Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM NO. 1 - DRAFT

Preliminary Design, Powder Mountain Tank and Well Pump Station Project

PREPARED FOR: Ryan Bradley, P.E.
Summit Mountain Holding Group

PREPARED BY: Jeff Beckman, P.E.
Greg Loscher, P.E.
Ryan Oberg, P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

COPIES: File

DATE: January 3, 2013

PROJECT: Powder Mountain Tank and Well Pump Station Project

SUBJECT: Preliminary Design

BACKGROUND AND INTRODUCTION

The Summit Mountain Holding Group (Owner) is in the process of developing and expanding the existing Powder Mountain Resort area. Drinking water for the limited existing development is supplied by a small well, and drinking water storage is provided at the existing 80,000 gallon Hidden Lake tank, located adjacent to the existing lodge, as well as a number of smaller tanks. The proposed new development will require planning, design and construction of a new drinking water supply well, new distribution system pipelines, and a new water storage tank. A water distribution system master plan was prepared for the Owner by NV5 Engineering in December 2012. The 2012 Powder Mountain Resort Water Master Plan (Master Plan) includes recommendations for water system infrastructure improvements, including the new well and storage tank.

The Owner retained Bowen, Collins & Associates (BC&A) to provide engineering services associated with design and construction of a drinking water storage tank and a well pump station at the Powder Mountain Resort. Figure 1 provides a vicinity map for the proposed location of

the storage tank and well pumps station. The purpose of this Technical Memorandum (TM) is to summarize the results of the following preliminary design tasks:

- Tank Storage Capacity
- Geotechnical Investigation
- Tank Design Criteria
- Tank Structural Layout
- Tank Site Plan
- Tank Inlet, Outlet, Overflow and Drain Piping
- Well House Design Criteria
- Well House Mechanical Layout
- Well House Site Plan
- Construction Access, Staging, and Storage
- System Hydraulics.

These items are discussed in detail in the following TM. Also provided with the preliminary design TM is a conceptual estimate of the construction costs for the project.

WATER TANK PRELIMINARY DESIGN

Storage Capacity

The 2012 Powder Mountain Resort Water Master Plan prepared by NV5 includes recommendations for a new water tank to provide drinking water and fire protection storage for both new and existing development.

The State of Utah under Utah Code, Rule R309-510, Facility Design and Operation: Minimum Sizing Requirements states the following: "Each storage facility shall provide equalization storage volume, to satisfy peak day demands for water for indoor use as well as outdoor use" as well as fire suppression storage and emergency storage. The State provides minimum guidelines for systems that do not have any operational data to use as a basis for planning. Based on State guidelines, the Master Plan recommends the following minimum storage capacities, summarized in Table 1:

Table 1-1
2012 Master Plan Storage Evaluation Summary

Development Phase	Equalization Storage (gallons)	Fire Flow Storage (gallons)	Total Storage Required (gallons)
Phase 1*	164,000	250,000	**414,000**
Future Build-out**	544,000	250,000	**794,000**

*Includes existing development and Phase 1
**Includes all phases of development listed in the 2012 Master Plan

Equalization storage is the sum of estimated indoor and outdoor water storage needs. Minimum fire flow storage required for the development was specified by the Weber County Fire District Fire Marshal. The Owner has indicated that they do not require emergency storage in the tank, and will provide portable back up power for the well pump station that supplies the tank to meet emergency needs.

Using the recommendations from the Master Plan, the new tank will be sized to meet the needs of Phase 1 development. An additional tank can be constructed in the future to meet the water storage requirements at the build out phase.

Tank Location

The proposed site for the tank is Earl's Peak. This site was selected by the Owner because it is located near the highest point in the development. The only viable alternative would be to locate the tank near the existing Hidden Lake Lodge site; however, the Owner has indicated that a tank at that site may interfere with plans for a potential new lodge in the future.

Geotechnical Investigation

A geotechnical investigation was prepared for the proposed tank site by IGES in November 2012. Key results from the geotechnical investigation include the following:

1. The subsurface at the proposed site consists of a thin surface layer of sand, gravel and boulders underlain by hard materials composed of dense combinations of sands, clays, silts and gravels.

2. There is a layer of clay soil at a depth ranging from approximately 9 to 12 feet below the surface that should be removed and replaced with structural fill.

3. Test drilling became difficult at a depth of approximately 19 feet, and practical refusal was reached at a depth of approximately 25 feet.

4. No subsurface water was encountered in the boring to the maximum depth of approximately 45 feet.

5. Temporary unretained cut slopes may be constructed at 1.5 horizontal to 1 vertical or flatter. Permanent unretained cut and fill slopes may be constructed at 3 horizontal to 1 vertical or flatter.

6. The project site is generally suitable for the proposed tank construction.

7. Geotechnical information related to foundations, subgrade preparation, excavation, backfill, materials and compaction are included in the geotechnical report.

Based on the results of the geotechnical investigation, it is recommended that the bottom of the excavation for the tank construction be located at least 12 feet below the existing ground surface, in order to remove the existing clay layer. A copy of the bore log from the geotechnical investigation is included in the Appendix.

Tank Design Criteria

General design criteria for the new tank were developed based on storage capacity recommended in the Master Plan, geotechnical investigation results, and hydraulic considerations. These criteria are summarized in Table 1-2.

BC&A recommends that the reservoir be constructed of reinforced concrete, and that the structure be buried with a minimum of two feet of soil cover on the deck. There are three primary options for concrete reservoirs: conventional reinforced concrete; strand-wound circular prestressed concrete consistent with the requirements of AWWA D-110; or post-tensioned concrete per AWWA D-115. Generally, for concrete reservoirs with wall heights less than or equal to 20 feet, conventional reinforced concrete is the more economical of the three options. Based on the dimensions of the reservoir, BC&A recommends design of a standard reinforced, circular, concrete reservoir.

Table 1-2
Tank Size and Site Layout Design Criteria

Description	Design Criteria
Target Design Volume	415,000 gallons
Future Expansion	Proposed tank site should allow for a future tank (equal in volume to the first tank) to be constructed to serve future phases of development
Reservoir Type and Configuration	Buried circular standard reinforced concrete
Temporary Construction Excavation Slopes	1.5H:1V
Floor Elevation*	8884.0 at high point; 8883.6 at low point; 8-inch concrete slab over 12-inch underdrain gravel layer and PVC liner
Floor Slope	1 percent minimum to drain near center of reservoir
High Water Elevation*	8900.0 (Corresponds to typical tank operating depth of 16 feet)
Overflow Elevation*	8901.0
Minimum Freeboard	3 feet above high water elevation
Tank Diameter	68 feet (inside)
Concrete Roof Elevation	8903.83 at wall; 8904.2 at center high point
Roof Backfill	2 feet
Finish Grade Elevation	8905.83 at wall; 8906.2 at center high point
Finish Grade Embankment Slopes	3H:1V

*Elevation Datum: NAVD 88.

Tank Structural Layout

A preliminary structural floor plan and cross-section for the tank was developed using the design criteria summarized in Table 1-2. The preliminary structural design is shown in Figures 2-3. General structural design criteria for the tank are summarized on Drawing S-02.

Tank Site Plan

The new tank will be located on Earl's Peak, and the roof will be buried with two feet of backfill. Final backfill grades surrounding the tank will be limited to slopes no greater than 3H:1V.

Preliminary discussions with Owner have identified the concept of backfilling around the tank to allow for construction of a future tank, as well as allowing for future ski lifts. Figure 4 shows a conceptual site plan as developed by the Owner. BC&A will work with the Owner to develop a site grading plan that minimizes the visual impact tot eh surrounding areas.

Tank Inlet, Outlet, Overflow and Drain Piping

The 2012 Master Plan prepared by NV5 includes recommendations for inlet and outlet pipe sizing for the new tank. Due to the small size of the tank, a single pipe will serve as both inlet and outlet, allowing the tank to be filled via the well pump station during low demand periods, and allowing the tank to feed water into the system to meet needs during high demand periods. The recommended sizes, materials, and design criteria for tank inlet, outlet, overflow and drain piping are shown in Table 1-3.

Table 1-3
Piping Size, Material, and Design Criteria

Piping	Size	Location	Material	Estimated Flow (gpm)	Velocity (fps)
Inlet/Outlet	16-inch	Buried Vault	Ductile Iron* Ductile Iron	2,600	4.8
Overflow	12-inch	Buried Exposed Air-gap	Ductile Iron* Ductile Iron	500	1.5
Drain	6-inch	Buried	Ductile Iron*	400 - 900	5 - 10
Underdrain	4- and 6-inch	Beneath Reservoir	Schedule 80 PVC	--	--

*Buried ductile iron pipe will be polyethylene encased per AWWA C105. Ductile Iron will be utilized under the tank and will transition to PVC away from the tank.

The inlet/outlet line design flow rate is equal to the peak instantaneous demand estimated by NV5 in the 2012 Master Plan. The tank inlet/outlet pipe will include an isolation valve and associated vault located outside the tank area. Per state requirements, the tank overflow capacity will be equal to the maximum inflow capacity, assumed equal to the well pump station design flow. The overflow will include a visible air gap per state requirements.

The tank drain will be designed to allow the Owner to drain the bottom four feet of the tank for maintenance in a period of approximately two hours. A drain valve, located in a manhole outside the tank area, will be used for periodic tank drainage. There is no pressurized water source available at the site for a pressurized tank internal wash down system, so it is our understanding that periodic tank cleaning will be performed using divers or another method. The tank will include an underdrain system, consisting of a well-graded gravel layer and PVC liner below the tank foundation. Perforated pipe will collect any leakage in the underdrain layer and convey it to a drain manhole.

All inlet/outlet, drain and overflow piping located beneath the reservoir will be concrete encased.

ACCESS HATCHES AND VENTS

The proposed tank will include one 4-foot by 6-foot access hatch with a ladder, as well as two 3-foot by 3-foot hatches to provide light during maintenance. Ladders and associated hardware will be Type 316 SST appropriate for submerged service. The tank will include one bumped-head or gooseneck style vent at the high point in the center of the roof.

WELL PUMP STATION PRELIMINARY DESIGN

The proposed well and associated pump station will provide a new water source for the existing and future Powder Mountain development. In late 2012, Laughlin Water Associates (LWA) LLC completed an assessment for the potential of developing new groundwater sources for the Powder Mountain area. In a report dated August 16, 2012, LWA evaluated and summarized water production from existing well sources, as well as identified potential new well sites. One of the recommended well sites was identified as Point of Diversion 8 (POD8). Subsequent to the report, the Owner along with further consultation with LWA, has decided to proceed with the development of a new well at the POD8 site. POD8 site is also referred to as the Saddle Well.

Although, testing and development of the well cannot occur until spring 2013, BC&A has been directed to proceed with the design of the pump station based upon the assumed well parameters as estimated by LWA. The following table provides the design criteria based upon the estimated well parameters:

Table 1-4
Assumed Well Production Parameters

Description	Assumed Parameter*
Max Well Production	500 gpm
Water Depth	700 ft below ground surface
Pump Level	1000 ft below ground surface
Casing Size	12-inch

* Parameters are based upon assumptions in LWA Report dated Aug 16, 2012.

It is not expected that the actual conditions will vary significantly from the assumed design criteria, however pump sizing will need to verified after the well has been tested and prior to construction.

The location the well is based upon the northing of N 457911.519 and easting of 437748.336, as indicated in the associated water right. The actual location of the well should be within 150 ft of the location identified in water right. Figure 1 identifies the proposed location of the well and pump station.

Well Pump Station Design Criteria

The two most common types of well pumps are vertical line shaft (VLS) and submersible pumps. The main difference between the two pumps is that a VLS pump has an aboveground motor with a line shaft connecting the motor to the submerged pump bowl. Submersible pumps use a submersible motor that is coupled directly to the pump bowl located within the well. Both pumping systems are commonly used and have associated advantages and disadvantages. A submersible pumping system is recommended for this application.

A submersible pump is recommended primarily due the estimated depth of the pump and the problems associated with deep (750-ft or greater) VLS systems. Deep VLS pumping systems often experience stretching in the line shaft due to the hydraulic forces placed on the shaft. This stretching minimizes clearances between the pump bowls potentially causing damage. Therefore, a submersible pump is recommended for this application. It is also recommended that a pit-less well design be utilized. A pit-less design allows for the building containing the flow meter and control valves to be constructed adjacent to the well rather than directly over the well head.

The preliminary design of the pump station consists of sizing the well pump, as well as preliminary mechanical and structural layouts of the building and associated equipment. The preliminary design parameters for the Saddle Well pump station are summarized in Table 1-5.

Table 1-5
Well Pump Requirements

Description	Criteria
Estimated Ground Surface Elevation at Well	8780
Tank High Water Surface	8900
Max. Well Water Depth	1,000 feet
Estimated Pump Head	1,200 feet (includes friction loss)
Pump Flow	500 gpm
Pump HP	200 Hp
Pump Type	Submersible
Discharge Size	6-inch

In addition to the pump, the pump station will include the following piping and equipment:

- 4-inch pump-to-waste line with control valve
- 6-inch flow meter, check valve and isolation valves
- Connection for portable emergency power generation power
- Pit-Less Adapter Design
- Space for potential future chlorination system (if ever required).

Well House Mechanical Layout

A preliminary mechanical layout of the pump control station is shown in Figures 4-5. The pumping control station heating and ventilation systems will be designed to maintain temperatures ranging from approximately 55 degrees during the winter months to no more than 10 degrees above the outside air temperature during the hottest months of summer. The following paragraphs briefly describe some of the design consideration for the well pump house.

Pump-to-Waste Line and Floor Drains. It is recommended that the pump system be equipped with a pump-to-waste line on the discharge piping of the pumping system. The pump-to-waste line will allow for a short period of pump operating flow to discharge to a drain to minimize the amount of sedimentation that could accumulate in the downstream system. The pump-to-waste line will be routed to just outside the downhill wall of the pump control station. This 4-inch pipeline outside the pump control station is being designed and will be constructed with an air gap and screen at the outlet into a common sump box located adjacent to the pump house. In the pump control station, the 4-inch pump-to-waste line includes an automatic pump control valve and a pressure control valve. The pressure control valve is required to maintain a safe operating range on the pump during a pump-to-waste event. The floor drains for the building will flow to the common sump box located adjacent to the building. The common sump box will then direct all collected flow from the floor drains and pump-to-waste flow to a designated flow path established by the owner.

Power and Control. The well pump system and control station will be powered from a 480 VAC, 3 phase utility service. The service will be provided to the pump station location as part of

another project and will provide reliable source of power. The system design will include both 480 VAC and 120/240 VAC power distribution systems, lighting, and controls. A backup generation system will not be provided as part of this scope of design, however a connection panel will be provided allowing for quick connection of an emergency generator.

The submersible pump motor will be connected to the distribution system with motor control center (MCC) equipped with an across the line motor starter. The MCC will have temperature and vibration sensors to protect the pump motor. The MCC enclosure will include cooling equipment that is vented to the building exterior to protect the internal equipment. The pump station will include all equipment necessary to control the operation of the pumps. The pump starting and stopping can be controlled from a pressure switch that is set to a corresponding water level in the associated storage tank.

Chlorination System. The U.S. Environmental Protection Agency has issued a rule under the National Primary Drinking Water Regulations: Ground Water Rule in 40 CFR Parts 9, 141 and 142. This regulation requires states to implement this new rule by December 1, 2009. In summary, this rule will require drinking water systems, supplying groundwater without treatment, provide 4-log removal or inactivation of viruses if the source is tested positive for coliforms. Treatment for viruses can most readily be accomplished by chlorination disinfection using established CT values (CT = chlorine residual concentration x contact time).

It is not the intent, nor scope of this project to include a chlorination system. However, it is prudent to provide sufficient space in the building for a chlorination system, if a system is ever required in the future. It should also be noted, that if a groundwater system is required to disinfect under the new rule, it will also be required to monitor and to measure residual chlorine and ensure compliance at the end of the designated contact time, before the first customer point of use.

Exact sizing of a potential chlorination system is difficult because typically a chlorine demand test should be performed on the source water in accordance with Standard Methods for the Examination of Water and Wastewater to determine the initial chlorine dosage. Additionally, certain inorganic compounds found in groundwater such as iron, manganese, and sulfides will reduce the chlorine residual (i.e. create a chlorine demand), and these must be included when determining the initial dosage. In the absence of a chlorine demand test report, the size of equipment necessary to chlorinate is unknown and an assumed area will be added to accommodate future requirements.

Well Discharge Pipeline. The pump system will provide water to the new culinary water storage tank via a common system distribution pipeline that will also connect to a proposed new development. The 6-inch discharge piping will run from the well head location, into the control building, then down through the floor to at least 15 feet past the building footings where it will then transition to a larger 16-inch diameter transmission/distribution line.

The 16-inch PVC transition pipeline was sized as part of the water master plan as prepared by NV5 Inc.. The preliminary length of the pipeline is approximately 1,600 feet, to be routed

between the well pump house building to the storage tank location. Velocities in the 6-inch discharge piping will be approximately 5.7 fps at 500 gpm.

Building Architectural Design. The architectural theme of the control building will conform to the mountain resort concept of the area. The Owner is working with an architect to develop specific design concepts. BC&A will incorporate the developed concepts into the final design.

Well House Site Plan

The well site will approximately 1,600 ft to the south of the proposed new tank. As previously mentioned, the location of the well must be within 150 ft of the point of diversion as identified in the associated water right. The well house should be located near the well to allow for electrical and control cabling. The Owner has recommended that the well house structure be located within a group of trees in an effort to reduce visible disruptions to the area. Figure 6 shows the proposed site plan for the well and well pump house location. A gravel access road will need to be constructed to the well pump house location.

CONSTRUCTION ACCESS, STAGING, AND STORAGE

General construction issues associated with building the proposed storage tank and pump station include site access, construction staging, temporary and final cut and fill slopes, and management of fill materials.

Site Access and Staging

Site access will be available via the existing canyon road and existing dirt roads. For this reason, all construction will need to be completed in summer months. Both the tank and the well site include ample space for construction staging, with the caveat that the Owner prefers to keep construction activities on the Weber County side of the property.

Final Cut and Fill Slopes

As mentioned in the geotechnical report, temporary unretained cut slopes may be constructed at 1.5H:1V or flatter. Permanent unretained cut and fill slopes may be constructed at 3H:1V or flatter.

Managing Cut and Fill Materials

It is unlikely that construction excavation activities at the tank and pump station sites will result in sufficient excess fill to construct all backfill improvements shown in Figure 1. Consequently, it will be necessary to bury and backfill the new tank, with provisions for additional surrounding backfill to be added at a future date.

SYSTEM HYDRAULICS

The water surface elevation in the new tank will vary from a high of 8900.0 to an absolute low of 8884.0 (floor elevation). It is necessary that the Owner evaluate the overall system hydraulics including the proposed facilities based upon the new tank water surface elevations. Preliminary discussions with the Owner have identified alternatives to ensure that flow and pressure requirements are met for the proposed development with the overall water distribution system. Some of these alternatives included hydraulically separating the new water tank from the existing storage at Hidden Lake. This would require pumping from the new transmission system to the existing Hidden Lake tank. Other alternative included abandoning the existing storage at Hidden Lake. Although it is outside the scope of this preliminary design, it is imperative that the Owner evaluate the overall system hydraulics for the proposed development.

INSTRUMENTATION AND ELECTRICAL

Instrumentation for the proposed tank will include a level sensor, high water and overflow alarms. Tank high and low water level settings will be used to control the operation of the well pump station, so that the well pump comes on when the tank level drops below the low water setting, and turns off when the tank is full. Flood sensors and pump alarms will be included in the well pump station. All tank and pump station access hatches and doors will include intrusion alarms.

LANDSCAPING

The storage tank and the well pump station site improvement designs will both include landscape restoration, to restore native vegetation and to blend the new facilities with the surrounding mountain landscape. All landscaping plants and seed will be low water use, and no permanent landscape irrigation is anticipated at either site. The Owner will provide recommendations for final landscape restoration.

FIGURES

C:\Documents and Settings\cmoultrie\Desktop\Summit Development.mxd cmoultrie 1/4/2013

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

SUMMIT MOUNTAIN HOLDING GROUP

POWDER MOUNTAIN TANK AND WELL PUMP STATION

VICINITY MAP

NORTH:

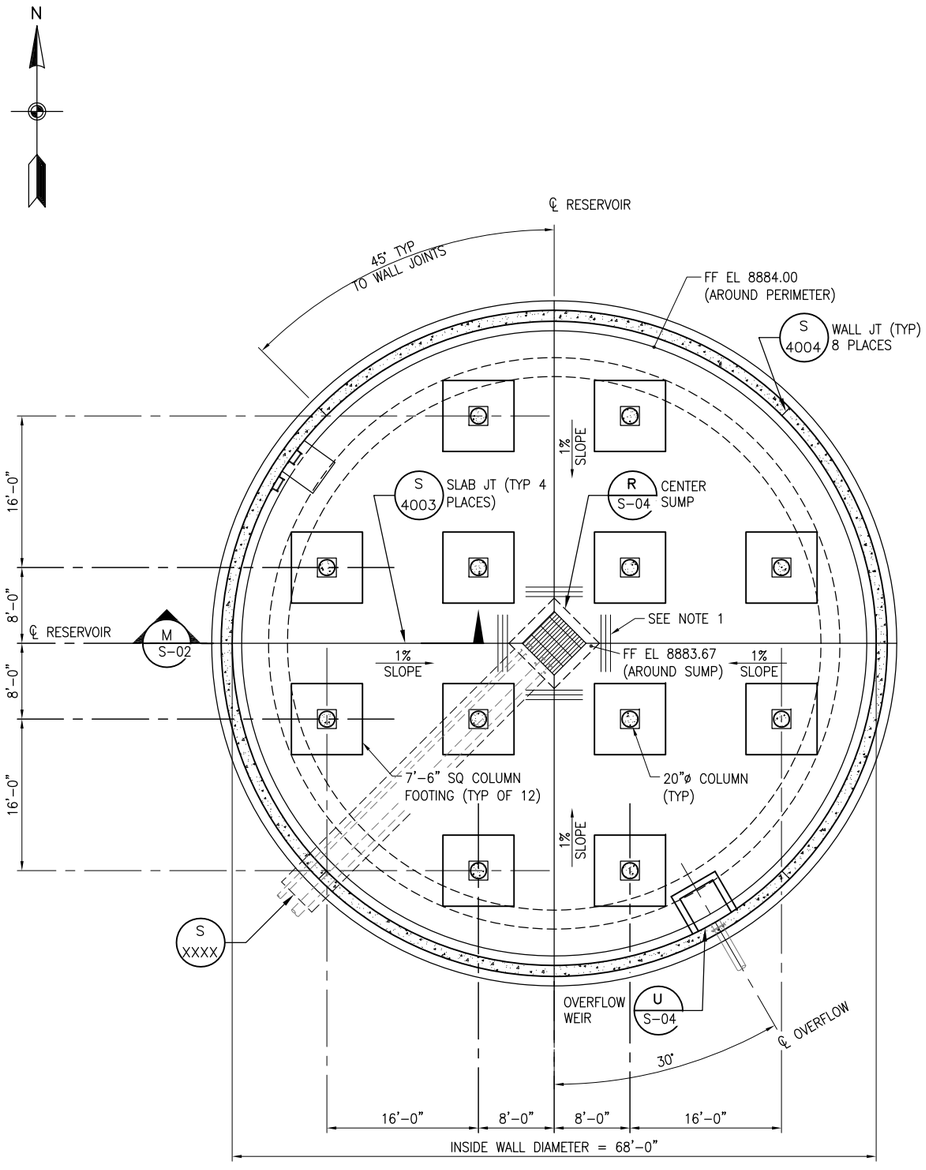
NORTH

SCALE:

1" = 1000'

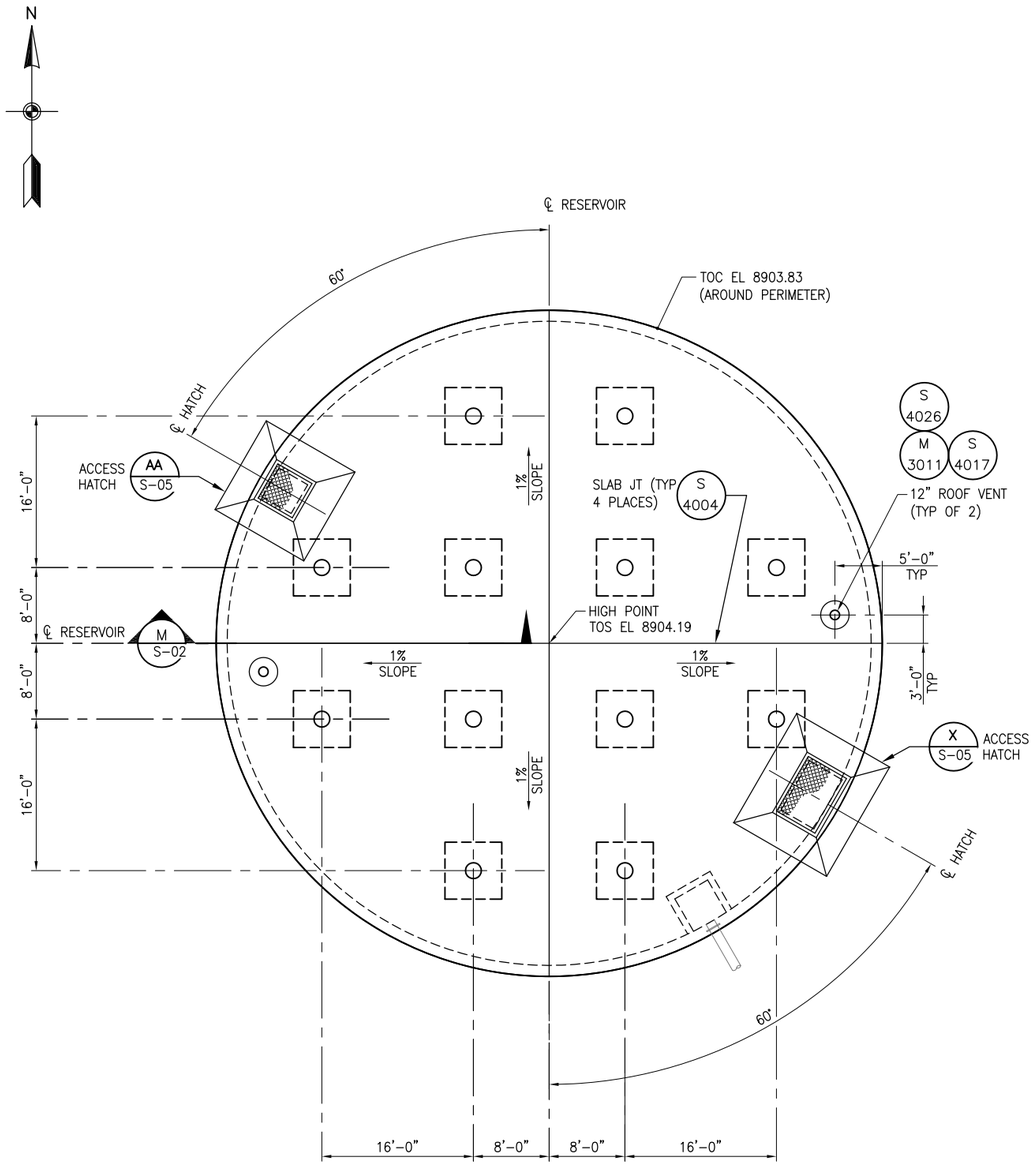
FIGURE NO.

1



ROOF PLAN

SCALE: 1/8"=1'-0"



FOUNDATION PLAN

SCALE: 1/8"=1'-0"

NOTES:

1. PROVIDE 3-#5 x 6-0" LG DIAGONAL BARS AT 6" SPACING IN EACH FACE OF BASE SLAB AT RE-ENTRANT CORNERS.

Bowen Collins & Associates, Inc. Consulting Engineers

30% REVIEW

NO.	DATE	REV. BY	DESCRIPTION
			REVISIONS

SUMMIT, LLC
EARL'S PEAK WATER PROJECT
WEBER COUNTY, UTAH

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

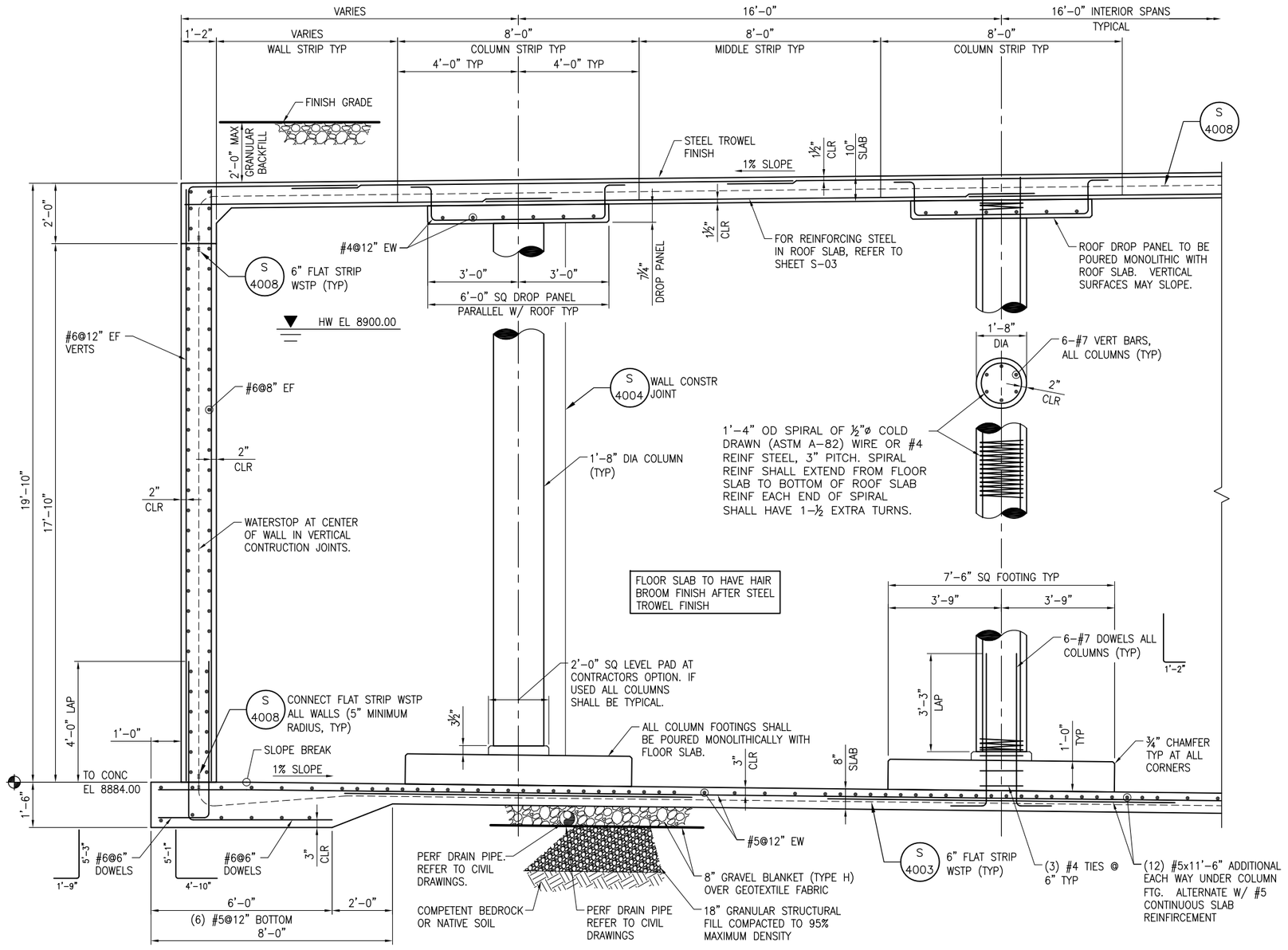
DESIGN R. DAVIS
DRAWN R. DAVIS
REVIEW
CHECKED
APPROVED

STRUCTURAL
RESERVOIR FOUNDATION AND ROOF PLAN

DATE: JANUARY, 2013
PROJECT NUMBER 347-12-01

DRAWING NO.
FIGURE 2

SHEET _____ OF XX



RESERVOIR SECTION

SCALE: 1/2"=1'-0"

M S-01

RESERVOIR GENERAL NOTES:

1. ROOF SLAB DESIGNED FOR A SUPERIMPOSED SOIL DEAD LOAD OF 250 PSF PLUS 280 PSF SNOW PLUS 120 PSF LIVE LOAD.
2. ALL STRUCTURAL CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4500 PSI AT 28 DAYS.
3. ALL REINFORCEMENT STEEL SHALL BE ASTM DESIGNATION A615 GRADE 60.
4. COVERAGE FOR REINFORCING BARS, EXCEPT WHERE OTHERWISE SHOWN, SHALL BE: 3" FOR COLUMNS AND CONCRETE PLACED AGAINST GROUND; 2" FOR INTERIOR WALL SURFACES EXPOSED TO WATER AND EXTERIOR WALL SURFACES WHICH ARE FORMED AND BACKFILLED; 1 1/2" FOR TOP AND BOTTOM OF ROOF SLABS.
5. LAPS FOR REINFORCING BARS, EXCEPT WHERE OTHERWISE SHOWN OR NOTED, SHALL BE CLASS B SPLICES. LAPS IN HORIZONTAL STEEL SHALL BE STAGGERED UNLESS SHOWN OTHERWISE.
6. DOWELS, PIPES, WATERSTOPS AND OTHER INSTALLED MATERIALS OR ACCESSORIES SHALL BE HELD SECURELY IN POSITION WHICH CONCRETE IS BEING PLACED.
7. DESIGN: INTERNATIONAL BUILDING CODE (2006), AMERICAN CONCRETE INSTITUTE (ACI 318-05), (ACI 350-06) AND (ACI 350.3-06).
8. ALL KEYWAYS AND CONSTRUCTION JOINTS IN CONCRETE SHALL BE CLEANED FOR BOND. CONSTRUCTION JOINTS BETWEEN FOOTINGS AND WALLS SHALL BE COVERED WITH POLYETHYLENE-COATED BURLAP MATS WHICH SHALL BE KEPT WET WITH WATER UNTIL CONCRETE IN WALLS IS PLACED. NO CURING COMPOUND SHALL BE APPLIED IN CONSTRUCTION JOINTS BETWEEN FOOTINGS AND WALLS.
9. REINFORCING BARS AND ACCESSORIES SHALL NOT BE IN CONTACT WITH ANY PIPE, PIPE FLANGE OR METAL PART EMBEDDED IN CONCRETE. A MINIMUM OF 2" CLEARANCE SHALL BE PROVIDED IN ALL CASES, UNLESS OTHERWISE SHOWN.
10. FOOTINGS ARE DESIGNED FOR A NET SOILS PRESSURE OF 4200 PSF MAX. FOR DEAD LOAD PLUS LIVE LOAD, PER SOILS INVESTIGATION RECOMMENDATIONS BY IGES (PROJECT NO. 01628-003 DATED NOVEMBER 9, 2012).
11. ALL ROOF OPENING DIMENSIONS ARE GIVEN TO THE CENTERLINE OF THE OPENING.
12. FOR ROOF SLAB REINFORCEMENT, SEE SHEET S-3.
13. TOP AND BOTTOM RING FOOTING TRANSVERSE BARS SHALL BE PLACED RADIALLY TO THE CENTER OF THE RESERVOIR.

WATERSTOP NOTES:

1. AT ALL SLAB CONSTRUCTION JOINTS, CONCRETE SHALL BE WORKED UNDER WATERSTOPS BY HAND, MAKING SURE THAT ALL AIR AND ROCK POCKETS ARE REMOVED.

Bowen Collins & Associates, Inc. Consulting Engineers

30% REVIEW

NO.	DATE	REV. BY	DESCRIPTION
			REVISIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

SUMMIT, LLC
EARL'S PEAK WATER PROJECT
WEBER COUNTY, UTAH

REVIEW
CHECKED
APPROVED

DESIGN R. DAVIS
DRAWN R. DAVIS

STRUCTURAL
RESERVOIR SECTION

PROJECT NUMBER 347-12-01
DATE: JANUARY, 2013

DRAWING NO.
FIGURE 3
SHEET ____ OF XX

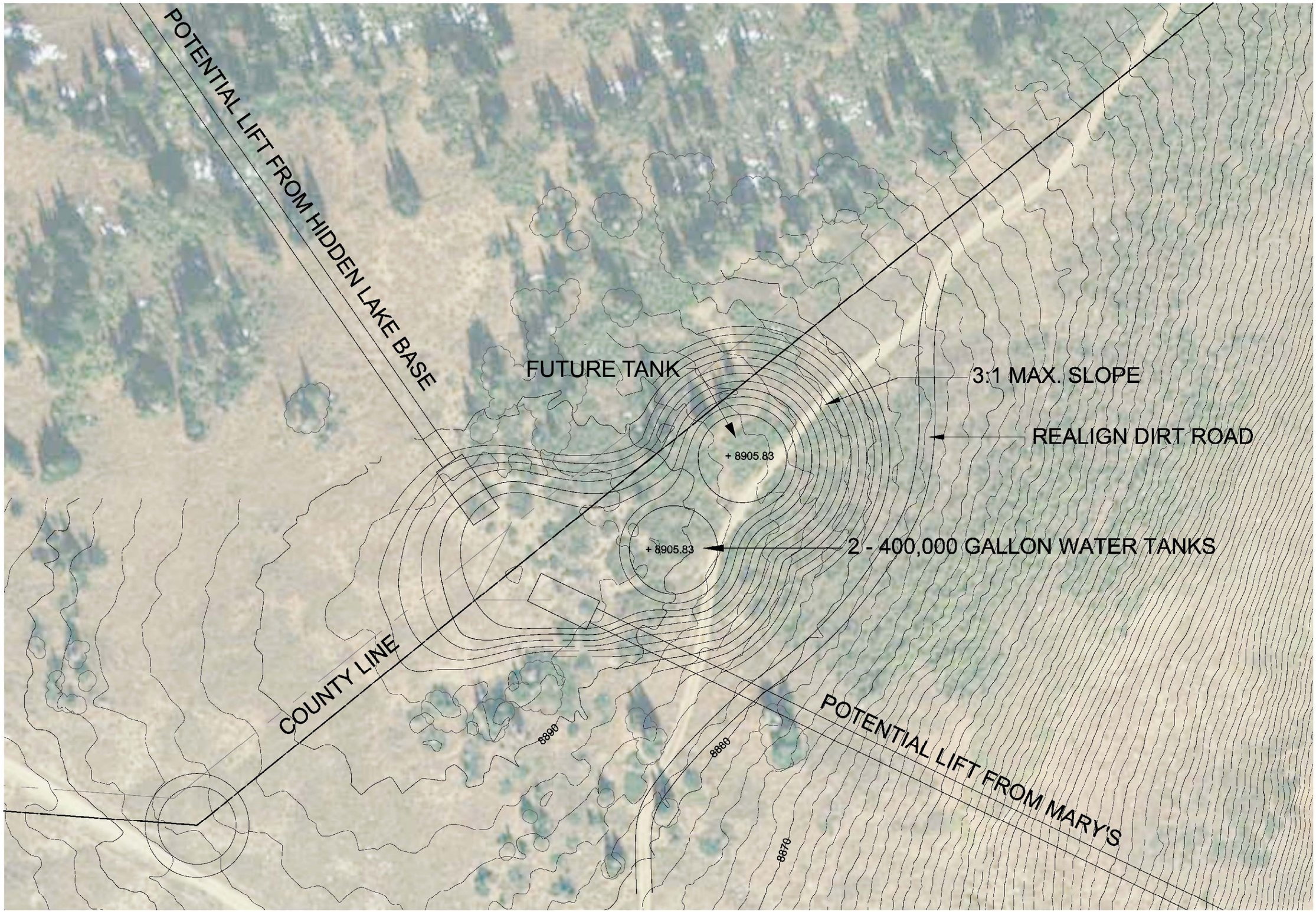


FIGURE NO. 4

SCALE: NTS

NORTH:

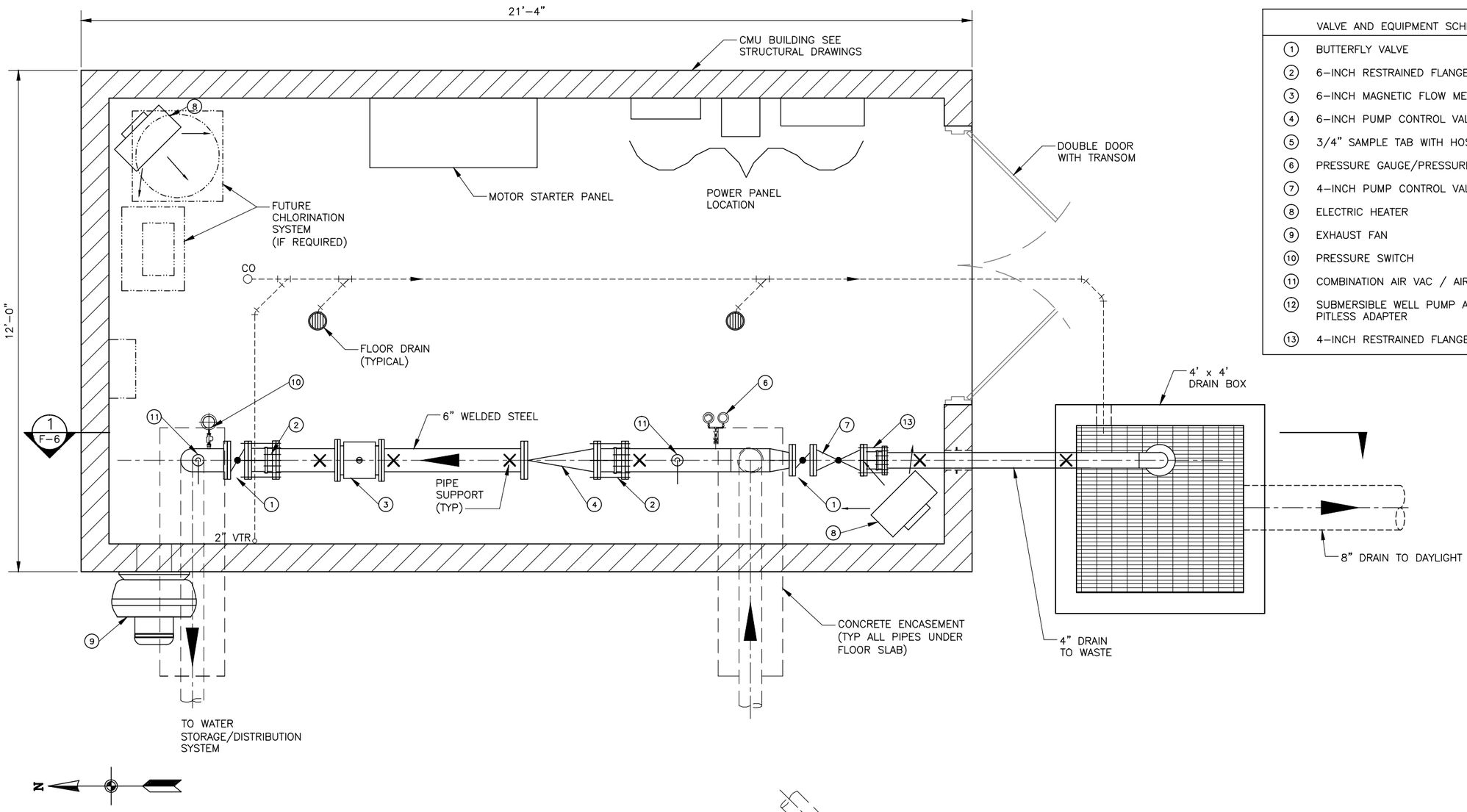
TANK SITE PLAN

SUMMIT MOUNTAIN HOLDING GROUP

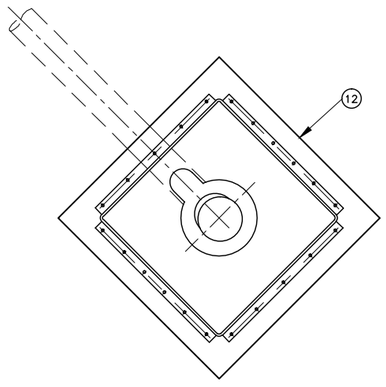
POWDER MOUNTAIN TANK AND WELL PUMP STATION

Bowen Collins & Associates, Inc. CONSULTING ENGINEERS

P:\Powder Mountain\2.0 - Design Phase\2.13 GIS\Projects\Figure_4_Tank Site Plan.mxd cmoultrie 1/7/2013



VALVE AND EQUIPMENT SCHEDULE	
1	BUTTERFLY VALVE
2	6–INCH RESTRAINED FLANGE DISMANTLING JOINT
3	6–INCH MAGNETIC FLOW METER
4	6–INCH PUMP CONTROL VALVE
5	3/4" SAMPLE TAB WITH HOSE BIBB
6	PRESSURE GAUGE/PRESSURE SWITCH
7	4–INCH PUMP CONTROL VALVE
8	ELECTRIC HEATER
9	EXHAUST FAN
10	PRESSURE SWITCH
11	COMBINATION AIR VAC / AIR RELEASE VALVE
12	SUBMERSIBLE WELL PUMP AND MOTOR WITH PITLESS ADAPTER
13	4–INCH RESTRAINED FLANGE DISMANTLING JOINT



PLAN
SCALE: 3/4"=1'–0"

Bowen Collins & Associates, Inc. Consulting Engineers

30% REVIEW

NO.	DATE	REV. BY	DESCRIPTION
			REVISIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

EARL'S PEAK WATER PROJECT
SUMMIT GROUP
WEBER COUNTY, UTAH

REVIEW
CHECKED
APPROVED

DESIGN R. OBERG
DRAWN R. GARCIA

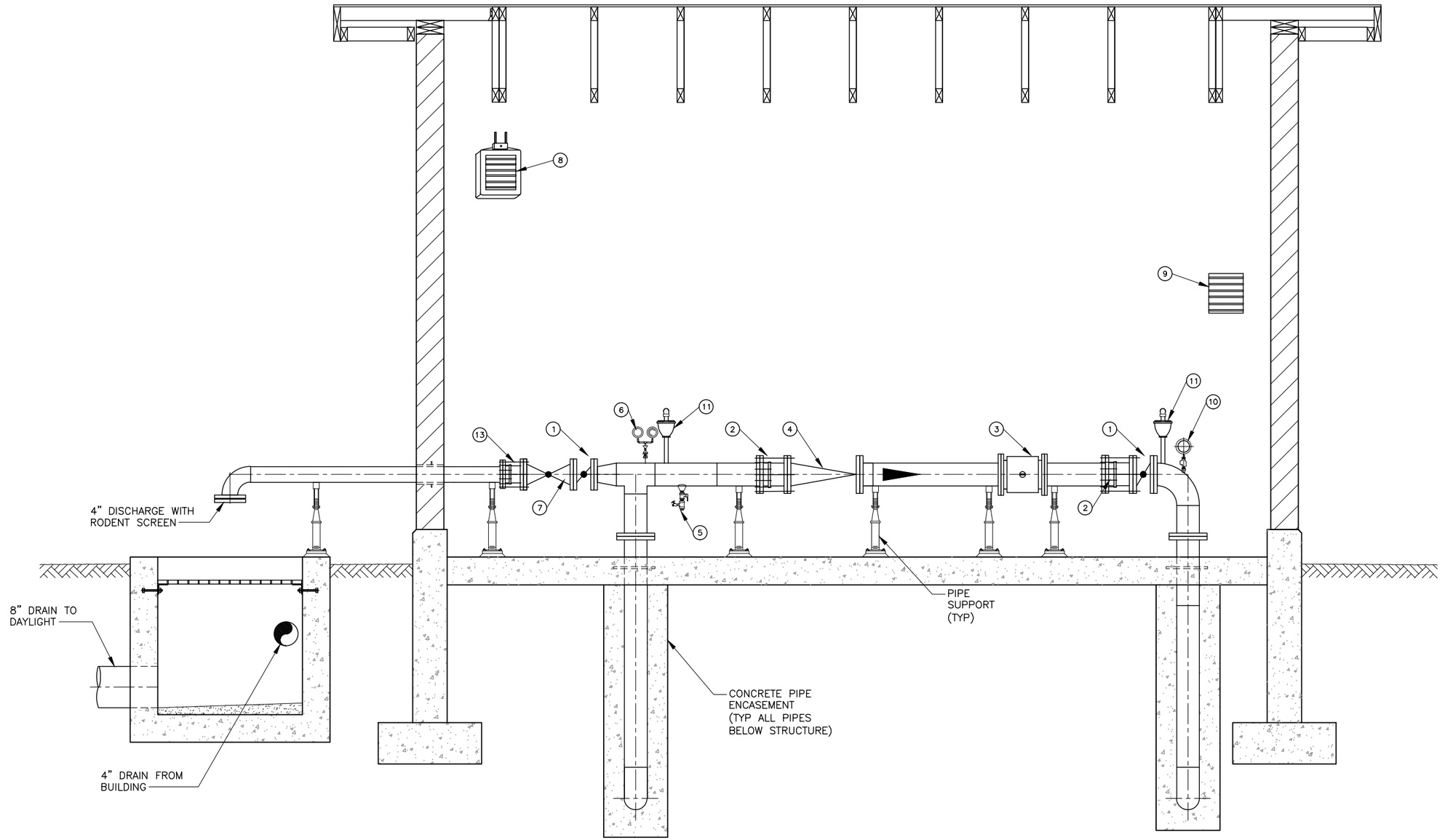
MECHANICAL
WELL PUMP STATION

PROJECT NUMBER 347–12–1
DATE: JANUARY 2013

DRAWING NO.
FIGURE–5

SHEET ____ OF ____

P:\Powder Mountain\2.0 – Design Phase\2.10 Drawings\sht\Figure_5.dwg Jan07,2013 – 11:05am



SECTION 1/F-5
SCALE: 3/4"=1'-0"

Bowen Collins & Associates, Inc. Consulting Engineers

30% REVIEW

REVISIONS

NO.	DATE	REV. BY	DESCRIPTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

EARL'S PEAK WATER PROJECT
SUMMIT GROUP
WEBER COUNTY, UTAH

REVIEW
CHECKED
APPROVED

DESIGN
DESIGN R. OBERG
DRAWN R. GARCIA

MECHANICAL

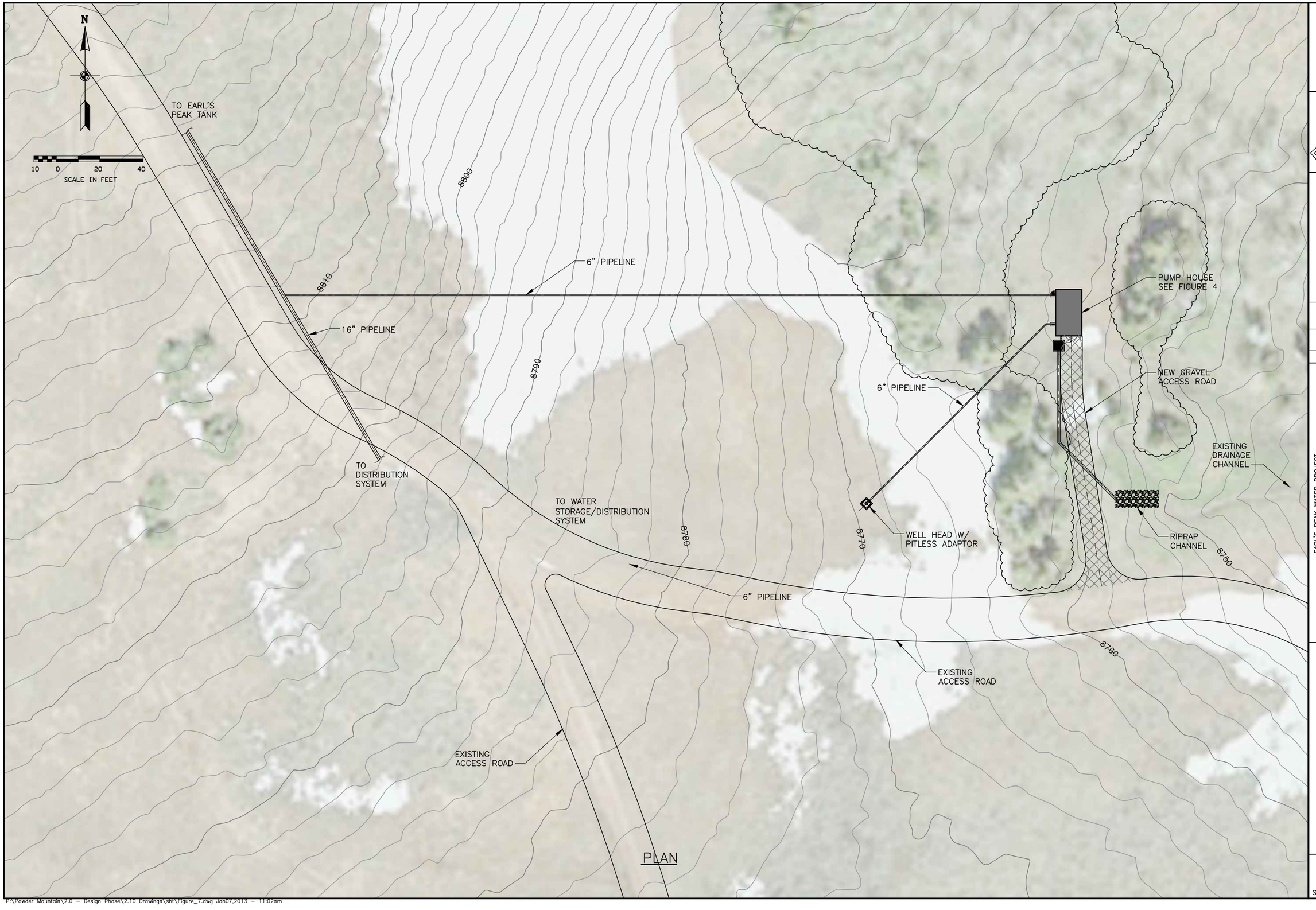
WELL PUMP STATION

PROJECT NUMBER 347-12-1
DATE: JANUARY 2013

DRAWING NO.
FIGURE-6

SHEET ____ OF ____

P:\Powder Mountain\2.0 - Design Phase\2.10 Drawings\sht\Figure_6.dwg Jan07,2013 - 11:06am



Bowen Collins & Associates, Inc. Consulting Engineers

30% REVIEW

REVISIONS

NO.	DATE	REV. BY	DESCRIPTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

EARL'S PEAK WATER PROJECT
SUMMIT GROUP
WEBER COUNTY, UTAH

REVIEW
CHECKED
APPROVED

DESIGN R. OBERG
DRAWN R. GARCIA

WELL PUMP STATION SITE PLAN

DATE: JANUARY 2013
PROJECT NUMBER 347-12-1

DRAWING NO.
FIGURE-7

SHEET ____ OF ____

P:\Powder Mountain\2.0 - Design Phase\2.10 Drawings\sht\Figure_7.dwg Jan07,2013 - 11:02am

CONCEPTUAL COST ESTIMATES

Engineers Opinion of Probable Cost

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

Date: 1/4/2013

Project: Earl's Peak 415,000 GAL Tank

Prepared by: GL

Owner: Summit Mountain Holding Group, LLC

No.	Item	Quantity	Units	Unit Cost	Cost
	Tank and Site Work				
1	Mobilization and Demobilization	1	LS	$36,000	$36,000
2	Excavation (Tank)	3,681	CY	$12	$44,172
3	Structural Fill (Road Base Subgrade)	201	CY	$40	$8,040
4	Structural Fill (Gravel Underdrain)	201	CY	$40	$8,040
5	PVC Pipe (Underdrain)	500	LF	$8	$4,000
6	PVC Liner (Underdrain)	5,410	SF	$0.60	$3,246
7	Backfill around Tank	4,323	CY	$8	$34,584
8	Structural Concrete	600	CY	$600	$360,000
9	PVC Pipe (Roof Drain)	250	LF	$8	$2,000
10	PVC Liner (Roof)	5,410	SF	$0.60	$3,246
11	Hatches	2	EA	$2,500	$5,000
12	SST Ladders	24	LF	$360	$8,640
	Tank and Site Work Subtotal:				**$516,968**
	Inlet/Outlet Valve Vault				
13	Structural Concrete	40	CY	$600	$24,000
14	Excavation	300	CY	$12	$3,600
15	Equipment (Valve, Piping)	1	LS	$6,000	$6,000
16	Backfill	240	CY	$8	$1,920
17	Hatch	1	EA	$2,500	$2,500
18	Galvanized Ladder	20	LF	$250	$5,000
	Inlet/Outlet Valve Vault Subtotal:				**$43,020**
	Yard Piping				
19	16" DIP Inlet/Outlet	100	LF	$150	$15,000
20	6" Drain	200	LF	$50	$10,000
21	12" Overflow	200	LF	$100	$20,000
22	Overflow Headwall and Catch Basin	1	LS	$5,000	$5,000
	Yard Piping Subtotal:				**$50,000**
	Drain Collection Vault				
23	Structural Concrete	40	CY	$600	$24,000
24	Excavation	300	CY	$12	$3,600
25	Equipment	1	LS	$1,200	$1,200
26	Backfill	240	CY	$8	$1,920
27	Hatch	1	EA	$2,500	$2,500
28	Galvanized Ladder	30	LF	$250	$7,500
	Drain Collection Vault Subtotal:				**$40,720**
	Electrical and Instrumentation				
28	Electrical Panels, Level Sensors, Conduit, etc.	1	LS	$10,000	**$10,000**
	Subtotal:				**$660,708**
	Contingency	10%			$66,071
	Total Cost:				**$726,779**

Engineers Opinion of Probable Cost

Bowen Collins & Associates, Inc.
CONSULTING ENGINEERS

Date: 1/4/2013

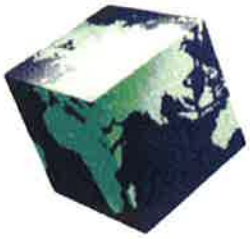
Project: Saddle Well Pump Station and Pipeline

Prepared by: RKO

Owner: Summit Mountain Holding Group, LLC

No.	Item	Quantity	Units	Unit Cost	Cost
	Pump Station				
1	Mobilization	5%	Lump		$ 25,400.00
2	Pump Station Building (includes Site Work)	1	Lump	$ 40,000	$ 40,000.00
3	Mechanical (including Well Pump, Piping, Valves, Etc.)	1	Lump	$ 375,000	$ 375,000.00
4	HVAC Equipment (Louver and Exhaust Fan)	1	Lump	$ 2,500	$ 2,500.00
5	Electrical (includes Unit Heaters)	1	Lump	$ 90,000	$ 90,000.00
	Pump Station Subtotal:				**$ 532,900.00**
	Pipeline to Tank				
6	16-Inch PVC Pipeline	1600	ft	$ 80	$ 128,000.00
	Pipeline Subtotal:				**$ 128,000.00**
	Pump Station and Pipeline Subtotal				**$ 660,900.00**
	Contingency	15%			$ 99,200.00
	Total Cost				**$ 760,100.00**

APPENDIX



IGES®

Intermountain GeoEnvironmental Services, Inc.
4153 South 300 West Salt Lake City, Utah 84107
Phone (801) 270-9400 ~ F: (801) 270-9401
www.igesinc.com

DESIGN GEOTECHNICAL INVESTIGATION
Powder Mountain Resort
Weber County, Utah

IGES Project No. 01628-003

November 9, 2012

Prepared for:

Summit, LLC

Intermountain GeoEnvironmental Services, Inc.
4153 South 300 West, Salt Lake City, Utah 84107 ~ T: (801) 270-9400 ~ F: (801) 270-9401

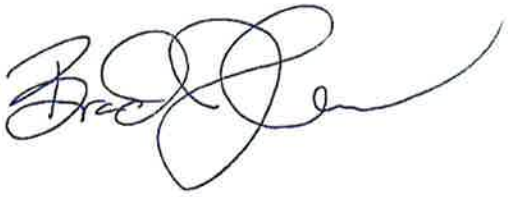
Prepared for:

Summit, LLC
c/o Mr. Ryan Begelman
1335 North 5900 East
Eden, Utah 84310

Design Geotechnical Investigation
Powder Mountain Resort
Weber County, Utah

IGES Project No. 01628-003

Prepared by:



David A. Glass, P.E.
Senior Geotechnical Engineer

Bradley M. Johnson, P.E.
Project Engineer

Reviewed by:

Jared Hawes, P.E.
Project Engineer

IGES, Inc.
4153 South 300 West
Salt Lake City, Utah 84107
(801) 270-9400

November 9, 2012

1.0 EXECUTIVE SUMMARY

This report presents the results of our design geotechnical investigation conducted for the development near Powder Mountain Ski Resort in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the subject site and to provide geotechnical recommendations foundation design, moisture control, and grading. While data collected in our preliminary investigation (IGES, 2012) were utilized in preparation of this report, the recommendations of this report supersede our preliminary recommendations. Our Scope of Work included additional geotechnical investigation, laboratory testing and preparation of this report.

We understand the project consists of developing approximately 200 of 2,000 acres of lightly forested land just south of the existing ski resort. Powder Mountain may undergo a major expansion that could include golf courses, ski lifts, residential, and commercial property development. Site development would include site infrastructure including roads and bridges, retaining structures, and associated underground utilities.

Subsurface soils were sampled in twenty two test pits and one boring excavated at representative locations across the site during the field investigation conducted by IGES. The locations of these explorations were selected based on development plans provided to IGES and the results of preliminary geologic and geotechnical studies. Site soils were predominantly loosely deposited and relatively easy to excavate, although coarse rock to 2 feet in diameter was commonly encountered. Surficial soil consists of mostly clayey/silty gravel, cobble and boulders. Bedrock was encountered 8 feet below existing grade in TP-01 and approximately 6 feet below existing grade in TP-18; however, bedrock was not encountered in any other test pit (maximum depth of the test pits was 15 feet below existing site grade). Bedrock was not encountered in the soil boring, which extended to a depth of 45 feet.

Based on the subsurface conditions encountered at the site, it is our opinion that portions of the subject site outside of mapped landslides are suitable for the proposed development. Areas within mapped landslides areas may be suitable for limited development; however, additional site-specific geotechnical/geologic study will be required on a case-by-case basis to assess the relative risk of future movement potential and to design suitable measures for landslide hazard mitigation, as required. Site development is also subject to Weber County Hillside Development Standards. Western Geologic (2012) has performed recent field work to identify landslides and other geologic hazards at the site.

Map review also indicates that Cambrian Middle Limestone Member (Cbm) may underlie the site. The presence of limestone on-site is problematic because karst structures are formed in

limestone formations. Corrosivity tests performed on site soils indicate that soils are acidic. In a previous geologic report by AMEC (2001), a depression potentially indicating a collapsed cavern was identified on-site. For critical structures (emergency facilities, water tanks, critical infrastructure), drilling of site soils and coring of site rock is recommended to ascertain the acid sensitivity of underlying rock and its continuity.

Shallow conventional spread or continuous wall footings constructed on compacted *granular* structural fill may be proportioned utilizing a maximum net allowable bearing pressure of **2,500 pounds per square foot (psf)**. Shallow conventional spread or continuous wall footings constructed on competent, undisturbed native soils may be proportioned utilizing a maximum net allowable bearing pressure of **1,600 psf**. If any portion of a foundation system is underlain by structural fill, then the entire structure must be underlain by a uniform fill blanket (minimum of 2 feet structural fill below all foundations) – native-fill transition zones are not allowed. Structural fill should be properly moisture-conditioned and compacted as outlined in this report. The net allowable bearing values presented above are for dead load plus live load conditions.

Based on our observations, soil classifications and variations in several laboratory CBR tests the near surface soils are expected to provide poor to fair pavement support. IGES was not provided with any anticipated traffic data, but have performed pavement analysis based on assumed traffic volume which includes anticipated construction traffic. Those assumptions are stated in Section 6.8 *Pavement Design.* For the primary access road, the recommended pavement section consists of 4 inches of asphalt over 6 inches of roadbase over 10 inches of granular borrow. In residential areas pavement is recommended to contain of 4 inches asphalt, 4 inches roadbase and 6 inches granular borrow. Additional pavement section alternatives are also discussed in Section 6.8.

NOTICE: The scope of services provided within this report is limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

DATE	
STARTED:	10/8/12
COMPLETED:	10/8/12
BACKFILLED:	10/8/12

Geotechnical Investigation
Summit LLC
Powder Mountain Development
Weber County Utah
IGES Project Number: 01628-003

IGES Rep: DAG
Rig Type: Odex
Boring Type:

BORING NO: **B-1**
Sheet 2 of 2

LOCATION
LATITUDE 41.36000 LONGITUDE 111.74640 ELEVATION 8,902 feet (above m.s.l)
Water Tank Site

DEPTH ELEVATION	DEPTH FEET	SAMPLES	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	Water Level	Dry Density(pcf)	Moisture Content (%)	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit (10 20 30 40 50 60 70 80 90)
					@ 25' SPT refusal on hard rock - no recovery	n/a							
8875													
	30				@ 30' No recovery	50/3"							
8870													
	35			GM	@ 35' Silty GRAVEL with sand, coarse sand and gravel, dense, 4" recovery, bent shoe on hard rock	50/4"							
8865													
	40			GM	@ 40' Silty GRAVEL, dense, coarse gravel in a silty sand matrix, fine- to medium-grained sand, reddish brown, moist, several angular rocks, refusal on rock	50/3"							
8860													
	45			GM	@ 45' Silty GRAVEL, dense, coarse gravel in a silty sand matrix, fine- to medium-grained sand, reddish brown, moist, several angular rocks	50/3"							
8855					Total depth 45 feet No groundwater Bottom of Boring @ 45.2 Feet								

N - OBSERVED BLOW COUNT PER 6 INCHES

LOG OF BORING (A) DAG V 3.01 01628-003 BORING.GPJ IGES.GDT 11/7/12

IGES

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 3.25" O.D./2.42" I.D. 'U' Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- Modified California Sampler
- Sample from Auger Cuttings

BORING LOG

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Figure A - 26b

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

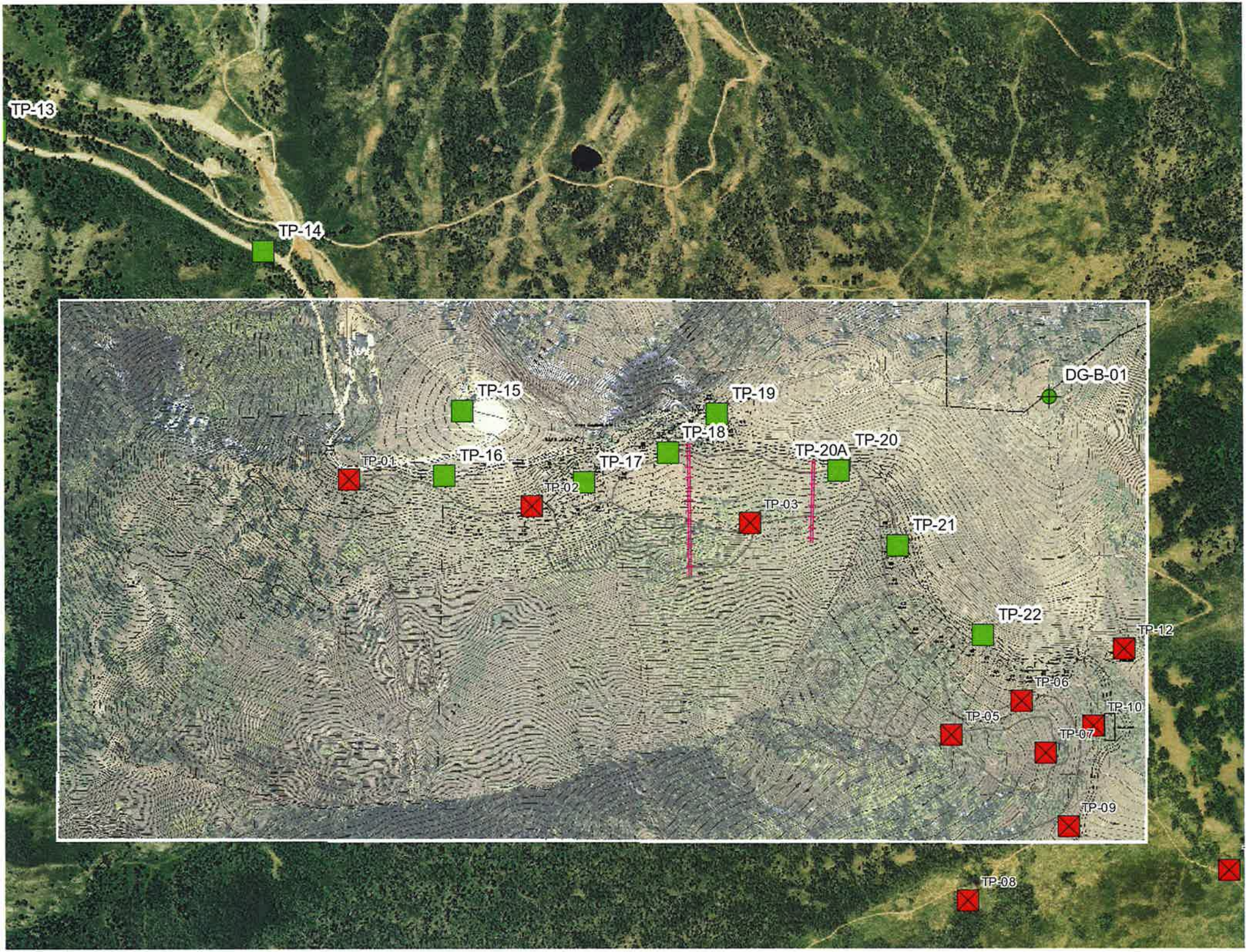
CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

IGES

Key to Soil Symbols and Terminology

FIGURE A-27

IGES, Inc. Project No.: 01628-003


TP-13
TP-14
TP-15
TP-19
DG-B-01
TP-18
TP-20
TP-20A
TP-01
TP-16
TP-17
TP-02
TP-03
TP-21
TP-22
TP-12
TP-06
TP-10
TP-05
TP-07
TP-09
TP-08

Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East, Suite 100, Draper, Utah 84020 ~ T: (801) 748-4044 ~ F: (801) 748-4045

December 6, 2012

Summit, LLC
c/o Mr. Ryan Begelman
1335 North 5900 East
Eden, Utah 84310

IGES Project No. 01628-003

Subject: Report Addendum
Water Tank Foundation and Backfill
Powder Mountain Resort
Weber County, Utah

Reference: IGES, Inc., 2012, Design Geotechnical Investigation, Powder Mountain Resort, Weber County, Utah, Project No. 01628-003, dated November 9, 2012

Mr. Begelman:

As requested, IGES is providing the following addendum to our referenced geotechnical report to address recommendation for the planned water tank. This addendum is in response to an informal request by Mr. Ryan Bradley (Summit, LLC) and Mr. Jeff Beckman (Bowen Collins Associates, BCA) to re-evaluate our recommendations presented in our referenced report with respect to the planned water tank.

Proposed Water Tank

Our understanding of the water tank is based on the preliminary cross-section titled "*Reservoir Section*" (S-2), undated, provided to IGES by BCA. The drawing indicates that the water tank will be a reinforced concrete structure; the perimeter of the tank will be founded on a thickened slab, and the roof structure will be supported on columns founded on conventional isolated footings. The column footings will be placed directly on the tank slab-on-grade (no foundation burial). The tank will have a height of about 20 feet (finish floor to top of concrete cover). The drawing indicates that the tank will be completely buried, with a maximum of 2 feet of cover – however, the tank may have as little as 10 feet of burial. The exact diameter of the tank has not been decided yet, but the diameter is expected to be on the order of 70 feet. The drawing suggests that the water will be about 15 feet deep.

Foundation Recommendations

Mat foundations (structural slabs, thickened slabs, e.g. the perimeter tank foundation) may be designed using an allowable bearing capacity of **2,500 psf** and a Modulus of Subgrade Reaction of **240 psi/inch**. The *net allowable* bearing value presented above is for dead load plus live load conditions. It should be noted that the Modulus of Subgrade Reaction is not a function of soil properties alone but is also influenced by other factors, including the width of the loaded area, the shape of the loaded area, and the specific location under the slab. As such, the structural engineer should exercise care and engineering judgment when using the above stated value for design.

Conventional spread or continuous wall footings constructed entirely on a minimum of 1 foot of structural fill or entirely on competent granular native soils may be proportioned utilizing a maximum net allowable bearing pressure of **4,200 pounds per square foot (psf)** for dead load plus live load conditions.

Sizing of Footings: The *maximum* recommended conventional spread footing width is 5 feet for continuous wall footings and 8 feet for isolated spread footings. Footings larger than the maximum allowable dimensions may induce static settlement in excess of ½ inch. Therefore, proposed conventional footings that are larger than the maximum recommended dimensions presented herein should be evaluated on a case-by-case basis by IGES.

The recommended bearing values presented above may be increased by 1/3 for transient loading such as for wind or seismic.

The preceding recommendations are intended to limit total static settlement to ½ inch or less.

Lateral Earth Pressure Recommendations

Ultimate lateral earth pressures from backfill acting against the buried tank may be computed assuming a friction angle of 36 degrees. This value assumes the tank backfill will consist of excavated coarse, granular soils, with a fines content equal to or less than 25 percent (after over-size material has been removed). Substantial processing of excavated site soils should be anticipated prior to use as tank backfill (removal of over-size material). Prior to backfill, IGES should evaluate backfill soils to assess compatibility with these recommendations. Backfill assessment may include observation and/or laboratory testing (grain size distribution, remolded direct shear).

Construction Considerations

The referenced tank section indicates that the tank slab/foundations will be founded on an 8-inch gravel layer and 2-inch sand layer (~ 1-ft. over-excavation), presumably to accommodate construction of an under-drainage system. IGES takes no exception to this design. However, due to the presence of abundant cobbles and boulders, a 1-ft. over-excavation may be impractical from a constructability standpoint. The Contractor should be made aware that an over-excavation up to 2 feet may be required to accommodate the necessary removal of abundant over-size material.

Since assessment of tank backfill may involve laboratory testing, sufficient lead-time must be given to IGES so as not to unnecessarily delay construction. A two-week advanced notice is recommended to minimize delays due to laboratory back-log.

Closure

The recommendations presented herein supersede the recommendations for tank foundation and backfill presented in our referenced geotechnical report (IGES, 2012). All other recommendations presented in our referenced report remain valid and should be implemented into the design and construction of the project.

We appreciate the opportunity to provide you with our services. If you have any questions please contact the undersigned at your convenience (801) 748-4044.

Respectfully Submitted,
IGES, Inc.

David A. Glass, P.E.
Senior Geotechnical Engineer