Bowen Collins
& Associates, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM

DATE: July 28, 2010

TO: Trace Robinson, P.E., Tom Beesley, P.E.
Riverton City
12830 S. Redwood Road
Riverton, Utah 84065

FROM: Craig Bagley, P.E., Matthew Stayner, P.E.
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PROFESSIONAL ENGINEER
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7/28/10
STATE OF UTAH

SUBJECT: 2010 Riverton City Storm Drain Master Plan Amendment

INTRODUCTION

Riverton City (City) retained Bowen Collins & Associates (BC&A) to complete an amendment to the 2004 Riverton City Storm Drain Master Plan. This amendment includes new hydrologic and hydraulic evaluations of the portion of Riverton City located west of Bangerter Highway. This area was restudied primarily because the future land use assumptions and drainage patterns in a portion of the study area have significantly changed since the 2004 master plan was completed. The study area and the areas where projected land use have changed since 2004 are shown in Figure 1.

The primary objective of this amendment is to identify storm drain improvements that will address future drainage needs in the study area while complying with the general discharge limits published in Salt Lake County's Southwest Canal and Creek Study associated with Rose Creek and Midas Creek. Another objective of this project was to perform a hydrologic evaluation of Rose and Midas Creeks. The results of that analysis are presented in a separate Technical Memorandum.

HYDROLOGIC ANALYSIS

A hydrologic computer model of the study area was developed in HEC-HMS (version 3.4) for the purpose of estimating storm water runoff volumes and peak discharges generated by a design cloudburst event. The model development process is outlined Appendix A.

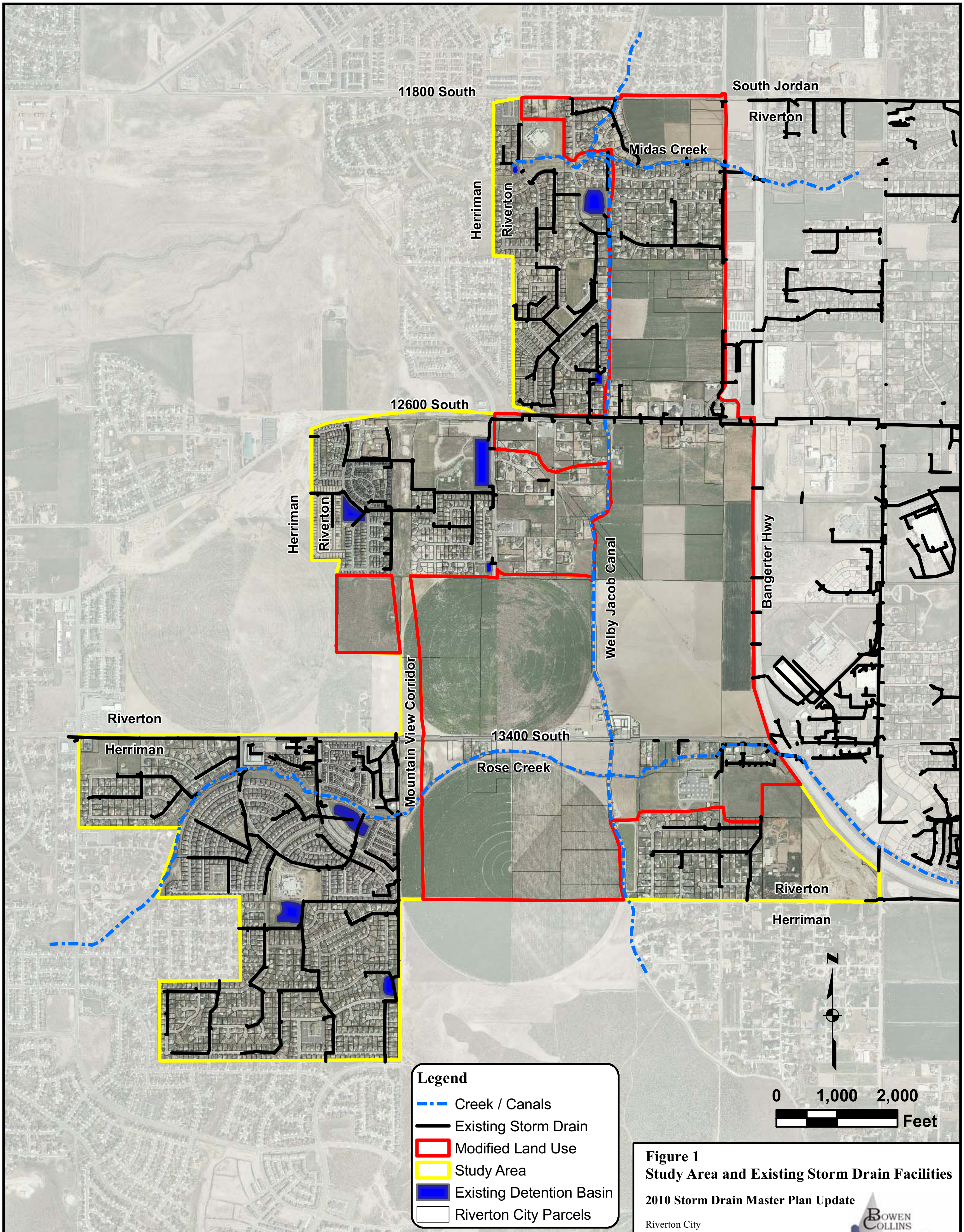

Figure 1
Study Area and Existing Storm Drain Facilities

2010 Storm Drain Master Plan Update

Riverton City

Bowen Collins & Associates, Inc. Consulting Engineers

Printing Date: April 30, 2010
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DRAINAGE FACILITIES ANALYSIS

The evaluation of drainage system facilities was performed only for projected full build-out development conditions. The capacity of the storm drain pipes was evaluated using the 10-year design storm event. The detention basins were evaluated using the 100-year design storm event.

The following major tasks were completed to identify needed drainage system facilities:

- Peak discharge rates and runoff volumes from design storm simulations were computed for the study area.

- Hydraulic capacities for existing storm drain pipelines in the study area were estimated based on storm drain inventory information collected as part of this study.

- Results from the hydrologic and hydraulic analyses were used to identify deficiencies in existing storm drain pipes and to estimate needed capacities of future storm drain pipes and storm water detention facilities in the study area.

- Recommended improvements that are needed to safely manage storm water runoff in the study area under projected future development conditions were identified. Work was also performed to confirm that recommended improvements complied with channel capacities and recommended discharge restrictions identified in the Southwest Canal and Creek Study.

SOUTHWEST CANAL AND CREEK STUDY CONSIDERATIONS

The Southwest Canal and Creek Study (SWCC) was prepared as a master drainage document to help Salt Lake County personnel identify design discharges and regional facilities that are required to manage storm water runoff in the canals and creeks in the southwest portion of Salt Lake County. Post-development design discharges for the segments of Rose Creek and Midas Creek that are located in Riverton were estimated based on the assumption that all future development would construct storm water detention facilities to attenuate the peak runoff rate to a maximum discharge of 0.2 cfs per acre.

Estimated allowable peak discharge into Midas Creek and Rose Creek were calculated by multiplying the total contributing area by 0.2 cfs per acre, in compliance with the assumption used in the SWCC study. It should be noted that the portion of the Rose Creek drainage area associated with this Master Plan Ammendment includes about 350 acres of land that the SWCC study assumed would drain to Midas Creek (see Figure 2). Table 1 shows the SWCC estimated allowable peak discharge. It also shows that the average unit discharge needs to be decreased to 0.16 to account for the additional 350 acres.

Table 3
Recommended Storm Drain Pipe
Design Criteria

ID	Recommended Deisgn Discharge* (cfs)	Estimated Slope	Manning's 'n'	Existing Diameter (in)	Proposed Diameter (in)	Discharge Capacity (cfs)
Subbasin 11800 South Street						
118S-1	1.6	0.010	0.013	-	18	10.5
Subbasin 12600 South Street						
126S1-1	24.8	0.019	0.013	24	-	31.3
126S2-1	31.8	0.020	0.013	30	-	58.6
126S2-2	14.2	0.020	0.036	36	-	34.4
126S2-3	15.9	0.020	0.013	24	-	32.1
126S2-1	31.8	0.020	0.013	30	-	58.6
Subbasin 13200 South Street						
132S1-1	2.2	0.022	0.013	-	18	15.6
132S1-2	12.6	0.022	0.013	-	18	15.6
Subbasin 13400 South Street						
134S2-1	5.1	0.015	0.013	-	18	12.9
134S3-1	2.9	0.015	0.013	-	18	12.9
134S3-2	33.5	0.002	0.013	-	42	45.1
Subbasin 4000 West Street						
40W1-1	1.4	0.015	0.013	-	18	12.9
40W2-1	8.1	0.005	0.013	-	18	7.4
40W2-2	16.0	0.003	0.013	-	30	20.6
40W2-3	15.9	0.003	0.013	30	-	20.6
40W3-1	28.3	0.004	0.014	42	-	59.2
40W3-2	54.8	0.004	0.013	42	-	63.8
40W4-1	6.9	0.005	0.013	-	18	7.4
Subbasin 4150 West Street						
4150W1-1	2.7	0.010	0.013	-	18	10.5
4150W1-2	16.8	0.005	0.013	-	24	16.0
4150W2-1	5.2	0.005	0.013	-	18	7.4
Subbasin 4570 West Street						
4570W1-1	7.9	0.007	0.015	-	18	7.6
4570W1-2	15.8	0.007	0.013	-	24	19.0
4570W2-1	23.7	0.006	0.013	-	30	31.9
Subbasin Butterfield Property						
BF1-1	31.1	0.011	0.014	-	30	40.1
BF2-1	6.0	0.018	0.015	-	18	12.2
BF3-1	4.4	0.011	0.013	-	18	11.0
BF3-2	2.0	0.005	0.013	-	18	7.4
Subbasin Diversion						
Div-1	22.4	0.005	0.013	-	30	29.1
Subbasin Havest Creek Estates						
HC-1	1.5	0.010	0.013	-	18	10.5
Subbasin Midas Creek Outfall						
MC-1	61.7	0.004	0.013	42	-	62.2
Subbasin Property Reserve Inc.						
PRI4-2	51.8	0.007	0.013	-	36	56.0
PRI7-1	32.5	0.002	0.014	-	42	41.9
PRI7-2	32.5	0.002	0.014	-	42	41.9
PRI14-1	5.8	0.022	0.015	-	18	13.5
PRI15-1	7.4	0.007	0.013	-	18	8.8
PRI17-1	5.6	0.005	0.013	-	18	7.4
PRI19-1	82.0	0.009	0.013	-	42	93.0
PRI20-1	86.7	0.008	0.015	-	42	78.2
Subbasin Riverton Boulevard						
RB3-1	63.3	0.009	0.013	-	36	61.7
Subbasin Scenic Cove						
SC-1	18.8	0.005	0.015	-	30	25.2
Subbasin Sunday Drive						
SD1-1	3.2	0.019	0.013	-	18	14.5
SD1-2	9.0	0.019	0.013	-	18	14.5
SD2-1	2.9	0.003	0.015	-	18	5.0
SD2-2	31.9	0.019	0.013	-	30	56.7
SD2-3	36.2	0.022	0.015	-	30	52.9
Subbasin Western Springs						
WS10-1	2	0.005	0.013	-	18	7.4
WS10-2	29.1	0.018	0.013	-	30	55.2

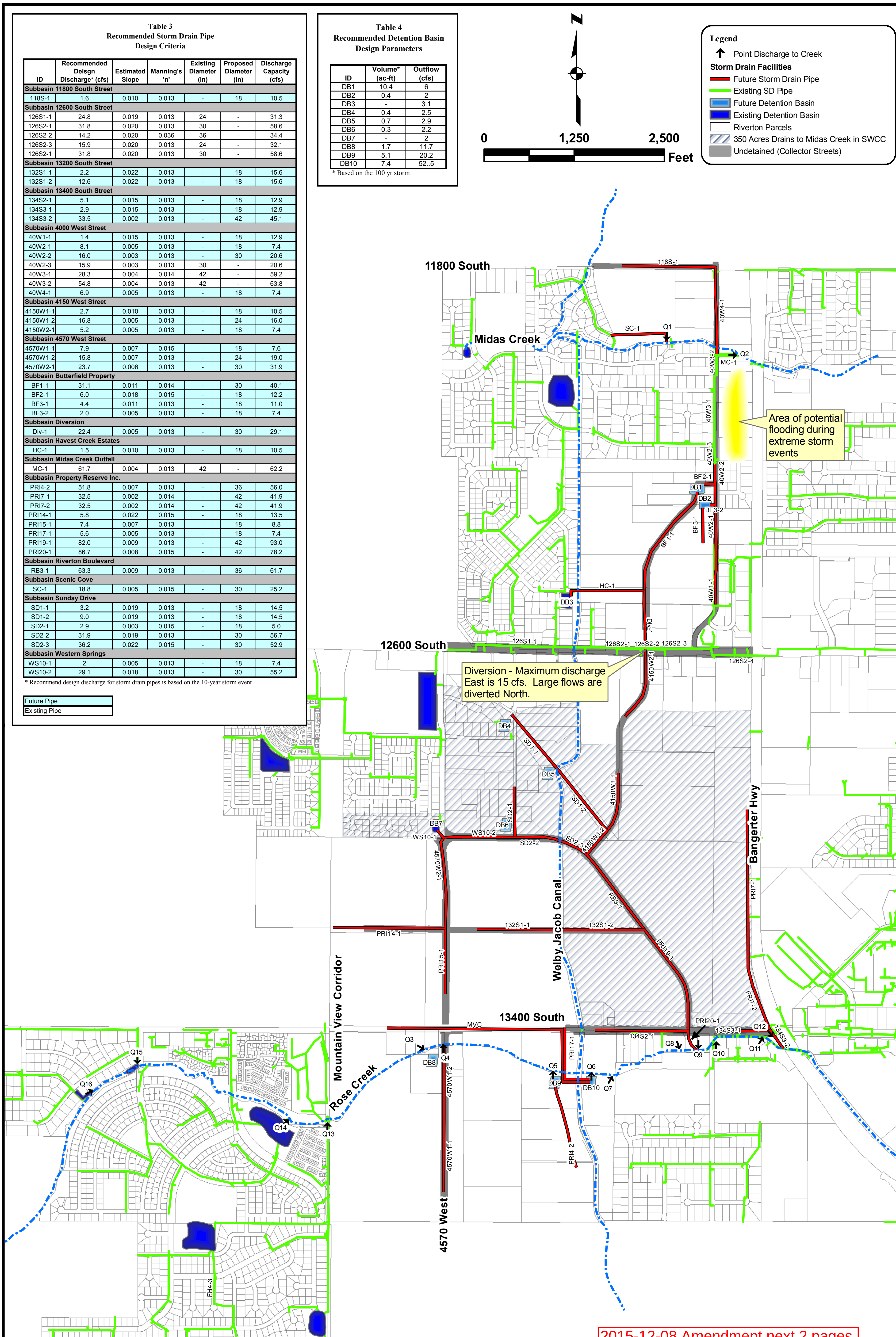
* Recommend design discharge for storm drain pipes is based on the 10-year storm event

Future Pipe
Existing Pipe

Table 4
Recommended Detention Basin
Design Parameters

ID	Volume* (ac-ft)	Outflow (cfs)
DB1	10.4	6
DB2	0.4	2
DB3	-	3.1
DB4	0.4	2.5
DB5	0.7	2.9
DB6	0.3	2.2
DB7	-	2
DB8	1.7	11.7
DB9	5.1	20.2
DB10	7.4	52..5

* Based on the 100 yr storm



2015-12-08 Amendment next 2 pages

Figure 2
Recommended Storm Drain Facilities
Riverton Southwest Area
Storm Drain Master Plan

Riverton City

Bowen Collins & Associates, Inc.
Consulting Engineers

Printing Date: July 28, 2010
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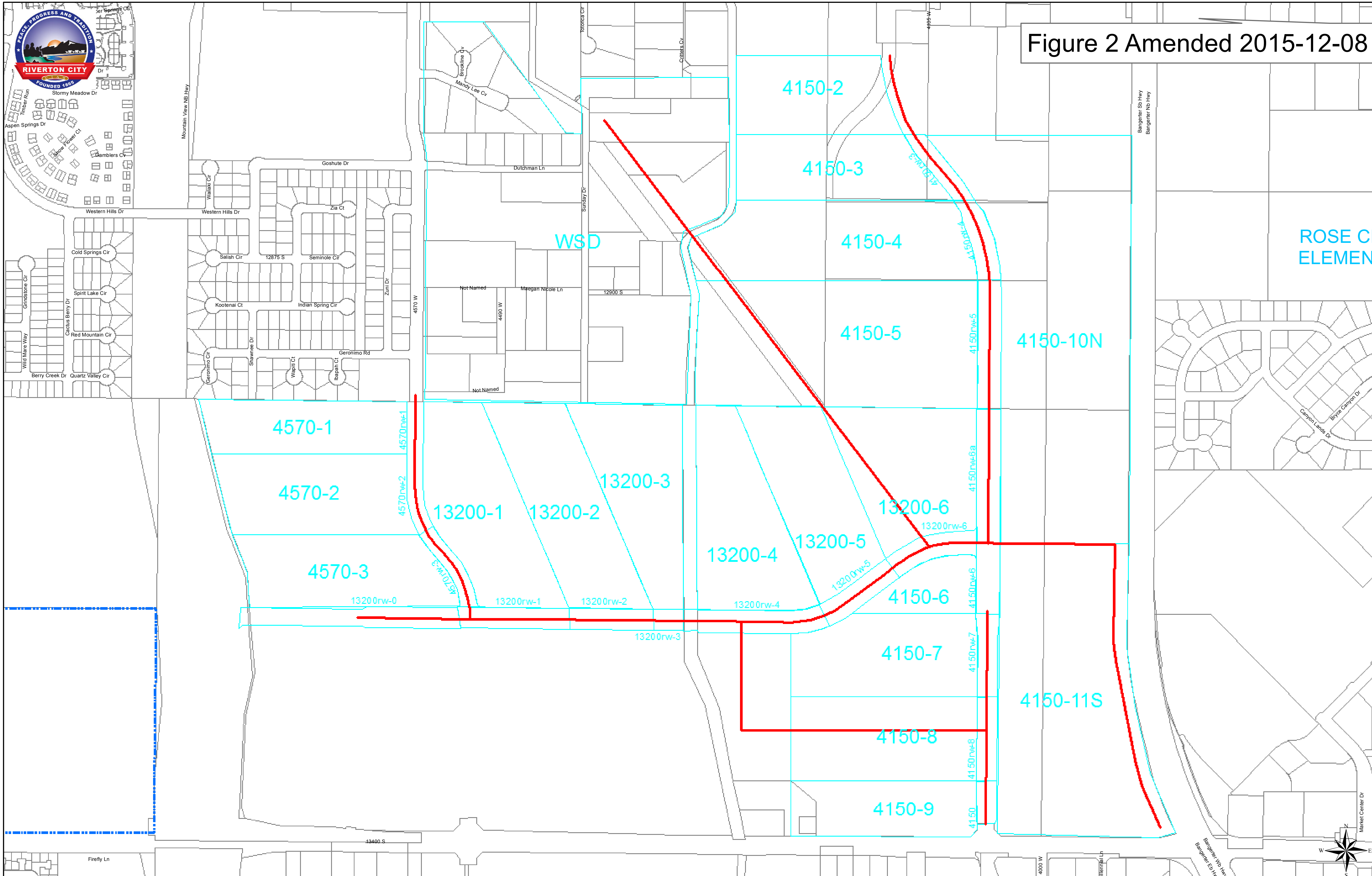

Figure 2 Amended 2015-12-08
RIVERTON CITY
4150-2
4150-3
4150-4
4150-5
4150-10N
WSD
ROSE CR
ELEMENT
4570-1
4570-2
4570-3
13200-1
13200-2
13200-3
13200-4
13200-5
13200-6
4150-6
4150-7
4150-8
4150-9
4150-11S
13200rw-0
13200rw-1
13200rw-2
13200rw-3
13200rw-4
13200rw-5
13200rw-6
4570rw-1
4570rw-2
4570rw-3
4150rw-3
4150rw-4
4150rw-5
4150rw-6a
4150rw-6
4150rw-7
4150rw-8
Goshute Dr
Western Hills Dr
Dutchman Ln
Mountain View NB Hwy
Bangerter Sb Hwy
Bangerter Nb Hwy
13400 S

Table 3 Amendment 2015-12-08

Road	District	Area (ac)	Release Rate @ 0.16 cfs/ac (cfs)	Flow	Q	n	Slope (ft/ft)	D	Pipe	Notes: RW runoff coefficient 95%, 10year intensity 2.46in/hr typical
				2						(2cfs) Release Western Springs mini pond 12960S 4370W
4570	4570-1	8.9	1.42		3.4	0.013	0.005	1.12	15	
4570	4570rw-1	0.3			3.4	0.013	0.005	1.12	18	
4570	4570-2	12.5	2.00		5.4	0.013	0.005	1.33	18	
4570	4570rw-2	0.5			5.4	0.013	0.005	1.33	18	
4570	4570-3	11.8	1.89		7.3	0.013	0.005	1.49	24	
4570	4570rw-2	0.6			7.3	0.013	0.005	1.49	24	
				10.7						(10.7cfs) 4570 Point Source(4570rw-2 + Tributary)
13200	13200rw-0	3.0			17.8	0.013	0.005	2.08	24	Confluence (132rw-0)
				5						(5 cfs) CenterCal Estimate point source(13200rw-1)
13202	13200-1	14.69	2.35		25.2	0.013	0.005	2.37	30	
13200	13200rw-1	1.5			25.2	0.013	0.005	2.37	30	
13202	13200-2	14.1	2.26		27.4	0.013	0.005	2.45	36	
13200	13200rw-2	1.1			27.4	0.013	0.005	2.45	36	
				6						(6 cfs)CenterCal Estimate point source(13200rw-3)
13200	13200-3	12.4	1.98		35.4	0.013	0.005	2.69	36	
13200	13200rw-3	0.4			35.4	0.013	0.005	2.69	36	
13200				-19						19cfs Diversion from 13200S System(13200rw-4)
13200	13200-4	13.7	2.19		18.6	0.013	0.005	2.11	36	36" to account for spillway(20cfs)(13200rw-4)
13200	13200rw-4	1.8			18.6	0.013	0.005	2.11	36	
13200	13200-5	12.4	1.98		20.6	0.013	0.005	2.20	42	
13200	13200rw-5	1.0			20.6	0.013	0.005	2.20	42	
13200	13200-6	13.8	2.21		22.8	0.013	0.005	2.28	42	
13200	13200rw-6	1.1			22.8	0.013	0.005	2.28	42	
4150	4150rw-6a	1.7			22.8	0.013	0.005	2.28	42	
4150	4150-6	4	0.64		23.4	0.013	0.005	2.31	42	
4150	4150rw-6	1.4			23.4	0.013	0.005	2.31	42	
				17.8						Confluence (4150rw-5 + tributary)
	WSD	76	12.16		12.2	0.013	0.01	1.58	18	Confluence Western Springs Drainage (@13200rw6 for WSD)
4150	4150-10N	46.7	7.47		60.9	0.013	0.003	3.63	42	
4150	4150-11S	33.8	5.41		66.3	0.013	0.003	3.75	42	42" RCP@0.5%
									42	Existing outfall
4150	4150-3	10.3	1.65		1.6	0.013	0.005	0.85	15	
4150	4150rw-3	1.3			1.6	0.013	0.005	0.85	15	
4150	4150-4	17.4	2.78		4.4	0.013	0.005	1.23	18	
4150	4150rw-4	1.0			4.4	0.013	0.005	1.23	24	
4150	4150-5	29.1	4.66		9.1	0.013	0.005	1.62	24	
4150	4150rw-5	1.4			9.1	0.013	0.005	1.62	24	
	4150rw-6a									accounted in 13200rw-6
				30						11cfs From Center Cal and additional diversion(13200rw-4)
4150	4150-7	12	1.92		31.9	0.013	0.005	2.59	36	36" to account for spillway(19"cfs)
4150	4150rw-7	1.4			31.9	0.013	0.005	2.59	36	
4150	4150-8	12.8	2.05		34.0	0.013	0.005	2.65	36	
4150	4150rw-8	1.4			34.0	0.013	0.005	2.65	36	
4150	4150-9	8.6	1.38		35.3	0.013	0.005	2.69	36	
4150	4150rw-9	0.7			35.3	0.013	0.005	2.69	36	
										Existing (2) 19"x30"

Table 1
Summary of Allowable Discharges into Rose Creek

Discharge Point	Contributing Area (acres)	Average Unit Discharge (cfs/ac)	Discharge (cfs)
SWCC Rose Creek Drainage Area in Riverton West of Bangerter	1417	0.20	284
Riverton SDMP Update Drainage Area West of Bangerter	1767	0.16	283

Table 2 shows the future discharge points for Rose and Midas Creeks. Discharge values for Q1 – Q11 were obtained from the updated hydrologic model that was completed as part of this study. Discharge values for Q12 – Q16 were provided by Riverton City and are based on the best available data from the 2004 SDMP, Salt Lake County discharge permits and development submittal calculations. Discharge point Q6, from the UDOT detention basin, was decreased from 66 cfs (UDOT design) to 52.5 cfs in order to bring the total discharge for Rose Creek down to the allowable discharge.

The recommended discharge restriction applies to all development, including City streets. If future streets are dedicated to the City that are not shown on Figure 2, runoff from those streets will need to be detained to the discharge restriction shown in Table 2. Alternatively, the streets can be allowed to discharge undetained to the storm drain system, in which case the private development area will be required to restrict their discharge beyond what is shown in Table 2.

Table 2
Summary of Future Discharges
into Midas and Rose Creeks

Discharge Point ID[1]	Future Discharge into Creek[2] (cfs)	Contributing Area (acres)	Unit Discharge (cfs/ac)
Discharges into Midas Creek			
Q1	18.8	51.8	0.36
Q2	61.7	437.0	0.14
Total:	**80.5**	**488.8**	**0.16**
Allowable[1]:	**97.8**		
Discharges into Rose Creek			
Q3	2.5	12.7	0.20
Q4	15.9	63.1	0.25
Q5	20.2	101.2	0.20
Q6	52.5	408	0.13
Q7	1.5	7.5	0.20
Q8	2.9	14.7	0.20
Q9	86.7	410.8	0.21

Table 2
Summary of Future Discharges
into Midas and Rose Creeks
(Continued)

Discharge Point ID[1]	Future Discharge into Creek[2] (cfs)	Contributing Area (acres)	Unit Discharge (cfs/ac)
Q10	5.3	26.7	0.20
Q11	5	25	0.20
Q12	33.5	164.5	0.20
Q13	12.1	261.2	0.05
Q14	31.26	196.2	0.16
Q15	3.32	27.8	0.12
Q16	10.7	47.8	0.22
Total:	**283.4**	**1767**	**0.16**
Allowable[1]:	**283.4**		

1 – See Figure 2 for locations of discharge points
2 – Based on the 10-year storm event.

RECOMMENDED DRAINAGE SYSTEM IMPROVEMENT PROJECTS

Information obtained by coordinating with City officials, field reconnaissance, and performing hydrologic and hydraulic analyses of projected full build-out conditions was used to identify drainage system improvements that are needed to safely collect and convey runoff in the study area. The recommended storm drain pipe improvements for the study area are shown on Figure 2 and are summarized in Table 3. The recommended regional detention basin improvements for the study area are shown on Figure 2 and are summarized in Table 4.

Table 3
Recommended Storm Drain Pipe
Design Criteria

ID	Recommended Deisgn Discharge* (cfs)	Estimated Slope	Manning's 'n'	Existing Diameter (in)	Proposed Diameter (in)	Discharge Capacity (cfs)
Subbasin 11800 South Street						
118S-1	1.6	0.010	0.013	-	18	10.5
Subbasin 12600 South Street						
126S1-1	24.8	0.019	0.013	24	-	31.3
126S2-1	31.8	0.020	0.013	30	-	58.6
126S2-2	14.2	0.020	0.036	36	-	34.4
126S2-3	15.9	0.020	0.013	24	-	32.1
126S2-1	31.8	0.020	0.013	30	-	58.6

Table 3

Recommended Storm Drain Pipe Design Criteria (Continued)

ID	Recommended Deisgn Discharge* (cfs)	Estimated Slope	Manning's 'n'	Existing Diameter (in)	Proposed Diameter (in)	Discharge Capacity (cfs)
Subbasin 13200 South Street						
132S1-1	2.2	0.022	0.013	-	18	15.6
132S1-2	12.6	0.022	0.013	-	18	15.6
Subbasin 13400 South Street						
134S2-1	5.1	0.015	0.013	-	18	12.9
134S3-1	2.9	0.015	0.013	-	18	12.9
134S3-2	33.5	0.002	0.013	-	42	45.1
Subbasin 4000 West Street						
40W1-1	1.4	0.015	0.013	-	18	12.9
40W2-1	8.1	0.005	0.013	-	18	7.4
40W2-2	16.0	0.003	0.013	-	30	20.6
40W2-3	15.9	0.003	0.013	30	-	20.6
40W3-1	28.3	0.004	0.014	42	-	59.2
40W3-2	54.8	0.004	0.013	42	-	63.8
40W4-1	6.9	0.005	0.013	-	18	7.4
Subbasin 4150 West Street						
4150W1-1	2.7	0.010	0.013	-	18	10.5
4150W1-2	16.8	0.005	0.013	-	24	16.0
4150W2-1	5.2	0.005	0.013	-	18	7.4
Subbasin 4570 West Street						
4570W1-1	7.9	0.007	0.015	-	18	7.6
4570W1-2	15.8	0.007	0.013	-	24	19.0
4570W2-1	23.7	0.006	0.013	-	30	31.9
Subbasin Butterfield Property						
BF1-1	31.1	0.011	0.014	-	30	40.1
BF2-1	6.0	0.018	0.015	-	18	12.2
BF3-1	4.4	0.011	0.013	-	18	11.0
BF3-2	2.0	0.005	0.013	-	18	7.4
Subbasin Diversion						
Div-1	22.4	0.005	0.013	-	30	29.1
Subbasin Havest Creek Estates						
HC-1	1.5	0.010	0.013	-	18	10.5
Subbasin Midas Creek Outfall						
MC-1	61.7	0.004	0.013	42	-	62.2

Table 3
Summary of Storm Drain Hydrologic and Hydraulic Analyses Modeling Results
(Continued)

ID	Recommended Deisgn Discharge* (cfs)	Estimated Slope	Manning's 'n'	Existing Diameter (in)	Proposed Diameter (in)	Discharge Capacity (cfs)
Subbasin Property Reserve Inc.						
PRI4-2	51.8	0.007	0.013	-	36	56.0
PRI7-1	32.5	0.002	0.014	-	42	41.9
PRI7-2	32.5	0.002	0.014	-	42	41.9
PRI14-1	5.8	0.022	0.015	-	18	13.5
PRI15-1	7.4	0.007	0.013	-	18	8.8
PRI17-1	5.6	0.005	0.013	-	18	7.4
PRI19-1	82.0	0.009	0.013	-	42	93.0
PRI20-1	86.7	0.008	0.015	-	42	78.2
Subbasin Riverton Boulevard						
RB3-1	63.3	0.009	0.013	-	36	61.7
Subbasin Scenic Cove						
SC-1	18.8	0.005	0.015	-	30	25.2
Subbasin Sunday Drive						
SD1-1	3.2	0.019	0.013	-	18	14.5
SD1-2	9.0	0.019	0.013	-	18	14.5
SD2-1	2.9	0.003	0.015	-	18	5.0
SD2-2	31.9	0.019	0.013	-	30	56.7
SD2-3	36.2	0.022	0.015	-	30	52.9
Subbasin Western Springs						
WS10-1	2	0.005	0.013	-	18	7.4
WS10-2	29.1	0.018	0.013	-	30	55.2

* Recommend design discharge for storm drain pipes is based on the 10-year storm event

Future Pipe
Existing Pipe

Table 4
Recommended Detention Basin
Design Parameters

ID	Volume* (ac-ft)	Outflow (cfs)
DB1	10.4	6
DB2	0.4	2
DB3	-	3.1
DB4	0.4	2.5
DB5	0.7	2.9
DB6	0.3	2.2
DB7	-	2
DB8	1.7	11.7
DB9	5.1	20.2
DB10	7.4	52..5

* Based on the 100 yr storm

CONCEPTUAL COST ESTIMATE

Conceptual cost estimates for the recommended improvements are presented in Table 5 for detention basins and Table 6 for storm drain pipes. Unit costs used in developing the conceptual construction costs are presented in Appendix C. The unit costs for construction were developed in 2010 dollars using information from a variety of sources including recent bids for similar projects, local contractors, and construction estimating guides.

Table 5
Estimated Cost of Capital Improvements
Detention Basins

Project Identifier	Type	Land Area (acres)	Excavation and Hauling (yd^3)	Landscaping (ft^3)	Estimated Project Cost
DB1	Regional	3.5	25,168	151,008	$ 1,814,000
DB2	Local	0.25	968	10,890	$ 274,000
DB3	Existing	-	-	-	-
DB4	Local	0.25	968	10,890	$ 274,000
DB5	Local	0.25	1,694	10,890	$ 287,000
DB6	Local	0.25	726	10,890	$ 270,000
DB7	Existing	-	-	-	-
DB8	Regional	0.6	4,114	24,684	$ 582,000
DB9	Regional	1.7	12,342	74,052	$ 938,000
DB10	Regional	2.5	17,908	107,448	$ 588,000
				Total:	$ 5,027,000

Table 6
Estimated Cost of Capital Improvements
Storm Drain Pipes By Subbasin

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
Subbasin 11800 South Street							
118S-1	Existing Asphalt	1,287	18	8	4	0	$ 253,352
Subbasin 13200 South Street							
132S1-1	Undeveloped	1,110	18	6	3	0	$ 158,748
132S1-2	Undeveloped	1,206	18	8	4	0	$ 182,071
						Subbasin Total	**$ 340,820**
Subbasin 13400 South Street							
134S2-1	Existing Asphalt	1,301	18	8	4	0	$ 255,610
134S3-1	Existing Asphalt	733	18	4	2	0	$ 140,676
134S3-2	Undeveloped	303	42	2	1	0	$ 82,513
						Subbasin Total	**$ 478,799**
Subbasin 4000 West Street							
40W1-1	Existing Asphalt	485	18	4	2	0	$ 101,834
40W2-1	Existing Asphalt	1,190	18	6	3	0	$ 225,278
40W2-2	Existing Asphalt	280	30	2	1	0	$ 70,061
40W4-1	Existing Asphalt	1,217	18	8	4	0	$ 242,423
						Subbasin Total	**$ 639,595**
Subbasin 4150 West Street							
4150W1-1	Undeveloped	837	18	6	3	0	$ 129,231
4150W1-2	Undeveloped	438	24	4	2	0	$ 85,090
4150W2-1	Undeveloped	1,046	18	6	3	0	$ 151,796
						Subbasin Total	**$ 366,117**
Subbasin 4570 West Street							
4570W1-1	Undeveloped	1,024	18	6	3	0	$ 149,472
4570W1-2	Undeveloped	1,027	24	6	3	1	$ 245,066
4570W2-1	Undeveloped	1,265	30	8	4	0	$ 239,726
						Subbasin Total	**$ 634,264**
Subbasin Butterfield Property							
BF1-1	Undeveloped	1,611	30	10	5	0	$ 304,027
BF2-1	Undeveloped	157	18	2	1	0	$ 29,929
BF3-1	Undeveloped	494	18	4	2	0	$ 79,269
BF3-2	Undeveloped	78	18	2	1	0	$ 21,414
						Subbasin Total	**$ 434,639**
Subbasin Diversion							
Div-1	Undeveloped	802.502	30	6	3	0	$ 158,052
Subbasin Havest Creek Estates							
HC-1	Undeveloped	1,102	18	6	3	0	$ 157,922

Table 6
Estimated Cost of Capital Improvements
Storm Drain Pipes By Subbasin
(Continued)

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
Subbasin Property Reserve Inc.							
PRI4-2	Undeveloped	1,233	36	8	4	1	$ 360,711
PRI7-1	Undeveloped	2,473	42	14	7	0	$ 658,345
PRI7-2	Undeveloped	652	42	4	2	0	$ 175,501
PRI14-1	Undeveloped	1,558	18	8	4	0	$ 220,123
PRI15-1	Undeveloped	906	18	6	3	0	$ 136,781
PRI17-1	Undeveloped	1,060	18	3	3	1	$ 209,520
PRI19-1	Undeveloped	1,596	42	8	4	0	$ 418,161
PRI20-1	Undeveloped	301	42	2	1	1	$ 149,454
						Subbasin Total	**$ 2,328,596**
Subbasin Riverton Boulevard							
RB3-1	Undeveloped	1,314	36	8	4	0	$ 309,000
Subbasin Scenic Cove							
SC-1	Undeveloped	885	30	6	3	0	$ 170,304
Subbasin Sunday Drive							
SD1-1	Undeveloped	1,036	18	0	3	0	$ 128,138
SD1-2	Undeveloped	1,055	18	0	3	0	$ 130,101
SD2-1	Existing Asphalt	718	18	4	2	0	$ 138,300
SD2-2	Undeveloped	598	30	4	2	0	$ 114,711
SD2-3	Undeveloped	452	30	4	2	0	$ 93,105
						Subbasin Total	**$ 604,355**
Subbasin Western Springs							
WS10-1	Undeveloped	137	18	2	1	0	$ 27,736
WS10-2	Undeveloped	994	30	6	3	0	$ 186,499
						Subbasin Total	**$ 214,235**
						Storm Drain Pipe Total	**$ 7,090,000**

LIMITATIONS OF MASTER PLAN DATA

This technical memorandum presents information that is intended to be used to plan for the funding and design of needed storm drain facilities in Riverton City. The design discharges associated with the recommended structural improvements are associated with projected full build-out conditions. More detailed analyses and studies should be completed during the design phase of the recommended storm drain projects. Some of the needed projects could be phased to match available funding streams. For example, a detention or retention facility could initially be constructed with a volume smaller than what is recommended if a significant portion of the storm drain collection system in developed parts of the City will not be constructed for some time. In addition, the actual locations of some of the drainage corridors, pipelines, and detention facilities may be changed to better fit conditions not known when this plan was developed.

REFERENCES

Bowen, Collins and Associates, April 2003, 2002 Southwest Canal and Creek Study.

Farmer, E.E., and J.E. Fletcher, February 1972, Rainfall Intensity-Duration-Frequency Relations for the Wasatch Mountains of Northern Utah, Water Resources Research, Vol.8, No. 1.

Hansen, Allen and Luce, Inc., June 2004, Riverton Storm Drainage Master Plan Amendment, West of Bangerter Highway.

U.S. Department of Agriculture, Soil Conservation Service, June 1986, Urban Hydrology for Small Watersheds, Technical Release 55.

APPENDIX A
HYDROLOGIC ANALYSIS

HYDROLOGIC ANALYSIS

A hydrologic computer model of the study area was developed in HEC-HMS (version 3.4), for the purpose of estimating storm water runoff volumes and peak discharges generated by a design cloudburst event. The model development process is outlined in the following general steps, with detailed information on each step provided later in this technical memorandum:

1. Delineate drainage basin and subbasin boundaries in the study area based on topography, parcel maps, aerial photography, existing storm drainage facility information and information from the City.
2. Estimate hydrologic modeling parameters for each subbasin in the study area based on soil type, land use, slope, and other storm water conveyance characteristics.
3. Develop a design precipitation event using local rainfall data.
4. Combine subbasin, channel routing, and storage elements in an integrated hydrologic model for the study area.

Drainage Basin Delineation

Aerial photography, topographic mapping, field observations, an existing storm drainage facility inventory and system knowledge from City employees were used to delineate drainage subbasins in the study area. The revised subbasins for this updated analysis are based on the best available data at this time. Subbasin boundaries for the hydrologic model are shown in Figure A-1.

Hydrologic Modeling Parameters

Loss Method. The SCS Curve Number method was used in the hydrologic model to calculate infiltration losses (see NRCS TR-55 publication for additional information). This method requires the input of a composite Curve Number and the percent impervious for each subbasin. A composite Curve Number was estimated for each subbasin based on soil type and vegetative ground cover. The hydrologic soil type was obtain from the NRCS SSURGO dataset. Table A1 shows the Curve Numbers used in this study based on soil type and as assumed grass cover in developed areas.

Table A1
SCS Curve Number

Soil Type	Curve Number*
A	49
B	69
C	79
D	84

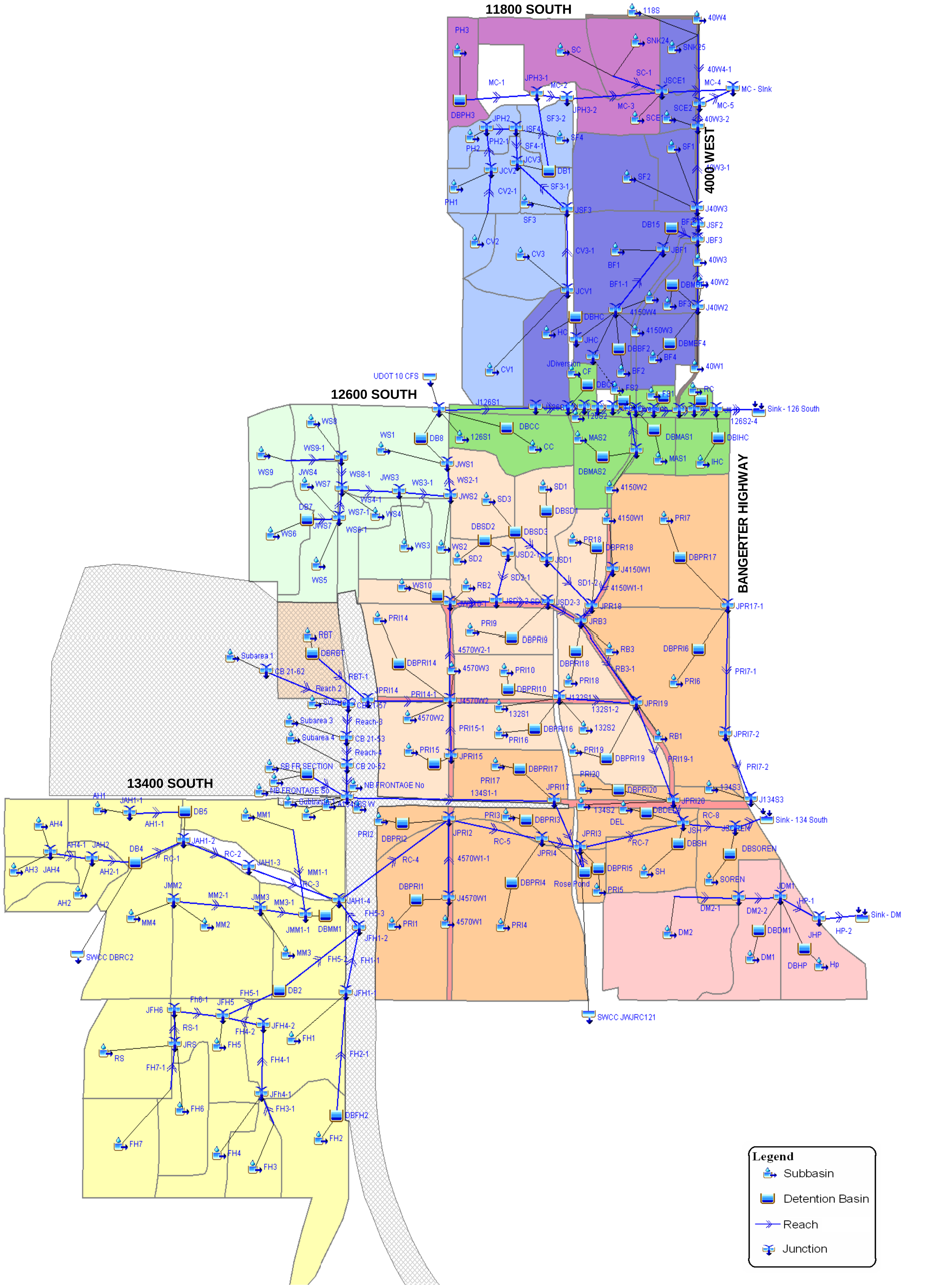

Figure A-1
Hydrologic Model Schematic

Riverton Southwest Area
Storm Drain Master Plan

Rivertion City

* From Table 2-2 in TR-55 "Open Space – Grass Cover 50% to 75%"

The amount of directly-connected impervious area for assumed post-development conditions was estimated using projected full build-out land use conditions. Table A2 shows the percent directly connected impervious used in this study based on land use. See Appendix B for input parameters used in this study.

Table A2
Average Imperviousness Based on Lot Size

Land Use Type	Directly Connected Imperviousness (Percent)
1/5 acre Residential Lot	40%
1/4 acre Residential Lot	35%
1/3 acre Residential Lot	25%
1/2 acre Residential Lot	20%
1 acre Residential Lot	15%
Roadway	90%
Commercial and Business	85%
School	50%

Transform Method. The SCS Unit Hydrograph was used in the hydrologic model to convert rainfall to runoff. This method requires "lag time" as an input parameter. Worksheet 3 in TR-55 was used to estimate the time of concentration. Previous studies have shown that the lag time in urban areas can be approximated as the time of concentration. See Appendix D for Time of Concentration input parameters used in this study.

Routing Method. The Muskingum-Cunge routing method was used in the hydrologic model to compute the effects of routing runoff hydrographs in the computer model. The input parameters for this routing method require the geometry and Manning's "n" of the conveyance facility. A schematic of the modeled drainage subbasin routing is presented in Figure A-1. See Appendix B for input parameters used in this study.

Design Storm

The design storm developed for the 2004 Storm Drain Master Plan was used in this study to analyze the storm drain pipes. Critical characteristics of the design storm are listed below:

Storm Duration: 3 Hours
Storm Distribution: Farmer and Fletcher, Second Quartile
Storm Depth: 1.13 inches

The storm depth is based on a 10-year recurrence interval as shown in the Rainfall Intensity Duration Analysis, Salt Lake County, Utah, (TRC North American Weather Consultants and Metrological Solutions Inc.).

The 100-year design storms developed for the Southwest Canal and Creek Study were used to analyze parameters of existing and proposed detention facilities. Critical characteristics of the detention facility design storms are listed below:

Storm Duration:	3 Hours
Storm Distribution:	Modified Farmer and Fletcher
Storm Depth:	1.77 inches (south valley subbasins) and 1.97 inches (high elevation subbasins)

Hydrologic Modeling Methods

The HEC-1 hydrologic computer model used to develop the 2004 Storm Drain Master Plan. That model was converted into a file so that the newer HEC-HMS computer program could be utilized. Drainage basin and subbasin boundaries in the study area were updated, added or removed to reflect recent proposed land use changes. Subbasins not affected by the proposed land use changes were left in the hydrologic model unchanged.

The hydrologic analysis of the study area was performed using the HEC-HMS software package, version 3.4, developed by the U.S. Army Corps of Engineers (USACE). The model input parameters were assembled as described.

The following standard assumptions were made in completing the hydrologic analysis of the study area:

1. Design Storm return frequency is equal to associated runoff return frequency.

2. Design storm rainfall has a uniform spatial distribution over the watershed.

3. Normal (SCS Type II) antecedent soil moisture conditions exist at the beginning of the design storm.

4. The hydrologic computer model accurately simulates watershed response to precipitation.

5. All storm water runoff generated by the model is conveyed through downstream model elements (the hydrologic model does not account for storm drain inlet or conveyance deficiencies).

APPENDIX B
HYDROLOGIC INPUT PARAMETERS

HEC-HMS MODEL INPUT PARAMETERS

Table B-1
Subbasin Parameters

Subbasin	Curve Number	Percent Impervious	Lag Time (Min.)
118S	77.6	90	6
126S1	84	90	7
126S2	60	90	7
132S1	60	90	9
132S2	60	90	8
134S2	84	90	7
134S3	84	90	5
40W1	84	90	8
40W2	84	90	8
40W3	84	90	8
40W4	84	90	5
4150W1	84	90	10
4150W2	84	90	6
4150W3	60	90	8
4150W4	60	90	6
4570W1	69	90	12
4570W2	84	90	8
4570W3	84	90	8
BF1	84	20	21
BF2	84	40.8	14
BF3	84	20	9
BF4	60	85	10
CC	83.9	15	20
CF	84	35	14
DEL	84	65.2	17
FS1	60	85	8
FS2	84	85	7
IHC	74.9	85	18
MAS1	76.3	85	18
MAS2	81.6	85	19
PRI1	81.2	21	20
PRI10	80.3	85	10
PRI14	79.9	85	19
PRI15	81.1	85	25
PRI16	60	85	10
PRI17	60	85	11
PRI18	84	85	13
PRI19	60	85	16
PRI2	84	25	19
PRI20	60	85	8
PRI3	81.9	52.1	16
PRI4	81.2	46.5	23
PRI5	84	25	17
PRI6	83.5	85	31
PRI7	71.5	85	25
PRI8	73.1	85	13
PRI9	84	85	10
RB1	84	90	15
RB2	84	90	11
RB3	84	90	7
RBT	77.3	20	25
RC	60	90	9
SC	79.6	28.3	20
SCE1	84	25	15
SCE2	84	20	8
SF1	84	20	14
SF2	84	20	23
SH	84	50	17
SNK24	84	20	16
SNK25	84	20	15

Table B-2
Reach Parameters

Name	Length (ft)	Slope	Manning's n	Shape	Diameter (ft)	Width	Side Slope
126S1-1	702	0.019	0.015	Circle	2	-	-
126S1-2	262	0.0275	0.013	Circle	2	-	-
126S2-1	110	0.0203	0.013	Circle	2.5	-	-
126S2-10	328	0.0203	0.013	Circle	2.5	-	-
126S2-2	42	0.005	0.036	Circle	3	-	-
126S2-3	288	0.0199	0.013	Circle	2	-	-
126S2-4	1006	0.01565	0.014	Circle	2	-	-
132S1-2	1180	0.022	0.013	Circle	2	-	-
40W2-1	1230	0.003	0.013	Circle	2.5	-	-
40W2-2	334	0.0025	0.013	Circle	2.5	-	-
40W2-3	220	0.0025	0.015	Circle	2.5	-	-
40W3-1	950	0.004	0.014	Circle	3.5	-	-
40W3-2	396	0.004	0.014	Circle	3.5	-	-
40W4-1	1100	0.005	0.013	Circle	2	-	-
4150W1-1	860	0.01	0.013	Circle	1.5	-	-
4150W1-2	430	0.005	0.013	Circle	2	-	-
4150W2-1	300	0.005	0.013	Circle	1.5	-	-
4570W1-1	1144	0.006	0.015	Circle	1.75	-	-
4570W2-1	1260	0.005	0.013	Circle	3	-	-
AH1-1	183	0.0046	0.015	Circle	3	-	-
AH2-1	203	0.005	0.015	Circle	2	-	-
AH4-1	765	0.0208	0.015	Circle	2	-	-
BF1-1	590	0.018	0.015	Circle	2.25	-	-
BF2-1	196	0.011	0.014	Circle	2	-	-
CF-1	184	0.0147	0.015	Circle	2.5	-	-
CV2-1	505	0.004	0.015	Circle	1.25	-	-
CV3-1	1472	0.005	0.015	Circle	2.5	-	-
DM2-1	828	0.015	0.015	Circle	2.5	-	-
DM2-2	729	0.006	0.015	Circle	3	-	-
FH1-1	213	0.01	0.015	Circle	3	-	-
FH2-1	1168	0.01	0.015	Circle	2.25	-	-
FH3-1	558	0.01	0.015	Circle	4	-	-
FH4-1	923	0.01	0.015	Circle	4	-	-
FH4-2	275	0.01	0.015	Circle	4.5	-	-
FH5-1	96	0.01	0.015	Circle	4.5	-	-
FH5-2	1979	0.03	0.015	Circle	2.5	-	-
FH5-3	1390	0.0224	0.015	Circle	3	-	-
Fh6-1	640	0.04	0.015	Circle	3	-	-
FH7-1	1375	0.01	0.015	Circle	3	-	-
FS1-1	315	0.01	0.014	Circle	2	-	-

Table B-2
Reach Parameters
(Continued)

Name	Length (ft)	Slope	Manning's n	Shape	Diameter (ft)	Width	Side Slope
FS1-2	260	0.018	0.013	Circle	2	-	-
FS1-3	340	0.01565	0.013	Circle	2	-	-
FS2-1	335	0.0166	0.013	Circle	2.5	-	-
HP-1	1309	0.02	0.015	Circle	2.5	-	-
HP-2	648	0.008	0.015	Circle	3	-	-
MC-1	1147	0.01	0.04	Trapezoid	-	4	2
MC-2	351	0.01	0.04	Trapezoid	-	4	2
MC-3	1657	0.01	0.04	Trapezoid	-	4	2
MC-4	1033	0.01	0.04	Trapezoid	-	4	2
MC-5	307	0.0038	0.014	Circle	3.5	-	-
MM1-1	1672	0.01	0.014	Circle	2	-	-
MM2-1	1300	0.02	0.015	Circle	2.5	-	-
MM3-1	1134	0.02	0.015	Circle	3	-	-
MVC2	180	0.005	0.013	Circle	4	-	-
PH1-1	850	0.004	0.015	Circle	1.5	-	-
PH2-1	371	0.005	0.015	Circle	2	-	-
PRI14-1	1550	0.022	0.015	Circle	3	-	-
PRI15-1	800	0.007	0.013	Circle	2	-	-
PRI19-1	1600	0.0085	0.013	Circle	3	-	-
PRI20-1	624	0.008	0.015	Circle	2	-	-
PRI7-1	2800	0.002	0.014	Circle	3.5	-	-
PRI7-2	680	0.002	0.014	Circle	3.5	-	-
RB3-1	1320	0.0085	0.013	Circle	3	-	-
RBT-1	1282	0.02	0.015	Circle	3	-	-
RC-1	808	0.02	0.04	Trapezoid	-	4	2
RC-2	1608	0.02	0.04	Trapezoid	-	4	2
RC-3	1460	0.02	0.04	Trapezoid	-	4	2
RC-4	1813	0.02	0.04	Trapezoid	-	4	2
RC-5	2094	0.02	0.04	Trapezoid	-	4	2
RC-6	524	0.02	0.04	Trapezoid	-	4	2
RC-7	1503	0.02	0.04	Trapezoid	-	4	2
RC-8	1198	0.02	0.04	Trapezoid	-	4	2
RC-9	498	0.02	0.04	Trapezoid	-	4	2
RS-1	434	0.042	0.015	Circle	2.5	-	-
SC-1	1207	0.005	0.015	Circle	1.5	-	-
SD1-1	1030	0.019	0.013	Circle	2	-	-
SD1-2	1050	0.019	0.013	Circle	2.5	-	-
SD2-1	963	0.003	0.015	Circle	1.5	-	-

Table B-2
Reach Parameters
(Continued)

Name	Length (ft)	Slope	Manning's n	Shape	Diameter (ft)	Width	Side Slope
SD2-2	680	0.019	0.013	Circle	3	-	-
SD2-3	1050	0.022	0.015	Circle	3.5	-	-
SF3-1	531	0.005	0.015	Circle	3	-	-
SF3-2	419	0.02	0.015	Circle	2	-	-
SF4-1	122	0.005	0.015	Circle	2	-	-
WS10-1	1024	0.018	0.013	Circle	3	-	-
WS2-1	185	0.005	0.015	Circle	2.5	-	-
WS3-1	345	0.0288	0.015	Circle	2.5	-	-
WS4-1	630	0.0288	0.015	Circle	2.5	-	-
WS6-1	482	0.0383	0.015	Circle	1.5	-	-
WS7-1	1005	0.0075	0.014	Circle	2	-	-
WS8-1	1239	0.0066	0.014	Circle	2	-	-
WS9-1	733	0.0276	0.015	Circle	1.5	-	-

HEC-HMS MODEL DESIGN STORMS

Table B-3
3-Hour, 10-Year Farmer Fletcher
Second Quartile Design Storm

Time	Precipitation (inches)
0:00	0
0:03	0
0:06	0
0:09	0.00226
0:12	0.00226
0:15	0.00226
0:18	0.00226
0:21	0.00226
0:24	0.00226
0:27	0.00339
0:30	0.00339
0:33	0.00452
0:36	0.00565
0:39	0.00904
0:42	0.01017
0:45	0.01017
0:48	0.01469
0:51	0.01921
0:54	0.0226
0:57	0.02712
1:00	0.03277
1:03	0.03729
1:06	0.03842
1:09	0.03955
1:12	0.04294
1:15	0.04407
1:18	0.05085
1:21	0.05876
1:24	0.06102
1:27	0.06102
1:30	0.06102

Time	Precipitation (inches)
1:33	0.05876
1:36	0.05085
1:39	0.0452
1:42	0.03955
1:45	0.0339
1:48	0.02486
1:51	0.0226
1:54	0.02034
1:57	0.01808
2:00	0.01582
2:03	0.01356
2:06	0.01243
2:09	0.0113
2:12	0.01017
2:15	0.01017
2:18	0.00904
2:21	0.00678
2:24	0.00678
2:27	0.00565
2:30	0.00565
2:33	0.00565
2:36	0.00565
2:39	0.00452
2:42	0.00452
2:45	0.00452
2:48	0.00339
2:51	0.00339
2:54	0.00226
2:57	0.00226
3:00	0.00113
Total:	**1.13**

Table B-4
3-Hour, 100-Year
Modified Farmer Fletcher
Valley South

Time	Precipitation (inches)
0:00	0
0:15	0.04
0:30	0.04
0:45	0.96
1:00	0.3
1:15	0.12
1:30	0.07
1:45	0.04
2:00	0.04
2:15	0.04
2:30	0.04
2:45	0.04
3:00	0.04
Total:	**1.77**

Table B-5
3-Hour, 100-Year
Modified Farmer Fletcher
High Elevation

Time	Precipitation (inches)
0:00	0
0:15	0.06
0:30	0.06
0:45	0.99
1:00	0.31
1:15	0.12
1:30	0.07
1:45	0.06
2:00	0.06
2:15	0.06
2:30	0.06
2:45	0.06
3:00	0.06
Total:	**1.97**

APPENDIX C
CONCEPTUAL COST ESTIMATE DATA

Table C-1
Conceptual Cost Estimate Unit Cost Summary

Description	Unit	Unit Cost
Detention Basins		
Excavation and Hauling	Cubic Yard	$13
Regional Detention Basins (1)		
Property Acquisition	Acre	$260,000
Landscaping (Non-irrigated Native)	Square Foot	$0.30
Inlet Apron	Lump Sum	$15,000
Outlet Structure	Lump Sum	$50,000
Emergency Spillway	Lump Sum	$5,000
Local Detention Basins (2)		
Property Acquisition	Quarter Acre Lot	$150,000
Landscaping (Irrigated Turfgrass)	Square Foot	$2.60
Inlet/Outlet Structure	Lump Sum	$12,000
Storm Drain Pipelines		
18-inch RCP (3)	Linear Foot	$100
18-inch RCP (4)	Linear Foot	$80
24-inch RCP (3)	Linear Foot	$125
24-inch RCP (4)	Linear Foot	$100
30-inch RCP (3)	Linear Foot	$135
30-inch RCP (4)	Linear Foot	$110
36-inch RCP (3)	Linear Foot	$170
36-inch RCP (4)	Linear Foot	$145
42-inch RCP (3)	Linear Foot	$195
42-inch RCP (4)	Linear Foot	$170
48-inch RCP (3)	Linear Foot	$240
48-inch RCP (4)	Linear Foot	$215
Manhole	Each	$4,000
Catch Basin	Each	$2,800
Traffic Control	Linear Foot	$16
Other		
Contingency	25 Percent of Construction Cost	
Engineering, Legal, and Administration	15 Percent of Construction Cost w/ Contingency	

(1) - All regional detention basins include an inlet apron, an outlet structure, an emergency spillway, non-irrigated native landscaping, and the property values assuming the land is undeveloped.

(2) - All local detention basins include a combination inlet/outlet structure, irrigated turfgrass landscaping, and property values assuming the land is developed.

(3) - Includes trenching, installation, backfill, and asphalt surface restoration.

(4) - Includes trenching, installation, and backfill w/out asphalt surface restoration

Table C-2
Estimated Cost of Capital Improvements

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
Subbasin 11800 South Street							
118S-1	Existing Asphalt	1287	18	8	4		$ 253,352
Subbasin 13200 South Street							
132S1-1	Undeveloped	1110	18	6	3		$ 158,748
132S1-2	Undeveloped	1206	18	8	4		$ 182,071
						Subbasin Total	**$ 340,820**
Subbasin 13400 South Street							
134S2-1	Existing Asphalt	1301	18	8	4		$ 255,610
134S3-1	Existing Asphalt	733	18	4	2		$ 140,676
134S3-2	Undeveloped	303	42	2	1		$ 82,513
						Subbasin Total	**$ 478,799**
Subbasin 4000 West Street							
40W1-1	Existing Asphalt	485	18	4	2		$ 101,834
40W2-1	Existing Asphalt	1190	18	6	3		$ 225,278
40W2-2	Existing Asphalt	280	30	2	1		$ 70,061
40W4-1	Existing Asphalt	1217	18	8	4		$ 242,423
						Subbasin Total	**$ 639,595**
Subbasin 4150 West Street							
4150W1-1	Undeveloped	837	18	6	3		$ 129,231
4150W1-2	Undeveloped	438	24	4	2		$ 85,090
4150W2-1	Undeveloped	1046	18	6	3		$ 151,796
						Subbasin Total	**$ 366,117**
Subbasin 4570 West Street							
4570W1-1	Undeveloped	1024	18	6	3		$ 149,472
4570W1-2	Undeveloped	1027	24	6	3	1	$ 245,066
4570W2-1	Undeveloped	1265	30	8	4		$ 239,726
						Subbasin Total	**$ 634,264**

Table C-2
Estimated Cost of Capital Improvements
(Continued)

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)		Estimated Project Cost
Subbasin Butterfield Property								
BF1-1	Undeveloped	1611	30	10	5		$	304,027
BF2-1	Undeveloped	157	18	2	1		$	29,929
BF3-1	Undeveloped	494	18	4	2		$	79,269
BF3-2	Undeveloped	78	18	2	1		$	21,414
DB1: 10.4 ac-ft Detention Basin								
Excavation and Hauling					25,168	Cubic Yards	$	327,184
Landscaping (Non-irrigated Native)					######	Square Feet	$	45,302
Inlet Apron					1	-		15,000
Outlet Structure					1	-		50,000
Emergency Spillway					1	-		5,000
Land acquisition					3.5	acre	$	901,333
Eng, Legal, Admin, Conting (35%)							$	470,337
							$	**1,814,157**
DB2: .4 ac-ft Detention Basin								
Excavation and Hauling					968	Cubic Yards	$	12,584
Landscaping (Irrigated Turfgrass)					10,890	Square Feet	$	28,314
Inlet/Outlet Structure					1	-	$	12,000
Land acquisition					0.2	acre	$	150,000
Eng, Legal, Admin, Conting (35%)							$	71,014
							$	**273,912**
						Subbasin Total	**$**	**2,522,708**
Subbasin Diversion								
Div-1	Undeveloped	803	30	6	3		$	158,052
Subbasin Havest Creek Estates								
HC-1	Undeveloped	1102	18	6	3		$	157,922

Table C-2
Estimated Cost of Capital Improvements
(Continued)

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
Subbasin Property Reserve Inc.							
PRI4-2	Undeveloped	1233	36	8	4	1	$ 360,711
PRI7-1	Undeveloped	2473	42	14	7		$ 658,345
PRI7-2	Undeveloped	652	42	4	2		$ 175,501
PRI14-1	Undeveloped	1558	18	8	4		$ 220,123
PRI15-1	Undeveloped	906	18	6	3		$ 136,781
PRI17-1	Undeveloped	1060	18	3	3	1	$ 209,520
PRI19-1	Undeveloped	1596	42	8	4		$ 418,161
PRI20-1	Undeveloped	301	42	2	1	1	$ 149,454
DB8: 1.7 ac-ft Detention Basin							
Excavation and Hauling					4,114	Cubic Yards	$ 53,482
Landscaping (Non-irrigated Native)					24,684	Square Feet	$ 7,405
Inlet Apron					1	-	15,000
Outlet Structure					1	-	50,000
Emergency Spillway					1	-	5,000
Land acquisition					0.6	acre	$ 300,000
Eng, Legal, Admin, Conting (35%)							$ 150,811
							$ 581,698
DB9: 5.1 ac-ft Detention Basin							
Excavation and Hauling					12,342	Cubic Yards	$ 160,446
Landscaping (Non-irrigated Native)					74,052	Square Feet	$ 22,216
Inlet Apron					1	-	15,000
Outlet Structure					1	-	50,000
Emergency Spillway					1	-	5,000
Land acquisition					1.7	acre	$ 442,000
Eng, Legal, Admin, Conting (35%)							$ 243,132
							$ 937,793

Table C-2
Estimated Cost of Capital Improvements
(Continued)

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
DB10: 7.4 ac-ft Detention Basin							
Excavation and Hauling					17,908	Cubic Yards	$ 232,804
Landscaping (Non-irrigated Native)					######	Square Feet	$ 32,234
Inlet Apron					1	-	15,000
Outlet Structure					1	-	50,000
Emergency Spillway					1	-	5,000
Land acquisition					2.5	acre	$ 641,333
Eng, Legal, Admin, Conting (35%)							$ 341,730
Total DB10 cost							**$ 1,318,102**
Riverton Portion of DB10 Cost (based on volume)					44.6	%	**$ 587,802**
						Subbasin Total	**$ 4,435,889**
Subbasin Riverton Boulevard							
RB3-1	Undeveloped	1314	36	8	4		$ 309,000
Subbasin Scenic Cove							
SC-1	Undeveloped	885	30	6	3		$ 170,304
Subbasin Sunday Drive							
SD1-1	Undeveloped	1036	18	0	3		$ 128,138
SD1-2	Undeveloped	1055	18	0	3		$ 130,101
SD2-1	Existing Asphalt	718	18	4	2		$ 138,300
SD2-2	Undeveloped	598	30	4	2		$ 114,711
SD2-3	Undeveloped	452	30	4	2		$ 93,105
DB4: .4 ac-ft Detention Basin							
Excavation and Hauling					968	Cubic Yards	$ 12,584
Landscaping (Irrigated Turfgrass)					10,890	Square Feet	$ 28,314
Inlet/Outlet Structure					1	-	$ 12,000
Land acquisition					0.20	acre	$ 150,000
Eng, Legal, Admin, Conting (35%)							$ 71,014
							$ 273,912

Table C-2
Estimated Cost of Capital Improvements
(Continued)

Project Identifier	Surface Condition	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Outlet Works (EA)	Estimated Project Cost
DB5: .7 ac-ft Detention Basin							
Excavation and Hauling					1,694	Cubic Yards	$ 22,022
Landscaping (Irrigated Turfgrass)					10,890	Square Feet	$ 28,314
Inlet/Outlet Structure					1	-	$ 12,000
Land acquisition					0.23	acre	$ 150,000
Eng, Legal, Admin, Conting (35%)							$ 74,318
							$ 286,654
DB6: .3 ac-ft Detention Basin							
Excavation and Hauling					726	Cubic Yards	$ 9,438
Landscaping (Irrigated Turfgrass)					10,890	Square Feet	$ 28,314
Inlet/Outlet Structure					1	-	$ 12,000
Land acquisition					0.15	acre	$ 150,000
Eng, Legal, Admin, Conting (35%)							$ 69,913
							$ 269,665
						Subbasin Total	**$ 1,434,587**
Subbasin Western Springs							
WS10-1	Undeveloped	137	18	2	1		$ 27,736
WS10-2	Undeveloped	994	30	6	3		$ 186,499
						Subbasin Total	**$ 214,235**
						Total	**$ 12,116,000**

APPENDIX D
TIME OF CONCENTRATION WORKSHEETS

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 40W1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L $\leq$ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.003			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.4			
18. Flow length, L ... ft	770			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 40W2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)				
Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+	=	0.01

Shallow Concetrated Flow				
Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	=	0.06

Channel Flow				
Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.003			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.4			
18. Flow length, L ... ft	770			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	=	0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan — Designed By: K. Ballentine — Date: 3/9/10

Location: Riverton, Utah — Checked By: M. Stayner — Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 40W3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+	=	0.01

Shallow Concetrated Flow

		Segment ID			
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

Channel Flow

		Segment ID			
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.005			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	4.4			
18. Flow length, L	ft	1,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 40W4

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

Shallow Concetrated Flow	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.020			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	8.8			
18. Flow length, L ... ft	900			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.03	+		= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.08**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan — Designed By: K. Ballentine — Date: 3/9/10

Location: Riverton, Utah — Checked By: M. Stayner — Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 118S

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	1		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+	= 0.01

Shallow Concetrated Flow

Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	300		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+	= 0.04

Channel Flow

Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1		
13. Wetted perimeter, P_w ... ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5		
15. Channel Slope, s ... ft/ft	0.020		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	8.8		
18. Flow length, L ... ft	1,350		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+	= 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.10**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 126S1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.01	+		= 0.01

Shallow Concetrated Flow

		Segment ID			
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	300			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.04	+		= 0.04

Channel Flow

		Segment ID			
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.020			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\ r^{2/3} s^{1/2}}{n}$ Compute V	ft/s	8.8			
18. Flow length, L	ft	2,100			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.07	+		= 0.07

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.12

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan — Designed By: K. Ballentine — Date: 3/9/10

Location: Riverton, Utah — Checked By: M. Stayner — Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 126S2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+		= 0.01

Shallow Concetrated Flow

		Segment ID			
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+		= 0.06

Channel Flow

		Segment ID			
12. Cross sectional flow area, a	ft^2	1.8			
13. Wetted perimeter, P_w	ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4			
15. Channel Slope, s	ft/ft	0.020			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	7.3			
18. Flow length, L	ft	1,400			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.05	+		= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.12

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 132S1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

<u>Shallow Concetrated Flow</u>

	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

<u>Channel Flow</u>

	Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8			
13. Wetted perimeter, P_w ... ft	4.8			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	3.6			
18. Flow length, L ... ft	1,100			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.08	+		= 0.08

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.15**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 132S2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	1		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+	= 0.01

Shallow Concetrated Flow

Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	400		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	= 0.06

Channel Flow

Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8		
13. Wetted perimeter, P_w ... ft	4.8		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4		
15. Channel Slope, s ... ft/ft	0.005		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6		
18. Flow length, L ... ft	800		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 134S2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)				
Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

Shallow Concetrated Flow				
Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow				
Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	6.2			
18. Flow length, L ... ft	1,400			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.12

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 134S3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID	Segment ID		
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.01	+		= 0.01

Shallow Concetrated Flow

		Segment ID	Segment ID		
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	300			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+		= 0.04

Channel Flow

		Segment ID	Segment ID		
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.010			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	6.2			
18. Flow length, L	ft	700			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+		= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.09**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4150W1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Unit	Segment ID			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+		= 0.01

Shallow Concetrated Flow	Unit	Segment ID			
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+		= 0.06

Channel Flow	Unit	Segment ID			
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.010			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	6.3			
18. Flow length, L	ft	2,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.09	+		= 0.09

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.16

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4150W2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)		Segment 1	Segment 2	Total
Segment ID				
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L $\leq$ 100 ft)	ft	1		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+	= 0.01

Shallow Concetrated Flow		Segment 1	Segment 2	Total
Segment ID				
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow		Segment 1	Segment 2	Total
Segment ID				
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.010		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	6.3		
18. Flow length, L	ft	1,050		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.05	+	= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.10**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan — Designed By: K. Ballentine — Date: 3/9/10

Location: Riverton, Utah — Checked By: M. Stayner — Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4150W3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L $\leq$ 100 ft) ... ft	1		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.01	+	= 0.01

Shallow Concetrated Flow

Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	400		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	= 0.06

Channel Flow

Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8		
13. Wetted perimeter, P_w ... ft	4.8		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4		
15. Channel Slope, s ... ft/ft	0.005		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	3.6		
18. Flow length, L ... ft	800		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4570W1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment 1		Segment 2		Total
Segment ID						
1. Surface description (Table 3-1)		Dense Grass				
2. Manning's roughness coeff., n (Table 3-1)		0.24				
3. Flow length, L (total L ≤ 100 ft)	ft	1				
4. Two-year 24-hour rainfall, P_2	in	1.3				
5. Land slope, s	ft/ft	0.010				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+		=	0.01

Shallow Concetrated Flow

		Segment 1		Segment 2		Total
Segment ID						
7. Surface description (paved or unpaved)		Paved				
8. Flow length, L	ft	400				
9. Watercourse slope, s	ft/ft	0.010				
10. Average velocity, V (Figure 3-1)	ft/s	2.0				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+		=	0.06

Channel Flow

		Segment 1		Segment 2		Total
Segment ID						
12. Cross sectional flow area, a	ft^2	3.1				
13. Wetted perimeter, P_w	ft	6.3				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5				
15. Channel Slope, s	ft/ft	0.005				
16. Manning's Roughness Coeff., n		0.02				
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	4.4				
18. Flow length, L	ft	2,100				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.13	+		=	0.13

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.20**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4570W2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment 1	Segment 2	Total
	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	1		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.01	+	= 0.01

Shallow Concetrated Flow

		Segment 1	Segment 2	Total
	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

		Segment 1	Segment 2	Total
	Segment ID			
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	3.7		
18. Flow length, L	ft	800		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4570W3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment 1	Segment 2	Total
Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	1		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+	= 0.01

Shallow Concetrated Flow	Segment 1	Segment 2	Total
Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	400		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+	= 0.06

Channel Flow	Segment 1	Segment 2	Total
Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8		
13. Wetted perimeter, P_w ... ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4		
15. Channel Slope, s ... ft/ft	0.005		
16. Manning's Roughness Coeff., n ...	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.7		
18. Flow length, L ... ft	900		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.07	+	= 0.07

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.14

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea 4150W4

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n ...	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	6.2			
18. Flow length, L ... ft	1,100			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.05	+		= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.10**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea BF1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	1,600		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.10	+	= 0.10

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr 0.35

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea BF2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

	Segment 1	Segment 2	Total
Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	30		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.020		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.14	+	= 0.14

<u>Shallow Concetrated Flow</u>

	Segment 1	Segment 2	Total
Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	300		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+	= 0.04

<u>Channel Flow</u>

	Segment 1	Segment 2	Total
Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1		
13. Wetted perimeter, P_w ... ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5		
15. Channel Slope, s ... ft/ft	0.010		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	6.2		
18. Flow length, L ... ft	900		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+	= 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.23**

U.S. Department of Agriculture
Natural Resources Conservation Service

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea BF3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID	Segment ID	
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L $\leq$ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

		Segment ID	Segment ID	
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow

		Segment ID	Segment ID	
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	3.7		
18. Flow length, L	ft	400		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+	= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.15

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea BF4

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID	Segment ID	
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L $\leq$ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

		Segment ID	Segment ID	
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

		Segment ID	Segment ID	
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	3.7		
18. Flow length, L	ft	500		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr **0.17**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea CC

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	525			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.07	+		= 0.07

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	1,100			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.07	+		= 0.07

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.33

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea CF

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment 1	Segment 2	Total
Segment ID				
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

Shallow Concetrated Flow

		Segment 1	Segment 2	Total
Segment ID				
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	100		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.01	+	= 0.01

Channel Flow

		Segment 1	Segment 2	Total
Segment ID				
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.010		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	5.2		
18. Flow length, L	ft	500		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+	= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr 0.23

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/09

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea DEL

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	30		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+	= 0.19

Shallow Concetrated Flow

Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	700		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.10	+	= 0.10

Channel Flow

Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8		
13. Wetted perimeter, P_w ... ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4		
15. Channel Slope, s ... ft/ft	0.005		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6		
18. Flow length, L ... ft	0		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.29**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea FS1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	300		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.02	+	= 0.02

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr **0.14**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea FS2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

<u>Shallow Concetrated Flow</u>

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	100		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.01	+	= 0.01

<u>Channel Flow</u>

	Segment ID			
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	3.7		
18. Flow length, L	ft	200		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.02	+	= 0.02

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.11

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Natural Resources Conservation Service

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TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea IHC

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID				
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L $\leq$ 100 ft)	ft	30			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.19	+	=	0.19

Shallow Concetrated Flow	Segment ID				
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600 V}$ Compute T_t	hr	0.06	+	=	0.06

Channel Flow	Segment ID				
12. Cross sectional flow area, a	ft^2	1.8			
13. Wetted perimeter, P_w	ft	4.8			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4			
15. Channel Slope, s	ft/ft	0.005			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s	3.6			
18. Flow length, L	ft	700			
19. $T_t = \frac{L}{3600 V}$ Compute T_t	hr	0.05	+	=	0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.30**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea MAS1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	800			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.05	+		= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.30**

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Natural Resources Conservation Service

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TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea MAS2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Item	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Item	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Item	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	1,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.31**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/09

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/09

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

		Segment ID	Segment ID	
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

<u>Shallow Concetrated Flow</u>

		Segment ID	Segment ID	
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

<u>Channel Flow</u>

		Segment ID	Segment ID	
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.010		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	5.2		
18. Flow length, L	ft	1,900		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.10	+	= 0.10

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.35**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)			
Segment ID			
1. Surface description (Table 3-1)	Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow length, L (total L ≤ 100 ft) ... ft	30		
4. Two-year 24-hour rainfall, P_2 ... in	1.3		
5. Land slope, s ... ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+	= 0.19

Shallow Concetrated Flow			
Segment ID			
7. Surface description (paved or unpaved)	Paved		
8. Flow length, L ... ft	900		
9. Watercourse slope, s ... ft/ft	0.010		
10. Average velocity, V (Figure 3-1) ... ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.13	+	= 0.13

Channel Flow			
Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8		
13. Wetted perimeter, P_w ... ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4		
15. Channel Slope, s ... ft/ft	0.005		
16. Manning's Roughness Coeff., n	0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6		
18. Flow length, L ... ft	0		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.31

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/09

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/09

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

		Segment ID	Segment ID	
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

<u>Shallow Concetrated Flow</u>

		Segment ID	Segment ID	
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	570		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.08	+	= 0.08

<u>Channel Flow</u>

		Segment ID	Segment ID	
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	3.6		
18. Flow length, L	ft	0		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.27**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/09

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI4

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)				
Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow				
Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow				
Segment ID				
12. Cross sectional flow area, a ... ft^2	1.8			
13. Wetted perimeter, P_w ... ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6			
18. Flow length, L ... ft	1,800			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.14	+		= 0.14

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.38**

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06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan　Designed By: K. Ballentine　Date: 3/9/09

Location: Riverton, Utah　Checked By: M. Stayner　Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI5

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	700			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.10	+		= 0.10

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	1.8			
13. Wetted perimeter, P_w ... ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6			
18. Flow length, L ... ft	0			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.29**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI6

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

<u>Shallow Concetrated Flow</u>

	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

<u>Channel Flow</u>

	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.004			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.9			
18. Flow length, L ... ft	3,800			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.27	+		= 0.27

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.51**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI8

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Units	Segment 1	Segment 2	Total
Segment ID				
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.020		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.14	+	= 0.14

Shallow Concetrated Flow

	Units	Segment 1	Segment 2	Total
Segment ID				
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow

	Units	Segment 1	Segment 2	Total
Segment ID				
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	400		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.03	+	= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.21

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI9

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	10			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \dfrac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.08	+		= 0.08

Shallow Concetrated Flow

		Segment ID			
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	300			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \dfrac{L}{3600\,V}$ Compute T_t	hr	0.04	+		= 0.04

Channel Flow

		Segment ID			
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \dfrac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.010			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \dfrac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	6.2			
18. Flow length, L	ft	1,100			
19. $T_t = \dfrac{L}{3600\,V}$ Compute T_t	hr	0.05	+		= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.17

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI10

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.010		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	6.2		
18. Flow length, L	ft	1,200		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.05	+	= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.17**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI14

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID	Segment ID	
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

		Segment ID	Segment ID	
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

		Segment ID	Segment ID	
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.7		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	3.6		
18. Flow length, L	ft	2,300		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.18	+	= 0.18

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.31**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI15

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment ID	Segment ID		
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L $\leq$ 100 ft)	ft	30			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.19	+	=	0.19

Shallow Concetrated Flow

		Segment ID	Segment ID		
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

Channel Flow

		Segment ID	Segment ID		
12. Cross sectional flow area, a	ft^2	1.8			
13. Wetted perimeter, P_w	ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4			
15. Channel Slope, s	ft/ft	0.005			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	3.6			
18. Flow length, L	ft	2,100			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.16	+	=	0.16

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.41

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI16

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	10			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.08	+		= 0.08

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	6.3			
18. Flow length, L ... ft	1,200			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.05	+		= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.17**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI17

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	10		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.08	+	= 0.08

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.010		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	6.2		
18. Flow length, L	ft	1,300		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr 0.19

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TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI18

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.020			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.14	+		= 0.14

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	6.2			
18. Flow length, L ... ft	600			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.03	+		= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.21**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI19

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	10			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.08	+		= 0.08

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	6.3			
18. Flow length, L ... ft	900			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.16**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea PRI20

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	10			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.08	+		= 0.08

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.010			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	6.3			
18. Flow length, L ... ft	0			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea RB1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	1		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.01	+	= 0.01

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.005		
10. Average velocity, V (Figure 3-1)	ft/s	1.5		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.07	+	= 0.07

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2	1.8		
13. Wetted perimeter, P_w	ft	4.8		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.4		
15. Channel Slope, s	ft/ft	0.003		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	2.8		
18. Flow length, L	ft	1,600		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.16	+	= 0.16

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ..... hr 0.25

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea RB2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L $\leq$ 100 ft) ... ft	1			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.01	+		= 0.01

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	1.8			
13. Wetted perimeter, P_w ... ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	3.7			
18. Flow length, L ... ft	1,600			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.12	+		= 0.12

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.19

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea RB3

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

<u>Sheet Flow</u> (Applicable to T_c only)

		Segment ID	Segment ID		
1. Surface description (Table 3-1)		Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)		0.24			
3. Flow length, L (total L ≤ 100 ft)	ft	1			
4. Two-year 24-hour rainfall, P_2	in	1.3			
5. Land slope, s	ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.01	+	=	0.01

<u>Shallow Concetrated Flow</u>

		Segment ID	Segment ID		
7. Surface description (paved or unpaved)		Paved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.010			
10. Average velocity, V (Figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	=	0.06

<u>Channel Flow</u>

		Segment ID	Segment ID		
12. Cross sectional flow area, a	ft^2	3.1			
13. Wetted perimeter, P_w	ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5			
15. Channel Slope, s	ft/ft	0.010			
16. Manning's Roughness Coeff., n		0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	6.3			
18. Flow length, L	ft	1,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	=	0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.11

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea RBT

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	1,000			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.14	+		= 0.14

Channel Flow

	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	1,200			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.08	+		= 0.08

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.41

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/10

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea RC

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	10			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.08	+		= 0.08

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	300			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.04	+		= 0.04

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	500			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.03	+		= 0.03

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.15

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SC

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			Total
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

Shallow Concetrated Flow

	Segment ID			Total
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	600		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.08	+	= 0.08

Channel Flow

	Segment ID			Total
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	1,000		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.34**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan　Designed By: K. Ballentine　Date: 3/9/10

Location: Riverton, Utah　Checked By: M. Stayner　Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SCE1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

		Segment 1	Segment 2	Total
Segment ID				
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L ≤ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.020		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.14	+	= 0.14

Shallow Concetrated Flow

		Segment 1	Segment 2	Total
Segment ID				
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	400		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+	= 0.06

Channel Flow

		Segment 1	Segment 2	Total
Segment ID				
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	800		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.05	+	= 0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr　0.25

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan — Designed By: K. Ballentine — Date: 3/9/10

Location: Riverton, Utah — Checked By: M. Stayner — Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SCE2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Item	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	10			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.020			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.06	+		= 0.06

Shallow Concetrated Flow

Item	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	500			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.07	+		= 0.07

Channel Flow

Item	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	0			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.13**

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan | Designed By: K. Ballentine | Date: 3/9/10

Location: Riverton, Utah | Checked By: M. Stayner | Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SF1

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	200			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.03	+		= 0.03

Channel Flow

	Segment ID			
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	300			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.02	+		= 0.02

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.24

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SF2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	2,100			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.13	+		= 0.13

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr 0.38

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan Designed By: K. Ballentine Date: 3/9/09

Location: Riverton, Utah Checked By: M. Stayner Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SH

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Item	Segment ID			
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.19	+		= 0.19

Shallow Concetrated Flow

Item	Segment ID			
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	650			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.09	+		= 0.09

Channel Flow

Item	Segment ID			
12. Cross sectional flow area, a ... ft^2	1.8			
13. Wetted perimeter, P_w ... ft	4.7			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.4			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	3.6			
18. Flow length, L ... ft	0			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr **0.28**

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06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan　Designed By: K. Ballentine　Date: 3/9/10

Location: Riverton, Utah　Checked By: M. Stayner　Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SNK24

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)	Dense Grass			
2. Manning's roughness coeff., n (Table 3-1)	0.24			
3. Flow length, L (total L ≤ 100 ft) ... ft	30			
4. Two-year 24-hour rainfall, P_2 ... in	1.3			
5. Land slope, s ... ft/ft	0.020			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr	0.14	+		= 0.14

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)	Paved			
8. Flow length, L ... ft	400			
9. Watercourse slope, s ... ft/ft	0.010			
10. Average velocity, V (Figure 3-1) ... ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2	3.1			
13. Wetted perimeter, P_w ... ft	6.3			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft	0.5			
15. Channel Slope, s ... ft/ft	0.005			
16. Manning's Roughness Coeff., n ...	0.02			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	4.4			
18. Flow length, L ... ft	1,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr	0.06	+		= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr　0.26

U.S. Department of Agriculture
Natural Resources Conservation Service

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06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Riverton Storm Drain Master Plan   Designed By: K. Ballentine   Date: 3/9/10

Location: Riverton, Utah   Checked By: M. Stayner   Date: 3/9/10

Check one: Present ✓ Developed

Check one: ✓ T_c T_t through subarea SNK25

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID			
1. Surface description (Table 3-1)		Dense Grass		
2. Manning's roughness coeff., n (Table 3-1)		0.24		
3. Flow length, L (total L $\leq$ 100 ft)	ft	30		
4. Two-year 24-hour rainfall, P_2	in	1.3		
5. Land slope, s	ft/ft	0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	0.19	+	= 0.19

Shallow Concetrated Flow

	Segment ID			
7. Surface description (paved or unpaved)		Paved		
8. Flow length, L	ft	300		
9. Watercourse slope, s	ft/ft	0.010		
10. Average velocity, V (Figure 3-1)	ft/s	2.0		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	+	= 0.04

Channel Flow

	Segment ID			
12. Cross sectional flow area, a	ft^2	3.1		
13. Wetted perimeter, P_w	ft	6.3		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.5		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coeff., n		0.02		
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s	4.4		
18. Flow length, L	ft	300		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.02	+	= 0.02

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 .... hr 0.25