

Advanced Engineering & Surveying, Inc.

3421 West Main Street • Rapid City, SD 57702

Phone: 605.718.8825 • Fax: 605.718.8837 • E-mail: advancedeng@rushmore.com

April 27, 2010

City of Rapid City
300 6th Street
Rapid City, SD 57701

Attn: Ali DeMersseman

Re: Additional Drainage Data (No. 10PD019)
Early FDN Child Care
1123 Kansas City Street

RECEIVED

APR 27 2010

Rapid City Growth
Management Department

Dear Ali,

Hopefully the attached data will allow approval of the drainage data.

Enclosed are the increased flows due to alley being paved vs. gravel (today). I calculate the increased flows to be 0.13 cfs.

I have calculated the two (2) drainage areas historical flow and 100 year event flow and required storage capacity above the historical with metering off site at the historical flow.

Area 1 – Porous Landscape

The required storage is 470 cft. The 6" PVC pipe meters the outflow at the historical rate of 0.72 cfs. The treated flow is being outlet to the Kansas City Street gutter line.

I have accommodated 312.5 cft of storage in the northeast corner of the parking lot utilizing existing contours and the 6" curb. This will drain to the porous landscape area and be filtered.

The landscape area accommodates 169.5 cft of storage, 0.85 deep. This total exceeds the required 470 cft storage needed.

The landscape area is detailed in Sheet C 2.0.

Area 2 – Grass Buffer

The historical flow is 0.72 cfs and the 100 year developed flows requires storage capacity of 391 cfs.

10PD019

I have designed a "V" grass channel from the downspout north along the west side of the building. This channel is 8" deep at the center and accommodates 400 cft of storage.

The under drain will collect the treated water and outlets it to the gutter line on Kansas City Street the outlet pipe will allow outlet flows at the historical rate of 0.72 cfs.

Hopefully this provides the needed data for the site drainage.

Sincerely,

Advanced Engineering & Surveying, Inc.

A handwritten signature in cursive script that reads "Ronald A. Bengs".

Ronald A. Bengs, P.E.

President

CC: Henriksen, Inc.

FAMILY FND CHILD CARE

1123 KANSAS CITY STR

ALLEY FLOW CALCULATIONS

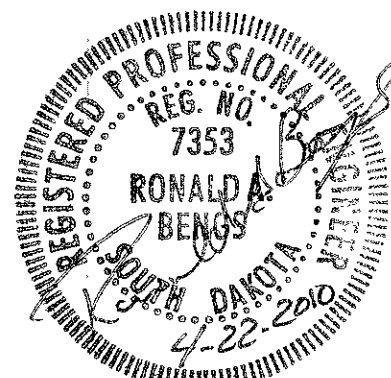
Existing Alley - Packed Gravel

Proposed ALLEY - 16' x 150' = 2,400 SF
= 0.06 AC T_c urban Basin: $\frac{L}{180} + 10 = \frac{150'}{180} + 10 = 10.8 \text{ min}$ $Q = CIA$ C_{100} Gravel = 0.65 C_{100} Asphalt = 0.93 $I_{100} = 7.50$ (10 min. Duration)Q Gravel Alley

$$Q_{100} = 0.65 (7.5) (0.06) \\ = 0.29 \text{ cfs}$$

Q Asphalt Alley

$$Q_{100} = 0.93 (7.5) (0.06) \\ = 0.42 \text{ cfs}$$

Increase Q_{100} due to paving = 0.13 cfs

AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
 1123 Kansas City Street, Rapid City, SD

Required Storage

Storm Duration D Min.	Peak Runoff Qp CFS	Storm Runoff Vr CF	Storage Volume Vs CF
5	1.88	563.70	346.76
10	1.49	891.94	458.06
15	1.24	1120.27	469.45
20	1.07	1282.01	414.25
30	0.89	1601.92	300.27
45	0.74	1990.80	38.34
60	0.58	2104.97	-498.32

$V_r = D * Q_p * 60$
 $V_s = 60 * D * (Q_p - Q_o)$

Qo = Max. Release Rate
 (Historical Flow, 100 yr, Tc=5 min)

Qp = Peak Runoff, CFS

Vr = Storm Runoff, CF

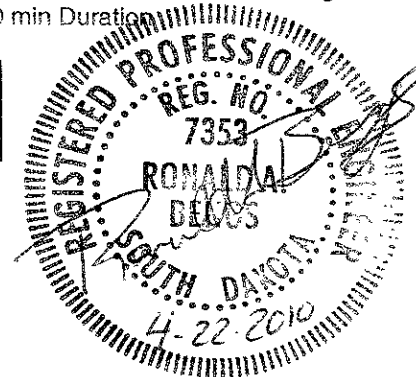
Vs = Storage Volume, CF

D = Duration, Min.

Qo = 0.72 Release Rate (Historical), Q100 Dev. 10 min Duration

Maximum "Storage Volume" Value = required storage volume

Total Storage Volume Required =	469.50	CF
--	---------------	-----------



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF		Areas AC	C10		C100	
	Historical	Developed					
Total Area	10,500	10,500	0.24				
Roof	0	1,324		0.90	0.90		
Grass	10,500	2,059		0.20	0.40		
Concrete	0	0		0.88	0.89		
Gravel	0	0		0.35	0.65		
Asphalt	0	7,117		0.90	0.93		
	10,500	10,500					

Intensity	
I10	I100
6.37	9.48

5 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

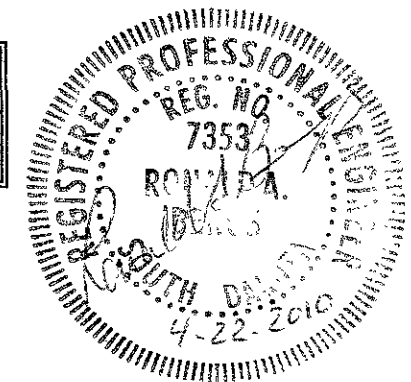
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.11	0.04	0.00	0.00	0.61	0.76

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.31 CFS
Q10 Dev		1.17 CFS
Q100 Hist		0.91 CFS
Q100 Dev		1.88 CFS

Difference (Dev - Hist)	
Q10	Q100
0.86	0.96



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF		Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
5	7.5

10 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.11	0.04	0.00	0.00	0.61	0.76

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.24 CFS
Q10 Dev		0.92 CFS
Q100 Hist		0.72 CFS
Q100 Dev		1.49 CFS

Difference (Dev - Hist)	
Q10	Q100
0.68	0.76



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF		Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
4.17	6.28

15 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

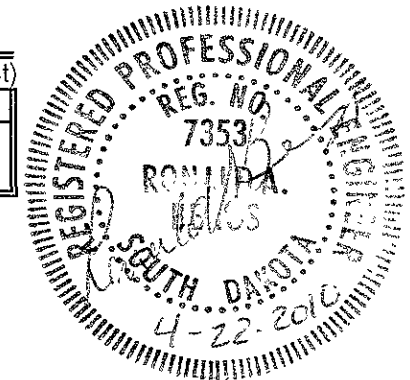
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.11	0.04	0.00	0.00	0.61	0.76

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.20 CFS
Q10 Dev		0.77 CFS
Q100 Hist		0.61 CFS
Q100 Dev		1.24 CFS

Difference (Dev - Hist)	
Q10	Q100
0.57	0.64



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
3.53	5.39

20 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

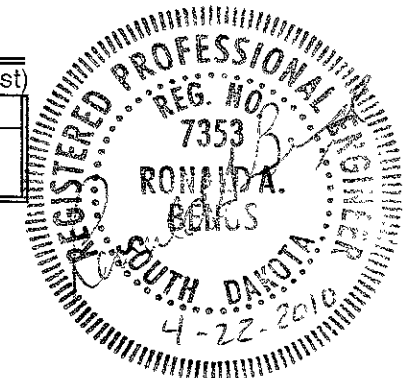
	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.11	0.04	0.00	0.00	0.61	0.76

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.17 CFS
Q10 Dev		0.65 CFS
Q100 Hist		0.52 CFS
Q100 Dev		1.07 CFS

Difference (Dev - Hist)	
Q10	Q100
0.48	0.55



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
2.89	4.49

30 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

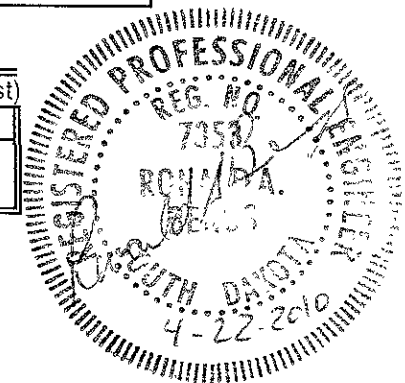
	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.11	0.04	0.00	0.00	0.61	0.76

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.14 CFS
Q10 Dev		0.53 CFS
Q100 Hist		0.43 CFS
Q100 Dev		0.89 CFS

Difference (Dev - Hist)	
Q10	Q100
0.39	0.46



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
2.38	3.72

45 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

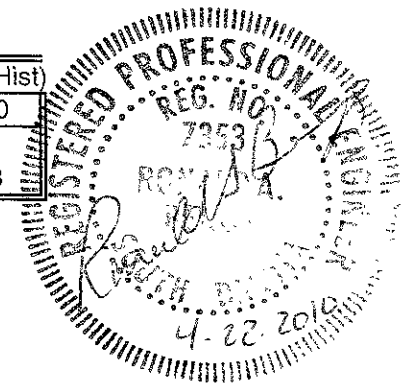
	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.11	0.04	0.00	0.00	0.61	0.76

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.11 CFS
Q10 Dev		0.44 CFS
Q100 Hist		0.36 CFS
Q100 Dev		0.74 CFS

Difference (Dev - Hist)	
Q10	Q100
0.32	0.38



AES Job No.: 10-013

Early Foundations Child Care - Porous Landscape Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF		Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	1,324		0.90	0.90
Grass	10,500	2,059		0.20	0.40
Concrete	0	0		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	7,117		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
1.86	2.95

60 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

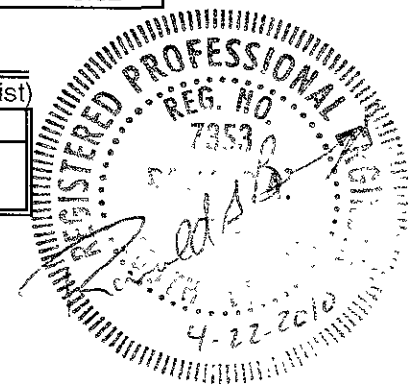
	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.11	0.04	0.00	0.00	0.61	0.76

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.11	0.08	0.00	0.00	0.63	0.82

Q10 Hist	CIA	0.09 CFS
Q10 Dev		0.34 CFS
Q100 Hist		0.28 CFS
Q100 Dev		0.58 CFS

Difference (Dev - Hist)	
Q10	Q100
0.25	0.30



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Required Storage

Storm Duration D Min.	Peak Runoff Qp CFS	Storm Runoff Vr CF	Storage Volume Vs CF
5	1.74	520.87	303.93
10	1.37	824.15	390.27
15	1.15	1035.14	384.32
20	0.99	1184.58	316.82
30	0.82	1480.18	178.54
45	0.68	1839.51	-112.95
60	0.54	1945.00	-658.28

$V_r = D * Q_p * 60$
 $V_s = 60 * D * (Q_p - Q_o)$

Qo = Max. Release Rate
 (Historical Flow, 100 yr. Tc=10 min)

Qp = Peak Runoff, CFS

Vr = Storm Runoff, CF

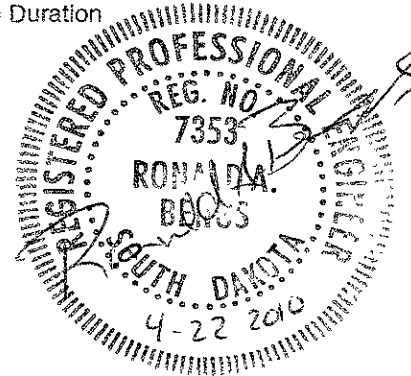
Vs = Storage Volume, CF

D = Duration, Min.

Qo = 0.72 Release Rate (Historical), Q100 Dev, 10 min Duration

Maximum "Storage Volume" Value = required storage volume

Total Storage Volume Required =	390.27	CF
--	---------------	-----------



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
6.37	9.48

5 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

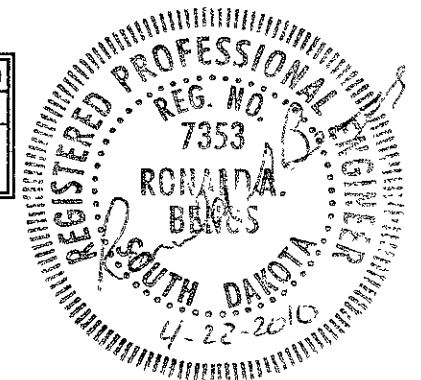
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.31 CFS
Q10 Dev		1.08 CFS
Q100 Hist		0.91 CFS
Q100 Dev		1.74 CFS

Difference (Dev - Hist)	
Q10	Q100
0.77	0.82



AES Job No.: 10-013

**Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD**

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
5	7.5

10 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

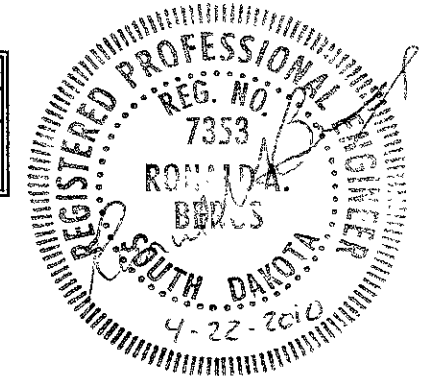
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.24 CFS
Q10 Dev		0.85 CFS
Q100 Hist		0.72 CFS
Q100 Dev		1.37 CFS

Difference (Dev - Hist)	
Q10	Q100
0.61	0.65



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
4.17	6.28

15 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

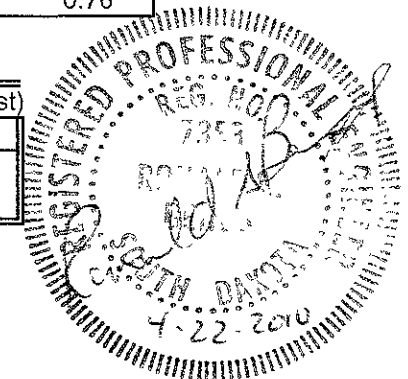
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.20 CFS
Q10 Dev		0.71 CFS
Q100 Hist		0.61 CFS
Q100 Dev		1.15 CFS

Difference (Dev - Hist)	
Q10	Q100
0.51	0.54



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
3.53	5.39

20 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.17 CFS
Q10 Dev		0.60 CFS
Q100 Hist		0.52 CFS
Q100 Dev		0.99 CFS

Difference (Dev - Hist)	
Q10	Q100
0.43	0.47



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC	C10	C100
	Historical	Developed			
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
2.89	4.49

30 min duration

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Historical	0.00	0.20	0.00	0.00	0.00	0.20

	Roof	Grass	Conc	Gravel	Asphalt	Total
C10 Composite Developed	0.59	0.06	0.05	0.00	0.01	0.70

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Historical	0.00	0.40	0.00	0.00	0.00	0.40

	Roof	Grass	Conc	Gravel	Asphalt	Total
C100 Composite Developed	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.14 CFS
Q10 Dev		0.49 CFS
Q100 Hist		0.43 CFS
Q100 Dev		0.82 CFS

Difference (Dev - Hist)	
Q10	Q100
0.35	0.39



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
2.38	3.72

45 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

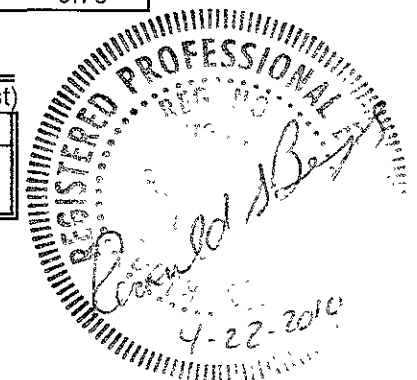
C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.11 CFS
Q10 Dev		0.40 CFS
Q100 Hist		0.36 CFS
Q100 Dev		0.68 CFS

Difference (Dev - Hist)	
Q10	Q100
0.29	0.32



AES Job No.: 10-013

Early Foundations Child Care - Grass Area
1123 Kansas City Street, Rapid City, SD

Rational Method

	Areas SF	Areas SF	Areas AC		
	Historical	Developed		C10	C100
Total Area	10,500	10,500	0.24		
Roof	0	6,930		0.90	0.90
Grass	10,500	2,938		0.20	0.40
Concrete	0	552		0.88	0.89
Gravel	0	0		0.35	0.65
Asphalt	0	80		0.90	0.93
	10,500	10,500			

Intensity	
I10	I100
1.86	2.95

60 min duration

C10 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.20	0.00	0.00	0.00	0.20

C10 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.06	0.05	0.00	0.01	0.70

C100 Composite Historical	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.00	0.40	0.00	0.00	0.00	0.40

C100 Composite Developed	Roof	Grass	Conc	Gravel	Asphalt	Total
	0.59	0.11	0.05	0.00	0.01	0.76

Q10 Hist	CIA	0.09 CFS
Q10 Dev		0.32 CFS
Q100 Hist		0.28 CFS
Q100 Dev		0.54 CFS

Difference (Dev - Hist)	
Q10	Q100
0.23	0.26



CivilTools ROUND PIPE HYDRAULICS

Calculations for a round pipe flowing full or partially full

ROUND PIPE HYDRAULIC CALCULATIONS	
Pipe Diameter (D):	6 Inches
Pipe Slope:	1.00%
Manning's 'n':	0.010
Full Velocity (Vf):	3.715 ft/sec.
Pipe Capacity (Qf):	0.729 cfs
Design Q (Qd, cms):	0.72 cfs
Qd/Qf:	98.7%
Depth Ratio:	80.8%
Vd/Vf:	114.0%
Flow Depth (d):	5 Inches
Flow Velocity (Vd):	4.24 ft/sec.
Slope for full flow:	0.97%

