Storm Drainage Report

Prepared for

Mag N Bag Lot

Project Site:

Snowbasin Resort

Prepared by:

Talisman Civil Consultants, LLC

1588 South Main Street, Suite 200

Salt Lake City, Utah 84115

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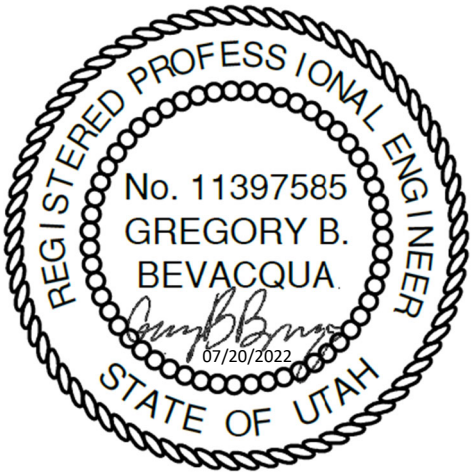
CIVIL CONSULTANTS



July 20, 2022

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1.0 PROJECT DESCRIPTION & EXISTING CONDITIONS

The project site is located on Snowbasin Road at UDOT Mile Marker 1.6 approximately. The site is bounded to the south by Snowbasin Road, and open space surrounds the remaining project area. A Vicinity Map is included in the Appendix. The existing site is a cleared lot previously used as a storage for mountain operations. The proposed changes to the existing condition include an alternate access to the west of the existing driveway. The site generally slopes from west to east with an average slope of approximately 6.0%.

The onsite limit of disturbance is approximately 5.23 acres, the drainage area of the project site is approximately 4.15 acres. The remaining 1.08 acres will collect and convey to the existing roadside ditch at the frontage of the site.

The soil classification for the entire project site is Hydrologic Soils Groups C per GIS data from the Utah Geospatial Resource Center. The existing soils are heavily compacted and for the purposes of the drainage analysis, the site is considered impervious

There is no known offsite drainage affecting the site. There is no known storm drain master plans for the area or previous drainage studies for the project site. The site is located in Zone X, areas determined to be outside 500-year floodplain, as shown on Flood Insurance Rate Map number 49057C0475F, dated June 2, 2015.

The existing onsite drainage appears to sheet flow from northwest to southeast where a rip rap path collects the runoff and ultimately conveys it to an existing drainage northeast of the site. The proposed onsite drainage consists of one basin, runoff will be collected into two vegetated swales along the north and south of the site that slopes southeast routed to a retention/detention pond at the southeast of the site. A post development basin map can be found in the appendix.

The pond is designed to retain the 80th percentile runoff volume and detain the runoff volume of the 100-year storm event. An emergency overflow route has been provided near the eastern boundary of the site where runoff exceeding the 100-year event can overflow to the existing natural drainage to the northwest.

2.0 METHODOLOGY

There are two components to the methodology used for design, retention and detention. To provide low impact water quality design retention volumes were calculated based on the 80th percentile storm volume using Utah DWQ' Guidance for Calculation of the 80th Percentile Storm Event. Detention volumes for the 100-year storm event were calculated using rainfall depths from NOAA Atlas 14.

Rational method for the 100-year storm volume and 80th percentile volume calculations are included in the appendix.

The parameters used for the design were:

- Water Quality Retention Volume: 80th percentile storm event per DWQ-2019-000161
- Detention Basin Sizing: The 100-year storm event per NOAA Atlas 14
- Maximum Release Rate: 0.1 cfs/acre
- Run-off Coefficients (c): Per Urban Drainage & Flood Control Volume 1

3.0 PROPOSED CONDITIONS, ANALYSIS & RESULTS

The proposed project will result in approximately 4.15 acres of impervious area, comprised of existing asphalt, new asphalt, gravel, and heavily compacted soils.

As shown on the post development drainage & grading plan (see appendix), the contributing area is considered impervious, although runoff coefficients very for each surface type. The proposed stormwater drainage system consists of two vegetated swales, and a retention/detention pond with the outlet set to retain the 80th percentile storm event and an emergency spillway set to detain the 100-year storm event volume.

Pond Design

The pond is 3 feet deep providing at least a foot of freeboard with 3:1 side slope, the outlet structure is a 3' x 3' catch basin, the grate is set to an elevation of 6360.4 feet, which will retain, 6,789 cubic-feet, slightly greater than the 80th percentile storm volume, with a 2.6" diameter orifice on the 18" outlet pipe to maintain allowable discharge of the site. The outlet pipe will have a flared end section on the downstream side which will flow directly into a riprap lined channel to aid in water quality and control velocity of discharge an emergency spillway will be set at an elevation of 6363.50 feet to detain the 100-year storm event. The pond has a total capacity of 32,078 cubic-feet.

Orifice Design

As the Catch Basin outlet is engaged the orifice was designed to achieve the maximum release rate of 0.1 cfs/acre, which calculates to be 2.6" diameter. Please see appendix for calculations

Emergency Spillway Design

An emergency spillway was designed to first detain the 100-year storm volume, and second to have capacity for the 100-year storm peak flow rate. The emergency spillway design: elevation of 6363.50 feet, 10 feet in length and width, minimum channel width of 13 feet and length of 48 feet, channel slope of 12.5% average, and rip rap lined. This design will accommodate 100-year peak flow rate, which is 17.44 cfs. Please refer to Appendix for calculations and Civil Improvement Plans.

Stormwater Quality & Green Infrastructure

To address storm water quality, the design provides vegetated swales and riprap-lined outlet, which are forms of Green Infrastructure.

4.0 CONCLUSION

The proposed storm drain system adequately retains the 80th percentile storm event, once the 80th percentile volume elevation is reached, the outlet structure will maintain a maximum release rate of 0.1 cfs/acre. A 100-year overflow route to the natural drainage leaving the project site has been provided.

APPENDIX

Exhibit 1 – Vicinity Map

POST DEVELOPMENT DRAINAGE & GRADING PLAN

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DRAINAGE CALCULATIONS

SNOWBASIN RESORT
MAG N BAG LOT

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100-Year Storm Event - Rational Method Stormwater Run-Off Calculations

**Run-off coefficients are referenced from UDFC Storm Drainage Criteria Manual Table 6-5 based on NCRS Hydrologic Soils Group*

Drainage Area (A)			Run-Off Coefficient (C)	C*A	
Compacted Gravel =	56,702	*sq-ft*	0.77	43,660.54	*sq-ft*
Pavement =	59,840	*sq-ft*	0.81	48,470.40	*sq-ft*
Compacted Soil =	64,150	*sq-ft*	0.73	46,829.50	*sq-ft*
Sum:	180,692	*sq-ft*		Sum: 138,960	*sq-ft*

NOAA ATLAS 14 - 100 YEAR STORM EVENT — **Allowable Discharge = .10cfs/acre**

Time	Intensity	Rainfall	Rainfall Excess	Allowed Discharge	Volume to Detain	Peak Flow
minutes	*in/hr*	*inches*	*cubic feet*	*cubic feet*	*cubic feet*	*cubic feet/second*
15	5.46	1.365	15,807	373	15,433	17.44
30	3.67	1.835	21,249	747	20,503	11.72
60	2.27	2.270	26,287	1,493	24,793	7.25
120	1.34	2.680	31,034	2,987	28,048	4.28
180	0.93	2.778	32,169	4,480	27,689	2.96
360	0.53	3.204	37,102	8,960	28,143	1.71
720	0.35	4.224	48,914	17,920	**30,994**	1.12
1440	0.22	5.328	61,698	35,840	25,859	0.71

Basin Volume

Volume per Civil 3D = **32,312 cf**
Retention Volume= **6,732 cf**

**80th Percentile Volume calculated based on Utah DWQ-2019-000161 A Guide to Low Impact Development within Utah*

80% Percentile Retention Volume

Tributary Area, A:	180,692 sf
Impervious Area:	180,692 sf
Imperviousness:	100%
80% Percentile Storm Depth, d:	0.50 in
Volumetric Runoff Coefficient, Rv:	0.89 sf
Required Water Quality Volume, WQV:	**6,698 cf**
Provided Water Quality Volume, WQV:	**6,732 cf**

$$R_V = 0.91 * imp - 0.0204$$

$$\text{WQV} = R_V * \text{d} * \text{A}$$

Volume Required & Provided

Storage Provided = **32,312 cf**
Storage Required = **30,994 cf**

Orifice Design:

The storm runoff will be detained at 0.2 cfs/acre

$$Q = C_d A_0 \sqrt{2gh}$$

Total acreage of development:	4.15 acres
Allowable discharge:	0.1 cfs/acre
Max head:	7.85 ft
Design diameter for new orifice:	**2.4 inch**

MAG-N-BAG
EMERGENCY SPILLWAY CALCULATIONS

$$Q = CLH^{3/2}$$

where:

Q = Discharge in cfs

C = Discharge coefficient from Handbook of Hydraulics, King and Brater, 5th Edition (or comparable)

L = Effective length of crest in feet

H = Depth of flow above elevation of crest in feet (approach velocity shall be disregarded in most applications)

Assumptions

- 100-Year-Q_{peak} : 17.44 cfs
- L:10 feet
- C:1.0
- H:1.6

Spillway Design

- Elevation: 6,361.60 feet
- Width of Spillway: 10 feet
- Length of Spillway: 10 feet
- Length of Channel: Minimum of 50 feet
- Channel Width: 13 feet
- Slope of Channel: 12.5 % average
- Channel: Rip-Rap Lined Channel

Capacity of Spillway

C	L	H	Q
Coefficient	*feet*	*feet*	*cubic feet per second*
1	10	1.6	20.48

$$Q = CLH^{3/2}$$

NOAA ATLAS 14 RAINFALL DATA

NOAA Atlas 14, Volume 1, Version 5
Location name: Huntsville, Utah, USA*
Latitude: 41.2107°, Longitude: -111.8409°
Elevation: 6454.62 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.18** (1.92-2.53)	**2.77** (2.45-3.19)	**3.73** (3.26-4.30)	**4.60** (3.98-5.29)	**5.95** (5.05-6.91)	**7.20** (5.95-8.45)	**8.68** (6.94-10.3)	**10.4** (8.04-12.7)	**13.3** (9.65-16.7)	**16.1** (11.1-20.8)
10-min	**1.67** (1.46-1.93)	**2.11** (1.87-2.44)	**2.84** (2.48-3.26)	**3.50** (3.04-4.03)	**4.53** (3.85-5.26)	**5.48** (4.52-6.43)	**6.60** (5.28-7.84)	**7.93** (6.11-9.64)	**10.1** (7.34-12.7)	**12.2** (8.41-15.8)
15-min	**1.38** (1.21-1.59)	**1.74** (1.54-2.01)	**2.35** (2.06-2.70)	**2.89** (2.51-3.33)	**3.74** (3.18-4.35)	**4.53** (3.74-5.32)	**5.46** (4.36-6.48)	**6.55** (5.05-7.96)	**8.36** (6.07-10.5)	**10.1** (6.95-13.1)
30-min	**0.928** (0.814-1.07)	**1.17** (1.04-1.35)	**1.58** (1.38-1.82)	**1.95** (1.69-2.24)	**2.52** (2.14-2.93)	**3.05** (2.52-3.58)	**3.67** (2.94-4.36)	**4.41** (3.40-5.36)	**5.63** (4.09-7.08)	**6.80** (4.68-8.79)
60-min	**0.574** (0.503-0.663)	**0.726** (0.641-0.838)	**0.979** (0.856-1.13)	**1.20** (1.05-1.39)	**1.56** (1.32-1.81)	**1.89** (1.56-2.22)	**2.27** (1.82-2.70)	**2.73** (2.11-3.32)	**3.49** (2.53-4.38)	**4.21** (2.90-5.44)
2-hr	**0.377** (0.336-0.428)	**0.472** (0.420-0.536)	**0.605** (0.535-0.688)	**0.730** (0.639-0.834)	**0.934** (0.800-1.07)	**1.12** (0.938-1.30)	**1.34** (1.09-1.58)	**1.60** (1.25-1.93)	**2.03** (1.49-2.52)	**2.42** (1.70-3.09)
3-hr	**0.291** (0.262-0.325)	**0.359** (0.324-0.401)	**0.444** (0.397-0.497)	**0.526** (0.467-0.590)	**0.656** (0.572-0.743)	**0.778** (0.666-0.890)	**0.926** (0.772-1.07)	**1.10** (0.887-1.30)	**1.38** (1.06-1.68)	**1.64** (1.21-2.08)
6-hr	**0.206** (0.189-0.225)	**0.251** (0.230-0.276)	**0.300** (0.274-0.330)	**0.345** (0.312-0.381)	**0.413** (0.369-0.459)	**0.469** (0.415-0.526)	**0.534** (0.465-0.607)	**0.607** (0.517-0.700)	**0.752** (0.620-0.885)	**0.884** (0.708-1.07)
12-hr	**0.137** (0.125-0.150)	**0.167** (0.153-0.184)	**0.200** (0.182-0.221)	**0.230** (0.208-0.254)	**0.275** (0.245-0.307)	**0.312** (0.275-0.351)	**0.352** (0.305-0.401)	**0.395** (0.335-0.456)	**0.462** (0.380-0.545)	**0.515** (0.413-0.621)
24-hr	**0.092** (0.084-0.100)	**0.113** (0.104-0.123)	**0.135** (0.124-0.148)	**0.154** (0.141-0.168)	**0.180** (0.165-0.197)	**0.201** (0.182-0.219)	**0.222** (0.200-0.243)	**0.243** (0.219-0.267)	**0.273** (0.243-0.300)	**0.296** (0.261-0.326)
2-day	**0.056** (0.052-0.062)	**0.070** (0.064-0.076)	**0.084** (0.077-0.092)	**0.096** (0.088-0.105)	**0.112** (0.103-0.123)	**0.125** (0.114-0.137)	**0.139** (0.125-0.153)	**0.153** (0.137-0.168)	**0.172** (0.152-0.190)	**0.187** (0.164-0.208)
3-day	**0.043** (0.039-0.046)	**0.053** (0.048-0.057)	**0.064** (0.058-0.070)	**0.073** (0.067-0.080)	**0.086** (0.078-0.094)	**0.096** (0.087-0.106)	**0.107** (0.097-0.118)	**0.118** (0.106-0.130)	**0.134** (0.118-0.148)	**0.146** (0.128-0.162)
4-day	**0.036** (0.033-0.039)	**0.044** (0.040-0.048)	**0.054** (0.049-0.059)	**0.062** (0.056-0.067)	**0.073** (0.066-0.080)	**0.082** (0.074-0.090)	**0.091** (0.082-0.100)	**0.101** (0.090-0.111)	**0.115** (0.101-0.127)	**0.125** (0.110-0.139)
7-day	**0.026** (0.024-0.028)	**0.032** (0.029-0.035)	**0.039** (0.036-0.043)	**0.045** (0.041-0.049)	**0.053** (0.048-0.058)	**0.059** (0.053-0.065)	**0.066** (0.059-0.073)	**0.073** (0.065-0.081)	**0.083** (0.073-0.092)	**0.090** (0.079-0.101)
10-day	**0.021** (0.019-0.023)	**0.026** (0.024-0.028)	**0.031** (0.029-0.034)	**0.036** (0.033-0.039)	**0.042** (0.038-0.045)	**0.046** (0.042-0.050)	**0.051** (0.046-0.056)	**0.055** (0.050-0.061)	**0.062** (0.055-0.068)	**0.066** (0.058-0.074)
20-day	**0.014** (0.013-0.016)	**0.018** (0.016-0.019)	**0.021** (0.019-0.023)	**0.024** (0.022-0.026)	**0.027** (0.025-0.030)	**0.030** (0.027-0.032)	**0.032** (0.029-0.035)	**0.035** (0.031-0.038)	**0.038** (0.034-0.042)	**0.040** (0.036-0.044)
30-day	**0.012** (0.011-0.013)	**0.015** (0.014-0.016)	**0.017** (0.016-0.019)	**0.019** (0.018-0.021)	**0.022** (0.020-0.024)	**0.024** (0.022-0.026)	**0.026** (0.024-0.029)	**0.028** (0.026-0.031)	**0.031** (0.028-0.034)	**0.033** (0.029-0.036)
45-day	**0.010** (0.009-0.011)	**0.012** (0.011-0.013)	**0.015** (0.013-0.016)	**0.016** (0.015-0.018)	**0.019** (0.017-0.020)	**0.021** (0.019-0.022)	**0.022** (0.020-0.024)	**0.024** (0.022-0.027)	**0.027** (0.024-0.029)	**0.029** (0.025-0.032)
60-day	**0.009** (0.008-0.010)	**0.011** (0.010-0.012)	**0.013** (0.012-0.014)	**0.015** (0.013-0.016)	**0.017** (0.015-0.018)	**0.018** (0.017-0.020)	**0.020** (0.018-0.021)	**0.021** (0.019-0.023)	**0.023** (0.021-0.025)	**0.024** (0.022-0.027)

[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.

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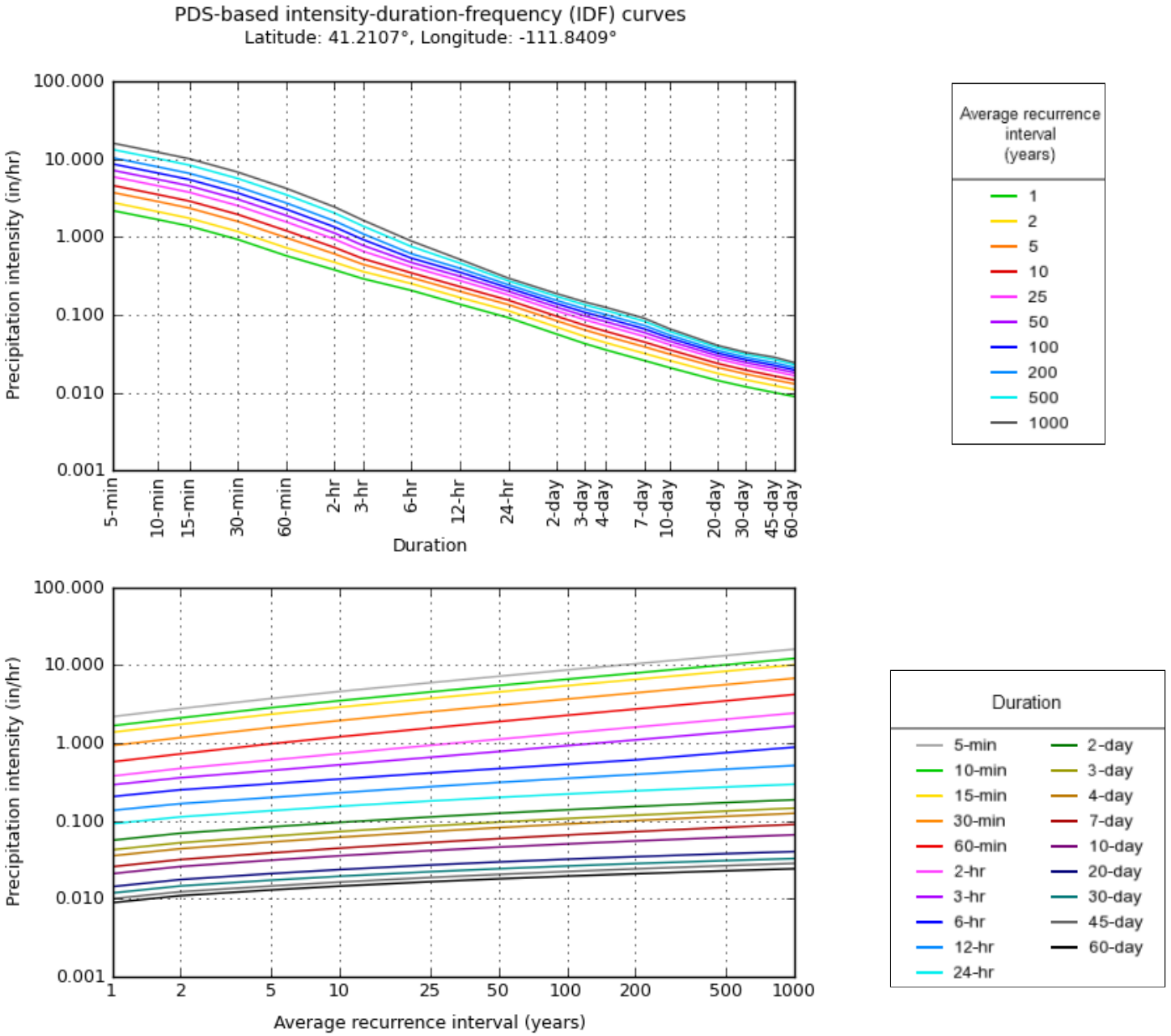
PF graphical



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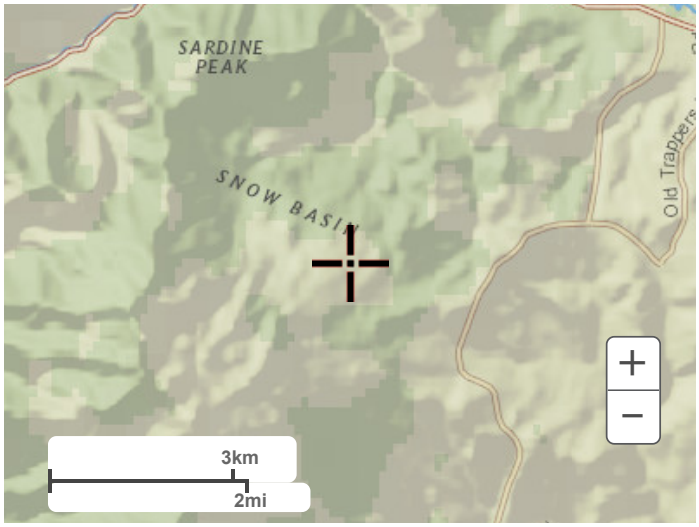
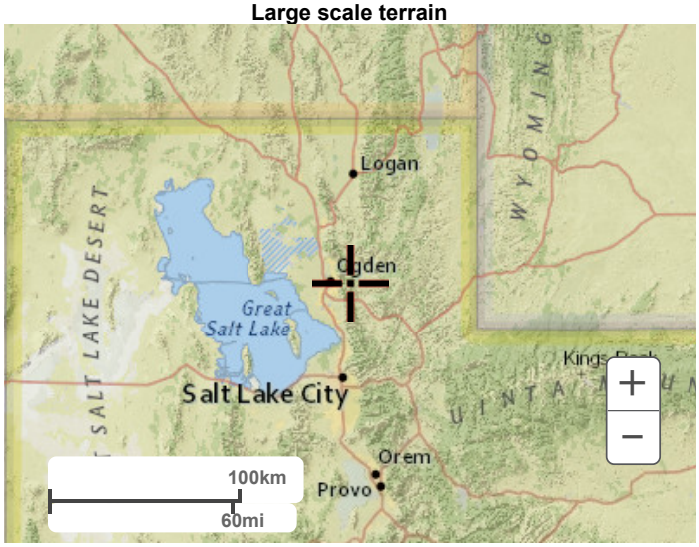
Maps & aerials

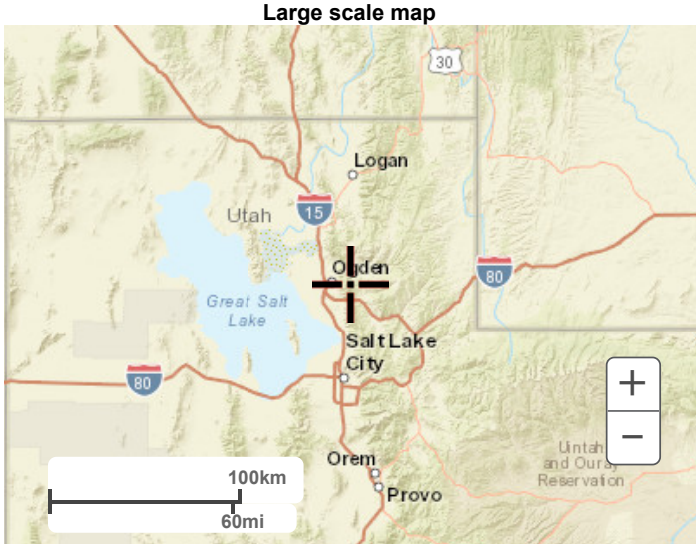
Small scale terrain



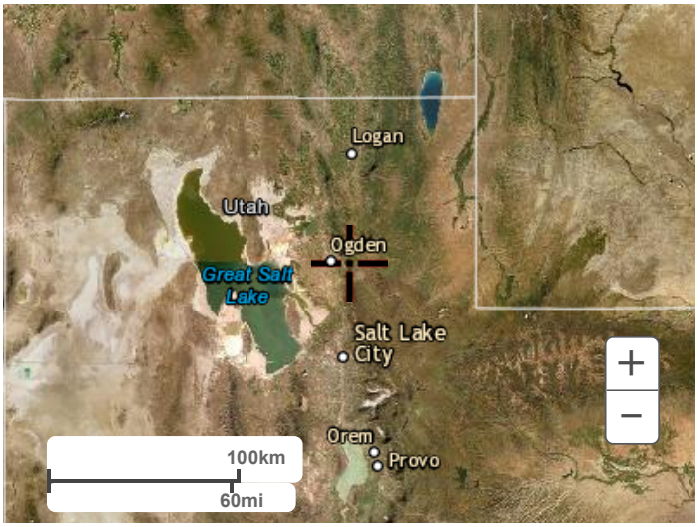
Large scale terrain



Large scale map



Large scale aerial



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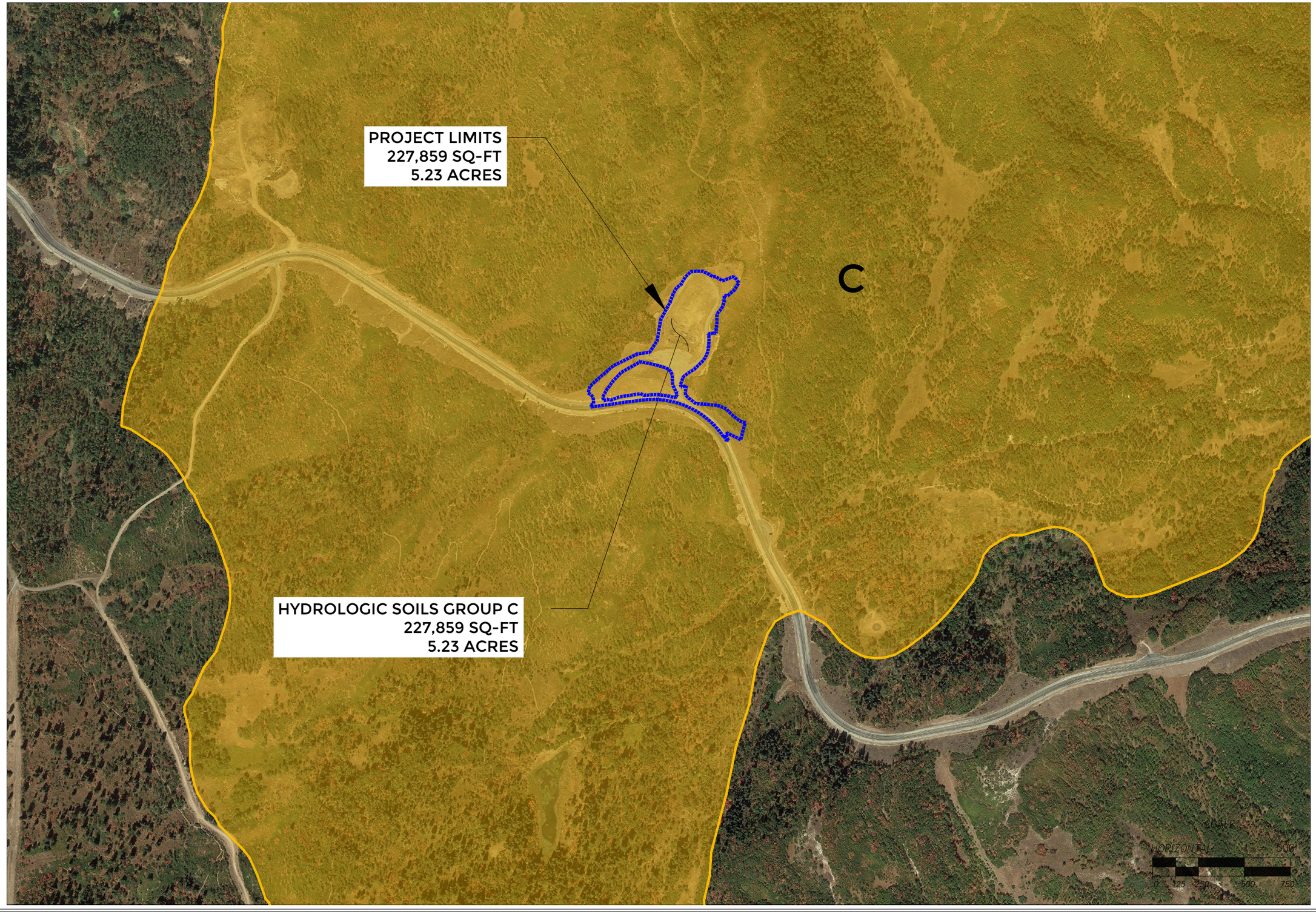

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SNOWBASIN RESORT
MAG N BAG LOT
DRAINAGE MAP

DATE: 06.20.2022

TCC JOB NO: 19-300-7B

SHEET NUMBER

SD-01