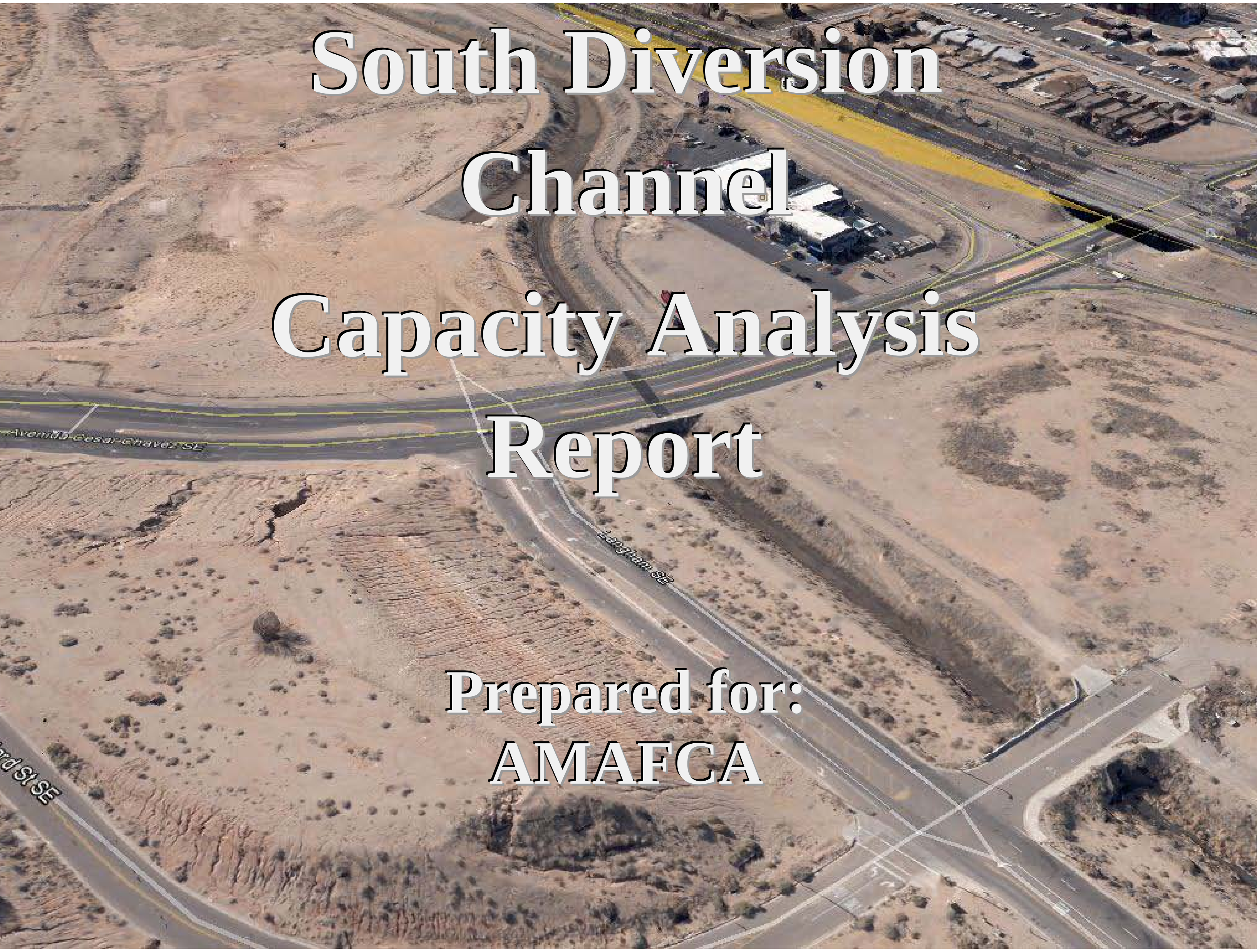
South Diversion Channel Capacity Analysis Report



Prepared for:
AMAFCA

Prepared by:

Easterling Consultants LLC

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Table of Contents

Summary Report

Overview

The purpose of this study is to broadly model the hydrology and hydraulics of the South Diversion Channel (SDC) to generally determine if the channels current capacity is sufficient under existing conditions and for fully developed conditions. The SDC is approximately 6 miles long located primarily parallel to Interstate 25 from north of Avenida Cesar Chavez to the Tijeras Canyon Arroyo where the channel turns west to the Rio Grande. The watershed draining to the SDC is approximately 8 square miles as shown on Plate 1. The slope of the SDC is less than 0.1% for most of SDC's length. Due to this relative flatness and large cross-sectional area, the channel functions primarily as a stepped pond with a storage volume of approximately 500 ac-ft. Many local area drainage studies have been performed within the watershed but this analysis is the first since the construction of the SDC in the early 1970's that investigates the full length of the channel upstream of the Tijeras Canyon Arroyo. Plate 2 indicates the largest studies within the watershed area and served as the basis for the subbasin framework for this study. The subbasins as defined in the Albuquerque Master Drainage Study (AMDS) are still mostly intact for the SDC watershed. Appendix A contains photos of the crossing structures with their dimensions labeled.

The entire watershed is incorporated into one HEC-HMS hydrologic model employing Muskingum Cunge routing within the SDC. The capacity of the channel is determined with HEC-RAS models. The final models indicate that during both the existing and developed conditions the channel has insufficient capacity at various points from the head of channel to just below the SDC's crossing of Interstate 25. This is most pronounced at the upstream sections of the channel and especially in the Developed Conditions model. Plates 3 and 4 show HEC-RAS results in tabular form with color enhancement showing areas with deficient freeboard in the model

Hydrology Methodology

AMAFCA has recently authorized the use of the Army Corps of Engineer's HEC-HMS software in place of AHYMO. This is the first AMAFCA project initiated utilizing HEC-HMS. The HEC-HMS modeling is implemented as prescribed in the Southern Sandoval County Arroyo Flood Control Authority's (SSCAFCA) Development Process Manual (DPM) with minor modifications. The SSCAFCA DPM was developed in an attempt to be compatible with AHYMO methods. While a strong attempt was made to adhere to subbasins as modeled in previous large area studies, especially the AMDS II study, each of these models was transcribed from AHYMO format to HEC-HMS while updates and corrections were made to the models. An effort is made to standardize the methodology across the entire watershed area. Many of the previous reports list multiple future options for improving drainage without specifying which options were eventually implemented. City of Albuquerque GIS data supplements some of these areas. As-built data, where available, has been used to help in determining the existing system especially related to major storm drains.

Table 1 lists each subbasin with the base hydrologic information, and deviations from previous studies. The table on Plate 2 shows summary HEC-HMS results for the subbasins. Full hydrology input and results information is found in Appendix B. Table 2 lists the hydrologic results at key points within the channel.

The key deviation from the SSCAFCA methodology is the decision to use the Time of Concentration (Tc) as traditionally defined rather than the recommended modification aimed at creating a hydrograph of the exact shape as an AHYMO hydrograph. A comparison analysis is performed to determine the difference in results using the two methodologies. Appendix B.6 reflects the results of this comparison that proves to be insignificant in this model. The Tc values generated in the Stadium Boulevard report are consistent with current practice and were incorporated directly for those subbasins. The remaining areas required the development of new Tc values due to differing basin boundaries or methods.

A new data collection technique is implemented for this study. Satellite remote sensing data is utilized for the estimation of the impervious area in each subbasin. This method was found to produce more consistent and defensible results than making assumptions based on zoning. This restudy of the South Diversion Channel for AMAFCA is the first to have made use of this data in the Albuquerque area. This methodology was refined by Smith Engineering in their Mid Valley Drainage Master Plan for the City of Albuquerque. The methodology was adjusted further for Thompson Engineering’s study of the Sanchez Farm Detention Pond/Goff Boulevard and Sunset Road Storm Drains. Due to these refinements a final test was recently performed to determine if these further refinements would change the outcomes of this study. Table 2 shows how these results (Labeled “Smith Equation”) compare to the original Existing Condition model. The differences were determined by AMAFCA staff to be too small to justify a full re-analysis.

Both the 6-hour and the 24-hour storms were modeled. Although the peak flow rates in the channel were similar between the models, the 6-hour storm peak rates are higher in most sections and this storm was determined to be the controlling storm.

Hydraulic Methodology

Using LIDAR and supplemental survey data (near Avenida Cesar Chavez) a digital terrain model is created for the entire length of the South Diversion Channel. With this model, HEC-GeoRAS is used to cut cross sections and insert crossings along the length of the channel. Cross sections are placed at locations that attempted to match the original Corps of Engineers model. Where the model became unstable, additional sections were added using interpolation built into HEC-RAS (version 4.1). Channel crossings were input based on field measurements, photographs, and as-built information where available. Roughness factors were adjusted based on the physical characteristics (Mannings n: RipRap 0.029-0.035; Earthen channel 0.028; Concrete 0.015). Routed flows from HEC-HMS (both existing and developed) were input into the HEC-RAS model and run as a mixed flow regime. The upstream starting water surface used the top of the outflow pipe elevation and the downstream starting water surface used critical depth. Output of the model runs were copied into an excel spreadsheet. Areas of interest are highlighted, such as water surface elevations that exceeded the 3 foot minimum freeboard requirements.

Key Findings and Recommendations

Bohannan Huston's Stadium Boulevard report (1994) indicated possible capacity issues with the SDC. Their report assumed a 35% value for the percentage of impervious area in much of the upper watershed and did not model the watershed or the channel in the lower half. Table 1 shows the percentage of imperviousness obtained from satellite data is significantly higher than the 35% value.

The flow capacity of the 108" storm drain draining into the upstream end of the SDC is key to the capacity issues in the first few segments. Plate 5 reflects the plan and profile for this storm drain and capacity calculations based on a culvert analysis. Previous reports had assumed that a significant amount of flow in this storm drain was diverted into the existing 48" storm drain as shown on Plate 5. The 48" storm drain continues under Interstate 25 and then to a storm drain system in Hazeldine. However, the as-built drawings for the 108" storm drain and field inspections indicate that the construction of the 108" storm drain did not maintain that connection. While the 48" storm drain appears to be in that location, it is walled off from the 108" storm drain. The depth of the 108" storm drain allows a high hydraulic head (15-20 feet) to build within this pipe in peak flows. This pressurized pipe and the absence of the 48" storm drain connection allows the pipe to deliver much more storm water to the SDC than previously modeled. This is the primary cause of the capacity issues encountered in the upstream sections of the channel.

It is recommended that a review of the model of the downstream systems be performed to determine if it is assumed that the capped 48" storm drain diverts storm flow from the 108" storm drain. If the downstream has capacity for this flow, than it might be possible to reconnect the two systems and divert some of the flow from the South Diversion Channel system. Two dimensional modeling of the 108" storm drain and channel would also add value in fully understanding the problems in this area.

It should be noted that as the peak flow rate moves downstream in the channel it begins to decrease within the southern half of the channel. This seems to be counterintuitive as the channel is still receiving additional flows in this reach. However, as mentioned previously, there is almost 500 ac-ft of storage within the channel segments and thus the channel has a pronounced storage routing affect which leads to the decreasing flow rates. Although modeling indicates there are capacity issues within the first few reaches of the SDC, it certainly does not indicate any capacity issues in the lower half of the channel. For this reason, increasing the capacity of the crossing structures in the upper 2/3 of the channel would relieve the upstream capacity issues, allowing more water to pass to the downstream segments. However, this option appears to be cost prohibitive. A more cost effective option may be the raising of the channel banks in the identified problem areas.

Table 1
Subbasin Hydrology Summary

Existing Conditions Subbasin Input

	Area (Acres)	% Impervious.- Raw Satellite	Estimated Error	% Imp- Sat. Adjusted	Stadium Report	AMDS II	Smith Equation	LAND TREATMENT PERCENTAGES A	B	C	D	Sub-basin boundary Notes
V-1	125.8	38	-19	57	35	45	46	0	32	11	57	From AMDS
V-2	34.0	37	-19	56	35	45	46	0	33	11	56	From AMDS
W-1	99.8	54	-5	59	35	45	66	0	31	10	59	From AMDS
V-3	41.4	50	-11	61	35	45	60	0	29	10	61	From AMDS
W-2	92.5	57	0	57	35	45	69	0	32	11	57	From AMDS
X-1	23.6	42	-17	60	35	45	51	0	30	10	60	From AMDS
Y-1	12.0	47	-14	61	35	45	57	0	29	10	61	From AMDS
Y-2	62.8	46	-15	61	35	45	55	0	29	10	61	From AMDS
W-4	67.2	43	-17	60	35	45	52	0	30	10	60	From AMDS
W-3	32.7	44	-17	60	35	45	53	0	30	10	60	From AMDS
W-5	50.9	30	-17	47	35	45	38	0	40	13	47	From AMDS
Z-1	44.9	36	-19	54	35	12	44	0	34	11	54	From AMDS
BB-3	25.4	43	-17	60	35	14	52	0	30	10	60	From AMDS
BB-4	44.8	42	-17	60	35	45	51	0	30	10	60	From AMDS
BB-6	96.4	32	-18	51	35	45	40	0	37	12	51	From AMDS
AA-1A	45.4	42	-18	60			51	0	30	10	60	Per Local G&D plans and site visit
CC-3	63.9	39	-19	57	35	5	47	0	32	11	57	From AMDS - Modified per Local G&Ds
BB-2	146.8	40	-18	58	60	5	48	0	31	10	58	Original From AMDS
BB-2A	105.2						14	0	13	14	73	Split from BB-2 - different treatment and flow direction
BB-2B	41.6						14	1	67	22	10	Split from BB-2 - different treatment and flow direction
BB-5	114.0	32	-18	50	35	45	40	0	38	13	50	From AMDS
BB-7	86.6	31	-18	49	35	45	39	0	38	13	49	From AMDS
BB-1A	17.6	41	-18	59	60	11	49	0	31	10	59	Northern Portion of AMDS Sub-basin BB-1
BB-1B	72.2	19	-11	30	60	11	28	0	15	5	80	Southern Portion - modified based on BHI UNM Housing CDMP and MC Pit Grading Plan
BB-8	61.2	48	-14	61	65	6	58	0	29	10	61	From AMDS
BB-9	62.1	38	-19	56	35	45	46	0	33	11	56	From AMDS
BB-10	45.1	37	-19	56	35	45	45	0	33	11	56	From AMDS
CC-4	60.8	3	1	2		0	16	0	74	25	2	From AMDS - Modified to include channel and based on BHI UNM Housing CDMP and MC Pit Grading Plan
CC-5	135.3	35	-19	53		16	43	0	35	12	53	From AMDS
CC-7	16.2	13	-7	20		0	23	0	60	20	20	From AMDS
CC-6	44.4	41	-18	59		45	50	0	31	10	59	From AMDS
BB-11	45.5	24	-15	39	35	7	33	0	46	15	39	From AMDS
BB-12	39.5	43	-17	60	35	45	52	0	30	10	60	From AMDS
CC-2	64.1	30	-18	47		20	38	0	40	13	47	From AMDS - modified to not include main channel
CC-8	88.1	45	-16	61		9	54	0	29	10	61	From AMDS
CC-10	53.1	42	-18	59		5	50	0	31	10	59	From AMDS
CC-9	92.8	29	-17	46		10	37	0	41	14	46	From AMDS
EE-1	58.0	47	-15	61		9	56	0	29	10	61	From AMDS - adjusted based on latest contours and ortho
EE-2	87.8	47	-14	61		16	57	0	29	10	61	From MC's Airport Study - retained name from AMDS
EE-4	39.7	54	-5	59		45	66	0	31	10	59	From AMDS-adjusted slightly based on latest contours and ortho
CC-11	59.3	43	-17	60		15	52	0	30	10	60	From MC's Airport Study - retained name from AMDS
CC-1	18.7	10	-4	14		45	20	10	30	10	50	From AMDS
CC-12	154.1	40	-18	58		4	49	0	31	10	58	From MC's Airport Study - retained name from AMDS
EE-5	270.7	43	-17	60		16	52	0	30	10	60	From MC's Airport Study - retained name from AMDS
GG-1	123.5	18	-11	29		6	27	15	42	14	29	From MC's Airport Study- retained AMDS label -Basin boundary modified to place Sunport Blvd into HH-1 - kept same percentage D based on orthophoto inspection
HH-2	246.5	40	-18	58		8	48	0	31	10	58	From MC's Airport Study - retained name from AMDS and split into two sub-basins per AMDS
HH-1	198.3					0	14	10	34	11	45	From MC's Airport Study-retained AMDS label -Adjusted to include Sunport Blvd. - large parking area added after satellite data was aquired - D estimated based on orthophoto
JJ-1	73.4	11	-5	15		0	21	70	11	4	15	From MC's Airport Study- retained name from AMDS - adjusted based on latest contours and ortho
KK-1	146.9	15	-8	22		0	24	10	51	17	22	From MC's Airport Study - retained name from AMDS and split into two sub-basins per AMDS - adjusted per latest mapping
KK-2	271.8	38	-19	57		9	46	0	33	11	57	From MC's Airport Study - retained name from AMDS and split into two sub-basins per AMDS
LL-1	307.9	10	-4	14		2	21	30	42	14	14	From MC's Airport Study - retained name from AMDS
MM-1	207.7	16	-9	25		12	25	30	34	11	25	From MC's Airport Study - retained name from AMDS
NN-1	78.2	20	-12	32		0	29	15	40	13	32	From MC's Airport Study - retained name from AMDS
PP-1	136.0	7	-2	9			19	15	57	19	9	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible
QQ-1	68.3	29	-17	46			37	15	29	10	46	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible
RR-1	17.4	30	-18	48			38	0	13	39	48	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible
SS-1	292.4	24	-15	39			32	0	15	46	39	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible
TT-1	78.1	23	-14	37			31	0	16	47	37	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible
UU-1	48.2	1	2	-1			15	0	25	75	0	New Sub-basin by EC - continued AMDS naming scheme-modified to match Wilson's SE Valley Study where feasible-No outfall to SDC

Developed Conditions Subbasin Input

		LAND TREATMENT PERCENTAGES A	B	C	D	Sub-basin boundary Notes
CC-3		0	10	10	80	Remaining Area to develop has SU for C2, IP, & O uses
BB-1A		0	10	10	80	Remaining Area to develop has SU for C2, IP, & O uses
CC-4		0	15	15	70	Zoned primarily R3 but UNM has master plan showing commercial - Use 70 for D
CC-2		0	13	12	75	Mixed uses including SU for PRD and SU for C2
CC-1		0	5	5	90	SU-1 for Commercial Uses
GG-1		0	15	15	70	IP Zoning in this area- I know of one large apartment project- Attached housing and Light Industrial are both 70% per DPM, Use 70%
HH-1		0	15	15	70	SU-1 for Airport and IP east of I-25, M-1 west of I25, use 70% for Light Industrial
JJ-1		0	10	10	80	M-2 Zoning, Use 80% D per DPM category for Heavy Industrial
KK-1		0	56	14	30	Area Upstream of I-25 is golf course, small portion downstream is M-2, Increase D to 30%
LL-1		0	40	20	40	East of Interstate is Golf Course, West is zoned M-2
MM-1		0	15	15	70	Primarily Zoned M-2 (remainder SU), use 70% for Light Industrial
NN-1		0	10	10	80	Only M-2 zoning, Heavy Industrial would be 80% per DPM but measured values for adjacent developed subbasins is approximately 50%, use 70% Light Industrial number
PP-1		0	15	15	70	Zoned M-2
QQ-1		0	20	20	60	Assuming undeveloped areas devlop with 80% D leads to overall 60% for subbasin
SS-1		0	10	30	60	Assuming undeveloped areas devlop with 80% D leads to overall 60% for subbasin
TT-1		0	10	30	60	
UU-1		0	10	10	80	Drains to the Tijeras Channel

Table 2
Channel Hydrology Results

Location/Station	Name of Point in HMS	HMS Notes	Existing 100-yr, 6-hr Results		Developed 100-yr, 6-hr		Exist 100-yr, 6-hr- Smith		Percent Reduction
			Flowrate (cfs)	Volume (ac-ft)	Flowrate (cfs)	Volume (ac-ft)	Flowrate (cfs)	Volume (ac-ft)	
Genesis	Reach-SDC 1st Seg.	US end	1076.4	67	1076	67	1065	65.2	1.06
1st crossing	Junction- SDC/CC-3		1132	74.6	1153	76.5	1108	72	2.12
US ACC	Reach-SDC CC-3 to ACC	DS end	1068	74.1	1088	76	1044	71.5	2.25
DS ACC	Junction-ACC and SDC		2442	165.7	2464	168.1	2346	156.3	3.93
37200	Junction-SDC/BB-1B		2408	175.1	2430	177.5	2309	165.7	4.11
36000	Junction-SDC/ CC-4		2276	176.8	2338	184.5	2179	167	4.26
Geneiva's Junction	Junction-SDC at Geneiva's		2877	250.9	2965	261	2742	235.7	4.69
DS Gibson	Junction-SDC at Gibson	Skipped in ras	2964	259.2	3053	269.2	2830	244	4.52
33615	Reach-SDC Rundown to 66"	US end	2941	258.5	3033	268.5	2805	243.4	4.62
33300	Reach-SDC 66" to Kirtland	US end	3037	271.6	3130	281.6	2893	255.6	4.74
Kirtland Junction (32538)	Reach-SDC 32538 to 31200	US end	3613	323.4	3714	334.4	3435	303.5	4.93
31200	Reach-31200 to 29860	US end	3523	321.2	3625	332.1	3347	301.3	5.00
29860	Reach-SDC 29860 to 28900	US end	3513	330	3640	348	3308	309.9	5.84
28900	Reach-SDC 28900 to26700	US end	3706	378.2	4020	420.6	3582	365.6	3.35
26700	Reach-SDC 26700 to 25530	US end	3882	418.8	4230	462.7	3745	403.1	3.53
25530	Reach-SDC 25530 to 23980	US end	3800	425.8	4184	475.9			
23980	Reach-SDC 23980 to 22990	US end	3690.1	431.8	4099	488			
22990	Reach-SDC 22990 to 21400	US end	3653	445.8	4127	515.5			
21400	Reach-SDC 21400 to 20200	US end	3497	447.5	3979	522.1			
20200	Reach-SDC 20200 to 19200	US end	3391	451.8	3893	537.4			
19200	Reach-SDC 19200 to 17900	US end	3314	455.9	3814	542.9			
17900	Reach-SDC 17900 to 16300	US end	3213	451.7	3708	538.2			
16300	Reach-163+00 to 148+00	US end	3100	448.2	3590	534.1			
14800	Reach-SDC DS to SS-1 Rundown	US end	3023	484.6	3527	578.8			
Just US of Junction	Reach-SDC to SS-1 Rundown	DS end	2837	471.9	3335	564.5			