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EL PASO STREETCAR PROJECT

DRAINAGE TECHNICAL MEMORANDUM

September 17, 2012

Updated: June 7, 2013

Prepared by:

PLANNING • ENGINEERING • PROJECT MANAGEMENT

MCi Moreno Cardenas Inc.

Leaders in Project Delivery & Performance

2505 E. Missouri Ave. El Paso, Texas 79903 • Ph. (915) 532.2091 • Fax (915) 542.0307 • www.morenocardenas.com

DRAINAGE TECHNICAL MEMORANDUM

For

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September 17, 2012
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This document was prepared by, or under the supervision of:

STATE OF TEXAS
MARCOS MEDINA
93830
LICENSED
PROFESSIONAL ENGINEER
6.7.13

Marcos Medina, P.E.
Texas P.E. No. 93830
Firm Registration No.: F-000554

PLANNING • ENGINEERING • PROJECT MANAGEMENT
MCi Moreno Cardenas Inc.
Leaders in Project Delivery & Performance

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PROJECT DESCRIPTION

The City of El Paso is implementing a streetcar system linking the Golden Horseshoe/International Bridges area to the University of Texas at El Paso area through Downtown. Construction will consist of up to 5.7-miles of track, streetcar stops, and minimal related street improvements costing approximately $90 million, including a vehicle maintenance facility near the Downtown Transfer Center. The streetcar route will utilize the Stanton Street and Oregon Street corridor on the north side of the project from Franklin Avenue to Baltimore Drive, ending with an extension to a stub-ended terminal on Stanton Street near Coffin Street or McKelligon Drive. Franklin Avenue, Kansas Street, Santa Fe Street, and Father Rahm Avenue form a one-way clockwise loop at the south end of the project. This will allow for operation of a downtown “circulator” route overlapped with another route that traverses the entire length of the project. The guideway is positioned within existing right lane adjacent to the curb or parking and the streetcar operates among normal automotive traffic. Along Oregon Street, the streetcar is proposed to travel in the transit-only lane also designated for the Rapid Transit System. In general, the stops will offer minimal amenities and will be located approximately two-to-four blocks apart, along the right edge of traffic in the existing parking lane or integrated with the sidewalk. Where feasible, these can be shared with Sun Metro’s “fixed-route” bus stops.

PURPOSE

The Streetcar improvements may have an impact on existing pavement and drainage facilities. Therefore, an analysis of the existing drainage infrastructure and watershed areas is required. The purpose of this Drainage Technical Memorandum (DTM) is to document the existing drainage issues and impacts to drainage infrastructure along the proposed route of the Streetcar. The DTM relied on information available from the Federal Emergency Management Agency (FEMA) and El Paso Stormwater Master Plan (SMP). Information from existing as-builts gathered from the City of El Paso was also used. Existing watershed areas were delineated using available LiDAR topography from the El Paso Water Utilities (EPWU). Original overall watershed boundaries as shown on the SMP were not altered. The overall watershed areas were subdivided using the LiDAR topography to delineate drainage areas along the Streetcar alignment.Existing drainage infrastructure was inventoried through topographic surveys prepared for the project and through site visits performed.

EXISTING CONDITIONS

The proposed Streetcar Project corridor traverses through the Central and West Central Regions of El Paso. The Central Region encompasses most of the downtown area and some of the City’s oldest and most historic neighborhoods. This area of the City is fully developed up to the foothills of the Franklin Mountains. The Central Region is characterized by two different drainage patterns and land types consisting of the Franklin Mountains and the valley.The West Central Region is at the southwest tip of the Franklin Mountains and just west of the downtown area. UTEP is located within the West Central Region.

The West Central Region has a significant amount of topographic relief that conveys flow from the mountainous terrain to the Rio Grande.

The majority of the existing streets consist of asphalt pavement with crowned slopes which drain stormwater runoff away from the center of the street towards the edges. The edges of the street are improved with curbs and gutters and pedestrian facilities including sidewalks and handicap ramps. Other improvements found at the edges of the street include, landscaping, illumination, drainage curb inlets, bus stops, electrical poles, communication pedestals, etc. Existing bridge decks consist of concrete pavement and only occur on Stanton and Oregon Streets which overpass Interstate 10.

Located within the West Central Region is Flow Path #23 (FP 23). FP 23 is a floodzone designated as Zone A2 by FEMA's Flood Insurance Rate Map dated October 15, 1982. Zone A2 is described as an areaof 100-year flood; base flood elevations and flood hazard factors determined. FP 23 generates stormwater runoff from the top of the Franklin Mountains at Scenic Drive and travels through an arroyo located between Robinson Avenue and New York Avenue. FP 23 crosses the Streetcar corridor at Stanton and Oregon Streets at the New York Avenue intersections. No floodzones within the Central Region affect the Streetcar corridor.

DRAINAGE CRITERIA

The El Paso Drainage Design Manual (EPDDM) criterion was followed for development of the drainage area calculations. The Rational Method was used to calculate the 10-year and 100-year flows for the subdivided drainage areas. This method is a function of the size of the basin area, time for drainage to traverse the longest route to the concentration point, and land cover.

Rational Method: $Q=CIA$

Where:
- Q = Peak discharge for a given frequency, in cubic feet per second
- C = Rational coefficient dependent on land cover and frequency
- I = Intensity for the given frequency, in inch per hour
- A = Computed area of the basin, in acres

The rational coefficient "C" is a function of land cover and land use. The Streetcar corridor is comprised of mainly paved area with fully developed abutting residential and commercial improvements. The recommended rational coefficient for this type of land coverand land use per the EPDDM is0.95.

Intensity data for common design storm events for the El Paso area have been developed and published in the Flood Frequency Determination, El Paso County and Incorporated Communities, Texas, Task Order 30, dated March 26, 2006, by Mapping Alliance Partnership. Drainage Regions for the City of El Paso were delineated and the intensity equations for typical storm events within each region were developed. The intensity equations used were for the Central and West Central Regions. The table below shows the intensities used for the drainage areas.

Intensity Calculation for Central and West Central Regions			
Region	Storm Frequency	Design Equation	Intensity (in/hr)
Central	10-year	I10 = 53.69/(Tc + 18)^0.8791	2.87
	100-year	I100 = 111.04/(Tc + 26.09)^0.9177	4.13
West Central	10-year	I10 = 59.91/(Tc + 18.202)^0.8791	3.18
	100-year	I100 = 140.07/(Tc + 26.090)^0.9189	5.19
*Source: El Paso Drainage Design Manual			

PROPOSED IMPROVEMENTS

The total length of the proposed Streetcar rail alignment is approximately 5-miles. The Streetcar rail trackwill be located in various sections of the roadway. The table below summarizes the proposed locations of the Streetcar rail.

Streetcar Rail Alignment		
Street	Segment	Rail Track Location
Santa Fe Street	Father Rahm Avenue to San Antonio Avenue	Eastern Edge
Santa Fe Street	San Antonio Avenue to Franklin Avenue	Eastern Edge
Franklin Avenue	Santa Fe Street to Oregon Street	Southern Edge
Franklin Avenue	Oregon Street to Mesa Street	Southern Edge
Franklin Avenue	Mesa Street to Kansas Street	Southern Edge
Stanton Street	Franklin Avenue to Montana Avenue	Eastern Edge
Stanton Street	IH 10 Overpass	Eastern Edge
Stanton Street	Montana Avenue to Baltimore Drive	Eastern Edge
Oregon Street	Glory Road to IH 10	Western Edge
Oregon Street	IH 10 Overpass	Western Edge
Oregon Street	IH 10 to Franklin Street	Offset from Western Edge
Kansas Street	Main Street to Mills Avenue	Western Edge
Kansas Street	Mills Avenue to Texas Avenue	Western Edge
Kansas Street	Texas Avenue to San Antonio Avenue	Western Edge
Kansas Street	San Antonio Avenue to Father Rahm Avenue	Offset from Western Edge
*Refer to proposed Typical Sections for more information		

CONCLUSION

The proposed Streetcar improvements will not have a significant impact to the existing drainage generated within the project corridor. The majority of the corridor consists of paved roadway with abutting residential and commercial areas. The introduction of the Streetcar will not increase the runoff within the corridor. The existing and proposed hydrologic table comparisons of runoff are the same. Stormwater runoff should not be allowed to pond on the proposed Streetcar track. A drainage system will be required in areas where the track is located on the edges of a crowned roadway section. Refer to the Appendices for additional drainage information.

APPENDICES

CALCULATION COVER SHEET

Project No.:	Project Name:
12-111	El Paso Streetcar Project

Project/Calculation Set/Subset:

Overall Watershed Map(s)

Total No. of Pages (Including Cover Sheet):	Total Number of Computer Runs:
6	
Prepared by:	**Date:**
Gerardo Garcia, E.I.T.	08/29/2012
Checked by:	**Date:**
Mark Medina, P.E.	08/29/2012

Description:

Per MCi's scope of services, the overall watershed areas from the El Paso Stormwater Master Plan (SMP) were subdivided using LiDAR topography which was provided by the El Paso Water Utilities (EPWU). The original overall watershed boundaries shown on the SMP were not altered.

Design Criteria and Assumptions:

Per MCi's scope of services, the rational method was used in accordance with the El Paso Drainage Design Manual. Runoff flow rates were calculated for the 10- and 100-year storm frequencies. Intensities were calculated for the Central and West Central Regions. Refer to attached calculation sheets.

Remarks:

The entire streetcar corridor consists of fully developed areas, therefore a coefficient of 0.95 was used for all areas.

Calculation Approved By:	*Mark Medina* 8.29.12 Project Manager or Task Leader/Date

Revision No:	Description of Revision:	Approved By:

Intensity Calculation for West and Central Region

Region	Storm Frequency	Design Equation	Intensity (in/hr)
Central	10-year	$I_{10} = 53.69 / (Tc + 18.000)^{0.8791}$	2.87
	100-year	$I_{100} = 111.04 / (Tc + 26.09)^{0.9177}$	4.13
West Central	10-year	$I_{10} = 59.91 / (Tc + 18.202)^{0.8791}$	3.18
	100-year	$I_{100} = 140.07 / (Tc + 26.090)^{0.9189}$	5.19

Source: El Paso Drainage Design Manual

Runoff Calculations for 10-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{10\text{-year}}$ Intensity (in/hr)	$Q_{10\text{-year}}$ Runoff (cfs)
DA-1	2.49	0.95	3.18	7.53
DA-2	2.11	0.95	3.18	6.36
DA-3	2.49	0.95	3.18	7.52
DA-4	2.13	0.95	3.18	6.44
DA-5	0.93	0.95	3.18	2.81
DA-6	0.78	0.95	3.18	2.35
DA-7	0.57	0.95	3.18	1.71
DA-8	0.20	0.95	3.18	0.59
DA-9	0.16	0.95	3.18	0.49
DA-10	0.21	0.95	3.18	0.64
DA-11	0.39	0.95	3.18	1.17
DA-12	0.10	0.95	3.18	0.31
DA-13	0.21	0.95	3.18	0.64
DA-14	1.13	0.95	3.18	3.42
DA-15	1.33	0.95	3.18	4.01
DA-16	3.11	0.95	3.18	9.39
DA-17	1.24	0.95	3.18	3.76
DA-18	2.02	0.95	3.18	6.10
DA-19	1.30	0.95	3.18	3.93
DA-20	1.32	0.95	3.18	4.00
DA-21	0.87	0.95	3.18	2.62
DA-22	3.34	0.95	3.18	10.09
DA-23	3.11	0.95	3.18	9.41
DA-24	1.71	0.95	3.18	5.16
DA-25	0.61	0.95	3.18	1.86
DA-26	1.43	0.95	3.18	4.32
DA-27	2.32	0.95	3.18	7.01
DA-28	2.09	0.95	3.18	6.30
DA-29	1.04	0.95	3.18	3.15
DA-30	2.14	0.95	3.18	6.45
DA-31	8.77	0.95	3.18	26.50
DA-32	1.46	0.95	3.18	4.42
DA-33	1.43	0.95	3.18	4.33
DA-34	9.30	0.95	3.18	28.09

Runoff Calculations for 10-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{10\text{-}year}$ Intensity (in/hr)	$Q_{10\text{-}year}$ Runoff (cfs)
DA-35	1.33	0.95	3.18	4.03
DA-36	5.83	0.95	3.18	17.62
DA-37	20.77	0.95	3.18	62.75
DA-38	9.14	0.95	3.18	27.61
DA-39	20.78	0.95	3.18	62.77
DA-40	17.81	0.95	3.18	53.81
DA-41	22.06	0.95	3.18	66.65
DA-42	2.47	0.95	3.18	7.45
DA-43	4.71	0.95	3.18	14.23
DA-44	133.67	0.95	3.18	403.82
DA-45	21.86	0.95	3.18	66.03
DA-46	21.91	0.95	3.18	66.19
DA-47	11.24	0.95	3.18	33.95
DA-48	12.21	0.95	3.18	36.89
DA-49	59.73	0.95	3.18	180.44
DA-50	9.40	0.95	3.18	28.40
DA-51	9.05	0.95	3.18	27.33
DA-52	12.86	0.95	3.18	38.85
DA-53	3.44	0.95	3.18	10.41
DA-54	9.29	0.95	3.18	28.07
DA-55	6.31	0.95	3.18	19.06
DA-56	19.70	0.95	3.18	59.51
DA-57	0.33	0.95	3.18	0.98
DA-58	2.48	0.95	3.18	7.48
DA-59	2.56	0.95	3.18	7.74
DA-60	1.85	0.95	3.18	5.58
DA-61	2.00	0.95	3.18	6.04
DA-62	0.19	0.95	3.18	0.57
DA-63	0.20	0.95	3.18	0.59
DA-64	1.46	0.95	3.18	4.41
DA-65	0.07	0.95	3.18	0.22
DA-66	0.70	0.95	3.18	2.11
DA-67	1.29	0.95	3.18	3.91
DA-68	0.78	0.95	3.18	2.36
DA-69	1.42	0.95	3.18	4.30
DA-70	3.51	0.95	3.18	10.59
DA-71	1.90	0.95	3.18	5.73
DA-72	0.13	0.95	3.18	0.41
DA-73	0.81	0.95	3.18	2.44
DA-74	0.67	0.95	3.18	2.02
DA-75	0.62	0.95	3.18	1.87
DA-76	0.09	0.95	3.18	0.27
DA-77	1.52	0.95	3.18	4.58
DA-78	1.65	0.95	3.18	4.99
DA-79	1.88	0.95	3.18	5.69
DA-80	1.70	0.95	3.18	5.14
DA-81	0.69	0.95	3.18	2.09

Runoff Calculations for 10-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{10\text{-year}}$ Intensity (in/hr)	$Q_{10\text{-year}}$ Runoff (cfs)
DA-82	0.36	0.95	3.18	1.08
DA-83	0.30	0.95	3.18	0.92
DA-84	1.00	0.95	3.18	3.01
DA-85	0.46	0.95	3.18	1.40
DA-86	4.01	0.95	3.18	12.11
DA-87	3.22	0.95	3.18	9.73
DA-88	2.31	0.95	3.18	6.98
DA-89	3.76	0.95	3.18	11.36

Runoff Calculations for 100-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{100\text{-year}}$ Intensity (in/hr)	$Q_{100\text{-year}}$ Runoff (cfs)
DA-1	2.49	0.95	5.19	12.29
DA-2	2.11	0.95	5.19	10.38
DA-3	2.49	0.95	5.19	12.27
DA-4	2.13	0.95	5.19	10.51
DA-5	0.93	0.95	5.19	4.59
DA-6	0.78	0.95	5.19	3.84
DA-7	0.57	0.95	5.19	2.79
DA-8	0.20	0.95	5.19	0.97
DA-9	0.16	0.95	5.19	0.81
DA-10	0.21	0.95	5.19	1.05
DA-11	0.39	0.95	5.19	1.91
DA-12	0.10	0.95	5.19	0.50
DA-13	0.21	0.95	5.19	1.04
DA-14	1.13	0.95	5.19	5.59
DA-15	1.33	0.95	5.19	6.55
DA-16	3.11	0.95	5.19	15.33
DA-17	1.24	0.95	5.19	6.13
DA-18	2.02	0.95	5.19	9.95
DA-19	1.30	0.95	5.19	6.41
DA-20	1.32	0.95	5.19	6.53
DA-21	0.87	0.95	5.19	4.28
DA-22	3.34	0.95	5.19	16.46
DA-23	3.11	0.95	5.19	15.35
DA-24	1.71	0.95	5.19	8.42
DA-25	0.61	0.95	5.19	3.03
DA-26	1.43	0.95	5.19	7.05
DA-27	2.32	0.95	5.19	11.45
DA-28	2.09	0.95	5.19	10.28
DA-29	1.04	0.95	5.19	5.15
DA-30	2.14	0.95	5.19	10.53
DA-31	8.77	0.95	5.19	43.26
DA-32	1.46	0.95	5.19	7.21
DA-33	1.43	0.95	5.19	7.07
DA-34	9.30	0.95	5.19	45.85
DA-35	1.33	0.95	5.19	6.58

Runoff Calculations for 100-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{100\text{-year}}$ Intensity (in/hr)	$Q_{100\text{-year}}$ Runoff (cfs)
DA-36	5.83	0.95	5.19	28.75
DA-37	20.77	0.95	5.19	102.41
DA-38	9.14	0.95	5.19	45.06
DA-39	20.78	0.95	5.19	102.44
DA-40	17.81	0.95	5.19	87.83
DA-41	22.06	0.95	5.19	108.78
DA-42	2.47	0.95	5.19	12.16
DA-43	4.71	0.95	5.19	23.22
DA-44	133.67	0.95	5.19	659.07
DA-45	21.86	0.95	5.19	107.77
DA-46	21.91	0.95	5.19	108.02
DA-47	11.24	0.95	5.19	55.42
DA-48	12.21	0.95	5.19	60.20
DA-49	59.73	0.95	5.19	294.49
DA-50	9.40	0.95	5.19	46.35
DA-51	9.05	0.95	5.19	44.61
DA-52	12.86	0.95	5.19	63.41
DA-53	3.44	0.95	5.19	16.98
DA-54	9.29	0.95	5.19	45.81
DA-55	6.31	0.95	5.19	31.11
DA-56	19.70	0.95	5.19	97.13
DA-57	0.33	0.95	5.19	1.60
DA-58	2.48	0.95	5.19	12.20
DA-59	2.56	0.95	5.19	12.63
DA-60	1.85	0.95	5.19	9.10
DA-61	2.00	0.95	5.19	9.85
DA-62	0.19	0.95	5.19	0.93
DA-63	0.20	0.95	5.19	0.97
DA-64	1.46	0.95	5.19	7.20
DA-65	0.07	0.95	5.19	0.36
DA-66	0.70	0.95	5.19	3.45
DA-67	1.29	0.95	5.19	6.38
DA-68	0.78	0.95	5.19	3.85
DA-69	1.42	0.95	5.19	7.03
DA-70	3.51	0.95	5.19	17.29
DA-71	1.90	0.95	5.19	9.35
DA-72	0.13	0.95	5.19	0.66
DA-73	0.81	0.95	5.19	3.98
DA-74	0.67	0.95	5.19	3.30
DA-75	0.62	0.95	5.19	3.05
DA-76	0.09	0.95	5.19	0.44
DA-77	1.52	0.95	5.19	7.48
DA-78	1.65	0.95	5.19	8.14
DA-79	1.88	0.95	5.19	9.28
DA-80	1.70	0.95	5.19	8.40
DA-81	0.69	0.95	5.19	3.41
DA-82	0.36	0.95	5.19	1.76

Runoff Calculations for 100-year frequency

Area ID	Area (Acres)	Runoff Coefficient (C)	$I_{100\text{-year}}$ Intensity (in/hr)	$Q_{100\text{-year}}$ Runoff (cfs)
DA-83	0.30	0.95	5.19	1.50
DA-84	1.00	0.95	5.19	4.92
DA-85	0.46	0.95	5.19	2.28
DA-86	4.01	0.95	5.19	19.77
DA-87	3.22	0.95	5.19	15.88
DA-88	2.31	0.95	5.19	11.40
DA-89	3.76	0.95	5.19	18.55

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX E