	$879,743
SUMMARY OF 410 COSTS	$6,952,561
CONSTRUCTION MANAGEMENT (15% OF 410 TOTAL)	$1,042,884
CONTINGENCIES (30% OF 410 TOTAL)	$2,085,768
ENGINEERING FEE ESTIMATE (20% OF 410 TOTAL & CONTINGENCIES)	$1,807,666
DESIGN MANAGEMENT (15% OF ENGINEERING FEE ESTIMATE)	$271,150
LAND ACQUISITION	$0
TOTAL PROJECT COST	**$12,160,029**

B2. UNIT PRICE TABLE FOR PAVING

Item No.	Item Reference No.	Spec No.	Item Description	Unit Measure	Unit Quantity	FY18 Unit Price (this column controls)	Total in Figures
1	222101	02221	Remove and Dispose of Existing Pavement and Curb -Assumes all concrete pavement thicknesses with or without asphalt overlay	SY	22,324	$ 6.00	$ 133,944.00
2	222102	02221	Remove and Dispose of Existing Driveways and Sidewalks	SY	2,235	$ 5.00	$ 11,175.00
3	231501	02315	Roadway Excavation	CY	9,392	$ 16.00	$ 150,277.33
4	233602	02336	Lime stabilized subgrade (8" thick)	SY	31,558	$ 4.00	$ 126,232.96
5	233603	02336	Lime (6% By Weight)	TON	757	$ 164.00	$ 124,213.23
6		02581	2" Sch. 40 Street Lighting Conduit	LF	3,800	$ 8.00	$ 30,400.00
7	275106	02751	11” Reinforced Concrete Pavement (Complete in Place)	SY	28,177	$ 70.00	$ 1,972,390.0
8	275401	02754	6” Concrete for Driveways	SF	9,832	$ 8.00	$ 78,656.00
9	277101	02771	6” Concrete Curb	LF	12,582	$ 4.00	$ 50,328.00
10	277501	02775	4-1/2” Concrete for Sidewalks	SF	38,798	$ 7.00	$ 271,586.00
11			Small signs	MI	0.8	$ 5,000.00	$ 4,000.00
12			Pavement Markings	MI	0.8	$ 10,000.00	$ 8,000.00
13	289301	02893	Traffic Signal/Intersection	EA	2	$ 325,000.00	$ 650,000.00
			Ancillary Items (10%)	LS	1	$ 361,120.25	$ 361,120.25
			Subtotal of Paving				$ 3,972,322.78
			General Items (10% of Paving Items)				$ 397,232.28
TOTAL FOR PAVING/TRAFFIC SIGNAL ITEMS							**$ 4,369,555**

B3. UNIT PRICE TABLE FOR STORM SEWER ITEMS

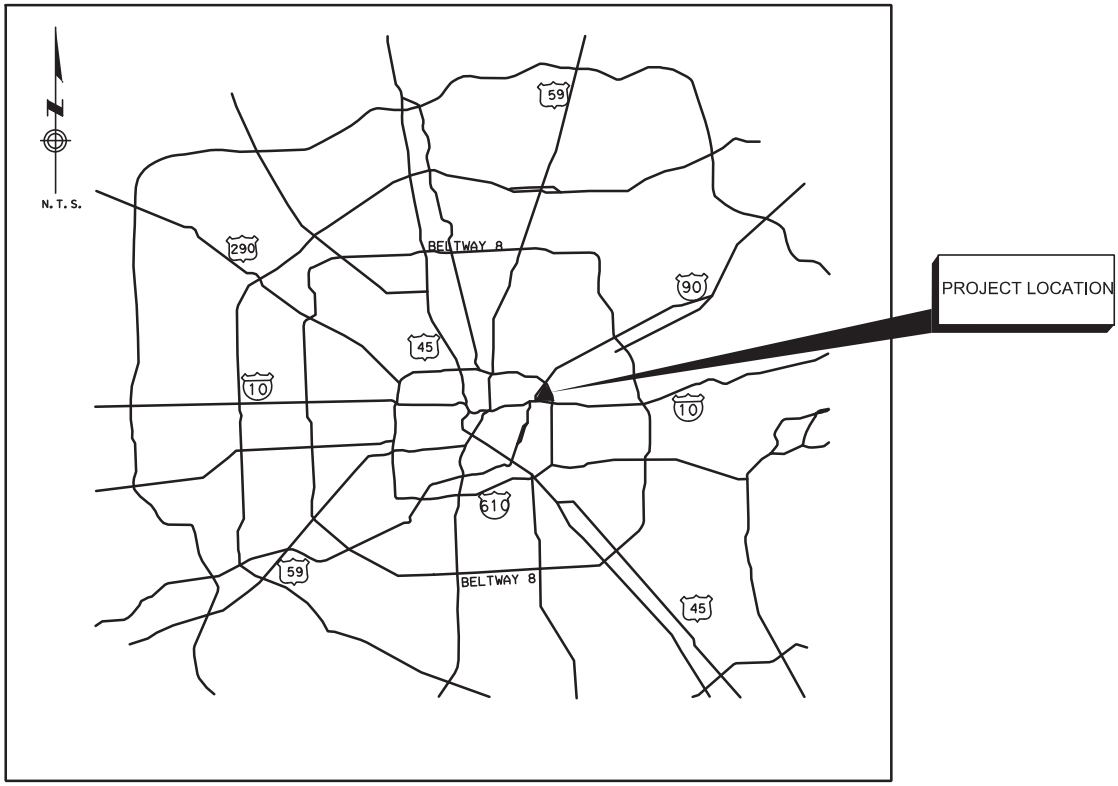
Item No.	Item Ref No.	Spec No.	Item Description	Unit Measure	Unit Quantity	FY18 Unit Price (this column controls)	Total in Figures
1	222106	2221	Remove Manholes (All Types, All Depths)	EA	3	$ 390.00	$ 1,170.00
2	222105	2221	Remove Inlets (All Types)	EA	4	$ 370.00	$ 1,480.00
3	222103	2221	Remove Storm Sewer Pipe (All Types)	LF	1,393	$ 20.00	$ 27,860.00
4	208202	02082/02087	Manholes (For 48” to 72” Dia. Pipe) (All Types)	EA	5	$ 6,340.00	$ 31,700.00
5	263101	02631	24-inch RCP	LF	152	$ 115.00	$ 17,480.00
6	263105	02631	48-inch RCP	LF	370	$ 250.00	$ 92,500.00
7	263108	02631	66-inch RCP	LF	866	$ 360.00	$ 311,760.00
8	263301	02632/02633	Curb Inlets (All Types)	EA	4	$ 2,910.00	$ 11,640.00
			Ancillary Items (10%)	LS	1	$ 49,559.00	$ 49,559.00
			Subtotal of Storm Sewer				$ 545,149.00
			General Items (10% of Storm Sewer Subtotal)				$ 54,514.90
TOTAL FOR STORM SEWER ITEMS							**$ 599,664**

B4. UNIT PRICE TABLE FOR WASTEWATER ITEMS

Item No.	Item Ref No.	Spec No.	Item Description	Unit Measure	Unit Quantity	FY18 Unit Price (this column controls)	Total in Figures
1	222109	02221	Remove Existing Sanitary Sewer Pipe (All Types)	LF	3,222	$ 20.00	$ 64,440.00
2	222108	02221	Remove Existing Sanitary Sewer Manhole (All Types)	EA	15	$ 800.00	$ 12,000.00
3	208204	02082	Sanitary Sewer Manholes (4' diameter)	EA	15	$ 4,200.00	$ 63,000.00
4	253102	02531	8” PVC	LF	404	$ 120.00	$ 48,480.00
5	253105	02531	15” PVC	LF	2,818	$ 230.00	$ 648,140.00
			Ancillary Items (20%)	LS	1	$ 167,212.00	$ 167,212.00
			Subtotal of Wastewater				$ 1,003,272.00
			General Items (10% of Wastewater Subtotal)				$ 100,327.20
TOTAL FOR WASTEWATER ITEMS							**$ 1,103,599**

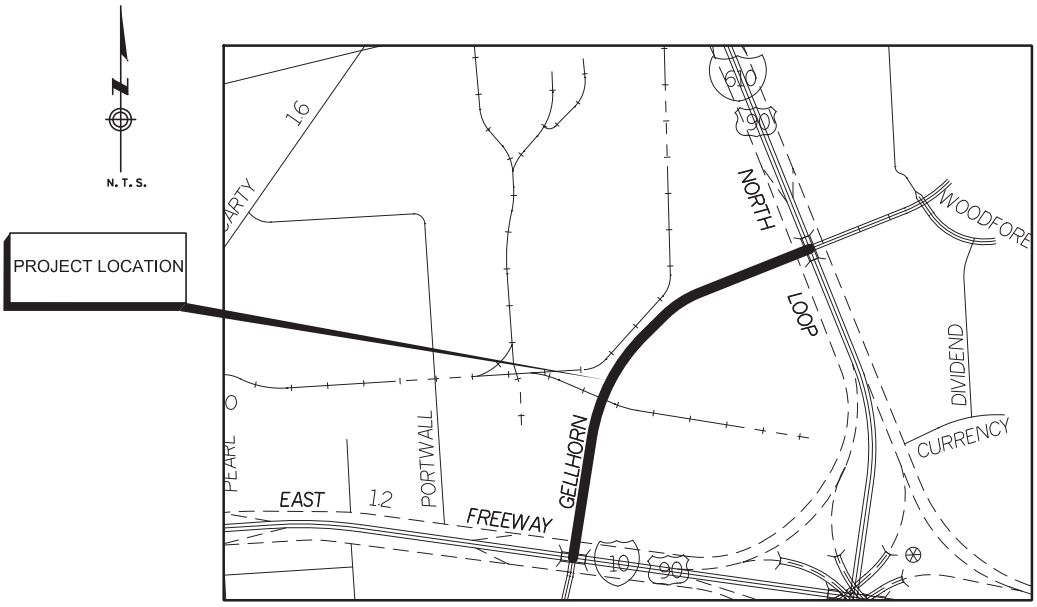
B5. UNIT PRICE TABLE FOR WATER ITEMS

Item No.	Item Ref No.	Spec No.	Item Description	Unit Measure	Unit Quantity	FY18 Unit Price (this column controls)	Total in Figures
1	251104	02511	12” Water Line	LF	3,687	$ 140.00	$ 516,180.00
2	222107	02511	Remove Existing Water Line (All Types)	LF	3,687	$ 16.00	$ 58,992.00
3	251204	02512	1½-2" Short Side	EA	12	$ 1,800.00	$ 21,600.00
4	251203	02512	1½-2" Long Side	EA	7	$ 2,500.00	$ 17,500.00
5	252001	252001	Remove and Salvage Fire Hydrants	EA	9	$ 400.00	$ 3,600.00
6	252002	252002	Fire Hydrant Assembly	EA	9	$ 5,400.00	$ 48,600.00
			Ancillary Items (20%)	LS	1	$ 133,294.40	$ 133,294.40
			Subtotal of Water				$ 799,766.40
			General Items (10% of Water Subtotal)				$ 79,976.64
TOTAL FOR WATER ITEMS							**$ 879,743**



LOCATION MAP

NTS



VICINITY MAP

NTS

STREET AND PAVING IMPROVEMENTS FOR GELLHORN DRIVE

KEYMAP NO 495 C & G
COUNCIL DISTRICT B

EXHIBIT A

LEGEND

PROP PAVEMENT

PROP SIDEWALK

TRAFFIC FLOW

PARCEL/ROW

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 100 200 400
SCALE: 1" = 400'

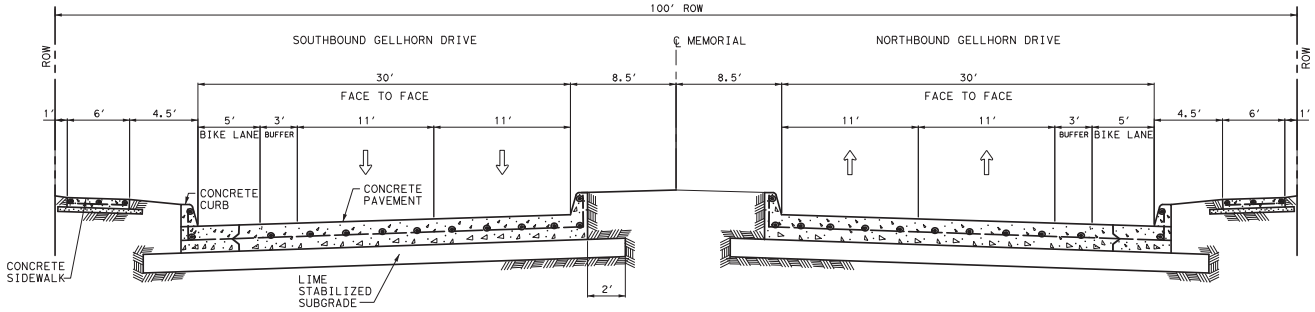
CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610
ALTERNATIVE 2
PROPOSED ROADWAY LAYOUT
OVERALL

EXHIBIT B

DATE: 11/22/2017 3:05:05 PM
P:\0017SH\0017SH_IS-CAD\SBO DSN\N-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-Prop02-Overall.dgn



(A) TYPICAL ROADWAY SECTION GELLHORN DRIVE

ALTERNATIVE 2

N.T.S.

DATE: 1/23/2017 3:07:46 PM
P:\0075\X0075_15-C40-S500 DSNW-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-Prop02-Typ X-Section01.dgn

	TBPE REG. NO. F-2742 3131 BRIARPARK Suite 200 Houston, Texas 77042 Phone (713) 622-1444 Fax (713) 968-9333 PGAL	CITY OF HOUSTON DEPARTMENT OF PUBLIC WORKS AND ENGINEERING	NEED AREA N-2016T-0015 CITY OF HOUSTON DATE 03/01/17	STREET & PAVING IMPROVEMENTS GELLHORN DR IH-10 TO IH-610 ALTERNATIVE 2 PROPOSED TYPICAL SECTION	EXHIBIT B SHEET 1 OF 1

LEGEND

PROP PAVEMENT
PROP SIDEWALK
TRAFFIC FLOW
PARCEL/ROW

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 988-9333

PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610
ALTERNATIVE 2
PROPOSED ROADWAY LAYOUT
SHEET 1 of 4

EXHIBIT B

DATE: 11/22/2017 3:04:28 PM
P:\0017SH\0017SH_IS-CAD\SBO DSN\N-0016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-Prop02_Layout1\layout001.dgn

LEGEND

PROP PAVEMENT
PROP SIDEWALK
TRAFFIC FLOW
PARCEL/ROW

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333

PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610
ALTERNATIVE 2
PROPOSED ROADWAY LAYOUT
SHEET 2 of 4

EXHIBIT B

DATE: 11/22/2017 3:04:57 PM
P:\0017SK\0017SK_IS-CADISSUD DSN\N-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC_Prop02_Layout\Layout002.dgn

LEGEND

PROP PAVEMENT
PROP SIDEWALK
TRAFFIC FLOW
PARCEL/ROW

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333

PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610
ALTERNATIVE 2
PROPOSED ROADWAY LAYOUT
SHEET 3 of 4

EXHIBIT B

DATE: 11/22/2017 3:04:45 PM
P:\0075\N0075\I5-CAD\5500 DSNW-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-Prop02-Layout\Plans003.dgn

LEGEND

PROP PAVEMENT
PROP SIDEWALK
TRAFFIC FLOW
PARCEL/ROW

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333

PGAL

0 25 50 100
SCALE: 1" = 100'

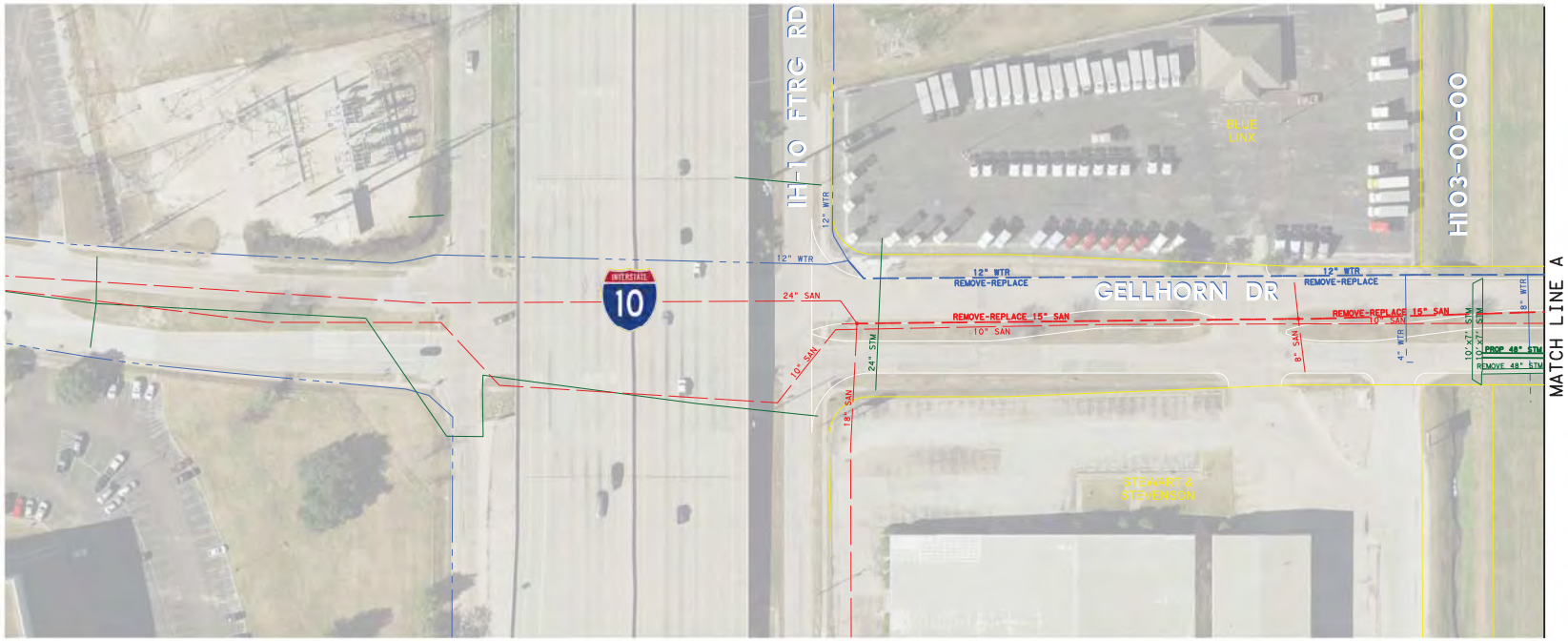
CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610
ALTERNATIVE 2
PROPOSED ROADWAY LAYOUT
SHEET 4 of 4

EXHIBIT B

DATE: 11/22/2017 3:04:55 PM
P:\0017SK\0017SK_IS-CADISSUD DSN\N-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC_Prop02_Layout1\Layout004.dgn



LEGEND

- PROP INLET
- PROP STORM SWR
- PROP STORM SWR MANHOLE
- EXIST STORM SWR
- PROP SAN SWR
- EXIST SAN SWR
- SAN SWR MANHOLE
- EXIST WTR LINE
- PROP WTR LINE

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

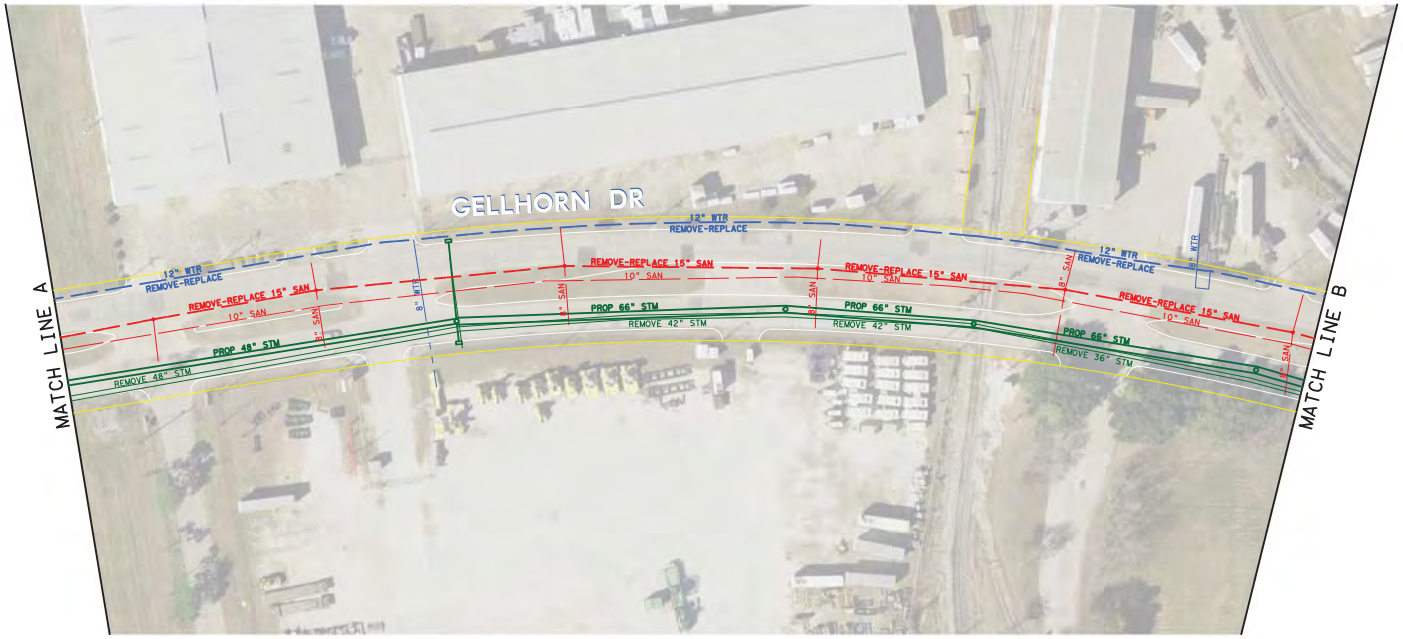
NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

PROPOSED STORM & UTILITY LAYOUT
SHEET 1 OF 4

EXHIBIT C

DATE: 11/22/2017 3:07:59 PM
P:\0017SK\0017SK_IS-CADD\SKD_DSN\N-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-UTL_Sheet01.dgn



LEGEND

- PROP INLET
- PROP STORM SWR
- PROP STORM SWR MANHOLE
- EXIST STORM SWR
- PROP SAN SWR
- EXIST SAN SWR
- SAN SWR MANHOLE
- EXIST WTR LINE
- PROP WTR LINE

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

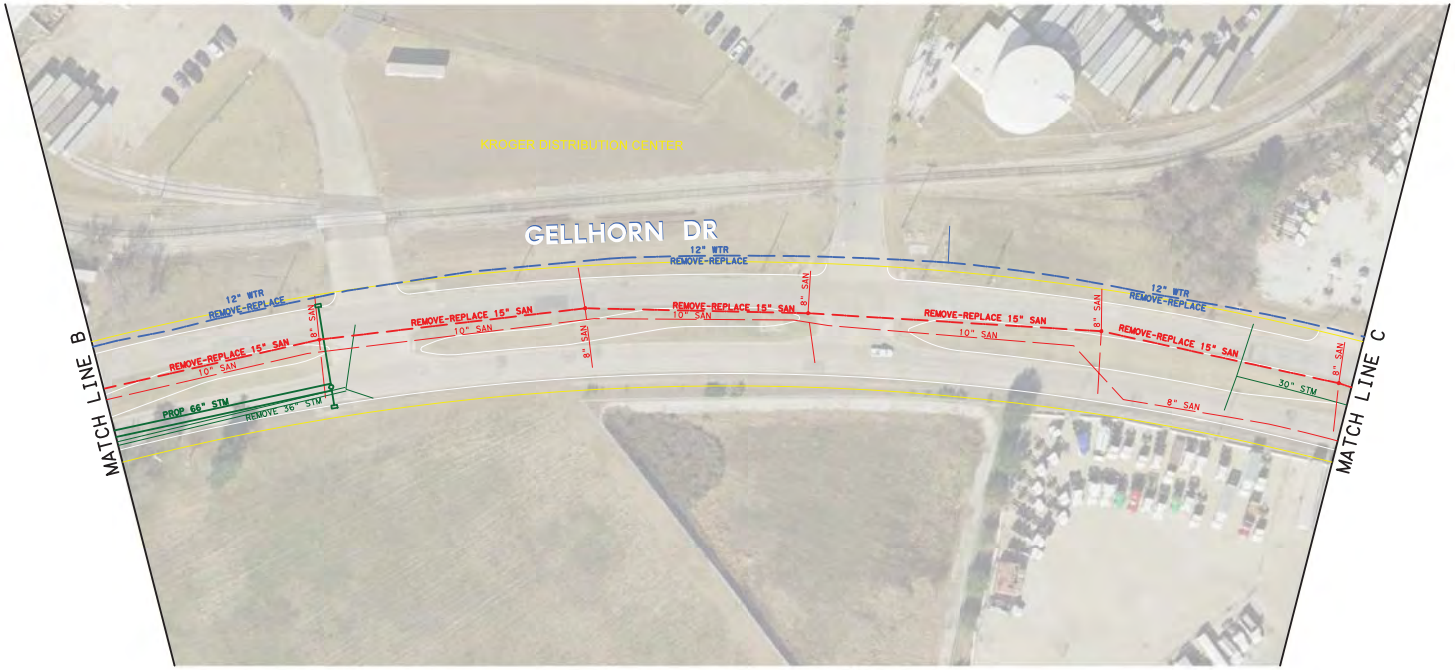
NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

PROPOSED STORM & UTILITY LAYOUT
SHEET 2 OF 4

EXHIBIT C

DATE: 11/22/2017 3:08:31 PM
P:\DOT\SA\DOT\SA_15-C\ADI\SKO DSN\W-EDIT-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-UTIL_Sheet002.dgn



LEGEND

- PROP INLET
- PROP STORM SWR
- PROP STORM SWR MANHOLE
- EXIST STORM SWR
- PROP SAN SWR
- EXIST SAN SWR
- SAN SWR MANHOLE
- EXIST WTR LINE
- PROP WTR LINE

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

PROPOSED STORM & UTILITY LAYOUT
SHEET 3 OF 4

EXHIBIT C

DATE: 11/22/2017 3:08:38 PM
P:\0017SK\0017SK_15-CADISSUO DSNW-2016T-0015 Gellhorn\Sheets\Recommended Sheets\0015-REC-UTL_Sheet003.dgn

LEGEND

- PROP INLET
- PROP STORM SWR
- PROP STORM SWR MANHOLE
- EXIST STORM SWR
- PROP SAN SWR
- EXIST SAN SWR
- SAN SWR MANHOLE
- EXIST WTR LINE
- PROP WTR LINE

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333

PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

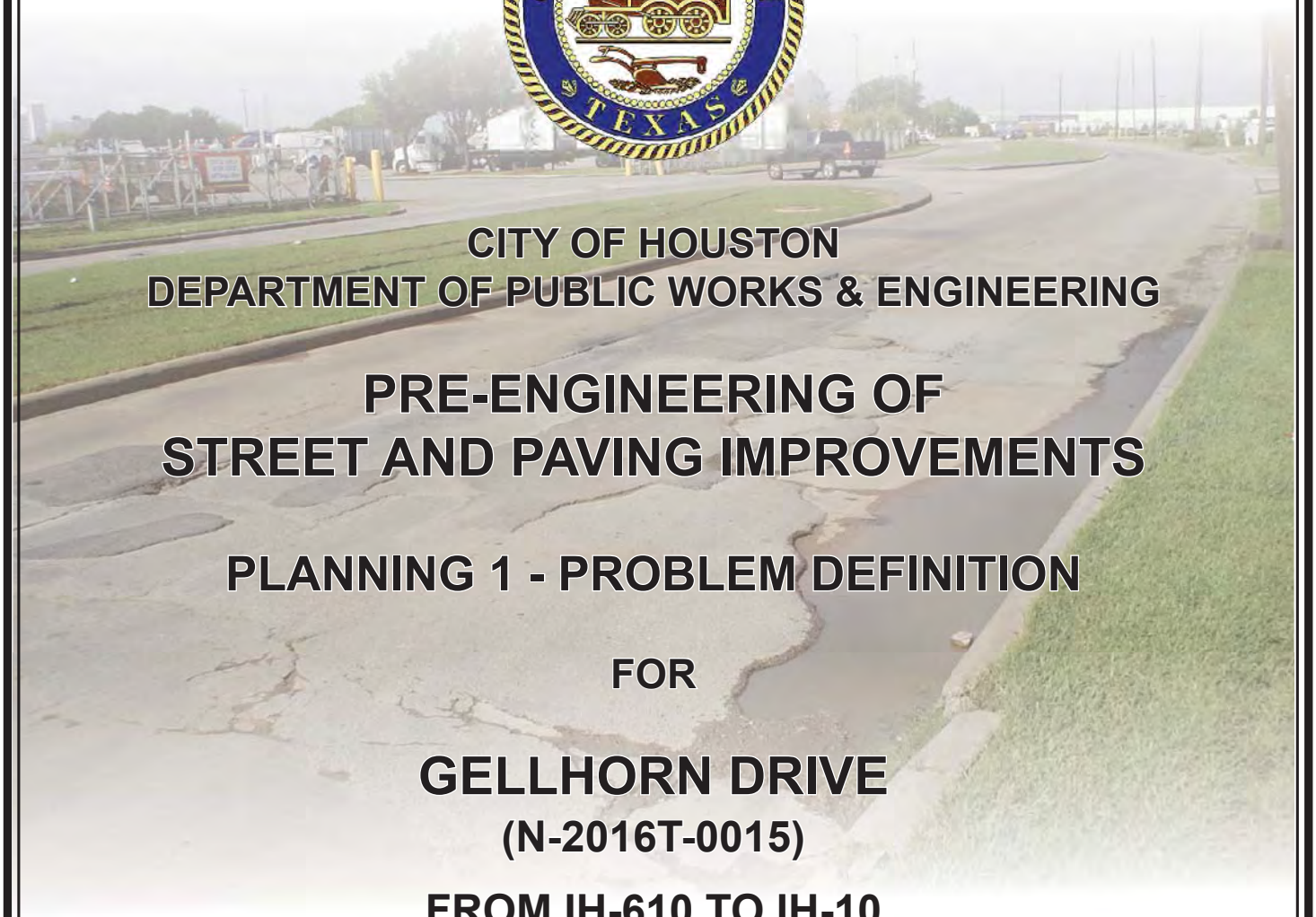
PROPOSED STORM & UTILITY LAYOUT
SHEET 4 OF 4

EXHIBIT C

DATE: 11/22/2017 308.54 PM
P:\0017SK\0017SK_IS-C\ADISSO DSNW-0067-005 Gellhorn\Sheets\Recommended Sheets\005-REC-UTL_Sheet004.dgn

APPENDIX 1

PLANNING 1 (PROBLEM DEFINITION)



CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS & ENGINEERING

PRE-ENGINEERING OF STREET AND PAVING IMPROVEMENTS

PLANNING 1 - PROBLEM DEFINITION

FOR

GELLHORN DRIVE

(N-2016T-0015)

FROM IH-610 TO IH-10

STATE OF TEXAS
COSTAS K. GEORGHIOU
58255
REGISTERED PROFESSIONAL ENGINEER

10/23/2017

PREPARED BY:

PGAL

F-2742
3131 BRIARPARK
HOUSTON, TEXAS 77042
713.622.1444

July 2016

TABLE OF CONTENTS

1.0 INTRODUCTION

- **1.1 Project Location**
- **1.2 Existing Roadway Characteristics**
- **1.3 Existing Right-of-Way**

2.0 NEEDS IDENTIFICATION

- **2.1 Data Collection**
- **2.2 Street and Traffic Needs**
  - **A.** Physical Condition of Roadway
  - **B.** Bridge at HCFCD D120-00-00
  - **C.** Capacity
  - **D.** Intersections
- **2.3 Drainage Needs**
- **2.4 Utility Needs**
  - **A.** Water Lines
  - **B.** Sanitary Sewers
- **2.5 Existing Private Utilities and Pipelines**
  - **A.** Gas Facilities
  - **B.** Electric / Street Lighting
  - **C.** Telephone, Communications Facilities
  - **D.** Pipelines

3.0 EXHIBITS

EXHIBIT A – Overall Layout
EXHIBIT B – Existing Conditions
EXHIBIT C – Pavement Condition Index Map
EXHIBIT D – Existing Wastewater System Map
EXHIBIT E – Existing Water System Map

APPENDICES

APPENDIX 1 - List of Record Drawings
APPENDIX 2 - Photographs and Notes from Site Reconnaissance
APPENDIX 3 - Drainage Report
APPENDIX 4 - Traffic Needs Identification

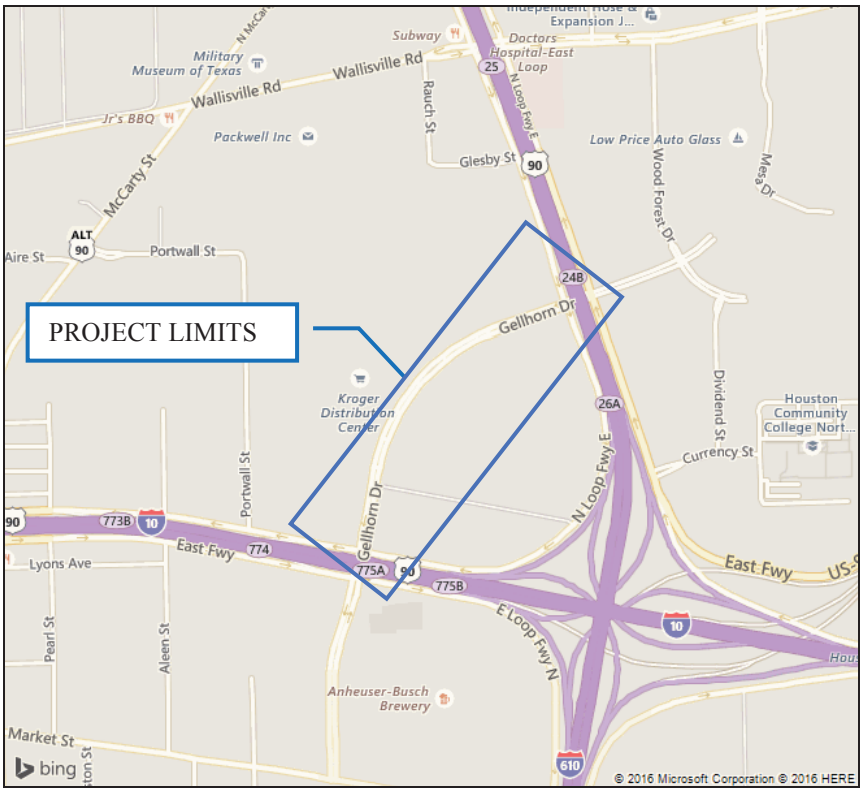
1.0 INTRODUCTION

This pre-engineering study has been prepared by PGAL for the City of Houston (City) under the terms of the Contract for Professional Engineering Services for pre-engineering services for Gellhorn Drive from Interstate Highway 10 to Interstate Highway 610, Project No. N-2016T-0015.

The purpose of the study is to provide assessment of existing conditions, identify the needs, provide alternative solutions and recommendations for street and paving improvements, drainage concepts, water line and sanitary sewer utility improvements, and cost estimates.

1.1 Project Location

The project is located in the Pleasantville Area super neighborhood in northeast Houston (Key Map 495 C & G, Council District B) between IH-10 on the south and IH-610 on the north (see Location Map below and Exhibit A – Overall Layout).



1.2 Existing Roadway Characteristics

Gellhorn Drive is classified as T-4-100 in the City of Houston's Major Thoroughfare Plan; a 4 lane Major Thoroughfare in a 100-foot wide right-of-way. The existing roadway functions as a 4-lane divided boulevard. The pavement is made of concrete and the road includes two separate closed conduit storm sewer systems. The total length of the study area is approximately 0.7 miles from IH-10 to IH-610 and mostly comprises of industrial and commercial properties.

Horizontal geometry of the roadway consists of one curve, with is an approximate radius of 2000 feet at the center of the study area.

The roadway was built approximately 50 years ago, and the concrete pavement condition is generally poor. The pavement has major cracks, asphalt patches, and potholes. The existing 4-foot wide sidewalks are in fair to poor condition with joint failures and uneven grades. There are various locations throughout the project where there is either sidewalk on only one side or neither side of the street. There are various bus stop locations that do not have adjacent sidewalk. The following segments do not have any existing sidewalks in place:

- Both sides of Gellhorn from HCFCD Ditch H103-00-00 to 1600' East of IH-610
- North side of Gellhorn from 1600' East of IH-610 to IH-610

There is one signalized intersection in the study area. Traffic signal equipment at this intersection requires modernization.

There are no community facilities that exist within close proximity of the study area.

Metro bus route #11 runs in both directions along Gellhorn Drive with stops at IH-10 and IH-610 as well as two more stops between on each side.

1.3 Existing Right-of-Way

The existing right-of-way (ROW) along Gellhorn Drive is generally 100 feet within the project limits. Below is a summary of ROW widths for streets intersecting Gellhorn.

Crossing Street	ROW Width
Interstate 10	340'
Interstate 610	340'

2.0 NEEDS IDENTIFICATION is evaluated in three major categories; Street and Traffic, Drainage, and Utility Needs (Water and Wastewater).

2.1 Data Collection was carried out by obtaining available record drawings from the City of Houston, shape files with record information for pavement condition and flooding from the City, contacting and obtaining record drawings for electrical and telecommunications, obtaining information regarding pipelines, and obtaining information regarding waterlines and sanitary lines from utility planning. A listing of record drawings obtained for this project is in Appendix 1.

2.2 Street and Traffic Needs identification was evaluated based on the condition and the capacity of the roadway. Pedestrian facilities, signalized intersections, and safety issues were also noted and are summarized below.

A. **Physical Condition of the Roadway:** The pavement condition rating (PCR) criteria provided by the City of Houston indicates that the existing pavement along Gellhorn in

the study limits falls under the medium high category with an average rating of 72.08 based on the 2015 PCR data. The pavement condition index (PCI) criteria provided by City of Houston indicates that the existing pavement along Gellhorn Dr in the study limits has an average rating of 81.02 based on 2016 PCI data. Neither the PCR nor the PCI values are representative of the very poor pavement conditions observed along Gellhorn. This discrepancy between PCR and PCI values and observed conditions will need to be considered by the City of Houston prior to the finalization of the Planning 2 stage, in order to determine the proper incorporation of pavement condition into the Candidate Project Priority Score's formula.

The existing pavement is approximately 50 years old and at the end of its usefulness. The observed pavement is showing signs of wear and tear with major transverse and longitudinal cracks, joint failures, spalling, potholes, and asphalt patches. The severe conditions are due to heavy-vehicle traffic that travels through Gellhorn and is likely to increase once CIP Project N-000623-0001 connects Gellhorn to Wallisville. Concrete panels varying in size have been replaced in various locations due to poor driving conditions over heavily deteriorated pavement. Pictures 2.2A.1 and 2.2A.2 depict these conditions. Evidence of ponding along the gutter was also observed during site visits. The table below summarizes the condition of the pavement in accordance with City of Houston's criteria. A detailed breakdown of the PCI values are also shown on Exhibit B - Existing Conditions Layout and Exhibit C – Pavement Condition Index Map.

Segment	Pavement Type	# of Lanes	2015 PCR City Provided	2016 PCI City Provided	Condition Based on 2015 PCR
Interstate 10 to Interstate 610	Concrete	4	72.08	81.02	Medium High

Picture 2.2A.1 – Pavement Conditions along Gellhorn

Picture 2.2A.2 – Pavement Conditions along Gellhorn

B. Bridge at HCFCD H103-00-00: Gellhorn Rd over Wallisville Outfall is a two barrel 10'H x 7'W box culvert (Picture 2.2B.1). A visual structural inspection was performed on Friday, June 17, 2016 to determine the general structural conditions of the culvert. The culvert appears to be in overall good condition.

a. Deck: Concrete roadway surface has transverse cracks. The SB roadway has some asphalt patches. There are no traffic safety features.

b. **Culvert:** The culvert boxes are structurally sound. The top slab, headwalls and wingwalls have minor cracks. There is a large amount of silt/dirt build-up in the North barrel.

c. **Channel/Ditch:** Upstream and downstream channel banks appear to be stable with no significant erosion. There is a large amount of silt/dirt build-up in the North barrel.

d. **Utilities:** There are no utilities at this culvert.

Picture 2.2B.1 – Gellhorn over Wallisville Outfall

C. **Traffic Volumes and Capacity:** Gellhorn is a Major Thoroughfare with a posted speed limit of 35 mph.

The preliminary Level of Service (LOS) was determined using the 2010 Highway Capacity Manual Methodology, based on field observations by ETSI and also V/C ratios and traffic assignments provided by the City of Houston. Based on the existing roadway geometry; results indicate that LOS for both 2016 and 2040 is “C”. Detailed traffic evaluation is shown in Appendix 4.

Street	Segment	2016 ADT	# of Lanes	2016 V/C Ratio	2016 LOS
Gellhorn	IH-10 to IH-610	3,702	4	0.170	C

Street	Segment	2040 ADT	# of Lanes	2040 V/C Ratio	2040 LOS
Gellhorn	IH-10 to IH-610	5,705	4	0.261	C

D. Intersections: There is only one signalized intersection within the study limit:

- Interstate 10:
  - Damaged curb and curb ramps.
  - Pedestrian facilities do not meet current ADA standards.

- Interstate 610:
  - Outdated signal equipment
  - Pedestrian facilities do not meet current ADA standards.
  - Defunct pedestrian equipment

E. Bikeways: Gellhorn has no existing bikeways. The City of Houston's Bike Plan proposes an on-street bikeway for Gellhorn Drive between IH-10 and IH-610.

2.3 Drainage Needs: The study area consists of storm sewer drainage systems and is within the Hunting Bayou watershed. The Gellhorn drainage network is divided into two systems. H0052 & H0051 outfall into HCFCD Unit No. H103-00-00. Both systems were analyzed to have adequate capacity for a 2-year storm event while both systems have inadequate capacity for the 100-year storm event. The following table summarizes the storm sewer system in study limits:

DRAINAGE AREAS & FLOODING SUMMARY					DRAINAGE SYSTEM CAPACITY			
OUTFALL	OUTFALL LOCATION	AREA (ACRE)	311 FLOODING COMPLAINTS	FLOODPLAIN ZONE	INLETS	2-YR CAPACITY	100-YR CAPACITY	STORM SEWER PIPE SIZES
H0052	D125-00-00	34.4	--	None	Insufficient	Sufficient	Insufficient	24" - 42"
H0051	D103-00-00	22.0	--	100-, 500-Year	Insufficient	Sufficient	Insufficient	24" - 42"

FIRM Maps No. 48201C0695L; shows that the southern half of the project area is located within the 100-year floodplain zone of Hunting Bayou.

The drainage system has no recorded 311 ROW & Structural flooding complaints or FEMA repetitive losses.

According to the National Wetland Inventory, no wetlands were identified in the project vicinity. See Appendix 3 for more detailed information on existing drainage system conditions.

2.4 Utility Needs: Existing water and sanitary sewers within the project area were researched utilizing the City of Houston's GIMS website and record drawings and are listed below. Existing wastewater and water lines in the study limits are depicted in Exhibit D - Wastewater System Map and Exhibit E – Water System Map.

A. Water Lines: Water lines presently serving Gellhorn from IH-10 to IH-610 are listed in the following table.

NO.	LOCATION	SIZE	MATERIAL	AGE	PLAN#
1	Along Gellhorn btw Interstate 10 to Interstate 610	12"	CI	1971	WD 3541

B. Sanitary Sewers: Sewer lines serving Gellhorn from IH-10 to IH-610 are listed in the following table.

NO.	LOCATION	SIZE	AGE	PLAN#	REHAB	REHAB PLAN#	REHAB YR
1	Crossing Gellhorn Dr along Interstate 10	18"	1999	34205	No	N/A	No
2	Crossing Gellhorn Dr along Interstate 10	24"	1999	34205	No	N/A	No
3	Along Gellhorn btw Interstate 10 & 900' from Interstate 610	15"	1971	15496	No	N/A	No
4	Along Gellhorn btw 900' from Interstate 610 & Interstate 610	8"	1998	34403	No	N/A	No
5	Along Gellhorn btw 900' from Interstate 610 & 500' from Interstate 610	8"	1971	15496	No	N/A	No
6	Along Gellhorn btw 700' from Interstate 610 & Interstate 610	8"	1985	27242	No	N/A	No
7	Along Gellhorn btw Interstate 10 & 700' from Interstate 610	10"	1992	29252	No	N/A	No

2.5 Existing Private Utilities and Pipelines:

A. Gas Facilities: Center Point Energy (CPE) provided gas and electric utility maps as logged under Center Point Energy ID 1403169794. Following gas lines were identified within the Gellhorn right-of-way.

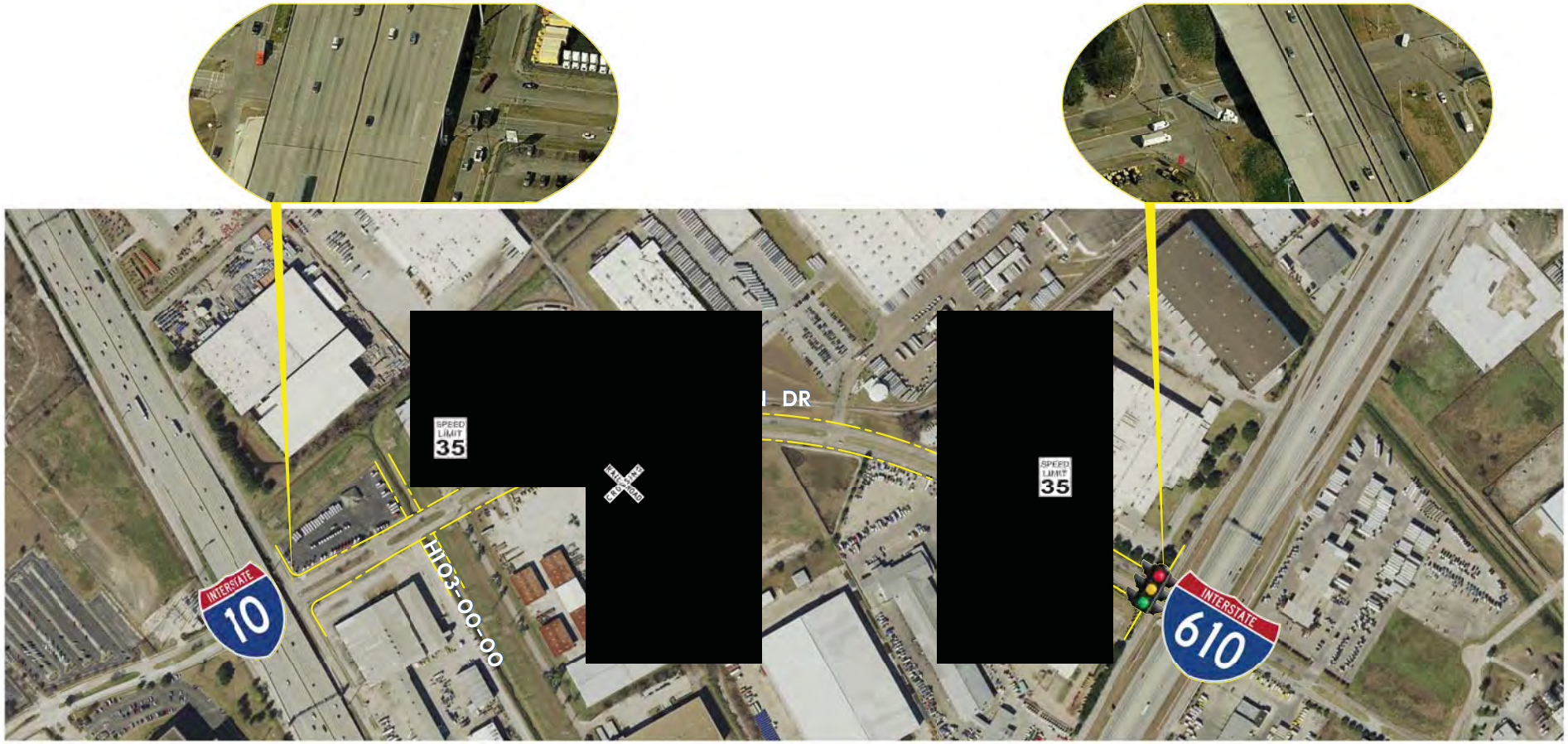
NO.	LOCATION	SIZE
1	Along Gellhorn btw IH-10 and IH-610	6 HP STL

B. Electric / Street Lighting: Street lighting in the project area is provided by cobra-head light fixtures mounted on wood poles in most areas. There are a few overhead power lines that cross Gellhorn within the study limits. As well as power lines that run along Gellhorn for its entirety.

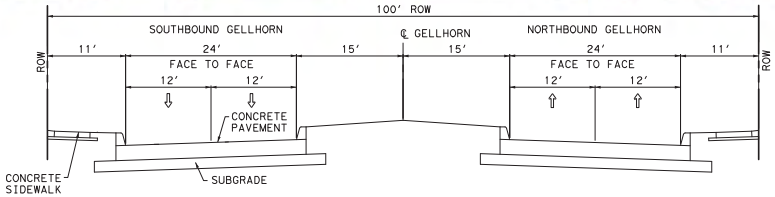
C. Telephone, Communications Facilities: 2-4” G.I.P duct lines were identified within the Gellhorn Drive Right-of-Way.

D. Pipelines: No pipelines were found in the study area.

EXHIBITS



[redacted]



(A) EXISTING TYPICAL ROADWAY SECTION GELLHORN DRIVE

FROM HOUSTON IH-10 TO IH-610

N.T.S.

[redacted]

LEGEND

EXIST ROW/PARCEL

SIGNALIZED INTERSECTION

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333

PGAL

0 100 200 400
SCALE: 1" = 400'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

OVERALL LAYOUT

EXHIBIT A

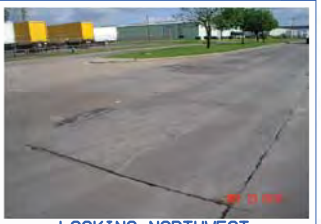
DATE: 11/22/2017 D.S.S.J.V. PW
P:\0017SK\0017SK_IS-CADD\SKO DSNW-2016T-0015 Gellhorn\Sheets\0015E-HNN_Exhibits_Overall.dgn

LOOKING SOUTH
ALONG GELLHORN DR

LOOKING EAST
ACROSS GELLHORN DR

LOOKING WEST
ALONG GELLHORN DR

LOOKING WEST
ACROSS GELLHORN DR



LOOKING NORTHWEST
ACROSS GELLHORN DR

LOOKING WEST
AT H103-00-00

LEGEND

EXIST ROW/PARCEL

PONDING

PCI PAVEMENT CONDITION INDEX

SIGNALIZED INTERSECTION

METRO METRO BUS SHELTER/STOP

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

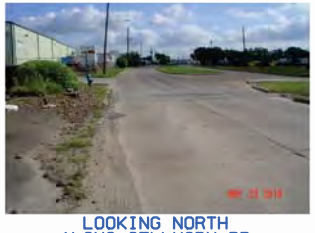
NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

EXISTING CONDITIONS
SHEET 1 of 4

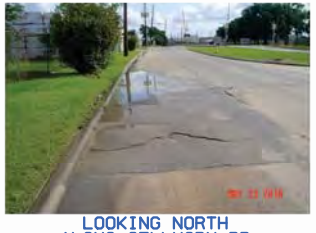
EXHIBIT B

DATE: 11/22/2017 2:15:58 PM
P:\0017SK\0017SK_15-C4010500 DSNW-0016T-0015 Gellhorn\Sheets\0015E-H101_Existing_Conditions001.dgn

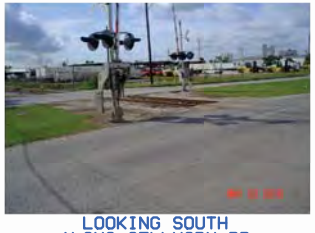


LOOKING NORTH
ALONG GELLHORN DR

LOOKING EAST
ACROSS GELLHORN DR



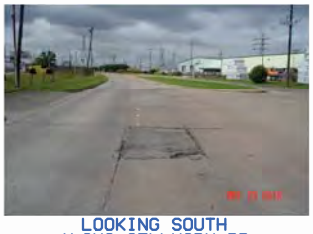
LOOKING NORTH
ALONG GELLHORN DR



LOOKING SOUTH
ALONG GELLHORN DR

LOOKING NORTH
ALONG GELLHORN DR

LOOKING WEST
ALONG GELLHORN DR



LOOKING SOUTH
ALONG GELLHORN DR

LOOKING SOUTHWEST
ALONG GELLHORN DR

LEGEND

EXIST ROW/PARCEL

PONDING

PCI PAVEMENT CONDITION INDEX

SIGNALIZED INTERSECTION

METRO METRO BUS SHELTER/STOP

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

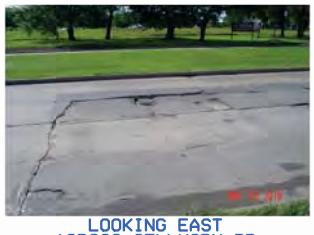
NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

EXISTING CONDITIONS
SHEET 2 of 4

EXHIBIT B

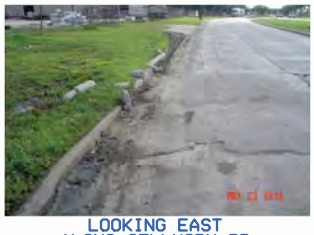
DATE: 11/22/2017 2:52:24 PM
P:\DOT\SK\DOT58_IS-C\ADISKO DSN\W-20167-005 Gellhorn\Sheets\005E-HNN-Existing_Conditions002.dgn



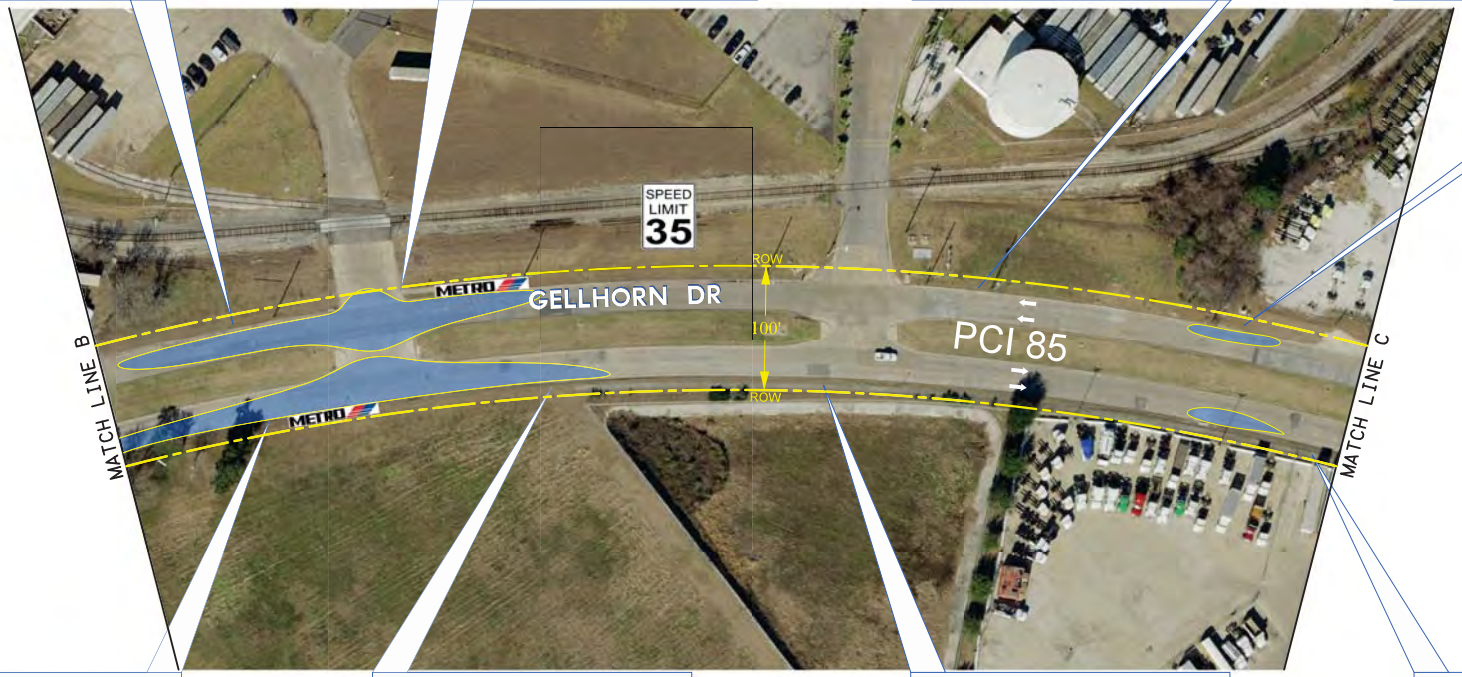
LOOKING EAST
ACROSS GELLHORN DR

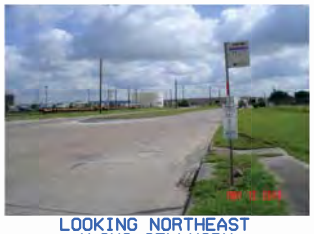
LOOKING NORTHEAST
ALONG GELLHORN DR

LOOKING WEST
ALONG GELLHORN DR



LOOKING EAST
ALONG GELLHORN DR





LOOKING NORTHEAST
ALONG GELLHORN

LOOKING NORTHEAST
ALONG GELLHORN DR

LOOKING NORTHEAST
ALONG GELLHORN DR

LOOKING WEST
ALONG GELLHORN DR

LEGEND

EXIST ROW/PARCEL

PONDING

PCI PAVEMENT CONDITION INDEX

SIGNALIZED INTERSECTION

METRO METRO BUS SHELTER/STOP

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

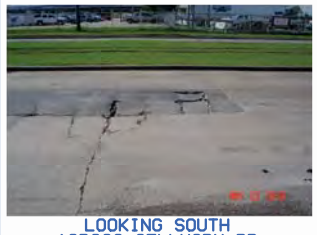
STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

EXISTING CONDITIONS
SHEET 3 of 4

EXHIBIT B

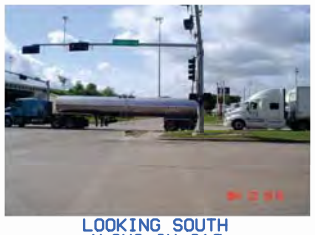
DATE: 11/22/2017 9:50:47 PM
P:\0017SK\0017SK_15-C4D15500 DSNW-2016T-0015 Gellhorn\Sheets\0015E-HNN_Existing_Conditions0003.dgn

LOOKING EAST
ALONG GELLHORN DR

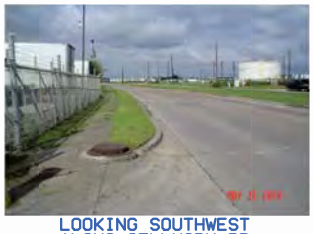


LOOKING SOUTH
ACROSS GELLHORN DR

LOOKING WEST
ALONG GELLHORN DR

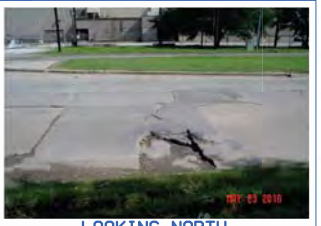


LOOKING SOUTH
ALONG IH-610



LOOKING SOUTHWEST
ALONG GELLHORN DR

LOOKING EAST
ALONG GELLHORN DR



LOOKING NORTH
ACROSS GELLHORN DR

LOOKING EAST
ALONG GELLHORN DR

LEGEND

EXIST ROW/PARCEL

PONDING

PCI PAVEMENT CONDITION INDEX

SIGNALIZED INTERSECTION

METRO METRO BUS SHELTER/STOP

TBPE REG. NO. F-2742
3131 BRIARPARK
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
Fax (713) 968-9333
PGAL

0 25 50 100
SCALE: 1" = 100'

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

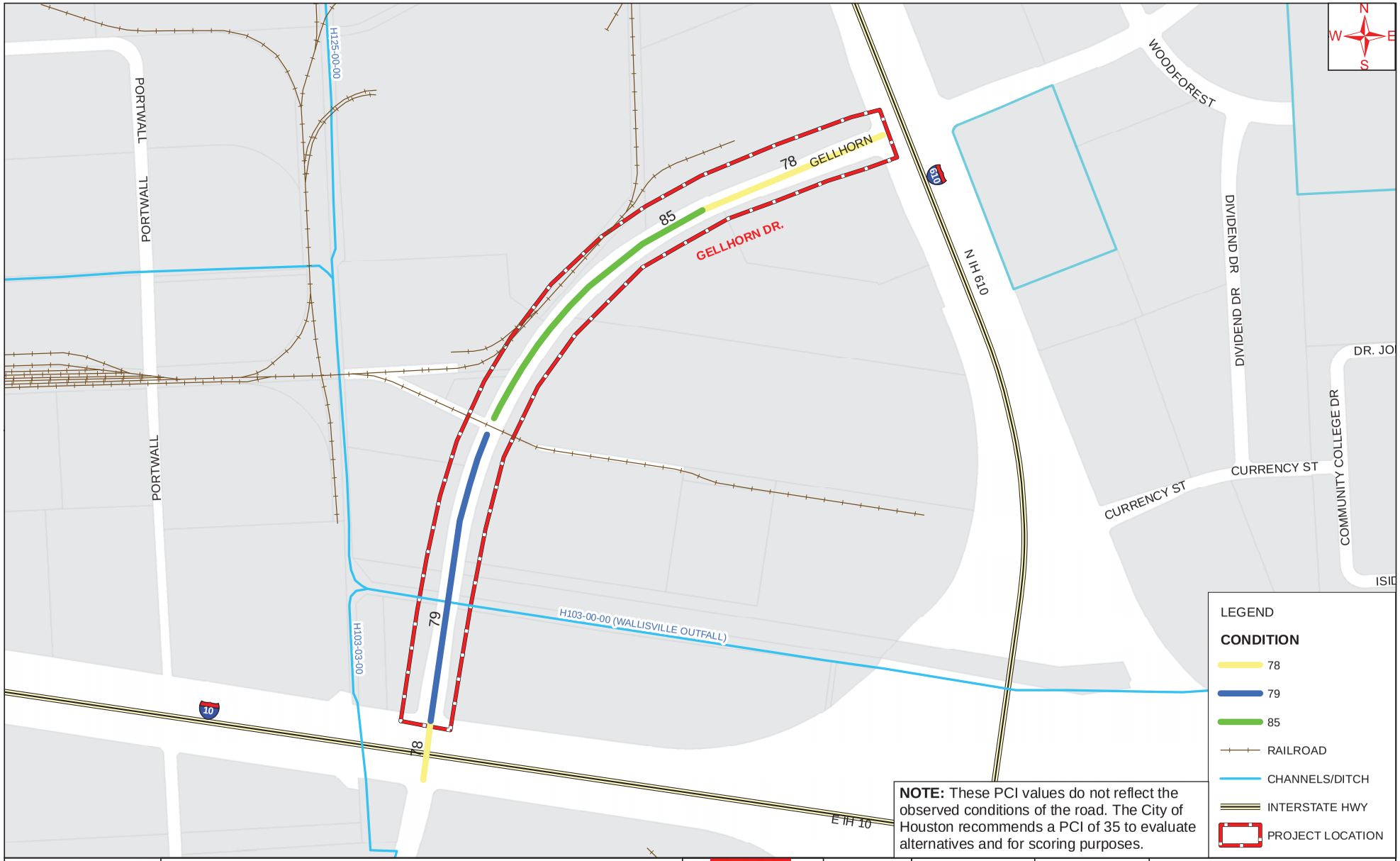
NEED AREA	
N-2016T-0015	
CITY OF HOUSTON	
DATE	03/01/17

STREET & PAVING IMPROVEMENTS
GELLHORN DR
IH-10 TO IH-610

EXISTING CONDITIONS
SHEET 4 of 4

EXHIBIT B

DATE: 11/22/2017 3:53:08 PM
P:\0017SK\0017SK_IS-C4D\SKD DSN\W-0067-005 Gellhorn\Sheets\005E-HNN_Existing_Conditions004.dgn



NOTE: These PCI values do not reflect the observed conditions of the road. The City of Houston recommends a PCI of 35 to evaluate alternatives and for scoring purposes.

iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

PGAL

DATE:	SCALE:	EXHIBIT C
JUNE, 2016	400 200 0 Feet	PAVEMENT CONDITION INDEX MAP GELLHORN DRIVE

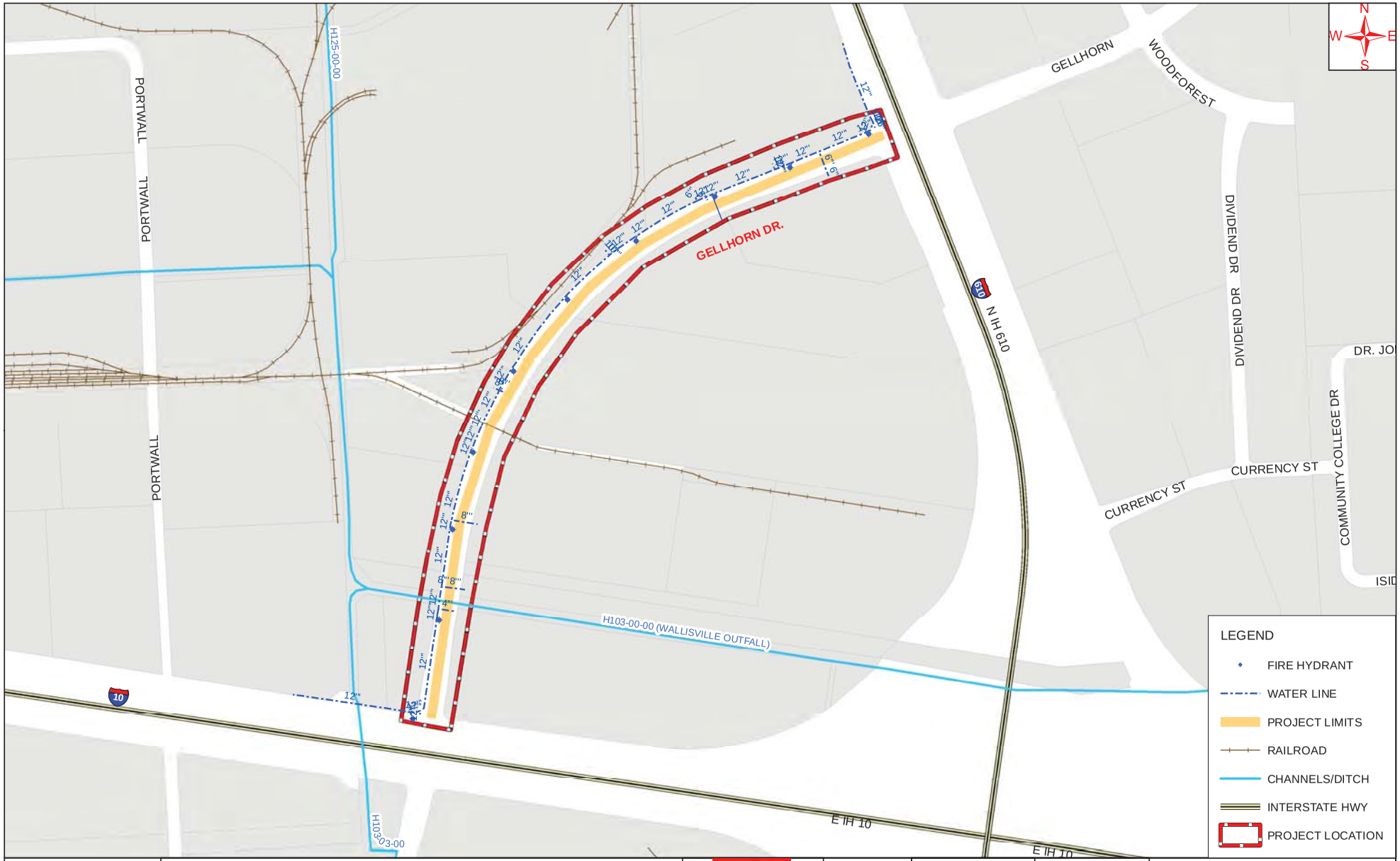
iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

PGAL

DATE:	SCALE:	EXHIBIT D
JUNE, 2016	400 200 0 Feet	EXISTING WASTEWATER SYSTEM MAP GELLHORN DRIVE



iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

PGAL

DATE:	SCALE:	EXHIBIT E
JUNE, 2016	400 200 0 Feet	EXISTING WATER SYSTEM MAP GELLHORN DRIVE

APPENDIX 1

APPENDIX 1 - LIST OF RECORD DRAWINGS

Gellhorn Rd

No.	Plan Number	Project Name
1	WD 3541	Houston Belt Railway Industrial Park Gellhorn Drive Plans for Storm Sewers, Sanitary Sewers and Paving
2	WD 4116	City of Houston WD Project No. 6838 Proposed Pressure Reducing Stations Along IH-10 & IH-610
3	WD 4844	City of Houston Department of Public Works Paving & Drainage Gellhorn Drive Market St. to 1270' N of Market St. and Wiggins St. to Josie St.
4	WD 5907	Century Development Corporation Construction Plans for Water, Drainage and Paving Improvements on Colquitt Street
5	WD 6525	Inside City Limits Glen Iris Section Four Paving - Storm Sewers - Sanitary Sewers - Water Lines
6	WD 6837	City of Houston Department of Public Works Water Main Extension Water Division Project 8712 B&V Project 10261
7	15496	Houston Belt Railway Industrial Park Gellhorn Drive Plans for Storm Sewers, Sanitary Sewers and Paving
8	27242	City of Houston 8 Inch Waste Sludge Force Main Expansion of Northeast Wastewater Treatment Plant
9	29252	City of Houston Wastewater Division CIP No. CR-307 Northeast Sludge Transfer System Phase I
10	34205	City of Houston Engineering, Construction and Real Estate Group Moonmist and East Freeway Lift Station Diversions
11	34403	City of Houston Engineering, Construction and Real Estate Group East Ten Park Lift Station Diversion
12	THD #313	State of Texas Houston Urban Expressways I-610 (East Loop) From Houston Ship Channel to I-10
13	THD #313A	State of Texas Houston Urban Expressways I-610 (East Loop) From Houston Ship Channel to I-11

APPENDIX 2

2.1 Looking West across Gellhorn Drive at Interstate 10 Intersection.

2.2 Looking Northwest across Gellhorn Drive at Interstate 10.

2.3 Looking Southeast across Gellhorn Drive near Interstate 10.

2.4 Looking Southeast across Memorial Drive near Interstate 10.

2.5 Looking Southeast across Gellhorn Drive.

2.6 Looking South along Gellhorn Drive.

2.7 Looking North along Gellhorn Drive.

2.8 Looking East across Gellhorn Drive.

2.9 Looking Northeast across Gellhorn Drive.

2.10 Looking Northeast along Gellhorn Drive.

2.11 Looking South along Gellhorn Drive.

2.12 Looking Northeast along Gellhorn Drive.

2.13 Looking South along Gellhorn Drive.

2.14 Looking Northeast along Gellhorn Drive.

2.15 Looking East along Gellhorn Drive.

2.16 Looking North across Gellhorn Drive near Interstate 610.

2.17 Looking East along Gellhorn Drive approaching Interstate 610 intersection.

2.18 Looking North across Gellhorn Drive.

2.19 Looking East along Gellhorn Drive at Interstate 610 intersection.

2.20 Looking South across Gellhorn Drive at Interstate 610 intersection.

APPENDIX 3

Planning 1 Drainage Analysis for Street and Paving Improvements for Gellhorn Dr (N-2016T-0015)

July 2016

STATE OF TEXAS
VINCENT N. JACOB
98325
LICENSED
PROFESSIONAL ENGINEER

11/28/17

Prepared by:

ISANI CONSULTANTS

3143 Yellowstone Blvd, Houston, TX 77054

P(713)747.2399, F(713)748.3748

TABLE OF CONTENTS

Sources of Data
General Information
Existing Drainage System Analysis
Methodology
Tailwater Conditions
Datum Adjustment
Existing Conditions and Modeling Results
- Drainage System H0052 (Outfall at HCFCD Unit No:H125-00-00, Hunting Bayou)
- Drainage System H0051(Outfall at HCFCD Unit No.H103-00-00, Hunting Bayou)

Floodplain Impact
Existing Overland Drainage Analyses

Exhibits
- Existing Storm Drainage System
- CDP Recommended Upgrades
- Overland Drainage System
- Floodplain & Repetitive Losses
- Drainage System Capacities

Tables
- Peak Flows
- Historical Flooding
- Inlet Capacities
- SWMM HGL Results

Appendices
- FEMA MAP
- TSARP MAP

DRAINAGE NEEDS EVALUATION

SOURCES OF DATA

The data collected and used for the drainage needs evaluation included City of Houston Record Drawings, City of Houston Geographic Information and Management System (GIMS), Comprehensive Drainage Plan (CDP) on the Storm Water Management Program (SWMP), 2008 LiDAR information, Tropical Storm Allison Recovery Project (TSARP) LIDAR information, and FEMA Federal Insurance Rate (FIRM) maps.

GENERAL INFORMATION

The study limits of Gellhorn Drive are approximately 0.67 miles long, extending from IH-10 to IH 610. Gellhorn Drive is a four-lane concrete curb and gutter roadway with landscaped median along its right-of-way for the entire project limits. The project area is located at (Key Map Nos. 495 C and 495 G; Council District “B” limits).

The study area consists of storm sewer drainage systems and is within the Hunting Bayou watershed. The TSARP watershed map is shown in Appendix A. Exhibit 1 is an overall drainage area map showing all of the storm sewer systems considered in this analysis.

EXISTING DRAINAGE SYSTEM ANALYSIS

The existing system storm sewer analyses were guided by criteria found in Chapter 9 of the City of Houston Infrastructure Design Manual (July 2015), Technical Paper 100-Storm Sewer Design Applications for the City of Houston, Texas, Capital Improvement Projects (TP-100) and Technical Paper 101-Guidelines for Consideration of Overland Flow for the Extreme Event for Improvement Projects in the City of Houston, Harris County, Texas Region (TP 101). For this report, both the 2-year (design event) and the 100-year (extreme event) analyses were performed for the drainage system associated with Gellhorn Drive Road and Paving Improvements Project.

Methodology

City of Houston IDF Curves (Chapter 9) are used for storm sewer and roadside ditch design in the City of Houston and the ETJ. The Rational Method was used for calculation of peak flows for the 2-year design and the 100-year extreme event analyses.

The formula for the Rational Method is given by the equation below:

$$Q = C\,I\,A \qquad (1)$$

Where: Q = peak discharge, cubic feet per second
C = Runoff Coefficient, dimensionless
I = Rainfall Intensity (inches per hour)
A = Area (acres)

The runoff coefficients were determined from COH criteria. Typical coefficients are listed in the table below:

Table 1. List of C values for Land Use Type

Land Use Type	Runoff Coefficient (C)
Residential Districts	
Lots more than ½ acre	0.35
Lots ¼ - ½ acre	0.45
Lots less than ¼ acre	0.55
Townhomes	0.60
Multi-Family Area	
Less than 20 Service Units/Acre	0.65
20 Service Units/Acre or Greater	0.80
Business Districts	0.80
Industrial Districts	
Light Areas	0.65
Heavy Areas	0.75
Railroad Yard Areas	0.30
Parks/Open Areas	0.18
Pavement/ROW	0.90

Alternatively, the C coefficient can be found from the equation:

$$C = 0.6I_a + 0.2 \quad (2)$$

Where: C = Runoff Coefficient
I_a = Impervious Area/Total Area

For this project, combinations of the C values were determined from Table 1.

The intensity is found from the formula:

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

Where: b=75.01 (2-year) and 125.4 (100-year)
d=16.2 (2-year) and 21.8 (100-year)
e=0.8315 (2-year) and 0.75 (100-year)
T_c=time of concentration (minutes) (3)

To determine the time of concentration (T_c) for a single drainage area in equation 3, the following formula is used:

$$T_c = 10\ A^{0.1761} + 15 \qquad (4)$$

Where: A = sub area (acres)

A dynamic analysis was performed to analyze the storm sewer systems using XP Storm Water Management Model (SWMM) software. Existing condition models for the Gellhorn Drive storm sewer systems were developed.

The SWMM model was selected based on its ability to incorporate all the components and aspects of the drainage system, such as culverts, weirs, orifices, storm sewers and detention facilities. The SWMM model uses a series of nodes and links to represent the physical characteristics of the drainage system.

The Rational Method described above was used in the runoff computations and forms the basis for the flows within the models. Table 2 shows the Peak Flow Computations. The runoff hydrographs for the sub areas were generated using the Clark Unit Hydrograph (T_c&R) Method in HEC-HMS. The loss method used was the Green & Ampt Method with accompanying parameters chosen according to the soil type predominant in the watershed. The hydrograph generation involved matching the peak flows derived from Rational Method by using the calculated T_c as explained above and adjusting the storage coefficient, R, for each sub area. The resulting inflow hydrographs were added to the sub drainage areas within the model as a 24-hour hydrograph using a 15-minute time step as a minimum.

Offsite overland flow is considered to be overland runoff that is outside the drainage area boundary of the storm sewer system that sheet flows into the roadway drainage system during the extreme event. The inflow hydrographs for overland areas were generated using the Clark Unit Hydrograph Method and were added to the overland drainage areas that interconnect to the system. “Method 4: Dynamic Flow Routing Analysis” found from Section 4.3 from TP-101, Guidelines for Consideration of Overland Flow for the Extreme Event for Improvement Projects in the City of Houston, Harris County, Texas Region was used for the overland flow analysis. XPSWMM model routes the inflow hydrographs through the use of fully dynamic equations for gradually varied flow through time series computations though overland and conduit drainage segments.

Overland flows are typically modeled by utilizing the interconnect pipes or channels that use the approximate roadway cross-sections in the SWMM model. For modeling purposes, small channels linked the manholes to the roadway cross-sections with the starting invert of the link being the rim elevation of the manhole. This allows the water to enter the roadway geometry (channels) when the HGL exceeds the rim elevation of the manhole.

In this study, the critical elevations (the maximum hydraulic grade elevations) for the existing roadway were based on design criteria found in TP 101, as summarized below:

1. 2-year (design) hydraulic grade lines are to be maintained below the gutter elevations at all times.
2. 100-year (extreme) hydraulic grade lines are to be maintained below the maximum ponding elevation.

3. The maximum ponding elevation for the 100-year event at any point along the street shall not be higher than the natural ground elevation at the right-of-way.

Tailwater Conditions

Outfall pipe soffit elevation was used as the tailwater for the 2-year design analysis while the 100-year water surface elevation of the outfall channel (from HEC-RAS model of H103-00-00, Wallisville Outfall, downloaded from HCFCD M3 System) was used for the 100-year analysis of Storm System H0051. Since H125-00-00 is an unstudied channel and therefore has no HEC-RAS model, a tailwater elevation 2 feet from the top of banks was used for the 100-year analysis of Storm System H0052.

Datum Adjustment

The as-built drawings for the storm sewer systems did not mention the elevation datum used. TSARP uses the NAVD 1988 (2001 adjustment). For use in the SWMM models, an appropriate datum adjustment was made by measuring average differences from LiDAR (NAVD) and the as-built datum from a few key intersections and applying throughout each drainage area uniformly.

Existing Conditions and Modeling Results

The Gellhorn Drive drainage network is divided into two storm sewer systems along the project limits. Storm system H0051 outfalls into HCFCD Unit H103-00-00 (Wallisville Outfall) and H0052 outfalls into HCFCD Unit H125-00-00. The existing storm drainage areas are shown in Exhibit 1, and their system capacities are shown in Exhibit 5.

Drainage System H0051 (Outfall at HCFCD Unit No.H103-00-00, Wallisville Outfall)

Based on CDP, drainage system H0051 drains approximately 21.97 acres of the southern part of the project. There is a conduit system that flows south along Gellhorn Drive before outfalling into HCFCD Unit No. H103-00-00 (Wallisville Outfall), a tributary of Hunting Bayou.

The storm sewer pipe sizes were 24” and 30” for the lateral systems and 36” to 48" along Gellhorn Drive. The 2-year capacity in CDP is listed as *adequate* for this system and has no recommended upgrades. Exhibit 2 shows the contributing areas and CDP recommended upgrades in the vicinity of the storm system. Exhibit 3 shows the overland drainage areas and flow paths based on LiDAR.

The storm sewer system had no 311 ROW flooding complaints or structural flooding complaints or NFIP losses recorded as shown in Table 3. Exhibit 4 shows the extent of the effective floodplain and the location of the complaints (if any). Approximately 870 linear feet of Gellhorn Drive is within the 100-year floodplain of Hunting Bayou (Zone AE) for Drainage System H0051.

As built drawings show Type “BB” throughout the storm sewer system along Gellhorn Drive. For the stretch of storm system H0052 along the frontage road of IH-610, TxDOT Type C inlets were found. The 2-year peak flow runoff was compared to the inlet capacity for each drainage area to determine if the existing capacity was sufficient. A handful of drainage areas were found to lack inlet capacity. A summary is provided in Table 4. Before the SWMM model was run, the drainage area was first revised (27 acres) to better represent existing conditions. The SWMM analyses show that the 2-year design event was *sufficient* while the 100-year extreme event was *insufficient* to handle the respective flows. The results of the existing analysis are shown in Table 5.

Drainage System H0052 (Outfall at HCFCD Unit No. H125-00-00)

Based on CDP, drainage system H0052 drains approximately 34.4 acres of the northern part of the project. There is a conduit system that flows north along Gellhorn, travels west along IH 610 Frontage Road and outfalls into HCFCD Unit No.H125-00-00. The existing storm drainage system is shown in Exhibit 1.

The storm sewer pipe sizes are 24" for the lateral systems and 30", 36", & 42" for the main trunk. The 2-year capacity in CDP is listed as *adequate* for this system and has no recommended upgrades. Exhibit 2 shows the contributing areas and CDP recommended upgrades in the vicinity of the storm system. Exhibit 3 shows the overland drainage areas and flow paths based on LiDAR.

The storm sewer system had no 311 ROW flooding complaints or structural flooding complaints or NFIP losses recorded as shown in Table 3. Exhibit 4 shows the extent of the effective floodplain and the location of the complaints (if any). Drainage System H0052 is not within the 100-year floodplain of Hunting Bayou (Zone AE). The absence of NFIP losses in the area are consistent with the extent of the floodplain and, as shown below, with the capacity of the storm sewer system.

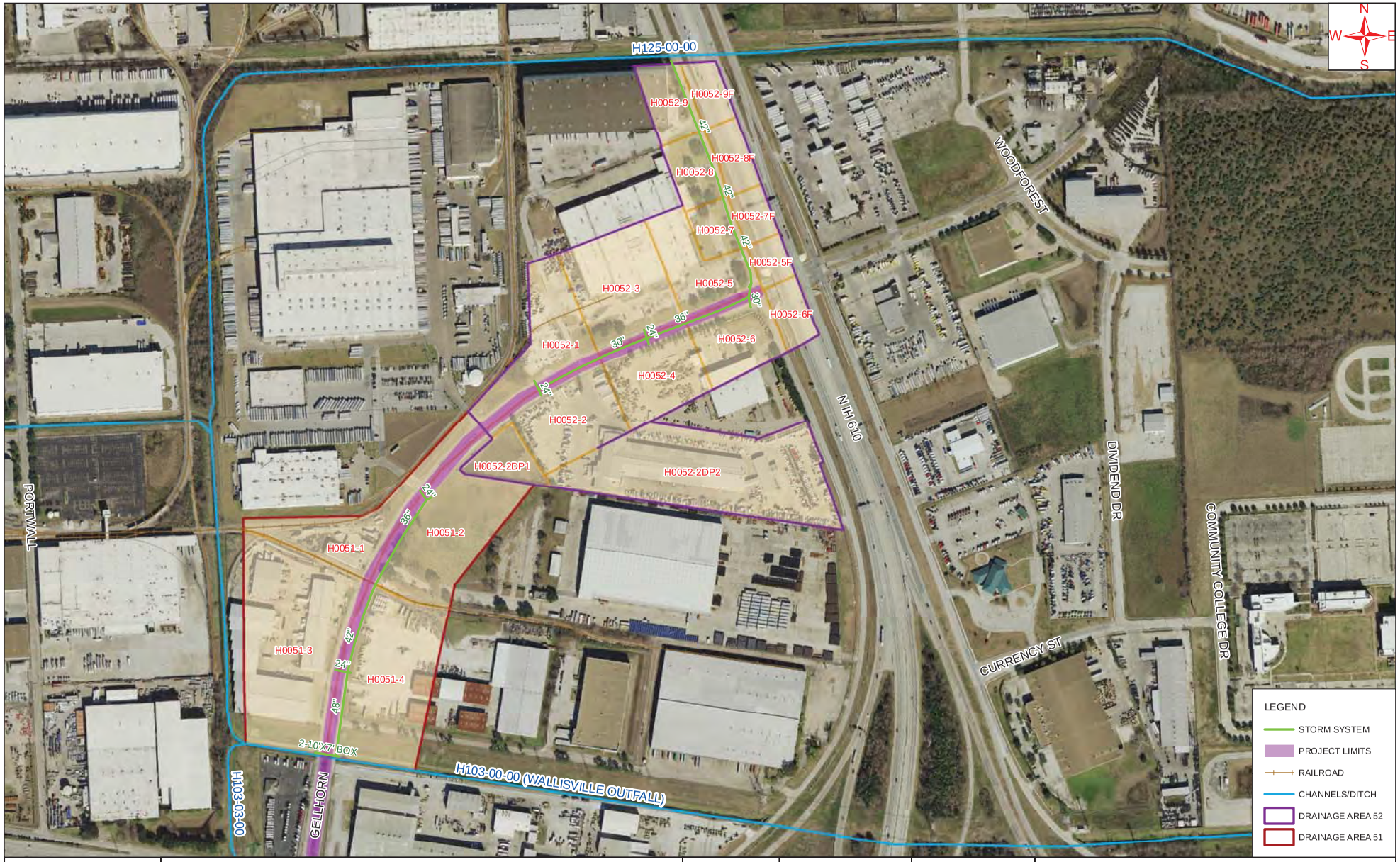
As built drawings show Type "BB" inlets throughout this storm sewer system. The 2-year peak flow runoff was compared to the inlet capacity for each drainage area to determine if the existing capacity was sufficient. All sub drainage areas for this system were found to lack enough inlet capacity. A summary is provided in Table 4. Before the SWMM model was run, the drainage area was first revised (42.1 acres) to better represent existing conditions. The SWMM analyses show that the 2-year design event was *sufficient* while the 100-year extreme event was *insufficient* to handle the respective flows. The results of the existing analysis are shown in Table 5.

FLOODPLAIN IMPACT

FIRM Maps No. 48201C0695L effective date June 18, 2007 shows that part of storm system H0051 is located within the 100-year floodplain (Zone AE) of Hunting Bayou. The effective FEMA map is provided in Appendix B. Alternately, the floodplain map (along with 311 Complaints) is depicted in Exhibit 4.

EXISTING OVERLAND DRAINAGE ANALYSIS

There is one overland drainage area contributing flows (~185 cfs) to system H0052 as identified from 2008 LiDAR, CDP and GIS shape files obtained from COH. Table 2 shows the contributing overland area and flows. The overland drainage systems are shown in Exhibit 4 along with contours and overland flow paths.



iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

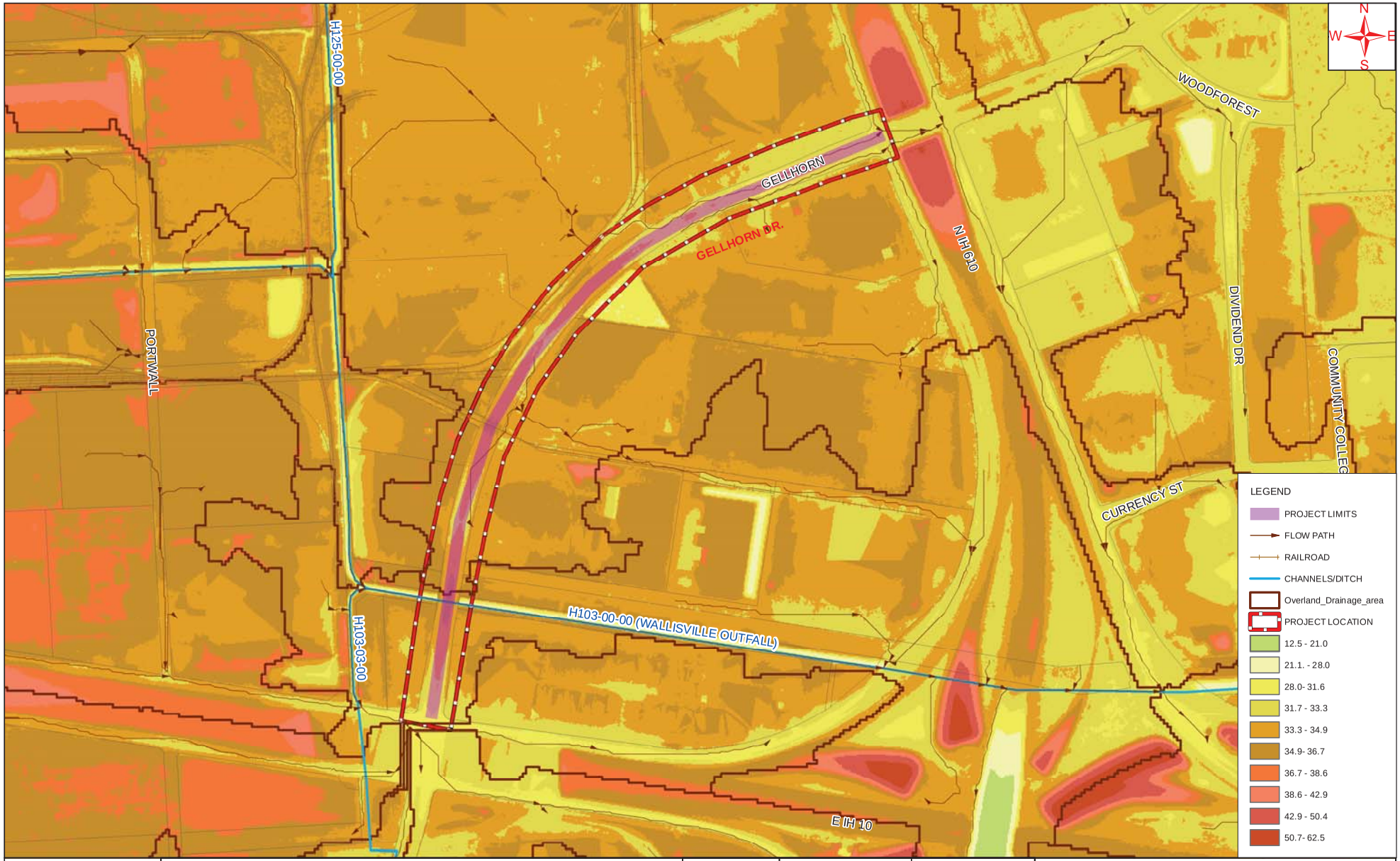
DATE:	SCALE:	EXHIBIT 1
JUNE, 2016	400 200 0 Feet	EXISTING STORM DRAINAGE SYSTEM GELLHORN DRIVE

iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

DATE:	SCALE:	EXHIBIT 2
JUNE, 2016	400 200 0 Feet	CDP RECOMENDED UPGRADES GELLHORN DRIVE

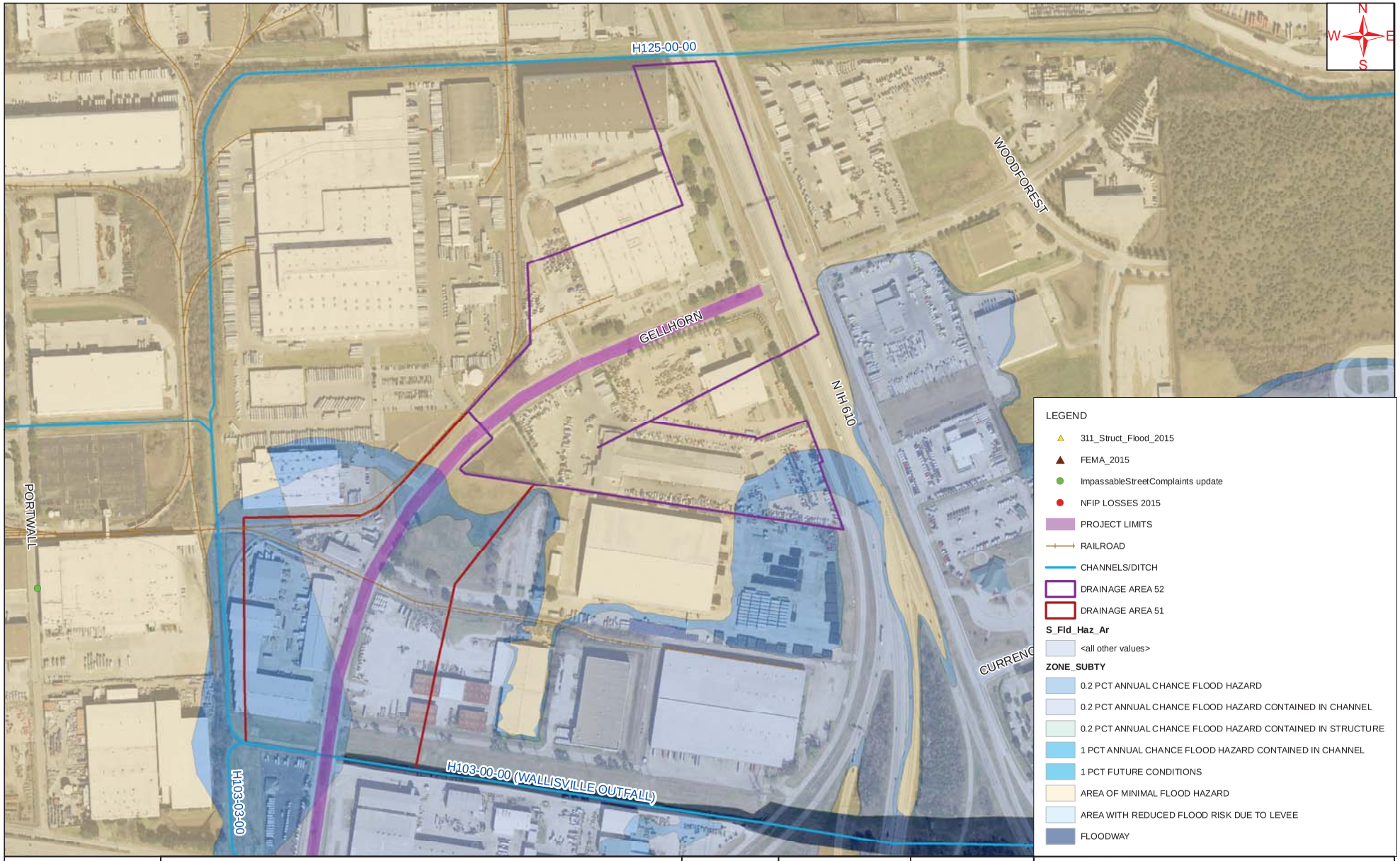


iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

DATE:	SCALE:	EXHIBIT 3
JUNE, 2016	400 200 0 Feet	OVERLAND DRAINAGE SYSTEM GELLHORN DRIVE

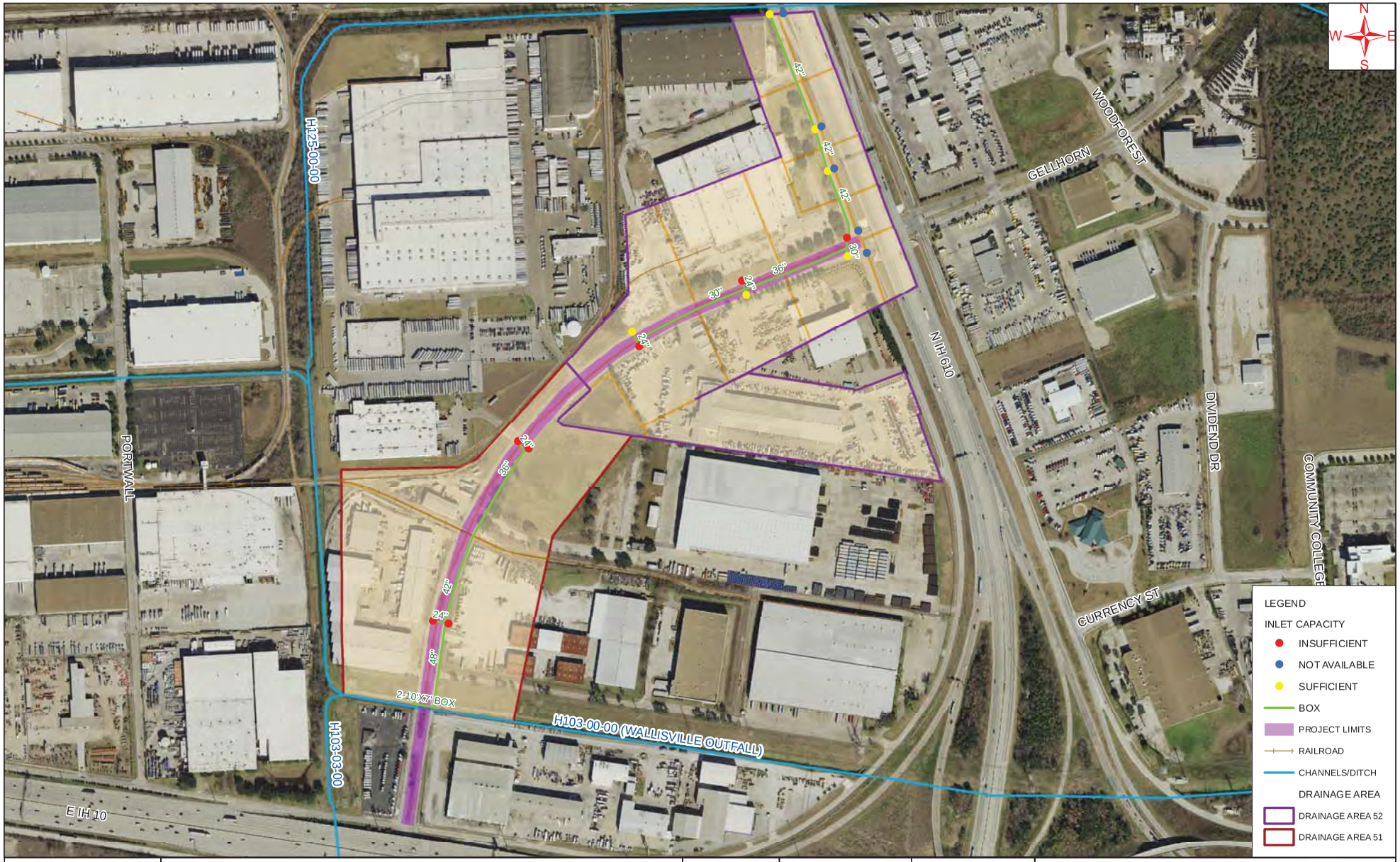


iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

DATE:	SCALE:	EXHIBIT 4
JUNE, 2016	400 200 0 Feet	FLOODPLAIN REPETITIVE LOSSES GELLHORN DRIVE



iSani CONSULTANTS
engineers | construction managers

STREET AND PAVING IMPROVEMENTS PROJECT # N-2016T-0015
GELLHORN DRIVE

FROM IH10 TO IH610

DATE:	SCALE:	EXHIBIT 5
JUNE, 2016	400 200 0 Feet	DRAINAGE SYSTEN CAPACITIES GELLHORN DRIVE

TABLE 2 - PEAK FLOW CALCULATIONS

SUB-AREA	AREA (Ac)	Tc (min)	RUNOFF COEFF. C									CA	INTENSITY		RUNOFF	
			0.2 AREA (AC)	0.35 AREA (AC)	0.55 AREA (AC)	0.65 AREA (AC)	0.75 AREA (AC)	0.8 AREA (AC)	0.9 AREA (AC)	% IMPERV.	WGH'T RUNOFF COEFF		2-YR i IN/HR	100-YR i IN/HR	2-YR Q CFS	100-YR Q CFS
H0051 (From 450 ft north of railroad crossing to Outfall at HCFCD Unit H103-00-00)																
H0051-1	4.13	27.8	1.25				1.54		1.34	64.1%	0.63	2.61	3.22	6.71	8.42	17.51
H0051-2	5.92	28.7	4.76						1.16	19.6%	0.34	2.00	3.17	6.62	6.33	13.22
H0051-3	9.51	29.9	1.02				7.76		0.73	77.0%	0.70	6.68	3.10	6.51	20.74	43.47
H0051-4	7.44	29.2	1.39				5.21		0.84	70.8%	0.66	4.94	3.14	6.57	15.52	32.45
H0052 (From 1000 ft north of railroad crossing to Outfall at H125-00-00)																
H0052-1	4.05	27.8	3.54						0.51	12.6%	0.29	1.17	3.23	6.71	3.76	7.83
H0052-2	3.94	27.7					3.47		0.47	86.8%	0.77	3.03	3.23	6.72	9.77	20.32
H0052-3	4.79	28.2	2.63				2.16			38.3%	0.45	2.15	3.20	6.67	6.87	14.32
H0052-4	3.45	27.4	3.17						0.28	8.1%	0.26	0.89	3.25	6.75	2.88	5.98
H0052-5	3.01	27.1	1.28				1.39		0.34	50.5%	0.53	1.60	3.27	6.78	5.24	10.87
H0052-5F	0.76	24.5	0.25						0.51	67.1%	0.67	0.51	3.44	7.06	1.75	3.59
H0052-6	2.83	27.0	1.80				0.34		0.69	34.6%	0.44	1.24	3.27	6.79	4.05	8.39
H0052-6F	1.10	25.2	0.40						0.70	63.6%	0.65	0.71	3.40	6.99	2.41	4.96
H0052-7	1.13	25.2	0.91				0.04		0.18	18.9%	0.33	0.37	3.39	6.98	1.27	2.61
H0052-7F	0.90	24.8	0.28						0.62	68.9%	0.68	0.61	3.42	7.03	2.10	4.32
H0052-8	1.57	25.8	1.14				0.13		0.30	26.1%	0.38	0.60	3.35	6.92	2.00	4.12
H0052-8F	1.15	25.2	0.23						0.92	80.0%	0.76	0.87	3.39	6.98	2.96	6.10
H0052-9	1.68	26.0	0.47				0.65		0.56	66.2%	0.65	1.09	3.34	6.90	3.63	7.49
H0052-9F	1.07	25.1	0.11						0.96	89.7%	0.83	0.89	3.40	6.99	3.01	6.20
H0052-2DP1	1.33	25.5	1.33							0.0%	0.20	0.27	3.37	6.95	0.90	1.85
H0052-2DP2	9.35	29.8	6.40				2.95			26.8%	0.37	3.49	3.11	6.51	10.85	22.74
H0052 (Overland DA from west)																
H103-00_08	55.33	63.9					55.33			85.0%	0.75	41.50	1.96	4.45	81.32	184.72

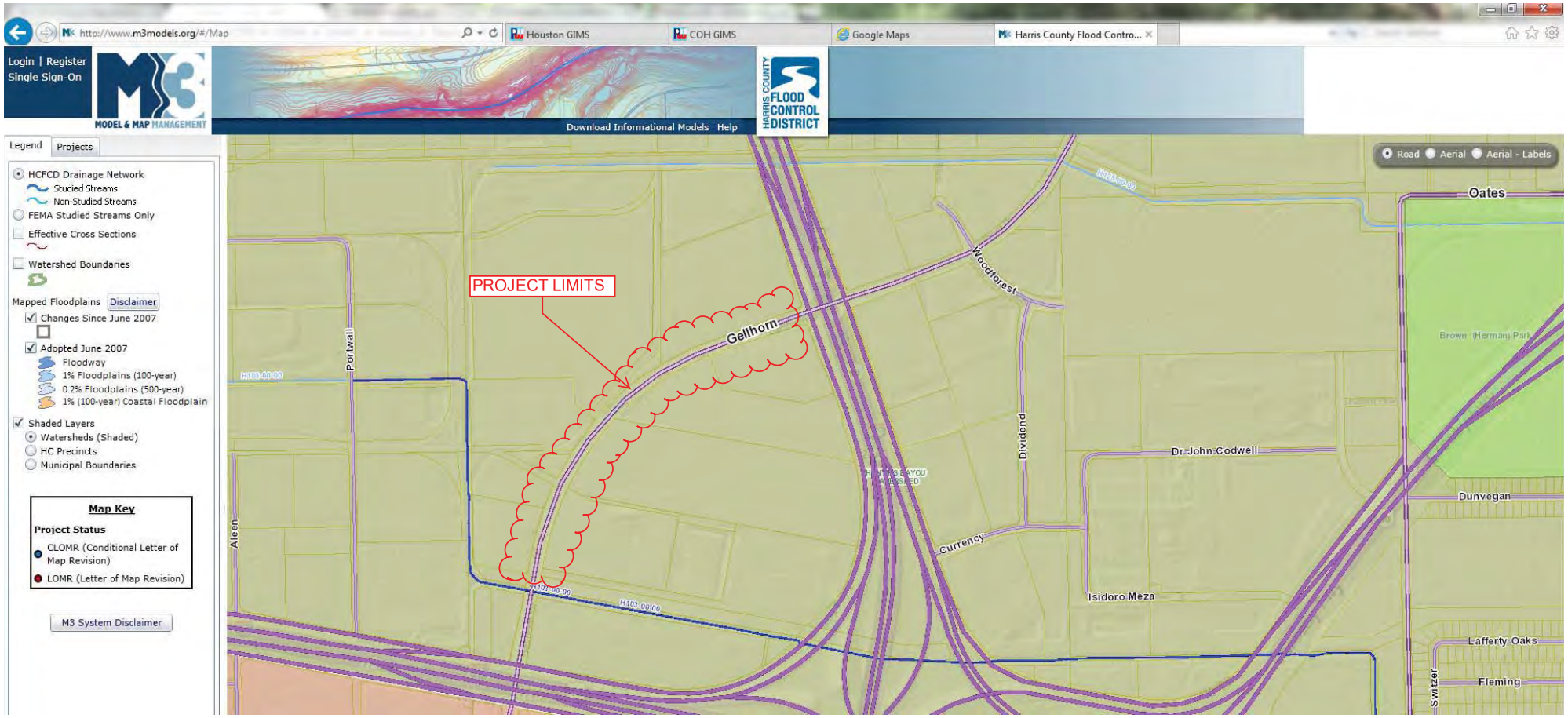
Table 3 - Historical Flooding, Gellhorn Drive

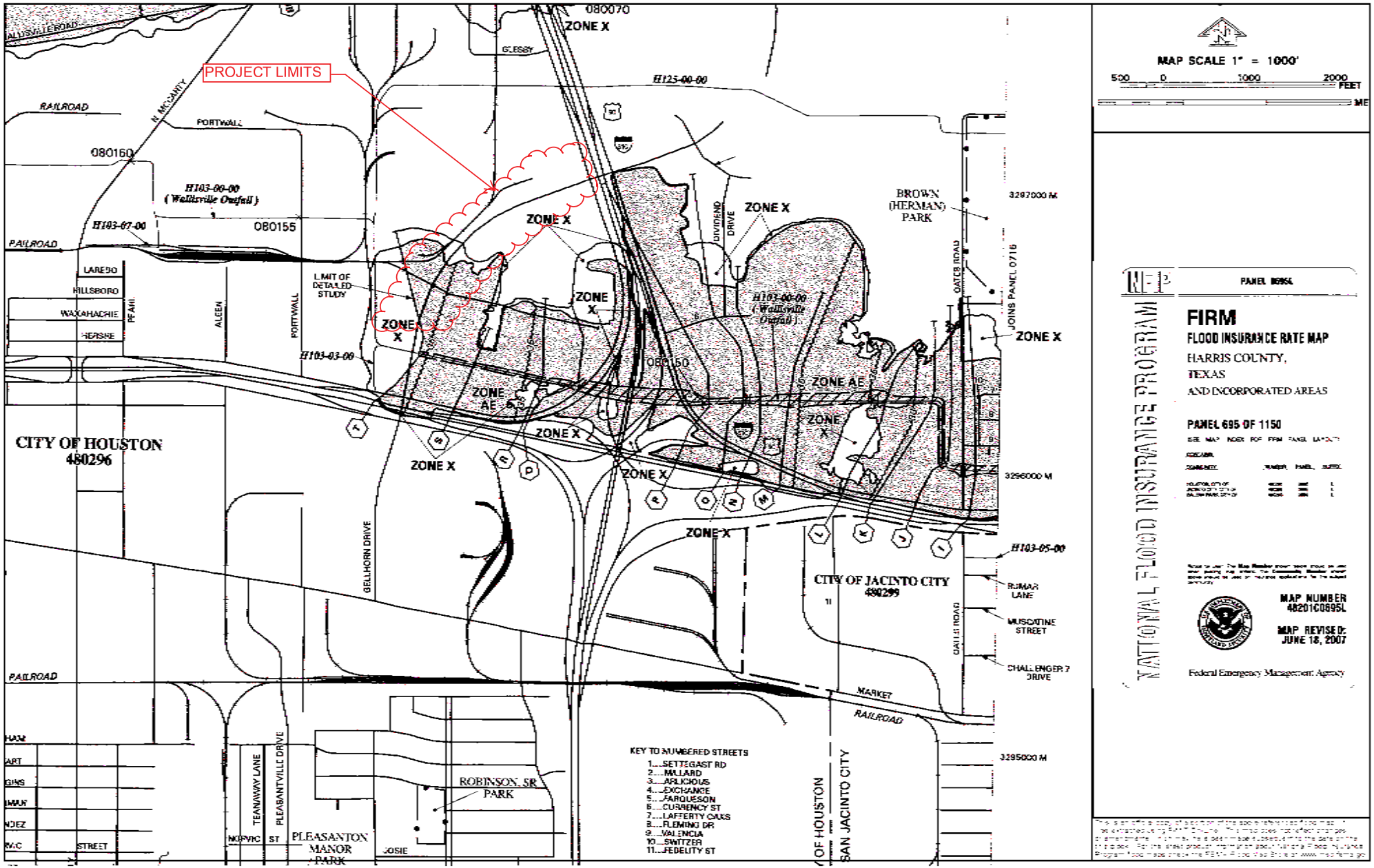
DRAINAGE SYSTEM	AREA (ACRES)	FLOODING COMPLAINTS, 2015			
		IMPASSABLE STREETS	NFIP LOSSES	STRUCTURAL FLOODING	311 ROW FLOODING
H0051	27.0	0	0	0	0
H0052	42.1	0	0	0	0

TABLE 4: Storm Sewer Inlet Capacities									
Sub Drainage Area ID	Drainage Area	Inlet Type	No. of Inlets	Inlet Capacity	Total No. of Inlets	Total Inlet Capacity	2-yr Flow	Sufficient Capacity	Notes
	(ac)			(cfs)		(cfs)	(cfs)		
H0051									
H0051-1	4.13	B-B	1	5	1	5.0	8.42	No	
H0051-2	5.92	B-B	1	5	1	5.0	6.33	No	
H0051-3	9.51	B-B	1	5	1	5.0	20.74	No	
H0051-4	7.44	B-B	1	5	1	5.0	15.52	No	
H0052									
H0052-1	4.05	B-B	1	5	1	5.0	3.76	Yes	
H0052-2	3.94	B-B	1	5	1	5.0	9.77	No	
H0052-3	4.79	B-B	1	5	1	5.0	6.87	No	
H0052-4	3.45	B-B	1	5	1	5.0	2.88	Yes	
H0052-5	3.01	B-B	1	5	1	5.0	5.24	No	
H0052-5F	0.76	Unknown	1		1	0.0	1.75	N/A	
H0052-6	2.83	B-B	1	5	1	5.0	4.05	Yes	
H0052-6F	1.10	Unknown	1		1	0.0	2.41	N/A	
H0052-7	1.13	TxDOT Type C (1 Extension)	1	12	1	12.0	7.27	Yes	
H0052-7F	0.90	Unknown	1		1	0.0	2.10	N/A	
H0052-8	1.57	TxDOT Type C (2 Extension)	1	15	1	15.0	2.99	Yes	
H0052-8F	1.15	Unknown	1		1	0.0	2.96	N/A	
H0052-9	1.68	TxDOT Type C (2 Extension)	1	15	1	15.0	8.45	Yes	
H0052-9F	1.07	Unknown	1		1	0.0	3.01	N/A	

TABLE 5 - SWMM HGL RESULTS
GELLHORN DRIVE

NODE NAME	2-YEAR STORM FREQUENCY			100-YEAR STORM FREQUENCY		
	CRITICAL ELEVATION (GUTTER)	EXISTING HGL	EXISTING PONDING	ALLOWABLE MPE	EXISTING HGL	EXISTING PONDING
H0051						
3001809	31.80	30.47		32.80	36.87	PONDING
3001752	33.87	30.07		34.87	36.83	PONDING
3001753	31.83	29.96		32.83	36.85	PONDING
H0051-OUT	35.21	29.50		36.21	36.21	
H0052						
3001750	32.87	30.19		33.87	36.64	PONDING
3001749	32.40	27.75		33.40	36.63	PONDING
3001209	32.78	26.59		33.78	36.63	PONDING
3001208	33.05	26.53		34.05	36.63	PONDING
H0052-7	33.60	26.13		34.60	36.61	PONDING
H0052-8	34.10	25.80		35.10	36.59	PONDING
H0052-9	34.20	24.66		35.20	33.00	
H0052-OUT	33.88	24.55		34.88	33.00	


http://www.m3models.org/#/Map
Houston GIMS
COH GIMS
Google Maps
Harris County Flood Contro...
Login | Register
Single Sign-On
MODEL & MAP MANAGEMENT
Download Informational Models
Help
HARRIS COUNTY FLOOD CONTROL DISTRICT
Legend
Projects
HCFCD Drainage Network
Studied Streams
Non-Studied Streams
FEMA Studied Streams Only
Effective Cross Sections
Watershed Boundaries
Mapped Floodplains
Disclaimer
Changes Since June 2007
Adopted June 2007
Floodway
1% Floodplains (100-year)
0.2% Floodplains (500-year)
1% (100-year) Coastal Floodplain
Shaded Layers
Watersheds (Shaded)
HC Precincts
Municipal Boundaries
Map Key
Project Status
CLOMR (Conditional Letter of Map Revision)
LOMR (Letter of Map Revision)
M3 System Disclaimer
Road
Aerial
Aerial - Labels
PROJECT LIMITS
Gellhorn
Portwall
Aleen
Woodforest
Dividend
Currency
Dr John Codwell
Isidoro Meza
Oates
Dunvegan
Lafferty Oaks
Fleming
Switzer


PROJECT LIMITS
080070
ZONE X
H125-00-00
RAILROAD
N. MCCARTY
FORTWALL
080160
H103-00-00
(Wallisville Outfall)
H103-07-00
080155
LIMIT OF DETAILED STUDY
ZONE X
ZONE AE
H103-03-00
080150
DIVIDEND DRIVE
BROWN (HERMAN) PARK
3297000 M
OATES ROAD
JOINS PANEL 0715
LAREDO
HILLSBORO
WAXAHACHIE
HERSHE
PEAHI
ALEEN
CITY OF HOUSTON
480296
BELLHORN DRIVE
3296000 M
CITY OF JACINTO CITY
480299
H103-05-00
RUMAR LANE
MUSCATINE STREET
CHALLENGER 7 DRIVE
MARKET
3295000 M
TEANAWAY LANE
PLEASANTVILLE DRIVE
ROBINSON, SR PARK
PLEASANTON MANOR PARK
JOSIE
KEY TO NUMBERED STREETS
1...SETTEGAST RD
2...MULLARD
3...ARLICIOUS
4...EXCHANCE
5...FARQUESON
6...CURRENCY ST
7...LAFFERTY OAKS
8...FLEMING DR
9...VALENCIA
10...SWITZER
11...FEDELITY ST
MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0695L
FIRM
FLOOD INSURANCE RATE MAP
HARRIS COUNTY,
TEXAS
AND INCORPORATED AREAS
PANEL 695 OF 1150
MAP NUMBER
48201C0695L
MAP REVISED:
JUNE 18, 2007
Federal Emergency Management Agency

APPENDIX 1

APPENDIX E – H125-00-00 PHOTOGRAPHS

Date: January 10, 2017

PHOTO 1: Ditch H125-00-00 and Culvert ; Looking South along IH 610 Frontage (South Bound)

Date: January 10, 2017

PHOTO 2: Culvert (2-8'x6' RCB) under IH 610 Frontage; Looking east along H125-00-00)

Date: January 10, 2017	PHOTO 3: Looking West along H125-00-00

Date: January 10, 2017	PHOTO 4: Looking West at along H125-00-00

Date: January 10, 2017	PHOTO 5: Railroad crossing and culvert; Looking West along H125-00-00

STATE OF TEXAS
ROBERT L. MARTIN
123284
LICENSED
PROFESSIONAL ENGINEER

9/26/2017

TRAFFIC OPERATIONS ANALYSIS

ON

GELLHORN ROAD:
FROM IH-10 TO IH-610
CORRIDOR N-2016T-0015

IN

HOUSTON, TEXAS

Presented to

PGAL

3131 Briarpark, Suite 200
Houston, Texas 77042

Conducted by

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.
TEXAS REGISTERED ENGINEERING FIRM NO. F - 000625

SEPTEMBER 2017

Corridor N-2016T-0005 – Gellhorn Drive: from IH-10 to IH-610

1. INTRODUCTION

Gellhorn Drive is a divided roadway with two lanes in each direction and a 30 foot wide median. The corridor is approximately 3/4th of a mile long and aligned in a south-west to north-east direction with a curvature. The speed limit on this roadway is 35 miles per hour (mph). A 4' wide sidewalk runs along the east side of Gellhorn Drive for approximately half the length of the segment within the study area and for about 500' along the west side near the south end of the corridor.

Under Planning 1, PGAL has contracted Ergonomic Transportation Solutions, Inc. (ETSI) to conduct a pre-engineering assessment on Gellhorn Drive Corridor between IH-10 and IH-610, which identified some key capacity and safety issues that need to be assessed in detail under Pre-engineering Planning 2. Pre-engineering Planning 1 report was subsequently submitted to PGAL in June 2016.

This report presents the Traffic Operations Analysis on Gellhorn Drive, from IH-10 to IH-610 under the City of Houston(COH)'s Work Order 15, Pre-engineering Planning Phase 2.

1.1 PURPOSE AND SCOPE

The purpose of this study is to assess traffic operations along Gellhorn Drive from IH-10 to IH-610 under existing (year 2016) and future (year 2040) traffic conditions and make recommendations to improve the quality of traffic flow, as well as to enhance safety.

The following tasks are covered in this study:

- Conduct turning movement counts during A.M and P.M peak periods at the following locations:
    - Gellhorn Drive at IH-10 (Unsignalized),
    - Gellhorn Drive at Kroger Access Driveway South (Unsignalized),

  - Gellhorn Drive at Kroger Access Driveway North (Unsignalized),
  - Gellhorn Drive at IH-610 (Signalized).
- Establish two peak traffic periods; weekday A.M. and weekday P.M.
- Assess collected traffic counts and develop assignments on the study network for weekday A.M. and weekday P.M. peak hours.
- Collect available traffic signal data from the City of Houston.
- Collect available traffic projections data from the City of Houston.
- Conduct traffic operational analyses under existing roadway geometry and traffic control conditions.
- Conduct traffic operational analyses under future roadway geometry and traffic control conditions.
- Test various alternative improvements.
- Assess the quality of traffic flow based on analysis results such as delays, queues, Level Of Service (LOS) etc.
- Make recommendations to improve the quality of traffic flow and safety, where necessary.

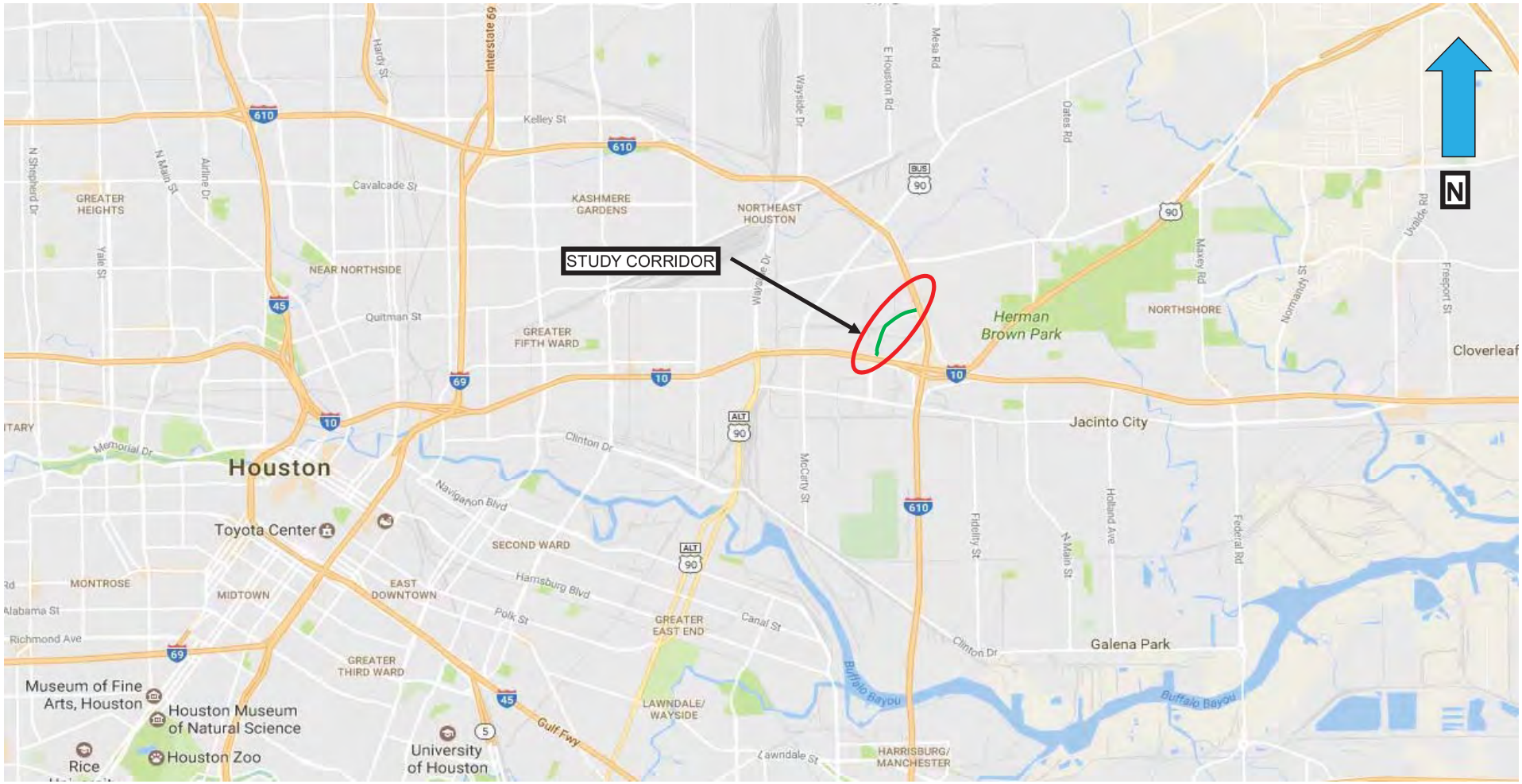
1.2 STUDY AREA

The study area covers Gellhorn Drive, from IH-10 to IH-610 that contains the above-mentioned intersections.

Exhibit 1.1 shows the general location of the study area.

Exhibit 1.2 shows the City of Houston's Major Thoroughfare & Freeway Plan with Gellhorn Drive and its adjacent roadways. Gellhorn Drive is shown on the map as a Major Thoroughfare with sufficient width. The MTFP Street Hierarchy Classification table lists Gellhorn Drive as a 4 lane Major Thoroughfare with a 100-foot ROW.

A project that would extend Gellhorn Drive from Woodforest Blvd to Wallisville Road is currently underway. This is expected to influence the future traffic on this corridor.



SOURCE: GOOGLE MAPS

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 1.1

STUDY AREA

MAJOR THOROUGHFARE (R.O.W. ONLY)
- SUFFICIENT WIDTH
- TO BE WIDENED
- TO BE ACQUIRED

MAJOR COLLECTOR (R.O.W. ONLY)
- SUFFICIENT WIDTH
- TO BE WIDENED
- TO BE ACQUIRED

FREEWAY / EXPRESSWAY (R.O.W. ONLY)
- SUFFICIENT WIDTH
- TO BE WIDENED
- TO BE ACQUIRED
- PROPOSED/SUGGESTED ALIGNMENT *

TRANSIT CORRIDOR
- TRANSIT CORRIDOR STREET
- COUNTY BOUNDARY
- METRO MAIN STREET RAIL
- METRO PROPOSED TRANSIT CORRIDORS
- RAIL ROAD
- HOUSTON CITY LIMITS
- LIMITED PURPOSE ANNEXATION **
- HOUSTON ETJ
- RESERVOIR
- WATERWAYS
- SAM HOUSTON PARKWAY (BELTWAY 8)
- HARDY TOLLROAD
- WESTPARK TOLLROAD

N

SOURCE: CITY OF HOUSTON

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 1.2

MAJOR THOROUGHFARE AND FREEWAY PLAN

2. TRAFFIC DATA

2.1 EXISTING TRAFFIC (YEAR 2016)

Based on the type of facilities being analyzed in this study, the two peak traffic periods – a typical weekday morning (7:00 A.M. to 9:00 A.M.) and a typical weekday evening (3:00 P.M. to 5:00 P.M.) were established. In this study, turning movement counts (TMC's) at the key intersections along this corridor were collected on different dates. The names of the intersections and data collection dates are summarized in the following **Table 2.1**:

Intersection Name	Date
Gellhorn Drive at IH-10	Tuesday, May 24, 2016
Gellhorn Drive at Kroger South Access Driveway	Tuesday, May 24, 2016
Gellhorn Drive at Kroger North Access Driveway	Tuesday, May 24, 2016
Gellhorn Drive at IH-610	Wednesday, May 25, 2016

Table 2.1: *Locations and dates of turning movement counts.*

The purpose of recording these counts was to determine the peak analyses hours, to gain an understanding how traffic fluctuates during such hours and to use them as input in the traffic analyses.

The City of Houston's traffic assignments show that the corridor carries 3,702 trips per day in the year 2016.

Table 2.2 shows the calculated 2016 ADTs and the ADTs generated by COH model for the same year.

Calculated 2010 ADTs were estimated by applying a K-factor of 0.077 to the peak hour volumes, which was derived from available 24-hour count within the study corridor.

From the traffic counts it was observed that the traffic mix within the corridor consists of an average of 28% trucks. The developments in the area of the study corridor are mainly

industrial comprising primarily of distribution warehouses. Thus there is a need for large radii at intersections and major driveways. Longer left turn bays are also needed to accommodate turning trucks to minimize interruption to thru traffic.

Street	Segment	2016 ADT (COH Model)	2016 ADT (ETSI)
Gellhorn Drive	IH-10 to IH-610	3,702	4,091

Table 2.2: *Gellhorn Drive 2016 ADT.*

From **Table 2.2** it appears that the COH's model assignment is close to ETSI estimated ADT.

Exhibit 2.1 shows the balanced existing (year 2016) traffic patterns in the study corridor during typical weekday A.M. and P.M. peak hours.

Detailed traffic count spread sheets are included in the **Appendix**.

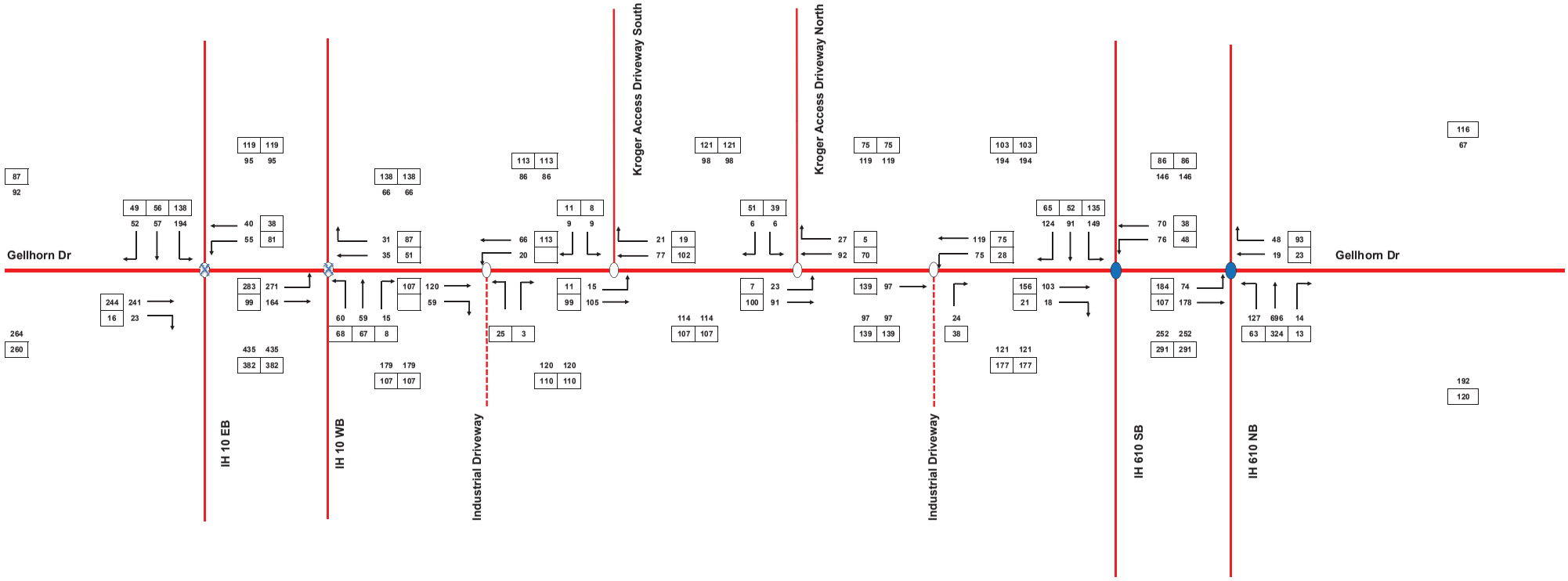
2.2 FUTURE TRAFFIC (YEAR 2040)

Average Daily Traffic (ADT) assignments along the study corridor for years 2016 and 2040 were provided by the City of Houston's model.

The future COH traffic assignments on Gellhorn Drive for year 2040 show an ADT of 5,705.

ETSI has developed peak hour traffic volumes for year 2040 at key intersections along this corridor based on the following data:

- Future Average Daily Traffic Assignments provided by the City of Houston.
- Existing (year 2016) AM and PM turning movement counts.
- K = 0.077, indicates the proportion of daily traffic during the peak hour.



NOT TO SCALE

TRAFFIC ANALYSIS

EXHIBIT 2.1 GELLHORN DRIVE

BALANCED EXISTING TRAFFIC CONDITIONS (YEAR 2016)

WEEKDAY A.M. & P.M. PEAK HOURS

- Calculated Compound Annual Growth Rate (CAGR) of 1.82% based on existing traffic counts and future traffic assignments provided by the City of Houston along Gellhorn Drive.

Table 2.3 shows calculated growth rate along Gellhorn Drive. The growth rate was then used to project year 2016 volumes to year 2040.

Street	Segment	2016 COH ADT	2040 COH ADT	2016 ETSI ADT	Annual Compound Growth Rate (2016-2040)	2040 ETSI ADT
Gellhorn Drive	IH 10 to IH 610	3,702	5,705	4,091	1.82%	6,304

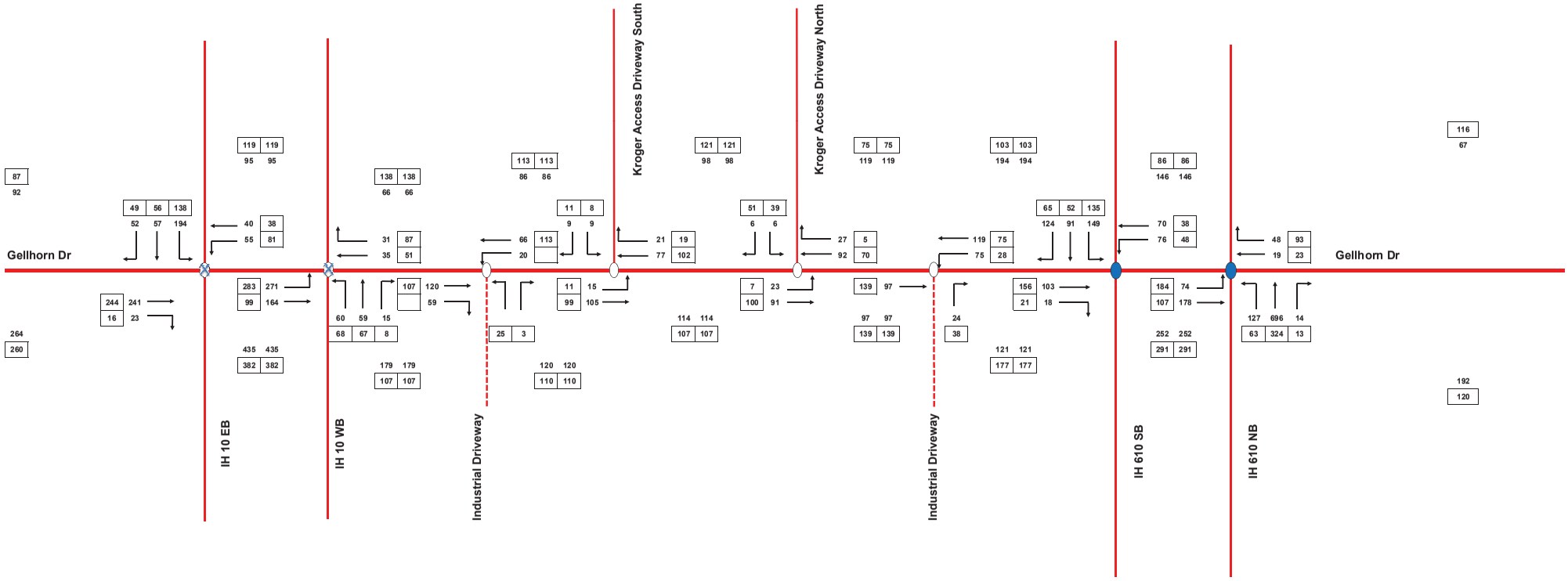
Table 2.3: *Growth Rate calculation*

Exhibit 2.2 shows the projected (year 2040) traffic volumes in the study corridor during typical weekday A.M. and P.M. peak hours.

3.0 TRAFFIC ANALYSES

3.1 METHODOLOGY

The concept of Level Of Service (LOS) is commonly used in order to determine the operating conditions of an intersection or roadway. The LOS concept is similar to a grading system, ranging from LOS A to LOS F, where LOS A represents free flow conditions and LOS F represents congested or jammed conditions. LOS is commonly evaluated on the basis of control delay per vehicle (in seconds per vehicle). Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. For this study, the Transportation Research Board's Highway Capacity Manual (2010) signalized and unsignalized methodologies were utilized. For unsignalized intersections, the delay is reported for minor approaches only. The average control delay per vehicle will be referred to as average delay throughout this report.



NOT TO SCALE

TRAFFIC ANALYSIS

EXHIBIT 2.1 GELLHORN DRIVE

BALANCED EXISTING TRAFFIC CONDITIONS (YEAR 2016)

WEEKDAY A.M. & P.M. PEAK HOURS

3.2 LEVEL OF SERVICE STANDARDS

Most public agencies consider LOS-C to be the desirable LOS, which should be the target for traffic flow improvements. However, there are circumstances, where LOS-C cannot be achieved with reasonable improvements. In such circumstances, LOS-D is considered to be acceptable. In this study the LOS threshold below which the quality of traffic flow is considered unacceptable is LOS-D. When traffic operations at a particular intersection within the study area drop below LOS-D, improvements would be recommended. When LOS-D cannot be achieved with reasonable improvements, the problem will be identified in the conclusion section of this report.

3.3 ANALYSIS TOOL

In order to evaluate the existing quality of traffic flow and to determine if improvements are necessary, capacity analyses were performed based on the procedures contained in Highway Capacity Manual (HCM), 2010 edition. The input data for these analyses included existing/proposed geometric features, existing/ proposed traffic control at the intersections and peak hour traffic volumes. The analysis software tool SYNCHRO was utilized in this study. It is a macroscopic traffic signal timing tool that is widely used to optimize signal-timing parameters for signalized intersections and generate coordinated traffic signal timing plans for arterials and networks.

3.4 ANALYSES RESULTS

Capacity and LOS analyses were performed for the following conditions during weekday A.M. and P.M. peak hours:

- Scenario 1 (Year 2016 Traffic Demand with Existing Geometry)
- Scenario 2 (Year 2040 Traffic Demand with Existing Geometry)

A Summary of all analyses results is presented in **Tables 3.1 and 3.2.**

TABLE 3.1: SUMMARY OF CAPACITY ANALYSES RESULTS FOR WEEKDAY A.M. PEAK HOUR

Intersection	EBL			EBT			EBR			WBL			WBT			WBR			NBL			NBT			NBR			SBL			SBT			SBR			MAX V/C Ratio	Int. Delay (Sec/Veh)	Int. LOS
	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS			
Scenario 1 (Year 2016 Traffic Demand with Existing Geometry, AM Peak)																																							
Gellhorn Drive at IH-610 NB frontage Road	22.0	65	C	6.7	41	A	N/A	N/A	N/A	N/A	N/A	N/A	12.4	22	B	N/A	N/A	N/A	N/A	N/A	N/A	32.9	#360	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.82	27.0	C
Gellhorn Drive at IH-610 SB frontage Road	N/A	N/A	N/A	23.2	35	C	N/A	N/A	N/A	41.3	m55	D	1.4	m3	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.4	101	B	N/A	N/A	N/A	0.82	19.1	B
Gellhorn Drive at Kroger Access Driveway North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.9	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	10.3	N/A	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	N/A
Gellhorn Drive at Kroger Access Driveway South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.8	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	9.6	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	N/A
Gellhorn Drive at IH-10 WB frontage Road	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.9	14	B	9.4	6	A	N/A	N/A	N/A	14.9	60	B	9.3	10	A	N/A	N/A	N/A	N/A	N/A	N/A	9.4	2	A	6.6	N/A	A	N/A	N/A	N/A
Gellhorn Drive at IH-10 EB frontage Road	13.0	36	B	9.1	4	A	8.9	8	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.5	14	B	N/A	N/A	N/A	10.9	8	B	9.7	2	A	N/A	N/A	N/A	N/A	10.6	B
Scenario 2 (Year 2040 Traffic Demand with Existing Geometry, AM Peak)																																							
Gellhorn Drive at IH-610 NB frontage Road	53.4	m128	D	14.9	73	B	N/A	N/A	N/A	N/A	N/A	N/A	15.4	36	B	N/A	N/A	N/A	N/A	N/A	N/A	39.5	#690	D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94	35	D
Gellhorn Drive at IH-610 SB frontage Road	N/A	N/A	N/A	20.6	49	C	N/A	N/A	N/A	60.2	m98	E	1.3	m5	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	36.0	258	D	N/A	N/A	N/A	0.94	32	C
Gellhorn Drive at Kroger Access Driveway North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.1	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	11.1	N/A	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	N/A
Gellhorn Drive at Kroger Access Driveway South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.0	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	10.1	N/A	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.3	N/A
Gellhorn Drive at IH-10 WB frontage Road	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.7	28	B	10.9	10	B	N/A	N/A	N/A	35.3	308	E	10.8	18	B	N/A	N/A	N/A	N/A	N/A	N/A	10.6	4	B	7.9	6	A	N/A	21.0	C
Gellhorn Drive at IH-10 EB frontage Road	21.7	108	C	10.2	8	B	10.4	16	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.3	28	B	N/A	N/A	N/A	12.1	8	B	12.2	10	B	N/A	N/A	N/A	N/A	14.4	B

TABLE 3.2: SUMMARY OF CAPACITY ANALYSES RESULTS FOR WEEKDAY P.M. PEAK HOUR

Intersection	EBL			EBT			EBR			WBL			WBT			WBR			NBL			NBT			NBR			SBL			SBT			SBR			MAX V/C Ratio	Int. Delay (Sec/Veh)	Int. LOS
	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS	Total Delay (S/V)	Queue Length (ft)	LOS			
Scenario 1 (Year 2016 Traffic Demand with Existing Geometry, PM Peak)																																							
Gellhorn Drive at IH-610 NB frontage Road	23.5	134	C	2.9	2	A	N/A	N/A	N/A	N/A	N/A	N/A	7.9	25	A	N/A	N/A	N/A	N/A	N/A	N/A	23.4	138	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.60	18.5	B
Gellhorn Drive at IH-610 SB frontage Road	N/A	N/A	N/A	25.6	49	C	N/A	N/A	N/A	19.7	37	B	2.7	5	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.9	67	B	N/A	N/A	N/A	0.60	17.6	B
Gellhorn Drive at Kroger Access Driveway North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.7	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.2	N/A	B	N/A	N/A	N/A	N/A	3.4	N/A
Gellhorn Drive at Kroger Access Driveway South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.9	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.6	N/A	A	N/A	N/A	N/A	N/A	1.1	N/A
Gellhorn Drive at IH-10 WB frontage Road	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.4	16	B	9.7	6	A	N/A	N/A	N/A	16.2	70	C	9.1	6	A	N/A	N/A	N/A	N/A	N/A	N/A	9.5	N/A	A	6.9	8	A	N/A	12.0	B
Gellhorn Drive at IH-10 EB frontage Road	11.6	22	B	9.2	4	A	8.4	6	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.2	14	B	N/A	N/A	N/A	11.1	12	B	9.4	N/A	A	N/A	N/A	N/A	N/A	9.9	A
Scenario 2 (Year 2040 Traffic Demand with Existing Geometry, PM Peak)																																							
Gellhorn Drive at IH-610 NB frontage Road	27.7	205	C	4.2	46	A	N/A	N/A	N/A	N/A	N/A	N/A	7.8	36	A	N/A	N/A	N/A	N/A	N/A	N/A	24.8	216	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.72	20.3	C
Gellhorn Drive at IH-610 SB frontage Road	N/A	N/A	N/A	27.1	72	C	N/A	N/A	N/A	27.3	65	C	2.8	7	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.6	116	B	N/A	N/A	N/A	0.72	20.2	C
Gellhorn Drive at Kroger Access Driveway North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.5	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.3	N/A	B	N/A	N/A	N/A	N/A	3.4	N/A
Gellhorn Drive at Kroger Access Driveway South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.7	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.6	N/A	A	N/A	N/A	N/A	N/A	1.1	N/A
Gellhorn Drive at IH-10 WB frontage Road	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.7	32	B	10.5	8	B	N/A	N/A	N/A	35.7	332	E	9.6	10	A	N/A	N/A	N/A	N/A	N/A	N/A	10.2	N/A	B	8.5	16	A	N/A	12.0	B
Gellhorn Drive at IH-10 EB frontage Road	14.2	44	B	9.6	8	A	9.6	12	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11.7	24	B	N/A	N/A	N/A	12.8	22	B	10.0	N/A	A	N/A	N/A	N/A	N/A	9.9	A

3.4.1 Scenario 1 (Year 2016 Traffic Demand with Existing Geometry)

This scenario has been tested under existing geometry and traffic patterns.

Capacity analysis results indicate that under existing (year 2016) traffic and geometric conditions, the quality of traffic flow as well as the overall intersection LOS is within acceptable limits for all intersections.

Exhibits 3.1 & 3.5 show the overall network under *Scenario 1* during the AM and PM peaks respectively.
Exhibits 3.2-3.4 & 3.6-3.8 show individual intersection geometries and capacity analysis results under *Scenario 1.*

3.4.2 Scenario 2 (Year 2040 Traffic Demand with Existing Geometry)

This Scenario, developed by PGAL, has been tested under the following geometric and traffic control conditions:

- Maintain the current geometry along Gellhorn Drive and its cross streets.

Capacity analysis results under *Scenario 2* indicates that the quality of traffic flow as well as the overall intersection LOS is within acceptable limits for all intersections, except for the northbound left turn movement on Gellhorn Drive at IH 10 westbound frontage road. Analysis shows the individual movement LOS to be E. From the current traffic volumes and the expected growth rate, it appears that a traffic signal would be warranted at the intersection of Gellhorn Drive at IH 10 by 2030.

Exhibit 3.9 & 3.13 show the overall network under *Scenario 2* during the AM and PM peaks respectively.
Exhibits 3.10-3.12 & 3.14-3.16 show individual intersection geometries and capacity analysis results for *Scenario 2*.

4. CONCLUSIONS

Based on field investigations and traffic analyses results, we conclude the following:

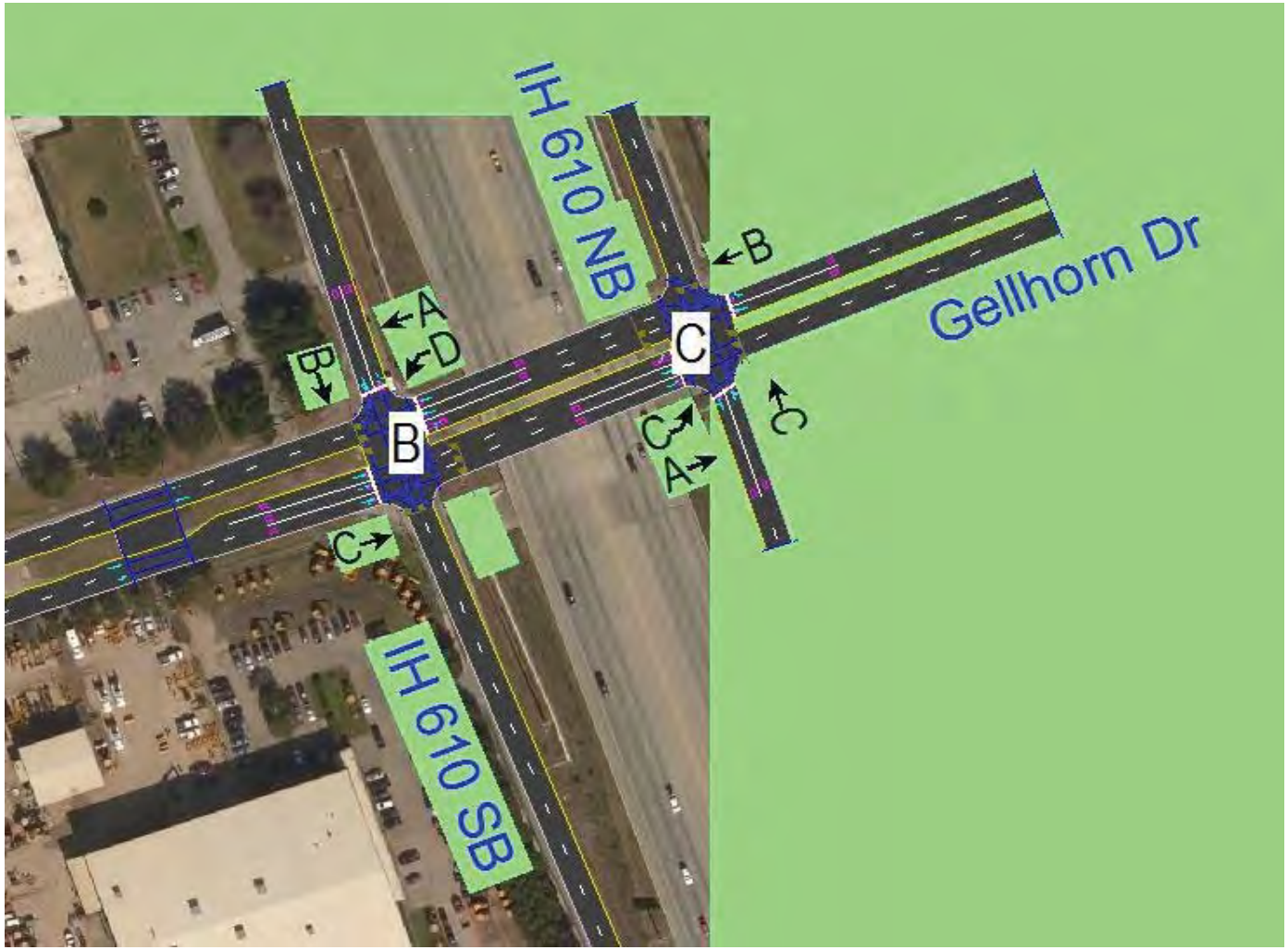
- The study corridor carries large truck volumes. According to the traffic counts collected by ETSI, 28% of the peak hour traffic is trucks. Furthermore, because the typical percentage of trucks during peak hours is lower than other hours, the percentage of trucks in the ADT is expected to be even higher than 28%.
- The area mainly comprises of industrial developments.
- Capacity analysis results under Scenario 1 (Year 2016 Traffic Demand with Existing Geometry), the overall LOS for all intersections is within acceptable limits.
- Capacity analysis results under Scenario 2 (Year 2040 Traffic Demand with Existing Geometry) shows that the existing geometric configuration of Gellhorn Drive would be sufficient to handle the future traffic demand.

5. RECOMMENDATIONS

- Based on the analysis at three key intersections (at IH 610, Kroger Access Driveways and IH 10), the existing facility can accommodate present and future travel demand, with minor improvements.
- The pavement has significant damage and should be replaced. Radii at major driveways should be large enough to accomodate WB 60 trucks.
- Pavement markings along Gellhorn need to be replaced.
- A traffic signal may be warranted within the next 13 years at Gellhorn and IH 10. At that time, a traffic signal warrant analysis should be conducted to determine if a traffic signal is feasible.
- The traffic signal at the intersection of Gellhorn at IH 610 needs to be modernized.

- Although no significant pedestrian volumes were observed, pedestrian facilities should be updated to meet current ADA and accessibility guidelines at all intersections within the study corridor.
- New sidewalks with street lighting should also be installed along the corridor.
- Left turn bays should be as long as the median length would permit at the major driveways to handle more than one truck at a time, especially at Kroger's driveways.

ETSI 5300 Hollister Road, Suite 220 Houston, Texas 77040 Tel. (713) 956-9601 Fax (713) 956-9667 Ergonomic Transportation Solutions, Inc.	NOT TO SCALE	EXHIBIT 3.1
		SCENARIO 1 - EXISTING GEOMETRY (2016) AM PEAK



ETSI
Ergonomic Transportation Solutions, Inc.
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667

NOT TO SCALE

EXHIBIT 3.2

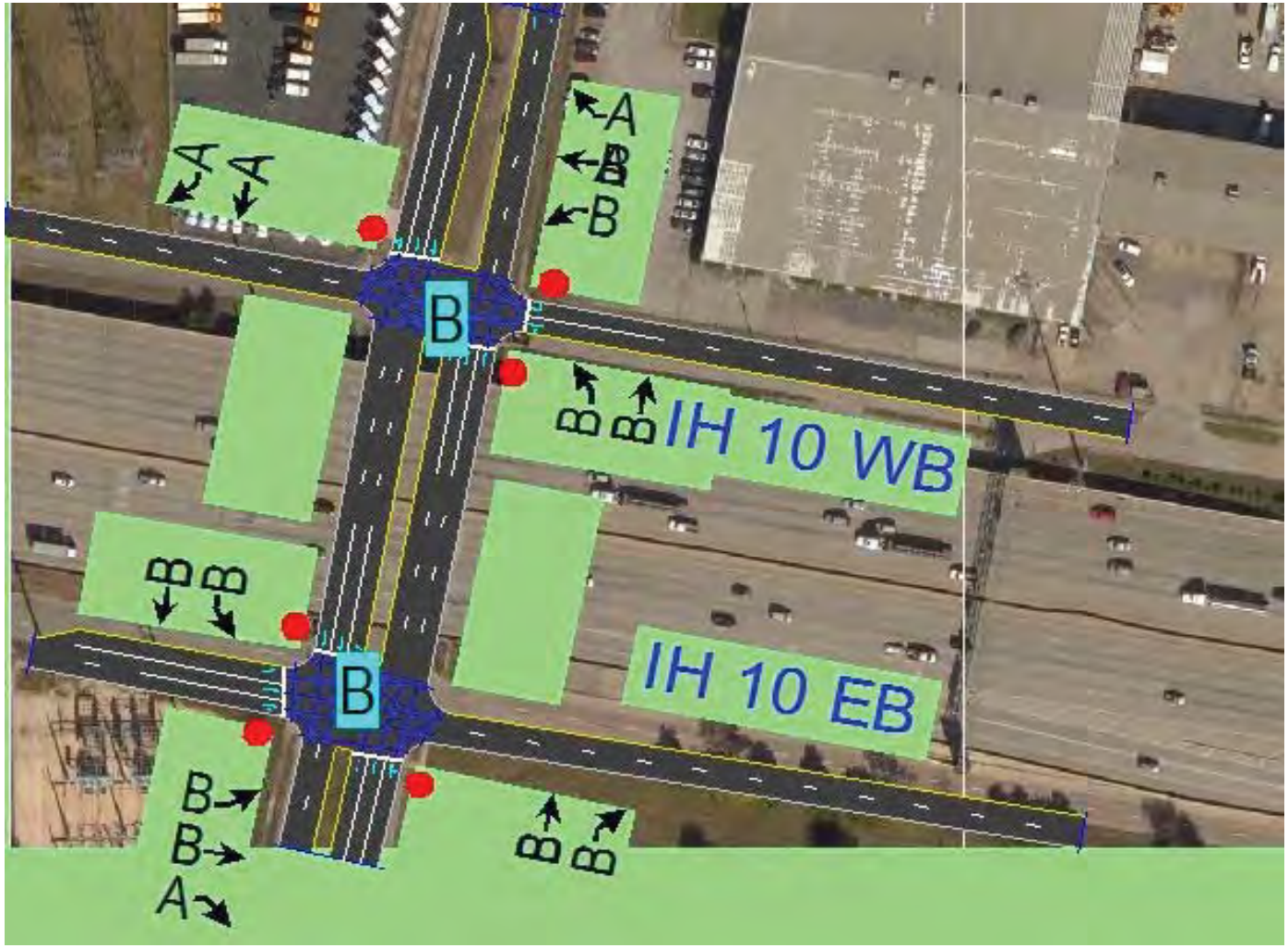
SCENARIO 1 - EXISTING GEOMETRY (2016) AM PEAK
GELLHORN AT IH 610

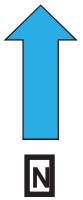
ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.3

SCENARIO 1 - EXISTING GEOMETRY (2016) AM
GELLHORN AT KROGER ACCESS DRIVEWAYS





ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.4

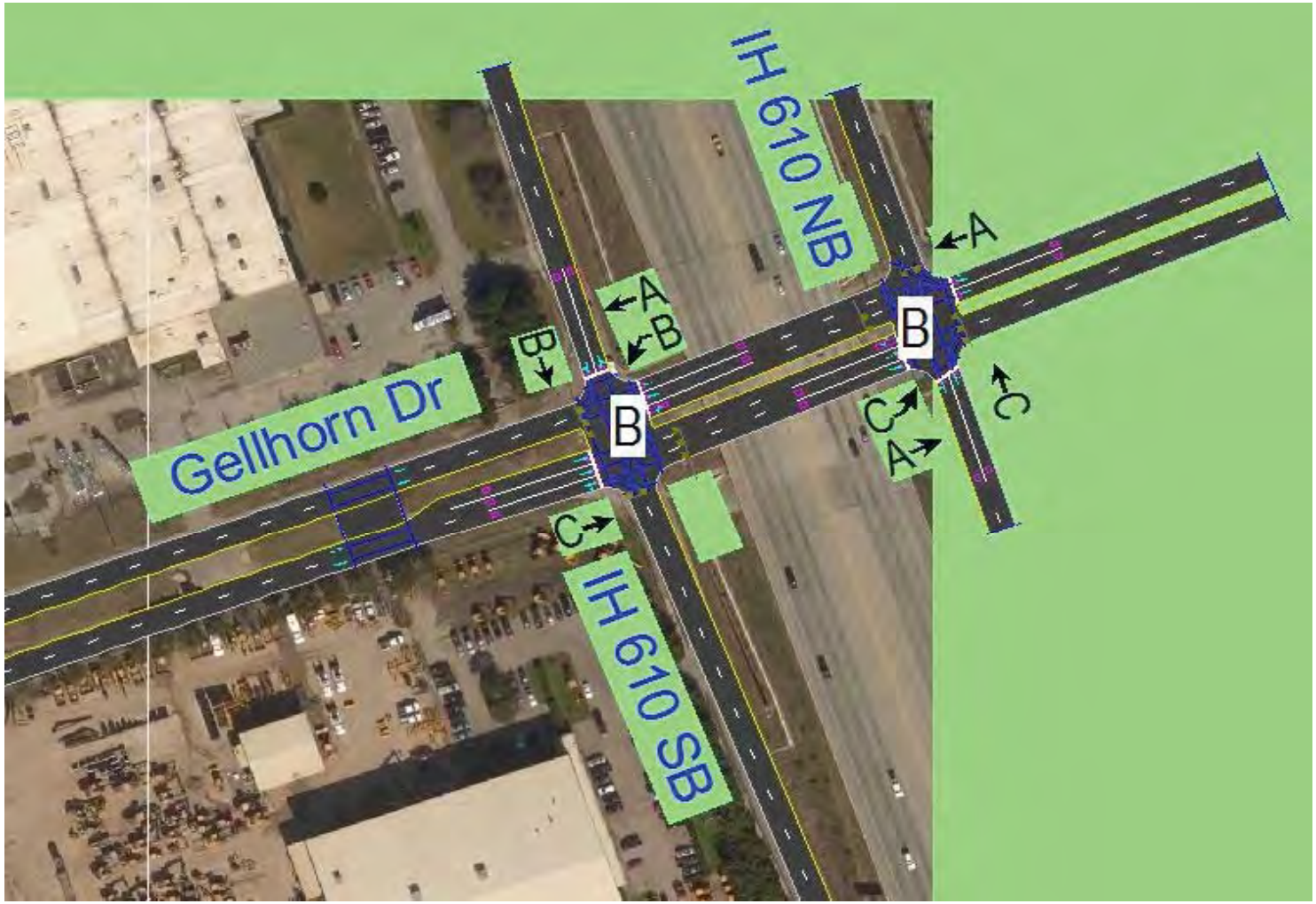
SCENARIO 1 - EXISTING GEOMETRY (2016) AM
GELLHORN AT IH 10

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.5

SCENARIO 1 - EXISTING GEOMETRY (2016) PM PEAK



ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.6

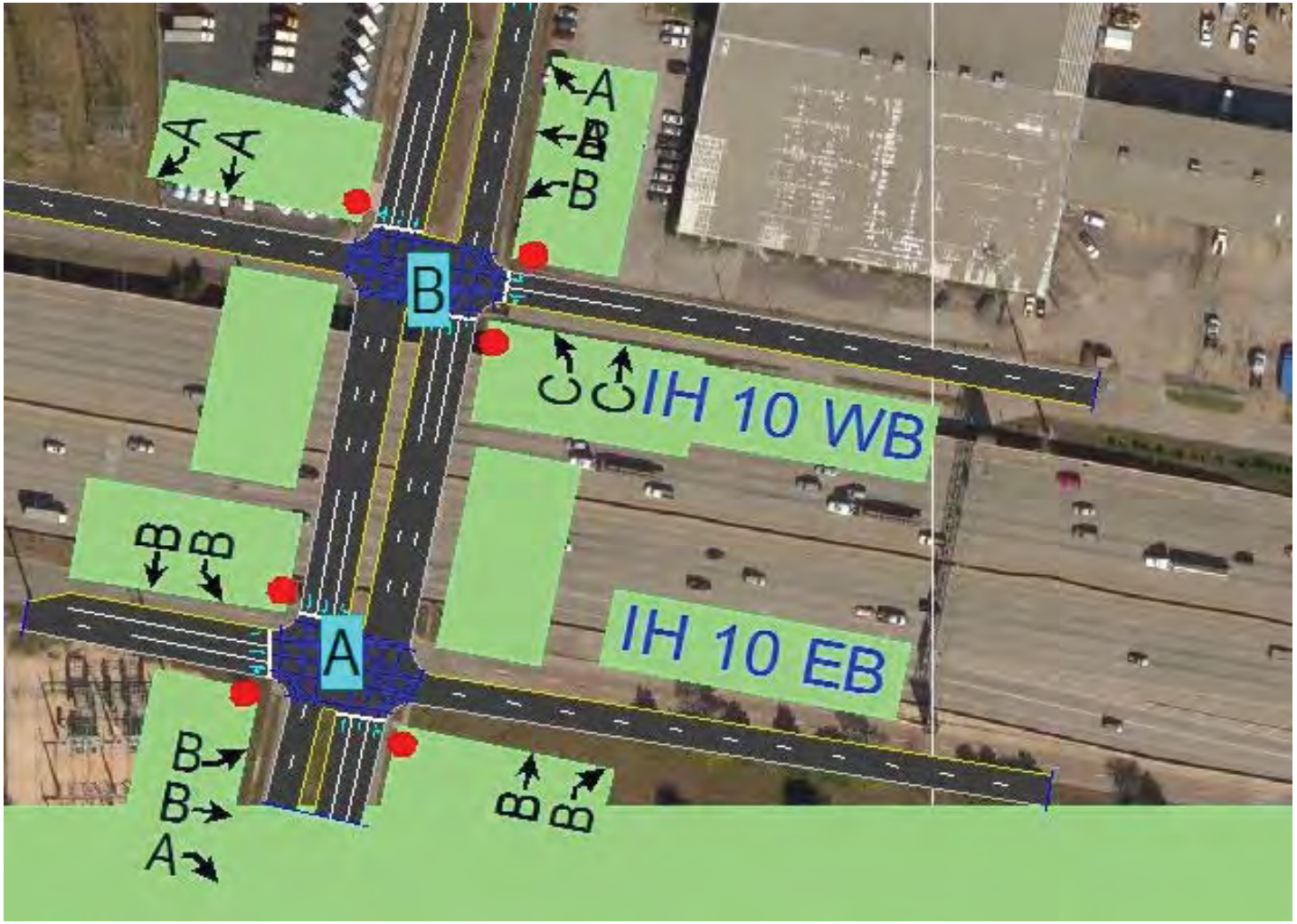
SCENARIO 1 - EXISTING GEOMETRY (2016) PM PEAK
GELLHORN AT IH 610

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.7

SCENARIO 1 - EXISTING GEOMETRY (2016) PM
GELLHORN AT KROGER ACCESS DRIVEWAYS



ETSI
Ergonomic Transportation Solutions, Inc.
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667

NOT TO SCALE

EXHIBIT 3.8

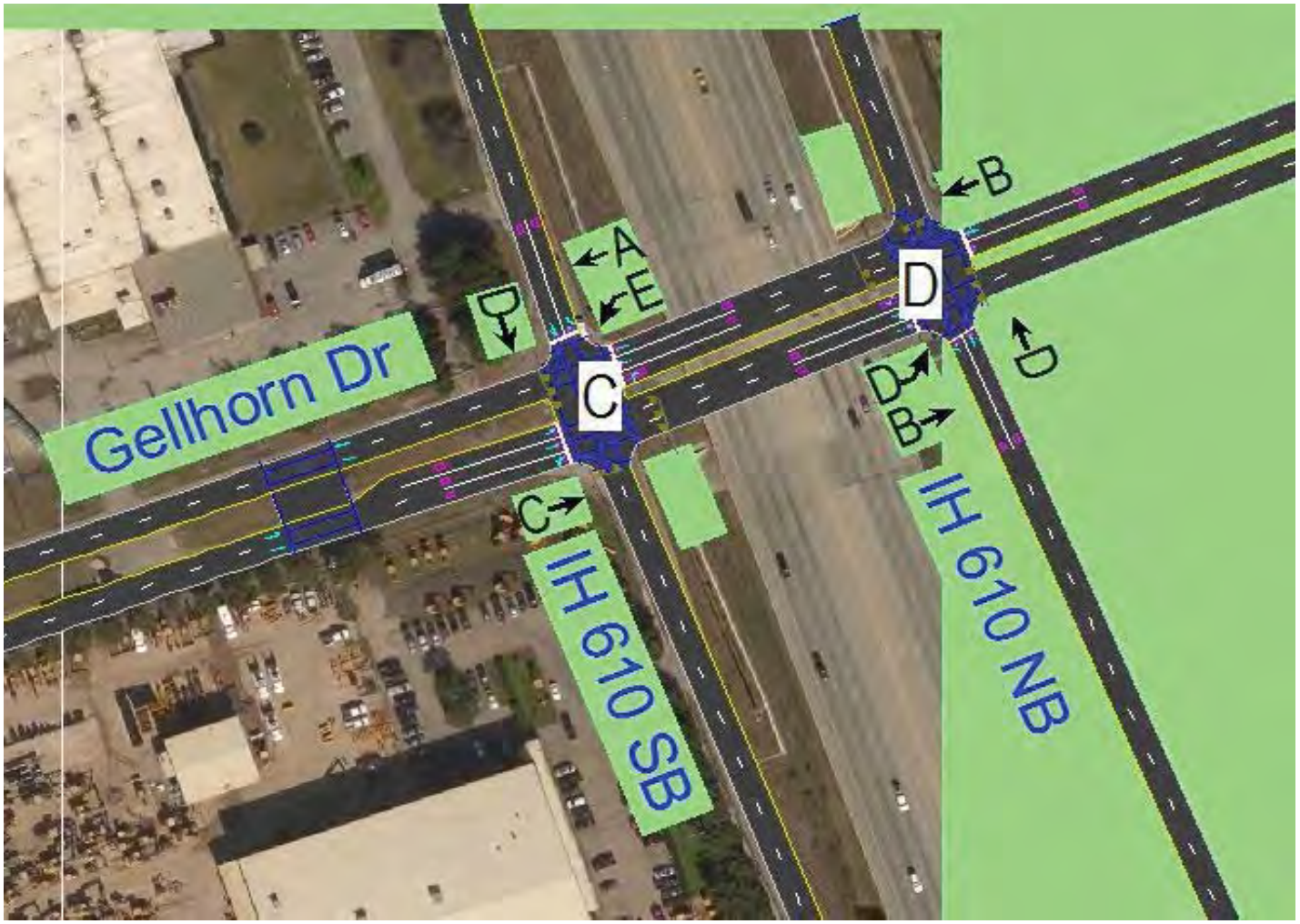
SCENARIO 1 - EXISTING GEOMETRY (2016) PM
GELLHORN AT IH 10

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.9

SCENARIO 1 - EXISTING GEOMETRY (2040) AM PEAK



ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.10

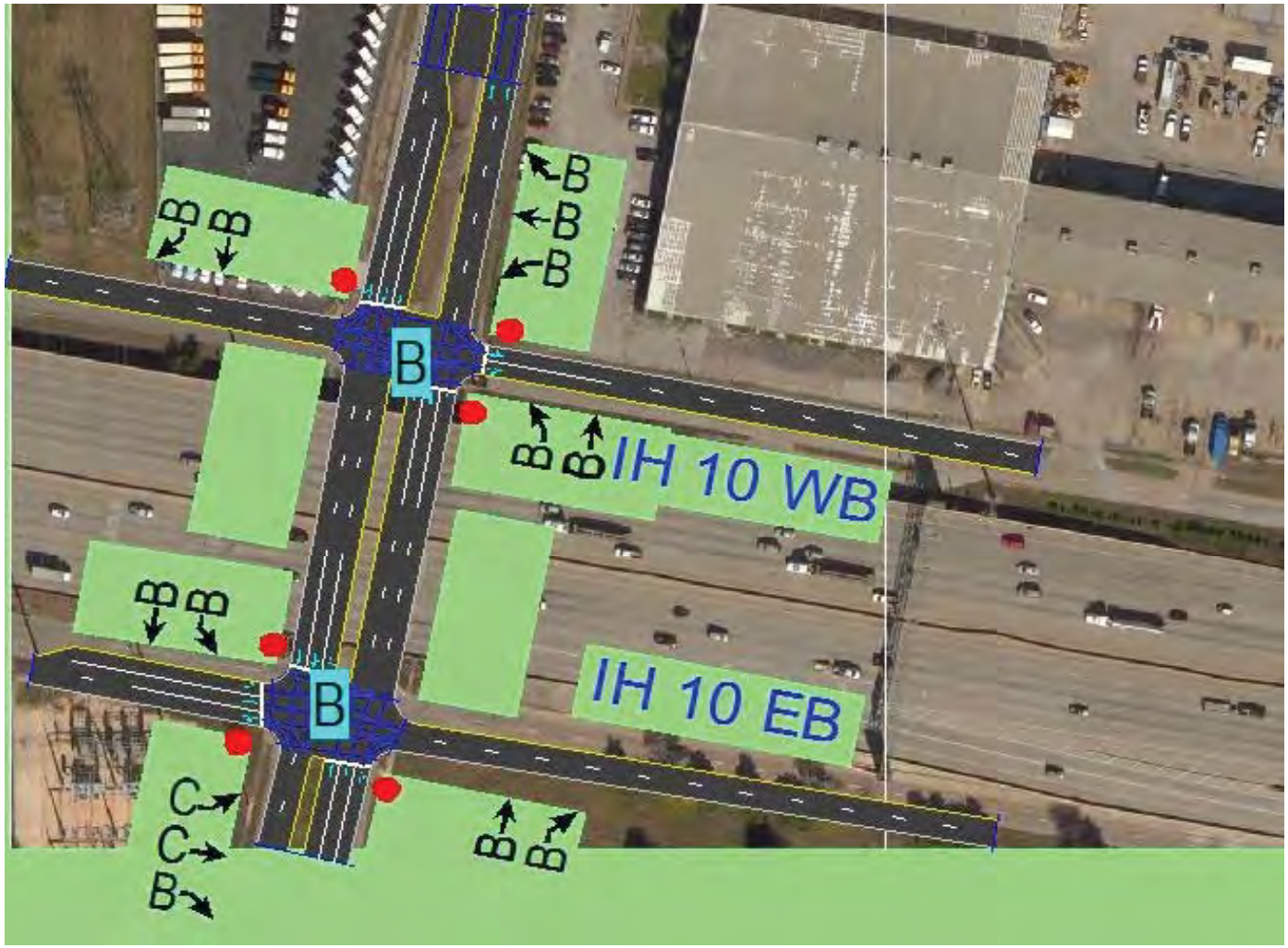
SCENARIO 2 - EXISTING GEOMETRY (2040) AM
GELLHORN AT IH 610

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.11

SCENARIO 2 - EXISTING GEOMETRY (2040) AM
GELLHORN AT KROGER ACCESS DRIVEWAYS



ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.12

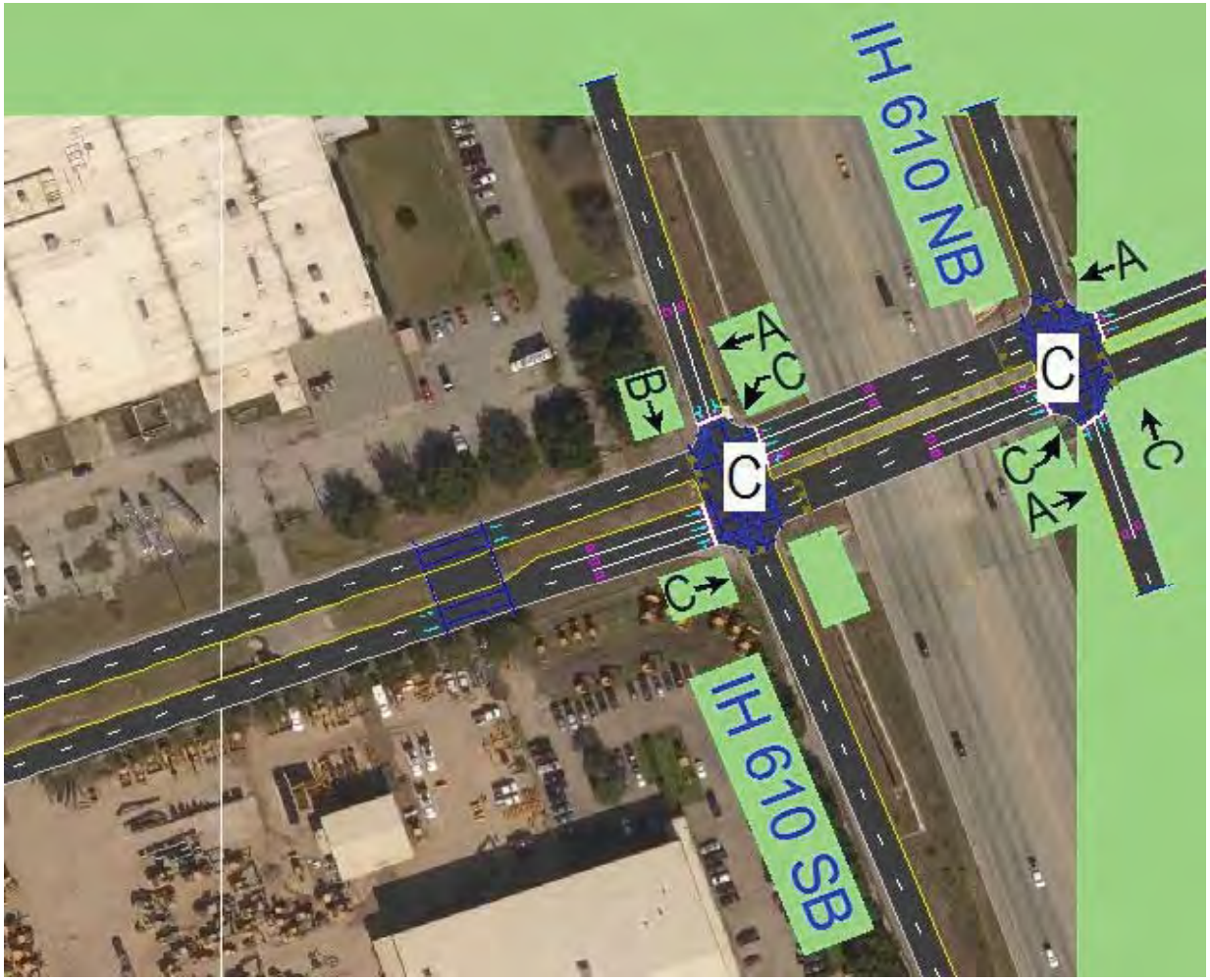
SCENARIO 2 - EXISTING GEOMETRY (2040) AM
GELLHORN AT IH 10

ETSI
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667
Ergonomic Transportation Solutions, Inc.

NOT TO SCALE

EXHIBIT 3.13

SCENARIO 1 - EXISTING GEOMETRY (2040) PM PEAK



ETSI
Ergonomic Transportation Solutions, Inc.
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667

NOT TO SCALE

EXHIBIT 3.14

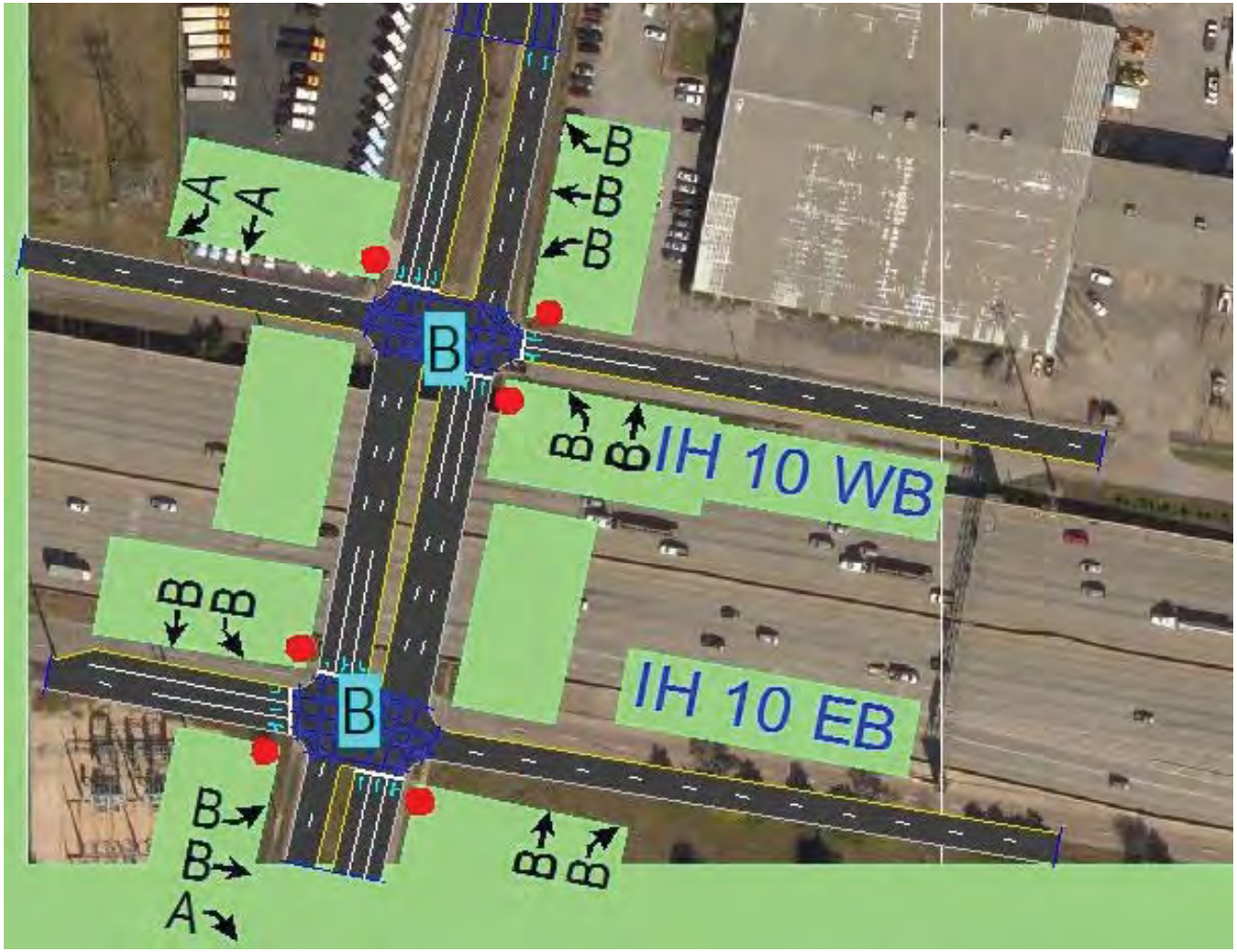
SCENARIO 2 - EXISTING GEOMETRY (2040) PM
GELLHORN AT IH 610

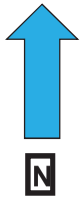
ETSI
Ergonomic Transportation Solutions, Inc.
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667

NOT TO SCALE

EXHIBIT 3.15

SCENARIO 2 - EXISTING GEOMETRY (2040) PM
GELLHORN AT KROGER ACCESS DRIVEWAYS





ETSI
Ergonomic Transportation Solutions, Inc.
5300 Hollister Road, Suite 220
Houston, Texas 77040
Tel. (713) 956-9601 Fax (713) 956-9667

NOT TO SCALE

EXHIBIT 3.16

SCENARIO 2 - EXISTING GEOMETRY (2040) PM
GELLHORN AT IH 10