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Final Stormwater Drainage Report

Blue Acres Subdivision, Phase 4

Weber County, UT

Submitted to:

Mr. Romney Buck
4115 West 2550 South
Ogden UT 84404

Prepared by:

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Reeve Job No.: 5036-01

Reeve & Associates, Inc.

April 20, 2015

RE: Blue Acres Subdivision - Drainage Report

Dear Mr. Buck:

As per requested by Weber County, we are submitting to you this report of the technical drainage study for the Blue Acres subdivision located on 2200 South, just east of 4300 West, in Weber County UT.

To perform this report we performed a hydrologic analysis for the proposed Blue Acres subdivision, Phase 4, using information obtained from NOAA Atlas 14. Based on the information we obtained, we were able to analyze the amount of water that would need to be detained using the Rational Method and Weber County Standards. From this data, we were able to design appropriate detaining facilities for the site. We propose an above ground detention system. Therefore it is our professional opinion that after the proposed detention basin has been completed; this project will detain the required 100-year for the Weber County, UT area, and should be permitted per the hydrologic analysis contained within this report.

If you have any questions, or we can be of further assistance, please let us know.

Sincerely,

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1.0 Introduction and Summary

1.1 Executive Summary

At the request of the Weber County Engineering Department, Reeve & Associates has prepared the following Storm Drainage Design Report for the proposed subdivision located on 2200 South, east of 4300 West, near Taylor, UT. Figure #1 contains a vicinity map that shows the proposed location and surrounding properties. The proposed subdivision will include 9 lots.

The drainage design was determined using the Rational Method. All drainage calculations and detention basin sizing was done based off information regarding the 100-yr storm event for the Weber County, UT region.

The following report outlines the objectives and procedures followed to determine the drainage design. A complete overview of both the hydrologic and hydraulic designs and calculations are presented in detail. The effects to the existing system are also addressed.

Figure #1
Vicinity Map – Blue Acres Subdivision Phase 4

2.0 Objectives and Procedures

2.1 Purpose of Report

At the request of the Weber County Engineering Department, Reeve & Associates has prepared the following Storm Drainage Design Report for the proposed subdivision located on 2200 South, east of 4300 West, near Taylor, UT. The purpose of this report is to explain the procedures used to determine the proposed drainage design, including peak discharge, detention and the effects on current drainage patterns.

2.2 Procedures

The Rational Method was used to determine the amount of runoff (Q) in cubic feet that the proposed project would generate upon completion. The Rational Method is a method used to predict the runoff for small basins by utilizing runoff coefficients based off land use. Small basins are used for areas less than 160 acres. The proposed subdivision sits on 6.40 acres.

Rainfall intensity data was obtained from NOAA Atlas 14. An analysis was performed for a one-hundred (100) year storm event. The detention system was designed based on the results of the 100-year storm.

The site will detain the generated runoff in a detention basin located on site. The generated runoff will discharge to the existing storm drain facility located in 2200 South at a reduced flow rate. The full design of the detention basin is described in full later in the report. The storm water is conveyed through the site through curb and gutter and a series of catch basins and storm drain pipes.

3.0 Hydrology

3.1 Analysis

The rainfall intensity for the proposed Blue Acres subdivision, assuming the 100-year storm event, are shown below. Rainfall intensities, in inches per hour, are listed below.

Table 1 – Rainfall Intensity

Time(min)	*Intensity (inches/hour)*
0	**0**
5	**6.64**
10	**5.05**
15	**4.17**
30	**2.81**
60	**1.74**
120	**0.95**
180	**0.65**
360	**0.36**
1400	**0.13**

Source: NOAA Atlas 14

Using the Rational Method, the peak runoff was calculated using the 60-min rainfall intensity listed above of 1.74 inches per hour. The equation used for the Rational Method is:

$$Q = CiA$$

Where,

C = Runoff Coefficient
i = Rainfall Intensity for chosen frequency
A = Watershed Area

3.1.1 Existing Conditions

The above equation was used to determine the current amount of stormwater runoff that is currently entering into the existing storm drain system based off of existing conditions. The total area of undeveloped land on the proposed site is 6.40 acres.

3.1.2 On-Site Detention Analysis

The on-site detention facility is designed to capture the runoff from the subdivision, releasing the generated runoff at a rate of 0.2cfs per acre. The area being detained includes: 30,671 square feet (0.70 acres) of paved area (including driveways), 222,225 square feet (5.10 acres) of landscaped area, and 25,931

square feet (0.59 acres) of roof area. These values were used to determine the weighted runoff coefficient needed to determine the detention basin volume.

Table 2 – Flow Rate Out of the Detention Basin

	Acres	*Q=0.2cfs/Acre*
Q(out)	**6.40**	**1.28 cfs**

The weighted runoff coefficient was determining the runoff coefficient for each surface area with in the designated area and determining the weighted average. See the table below for the weighted runoff coefficient results.

Table 3 – Runoff Coefficient – On-Site Detention

Surface Type	*Area (ft²)*	*Runoff Coefficient*
Paved Area	*30,671*	**0.90**
Landscaped Area	*222,225*	**0.20**
Roof	*25,931*	**0.80**
	Weighted Coefficient	**0.33**

To determine the amount of water that would need to be detained during a 100-year, for each time interval the difference of volume between existing conditions and proposed conditions was reviewed. The highest difference is what the system should be able to detain, see appendix for complete calculations. The total volume required to detain on-site is listed in Table 4.

Table 4 – Required Volume for On-Site Detention

Detention System	*Volume (cf)*
Open Basin	**8,735**

Based on the calculations and results demonstrated above, and according to our professional opinion, we propose that the on-site detention system shall have the capacity to hold up to 8,735 cubic feet of stormwater.

4.0 Hydraulics

4.1 Existing Storm Drain Facility

There is an existing 18" storm drain line running east/west in 2200 West. The discharge from the subdivision will connect to the existing facility.

4.2 Proposed Design

A open area detention basin will be used on site to capture the generated storm water from the subdivision. The basin will provide 1' free board from high water elevation to top of the basin. The side slopes of the basin will not exceed 3:1 slope. The basin will include a control structure with orifice that will ensure the basin does not discharge at a rate greater the the required 0.2 cfs/acre.

The design of the detention basin is based on the volume required for the subdivision. As seen in Table 4, the site needs to detain 8,735 cubic feet. The detention basin calculations are seen below.

High Water Area (elev. 4237.65) = 4,992 s.f.
Bottom Area (elev. 4235.00) = 1,682 s.f.

[4,992 + 1,682]/2 = 3,337 s.f. average
3,337 s.f. x 2.65 ft deep = 8,843 c.f.

Our analysis shows a required amount of 8,735 cubic feet for the designated areas. The proposed basin will hold 8,843 cubic feet, which is greater than required amount.

4.3 Orifice Sizing

The following equation was used to determine the sized of the orifices for the two detention facilities:

$$R = \sqrt{(Q/(1.948*((64.4*H)^{0.5}))}$$

Where,

R = Radius (ft)
Q = Peak Discharge (cfs)
H = Head (ft)

The orifice size at the outlet of the detention basin will allow the system to discharge 1.28 cfs. See calculation below for orifice sizing.

$$R = \sqrt{(1.28/(1.948*((64.4*3)^{0.5}))}$$

R = 2.6 inches

D = 5.2 inches

For the detention basin, the peak flow discharge (Q) shall be 1.28 cfs, the orifice size at the outlet shall be 5.2" diameter. By allowing 1.28 cfs to discharge from the basin, the site will not cause any adverse changes to the existing storm drain system. The detention basin will discharge into the existing storm drain pipe in 2200 South.

5.0 Summary and Conclusions

5.1 Summary and Conclusion

In our professional opinion, an on-site detention basin shall be used to detain the water accumulated during a 100-year event in the Weber County UT area for the Blue Acres Subdivision, Phase 4.

Therefore, we conclude that the proposed design outlined in this report has adequate storage capacity to detain the required 100-year storm .

Appendix

Storm Runoff Calculations

Blue Acres Subdivision - Phase 4

6/19/2014 TJH

The following runoff calculations are based on the Rainfall - Intensity - Duration Frequency Curve for the Weber County, UT area taken from data compiled by NOAA Atlas14, using a 100 year storm.

Runoff storm water has been calculated for two different sets of conditions, one being the existing undeveloped land and the other with land fully improved. The difference between the two quantities will be detained in a holding pond. All water that runs off and over the property at present will be diverted into the holding pond and released at a reduced rate into the existing drainage system.

The calculations are as follows:

1. Runoff from the undeveloped existing land.

Runoff Coefficient	C =	0.200	
Rainfall Intensity	i =	2.81	IN./HR.
Runoff Quantity	Q =	0.2	per acre
Acreage	A =	6.40	ACRES

Q(out) = A*0.2 1.28 CFS

2. Runoff from developed land

Runoff Coefficients

Paved Area	30,671	C = 0.9
Landscaped Area	222,225	C = 0.2
Roof	25,931	C = 0.8

Weighted Runoff Coefficient C = 0.33

Rainfall Intensity i = varies with time

Runoff Quantity Q = CiA

3. Detention Basin

Volume in Q * t

Volume out 1.28 * t

The capacity of the detention basin is calculated as the maximum difference between the volume flowing in and the volume flowing out.

The outflow from the detention basin is limited to outflow if undeveloped.

Use 1.28 cfs for Q outflow

The required volume of the detention basin is 8,735 cubic feet

USE A 5.2 INCH DIAMETER ORIFICE AT OUTLET

DETENTION BASIN

Cumulative Volume For Detention Pond
Blue Acres Subdivision - Phase 4

C =	0.33
A =	6.40
Q(out) =	1.28

time (min)	time (sec)	i (in./hr.)	Q (cfs)	Vol. in (cf)	Vol. out (cf)	Difference (cf)
0	0	0.00	0.00	0.00	0.00	0.00
5	300	6.64	14.14	4243.46	384.06	3859.40
10	600	5.05	10.76	6454.65	768.12	5686.53
15	900	4.17	8.88	7994.82	1152.18	6842.65
30	1800	2.81	5.99	10774.80	2304.36	8470.44
60	3600	1.74	3.71	13343.88	4608.71	8735.17
120	7200	0.95	2.03	14616.91	9217.42	5399.49
180	10800	0.65	1.39	14977.35	13826.13	1151.22
360	21600	0.36	0.77	16702.85	27652.26	-10949.41
1440	86400	0.13	0.27	23006.68	110609.06	-87602.37

Weber County, UT area
NOAA Atlas 14

Storm Runoff Calculations

Blue Acres Subdivision - Phase 4

2/12/2015 TJH

The following runoff calculations are based on the Rainfall - Intensity - Duration Frequency Curve for the Weber County, UT area taken from data compiled by NOAA Atlas14, using a 10 year storm.

Runoff storm water has been calculated to determine the amount of flow that will be generated onsite due to the development to size the proposed storm drain pipes for the development.

The calculations are as follows:

1. Runoff from developed land

Runoff Coefficients

Paved Area	53,491	C = 0.9
Landscaped Area	387,570	C = 0.2
Roof	45,225	C = 0.8

Weighted Runoff Coefficient C = 0.33

2. Runoff from the developed land.

Runoff Coefficient	C =	0.333	
Rainfall Intensity	i =	0.85	IN./HR.
Acreage	A =	11.16	ACRES

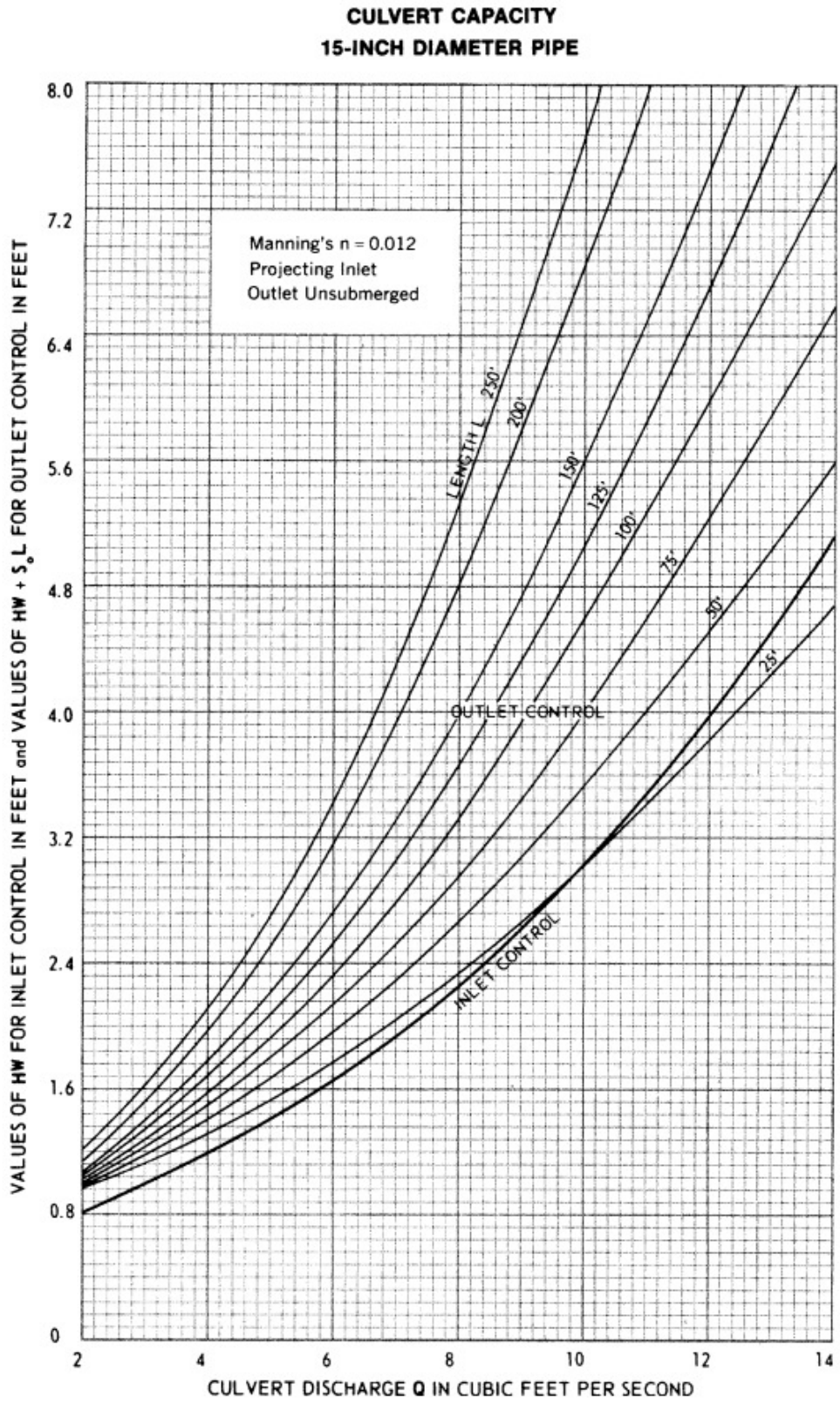
Q = CIA 3.16 CFS

The amount of flow that is generated over the entire development for a 10 year storm is 3.16 cfs.

A 15" RCP pipe at the designed slope of 0.25% will carry 3.50 cfs.
A 12" RCP pipe at the designed slope of 0.25% will carry 1.93 cfs.

A 15" RCP pipe is required for the development.

Figure 43


CULVERT CAPACITY
15-INCH DIAMETER PIPE
Manning's n = 0.012
Projecting Inlet
Outlet Unsubmerged
LENGTH L
250'
200'
150'
125'
100'
75'
50'
25'
OUTLET CONTROL
INLET CONTROL
VALUES OF HW FOR INLET CONTROL IN FEET and VALUES OF HW + S0L FOR OUTLET CONTROL IN FEET
CULVERT DISCHARGE Q IN CUBIC FEET PER SECOND
8.0
7.2
6.4
5.6
4.8
4.0
3.2
2.4
1.6
0.8
0
2
4
6
8
10
12
14

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