BYU | CIVIL & ENVIRONMENTAL ENGINEERING
IRA A. FULTON COLLEGE

CAPSTONE

SANTAQUIN CITY TRAIL CORRIDOR AND RIGHT OF WAY DESIGN

Project ID: CEEn_2016CPST_010

by

Silverstone Engineering & Surveying
Savannah Keane
Joel Whitmer
Clay Hansen
Brandon Walker

A Capstone project submitted to

Norm Beagley
Santaquin City

Department of Civil and Environmental Engineering
Ira A. Fulton College of Engineering and Technology
Brigham Young University

Executive Summary

Silverstone Engineering & Surveying was tasked with completing a full functioning design of a trail and right of way corridor for the city of Santaquin along Highland Drive. The intended impact of the trail is to increase the safety of pedestrian traffic along Highland Drive, specifically that of children walk to the nearby elementary school, Orchard Elementary. The trail was completed according Santaquin city standards. The main effort in completing the design came through the use of Civil 3D. Using Civil 3D, our team was able to complete a full plan view design of the 8 foot wide trail that completes a sine wave every 150 feet. Creating an alignment and assembly, we were then able to create a corridor which provides detailed information regarding elevations of the proposed trail and its' drainage system. This corridor also allowed us to identify cut and fill values between the existing surface and the proposed trail. A complete drainage analysis was performed to determine storm drain facility sizes and elevations. Using the information obtained from Civil 3D, a cost analysis was performed, including material, excavation, and labor costs, for the client.

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Performance Standards

Contained herein is a proposed trail corridor and right of way design requested by Santaquin City.

Our team will provide work for this Capstone project "as is" using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as "stamped deliverables" without first being reviewed, approved and stamped by a qualified and relevant license professional engineer.

Members of the team who prepared this proposal can be contacted by the following means:

Name	Email	Phone Number
Savannah Keane	savk22@gmail.com	(208) 305-9436
Joel Whitmer	joel7whitmer@gmail.com	(801) 836-2320
Clay Hansen	clay.handsome@gmail.com	(801) 400-2325
Brandon Walker	btkw24@gmail.com	(385) 224-2644

Introduction

PROJECT TITLE: Trail and Right of Way Corridor Design for the City of Santaquin
PROJECT ID: CEEn-2016CPST-010
PROJECT SPONSOR: The City of Santaquin
TEAM NAME: Silverstone Engineering and Surveying

Background Information

The objective of this project was to complete a full functioning design of a trail and right of way corridor for the city of Santaquin. The purpose is to provide a safe, comfortable route for pedestrians to travel along the existing frontage road, particularly targeting the children walking to and from the nearby elementary school. This trail will also serve as a showpiece that will be visible from the Interstate 15 freeway. Our team completed a full engineering assessment for the trail and right of way corridor. Components of the project include:

- Complete design of an 8 ft wide trail along Highland Drive from 120 East to approximately 130 South.
- Full cut and fill design for the corridor
- Meandering curve trail as per Santaquin City Standards
- Full runoff and drainage analysis
- Property acquisition to complete all Right-of-Way improvements
- Rerouting or relocation of driveways directly connecting onto Highland Drive, as was practical.
- Full curb & gutter design on the southeast side of the frontage road
- Full design of storm drainage facilities to accommodate storm drain capture, collection & conveyance.
- XeriScape landscape design.
- Financial analysis of the entire project

Resources

There were many resources available to our team for the completion of this project. In order to comply with Santaquin city standards (see appendix), our team had to review and understand the current city standards and how they applied to our specific project. Within the city standards, we were able to find detailed requirements for curb and gutter dimensions, trail asphalt depths, sub base depths, requirements regarding compacted fill, requirements for storm drain sizes, and slope requirements of storm drain systems. These detailed standards made the cross sectional design of the proposed trail efficient, eliminating the need for many assumptions regarding the cross sectional portion of the trail design.

Another valuable resource for the completion of this project included contacts more knowledgeable in the various subjects related to this project. The most helpful being Jason Barker with Focus Engineering and Surveying. After meeting with him, our team had a better understanding of corridor creation. This understanding helped the project to move forward quickly.

Governing Assumptions

One of the major assumptions made for the project came in the cost analysis portion. Many prices were assumed, from internet research, for concrete, asphalt, excavation, xeriscape materials, and labor. Using the resource available to us, we feel that the values represented in the cost analysis section of this report are realistic values in the construction industry.
Another major assumption was made when calculating the size of the storm drains needed. In order to determine the demands required for the storm drains, we assumed a 95% run-off coefficient. Using this value we were able to calculate the required flow in the storm drains, thus allowing us to determine the required size of pipe.

Report

Design of the Trail

The general design of the trail was specified, leaving little room for variance. The major constraint given to us, was to design the trail to complete a sine wave, roughly, every 150 feet. The trail was to maintain an 8 foot width throughout the length of the design. In addition, the portions of trail that connected to roads were required to connect relatively perpendicular to the road.

Figure 1: Preliminary Trail Design with Sine Wave Every 150 ft.

Creating the Existing Surface

One of the major problems we faced, was creating the existing surface in AutoCAD. An existing surface was necessary to determine cut and fill quantities for the project as well as tying the proposed trail surface into the existing portions of sidewalk on the north and south ends.

There were many resources available to us to create the existing surface in AutoCAD. We first attempted to upload the LiDAR data from Utah AGRC into AutoCAD, but this proved to be difficult. Instead, we contacted Norm Beagley with the City of Santaquin to obtain the topographic points taken of the area that they had previously obtained. Using the excel sheet provided to us, we were able to upload all of the points, connect the boundaries, and use them to create a surface in AutoCAD.

Point #	Northing	Easting	Elevation	Description
111048	7156854	1561208	5081.515	EOA
111049	7156844	1561217	5083.969	NG
111050	7156834	1561228	5085.984	NG
111051	7156864	1561218	5081.455	EOA
111052	7156877	1561232	5081.192	EOA
111053	7156871	1561239	5080.673	EOA
111054	7156869	1561240	5081.174	TBC
111055	7156869	1561240	5081.16	TBC
111056	7156875	1561257	5081.165	TBC
111057	7156866	1561274	5081.823	TBC
111058	7156849	1561281	5082.453	TBC
111059	7156830	1561284	5083.189	TBC
111060	7156830	1561280	5083.318	TBS
111061	7156842	1561278	5082.87	TBS
111062	7156853	1561276	5082.433	TBS
111063	7156835	1561286	5082.584	EOA
111064	7156852	1561282	5082.078	EOA
111065	7156867	1561276	5081.379	EOA
111066	7156888	1561263	5080.121	EOA
111067	7156914	1561290	5079.047	EOA
111068	7156913	1561298	5079.188	EOA
111069	7156896	1561305	5080.118	EOA
111070	7156878	1561315	5081.042	EOA
111071	7156859	1561322	5082.062	EOA
111072	7156898	1561221	5081.181	EOA
111073	7156915	1561218	5081.104	FIRE_HYDRANT
111074	7156914	1561218	5081.348	WATER_VALVE
111075	7156924	1561224	5080.744	ELEC_JUNCTION_BOX
111076	7156928	1561228	5081.025	ELEC_JUNCTION_BOX
111077	7156916	1561246	5080.535	IRRIG_valve
111078	7156924	1561251	5080.236	SEWER_MANHOLE

Figure 2: A portion of the topographic data of existing conditions

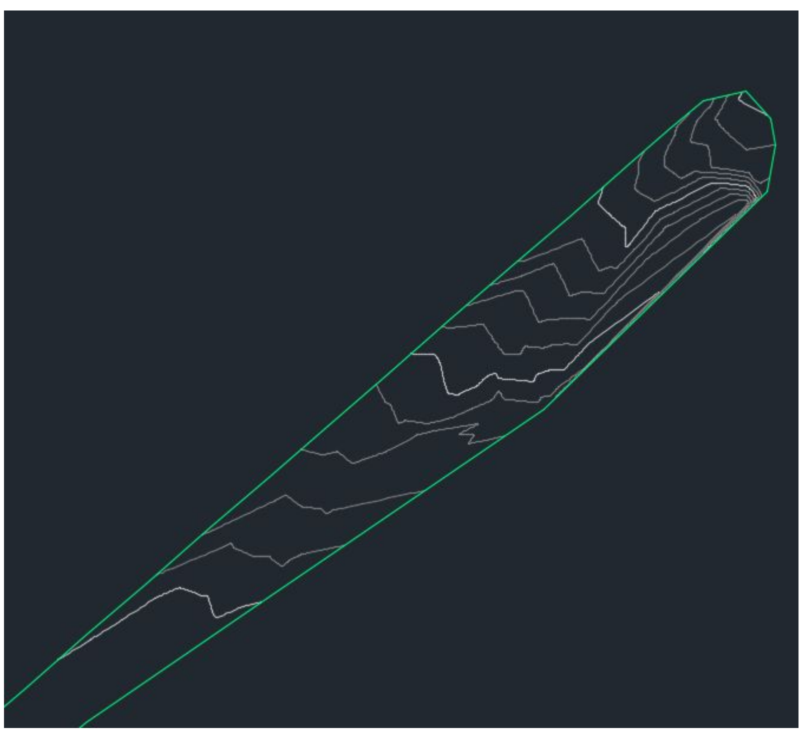


Figure 3: Existing Surface created from Topographic points in AutoCAD

Creating Trail Corridor

Creating Assembly of Trail with Curb and Gutter

The proposed trail surface was created using the assembly and corridor tools in AutoCAD. Using the existing edge of asphalt as the reference point, we created an assembly containing the trail and the curb and gutter. The assembly was designed to tie into the existing grade at the back of the trail, either with a cut or a fill, whichever was necessary.

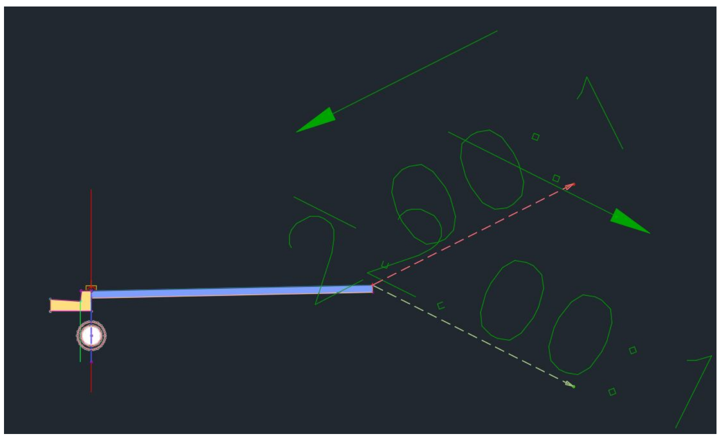


Figure 4: Trail assembly

Using the Assembly to Create the Corridor

By creating this trail and curb assembly, we used it for the next step in the corridor creation. We created an alignment along the existing edge of asphalt and attached the assembly to the alignment, which then creates a corridor. As seen in figure 5, our assembly was designed to attach into the existing grade to make a smooth transition from the trail to existing grade.

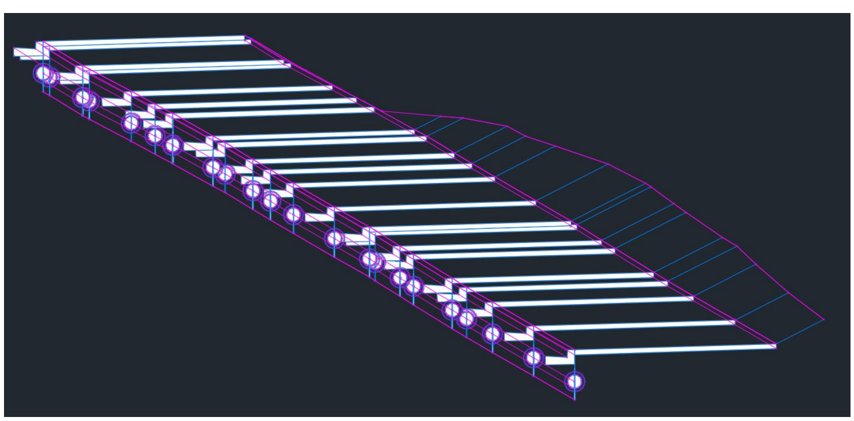


Figure 5: The 3-D view of the assembly attached to the alignment.

Using Trail Corridor

Once the trail corridor was created, we were then able to use it to acquire all the needed data concerning the construction of the trail. This was the main reason why we decided to use Civil 3D instead of using ArcGIS. Once we got to this point, the rest of the project was extremely efficient.

Cut and Fill

Using the volumes dashboard in Civil 3D, determining the cut and fill amounts was as easy as selecting the existing and proposed surface. AutoCAD automatically calculates the differences between the 2 surfaces. The resulting Net (adjusted) came out to be 322 Cu.Yd. as seen in figure 6. It is important to note that because of how we designed the corridor in Civil 3D, this 322 Cu.Yd value includes fill material, asphalt material for the trail, and concrete material for the curb and gutter.

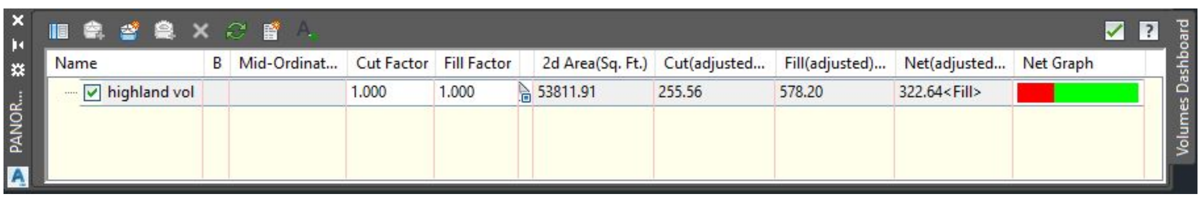


Figure 6: Cut and fill results from Volumes dashboard in Civil 3D.

Trail Grading and Profile

By using the corridor we created, the grading, elevations, and profile views were able to be created quickly and accurately. Figure 7 shows the completed grading plan for the trail. It is easy to see the contours and how they tie into the trail.

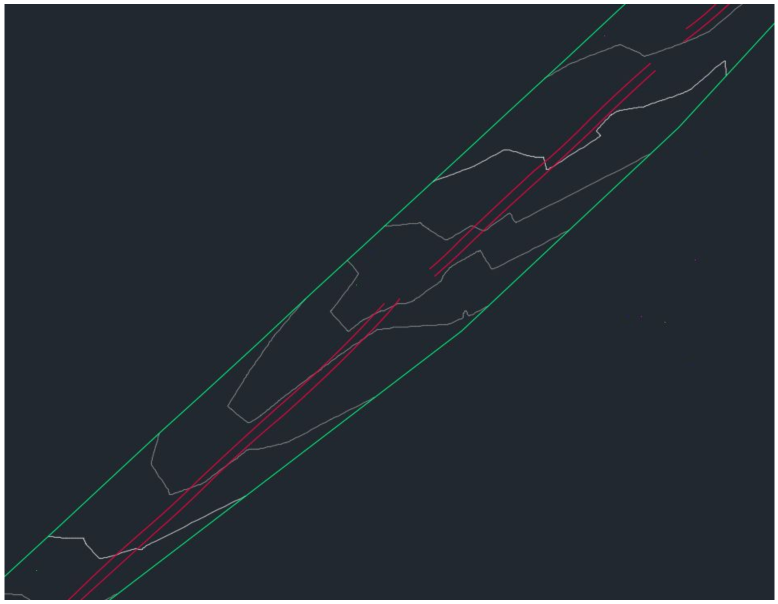


Figure 7: Proposed grading of trail corridor.

Assigning the corridor to a profile plot in Civil 3D, gives us a visual representation of how the elevation changes across the length of the trail. In figure 8 we can see both the existing surface elevations and the proposed trail surface elevations. We are also able to see, in figure 9, slopes assigned to each section which correlate to slope assignments for storm drain flow and depth (see appendix).

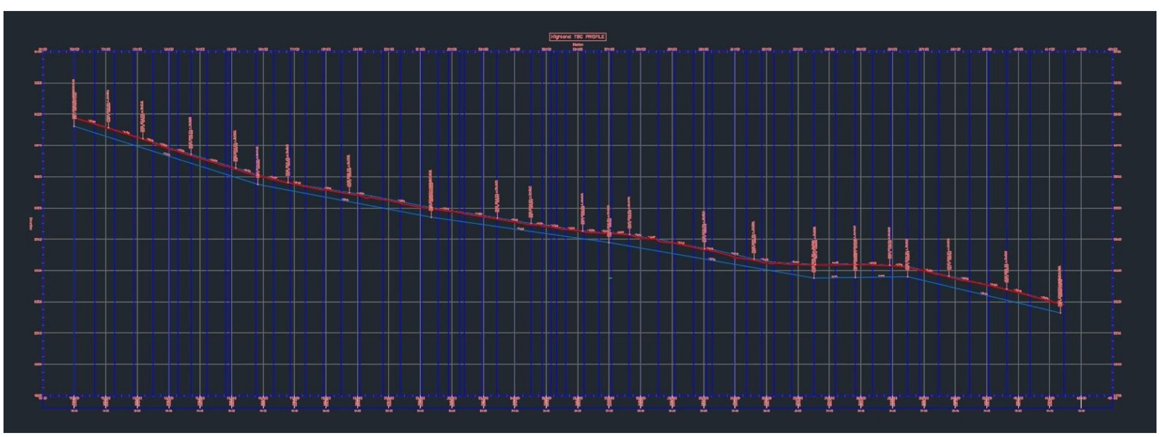


Figure 8: Profile elevations of proposed drain line (blue) and proposed trail surface (red).

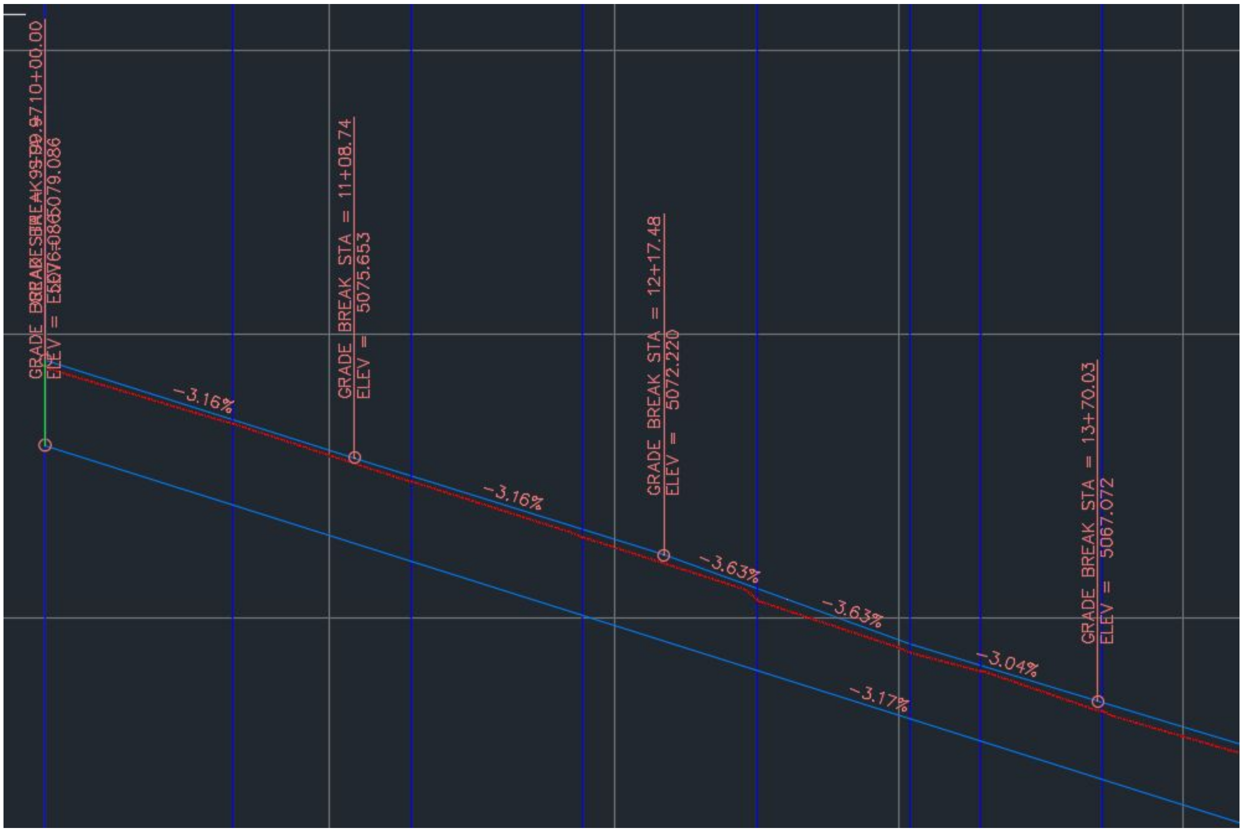


Figure 9: Slope assignments for storm drain flow.

Determining Land Acquisition

Finally, with the creation of the trail corridor, we were able to determine the lots that may require land acquisition for the city of Santaquin. Throughout the entire length of the trail, we determined that there would be very little land acquisition for this project. Figure 10 was retrieved from the Utah County parcel data and was used to determine land acquisition.

Figure 10: Parcel data from Utah County.

From the above image, the Topham property lines don't seem to account for a road right of way. We designed the trail in an effort to stay close to the road so that property acquisition would be minimized, but a portion of this lot must be purchased. Overlaying the parcel map on our own corridor was difficult, but we estimated that a maximum of 3000 square feet of land would need to be bought. With more precise location information, the amount of land needed may be significantly less than 3000 square feet.

Creating Plan View

In order to provide the City of Santaquin with a visual image of the design of the trail, a plan view was created. The plan view shown in Figure 11, shows the layout of the curb and gutter, the trail itself, and the existing roads and driveways. This plan view gives a visual representation of how that trail system will look.

Figure 11: Plan View of Trail with Curb and Gutter

Connecting Trail to the Street (ADA ramp and Curb and Gutter)

The following images represent how the trail will merge with cross streets. The intersection represented is 400 S and Highland Drive. Figure 12 shows how the curb will wrap around the west landscaped section and end at the trail. The gutter will continue across the intersection. Figure 13 shows how the trail will slope down to the elevation of the road by means of an ADA ramp, the landscaped sections on either side of the trail will descend at the same grade and, while wrapping around the west landscaped section the curb, will match the elevation of that section.

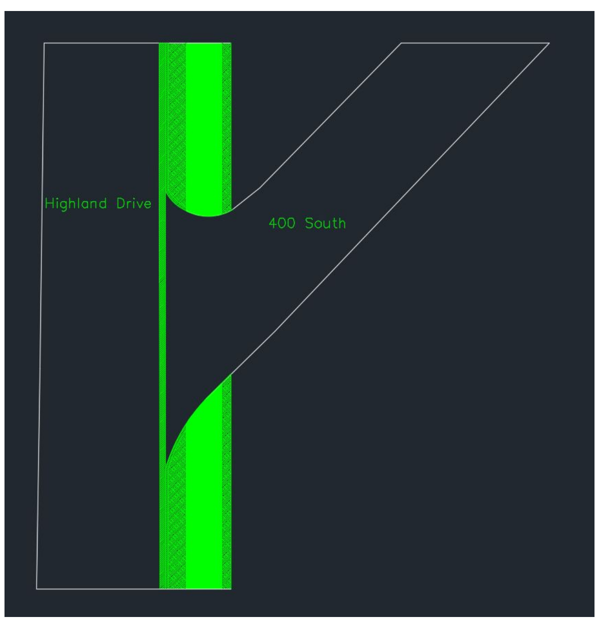


Figure 12: Junction of Trail Corridor and 400 South

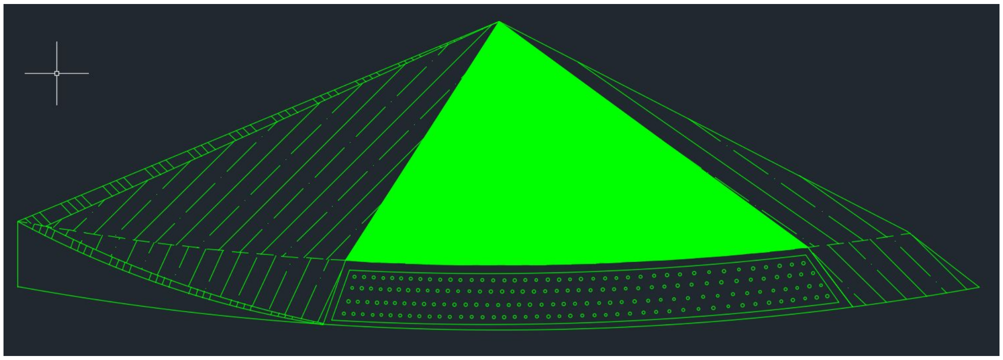


Figure 13: 3D View of ADA Ramp and Corridor/Street Merge

Creating Cross Sections

The cross section design followed the specifications for typical high back curb and gutter found in the Santaquin City Standards document. The section in figure 14 would be located at an eastern peak of the trails' sign wave. Moving North or South from this point the 2 ft section on the right would increase and the 4 ft section on the left would decrease.

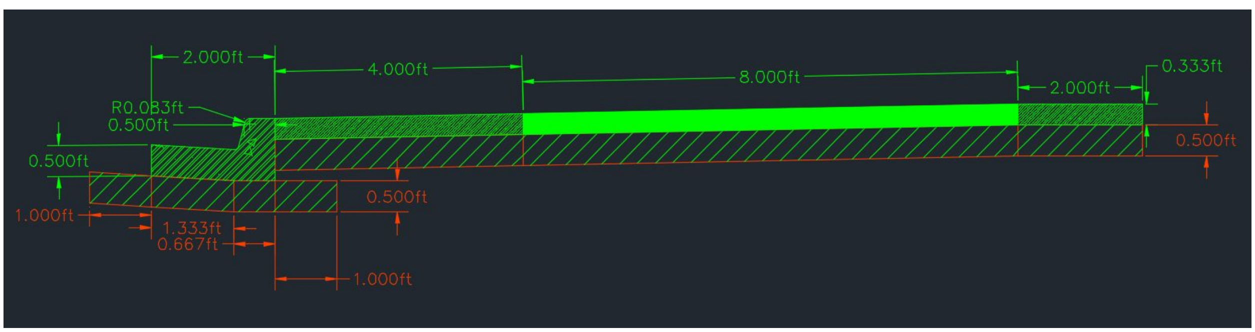


Figure 14: Corridor Cross Section

Drainage Analysis

After the trail was designed, a brief drainage analysis was conducted to ensure that all run off could be captured and stored. Currently, the east side of highland drive has a very small ditch that allows for the road and yards to drain. A culvert currently runs under highland drive just north of 400 East. After the trail is built, this ditch will completely disappear and will need to be replaced by a storm drain. The hope is that the new storm line will be installed underneath the proposed trail with drains installed directly into the new curb and gutter. Impervious area and curve numbers were estimated for further use for runoff analysis. We looked up storm information provided on NOAA atlas 14 (see appendix). We decided to use storms with 24 hour durations and calculated their max intensity. Table 1, displayed below, shows the precipitation and intensity for storms of different return periods for the Santaquin area.

Table 1: Precipitation and intensity data corresponding to increasing year storms

Storms	Precipitation (in)	Max Intesity (in/hr)
1 Year Storm	1.27	0.54
2 Year Storm	1.57	0.67
5 Year Storm	1.88	0.80
10 Year Storm	2.14	0.92
25 Year Storm	2.49	1.07

Using WMS, a modified watershed area was created around highland drive and is pictured below in figure 15. This watershed was imported into HMS and the 25 year storm was analyzed. From the hyetograph created by HMS the peak flow was observed to be 140 cfs.

Figure 15: Watershed data relating to the trail.

Profile lines were drawn in the the profile view of the corridor we created to calculate slopes and lengths of the needed pipes. Using these lengths, slopes, and the 25 year flow, a basic spreadsheet was created to approximate the needed pipe sizes (see appendix). From this spreadsheet the average required pipe size across the whole corridor was found to be 32 inches. For the purpose of efficiency and ease of construction we decided to use a uniform pipe size for the entire corridor. By doing this some pipes may be slightly undersized to handle a 25 year storm but due to the inaccuracy of estimating flows we felt very comfortable doing this. Pipe sizing may also need to be different depending on existing storm drain pipes.

Adding Features to Trail

We wanted to do just a few simple things in order to make the trail more appealing to people driving down the road. The city of santaquin owns a small parcel of land in between 300 south 400 east and highland drive. Originally we thought of designing some kind of miniature park for this area but decided that wouldn't be very safe because of the traffic in the area. Instead we decided to use the area as a break point for trail users. This area will have a large bench, trash can, and bike maintenance station (see appendix). These bike maintenance stations have recently been installed on byu and we feel these stations would be a great asset to cyclists on the trail.

After driving down highland drive in the dark we decided that the addition of street lights would make the trail much safer for evening and morning trail users. The lights were placed according the Santaquin city standards in an effort to both be efficient and provide adequate lighting to the trail.

Cost Analysis of Trail

Trying to keep the overall cost of the project low was one of major priorities. For this reason the trail corridor was kept as narrow as possible and we decided to decorate around the trail with xeriscape materials. These decisions meant we had minal land acquisition and there was no need to install and maintain a complicated irrigation system. Table 2, displayed below, shows all of our different costs along with estimated units prices.

Table 2: Full Cost Analysis of Material, Labor, Excavation, and Rental

Cost items	Quanity	Units	Unit Cost	Cost
Net Adjusted Fill	321.7	yd^3	$ 25.00	$ 8,042.50
Cut	255.75	yd^3	$ 25.00	$ 6,393.75
Fill that must be hauled	73.9	yd^3	$ 50.00	$ 3,694.58
sub grade prep	22581.54	ft^2	$ 2.00	$ 45,163.08
Curb and gutter	3696	ft	$ 15.00	$ 55,440.00
Pavement	20072.48	ft^2	$ 4.50	$ 90,326.16
ADA ramps	11		$ 1,000.00	$ 11,000.00
Bench	1		$ 1,000.00	$ 1,000.00
Trash Can	2		$ 200.00	$ 400.00
Property	0.072	acre	$ 65,328.87	$ 4,688.20
Landscape gravel 1	58	yd^3	$ 165.00	$ 9,583.22
Landscape gravel 2	58	yd^3	$ 74.00	$ 4,297.93
Drain Pipe	3696	ft	$ 60.00	$ 221,760.00
Street Lights	8		$ 8,000.00	$ 64,000.00
Bike Station	1		$ 3,000.00	$ 3,000.00
		Total Cost		**$ 528,789.41**

Our total cost estimate came in at just over a half million dollars. Though this number may seem high for the construction of a basic trail it seems perfectly reasonable to pay for all the necessary corridor improvements. At this stage, we have limited knowledge as to the exact costs of many of theses different construction goods and services.

Conclusion

As a team, we feel that Silverstone Engineering has delivered reasonably good work compared to the requested work requirements. The existing surface creation, corridor creation, and resulting data are all on par with real life work produced by a site civil design firm. Using the topographic points provided, the City of Santaquin will now have use of an existing surface of the trail section. In addition, they have a corridor assembly to use in regards to construction of the trail. The cut and fill, slope, elevation, land acquisition, and cross section data are all reasonably accurate to our knowledge.

The drainage portion was the most technical part of the project, and was the part that we were most uncertain about. Determining the size of pipes to use in the storm drain system proved to require many variables that we were unsure about. We suggest that the City of Santaquin conduct further investigation in this area before continuing with the project.

Appendix A

Storm Drain Manhole/Combo Box Typical

* Assume RCP for Pipe Diameters and Wall Thickness

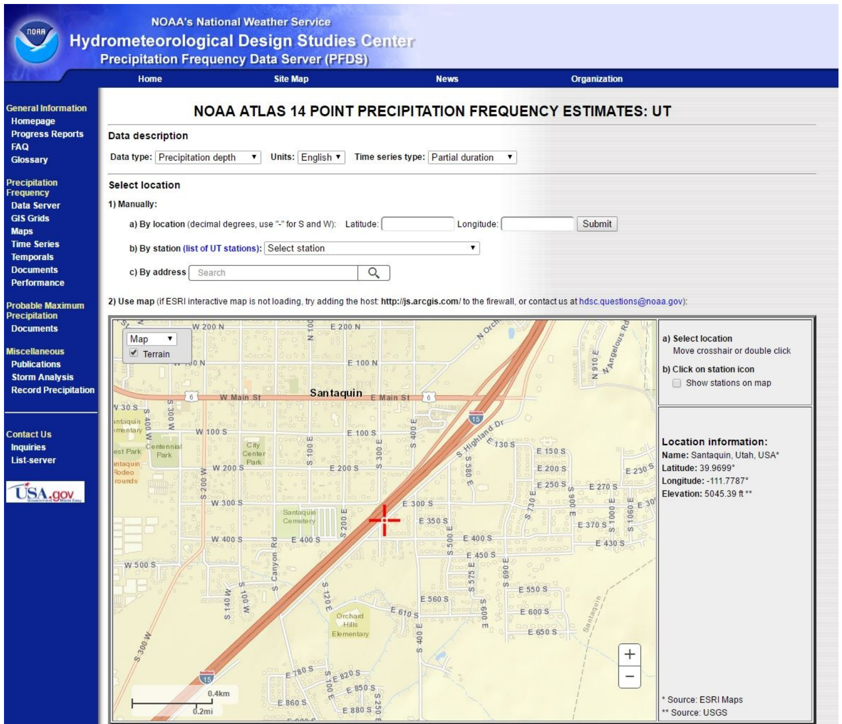
Pipe Diameter (In.)	Wall Thickness (In.)	Hole Diameter (In.)	Minimum Difference Ring-to-Pipe Invert (In.)	Minimum Difference Ring-to-Pipe Invert (Feet)
12	2.25	20.50	37.25	3.10
15	2.25	23.75	40.25	3.35
18	2.5	27.00	43.50	3.63
21	3.0	31.00	47.00	3.92
24	3.0	34.00	50.00	4.17
27	4.0	39.00	54.00	4.50
30	4.125	42.26	57.13	4.76
36	4.94	49.88	63.94	5.33
42	5.12	56.24	70.12	5.84
48	5.71	63.42	76.71	6.39

The above minimum guidelines may not be sufficient for instances where the number of pipes in a manhole or box requires a larger structure. Larger structures may require deeper minimum depths for structural considerations.

Flow= 140.0 cfs
n= 0.015
Sarting at the south end

Pipe Section	Slope	Length (ft)	Required Diamter	Flow in each pipe	Daimter (in)	
1	3.17%	612	1.81	26.742	21.7	
2	1.91%	560	2.54	51.211	30.4	
3	1.44%	572	3.10	76.205	37.3	
4	1.74%	660	3.38	105.044	40.6	
5	3.00%	140	3.19	118.152	38.3	outlet 1
-6	0.15%	300	2.44	13.109	29.3	
7	2.38%	500	1.77	21.848	21.2	outlet 2
Total length		3204				

Average Pipe Size (in) = 32.19
Pipe Size Selceted (in) = 30



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.128** (0.111-0.151)	**0.163** (0.142-0.193)	**0.226** (0.195-0.267)	**0.281** (0.240-0.334)	**0.367** (0.305-0.437)	**0.444** (0.361-0.530)	**0.532** (0.423-0.640)	**0.634** (0.489-0.772)	**0.796** (0.586-0.987)	**0.941** (0.667-1.19)
10-min	**0.195** (0.168-0.229)	**0.249** (0.216-0.294)	**0.345** (0.296-0.407)	**0.428** (0.365-0.508)	**0.559** (0.465-0.664)	**0.675** (0.550-0.807)	**0.810** (0.644-0.975)	**0.966** (0.744-1.18)	**1.21** (0.891-1.50)	**1.43** (1.01-1.81)
15-min	**0.241** (0.209-0.285)	**0.308** (0.268-0.365)	**0.427** (0.367-0.504)	**0.531** (0.452-0.630)	**0.692** (0.576-0.824)	**0.837** (0.681-1.00)	**1.00** (0.798-1.21)	**1.20** (0.922-1.46)	**1.50** (1.10-1.86)	**1.78** (1.26-2.24)
30-min	**0.325** (0.281-0.383)	**0.415** (0.361-0.491)	**0.575** (0.494-0.679)	**0.715** (0.609-0.848)	**0.932** (0.775-1.11)	**1.13** (0.918-1.35)	**1.35** (1.07-1.63)	**1.61** (1.24-1.96)	**2.02** (1.49-2.51)	**2.39** (1.70-3.02)
60-min	**0.402** (0.348-0.474)	**0.514** (0.446-0.608)	**0.711** (0.612-0.840)	**0.885** (0.754-1.05)	**1.15** (0.959-1.37)	**1.40** (1.14-1.67)	**1.67** (1.33-2.01)	**1.99** (1.54-2.43)	**2.50** (1.84-3.10)	**2.96** (2.10-3.73)
2-hr	**0.505** (0.447-0.584)	**0.636** (0.559-0.736)	**0.840** (0.736-0.974)	**1.02** (0.887-1.19)	**1.31** (1.11-1.53)	**1.57** (1.31-1.84)	**1.87** (1.51-2.22)	**2.22** (1.74-2.66)	**2.77** (2.07-3.38)	**3.26** (2.35-4.06)
3-hr	**0.582** (0.521-0.663)	**0.726** (0.650-0.828)	**0.927** (0.828-1.06)	**1.11** (0.982-1.27)	**1.39** (1.21-1.60)	**1.64** (1.39-1.89)	**1.93** (1.61-2.25)	**2.27** (1.85-2.68)	**2.83** (2.21-3.40)	**3.33** (2.51-4.08)
6-hr	**0.756** (0.687-0.844)	**0.933** (0.847-1.04)	**1.15** (1.04-1.28)	**1.33** (1.20-1.49)	**1.59** (1.41-1.79)	**1.82** (1.60-2.06)	**2.09** (1.80-2.39)	**2.40** (2.04-2.78)	**2.94** (2.42-3.46)	**3.42** (2.75-4.09)
12-hr	**0.971** (0.887-1.07)	**1.19** (1.09-1.32)	**1.44** (1.31-1.60)	**1.65** (1.50-1.83)	**1.95** (1.75-2.17)	**2.18** (1.94-2.44)	**2.43** (2.13-2.74)	**2.72** (2.35-3.10)	**3.21** (2.72-3.72)	**3.65** (3.03-4.28)
24-hr	**1.27** (1.19-1.36)	**1.57** (1.46-1.68)	**1.88** (1.76-2.02)	**2.14** (2.00-2.29)	**2.49** (2.32-2.66)	**2.76** (2.55-2.95)	**3.02** (2.79-3.25)	**3.30** (3.02-3.54)	**3.66** (3.33-3.94)	**3.93** (3.55-4.32)
2-day	**1.43** (1.34-1.53)	**1.76** (1.64-1.89)	**2.13** (1.98-2.28)	**2.43** (2.26-2.60)	**2.85** (2.64-3.06)	**3.18** (2.93-3.42)	**3.53** (3.24-3.79)	**3.88** (3.54-4.18)	**4.37** (3.94-4.73)	**4.75** (4.25-5.17)
3-day	**1.58** (1.48-1.69)	**1.94** (1.82-2.09)	**2.36** (2.21-2.54)	**2.71** (2.53-2.92)	**3.20** (2.98-3.45)	**3.59** (3.32-3.87)	**4.00** (3.68-4.31)	**4.43** (4.04-4.79)	**5.01** (4.52-5.44)	**5.47** (4.90-5.98)
4-day	**1.72** (1.61-1.86)	**2.13** (1.99-2.29)	**2.60** (2.43-2.80)	**2.99** (2.79-3.23)	**3.56** (3.31-3.83)	**4.00** (3.71-4.32)	**4.47** (4.12-4.83)	**4.97** (4.54-5.39)	**5.66** (5.11-6.16)	**6.20** (5.55-6.79)
7-day	**2.00** (1.88-2.15)	**2.47** (2.32-2.66)	**3.01** (2.81-3.23)	**3.45** (3.21-3.70)	**4.06** (3.77-4.36)	**4.54** (4.21-4.88)	**5.04** (4.64-5.44)	**5.55** (5.07-6.00)	**6.25** (5.65-6.80)	**6.79** (6.09-7.43)
10-day	**2.27** (2.13-2.43)	**2.80** (2.63-2.99)	**3.38** (3.16-3.61)	**3.85** (3.60-4.12)	**4.49** (4.17-4.80)	**4.97** (4.61-5.32)	**5.47** (5.04-5.86)	**5.97** (5.48-6.41)	**6.63** (6.03-7.15)	**7.15** (6.45-7.73)
20-day	**3.06** (2.89-3.25)	**3.78** (3.57-4.02)	**4.52** (4.27-4.81)	**5.10** (4.80-5.42)	**5.86** (5.51-6.22)	**6.42** (6.02-6.82)	**6.97** (6.51-7.42)	**7.52** (6.99-8.02)	**8.21** (7.58-8.80)	**8.72** (8.02-9.38)
30-day	**3.67** (3.46-3.90)	**4.53** (4.28-4.82)	**5.42** (5.12-5.77)	**6.14** (5.79-6.53)	**7.10** (6.67-7.55)	**7.82** (7.32-8.33)	**8.55** (7.96-9.12)	**9.27** (8.59-9.91)	**10.2** (9.39-11.0)	**10.9** (9.97-11.8)
45-day	**4.65** (4.40-4.93)	**5.72** (5.41-6.06)	**6.79** (6.42-7.20)	**7.64** (7.21-8.09)	**8.74** (8.22-9.26)	**9.55** (8.96-10.1)	**10.4** (9.68-11.0)	**11.2** (10.4-11.9)	**12.2** (11.2-13.1)	**12.9** (11.9-13.9)
60-day	**5.58** (5.27-5.91)	**6.87** (6.49-7.29)	**8.14** (7.68-8.62)	**9.12** (8.60-9.66)	**10.4** (9.76-11.0)	**11.3** (10.6-12.0)	**12.2** (11.4-12.9)	**13.0** (12.1-13.8)	**14.1** (13.1-15.1)	**14.9** (13.7-15.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates ▼ Submit

(385) 224-2644
btkw24@gmail.com

BRANDON WALKER

SKILLS & ABILITIES

- Fluent in Spanish (read and write)- nine years of experience, lived for two years in Argentina
- Computer skills (type 70+ wpm, proficient in Microsoft Office including VBA programming)
- Data analysis (1.5 years of experience compiling sales reports for national homeopathics company)
- Basic knowledge of engineering mechanics, CAD, and environmental, structural, geotechnical and materials engineering

WORK EXPERIENCE

ASSISTANT TO V.P. OF SALES, DESERET BIOLOGICALS

March 2014 – March 2016

Managed salesforce account. Compiled quarterly sales reports finding deficiencies in sales reps, customers, etc. Mass email clients.

ALARM TECHNICIAN, MOUNTAIN WEST SECURITY

June - September 2011, February - July 2014, July – September 2015

Installed residential and commercial security, fire, and surveillance systems. Provided customer service.

BRIDGE BUILDING COMPETITION COORDINATOR, BYU CIVIL ENGINEERING DEPARTMENT

November 2014 – March 2015

Coordinated bridge building competition among nine local schools. Maintained contact with teachers/administrators during process of ordering, preparing and delivering materials, and organized and carried out the competition at each school.

EDUCATION

BRIGHAM YOUNG UNIVERSITY

Currently in third of four year Civil Engineering Degree along with Spanish Minor and university honors program. Maintain 3.81 GPA. Member of Tau Beta Pi (engineering honors society).

AMERICAN FORK HIGH SHCOOL

Graduated with honors and 4.0 GPA. Participated in Track and Field and Spanish club.

LEADERSHIP/SERVICE

- Eagle Scout
- Held leadership positions in church over groups ranging from 6-200 over the past 10 years
- Two-year religious mission in Argentina
- Supervisor of two employees (Mountain West Security)
- Held volunteer position in BYU ASCE student chapter organizing field trips with local engineering companies for first-year engineering students

REFERENCES

KEVIN BRADBURN , ORCHARD SECURITIES

(801) 361-3564

JACOB CARTER, DESERET BIOLOGICALS

(801) 361-1655

Joel Whitmer

3832 s. 2475 w.
West Valley City, Utah 84119
joel7whitmer@gmail.com
801-836-2320

Hometown: West Valley City, Utah
College Class: Senior

EXPERIENCE

Focus Engineering and Surveying Midvale, Utah *April 2016 - Current*
Site Civil CAD Designer/Structural Engineering Designer-Intern

- Structural Engineering of residential homes, detached garages and small commercial buildings using StruCalc, Hilti Profis, and Forte. Create site grading plans using Civil 3D according to my own judgement. Maintain deadlines of projects while working under a heavy influx of new projects.

West Valley City Public Works West Valley City , Utah *May 2015 - August 2015*
Inspector-Intern

- Performed regular concrete, compaction, and other constructions site tests. Oversaw the construction and maintenance of many sidewalks, roads, and storm drain systems. Took GPS points in the field for use in mapping programs. Stormwater quality checks. Regularly worked unsupervised to accomplish assignments.

Romney Pest Control San Antonio , Texas *April 2014 - August 2014*
Route Manager

- Managed routes and accounts for customers. Performed door to door interactions to sell the product. Overcame concerns and to acquire a feeling of trust in a short amount of time.

Marshall Industries West Valley City , Utah *April 2013 - August 2013*
Audio Data Installer

- Installed audio and data lines in existing, newly constructed, and under construction buildings. Major problem solving to find best ways to connect the electronics, while making it quick and efficient.

EDUCATION

Brigham Young University Provo , Utah **Graduation**-June 2017
Civil and Environmental Engineering, Structural Emphasis GPA ***3.48***

SKILLS

- AutoCAD, Civil 3D, StruCalc, Forte, Hilti Profis, RetainPro
- Visual Basic Spreadsheets
- Moldable and easy to work with
- Quick learner and efficient worker.

Accomplishments and Life Experience

- Leadership experience while serving LDS mission
- Leadership experience through sports
- Leadership experience through Eagle Scout
- Navigated college debt free, supporting myself.

INTERESTS

- Member of BYU Steel Bridge Team
- Camping
- Backpacking
- Rock Climbing/Canyoneering
- Reading Fiction

Clay Hansen

(801) 400-2325 • clay.handsome@gmail.com • 421 N 800 E Provo, UT 84606

EDUCATION

BS, Civil and Environmental Engineering expected graduation: April 2017
Brigham Young University, Provo, UT

- 3.17 GPA
- Relevant coursework: Fluid Mechanics, Surveying, Environmental Engineering, Public Speaking

PROFESSIONAL EXPERIENCE

Lab Tech November 2015 - Current
Civil Engineering Department: BYU, Provo

- Used critical thinking skills to help on over four graduate level research projects

Student Laborer October 2013 - November 2015
Site Development Hard Surface Team: BYU, Provo

- Maintained a self-motivated, high-quality of workmanship
- Acted as the student lead on a variety of projects

Construction Laborer and Equipment Operator June 2008 - August 2015
Porter Tanner Associates: Barnwell, AB

- Worked with varying sizes of teams on multiple major excavation projects, including: Sewer lift stations, irrigation pipelines, and a water treatment plant

Ranch Hand June 2010 - August 2015
Eagle Ag. Corporation: Barnwell, AB

- Coordinated with a team during harvest, often spending long hours to meet deadlines
- Worked independently taking care of a cattle

VOLUNTEER AND LEADERSHIP

BYU Concrete Canoe Project Leader September 2013 - Current

- Organized supplies and volunteers for projects
- Designed and built automatic curing system

ASCE Student Chapter Officer August 2014 - April 2015

- Supervised up to six volunteers to coordinate social events
- Gathered information and helped put together an annual club report

Full-time Volunteer March 2011 - March 2013
Church of Jesus Christ of Latter-day Saints, San Diego, CA

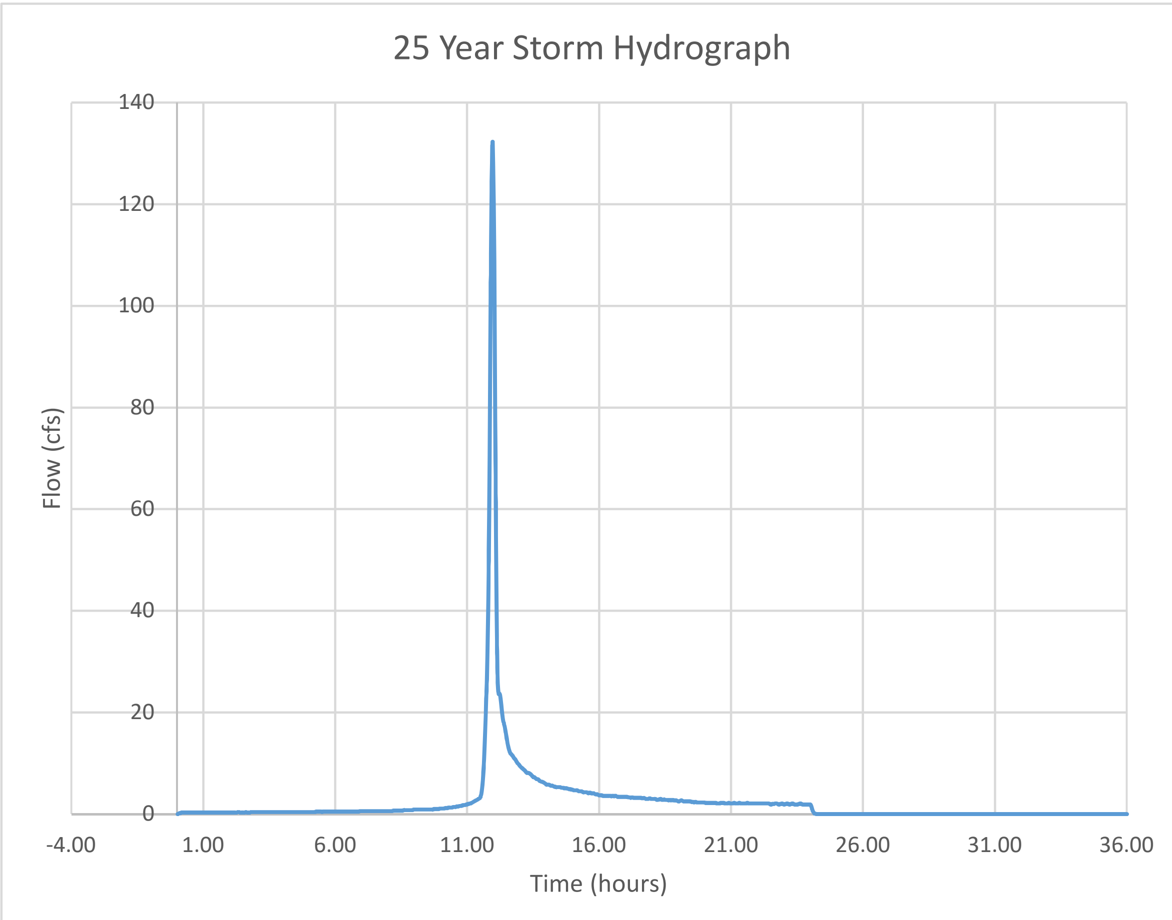
- Taught monthly trainings to 10-20 fellow volunteers
- Worked with one other volunteer to effectively schedule time and carry out plans

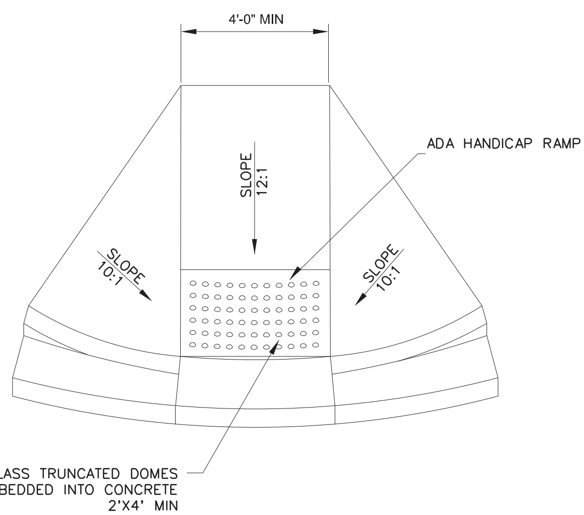
SKILLS

- Heavy Equipment Operator, Street Sweeper, Valid Canadian Class A Driver's License
- Horse Training, Ranch Roping
- Microsoft Excel

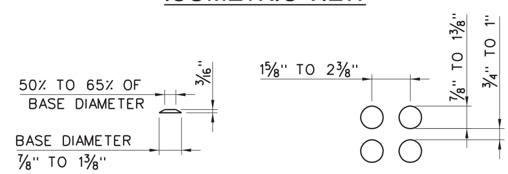
HMS

Area	0.1723	mi2
Curve Number	75	
Impervious Area	0.1	
Lag Time	3.6477	min
Loss Method	SCS CN	
Transform Method	SCS Unit Hydrograph	



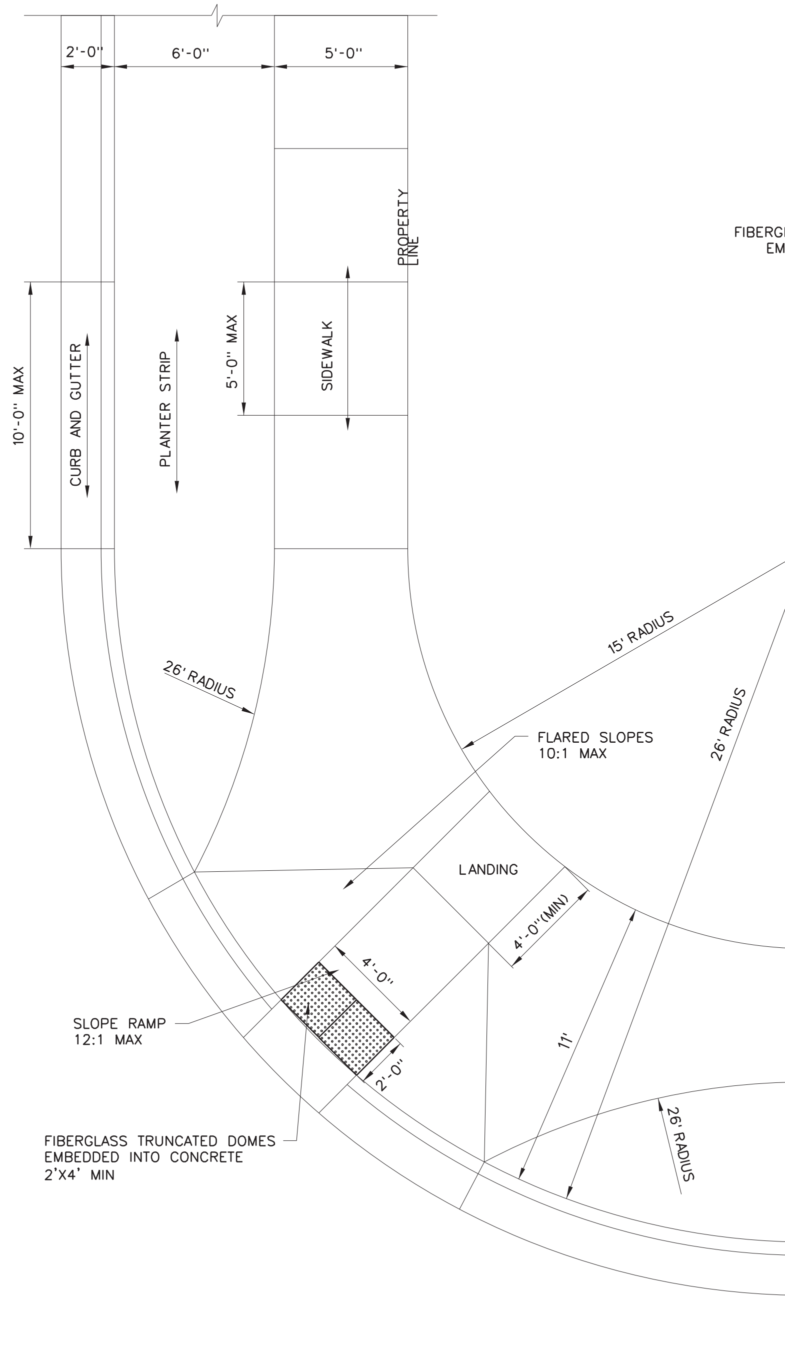
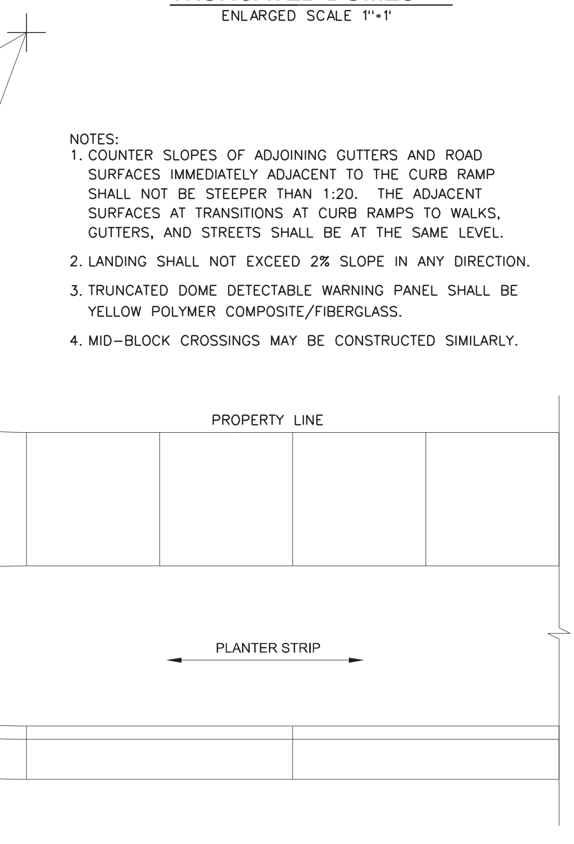


ISOMETRIC VIEW



TRUNCATED DOMES

ENLARGED SCALE 1"=1'

NOTES:

1. COUNTER SLOPES OF ADJOINING GUTTERS AND ROAD SURFACES IMMEDIATELY ADJACENT TO THE CURB RAMP SHALL NOT BE STEEPER THAN 1:20. THE ADJACENT SURFACES AT TRANSITIONS AT CURB RAMPS TO WALKS, GUTTERS, AND STREETS SHALL BE AT THE SAME LEVEL.
2. LANDING SHALL NOT EXCEED 2% SLOPE IN ANY DIRECTION.
3. TRUNCATED DOME DETECTABLE WARNING PANEL SHALL BE YELLOW POLYMER COMPOSITE/FIBERGLASS.
4. MID-BLOCK CROSSINGS MAY BE CONSTRUCTED SIMILARLY.

ELEVATION VIEW

NOT TO SCALE

REVISION

NO.	DESCRIPTION	BY	APR.	DATE

RESIDENTIAL CURB RAMP AT INTERSECTION

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG2A
CAD DWG:	std_dwgs_6-12.dgn
PLOT SCALE:	1.000
DRAWN BY:	NEB
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

DIVISION 12

CONCRETE CURB, GUTTER AND SIDEWALK

Section 12.01 GENERAL

This section covers installation of curb and gutter, sidewalk, combination of curb, gutter and sidewalk, cross gutter, drive approaches, handicap ramps and curb returns. All improvements shall be constructed to the dimensions and thickness shown on the Standard Drawings.

All compaction testing must be completed no less than 24 hours prior to the placement of any asphalt or concrete within the roadway and sidewalk.

No surface improvements (i.e. Roadbase, asphalt, curb, gutter, sidewalk…) shall be installed until all conduits and public utility crossings (i.e. Power conduits, gas line conduits…) are fully and completely installed.

Section 12.02 CONCRETE

Concrete shall be Class AA(AE) and shall meet all of the requirements of Division 8, Portland Cement Concrete. Under no condition shall the water cement ratio exceed 0.53.

Section 12.03 GRADE

Minimum flow line grade shall be 0.5 percent. Grade stakes for curb, gutter and/or sidewalk shall be placed every 25-feet around curves, 50-feet on tangent sections, at ¼ deltas and at the edges of the landings on curb returns. Grade stakes shall be placed at all PC's, PT's, PCR's, VPC's, and VPT's. Grade stakes shall also be set at the point of change in grade not requiring a vertical curve. Grade stakes and cut sheets shall have the centerline station of the street written on them that are the same as the stationing shown on the improvements drawings.

After construction, gutters shall be checked by flowing water. The Public Works Representative/Engineer shall be present during the flow test. Any high spots or depressions (which exceed 0.02 feet) shall be repaired by grinding high spots to the correct grade and/or removing concrete and replacing to the correct grade. Puddling shall not stand from flow line past lip of gutter.

Section 12.04 FORMS

All forms shall be steel, except at curves with a radius smaller than 200 feet. They shall be of a size to match the sections shown on the Standard Drawings. Forms shall be held firmly in place with stakes or other approved means and shall be true to line and grade.

All forms shall be clean and coated with a light oil to prevent the concrete from adhering to them. Clamps, spreaders and braces shall be used where required to insure rigidity in the forms.

Forms shall not vary from vertical grade by more than 0.02 feet and from horizontal alignment by more than 0.02 feet. All forms shall have smooth even lines in both the horizontal and vertical plane.

Forms for curved sections shall be so constructed and placed that the finish surface of walls and edge of sidewalks, curbs and gutters will not deviate from the arc of the curve.

Section 12.05 SUBGRADE PREPARATION

The Developer/Contractor shall grade to the line and grade approved by the City. **No concrete shall be placed without approved cut sheets**. The sub-grade shall be properly shaped to conform to the cross section shown on the Standard Drawings, graded and compacted. Compaction shall meet the requirements of Division 7 Earthwork.

DIVISION 19

STREET LIGHTING

Section 19.01 GENERAL

This division describes the design and installation of street lights.

Parts equivalent to the specified Hadco and Mountain States Lighting parts may be approved by the Public Works Representative/City Engineer.

Developers of land are responsible for payment for street lights. Santaquin City installs street lights in Santaquin.

If the developer/concractor will be installing the street light bases and conduit, the developer/contractor shall submit a bond for the installation of the bases, conduits and wire for an amount determined by the Public Works Representative/City Engineer.

Section 19.02 STREET LIGHTS ALONG LOCAL AND COLLECTOR STREETS

Refer to Standard Drawing L1 for a detail of the street light to be used along local and collector streets.

Sub-section A. Placement

Street lights along collector streets are placed at intersections and between intersections as needed so spacing does not exceed 350 feet. They are to be placed in the planter strip with the center of the pole 30" from the back of the curb.

Street lights along local streets are placed at intersections and between intersections as needed so spacing does not exceed 500 feet. They are to be placed in the planter strip with the center of the pole 30" from the back of the curb.

Installation of street lights along local and collector streets occurs at the time that land is subdivided along new or existing streets.

Sub-section B. Luminaire

The luminaire shall be a polyacrylic acorn style light. It must have a 10 year warrantee against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, black, steel, one-piece construction, 14' tall pole.

The base shall be a 29" high, 17" diameter, fluted, black decorative high density elastomer base (76 lbs per cubic foot – ½" minimum thickness) with with a "SANTAQUIN CITY" logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 Optics LED assembly with 40 total LED's.

Sub-section E. Installation

The foundation shall be a cast-in-place concrete foundation, and shall be installed in accordance with Division 7, Earthwork, Division 8, Portland Cement Concrete, and Division 9, Reinforcing Steel.

Section 19.03 STREET LIGHTS ALONG MAIN STREET

Refer to Standard Drawings L2 and L4 for details of the street light to be used along Main Street.

Sub-section A. Placement

Street lights along Main Street are placed at intersections and between intersections as needed so spacing does not exceed 200 feet.

Installation of street lights along Main Street occurs at the time sites are developed.

Sub-section B. Luminaire

The luminaire shall be an acrylic teardrop style light. It must have a 10 year warrantee against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, fluted, black, steel, one-piece construction, 20’ tall pole. A 120 Volt AC receptacle, two 30” banner arms, a flag holder, and a plant holder shall be mounted on the pole. The pole shall also have a hole with grommet for irrigation water tubing to hanging plant.

The base shall be a 38” high, 22” diameter, fluted, black decorative high density elastomer base with a “SANTAQUIN CITY” logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 light distribution LED assembly with 80 total LED’s.

Sub-section E. Installation

The foundation, installation and electrical connections shall meet the requirements of UDOT Highway Luminaire Pole Ground Mount Standard Drawing SL14 and Luminaire Slip Base Details Standard Drawing SL15, or replacement sheets containing similar but updated information as may be produced by UDOT from time to time.

Section 19.04 STREET LIGHTS ALONG ARTERIAL STREETS

Refer to Standard Drawings L3 and L4 for details of the street light to be used along arterial streets.

Sub-section A. Placement

Street lights along arterial streets are placed at intersections and between intersections as needed so spacing does not exceed 500 feet. They are to be placed in the planter strip with the center of the pole 30” from the back of the curb.

Installation of street lights along arterial streets occurs at the time sites are developed.

Sub-section B. Luminaire

The luminaire shall be an acrylic teardrop style light. It must have a 10 year warrantee against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, fluted, black, steel, one-piece construction, 20’ tall pole. A 120 Volt AC receptacle insert shall be mounted on the pole. The pole shall also have a hole with grommet for irrigation water tubing to hanging plant.

The base shall be a 38” high, 22” diameter, fluted, black decorative high density elastomer base with a “SANTAQUIN CITY” logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 light distribution LED assembly with 80 total LED’s.

Sub-section E. Foundation

The foundation shall be a cast-in-place concrete foundation (see Standard Drawing L4), and shall be installed in accordance with Division 7, Earthwork, Division 8, Portland Cement Concrete, and Division 9, Reinforcing Steel.

All excess material excavated by the Developer/Contractor shall be removed from the site. Removal of the excavated material shall be done before or immediately after the concrete is placed. The Developer/Contractor shall maintain adequate barricades and other devices to protect the public until excavated material is removed.

Placement of concrete on unsuitable materials shall not be permitted. The subgrade surface shall have a 6-inch road base foundation as shown on the Standard Drawings. Prior to the placing of concrete, the subgrade shall be compacted using a mechanical foot compactor, with compaction being at least ninety-five percent (95%) of the maximum dry density as determined by AASHTO T-180 (Modified Proctor). The surface shall be proof rolled prior to placing any concrete and no concrete shall be placed until the surfaces have been inspected and approved by the Public Works Representative/Engineer.

All trails to be constructed of bituminous asphalt cement pavement shall have the subgrade sterilized directly below the trail prior to roadbase being placed. The method of sterilizing shall be approved by the Public Works Representative/City Engineer.

Section 12.06 CONSTRUCTION OF CURB, GUTTER AND SIDEWALK

Concrete curb, gutter and sidewalk may be constructed by first constructing the curb and gutter and then constructing the sidewalk behind it. If this method is used the joint between the back of curb and front edge of sidewalk shall be sealed. The curb and gutter may be placed using stationary forms or the slip method of forming. No sidewalk shall not be constructed until after all public utilities have been installed.

Monolithic curb, gutter and sidewalk may be constructed. Stationary forms can be used to place combination curb, gutter and sidewalk. The slip form method can be used if it can be demonstrated that the tolerances specified herein can be met.

Curb and gutter to be installed with bituminous asphalt cement pavement shall have contraction joints placed every 10 feet by use of 1/8-inch steel template of the exact cross section of the curb and gutter. Where dividing plates are used joints shall have a minimum of 2-inches of concrete under the plate, or the joint will be sealed with an approved sealant. Remove the templates as the concrete takes initial set. Cut the joint 1-1/2 inches deep when using the slip form method to place the concrete. Use 1/2-inch thick, pre-molded, expansion joint filler at curb and gutter radii, where the curb and gutter abuts a solid object and at intervals not to exceed 30 feet, unless otherwise specified by the Public Works Representative/Engineer.

Joints in sidewalk, when placed separately and adjacent to the curb shall match the contraction and expansion joints in the curb and gutter as well as where the sidewalk abuts a solid object. Sidewalks not placed adjacent to the curb shall have contraction joints at 5-foot intervals. The joints shall be approximately 3/16 inch wide and approximately one-half of the total slab thickness in depth. Expansion joints shall be 1/2-inch thick. They shall be placed every 30 feet and where new sidewalk adjoins existing sidewalks or abuts a solid object.

Material for 1/2-inch expansion joints shall be as specified in AASHTO M-153 and AASHTO M-213, and shall be installed with its top approximately 1/4-inch below the concrete surface.

After the concrete placed for a sidewalk has been brought to the established grade and screeded, it shall be float finished, edged and then given a light broom finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of 1/2 inch.

After concrete has been placed in curb and gutter forms, it shall be consolidated so as to insure a thorough mixture, eliminate air pockets, and create uniform, smooth sides. As the concrete takes its initial set the forms shall be removed and all exposed surfaces shall be float finished, edged and broomed lightly. The curb and gutter shall be constructed to the dimensions shown in the Standard Drawings.

The top and face of the curb and also the top of the apron on combination curb and gutter must be finished true to line and grade and without any noticeable irregularities of surface. The surface or face of the curb and gutter shall not vary more than 1/4 inch from a straight edge ten feet in length, placed on the curb parallel to the street center line nor shall any part of the exposed surface present a wavy appearance.

Section 12.07 CONCRETE CURB WALL

Concrete curb wall shall be Class AA(AE) and shall meet all of the requirements of Division 8, Portland Cement Concrete.

Reinforcing steel shall meet the requirements of Division 9, Reinforcing Steel.

Excavation for and backfill around the curb walls shall meet all the requirements of Division 7, Earthwork.

The curb walls shall be constructed to the dimensions and grades shown on the Standard Drawings or improvement drawings or as determined by the Public Works Representative/Engineer.

Section 12.08 6-INCH CONCRETE DRIVE APPROACH

The concrete to be used for the drive approach shall be Class AA(AE) and shall meet the requirements of Division 8, Portland Cement Concrete.

The drive approach shall be a minimum of 6-inch thick. They shall be constructed to the dimensions shown on the Standard Drawings. The concrete shall be finished as described above for sidewalks.

The drive approaches shall have a compacted 6-inch untreated base course under them.

Section 12.09 ACCESSIBILITY STANDARDS IN PUBLIC RIGHTS-OF-WAY

This section sets guidelines for accessibility in public rights-of-way. These guidelines are to be applied during the design, construction, and alteration of improvements in public rights-of-way. These guidelines are to be followed insomuch as they are technically feasible. Every attempt should be made to comply with the current guidelines of the "Americans with Disabilities Act" (ADA).

The construction of curb ramps and drive approaches shall conform to the Standard Drawings.

The following definitions apply:

a) The pedestrian access route is an accessible corridor for pedestrian use within the public right-of-way.

b) Pedestrian crossings are those locations in which pedestrians cross streets.

c) A ramp is a portion of the pedestrian access route that makes a vertical transition between two flatter surfaces. It is sloped in the direction of travel. It does not include the side flares that exist on a perpendicular curb ramp.

d) The side flare is the portion of a perpendicular curb ramp that transitions between the plane of the ramp surface and the plane of the flatter adjacent sidewalk.

e) The term perpendicular curb ramps refers to all features associated with a ramp whose running slope is perpendicular to the curb line.

f) The term parallel curb ramps refers to all features associated with a ramp whose running slope is in the direction of sidewalk travel.

g) Blended transitions are locations along the pedestrian access route in which the street and the sidewalk are at the same level.

h) Detectable warning is a surface feature built in or applied to walking surfaces or other elements to warn of hazards on a circulation path.

The pedestrian access route shall not be less than 4 feet wide, not including the curb, and shall have a cross slope of not more than 2%.

Concrete surfaces shall have a broom finish to increase slip resistance.

Sub-section A. Sidewalks:

The cross slope shall not exceed 2%.

Changes in level/elevation (vertical rises between adjacent surfaces) shall meet the following requirements:

1) Differences of up to ¼ inches can remain without beveling.

2) Differences of over ¼ inch but no more than ½ inch must be beveled with a maximum grade of 2:1 (50%).

3) Differences of over ½ inch must be removed or a ramp must be created having a maximum grade of 12:1 (8.33%).

Sub-section B. Curb Ramps:

Curb ramps shall be provided wherever a pedestrian access route crosses a curb.

The ramp grade shall not exceed 12:1 (8.33%).

The cross slope of the ramp shall not exceed 50:1 (2%), except that on perpendicular curb ramps at midblock crossings, the cross slope may match the slope of the adjacent street.

The minimum ramp width shall be 48 inches.

No lip shall exist at the bottom of curb ramps.

Sub-section C. Landings:

A landing shall exist at the top of curb ramps. The landing shall not have a slope in excess of 2% in any direction, and shall be a minimum of 48 inches by 48 inches in size. Parallel curb ramps and blended transitions shall have a landing at the bottom of the ramp (still in the sidewalk, not in the street) meeting the same criteria.

At the foot of diagonal curb ramps (ramps located in the curb return, whose running slope is directed diagonally into the intersection), a 48-inch by 48-inch landing of clear space must exist, beyond the curb line, entirely contained within the crosswalks, and outside of the vehicular travel lanes.

Sub-section D. Side Flares:

The slope of side flares on perpendicular curb ramps shall not exceed 10:1 (10%).

If it is not technically feasible to achieve a 4-foot landing (measured in the direction of the running slope of the ramp) at the top of a perpendicular curb ramp, the landing may be reduced to 3 feet, in which case the slope of the side flares shall not exceed 12:1 (8.33%).

Sub-section E. Built up Curb Ramps:

Built-up curb ramps shall be located so that they do not project into vehicular traffic lanes.

Sub-section F. Obstructions:

Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

Sub-section G. Location of Marked Crossings:

Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides.

Sub-section H. Diagonal Curb Ramps:

If diagonal (or corner type) curb ramps have returned curbs or other well defined edges, such edges shall be parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have a forty-eight (48) inch minimum clear space. If diagonal curb ramps are provided at marked crossings, the forty-eight (48) inch clear space shall be within the markings. If diagonal curb ramps have flared sides, they shall also have at least a twenty-four (24) inch long segment of straight curb located on each side of the curb ramp and within the marked crossing.

Sub-Section L. Curb Ramps Associated with Trails.

Any curb ramps associated with an asphalt trail system shall be installed only after the asphalt trail has been constructed

Sub-section J. Detectable Warnings:

Detectable warning panels shall be placed at ramps and other locations in which the pedestrian access route crosses streets. They are intended to warn visually-impaired people of potential hazards by indicating the transition from sidewalk to street.

The detectable warning panels shall be cast-in-place and shall be yellow polymer composite/fiberglass:.

They shall consist of truncated domes aligned in a square grid pattern having the following characteristics:

1) Base diameter of 0.9 inch – 1.4 inch
2) Top diameter of 50%-60% of base diameter
3) Height of 0.2 inch
4) Center-to-center spacing of 1.6 inch – 2.4 inch

The detectible warning shall be 2 feet deep (measured in the direction of pedestrian travel). They shall run across the full width of ramps or blended transitions. They should be set back 6” to 8” from the flowline of the gutter.

The detectable warning panel shall be installed so that it is flush (at the base of the truncated domes) with the adjacent concrete.

Sub-section K. Islands:

Any raised islands in crossing shall be cut through level with the street or have curb ramps at both sides and a level area at least forty-eight (48) inches long between the curb ramp in the part of the island intersected by the crossing.

Sub-section L. Pedestrian Crossings:

Where crosswalks are marked, they shall be at least 8 feet wide.

The foot of a curb ramp shall be wholly contained within the crosswalk markings.

The cross slope (measured perpendicular to the direction of pedestrian travel) of marked or unmarked crosswalks is limited to 2%, except at mid-block crossings.

The counterslope of the gutter or street surface at the bottom of a ramp or blended transition (measured in the direction of pedestrian travel) shall not exceed 5%.

The maximum running slope (measured in the direction of travel) for crosswalks is 5%.

Section 12.10 LANDSCAPE RESTORATION

Areas of new construction that cover or disturb existing landscaped areas with fills and cuts or areas disturbed by construction of retaining walls shall have the landscape restored. Areas that have lawn or flower beds shall be restored including sprinkling systems that might be damaged or relocated because of construction. Lawn covered or removed shall be replaced by sod.

The replaced topsoil shall be fertile, sandy loam topsoil, obtained from well-drained areas. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, sticks, plants or their roots, toxic substances or other extraneous matter that may be harmful to plant growth and would interfere with future maintenance. Topsoil pH range shall be 5.3 to 6.0.

DIVISION 13

STORM DRAINS

Section 13.01 GENERAL

This section covers installation of storm drainpipe, manholes, and curb face inlet boxes. All improvements shall be constructed to the dimension and thickness shown on the Standard Drawings.

Section 13.02 PIPE INSTALLATION

Installation of pipe shall be in an open trench unless otherwise shown. Trench and backfill shall meet the requirements of Division 2, Trench Excavation and Backfill.

Section 13.03 PIPE

Pipe and pipe laying shall meet the requirements of Division 4, Concrete Pipe, Division 4A, PVC Plastic Pipe, Division 4B, Polyethylene Corrugated Pipe, Division 4C, Polyethylene Corrugated Pipe with Water Tight Joints. Pipe shall be laid with the bells up grade. The minimum size pipe used in a storm drain shall be fifteen inches (15”).

Section 13.04 MANHOLES

Manholes shall meet the requirements of Division 5, Manholes. Where the size of the storm drain does not permit use of manholes, precast or cast-in-place reinforced concrete boxes shall be used. Concrete used in precast or cast-in-place boxes shall be Class AA(AE).

Section 13.05 CONCRETE

Concrete shall meet the requirements of Division 8, Portland Cement Concrete.

Section 13.06 REINFORCING STEEL

Reinforcing steel shall meet the requirements of Division 9, Reinforcing Steel.

Section 13.07 STORM DRAIN INLET BOXES

This section covers the types of inlet boxes and grates that may be used. Combinations of single inlets may be required depending on the design capacity of each inlet.

Sub-section A. Concrete inlet boxes:

The concrete to be used for the storm drain inlet boxes shall be Class AA(AE). The boxes shall be built to the dimensions and reinforced as shown on the Standard Drawings. The boxes may be precast or cast-in-place. Pipes connecting to the inlet boxes shall be flush with the inside wall of the box and grouted inside and outside of the boxes. The grout and pipe inside the box shall be flush with the inside wall.

Excavation and backfill of the boxes shall meet the requirements of Division 7, Earthwork.

The storm drain inlet grate and frame shall be a D & L Supply I-3518 single unit with curb box with type "V" grate or equal. Grates and frames are to be dipped in cold tar epoxy following fabrication. Following construction of the curb and gutter improvements and before the final inspection each inlet box shall have a decal mounted on the curb face adjacent to the inlet box. The decal shall be purchased from the City by the Developer.

Sub-section B. PVC inlets:

PVC surface drainage inlets shall be of the road and highway structure type. The **ductile iron frame, grate** for each of these structures are considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The road and highway structure shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc. or prior approved equal.

Materials: The road and highway structure shall be manufactured from PVC stock, utilizing thermo-molding process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the main body of the structure. The pipe stock used to manufacture the main body and pipe stubs of the curb inlet basin shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Stand for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.

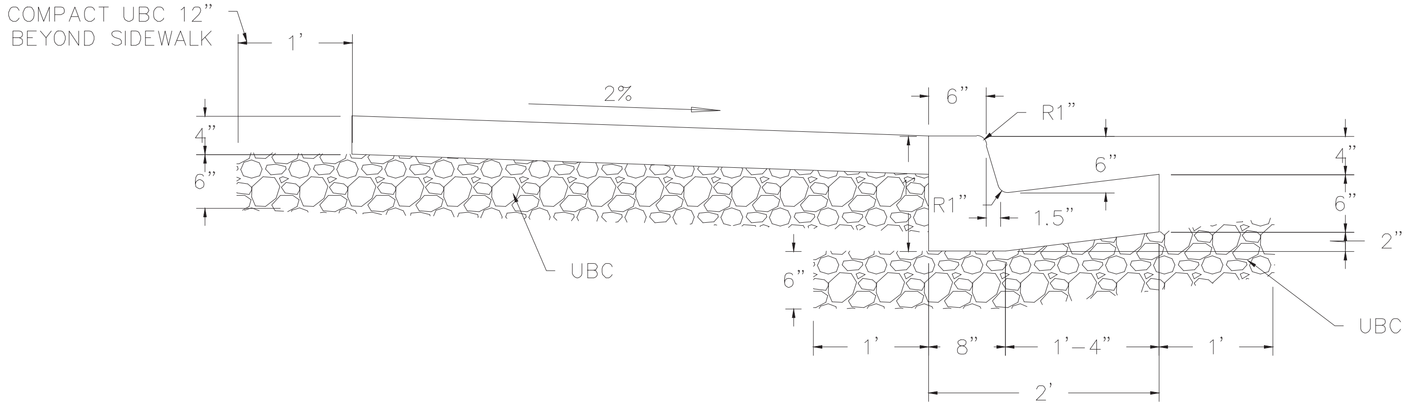
The grate and frame for all road and highway structures shall be ductile iron and shall be made specifically for each so as to provide a round bottom flange that closely matches the diameter of the PVC basin body. The grate and frame shall be capable of supporting H-25 wheel loading for heavy-duty traffic. The metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron.

Installation: The specified PVC road and highway structure shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 1 or 2 materials as defined in ASTM D2321. The road and highway structure shall be bedded and backfilled uniformly in accordance with ASTM D2321. An 8-inch to 10-inch thick concrete ring will be poured under the frame and grate as recommended by details provided by the manufacturer. The road and highway structure body will be cut at the time of final grade so as to maintain a one piece, leak proof structure. No brick, stone, or concrete block will be used to set the frame and grate to the final grade height.

Section 13.08 PIPE CONNECTING INLET BOXES TO EXISTING STORM DRAINS

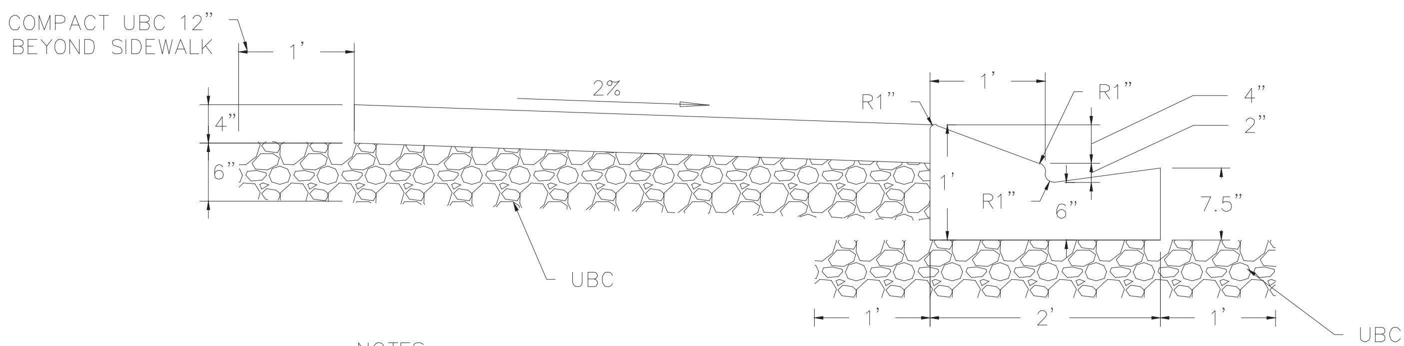
The pipe to be used for connecting a new inlet box to an existing storm drain shall be of the same type of pipe as the existing pipe to which it is being connected. Where possible such connections shall be made by installation of a manhole. The Public Works Representative/Engineer shall approve connection locations and methods.

Connections to concrete pipe shall be by coring a hole in the pipe and then grouting the connecting pipe to the concrete pipe. Connections to PVC or HDPE pipe shall be as per manufacture's recommendations. These recommendations will be reviewed with the Public Works Representative/Engineer prior to construction.



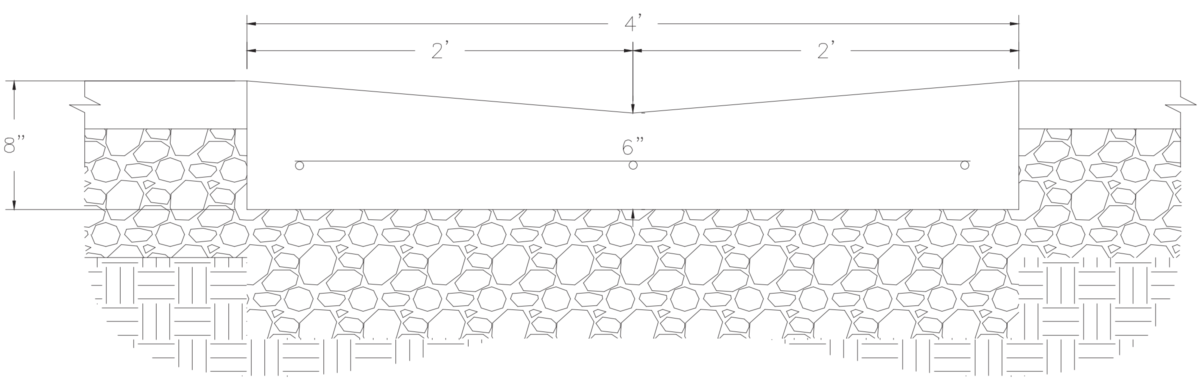
NOTES:
1. PROVIDE A TOOLED JOINT EVERY 10' IN CURB & GUTTER, & EVERY 5' IN SIDEWALK.
2. PROVIDE AN EXPANSION JOINT EVERY 30' IN SIDEWALK.

TYPICAL HIGH BACK CURB AND GUTTER



NOTES:
1. 24" MOUNTABLE CURB IS APPROVED ONLY ON A CASE BY CASE BASIS. (FACTORS FOR APPROVAL INCLUDE SUBDIVISION SIZE, STORM WATER DRAINAGE ISSUES, STREET WIDTH, AND SURROUNDING SUBDIVISIONS
2. TRANSITIONS TO HIGH BACK CURB SHALL BE ACCOMPLISHED IN A MINIMUM OF 6'. (FOR CURB INLET BOXES, ETC.)

MODIFIED CURB AND GUTTER



CROSS GUTTER

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REVISION

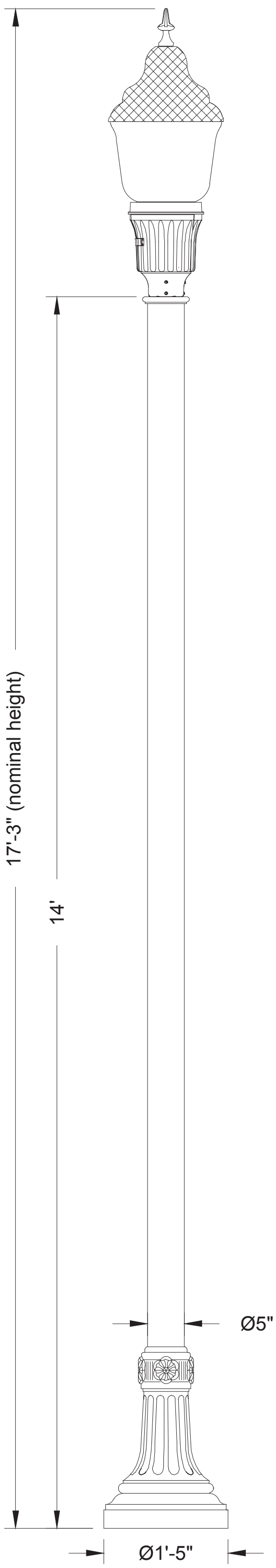
NO.		BY	APR	DATE

CURB & GUTTER AND CROSS GUTTER DETAILS

SANTAQUIN CITY
275 WEST MAIN STREET

CG4

ADOPTED DATE:
19 - OCT - 16



Specifications

POST DESCRIPTION
The lighting post shall be all aluminum, one-piece construction, with a classic tapered and fluted base design. The shaft shall be Ø5" smooth.

MATERIALS
The base shall be heavy wall, cast aluminum produced from certified ASTM 356.1 ingot per ASTM B-179-95a or ASTM B26-95. The straight shafts shall be extruded from aluminum, ASTM 6061 alloy. All hardware shall be tamper resistant stainless steel. Anchor bolts to be completely hot dip galvanized.

CONSTRUCTION
The shaft shall be double welded to the base casting and shipped as one piece for maximum structural integrity. The shaft shall be circumferentially welded inside the base casting at the top of the access door, and externally where the shaft exits the base. All exposed welds below 8' shall be ground smooth. All welding shall be per ANSI/AWS D1.2-90. All welders shall be certified per Section 5 of ANSI/AWS D1.2-90.

DIMENSIONS
The post shall be 14'-0" in height with a 17" diameter base. The shaft diameter shall be 5". At the top of the post, a Ø3" x 3" tall tenon with a transitional donut shall be provided for luminaire mounting.

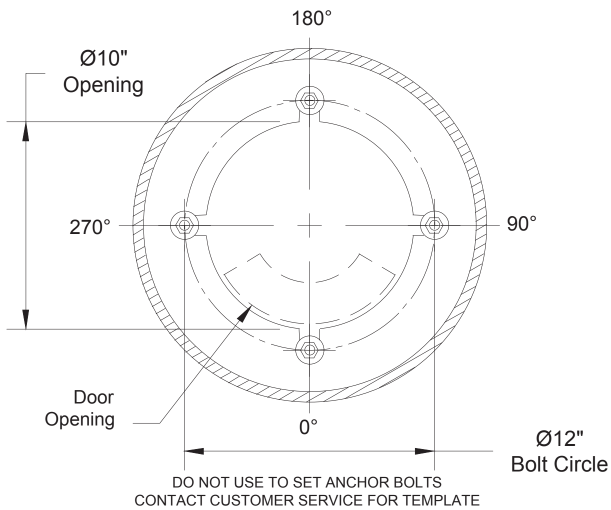
INSTALLATION
The post shall install with four, stainless steel L-type anchor bolts to be installed on a 12" diameter bolt circle. A door shall be provided in the base for anchorage and wiring access. A grounding screw shall be provided inside the base opposite the door.

FINISH
The entire assembly shall have a standard Holophane 'black' finish.

LUMINAIRE DESCRIPTION
- Granville Premier II LED
- 40W 215mA Driver, 4k CCT
- Auto-Sensing 120-277V
- Symmetric Type V, No Trim, Spike Finial, Full Cover
- NEMA Twistlock Photocontrol Receptacle
- DTL Twistlock Photocontrol For Solid-State Lighting 120-277V
- 25ft Prewired Leads

For complete specifications see LUM_GPD.

Anchorage Detail



DO NOT USE TO SET ANCHOR BOLTS
CONTACT CUSTOMER SERVICE FOR TEMPLATE

Catalog #'s:
GPD404KASMB5NSBFCVRBHPCSL25 - NYA14S5J17P07ABGBK

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REVISION

NO.		BY	APR	DATE

Santaquin

LOCAL AND COLLECTOR STREET LIGHTING DETAILS

SANTAQUIN CITY
275 WEST MAIN STREET

L1

ADOPTED DATE:
19 – OCT – 16