4.2 Conveyance Elements

Conveyance Elements are existing or proposed facilities that convey flows downstream. Typical conveyance elements include, but are not limited to, open channels, reinforced concrete pipe (RCP), and street curb and gutter. Existing conveyance element geometries were determined from field observation and the City storm GIS information.

Table 7 presents a summary of peak flows for the existing conditions and DBDPA elements under the 2-, 10-, and 100-year conditions. The null values within the table represent the following conditions:

1) Null values in the DBDPA Conditions columns reflect existing facilities that are not needed in the DBDPA because of upstream modifications.

2) Null values in the Existing Conditions columns reflect DBDPA recommended facilities that do not currently exist or were not represented in the Existing Conditions model.

The following conveyance element descriptions provide general location and general facility description. General geometric model data is provided as well as resultant modeled peak flows. Each conveyance element was analyzed and inventoried to determine the geometric characteristics. Slope was approximated from GIS surface model or record drawing plan and profiles. For open channel elements side slopes were approximated from field inspection and City GIS topography. Manning's "n" values were used according to RCIDCM Table 4.7. Values include 0.015 for concrete curb and gutter with asphalt pavement and 0.013 for RCP.

CAUTION STATEMENT

The user of this design plan is advised to exercise caution when using open channel peak flows and hydrographs given in this report. The HEC-HMS model assumes that all adjacent subbasin flows enter the channel element at a design point, typically the downstream end of the element. The open channel element is simply routing the upstream incoming flow and ignoring the possibility that additional flow may enter from the adjacent subbasin at any point. Due to this modeling limitation, flow used for channel design may need to be increased appropriately using engineering judgment to reflect incoming subbasin flows.

Surface drainage is only an approximation since storms rarely follow ideal patterns and other factors such as ground cover and infiltration may vary with time or from assumed conditions. The intent of a hydrologic/hydraulic analysis is to provide a reasonably dependable and consistent approximation of runoff and flow characteristics.

Table 7. DBDPA Peak Flow and Runoff Volume Summary

DBDPA Element	Peak Outflow (cfs)						Runoff Volume (Ac-ft)					
	Existing Conditions			DBDPA Conditions			Existing Conditions			DBDPA Conditions		
	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}
1	115	115	115	40	71	71	7.3	11.0	13.0	1.4	3.2	4.5
3	209	500	500	---	---	---	8.2	22.6	32.5	---	---	---
5	194	531	1106	---	---	---	7.6	21.4	42.9	---	---	---
7	41	343	879	12	28	161	1.4	9.3	26.7	0.4	1.0	3.7
9	41	344	883	12	28	162	1.4	9.3	26.7	0.4	1.0	3.7
15	21	21	21	65	115	126	1.4	2.0	2.3	2.2	5.3	7.5
17	59	96	96	57	96	96	1.9	4.6	6.3	1.9	4.6	6.3
19	21	34	38	19	34	38	0.7	1.6	2.3	0.6	1.6	2.2
21	14	23	24	12	23	24	0.4	1.1	1.5	0.4	1.1	1.5
23	4	4	4	4	4	4	0.2	0.3	0.4	0.2	0.3	0.4
25	30	70	116	30	70	116	1.0	2.6	4.6	1.0	2.6	4.6
27	24	101	431	---	---	---	0.9	2.7	10.6	---	---	---
29	4	9	14	4	9	14	0.1	0.3	0.5	0.1	0.3	0.5
31	3	6	10	3	6	10	0.1	0.2	0.4	0.1	0.2	0.4
33	11	75	397	---	---	---	0.4	1.5	8.7	---	---	---
35	3	9	19	---	---	---	0.1	0.3	0.6	---	---	---
37	133	133	133	79	133	133	5.6	9.9	12.2	3.3	6.8	9.5
39	143	158	169	75	129	169	5.5	10.6	13.5	3.2	6.4	10.1
41	134	139	139	67	112	139	5.2	9.9	12.3	2.9	5.7	8.9
43	145	230	230	60	100	230	5.1	12.9	17.1	2.6	5.1	10.3
45	67	128	128	50	50	50	2.4	7.2	9.6	2.2	4.0	5.0
47	28	28	28	28	28	28	1.4	2.4	2.9	1.4	2.4	3.0
49	36	36	36	34	36	36	1.4	2.8	3.5	1.4	2.8	3.5
51	3	14	15	3	14	15	0.1	0.7	1.2	0.1	0.7	1.2
53	22	22	22	25	25	25	0.8	1.2	1.4	0.8	1.7	2.2
55	4	8	14	4	8	14	0.1	0.3	0.5	0.1	0.3	0.5
57	10	25	40	---	---	---	0.3	0.8	1.5	---	---	---
59	10	90	708	10	24	39	0.3	1.4	15.1	0.3	0.8	1.5
63	31	72	129	31	50	50	1.1	3.5	7.2	1.1	2.3	3.2
65	18	37	68	18	37	59	0.6	1.4	2.7	0.6	1.4	2.3
67	4	9	15	4	9	14	0.1	0.3	0.5	0.1	0.3	0.5
69	13	19	26	---	---	---	0.5	1.0	1.4	---	---	---
71	7	7	7	---	---	---	0.3	0.5	0.6	---	---	---
73	5	7	7	---	---	---	0.2	0.3	0.5	---	---	---
75	13	28	33	13	28	33	0.5	1.1	1.8	0.5	1.1	1.8

Ferber Engineering Company, Inc.

Dover Street Drainage Improvements
Red Dale DBDP AMENDMENT

DBDPA Element	Peak Outflow (cfs)						Runoff Volume (Ac-ft)					
	Existing Conditions			DBDPA Conditions			Existing Conditions			DBDPA Conditions		
	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}
77	2	2	2	2	2	2	0.2	0.3	0.3	0.2	0.3	0.3
79	9	14	14	9	14	14	0.3	0.7	1.0	0.3	0.7	1.0
81	13	87	171	13	108	214	2.9	8.2	14.2	2.9	9.2	17.2
83	37	40	40	35	40	40	2.4	4.9	6.1	2.5	4.9	6.1
85	16	21	21	18	21	21	1.3	2.7	3.3	1.4	2.7	3.3
87	13	21	25	13	29	29	1.0	2.0	2.5	1.0	2.7	3.5
89	13	15	15	13	15	15	1.0	1.8	2.2	1.0	1.8	2.2
91	7	15	15	7	15	15	0.4	1.0	1.4	0.4	1.0	1.4
93	4	9	15	4	9	15	0.1	0.3	0.5	0.1	0.3	0.5
95	11	11	11	11	11	11	0.7	1.0	1.2	0.7	1.0	1.2
97	65	201	201	74	213	249	2.5	8.7	14.0	2.8	8.9	15.5
99	63	200	200	72	207	285	2.4	8.5	13.8	2.7	8.7	15.9
101	55	188	197	63	180	187	2.1	7.7	13.1	2.4	7.8	12.9
103	53	194	199	63	187	189	1.7	6.9	11.1	2.0	7.1	10.9
105	49	181	246	59	188	246	1.5	6.4	11.7	1.8	6.6	11.9
107	10	21	21	11	21	21	0.3	1.0	1.4	0.3	1.0	1.4
109	6	24	44	7	25	44	0.1	0.8	1.6	0.2	0.8	1.6
111	39	42	42	42	42	42	1.2	2.8	3.5	1.4	2.8	3.6
113	27	48	48	30	48	48	0.8	2.4	3.2	0.9	2.4	3.3
115	2	4	7	2	4	7	0.2	0.6	1.8	0.2	0.6	1.8
117	0	0	2	0	0	2	0.1	0.3	1.3	0.1	0.3	1.3
119	51	105	163	35	76	100	1.8	4.3	7.2	1.3	3.0	5.0
121	33	67	100	17	37	50	1.2	2.8	4.5	0.6	1.5	2.5
123	26	47	73	14	30	95	0.9	2.0	3.3	0.5	1.2	2.8
125	13	14	14	---	---	---	0.4	0.8	1.1	---	---	---
127	9	69	367	---	---	---	0.3	1.3	7.9	---	---	---
129	6	41	272	---	---	---	0.2	0.8	5.8	---	---	---
131	6	17	30	6	12	67	0.2	0.5	1.0	0.2	0.5	1.6
133	4	14	14	---	---	---	0.1	0.5	0.7	---	---	---
135	13	27	45	13	27	45	0.5	1.1	1.9	0.5	1.1	1.9
137	8	18	29	8	18	29	0.3	0.7	1.2	0.3	0.7	1.2
139	12	12	12	12	12	12	0.5	0.9	1.1	0.5	0.9	1.1
141	6	12	20	6	12	20	0.2	0.5	0.8	0.2	0.5	0.8
143	0	0	2	0	0	2	0.1	0.3	1.3	0.1	0.3	1.3
145	70	121	137	---	---	---	2.3	5.5	7.9	---	---	---
147	41	343	881	12	28	162	1.4	9.4	26.7	0.4	1.0	3.7
149	14	221	417	---	---	---	0.1	5.6	14.3	---	---	---

DBDPA Element	Peak Outflow (cfs)						Runoff Volume (Ac-ft)					
	Existing Conditions			DBDPA Conditions			Existing Conditions			DBDPA Conditions		
	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}	Q_2	Q_{10}	Q_{100}	V_2	V_{10}	V_{100}
8000	---	---	---	223	587	882	---	---	---	8.7	24.0	42.4
8002	---	---	---	219	579	750	---	---	---	8.5	23.5	39.9
8004	---	---	---	215	570	750	---	---	---	8.3	23.1	39.4
8006	---	---	---	14	31	50	---	---	---	0.5	1.2	2.0
8008	---	---	---	92	215	293	---	---	---	3.2	8.3	14.4
8010	---	---	---	6	12	101	---	---	---	0.2	0.5	1.8
8012	---	---	---	19	38	71	---	---	---	0.7	1.5	2.8
8014	---	---	---	106	312	442	---	---	---	4.3	13.0	22.9
8016	---	---	---	83	196	293	---	---	---	2.9	7.4	13.4
8018	---	---	---	67	121	137	---	---	---	2.3	5.5	7.9
8020	---	---	---	13	69	100	---	---	---	0.4	1.6	3.9
8022	---	---	---	9	61	100	---	---	---	0.3	1.3	3.7
8024	---	---	---	6	34	50	---	---	---	0.2	0.8	2.0
8026	---	---	---	0	12	50	---	---	---	0.0	0.1	1.3
8030	---	---	---	0	0	124	---	---	---	0.0	0.0	1.9
8034	---	---	---	11	50	50	---	---	---	0.1	2.1	3.2
8040	---	---	---	16	130	160	---	---	---	0.2	4.2	7.9
8042	---	---	---	16	130	130	---	---	---	0.2	4.3	7.1
8044	---	---	---	16	100	100	---	---	---	0.2	3.7	5.8
8046	---	---	---	0	13	50	---	---	---	0.0	0.1	1.3

Element 1

Conveyance Element 1 is an ***existing 42" RCP*** along Leland Lane.

Location: Element 1 is an existing 42" RCP element that extends from Element 1000 to Element 1002. More generally, this element extends from 32nd Street along Leland Lane to the Dover Street Channel.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	3.5
Depth (ft)	3.5
Length (ft)	537
Slope (ft/ft)	0.012
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	40
$Q_{10,DBDP,ELEM}$ *(cfs)*	71
$Q_{100,DBDP,ELEM}$ *(cfs)*	71
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	15
$Q_{100,DBDP,OVFL}$ *(cfs)*	111
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.87*
Street V_{100} (fps)	5.25*

Required Improvements: No improvements are necessary for the existing 42" RCP. Under the 100-year conditions the overflow depth on Leland Lane is 0.87 feet which less than the allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 7

Conveyance Element 7 is an ***existing open channel.***

Location: Element 7 is an existing open channel element that extends from Element 7014 to Element 147. This a portion of the historic channel and irrigation system used for agricultural purposes prior to residential development.

Modeled Element:

Type	Trapezoidal Channel
Bottom Width/Diameter (ft)	10
Depth (ft)	N/A
Length (ft)	538
Slope (ft/ft)	0.0095
Side Slopes (H:V)	2
Manning's n	0.035
$Q_{2,DBDP,ELEM}$ *(cfs)*	12
$Q_{10,DBDP,ELEM}$ *(cfs)*	28
$Q_{100,DBDP,ELEM}$ *(cfs)*	161
Overflow Channel	N/A
Q_{100} **Depth *(ft)***	**2.08***
V_{100} *(fps)*	**5.48***

Required Improvements: The existing open channel is composed of a 10-foot wide trapezoidal channel with 2H:1V side slopes at the smallest cross section. The channel includes a privately owned pond with a spillway structure located on the east end. It is recommended that a drainage easement be pursued for maintenance reasons. Eutrophication occurs periodically within the pond causing odors, which have become a nuisance to the neighbors. If an easement cannot be obtained, the discussion within Element 39 presents a solution that provides a more consistent flow into the pond in order to encourage flow circulation and flushing.

*Values determined using computer program Bentley FLOWMASTER.

Element 9

Conveyance Element 9 is an ***existing open channel*** along Fremont Street.

Location: Element 9 is an existing open channel element that extends from Element 1008 to Element 1010. This element represents a short section of concrete open channel adjacent to the east side of Fremont Street.

Modeled Element:

Type	Rectangular Channel
Bottom Width/Diameter (ft)	9
Depth (ft)	N/A
Length (ft)	74
Slope (ft/ft)	0.057
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	12
$Q_{10,DBDP,ELEM}$ *(cfs)*	28
$Q_{100,DBDP,ELEM}$ *(cfs)*	162
Overflow Channel	N/A
Q_{100} **Depth (ft)**	**0.91***
V_{100} *(fps)*	**19.69***

Required Improvements: The existing open channel is a 9-foot wide rectangular concrete channel. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 15

Conveyance Element 15 is an ***existing open channel.***

Location: Element 15 is an existing open channel element that extends from Element 1014 to Element 1016. This is a portion of the original Cedar Canyon flood control channel.

Modeled Element:

Type	Rectangular Channel
Bottom Width/Diameter (ft)	3
Depth (ft)	N/A
Length (ft)	387
Slope (ft/ft)	0.021
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	65
$Q_{10,DBDP,ELEM}$ *(cfs)*	115
$Q_{100,DBDP,ELEM}$ *(cfs)*	126
Overflow Channel	N/A
Q_{100} *Depth (ft)*	2.94*
V_{100} *(fps)*	14.29*

Required Improvements: The existing open channel is composed of a 3-foot wide rectangular channel with rock-lined bottom and stone walls. No improvements necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 17

Conveyance Element 17 is an ***existing 36" RCP.***

Location: Element 17 is an existing 36" RCP element that extends from Element 1016 to Element 1018. This is a portion of the original Cedar Canyon flood control project located between Monte Vista and Elmhurst Drives.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	3
Depth (ft)	3
Length (ft)	463
Slope (ft/ft)	0.017
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	57
$Q_{10,DBDP,ELEM}$ *(cfs)*	96
$Q_{100,DBDP,ELEM}$ *(cfs)*	96
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	26
$Q_{100,DBDP,OVFL}$ *(cfs)*	87
Overflow Channel	Street Flow
Street Q_{100} Depth *(ft)*	0.73*
Street V_{100} *(fps)*	6.72*

Required Improvements: No improvements are necessary. The overflow depth on the street is 0.73 feet, which is below the maximum allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 19

Conveyance Element 19 is an ***existing 36" RCP*** between Juniper Street and Monte Vista Drive.

Location: Element 19 is an existing 36" RCP element that extends from Element 1018 to Element 1020. This is a portion of the original Cedar Canyon flood control channel located between Juniper Street and Monte Vista Drive.

Modeled Element:

Type	Pipe Flow
Bottom Width/Diameter (ft)	3
Depth (ft)	1.21
Length (ft)	301
Slope (ft/ft)	0.026
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	19
$Q_{10,DBDP,ELEM}$ *(cfs)*	34
$Q_{100,DBDP,ELEM}$ *(cfs)*	38
Overflow Channel	N/A

Required Improvements: No improvements are necessary. The 36" RCP is fed from two 18" RCP storm sewer mains in Canyon Lake Drive and Forest Street. No overflow occurs during the 100-year storm event.

Element 21

Conveyance Element 21 is an ***existing 18" RCP*** along Canyon Lake Drive.

Location: Element 21 is an existing 18" RCP element that extends from Element 1020 to Element 1022. This element is a culvert extending across Canyon Lake Drive at Hillsview Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.5
Length (ft)	321
Slope (ft/ft)	0.037
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	12
$Q_{10,DBDP,ELEM}$ *(cfs)*	23
$Q_{100,DBDP,ELEM}$ *(cfs)*	24
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	13
$Q_{100,DBDP,OVFL}$ *(cfs)*	38
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.52*
Street V_{100} (fps)	4.86*

Required Improvements: No improvements are necessary. Under the 100-year conditions the overflow depth on Canyon Lake Drive is 0.52 feet which is less than the allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 23

Conveyance Element 23 is an ***existing 18" RCP*** along Forest Street.

Location: Element 23 is an existing 18" RCP element that extends from Element 1020 to Element 1024. This element is a storm sewer located in Forest Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	0.65
Length (ft)	240
Slope (ft/ft)	0.011
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	4
$Q_{10,DBDP,ELEM}$ *(cfs)*	4
$Q_{100,DBDP,ELEM}$ *(cfs)*	4
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	18
$Q_{100,DBDP,OVFL}$ *(cfs)*	50
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.58*
Street V_{100} (fps)	5.41*

Required Improvements: No improvements are necessary. Under the 100-year conditions the overflow depth on Forest Street is 0.58 feet, which is less than the allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 25

Conveyance Element 25 is ***existing street curb and gutter*** on Monte Vista Drive.

Location: Element 25 is an existing street element that extends from Element 1008 to Element 1026. This element is the north portion of Monte Vista Drive.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.64
Length (ft)	304
Slope (ft/ft)	0.021
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	30
$Q_{10,DBDP,ELEM}$ *(cfs)*	70
$Q_{100,DBDP,ELEM}$ *(cfs)*	116
Overflow Channel	N/A
Street Q_{100} Depth (ft)	0.84*
Street V_{100} (fps)	7.51*

Required Improvements: The existing element is Monte Vista Drive from Element 1018 to Canyon Lake Drive. The 100-year flow depth on Monte Vista Drive is 0.84 feet, which is below the allowable 100-year street flow depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 29

Conveyance Element 29 is ***existing street curb and gutter*** on Schamber Street.

Location: Element 29 is an existing street element that extends from Element 7006 to Element 1032. This element is the west portion of Schamber Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.37
Length (ft)	495
Slope (ft/ft)	0.023
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	4
$Q_{10,DBDP,ELEM}$ *(cfs)*	9
$Q_{100,DBDP,ELEM}$ *(cfs)*	14
Overflow Channel	N/A
Street Q_{100} Depth (ft)	0.37*
Street V_{100} (fps)	3.28*

Required Improvements: The existing element is Schamber Street Element 7006 to 38th Street. The 100 year flow depth on Schamber Street is 0.37 feet, which is below the allowable 100-year street flow depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 31

Conveyance Element 31 is ***existing street curb and gutter*** on Twin Elms Drive.

Location: Element 31 is an existing street element that extends from Element 7006 to Element 1030. This element is a portion of Twin Elms Drive to Schamber Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.34
Length (ft)	627
Slope (ft/ft)	0.025
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	3
$Q_{10,DBDP,ELEM}$ *(cfs)*	6
$Q_{100,DBDP,ELEM}$ *(cfs)*	10
Overflow Channel	N/A
Street Q_{100} Depth *(ft)*	0.34*
Street V_{100} *(fps)*	2.88*

Required Improvements: The existing element is Twin Elms Drive from Element 1030 to Schamber Street. The 100-year flow depth in the street is 0.34 feet, which is below the allowable 100-year street flow depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 37

Conveyance Element 37 is an ***existing 48" RCP*** in West Saint Patrick Street.

Location: Element 37 is an existing 48" RCP element that extends from Element 7014 to Element 1038. The element extends along West Saint Patrick Street from Evergreen Drive to Rushmore Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	4
Depth (ft)	4
Length (ft)	397
Slope (ft/ft)	0.013
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	79
$Q_{10,DBDP,ELEM}$ *(cfs)*	133
$Q_{100,DBDP,ELEM}$ *(cfs)*	133
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	5
$Q_{100,DBDP,OVFL}$ *(cfs)*	53
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.59*
Street V_{100} (fps)	5.54*

Required Improvements: The primary function of the existing 48" RCP is to convey flows collected in the Cedar Canyon flood control channel (Element 15) to the Dover Street Channel. The existing 48" RCP is not sufficient to carry the 100-year flows from Saint Patrick Street. The existing condition produces 133 cfs of street flow. A parallel storm sewer system is called out by the proposed conveyance elements 8040, 8042 and 8044. With the proposed improvements, the street flow depth during the 100 year conditions is 0.59 feet, falling beneath the maximum allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 39

Conveyance Element 39 is an ***existing 48" RCP*** in West Saint Patrick Street.

Location: Element 39 is an existing 48" RCP element that extends from Element 1038 to Element 1040. This element is a portion of storm sewer in West Saint Patrick Street from Rushmore Street to Fremont Street.

Modeled Element:

Type	Pipe Flow
Bottom Width/Diameter (ft)	4
Depth (ft)	3.35
Length (ft)	346
Slope (ft/ft)	0.013
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	75
$Q_{10,DBDP,ELEM}$ *(cfs)*	129
$Q_{100,DBDP,ELEM}$ *(cfs)*	169
Overflow Channel	N/A

Required Improvements: The primary function of the existing 48" RCP is to convey flows collected in the Cedar Canyon flood control channel (Element 15) to the Dover Street Channel. The existing 48" RCP is not sufficient to carry the 100 year flows from Saint Patrick Street. The 100-year storm event produces 166-cfs flow. A parallel storm sewer system is called out by the proposed conveyance elements 8040, 8042 and 8044. With the proposed improvements, the street flow depth during the 100-year conditions is 0.86 feet, falling beneath the maximum allowable flow depth set by the RCIDCM.

It is recommended that a 48" by 48" by 24" RCP tee be placed on the existing 48" RCP at the intersection of West Saint Patrick Street and Rushmore Street and discharge a portion of the 48" RCP flow into Element 7, the existing detention pond. The flow will allow the pond to flush during most rain events minimizing the effects of eutrophication and, consequently, the odor from the pond.

Element 41

Conveyance Element 41 is an ***existing 48" RCP*** in West Saint Patrick Street.

Location: Element 41 is an existing 48" RCP element that extends from Element 1040 to Element 1042. This element is a portion of storm sewer in West Saint Patrick Street from Fremont Street to Twin Elm Drive right of way.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	4
Depth (ft)	4
Length (ft)	421
Slope (ft/ft)	0.007
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	67
$Q_{10,DBDP,ELEM}$ *(cfs)*	112
$Q_{100,DBDP,ELEM}$ *(cfs)*	139
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	0
$Q_{100,DBDP,OVFL}$ *(cfs)*	157
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.92*
Street V_{100} (fps)	6.4*

Required Improvements: The primary function of the existing 48" RCP is to convey flows collected in the Cedar Canyon flood control channel (Element 15) to the Dover Street Channel. The existing 48" RCP is not sufficient to carry the 100-year flows from Saint Patrick Street. The 100-year event produces street flows of 157 cfs. A parallel storm sewer system is called out by the proposed conveyance elements 8040, 8042 and 8044. With the proposed improvements, the street flow depth during the 100-year event is 0.92 feet, falling below the maximum allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 43

Conveyance Element 43 is an ***existing 48" RCP*** in West Saint Patrick Street.

Location: Element 43 is an existing 48" RCP element that extends from Element 1042 to Element 1044. This element is a portion of storm sewer in West Saint Patrick Street from Twin Elm Drive right of way to 38th Street.

Modeled Element:

Type	Pipe Flow
Bottom Width/Diameter (ft)	4
Depth (ft)	3.18
Length (ft)	226
Slope (ft/ft)	0.021
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	60
$Q_{10,DBDP,ELEM}$ *(cfs)*	100
$Q_{100,DBDP,ELEM}$ *(cfs)*	230
Overflow Channel	N/A

Required Improvements: The primary function of the existing 48" RCP is to convey flows collected in the Cedar Canyon flood control channel (Element 15) to the Dover Street Channel. The existing 48" RCP is not sufficient to carry the 100-year flows from Saint Patrick Street. The 100-year event produces 230 cfs. A parallel storm sewer system is called out by the proposed conveyance elements 8040, 8042 and 8044. With the proposed improvements the street flow depth during the 100-year conditions is 0.86 feet, falling below the maximum allowable depth established by the RCIDCM.

Element 45

Conveyance Element 45 is an ***existing 36" RCP*** in 38th Street.

Location: Element 45 is an existing 36" RCP element that extends from Element 1044 to Element 1046. This element is a portion of storm sewer in the north end of 38th Street from West Saint Patrick Street to Canyon Lake Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	3
Depth (ft)	3
Length (ft)	372
Slope (ft/ft)	0.03
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	50
$Q_{10,DBDP,ELEM}$ *(cfs)*	50
$Q_{100,DBDP,ELEM}$ *(cfs)*	50
$Q_{2,DBDP,OVFL}$ *(cfs)*	17
$Q_{10,DBDP,OVFL}$ *(cfs)*	161
$Q_{100,DBDP,OVFL}$ *(cfs)*	324
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	1.02*
Street V_{100} (fps)	7.26*

Required Improvements: The existing 36" RCP is not sufficient to carry the 100 year flows from Saint Patrick Street. The 100-year event produces 324 cfs at a flow depth of 1.65-feet. A parallel storm sewer is to be constructed. The parallel system is called out by the proposed conveyance elements 8040, 8042 and 8044. With the proposed improvements the street flow depth during the 100-year conditions is 0.86 feet, falling below the maximum allowable depth established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 47

Conveyance Element 47 is an *__existing 36" RCP__* in Canyon Lake Drive.

Location: Element 47 is an existing 36" RCP element that extends from Element 1046 to Element 1048. This element is located in Canyon Lake Drive from 38th Street to Boulder Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	3
Depth (ft)	3
Length (ft)	469
Slope (ft/ft)	0.003
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	28
$Q_{10,DBDP,ELEM}$ *(cfs)*	28
$Q_{100,DBDP,ELEM}$ *(cfs)*	28
$Q_{2,DBDP,OVFL}$ *(cfs)*	13
$Q_{10,DBDP,OVFL}$ *(cfs)*	27
$Q_{100,DBDP,OVFL}$ *(cfs)*	39
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.53*
Street V_{100} (fps)	4.91*

Required Improvements: The existing 36" RCP has a street overflow depth of 0.53 feet on Canyon Lake Drive, less than the maximum flow depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 49

Conveyance Element 49 is an ***existing 24" RCP*** in Boulder Street.

Location: Element 49 is an existing 24" RCP element that extends from Element 1048 to Element 50. The element lies in a portion of Boulder Street from Canyon Lake Drive to 38th Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	2
Depth (ft)	2
Length (ft)	820
Slope (ft/ft)	0.02
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	34
$Q_{10,DBDP,ELEM}$ *(cfs)*	36
$Q_{100,DBDP,ELEM}$ *(cfs)*	36
$Q_{2,DBDP,OVFL}$ *(cfs)*	11
$Q_{10,DBDP,OVFL}$ *(cfs)*	102
$Q_{100,DBDP,OVFL}$ *(cfs)*	210
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	1.12*
Street V_{100} (fps)	6.24*

Required Improvements: The existing 24" RCP diverts 210 cfs to the adjacent street which yields a flow depth of 1.12 feet. The depth is below the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 51

Conveyance Element 51 is an *existing 15" RCP.*

Location: Element 51 is an existing 15" RCP element that extends from Element 1050 to Element 1052. This element extends from 38th Street west to Valley West Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.25
Depth (ft)	1.25
Length (ft)	1399
Slope (ft/ft)	0.087
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	3
$Q_{10,DBDP,ELEM}$ *(cfs)*	14
$Q_{100,DBDP,ELEM}$ *(cfs)*	15
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	0
$Q_{100,DBDP,OVFL}$ *(cfs)*	11
Overflow Channel	Street Flow
Street Q_{100} Depth *(ft)*	0.35*
Street V_{100} *(fps)*	2.98*

Required Improvements: No improvements are necessary. The existing 15" RCP carries enough runoff to produce a 100-year street overflow depth of 0.35 feet, which is below the maximum allowable established by the RCIDCM.

*Values determined using computer program Bentley FLOWMASTER.

Element 53

Conveyance Element 53 is an ***existing 24" RCP*** in Canyon Lake Drive.

Location: Element 53 is an existing 24" RCP element that extends from Element 1046 to Element 1054. This element extends across Canyon Lake Drive at the 38th Street intersection.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	2
Depth (ft)	2
Length (ft)	124
Slope (ft/ft)	0.01
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	25
$Q_{10,DBDP, ELEM}$ *(cfs)*	25
$Q_{100,DBDP, ELEM}$ *(cfs)*	25
$Q_{2,DBDP, OVFL}$ *(cfs)*	14
$Q_{10,DBDP, OVFL}$ *(cfs)*	159
$Q_{100,DBDP, OVFL}$ *(cfs)*	322
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.92*
Street V_{100} (fps)	8.72*

Required Improvements: The existing 24" RCP produces a 100-year street overflow depth of 0.92 feet. It is recommended that street improvements include lowering the street and increasing the capacity.

*Values determined using computer program Bentley FLOWMASTER.

Element 55

Conveyance Element 55 is ***existing street curb and gutter*** on Fremont Street.

Location: Element 55 is an existing street element that extends from Element 1040 to Element 1056. This element is a portion of Fremont Street from West Saint Patrick Street to Washington Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.37*
Length (ft)	362
Slope (ft/ft)	0.012
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	4
$Q_{10,DBDP,ELEM}$ *(cfs)*	8
$Q_{100,DBDP,ELEM}$ *(cfs)*	14
Overflow Channel	N/A
Street Q_{100} Depth *(ft)*	0.37*
Street V_{100} *(fps)*	3.28*

Required Improvements: The existing street conditions during the 100 year storm event produce a flow depth of 0.37 feet. The flow depth is below the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 59

Conveyance Element 59 is ***existing street curb and gutter*** on 32nd Street.

Location: Element 59 is an existing street element that extends from Element 1062 to Element 1060. This element is a portion of 32nd Street from inlets on 38th Street to Dover Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.53*
Length (ft)	138
Slope (ft/ft)	0.004
Side Slopes (H:V)	N/A
Manning's n	0.015
$Q_{2,DBDP,ELEM}$ *(cfs)*	10
$Q_{10,DBDP,ELEM}$ *(cfs)*	24
$Q_{100,DBDP,ELEM}$ *(cfs)*	39
Overflow Channel	N/A
Street Q_{100} Depth *(ft)*	0.53*
Street V_{100} *(fps)*	4.91*

Required Improvements: The existing street conditions during the 100-year storm event produce a flow depth of 0.53 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 63

Conveyance Element 63 is a ***proposed 36" RCP*** in Leland Lane.

Location: Element 63 is an existing street element that extends from Element 1002 to Element 1064. This element is in a portion Leland Street from Dover Street Drainage Channel to Evergreen Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	3
Depth (ft)	3
Length (ft)	809
Slope (ft/ft)	0.005
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	31
$Q_{10,DBDP,ELEM}$ *(cfs)*	50
$Q_{100,DBDP,ELEM}$ *(cfs)*	50
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	14
$Q_{100,DBDP,OVFL}$ *(cfs)*	53
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.59*
Street V_{100} (fps)	5.54*

Required Improvements: The existing conditions produce greater street flow depths than allowed by the RCIDCM for a 100-year storm event. The 100-year event produces 103 cfs. A proposed 36" RCP is to be constructed lowering the street overflow depth to 0.59 feet. To capture enough flow to comply with street regulations it is estimated that four (4) Type "E" inlets will be needed. The Type "E" inlets will need to capture approximately 50 cfs. The four inlets were included in the cost estimate.

*Values determined using computer program Bentley FLOWMASTER.

Element 65

Conveyance Element 65 is ***existing street curb and gutter*** on Jefferson Street.

Location: Element 65 is an existing street element that extends from Element 1064 to Element 1066. This element is a portion of Jefferson Street from Evergreen Drive to Rushmore Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.62*
Length (ft)	283
Slope (ft/ft)	0.005
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	18
$Q_{10,DBDP,ELEM}$ *(cfs)*	37
$Q_{100,DBDP,ELEM}$ *(cfs)*	59
Overflow Channel	N/A
Street Q_{100} Depth (ft)	0.62*
Street V_{100} (fps)	5.77*

Required Improvements: The existing street conditions during the 100-year storm event produce a flow depth of 0.62 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 67

Conveyance Element 67 is ***existing street curb and gutter*** on Jefferson Street.

Location: Element 67 is an existing street element that extends from Element 1066 to Element 1068. This element is a portion of Jefferson Street from Rushmore Street to Fremont Street.

Modeled Element:

Type	Street Flow
Bottom Width/Diameter (ft)	N/A
Depth (ft)	0.44
Length (ft)	361
Slope (ft/ft)	0.005
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	4
$Q_{10,DBDP,ELEM}$ *(cfs)*	9
$Q_{100,DBDP,ELEM}$ *(cfs)*	14
Overflow Channel	N/A
Street Q_{100} Depth *(ft)*	0.37*
Street V_{100} *(fps)*	2.16*

Required Improvements: The existing street conditions during the 100-year storm event produce a flow depth of 0.37 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 75

Conveyance Element 75 is an ***existing 12" RCP*** in 32nd Street.

Location: Element 75 is an existing 12" RCP element that extends from Element 3000 to Element 3002. This element crosses 32nd Street between Harmony Lane and West Saint Cloud Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1
Depth (ft)	1
Length (ft)	274
Slope (ft/ft)	0.013
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	13
$Q_{10,DBDP,ELEM}$ *(cfs)*	28
$Q_{100,DBDP,ELEM}$ *(cfs)*	33
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	0
$Q_{100,DBDP,OVFL}$ *(cfs)*	12
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.36*
Street V_{100} (fps)	3.09*

Required Improvements: The primary purpose of the element is to convey flows from Harmony Lane and Canyon Lake Drive to an existing open channel which discharges into Rapid Creek. The existing 12" RCP carries enough flow so that the 100-year street overflow depth is 0.36 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 77

Conveyance Element 77 is an ***existing 12" RCP*** in Harmony Lane.

Location: Element 77 is an existing 12" RCP element that extends from Element 3002 to Element 3004. This element is in a portion of Harmony Lane from 32nd Street to inlets on Harmony Lane.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1
Depth (ft)	1
Length (ft)	283
Slope (ft/ft)	0.003
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	2
$Q_{10,DBDP,ELEM}$ *(cfs)*	2
$Q_{100,DBDP,ELEM}$ *(cfs)*	2
$Q_{2,DBDP,OVFL}$ *(cfs)*	9
$Q_{10,DBDP,OVFL}$ *(cfs)*	21
$Q_{100,DBDP,OVFL}$ *(cfs)*	35
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.5*
Street V_{100} (fps)	4.7*

Required Improvements: The primary purpose of the 12" RCP is to convey flows off Harmony Lane to the existing open channel which discharges into Rapid Creek. The existing 12" RCP carries enough flow so that the 100-year street overflow depth is 0.50 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 79

Conveyance Element 79 is an *__existing 18" RCP__* in 32nd Street.

Location: Element 79 is an existing 18" RCP element that extends from Element 3000 to Element 3006. This element crosses 32nd Street at the West Saint Cloud intersection.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.5
Length (ft)	149
Slope (ft/ft)	0.015
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	9
$Q_{10,DBDP,ELEM}$ *(cfs)*	14
$Q_{100,DBDP,ELEM}$ *(cfs)*	14
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	5
$Q_{100,DBDP,OVFL}$ *(cfs)*	29
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.47*
Street V_{100} (fps)	4.37*

Required Improvements: The primary purpose is to convey flows off Saint Cloud into the existing open channel which discharges into Rapid Creek. The existing 18" RCP carries enough flow so that the 100-year street overflow depth is 0.47 feet. The flow depth is less than the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 81

Conveyance Element 81 is an ***existing 42" RCP*** in 32nd Street.

Location: Element 81 is an existing 42" RCP element that extends from Element 4000 to Canyon Lake Elementary Detention. This element is the outlet for Canyon Lake Elementary Detention crossing under 32nd Street.

Modeled Element:

Type	Pipe Flow
Bottom Width/Diameter (ft)	3.5
Depth (ft)	3.5
Length (ft)	120
Slope (ft/ft)	0.001
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	13
$Q_{10,DBDP,ELEM}$ *(cfs)*	108
$Q_{100,DBDP,ELEM}$ *(cfs)*	214
Overflow Channel	N/A

Required Improvements: The primary purpose is to convey flows from Canyon Lake Elementary Detention to an existing open channel which discharges into Rapid Creek. No overflow occurs. No improvements are necessary.

Element 83

Conveyance Element 83 is an *__existing 24" RCP.__*

Location: Element 83 is an existing 24" RCP element that extends from Canyon Lake Elementary Detention to Element 4002. This element extends from the intersection of Canyon Lake Drive and 32nd Street to Canyon Lake Elementary Detention.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	2
Depth (ft)	2
Length (ft)	526
Slope (ft/ft)	0.016
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ (cfs)	35
$Q_{10,DBDP,ELEM}$ (cfs)	40
$Q_{100,DBDP,ELEM}$ (cfs)	40
$Q_{2,DBDP,OVFL}$ (cfs)	0
$Q_{10,DBDP,OVFL}$ (cfs)	63
$Q_{100,DBDP,OVFL}$ (cfs)	147
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.71*
Street V_{100} (fps)	6.39*

Required Improvements: The existing 24" RCP carries flow from Canyon Lake Drive to the Canyon Lake School Detention. Overflow occurs and the resulting street depth is 0.71 feet, which is below the maximum allowable depth established by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 85

Conveyance Element 85 is an ***existing 24" RCP*** in Canyon Lake Drive.

Location: Element 85 is an existing 24" RCP element that extends from Element 4002 to Element 4004. This element is in a portion of Canyon Lake Drive from the intersection at 32nd to a point approximately halfway to Evergreen Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	2
Depth (ft)	2
Length (ft)	649
Slope (ft/ft)	0.007
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	18
$Q_{10,DBDP, ELEM}$ *(cfs)*	21
$Q_{100,DBDP, ELEM}$ *(cfs)*	21
$Q_{2,DBDP, OVFL}$ *(cfs)*	0
$Q_{10,DBDP, OVFL}$ *(cfs)*	39
$Q_{100,DBDP, OVFL}$ *(cfs)*	89
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.67*
Street V_{100} (fps)	4.45*

Required Improvements: The existing 24" RCP carries flow off of Canyon Lake Drive resulting in a flow depth of 0.67 feet for the 100-year storm event. The depth is less than the maximum allowable depth defined by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 87

Conveyance Element 87 is an ***existing 24" RCP*** in Canyon Lake Drive.

Location: Element 87 is an existing 24" RCP element that extends from Element 4004 to Element 4006. This element is in a portion of Canyon Lake Drive from point approximately 160-feet east of Evergreen Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	2
Depth (ft)	2
Length (ft)	350
Slope (ft/ft)	0.012
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	13
$Q_{10,DBDP,ELEM}$ *(cfs)*	29
$Q_{100,DBDP,ELEM}$ *(cfs)*	29
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	10
$Q_{100,DBDP,OVFL}$ *(cfs)*	41
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.54*
Street V_{100} (fps)	5.01*

Required Improvements: The existing 24" RCP carries flow off of Canyon Lake Drive resulting in a flow depth of 0.54 feet for the 100-year storm event. The depth is less than the allowed depth set by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 89

Conveyance Element 89 is an ***existing 18" RCP*** in Canyon Lake Drive.

Location: Element 89 is an existing 18" RCP element that extends from Element 4006 to Element 4008. This element is in a portion of Canyon Lake from approximately 160-feet east of Evergreen Drive to approximately 100-feet west of Evergreen Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.5
Length (ft)	265
Slope (ft/ft)	0.018
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	13
$Q_{10,DBDP,ELEM}$ *(cfs)*	15
$Q_{100,DBDP,ELEM}$ *(cfs)*	15
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	23
$Q_{100,DBDP,OVFL}$ *(cfs)*	52
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.59*
Street V_{100} (fps)	5.5*

Required Improvements: The existing 18" RCP carries flow off of Canyon Lake Drive resulting in a flow depth of 0.59 feet for the 100-year storm event. The depth is less than the allowed depth set by the RCIDCM. It is recommended that the street intersections be reconstructed at Canyon Lake Drive so the flow is kept on Canyon Lake Drive and not transferred to Evergreen Drive.

*Values determined using computer program Bentley FLOWMASTER.

Element 91

Conveyance Element 91 is an ***existing 18" RCP*** in Canyon Lake Drive.

Location: Element 91 is an existing 18" RCP element that extends from Element 4008 to Element 4010. This element is in a portion of Canyon Lake Drive from Evergreen Drive to Rushmore Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.5
Length (ft)	355
Slope (ft/ft)	0.017
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	7
$Q_{10,DBDP,ELEM}$ *(cfs)*	15
$Q_{100,DBDP,ELEM}$ *(cfs)*	15
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	0
$Q_{100,DBDP,OVFL}$ *(cfs)*	11
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.35*
Street V_{100} (fps)	2.98*

Required Improvements: The existing 18" RCP carries flow off of Canyon Lake Drive resulting in a flow depth of 0.35 feet for the 100-year storm event. The depth is less than the allowed depth set by the RCIDCM. It is recommended that the street intersections be reconstructed at Rushmore Street and Canyon Lake Drive so the flow is kept on Canyon Lake Drive and not transferred to Rushmore Street.

*Values determined using computer program Bentley FLOWMASTER.

Element 93

Conveyance Element 93 is an ***existing 18" RCP*** in Canyon Lake Drive.

Location: Element 93 is an existing 18" RCP element that extends from Element 4010 to Element 4012. This element is in a portion of Canyon Lake Drive from Rushmore Street to Sunnyvale Drive.

Modeled Element:

Type	Pipe Flow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.23
Length (ft)	558
Slope (ft/ft)	0.019
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	4
$Q_{10,DBDP,ELEM}$ *(cfs)*	9
$Q_{100,DBDP,ELEM}$ *(cfs)*	15
Overflow Channel	N/A

Required Improvements: No improvements are necessary. The existing 18" RCP has the capacity to convey all flows from Canyon Lake Drive, resulting in minimum street flow.

Element 95

Conveyance Element 95 is an ***existing 18" RCP*** in Canyon Lake Drive.

Location: Element 95 is an existing 18" RCP element that extends from Element 4002 to Element 4014. This element crosses Canyon Lake Drive at Soo San Drive and 32nd Street.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	1.5
Depth (ft)	1.5
Length (ft)	97
Slope (ft/ft)	0.02
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	11
$Q_{10,DBDP, ELEM}$ *(cfs)*	11
$Q_{100,DBDP, ELEM}$ *(cfs)*	11
$Q_{2,DBDP, OVFL}$ *(cfs)*	9
$Q_{10,DBDP, OVFL}$ *(cfs)*	44
$Q_{100,DBDP, OVFL}$ *(cfs)*	84
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.72*
Street V_{100} (fps)	6.63*

Required Improvements: The existing 18" RCP carries flow off of Soo San Drive resulting in a flow depth of 0.72 feet for the 100-year storm event. The depth is less than the allowed depth set by the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 97

Conveyance Element 97 is an ***existing 48" RCP*** in Canyon Lake Drive.

Location: Element 97 is an existing 48" RCP element that extends from Element 5000 to Element 5002. This element is in a portion of Canyon Lake Drive from Jackson Boulevard to Sunset Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	4
Depth (ft)	4
Length (ft)	623
Slope (ft/ft)	0.015
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ (cfs)	74
$Q_{10,DBDP,ELEM}$ (cfs)	213
$Q_{100,DBDP,ELEM}$ (cfs)	249
$Q_{2,DBDP,OVFL}$ (cfs)	0
$Q_{10,DBDP,OVFL}$ (cfs)	0
$Q_{100,DBDP,OVFL}$ (cfs)	47
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.57*
Street V_{100} (fps)	5.28*

Required Improvements: The primary purpose is to convey flows from Canyon Lake Drive to Jackson Boulevard and eventually Park Drive where the flow is discharged into Rapid Creek. The existing 48" RCP collects flow off Canyon Lake drive and produces a street flow depth of 0.57 feet. The flow depth is less than allowed by the RCIDCM. It is recommended that intersection improvements be made for Sunset Drive and Lakeview Drive to maintain flow on Canyon Lake Drive with no diversion to the adjacent side streets.

*Values determined using computer program Bentley FLOWMASTER.

Element 99

Conveyance Element 99 is an ***existing 54" RCP*** in Canyon Lake Drive.

Location: Element 99 is an existing 54" RCP element that extends from Element 5002 to Element 5004. This element is in a portion of Canyon Lake Drive from Sunset Drive to Minnekahta Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	4.5
Depth (ft)	4.5
Length (ft)	304
Slope (ft/ft)	0.016
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	72
$Q_{10,DBDP,ELEM}$ *(cfs)*	207
$Q_{100,DBDP,ELEM}$ *(cfs)*	285
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	0
$Q_{100,DBDP,OVFL}$ *(cfs)*	0
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0*
Street V_{100} (fps)	0*

Required Improvements: The existing 54" RCP collects street flows from Canyon Lake Drive and also conveys flows from the Red Dale drainage to Park Drive. The existing facilities are adequate for Canyon Lake Drive to maintain compliance with the RCIDCM. No improvements are necessary.

*Values determined using computer program Bentley FLOWMASTER.

Element 101

Conveyance Element 101 is an ***existing 54" RCP*** in Canyon Lake Drive.

Location: Element 101 is an existing 54" RCP element that extends from Element 5004 to Element 5006. This element is in a portion of Canyon Lake Drive from Minnekahta Drive to Dale Drive.

Modeled Element:

Type	Pipe with Overflow
Bottom Width/Diameter (ft)	4.5
Depth (ft)	4.5
Length (ft)	351
Slope (ft/ft)	0.001
Side Slopes (H:V)	N/A
Manning's n	0.013
$Q_{2,DBDP,ELEM}$ *(cfs)*	63
$Q_{10,DBDP,ELEM}$ *(cfs)*	180
$Q_{100,DBDP,ELEM}$ *(cfs)*	187
$Q_{2,DBDP,OVFL}$ *(cfs)*	0
$Q_{10,DBDP,OVFL}$ *(cfs)*	9
$Q_{100,DBDP,OVFL}$ *(cfs)*	143
Overflow Channel	Street Flow
Street Q_{100} Depth (ft)	0.98*
Street V_{100} (fps)	3.34*

Required Improvements: The existing 54" RCP is not large enough to comply with the 100-year street flow depths set by the RCIDCM. The 100-year event produces 330 cfs at a depth of 1.50 feet. A proposed parallel storm sewer is to be constructed reducing the flow depths to 0.98 ft in Canyon Lake Drive, which complies with the allowed depth. The proposed system is called out as Conveyance Element 8046. It is also recommended that intersection improvements be made to convey the flow from Canyon Lake Drive onto Minnekahta Drive.

*Values determined using computer program Bentley FLOWMASTER.