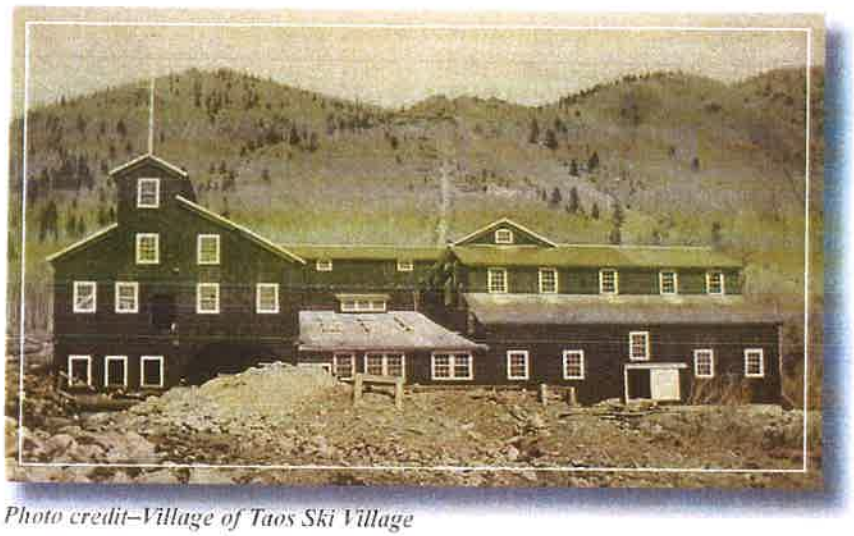
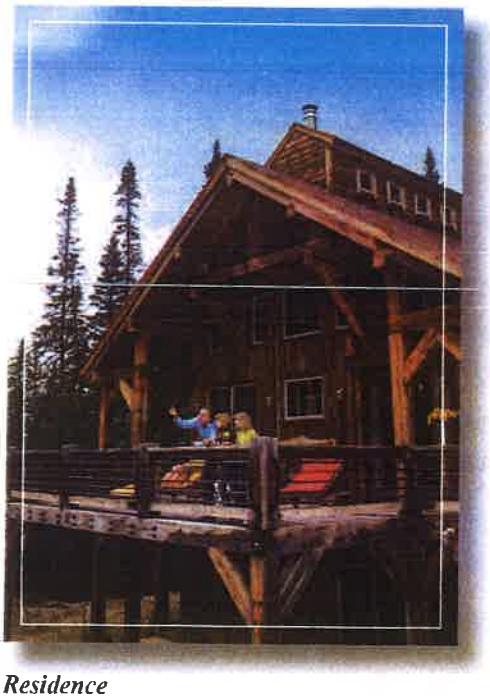
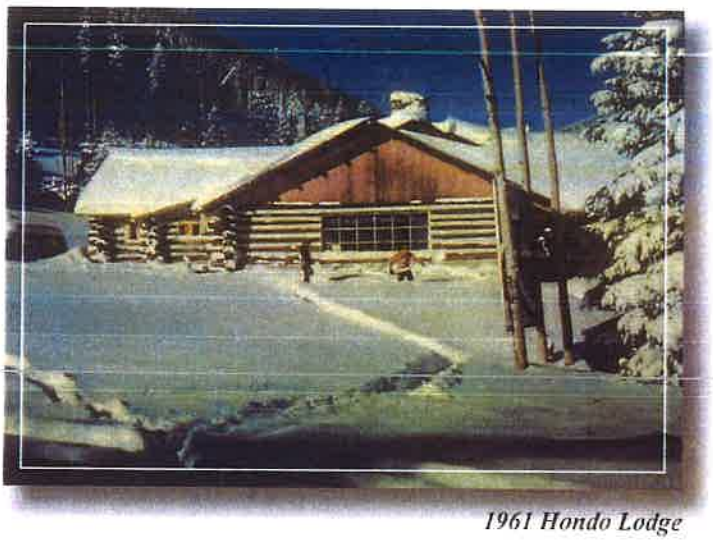


Photo credit–Village of Taos Ski Village

Alpine Rustic Architecture



Residence



1961 Hondo Lodge

Residence, Cliffhanger Loop Road

Village Character Goal, Objectives and Strategies

The objectives and strategies of this element will create an authentic community design plan that reflects the natural beauty and design opportunities inherent in the Village landscape and tradition.

Goal

The Village is designed and developed to enhance the natural beauty and design traditions that define its unique sense of place.

Objective

Public art contributes to the sense of place and beauty of the built environment. Art should be included in the design of public spaces, including trails, parks, pedestrian areas, and plazas.

Strategies

- The Village will work with the TIDD Board and developers in incorporating public spaces and urban design elements into proposed development.
- The Village will set aside lodgers' tax revenues and impact fees for a public art program.

Objective

The Village recognizes that community design traditions evolve over time and community design should not be contrived or imported from other places or cultures.

Strategy

- Create Design Guidelines that reflect the inherent character of the Village.

Objective

The Village will encourage new development to meet the highest standards of community design. These standards include conservation of water and energy, utilizing natural building materials that are not only beautiful but are fire-resistant, and minimizing impacts to slopes and the natural topography.

Strategy

- Taos Ski Valley Village competes with a number of other destination resorts. All new projects will be expected to meet design standards of high quality, which continue and exceed the standards of the original Village..

Objective

The Village will encourage distinct community design standards especially in regards to the Village Core and Kachina areas, to create a stronger sense of place and identity.

Strategies

The Planning & Zoning Commission and Village Council will update the zoning regulations to codify community design requirements. Amendments will focus on community design standards for the Village Core and the Kachina areas for the overall purpose of distinguishing them as separate but interrelated places. Other strategies include: Stronger pedestrian emphasis and a reduction in vehicular traffic parking needs.

- Continue compatibility with surrounding wildlife and the natural environment
- Assemble a built environment that connects buildings, spaces and structures through common scale, materials and design
- Work with the Chamber of Commerce, business owners, and property owners to adopt a comprehensive plan for signage and way finding in the Amizette, and Kachina areas
- Enforce the sign code by conducting a full "sweep" of the Village to identify non-conforming signs

APPENDIXES

Appendix A

Previous Plans

The Village has contracted for or created a number of plans since incorporation in 1996. Below is a summary of these plans with a brief description. Taos County, the US Forest Service and Taos Ski Valley, Inc. and other agencies have created plans that impact the Village. A brief summary of these plans is also included.

Proposed Taos Ski Valley Inc. Master Development Plan-Environmental Impact Statement, April 1981, United States Forest Service

This EIS evaluates the 1980 Master Development Plan for feasibility. Six alternatives were created for up mountain development with a full capacity of 4800 skiers a day. Four alternatives were created for parking and transportation.

Report of Vehicle and Pedestrian Study for the Village of Taos Ski Valley, New Mexico (1998) Larkin Group Study

This study was commissioned to quantify traffic conditions for pedestrian and vehicles. Roadway projects were recommended to manage projected traffic as the result of new development. This study also examines snow storage, signage, subdivisions and road maintenance issues. The study states "The most critical areas for concern within the Village are Thunderbird Road, Ernie Blake Road and Twining Road." Amizette was not included in this study.

Village of Taos Ski Valley Master Plan (Adopted July 5, 2006)

The major themes of the 2006 Comprehensive Plan were to set a priority for economic diversification, protection of natural resources, and clustering commercial development to create a high-quality urban design, encouraging pedestrian amenities, and increasing the capacity and efficiency of public services and infrastructure.

Water System Master Plan for the Village of Taos Ski Valley (May 2007)

This Plan for the Village by McLaughlin Rincon Engineering Firm is a system design that integrates all elements of water infrastructure including water rights, lack of storage and failing pipelines.

Village of Taos Ski Valley Master Plan (Revised November 2010)

The 2006 Master Plan reflected many of the same values that were articulated in the 2006 Comprehensive Plan. Major themes of the 2010 Master Plan include maintaining and improving Village character, services, and infrastructure, protecting the environment, expanding recreational activities such as adding snowboarding, creating mixed-use developments and developments that preserve open space, and overseeing land use.

2011 Preliminary Engineering Report by McLaughlin Water Ltd

The Village hired McLaughlin Water Ltd. to prepare a Preliminary Engineering Report (PER) for the expansion and upgrades to the wastewater treatment plant. The primary purpose of the PER is to "provide the preliminary design basis for an optimum next phase, near future, plan expansion/upgrade project."

The PER states that the existing plant is not amenable to expansion or upgrading for higher levels of water quality. The PER recommends a new sequencing batch reactor (SBR) to be followed by precipitation, multi-media filtration, and UV disinfection for the new facility.

The PER states that a pump station at Amizette is a feasible solution for providing sewer services. The PER recommends a new facility with a capacity of 310, 000 gpd to accommodate existing demand and future development potential.

The Village of Taos Ski Valley Parcel Conceptual Plan 2012

The Village's zoning regulations require all land owners within the Core Village Zone to submit a Parcel Conceptual Plan prior to submitting a site plan or preliminary sketch plat for a subdivision. The Planning and Zoning Commission is responsible for reviewing each parcel conceptual plan. Site-specific development plans need to be consistent with each parcel conceptual plan. The Parcel Conceptual Plan is a master planned approach to development. The process is intended to integrate snow storage, open space, parking, landscaping, utilities and other improvements between individual parcels due to the complexity of infill development and the scarcity of land and rights-of-way. The Commission approved a Plan for six parcels in June 2012.

The Taos Ski Valley Master Plan 2012 (Not formally adopted)

This plan designated seven Development Zones with their individual land uses and design standards intended to assist the community in evaluating proposals for new development and redevelopment. Central goals were: creating a vision for the Village of Taos Ski Valley for the next 25 years; encouraging a diverse and sustainable mix of hospitality, art, recreation, food and retail businesses; encouraging smart growth; improving the visual character of the three primary community zones (Amizette, Core Village, and Kachina Basin); establish a community-wide trail system; create a strong character and identity for the Village of Taos Ski Valley.

The Taos Ski Valley Master Plan 2014 (Proposed July 2014, not adopted)

This plan is essentially the same as the 2012 Taos Ski Valley Master Plan with a few statistical changes and recommendations to include the 2015 Tax Increment Development District (TIDD) information and Impact Fees.

Village of Taos Ski Valley Infrastructure Capital Improvements Plan (ICIP)

Every year the Village Council adopts an ICIP that is a list of unfunded infrastructure projects presented in a priority order for a five-year period.

The Village of Taos Ski Valley Community Wildfire Protection Plan (CWPP) June 2016

The CWPP is the result of a collaborative effort to bring together residents, property and business owners, elected and appointed officials and all levels of government and community organizations to reduce the risks associated with a forest fire. The CWPP includes a series of objectives and maps that will implement the CWPP over the next five years.

The Roadway Improvements Element of the Village Master Plan

The Planning and Zoning Commission adopted this plan on July 6, 2015 and the Village Council also found it necessary to adopt the same element on July 14, 2015. This element of the Master Plan reflects the most current goals, policies and objectives for the improvement and maintenance of Village roadways

The Wireless Communication Plan for the Village of Taos Ski Valley, July 2015

The Planning and Zoning Commission adopted this plan that reflects the current goals, policies and objectives for safe and reliable wireless communication for the Village. Also, the Village Council found it necessary to adopt this element on July 14, 2015.

Private Master Development Plans

Comprehensive Plan Twining-Amizette, Taos County, New Mexico (1971)

A report to the Taos County Commission laid out the goals related to Resort and Community Development for the "Twining- Amizette Community." The majority of the goals relate to " clean water, clean air and an abundance of undisturbed natural area": "...to encourage the future of Taos Ski Valley as a year round resort; and "...to encourage planned development of the ski resort to its fullest extent in terms of both skier capacity...and the amenities offered to summer guests and permanent residents." Separate goals that related to Community Development were listed. all consistent with today's intent. particularly "...to stress the importance of a carefully planned community due to minimal amount of easily urbanized lands in Twining-Amizette".

The Master Plan for Kachina Village (1973)

The Pattison Trust and Taos Ski Valley, Inc. joined together to hire an architectural and engineering consultant team to prepare a development plan for the Kachina area. The plan explored alternative development scenarios for the area and included preliminary engineering studies for the necessary infrastructure and utility improvements.

This Master Plan included development plans, design guidelines and development criteria.

Several other master development plans have been prepared for the Kachina area. These include the 2008 study provide by SMPC architects, several plans prepared by Comet Studios between 2007 and 2010. and a more recent study by Champalimaud consultants. None of the plans were formally adopted by the Village. The limiting factors in supporting new development in Kachina at that time were water and fire suppression capacity and limitations of the wastewater treatment plant.

Proposed Taos Ski Valley Inc. Master Development Plan, Environmental Impact Statement, U. S. Forest Service, April 1981

The EIS evaluates the Master Development Plan proposal that was submitted to the U. S. Forest Service by Taos Ski Valley, Inc. in 1980 for up-mountain development, parking and transportation. At that time, full development capacity was 4800 skiers a day with parking for 1065 cars and 25 buses. The effects of implementing each of the five alternatives were evaluated, with one set of alternatives for parking and one set for up-mountain improvements.

Taos Ski Valley, Inc. Redevelopment Plan, Design Workshop, November 2010

A planning consultant prepared a Redevelopment Plan for Taos Ski Valley, Inc. for the Core Village area in 2010. This plan formed the background for the addition of the Core Village Zone and related development standards and procedures. The Plan contains a brief analysis of topography and slope, sun and shadow patterns, walking distances to ski facilities and the character of the Village that needs to be preserved.

Taos Ski Valley Core Village Revitalization 2012 Conceptual Plan Presentation

This graphic version depicts proposed land uses, brief design requirements for development and ski valley infrastructure improvements. It is a condensed version of the Redevelopment Plan of 2010.

The Core Village Zone of Taos Ski Valley Way Finding Signage Plan & Design Standard, June 2016, Zehren and Associates

This is a graphic plan which creates a standard sign program for Taos Ski Valley to facilitate circulation patterns for pedestrian and vehicles.

Village of Taos Ski Valley Amended Zoning Regulations to Include Core Village Zone

The Planning & Zoning Commission and the Village Council amended the Zoning Regulations to include the Core Village Zone to the zoning map and to adopt a variety of development standards to facilitate new development within the Village Core.

Pattison Land Master Plan, Northside at Taos Ski Valley. June 2015

The Pattison Family owns 1,299 acres of land in Taos Ski Valley. This planning process provides a preliminary master plan that studies the feasibility and development potential of the site as a mixed-use resort destination. Several real estate scenarios are examined and evaluated according to their feasibility in terms of site development that is sensitive to the area and the environmental constraints, as well as their economic viability. This plan presents a thorough analysis. The final recommendation was that the site be valued more for its natural characteristics than potential for ski development due to excessive costs.

Final Environmental Impact Statement for Taos Ski Valley's 2010 Master Development Plan-Phase One Projects, Carson National Forest, Taos Country, New Mexico, August 2012

This Plan analyzes and discloses the estimated environmental impacts of implementing the 2010 Master Development Plan-Phase 1 Projects. Three alternatives for the ski mountain (winter and summer activities) were created and analyzed, as were parking lot re-configurations to improve the sense of arrival into the Taos Ski Valley.

https://www.fs.usda.gov/project/?project=34310

Second Revised Economic Impact Analysis for Taos Ski Valley Inc., Doug Kennedy Advisors, January 7, 2015

An economic study commissioned by Taos Ski Valley Inc. to assess the potential impacts of the redevelopment of the Ski area with regard to local and regional growth, tax revenues, fiscal impacts over the next decade.

The Core Village Zone of Taos Ski Valley Way Finding and Signage Plan, TSVI., Zehren and Associates, June 2016

This is a graphic plan of the design standards, locations and pedestrian/ vehicular way finding signage created for the Village by Zehren and Associates for TSVI.

Regional Plans

Taos County Comprehensive Plan & Growth Management Plan (2004-2016)

The County Commissioners adopted a comprehensive plan in 2004. This plan combines land use and water resources. The plan outlines the goals, objectives, and strategies for addressing a variety of community development issues. The plan focuses heavily on preserving rural land from inappropriate development and preserving water resources. Taos County updated the 2004 Comprehensive Plan in the fall of 2016.

The Growth Management Plan was initiated as the next step from the Comprehensive Plan towards adopting zoning ordinances for the County's neighborhood associations.

Taos Regional Water Plan

The Taos Regional Water Plan was created through a committee of stakeholders during 2008. One of the main components of the Plan was the public welfare statement. The public welfare statement is a written proclamation of the importance of water resources to the community. The State Engineer reviews the transfer of water rights against the welfare statement.

The Interstate Stream Commission worked with all stakeholders throughout 2016 to update the Regional Water Plan.

The Plan addressed the following issues:

- the Rio Grande compact and availability of water rights
- drought vulnerability
- infrastructure needs
- water quality
- public education
- protection of agriculture
- protection of water rights
- planning for growth
- watershed protection
- data gaps

Rio Hondo Watershed Restoration Action Strategy, 2006

The Village participated in the Watershed Restoration Action Strategy (WRAS) and Non-Point Source Abatement Plan in 2006. The WRAS is "a non-regulatory, voluntary approach to addressing non-point source impacts to water quality."

The WRAS identified a number of concerns regarding water quality in the upper Rio Hondo watershed, including sedimentation from grazing and steep slope trails and developments, impacts of future resort development, prevention of catastrophic wildfire, and the application of salt and sand to roadways and parking lots.

Revised Forest Plan, Carson National Forest, United States Forest Service

The Carson National Forest is beginning the process of revising their 1986 Forest Plan. According to the Forest Service, the revised plan will incorporate changed conditions, best available science, and new public issues. It is intended to be a "science based framework for integrating resource management, which will promote healthy, resilient, diverse, and productive national forest grasslands with a range of social, economic and ecological benefit now and for future generations." (www.fs.usda.gov/detail/carson/land management/planning/?cid=stelprdb5443166).

The Forest Plan is expected to be available for public review and comment in the Fall/Winter of 2017.

Town of Taos 2013 UPDATED Community Economic Development Strategic Foundational Plan & Community Economic Development Element

This plan was done in response to Taos' participation in recertification as a Certified Communities Initiative participant, and was an update to the 2010 project of the same name. This effort was a progression towards a formal community economic development plan. It was an update to the original Foundation Plan.

Taos County Comprehensive Plan Update 2016- Visions, Goals and Strategies

This document updates the 2004 Taos County Comprehensive Plan to describe and respond to conditions in 2016. The update reflects the current needs and visions of the community residents. It is organized as community values, goals and strategies and defines the direction for the County Commissioners.

Appendix B

Planning and Zoning Resolutions

Planning and Zoning Commission

Resolution 16-284

APPROVING THE ROADWAY IMPROVEMENTS ELEMENT OF THE VILLAGE MASTER PLAN

WHEREAS, the Planning and Zoning Commission adopted the Village of Taos Ski Valley Master Plan in November 8, 2010 by Resolution 11-198; and

WHEREAS, Section 3-19-10 of the New Mexico state statutes allow the Planning and Zoning Commission to adopt "a part of the master plan as work progresses on the master plan; provided the part corresponds with one of the functional subdivisions of the subject matter of the plan;" and

WHEREAS, the Planning and Zoning Commission finds it necessary to adopt the Roadway Improvements Element of the Master Plan to reflect the most current goals, polices, and objectives for the improvement and maintenance of Village roadways in order to better serve the safety and overall welfare of the Village; and

WHEREAS, the goals, policies, and objectives of the Roadway Improvements Element are based on careful and comprehensive studies of existing conditions, probable future growth of the Village, and citizen input from Village residents, businesses, and property owners; and

WHEREAS, the Planning and Zoning Commission has reviewed the Roadways Improvements Element, together with the accompanying maps, charts, descriptive and explanatory matter; and

Now, be it resolved, that the Planning and Zoning Commission approves the Roadway Improvements Element and encourages the Village Council to adopt the Roadway Improvements Element.

APT-9:108

Approved by the Planning and Zoning Commission this 6Th day of July, 2015.

THE VILLAGE OF TAOS SKI VALLEY, NM SEAL INCORP. 1996

Planning and Zoning Commission

Tom Wittman, Chair

ATTEST:

Village Clerk

Vote: For 5 Against 0 Abstain 0

Planning & Zoning Commission

Approving the Roadway Improvements Element of the Village Master Plan

Resolution 2016-289

ADOPTING THE ROADWAY IMPROVEMENTS ELEMENT OF THE VILLAGE MASTER PLAN

WHEREAS, the Planning and Zoning Commission adopted the Village of Taos Ski Valley Master Plan in November 8, 2010 by Resolution 11-198; and

WHEREAS, the Planning and Zoning Commission approved Resolution 15-285 – Approving the Roadway Improvements Element of the Village Master Plan; and

WHEREAS, Resolution 15-285 encourages the Village Council to adopt the Roadway Improvements Element; and

WHEREAS, the Village Council finds it necessary to adopt the Roadway Improvements Element of the Master Plan to reflect the most current goal, polices, and objectives for the improvement and maintenance of Village roadways in order to better serve the safety and overall welfare of the Village; and

WHEREAS, the goal, policies, and objectives of the Roadway Improvements Element are based on careful and comprehensive studies of existing conditions, probable future growth of the Village, and citizen input from Village residents, businesses, property owners, and committees; and

WHEREAS, the Village Council has reviewed the Roadways Improvements Element, together with the accompanying maps, charts, descriptive and explanatory matter; and

Now, be it resolved, that the Village Council adopts the Roadway Improvements Element of the Village Master Plan.

PASSED, ADOPTED AND APPROVED this 14th day of July, 2015.

THE VILLAGE OF TAOS SKI VALLEY

Neal King
Mayor

Attest:

Ann M. Wooldridge
Village Clerk

Vote: For 4 Against 0

THE VILLAGE OF TAOS SKI VALLEY, NEW MEXICO SEAL

INTRODUCTION

The Village of Taos Ski Valley (Village) adopted this Roadway Improvements Element of the Master Plan to provide residents, property owners, developers and the Village staff with a clear guide of how the Village roadway network should be improved and maintained within the next twenty years. The Council and the Planning & Zoning Commission believe it is necessary to adopt the Roadway Improvements Element prior to the adoption of the complete Master Plan due to the redevelopment taking place within the Core Village. As new development occurs in the Core Village (and elsewhere), it is more important for the Village to approve the preferred design, construction, and priorities of roadway improvements to facilitate safe and convenient circulation for vehicles, pedestrians, and bicycles.

EXISTING CONDITIONS

The existing roadway system is characterized by steep terrain with narrow rights-of-way, gravel road surfaces, several steep switchbacks, and icy driving conditions. The existing conditions make roadway improvements very difficult and very expensive. Furthermore, the icy conditions, narrow roads, lack of sidewalks, and steep switch-backs cause safety hazards for drivers and pedestrians. The intensity of development proposed in the Village Core will exaggerate these conditions if new roadways are not designed and maintained properly.

There are 5.6 miles of public roads and .9 miles of private roads within the Village. This does not include the 7.7 miles of NM 150 between the intersection of NM 230 and the Village entry and the roadways located in the U.S. Forest Service (USFS) parking lot. Only the USFS parking lot, the Pioneer Glade subdivision, and Sutton Place are paved roads; however, recent development plans include pavement of several roads within the Village Core area and Twining Road to Kachina area.

The Village is a member of the Northern Pueblos Regional Planning Organization (NPRTPO). The NPRTPO is a state-designated organization that orchestrates rural transportation planning with local and regional government agencies. The NPRTPO develops the Regional Transportation Improvement Plan Recommendation, a regional transportation plan consisting of project recommendations from rural, municipal, county, and tribal governments within the region. The Village Public Works Department is responsible for maintaining public roads, including snow removal and snow storage. Snow storage easements are scattered throughout the Village along roadways.

Erosion is a concern to the Village and private property owners due to the impacts to roadways, culverts, water quality, and riparian areas.

The **Existing Conditions Map** and **Table #1 - Existing Conditions** identify the individual roadway sections, their ownership, length, rights-of-way, surface type, slope and general condition. The general condition is determined by the combination of width, slope, surface condition, and drainage. The **Roadway Slope Map** identifies the average slope of each roadway. The slopes in the Roadway Slope Map should be verified prior to any additional planning or design.

PREVIOUS PLANS

The Village has entertained numerous roadway improvement proposals since the Village was first incorporated in 1996. The Village adopted a Master Plan in 2006 and an updated Master Plan in 2010. The Council adopts the annual Infrastructure Capital Improvements Plan. Below is a summary of these plans and a brief description of the roadway improvements that have been considered.

Some of the proposed projects found in previous plans have already been completed while many of the proposals have been disregarded due to the estimated cost or the lack of additional rights-of-way. Other projects will be completed through the Tax Increment Development District (TIDD). The current status or funding sources of each project is indicated in parentheses wherever possible.

2006 Comprehensive Plan

The Village Council recognized the importance of roadway improvements when it adopted the first Comprehensive Plan in 2006. The Comprehensive Plan included the following recommendations for transportation and circulation:

1. In order to enhance the Village core, increase pedestrian safety, reduce pedestrian/vehicle conflicts and generally create a pedestrian oriented Village core, every attempt will be made with both public and private projects to place priority on a pedestrian only Village core.
2. Any new parking structures or surface lots will be encouraged to locate beyond the perimeter of the Village core, although such parking may be allowed within the Village core.
3. Any new roadway in the Village will allow for adequate emergency vehicle access, snow storage, and pedestrian walkways as determined by the appropriate Village department, whether built by the Village or by a private party.
4. Because of the existing problem with snow storage, the Village will develop snow storage areas away from existing roadways where possible.

1999 Larkin Group Study

This study was conducted to quantify traffic conditions for vehicle and pedestrians and to recommend roadway projects to satisfy the projected traffic demand as a result of new development. The study also examined snow storage, signage, subdivision regulations, and maintenance issues. The study states, "The most critical areas of concern for travel within the Village seem to be along Thunderbird Road and Ernie Blake Road and along Twining Road." Amizette was not included in the study.

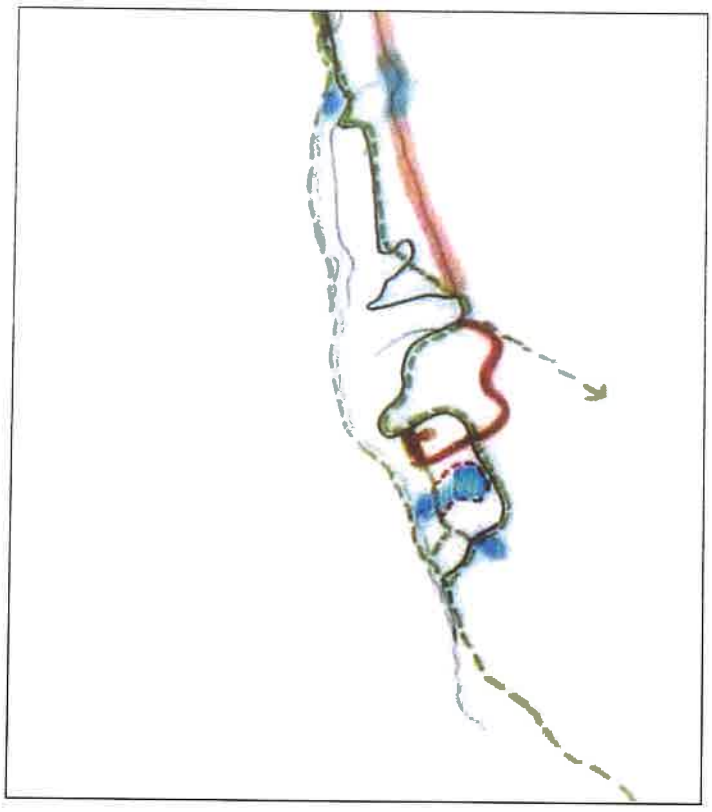
The Study recommended the following roadway improvements:

1. **Relocation of Ernie Blake Road** along the Sierra Del Sol condominiums toward the Twining Condominiums and connect to a new intersection at Twining Road. (TIDD)
2. **Improve Thunderbird Road** with 6 foot sidewalks and curb and gutter. (TIDD)
3. **Twining Road Drainage System** to provide positive drainage. (COMPLETE)
4. **Twining Road Pavement** near the Ernie Blake Road intersection. (TIDD)
5. **Phoenix Switchback Intersection Improvements** to improve turning movements. (COMPLETE)
6. **Cliffhanger Drive Improvement** to improve the sharp curves at Twining Road. (FURTHER STUDY)
7. **Ernie Blake Drainage Improvements** to reduce ponding at the Thunderbird Road intersection. (COMPLETE)
8. **Improve Cliffhanger Drive** as a potential one way pair with Twining Road.
9. **O.E Pattison Loop** to become a one way road. (COMPLETE)
10. **Improve Twining Road** with grade changes and acquire snow storage easements and apply dust suppressants during summer months. (COMPLETE)
11. **Kachina Road Avalanche Structure** (and avalanche bridge) to minimize damage caused by avalanches and provide an alternative access to Kachina. (FURTHER STUDY)
12. **Pedestrian Facilities** at Ernie Blake Road and Thunderbird Road, including a pedestrian path between Dolcetto Road and Twining Road. (FURTHER STUDY)

2010 Master Plan

The 2010 Master Plan included a variety of recommendations to improve roadways and traffic circulation. These included:

- develop a pedestrian circulation plan, (PARCEL CONCEPTUAL PLAN + TIDD)
- provide appropriate street lights, (IN PROGRESS)
- consider people moving options such as an electric shuttle, cog railroad, gondola or funicular, (FURTHER STUDY)
- examine the potential for a bypass to Kachina Road, (FURTHER STUDY)
- create areas of snow storage, (IN PROGRESS)
- "a landscaped entry along Armadillo Road (previously the Armadillo parking lot) that focuses attention in the "Center" and the scenic vista of the narrowing valley beyond" and "Prohibit parking along Armadillo Road." (FUTURE DOT MUNICIPAL ARTERIAL PROJECT)



The map illustrates the proposed Kachina Bypass. (FURTHER STUDY)

A gondola was also recommended to connect the Village Core and Kachina.

The Master Plan also included typical roadway sections to identify design standards for different roadways. However, the map and the illustrations do not identify which roadways should be developed to the particular standard.

Road Type	Right-of-Way	Travel Lane Width	Speed	Other
Entry Avenues and Queuing Lanes	60′	10′	30 MPH	on-street parking, 12′ landscape buffer & sidewalk
Main Road	50′	12′	20 MPH	on-street parking, 12′ landscape buffer & sidewalk
One-Way Lane	24′	12′	not identified	6′ landscape buffer
Rural Road	24′	12′	not identified	6′ landscape buffer

The Master Plan also recommended:

1. "Study the feasibility of improving the Kachina High Road for year-round use." (FURTHER STUDY)
2. "Also look at ways to improve Phoenix Switchback." (COMPLETE)
3. "The terminus of Armadillo is a public space, opening onto community facilities and providing a hub for transit services and mixed-use buildings." (IN PROGRESS)

2012 Parcel Conceptual Plan

The Planning & Zoning Commission and the Village Council amended the Zoning Regulations (Ordinance 14-30) to include the Core Village Zone to the zoning map and adopted a variety of development standards and procedures to facilitate new development within the Village Core. The Core Village Zone allows property owners to submit a Parcel Conceptual Plan for the purpose of "facilitating the redevelopment and revitalization of the CVZ area, stimulating a consistent and sustainable mixture of commercial, residential and recreational land uses, promoting a reasonable bed base of residential and lodging units to support the resort, fostering a vibrant pedestrian activity zone, and providing a base village environment that supports resort operations and provides a positive resident and visitor experience in multiple seasons."

Following the approval of the CVZ, the developers of Taos Ski Valley, Inc. submitted a Parcel Conceptual Plan for 6 parcels within the CVZ. The Parcel Conceptual Plan proposed roadway improvements for Sutton Place, Thunderbird Road, and the relocation of Ernie Blake and Burroughs Roads.

APT-9.116

2015 Tax Increment Development District (TIDD)

The Village Council unanimously approved the formation of the TIDD and village residents and property owners overwhelmingly approved the TIDD in early 2015. The TIDD is a public finance "mechanism" whereby the developer provides the up-front bond financing for a variety of public infrastructure improvements in return for the dedication of future gross receipts taxes and property tax increments. The tax increments are used to re-pay the debt service of the bonds. A portion of the incremental taxes are dedicated to the local government to pay for the on-going operations and maintenance of the infrastructure after it has been developed and dedicated to the local government. The TIDD estimated over $52 million in overall infrastructure needs. The following table identifies only the transportation and roadway improvements of the TIDD.

TIDD Projects

Project	Year	Cost Estimate
Sutton Place Crossing	2015	$1,460,000
Snow Storage Solution	2016-2017	$525,000
Ernie Blake & Thunderbird Road Upgrades	2016-2017	$1,650,000
West Burroughs Crossing	2017	$1,320,000
Route 150/Village Entry Road	2017	$1,650,000
Strawberry Hill Access & Crossing	2018	$2,335,000
Parking Lot Upgrades & RV Park	2018	$1,100,000
Twining Road Pavement (.5 miles)	2018	$660,000
Pave Road to Kachina	2018	$2,200,000
Public Parking Facility (at Kachina)	2019	$1,000,000
	TOTAL	$13,900,000

Infrastructure Capital Improvements Plan (ICIP)

Every year the Village Council adopts an ICIP. The ICIP is a list of unfunded infrastructure projects presented in priority order for a five year period. The following roadway and parking improvement projects have been included in the ICIP since 2011:

Project	Estimated Cost
Twining Road Improvement – Phase III Construction	$50,000
Purchase Land for Pedestrian Walkways in Village Core	$150,000
Village Core Pedestrian Walkway Construction	$45,000
Construct Kachina Road Improvements – Phase II	$70,000
Construct Kachina Road Improvements – Phase III	$70,000
Phases I - IV Village Core Infrastructure Improvements	$750,000
Phases IV – VIII Road Improvements	$55,000
Acquire Land and Design New Village Entry Road	$400,000
Construct Phase I Village Entry Road	$1,800,000
Design and Construct Kachina Road Improvements (Hiker Parking to Bavarian)	$100,000
Beaver Pond Sediment Control / Riparian Restoration	$100,000/$50,000/$150,000
Terry Sports Demolition	$50,000

State and Regional Plans

The Village falls within District 5 of the New Mexico DOT (DOT). DOT completes a Statewide Transportation Improvements Plan for state highways such as NM 150. The Northern Pueblos Regional Transportation Planning Organization (NPRTPO) is responsible for coordinating regional transportation planning with the Village and other government agencies and communities.

EXISTING ORDINANCES

Zoning Regulations

The Core Village Zone of the Village Zoning Regulations includes development standards for new roadways. It states, "The typical cross-sections should strive to strike a balance that provides a functionally efficient, safe and connected network of vehicular and pedestrian facilities with street cross-sections that balance the need for necessary vehicular movement with the minimized speeds and traffic management controls necessary to promote a pedestrian-oriented resort community. Parking on roads shall not be permitted unless the road is specifically designed for on-road parallel parking."

Impact Fees

The Village Council adopted impact fees as a part of the zoning ordinance. Impact fees are imposed on new development to pay "its fair and proportionate share of the costs to the Village of Taos Ski Valley associated with providing necessary public services and public facilities...that serve such development." (Ordinance 14-30. Section 22). Impact fees are charged for 1) roadway, pedestrian and drainage improvements, 2) parks & recreation / open space, 3) general government facilities, and 4) public safety. The fee for roadway, pedestrian and drainage improvements is $2.4773 per square foot of development. The fee is determined from an estimate of the total square footage of future development divided by the total estimated costs of the public services and public facilities. Water and sewer systems are not included in the impact fee ordinance. These estimates were prepared by the Village staff and are contained in the "Public Facilities Needs Assessment Report" which was approved by the Village Council on June 10, 2014.

Public Facilities Needs Assessment Report
June 10. 2014

"In addition to the current deficiencies found in the Village's transportation system, future traffic problems generated by increased residential and commercial growth in Taos Ski Valley will severely impact the Village's current roadway system. Because all the traffic into or out of the Village must use NM State Highway 150, the traffic volume on the streets at the north end of the Village are highest. Additionally, this area will see the greatest traffic impact as a result of growth in the southern section of the Village. Specific areas where existing traffic problems will be further exacerbated by new growth are the following:

- Ernie Blake Road
- Sutton Place
- Thunderbird Road
- Twining Road
- The intersection of Phoenix Switchback and Twining Road
- Kachina District Roads and Intersections
- Lack of snow storage along Twining Road and in commercial core creates traffic congestion problems and safety issues.

Taos Ski Valley receives on average 300 inches of snow per year. Because of this, adequate **snow removal and storage sites are needed in order to facilitate traffic, pedestrian and emergency vehicle movement throughout the Village**."

The Assessment identified the following roadway improvements and cost estimates:

VTSV Road Improvements	Costs
Phoenix Switchback Retaining Wall (COMPLETE)	$275,000.00
Village Entry Road (TIDD)	$2,548,273.00
Twining Rd, ending at Phoenix Switchback, sidewalk, street lights, curb, gutter, storm water management, etc. (TIDD)	Phase I - $528,895.50 Phase II - $528,895.50
Ernie Blake paving, sidewalk, street lights, curb, gutter, storm water management, etc. (TIDD + LAND ACQUISITION)	$459,430.00
Replace Sutton Place river crossing (TIDD)	$375,000.00
Sutton Place resurfacing, sidewalk, street lights, curb, gutter, storm water management, etc. (TIDD)	$278,771.00
Thunderbird Rd. Paving, sidewalk, street lights, curb, gutter, storm water management, etc. (TIDD)	$293,655.00
Kachina District Improvements (TIDD)	$275,000.00
West Burroughs Road sidewalk, street lights, curb, gutter, storm water management, etc. (TIDD – NEED RIGHT OF WAY)	$303,402.00
Purchase of Land for Snow Storage & Right of Way (TIDD)	$525,000.00
Total:	**$6,291,322.00**

Subdivision Ordinance

The subdivision ordinance includes designs standards for new roadways to be constructed within a new subdivision. These standards are intended to preserve views and protect the natural characteristics of the hillside. Specific design standards require a minimum street right-of-way width not less than thirty (30) feet, two 12-foot travel lanes, twenty (20) feet snow storage easement on each side (excluding driveways), and a slope not to exceed 12% grade.

The Village applies these standards for re-design and re-construction of existing roadways when a development necessitates roadway improvements to service the development.

GOAL, POLICIES, AND OBJECTIVES

The goal, policies, and objectives present a framework for evaluating new development proposals and for implementing roadway projects.

Goal

The Village accommodates the transportation needs of all users with a safe, convenient, and cost effective roadway network.

Policies

1. The Village will improve roadways (or propose new roadways) where there is a clear benefit to public safety, convenience, and welfare and when the development of the Village's public facilities requires new roadways.
2. Private property owners will pay for all necessary roadway improvements which are necessitated by new development, particularly in areas where the existing roadways do not meet design standards.
3. The Village will accept dedication of roadways only when they are built to the Village's design standards and protect the public safety and welfare.
4. Village roads will be designed, constructed, and maintained to provide adequate snow storage areas without placing an undue burden to individual property owners or the Village.
5. Roadway design will minimize cut and fill to avoid erosion and landslides and to minimize sedimentation and jeopardize surface water quality; the installation of underground utilities will be coordinated to the maximum extent possible prior to any construction to avoid trenching after the roadway has been improved.
6. The Village will maintain public roadways to ensure the safety and convenience of the public.
7. The Village will seek funding from federal and state agencies for roadway improvements, including the DOT Coop program, wherever possible and feasible.
8. The Village will participate in regional transportation and transit planning efforts sponsored by Taos County, DOT, the Regional Transit Authority, the Town of Taos Chile Line, the Northern Pueblos Planning Organization, or the Intergovernmental Council of the Enchanted Circle.

Objectives

1. Improve Village roadways

Each of the following roadways will be designed and developed according to the proposed conditions and typical cross sections to the maximum extent feasible. Not all roadway sections can be developed to these standards for the entire length the roadway, however. The roadway design should balance the needs for vehicle traffic, access to private property, public safety, lighting, pedestrian safety, snow storage requirements, signage, rights-of-way, utility easements, driveways, drainage and slope, and other potential limitations.

a. Thunderbird Road

The Planning & Zoning Commission approved the roadway improvements to Thunderbird Road as a part of the Conditional Use Permit for the Parcel D Development. There will be a minimum of a five-foot sidewalk on both sides; however, the Village will continue negotiations with adjacent property owners to acquire the necessary rights-of-way for adequate sidewalks.

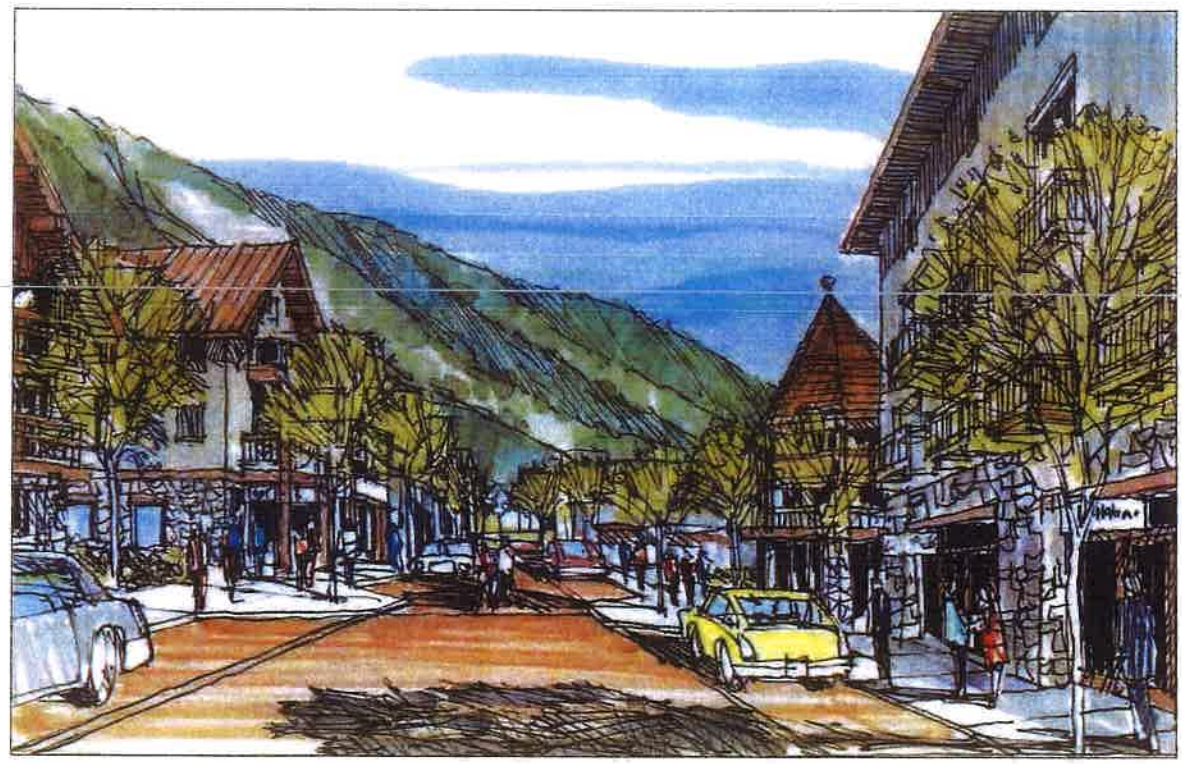


Illustration of Thunderbird Road taken from the TSV, Inc. Core Revitalization Conceptual Plan. February 2012.

b. Ernie Blake Road

Ernie Blake is currently not safe for two-way traffic. The Planning & Zoning Commission approved Option #3 for the new alignment of Ernie Blake Road during a Commission meeting held on August 4, 2014 . A land acquisition or land exchange will be required with private property owners to improve the roadway to safe conditions prior to permitting two-way traffic along the entire length of the road. The road will be realigned to reduce the slope and provide a perpendicular intersection at Twining Road. It will include two travel lanes, curb and gutter, and sidewalks.

c. Sutton Place

Sutton Place will be developed as a part of the mixed-use development on Parcel G. It will include two 10-foot travel lanes, curb and gutter, a landscape strip of various widths, and an 8- to 6-foot sidewalk on the east side. The existing walkway along the Edelweiss will serve as the pedestrian passage on the west side.

d. West Burroughs Road

West Burroughs Road will remain a private road beyond the Lake Fork Stream to provide access to private developments. The design and schedule for construction to be determined between the developer and the consulting engineers.

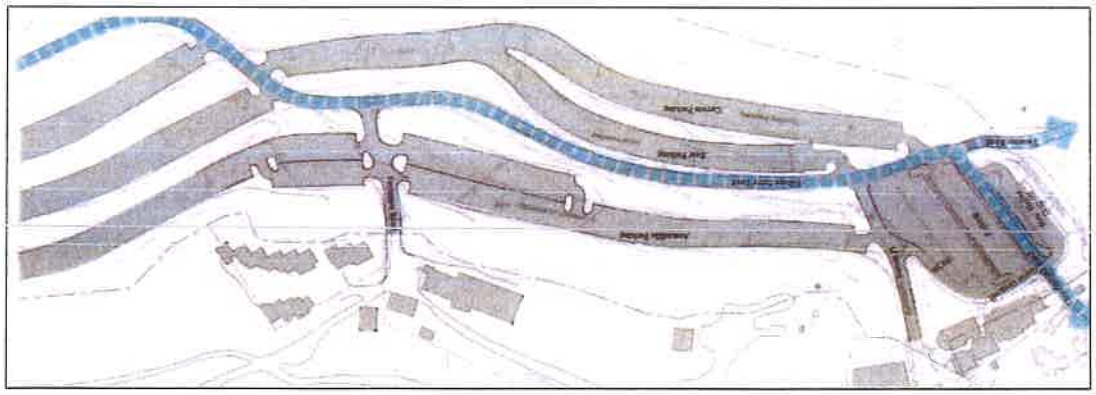
e. Twining Road to the Phoenix Switchback

Twining Road improvements will include water line upgrades and dry utilities, pavement of two 12-foot travel lanes, shoulders and roadside drainage ditches.

A ROAD SITE PLAN AND TYPICAL SECTIONS OF ROADWAY IMPROVEMENTS FOR THE VILLAGE CORE AREA ARE INCLUDED AS EXHIBITS #1 - #5.
A NARRATIVE IS INCLUDED AS EXHIBIT #6.

2. Adopt a comprehensive **snow management plan** by winter, 2015.
3. The Village anticipates increases in dust pollution as new development occurs at the Kachina area. The Village Public Works Department will apply **bionic soil** to selected sections of gravel roads for more effective **dust and erosion control**. Thunderbird Road and Twining Road are likely candidates as a pilot project to determine if the bionic soil should be applied throughout the Village. Completed in 2015 and 2016.
4. Utilize **GIS** to compete a comprehensive inventory of roadway conditions, rights-of-way, and the location, type, and age of all roadway signs, utilities, and drainage structures. To be completed by 2017.
5. Amend the Village Zoning Regulations to quantify the **shared parking** calculations for mixed use developments. To be completed by 2017.
6. Work with TSV, Inc. and the US Forest Service to design and construct a new **Village Entry** road. The road will provide direct access to Twining Road and Thunderbird Road. Sidewalks will not be necessary. A landscaped median, way-finding signs, and adequate lighting should be included in the design. To be completed by 2017. A typical cross section is included as **EXHIBIT #7**.

The proposed alignment of the new Village Entry taken from the TSV, Inc. Core Village Conceptual Plan. February 2012.



7. **Adopt roadway design standards** for Village roadways. Standards should address minimum slope, drainage, travel lane width, sidewalk width, crosswalks, landscape buffers, public lighting, snow storage, and other potential conditions. Standards will be adopted for Primary and Secondary Roads. A Primary Road serves high density commercial development and anticipates heavy pedestrian traffic. There should be a 10-foot travel lane, ample sidewalks with space for street lights, trash receptacles, ski racks, benches, planting strips, street trees, and other street furniture to create an urban character. A Secondary Road

serves the residential areas of the Village. The car is the predominant use of the Secondary Road with limited pedestrian traffic. There should be a 30-foot right-of-way with two 10- to 12-foot travel lanes, a 3-foot drainage swale, and a ten foot front set-back on private property for snow storage. Completed by 2018.

8. Install standard **name signs on all Village roads** and **require standard name signs on all private roads**. To be completed by 2019.

Table #2 summarizes the **Proposed Roadway Improvements** for all roadways. Roadway maintenance will consist of routine grading, clearing of drainage and culverts, dust control with magnesium chloride and water, and the application of base course and/or pit run. The **Roadway Improvement Plan Map** identifies the location and proposed improvements.

Any paving, curb and gutter improvements to roadways must be preceded by the proper design and installation of all underground utilities to avoid any unnecessary cuts to the finished road surface. The village will coordinate with utility providers on the timing and placement of underground utilities during the planning, design, and construction phases of each project.

FUNDING SOURCES

The following is a summary of potential funding sources for the roadway improvements and related projects. The Village will utilize the impact fees as much as possible to leverage additional funds for roadway improvements.

- **Tax Increment Development District**

As described above, the TIDD will be paying for over $15 million in roadway improvements within the next several years. These projects are:

1. Sutton Place Crossing
2. Snow Storage Solution
3. Ernie Blake & Thunderbird Road Upgrades
4. West Burroughs Crossing
5. Route 150/Village Entry Road (Trenching)
6. Strawberry Hill Access & Crossing
7. Parking Lot Upgrades
8. Twining Road Pavement (.5 miles)
9. Pave Road to Kachina
10. Public Parking Facility (at Kachina)

The Village will work with the TIDD Board of Directors, TSV, Inc. and other developers and engineers to coordinate in the planning, phasing, design, construction, and dedications of these projects.

- **Local Government Road Fund**

The Local Government Road Fund was established by state law to provide funds to local governments for projects where local entities take the lead in developing and contracting construction and maintenance projects. Funding is eligible for project development, construction, reconstruction, improvement, maintenance or repair of public highways, streets and public school parking lots, and acquisition of right-of-way. The State will pay for 75% of the project costs if the Village contributes 25% of the project costs. There are four primary Programs funded by Local Government Road Fund: 1) The County Arterial Program, 2) the School Bus Route Program, 3) the Cooperative Agreement Program, and 4) the Municipal Arterial Program. The County Arterial Program and the School Bus Route Program do not apply to the Village; however, the Cooperative Agreement Program and the Municipal Arterial Program are excellent sources of funding for maintaining and improving the Village roads.

- **US Department of Transportation - Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants**

TIGER can provide discretionary, competitive grants for capital funding directly to any public entity, including municipalities. This flexibility allows traditional partners at the state and local level to work directly with a host of entities that own, operate, and maintain transportation infrastructure. TIGER's competitive structure and broad eligibility allow project sponsors to develop multi-modal, multi-jurisdictional projects that may not be eligible for funding through traditional DOT programs. The TIGER program focuses on capital projects that generate economic development, and improve access to reliable, safe and affordable transportation for disconnected communities, both urban and rural, while emphasizing improved connection to employment, education, and services, workforce development, and community revitalization.

- **Highway Safety Improvement Program**

The New Mexico Highway Safety Improvement Program (NM HSIP) is designed to reduce traffic crashes causing fatalities and serious injuries in New Mexico. The New Mexico DOT issues an announcement soliciting proposals for either engineering stand-alone transportation safety improvement projects or non-construction transportation safety programs for consideration for discretionary funding in the appropriate fiscal year.

Local governments must send their applications first to the Regional Transportation Planning Organization (RTPO) for review, processing, and approval and then have the RTPO submit the applications to the DOT General Office, Traffic Technical Support Bureau.

CONCLUSIONS

The Roadway Improvements Element will be used as a guide to develop the annual Infrastructure Capital Improvements Plan and to work with private land owners, developers, and the state of New Mexico DOT in meeting the transportation needs of the community.

The Roadway Improvements Element was adopted prior to the other elements of the Master Plan due to the amount of development planned for the Core Village and the need to identify the Village's priorities and design standards for future roadway improvements.

The Village recognizes that many of the existing roadways are too narrow and too steep to allow for proper slope, drainage, and snow storage. The Village also recognizes that the cost of improving these roads to current standards is not feasible from an engineering and financial perspective. Nonetheless, the Village will work diligently to make any necessary roadway improvement to protect the health, safety and welfare of all residents and guests of the Village of Taos Ski Valley.

TABLE #1 – EXISTING CONDITIONS						
Name	Ownership	Right of Way Width	Surface Type	Distance (Feet)	Average Slope (%)	General Condition
Armadillo	USFS	0	Paved	1222	5.4	Fair
Bear	USFS	0	Paved	640	2.3	Fair
Big Horn Hill	Public	20	Gravel	323	18.7	Poor
Bison	USFS	0	Paved	823	6.4	Fair
Black Bear Drive	Public	20	Gravel	109	unknown	Fair
Bull of the Woods Road	Public	30	Gravel	1261	23.9	Poor
Chipmunk Lane	Public	20	Gravel	483	20.9	Poor
Cliffhanger Loop	Public	20	Gravel	1187	13.1	Poor
Coyote	USFS	0	Paved	1263	4.0	Fair
Coyote Lane	Public	20	Gravel	1199	16.6	Fair
Dolcetto Lane	Public	20	Gravel	968	17.3	Poor
Eagle	USFS	0	Paved	1106	4.4	Fair
Ernie Blake Road	Public	30	Gravel	393	6.7	Poor
Firehouse Road	Private	0	Gravel	737	12.9	Fair
Gila Monster	USFS	0	Paved	841	7.6	Fair
Kachina Road	Public	50	Gravel	5230	4.1	Good
Lake Fork	Private	20	Gravel	511	8.1	Fair
Lynx Road	Public	40	Gravel	629	7.3	Fair
Mineslide Road	Private	0	Gravel	754	4.4	Poor
O.E. Pattison	Public	20	Gravel	738	3.8	Fair
Ocean Blvd	USFS	0	Gravel	1227	26.8	Fair
Phoenix Switchback	Public	30	Gravel	1503	8.0	Fair
Porcupine Road	Public	50	Gravel	1876	4.6	Good
Snow Shoe Trail	Public	20	Gravel	506	13.2	Fair
State Road 150	State	0	Paved	40667	12.2	Fair
Sutton Place	USFS	0	Gravel	340	23.2	Fair
Thunderbird Road	Public	30	Gravel	511	7.3	Fair
Twining Road	Public	30	Gravel	2046	5.2	Fair
Wolf Lane	Public	20	Gravel	222	2.3	Fair
Kachina Road South	Public	50	Gravel	1777	6.1	Good
Deer Blvd	USFS	0	Paved	735	13.9	Fair
Armadillo	USFS	0	Paved	92	8.2	Fair
Upper Twining Road	Public	20	Gravel	1583	5.7	Good
Zap's	Public	40	Gravel	1257	4.6	Fair
Blue Jay Ridge Road	Private	40	Gravel	1465	1.8	Fair
Emma	Public	0	Gravel	849	9.8	Poor
Gusdorf	Public	40	Gravel	643	10.0	Poor
Deer Lane	Public	40	Gravel	381	12.8	Fair
Big Horn Cove	Public	30	Gravel	135	1.9	Fair
Marmot Trail	Public	0	Gravel	292	6.5	Fair
Coyote	USFS	0	Paved	624	4.9	Fair
Bear	USFS	0	Paved	256	6.1	Fair
Bear	USFS	0	Paved	459	6.9	Fair
Burroughs Road	Public	30	Paved	597	2.8	Good
Lily Lane	Public	30	Paved	182	11.5	Fair
Gerson	Public	40	Gravel	513	6.9	Poor
Ocean Blvd	USFS	0	Paved	1180	4.4	Fair
Twining Road	USFS	0	Gravel	666	9.2	Fair
Twining Road	Public	30	Gravel	396	8.3	Fair
Twining Road	Public	30	Gravel	530	10.7	Fair
Firehouse Road	Private	0	Gravel	703	11.0	Fair
Borroughs	Private	30	Gravel	126	12.8	Poor
Firehouse Road	USFS	0	Gravel	222	4.1	Poor
Sutton Place	Private	0	Gravel	199	9.0	Fair
Marmot Trail	Public	0	Gravel	103	4.7	Fair
O.E. Pattison Loop	Public	20	Gravel	291	7.6	Fair
Twining Road	Public	30	Gravel	485	16.0	Fair
Twining Road	Public	30	Gravel	113	46.2	Fair
Twining Road	Public	30	Gravel	529	14.3	Fair
Kachina Road South	Public	50	Gravel	1818	6.8	Fair
Kachina Road South	Public	50	Gravel	522	6.6	Fair

Year	Name	Improvement	Source
2015/2016	Sutton Place	Pave, Curb & Gutter, Sidewalk	TIDD
2016	Zap's Road	Grading & Drainage	DOT – NPRTPO
2016	Twining Road	Grading & Drainage	DOT – NPRTPO
2016	Kachina Road South	Grading & Drainage, Widen 20' for Snow Storage	DOT – NPRTPO
2016	Coyote Lane	Maintenance	DOT – NPRTPO
2016/2017	Ernie Blake Road	Realignment, Pave, Curb & Gutter, Sidewalk	TIDD
2016/2017	Thunderbird Road	Pave, Curb & Gutter, Sidewalk	TIDD
2016/2017	Snow Storage Solution	Acquire land and equipment for snow storage	TIDD
2017	West Burroughs Crossing	Pave, Curb & Gutter, Sidewalk	TIDD
2017	NM 150 / Village Entry	Planning and Design, Pave and Shoulder	TIDD
2017	Upper Twining Road	Grading & Drainage, Widen 10' for Snow Storage	DOT – NPRTPO
2017	Chipmunk Lane	One-Way, Improve Intersection at Phx Switchback	DOT – NPRTPO
2017	Phoenix Switchback	Improve Intersection at Chipmunk	DOT – NPRTPO
2017	Big Horn Hill	Grading & Drainage	DOT – NPRTPO
2018	Bull of the Woods Road	Maintenance	DOT – NPRTPO
2018	Dolcetto Lane	Maintenance	DOT – NPRTPO
2018	Emma	Reconcile Roadway alignment with Right of Way	DOT – NPRTPO
2018	Lake Fork Creek	Gravel	DOT – NPRTPO
2018	Kachina Road	Pavement	TIDD
2018	Strawberry Hill	Pave, Curb & Gutter, Sidewalk	TIDD
2018	Twining Road (.5 miles)	Dust Control, Pave, Curb & Gutter	TIDD
2018	Parking Lot Upgrades	Redesign and resurface the TSV parking lot	TIDD
2019	State Road 150	Resurface & Bike Lane	DOT - NPRTPO
2019	Wolf Lane	Grading & Drainage	DOT – NPRTPO
AS NEEDED	Big Horn Cove	Maintenance	DOT – NPRTPO
AS NEEDED	Deer Lane	Maintenance	DOT - NPRTPO
AS NEEDED	Black Bear Drive	Maintenance	DOT - NPRTPO
AS NEEDED	Porcupine Road	Maintenance	DOT – NPRTPO
AS NEEDED	Snow Shoe Trail	Maintenance	DOT – NPRTPO
AS NEEDED	Twining Road	Maintenance	DOT – NPRTPO
AS NEEDED	Lily Lane	Maintenance	DOT – NPRTPO
AS NEEDED	Lynx Road	Maintenance	DOT – NPRTPO
AS NEEDED	Marmot Trail	Maintenance	DOT – NPRTPO
AS NEEDED	O.E. Pattison Loop	Maintenance	DOT – NPRTPO
AS NEEDED	Gerson	Maintenance	DOT – NPRTPO
AS NEEDED	Gusdorf	Maintenance	DOT – NPRTPO
AS NEEDED	Cliffhanger Loop	Maintenance	DOT – NPRTPO
AS NEEDED	John Burroughs Trail	Maintenance	DOT - NPRTPO
N/A	Bear	Pave, Curb & Gutter	Private
N/A	Blue Jay Ridge Road	None	Private
N/A	Firehouse Road	None	Private
N/A	West Burroughs Road	Pave, Curb & Gutter, Sidewalk	Private
N/A	Armadillo	None	N/A
N/A	Bear	None	N/A
N/A	Bison	None	N/A
N/A	Coyote	None	N/A
N/A	Deer Blvd	None	N/A
N/A	Eagle	None	N/A
N/A	Gila Monster	None	N/A
N/A	Lake Fork	None	N/A
N/A	Mineslide Road	None	N/A
N/A	Ocean Blvd	None	N/A

0	Paved	1222	5.4	Fair
0	Paved	640	2.3	Fair
20	Gravel	323	18.7	Poor
0	Paved	823	6.4	Fair
30	Gravel	1261	23.9	Poor
20	Gravel	483	20.9	Poor
20	Gravel	1187	13.1	Poor
0	Paved	1263	4.0	Fair
20	Gravel	1199	16.6	Fair
20	Gravel	968	17.3	Poor
0	Paved	1106	4.4	Fair
30	Gravel	393	6.7	Poor
0	Gravel	737	12.9	Fair
0	Paved	841	7.6	Fair
50	Gravel	5230	4.1	Good
20	Gravel	511	8.1	Fair
40	Gravel	629	7.3	Fair
0	Gravel	754	4.4	Fair
20	Gravel	738	3.8	Fair
0	Gravel	1227	26.8	Fair
30	Gravel	1503	8.0	Fair
50	Gravel	1876	4.6	Good
20	Gravel	506	13.2	Fair
0	Paved	40667	12.2	Poor
0	Gravel	340	23.2	Fair
30	Gravel	511	7.3	Fair
30	Gravel	2046	5.2	Fair
20	Gravel	222	2.3	Fair
50	Gravel	1777	6.1	Good
0	Paved	735	13.9	Fair
0	Paved	92	8.2	Fair
20	Gravel	1583	5.7	Good
40	Gravel	1257	4.6	Good
40	Gravel	1465	1.8	Fair
0	Gravel	849	9.8	Poor
40	Gravel	643	10.0	Poor
0	Gravel	381	12.8	Fair
30	Gravel	135	1.9	Fair
0	Gravel	292	6.5	Fair
0	Paved	624	4.9	Fair
0	Paved	256	6.1	Fair
0	Paved	459	6.9	Fair
30	Paved	597	2.8	Good
0	Paved	182	11.5	Fair
0	Gravel	513	6.9	Poor
0	Paved	1180	4.4	Fair
0	Gravel	666	9.2	Fair
0	Gravel	396	8.3	Fair
0	Gravel	530	10.7	Fair
0	Gravel	703	11.0	Fair
30	Gravel	126	12.8	Poor
0	Gravel	222	4.1	Poor
0	Gravel	199	9.0	Fair
0	Gravel	103	4.7	Fair
20	Gravel	291	7.6	Fair
30	Gravel	485	16.0	Fair
30	Gravel	113	46.2	Fair

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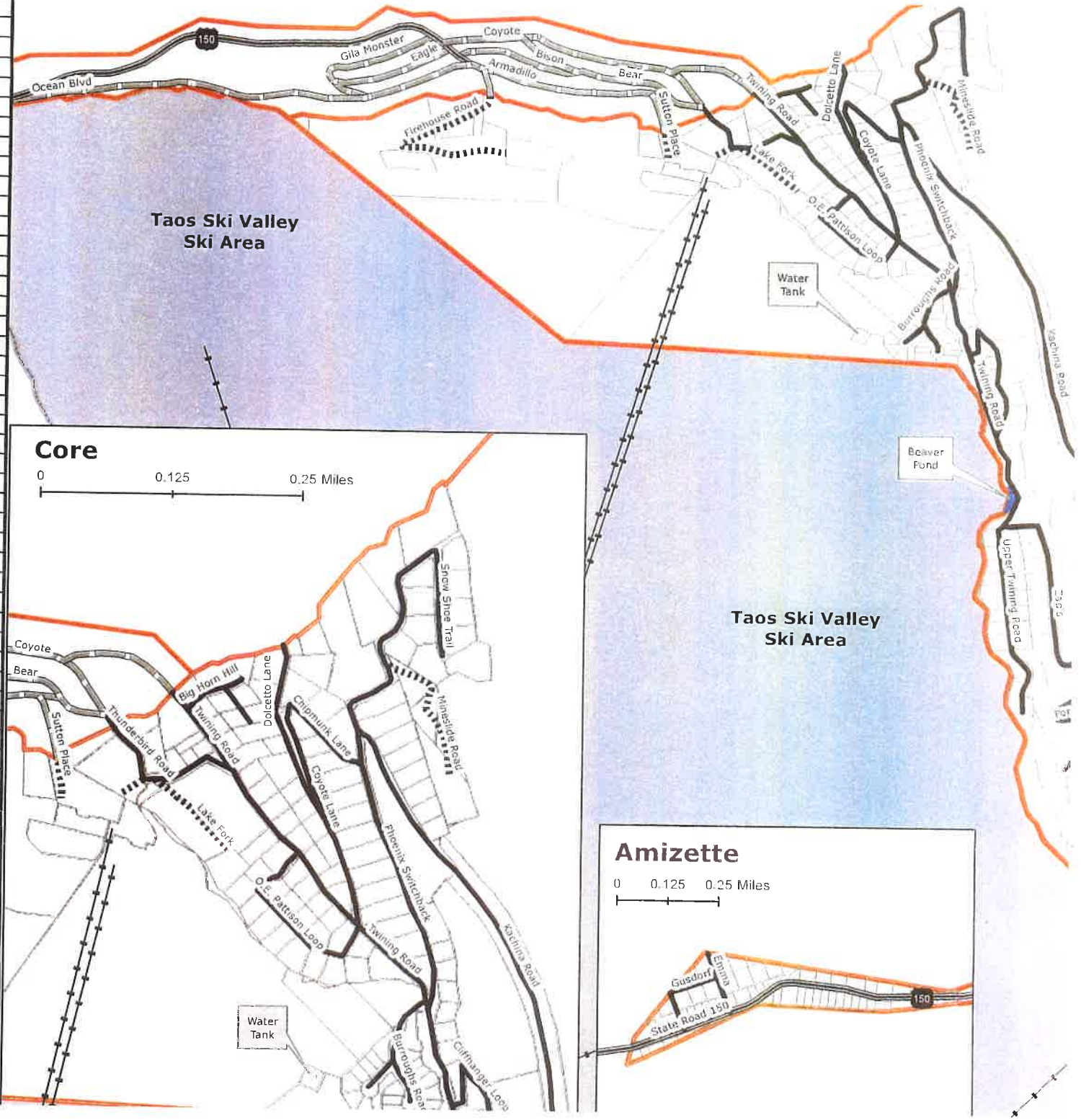
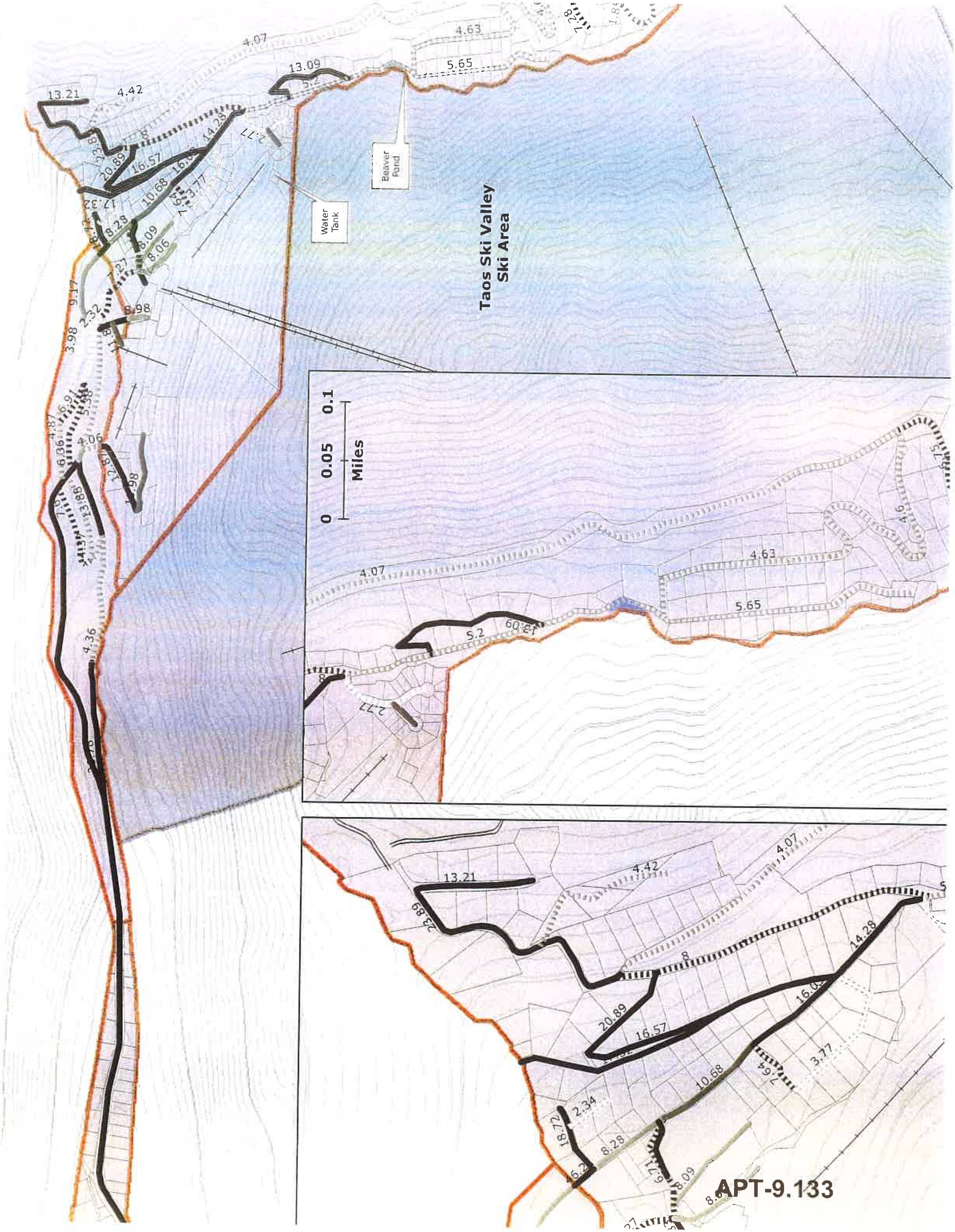


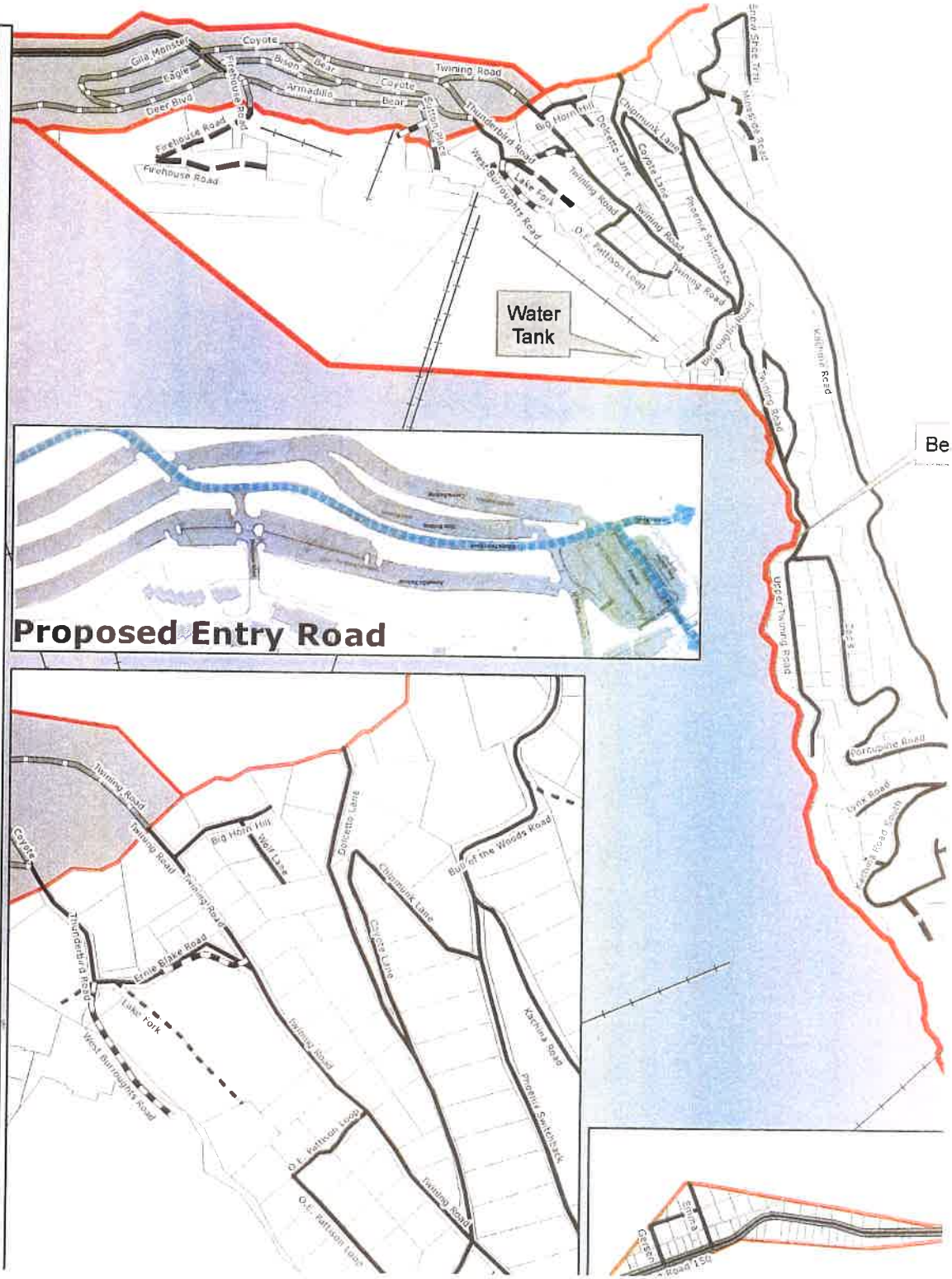

Taos Ski Valley
Ski Area
Beaver Pond
Water Tank
0 0.05 0.1
Miles

APT-9.133

Improvements Plan

LE #2 - PROPOSED ROADWAY IMPROVEMENTS

	Proposed Improvement	Funding Source
	Pave, Curb & Gutter, Sidewalk	TIDD
	Grading & Drainage	NM DOT – RTPO
	Grading & Drainage	NM DOT – RTPO
	Grading & Drainage, Widen 20' for Snow Storage	NM DOT – RTPO
uth	Maintenance	NM DOT – RTPO
	Realignment, Pave, Curb & Gutter, Sidewalk	TIDD
d	Pave, Curb & Gutter, Sidewalk	TIDD
lution	Acquire land and equipment for snow storage	TIDD
	Pave, Curb & Gutter, Sidewalk	TIDD
Entry	Planning and Design	TIDD
	Grading & Drainage, Widen 10' for Snow Storage	NM DOT – RTPO
oad	One-Way, Improve Intersection at Phx Switchback	NM DOT – RTPO
ick	Improve Intersection at Chipmunk	NM DOT – RTPO
	Grading & Drainage	NM DOT – RTPO
Road	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Reconcile Roadway alignment with Right of Way	NM DOT – RTPO
	Gravel	NM DOT – RTPO
	Maintenance	TIDD
	Pave, Curb & Gutter, Sidewalk	TIDD
miles)	Pave, Curb & Gutter	TIDD
ades	Redesign and resurface the TSV parking lot	TIDD
	Resurface & Bike Lane	NM DOT - RTPO
	Grading & Drainage	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RMPO
p	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
	Maintenance	NM DOT – RTPO
Trail	Maintenance	NM DOT - RTPO
oad	Pave, Curb & Gutter	Private
	None	Private
	None	Private
Road	Pave, Curb & Gutter, Sidewalk	Private
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A
	None	N/A



EXHIBITS

#1 – ROAD SITE PLAN

#2 – SUTTON PLACE ROAD SECTIONS

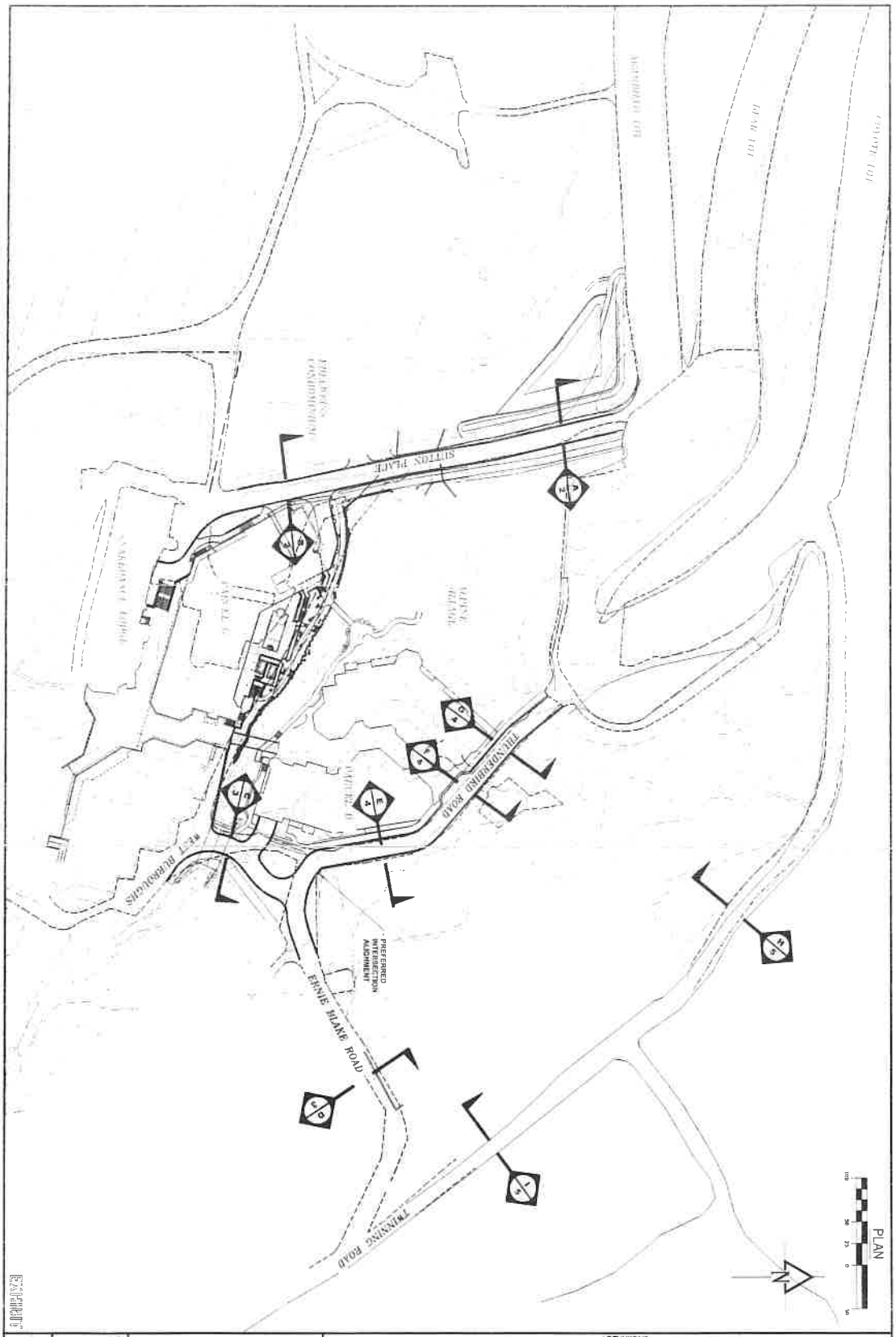
#3 – WEST BURROUGHS & ERNIE BLAKE ROAD SECTIONS

#4 – THUNDERBIRD ROAD SECTIOMS

#5 – TWINING ROAD SECTIONS

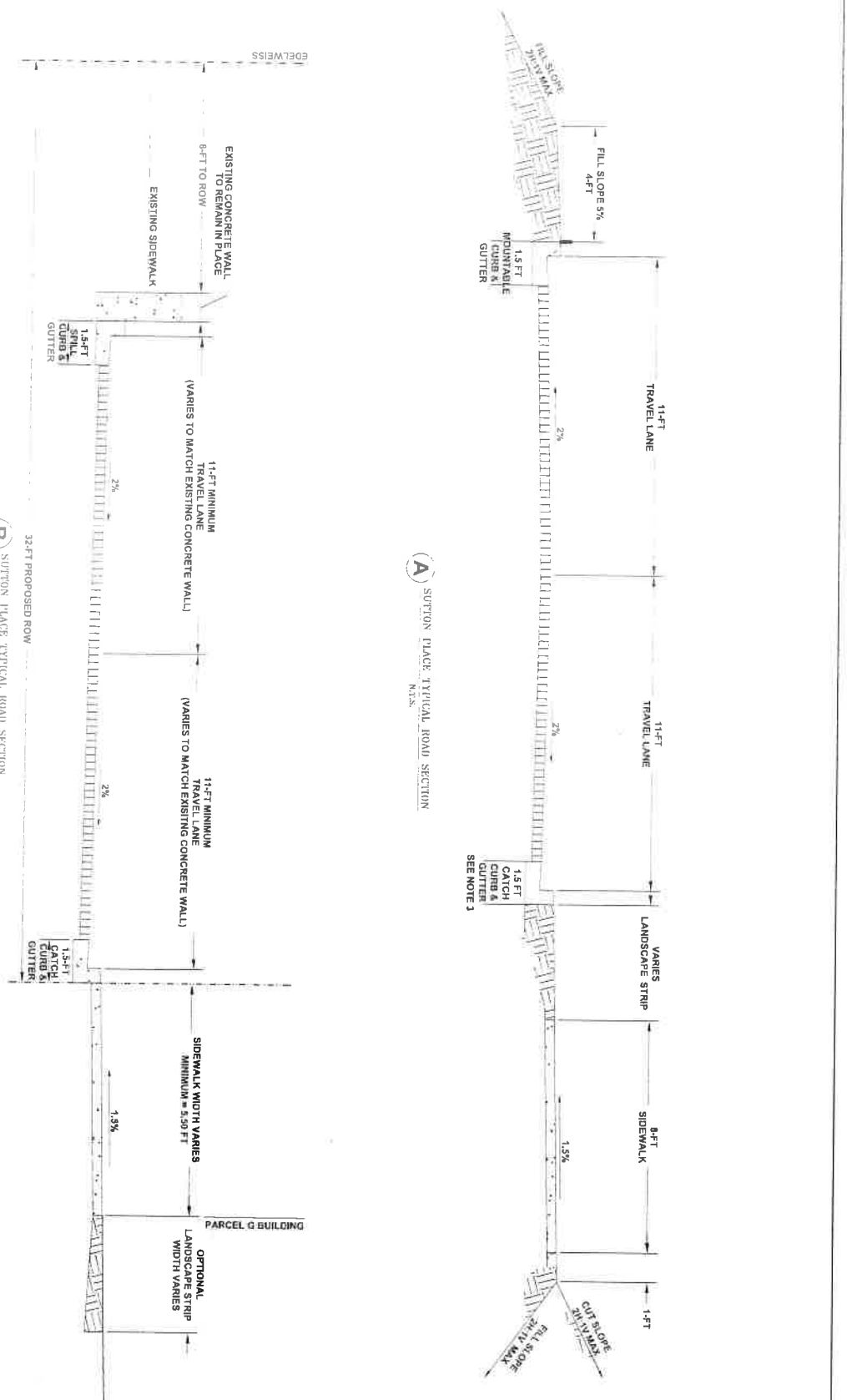
#6 – CORE ROADWAY IMPROVEMENTS NARRATIVE

 # 7- ENTRY DRIVE AND ARRIVAL CONCEPT TYPICAL CROSS SECION



1 OF 5	Drawn: CH Designer: SF Checked: DC	Russell Planning & Engineering, Inc. Civil Engineering Services 934 Main Avenue, Unit C Durango, Colorado 81301 Phone: (970) 385-4546 Fax: (970) 385-4562	TAOS SKI VILLAGE OVERALL VILLAGE ROAD PLAN ROAD SITE PLAN	REVISIONS:	CALL 811 TWO WORKING DAYS BEFORE YOU DIG
1	Date of Submittal: 05/24/15				

File Name: R:\Current Projects\Taos Projects 2015\SV - Village Utilities and Roads\ACAD\Level 3 Production Dwgs\Roads\OVERALL ROAD PLAN Plotted: 6/25/2015 12:24 PM Plot Style: HALF.STB Plotted By: SARAH SFTCSTER



EXHIBIT

2	2 OF 5	Drawn: CH Drafted: SF Checked: DC	Date of Submittal 05/24/15	Russell Planning & Engineering, Inc. Civil Engineering Services 934 Main Avenue, Unit C Durango, Colorado 81301 Phone: (970) 385-4546 Fax: (970) 385-4502

TAOS SKI VILLAGE
OVERALL VILLAGE ROAD PLAN
SUTTON PLACE ROAD SECTIONS

REVISIONS:

CALL 811 TWO WORKING DAYS BEFORE YOU DIG

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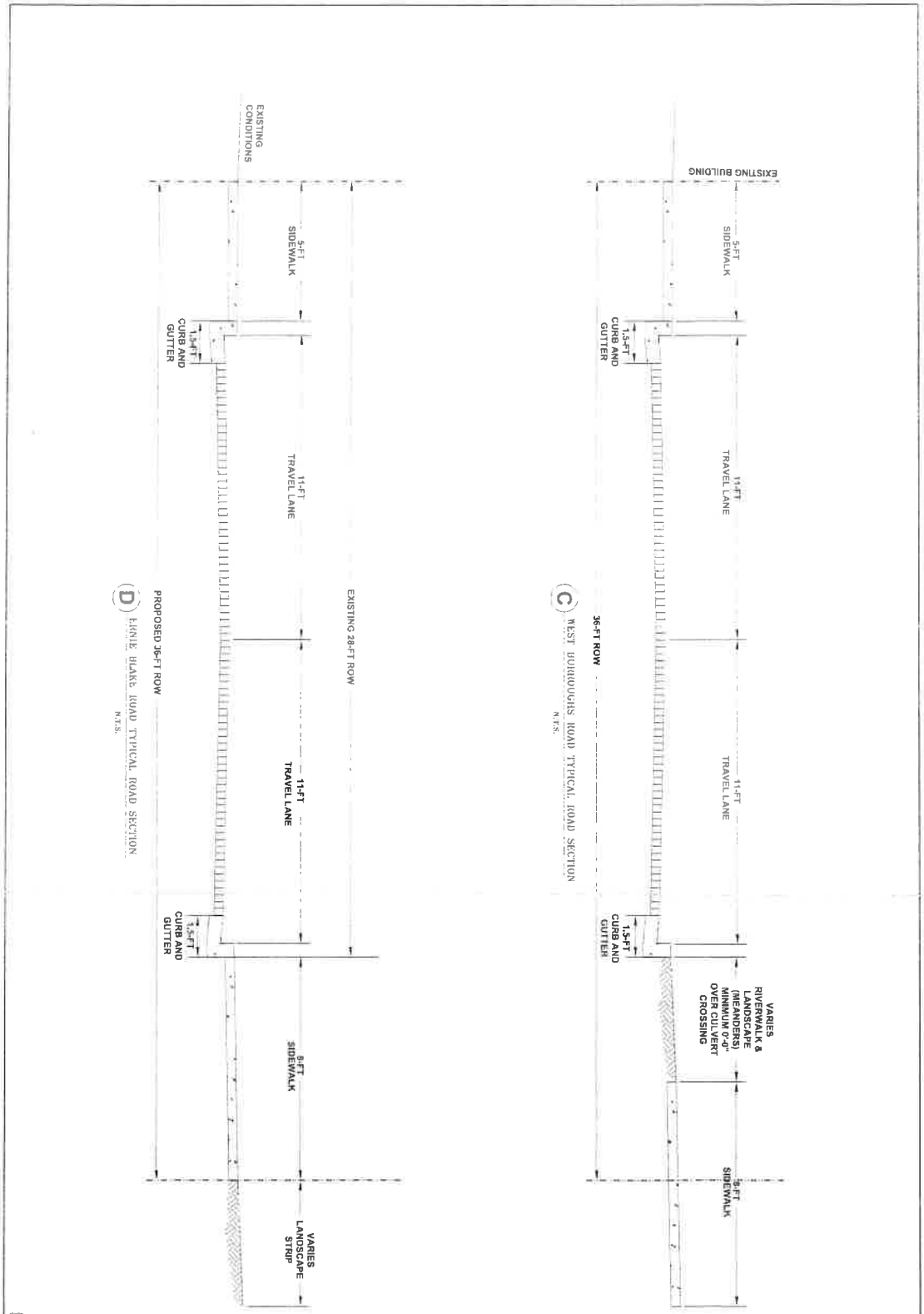

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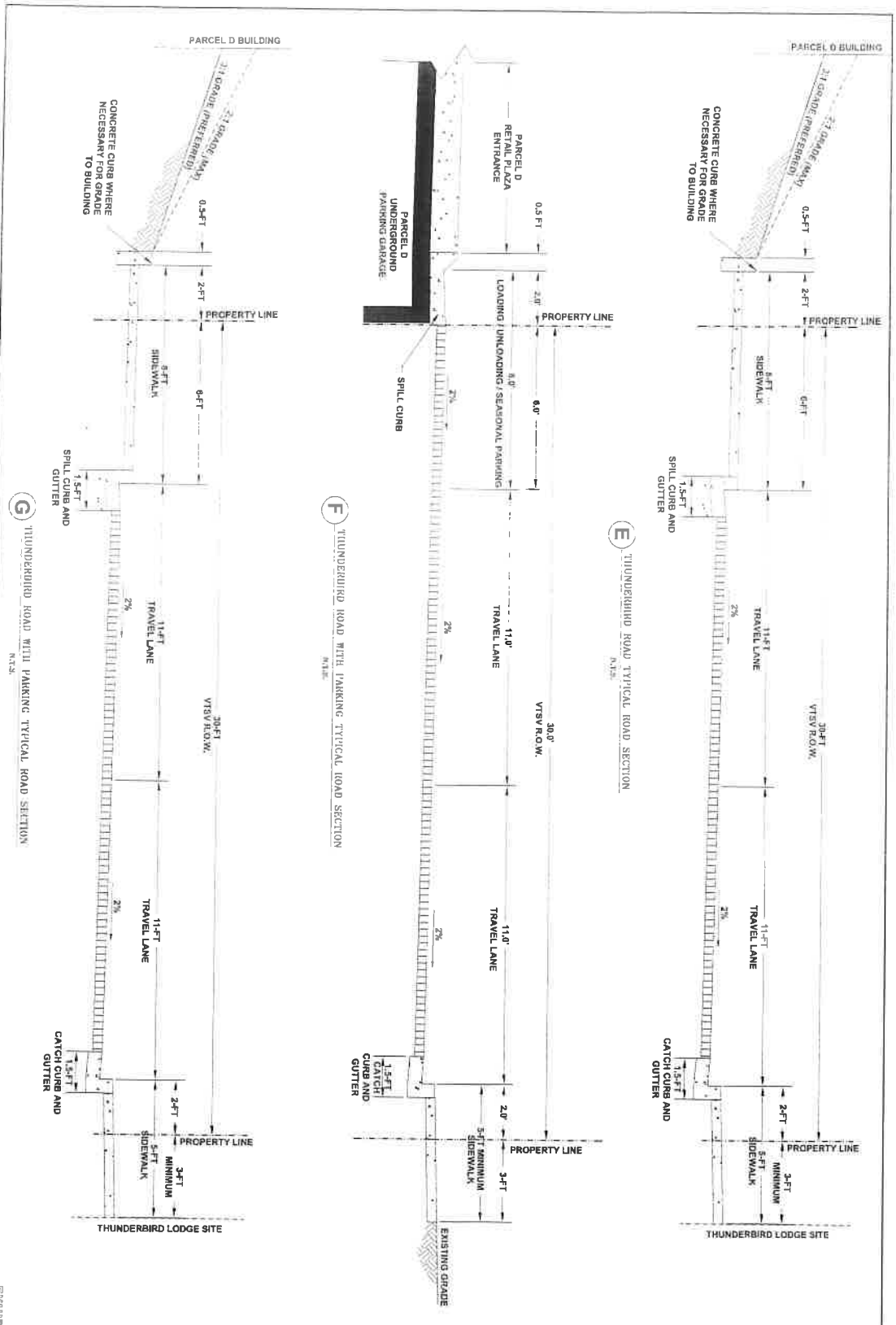

EXHIBIT

4	4 OF 5	05/24/15	Drafted: CH Checked: SF DC	Russell Planning & Engineering, Inc. Civil Engineering Services 934 Main Avenue, Unit C Durango, Colorado 81301 Phone: (970) 385-4546 Fax: (970) 385-4602	TAOS SKI VILLAGE OVERALL VILLAGE ROAD PLAN ERNIE BLAKE ROAD AND WEST BURROUGHS ROAD SECTIONS

REVISIONS:

CALL 811 TWO WORKING DAYS BEFORE YOU DIG

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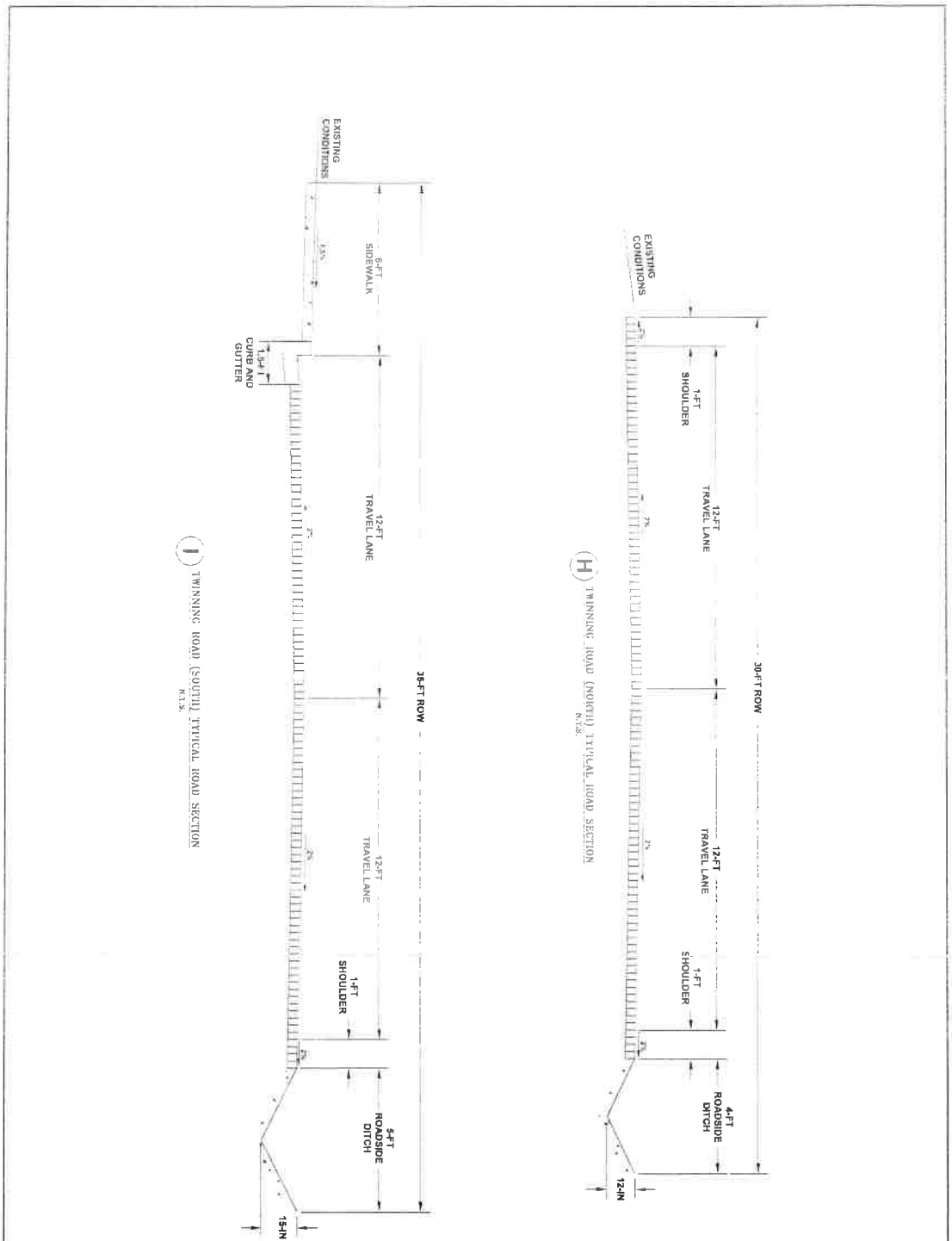


5	5 OF 5	Date of Submittal: 05/24/15	Drawn: CH Drafted: SF Checked: DC	Russell Planning & Engineering, Inc. Civil Engineering Services 934 Main Avenue, Unit C Durango, Colorado 81301 Phone: (970) 385-4546 Fax: (970) 385-4502	TAOS SKI VILLAGE OVERALL VILLAGE ROAD PLAN TWINNING ROAD SECTIONS

REVISIONS:

CALL 811 TWO WORKING DAYS BEFORE YOU DIG

File Name: R:\Current Projects\Land Projects 3\TSV - Village Utilities and Roads\ACAD\Level 2 Production Dwgs\Roads\Road Sections Plotted: 6/25/2015 12:35 PM Plot Style: HALF.STB Plotted By: SARAH SF. FOSTER

EXHIBIT #6

CORE ROADWAY IMPROVEMENTS

The redevelopment of the Village Core between 2015 and 2019 (+/-) will have temporary but important impacts to vehicle and pedestrian traffic during various phases of construction. The proposed improvements during construction are outlined below.

- Sutton Place

Sutton Place will be closed during the summer 2015 construction of Parcel G but will re-open during the 2015-2016 ski season. The developers will add a gravel surface in October 2015. Underground utilities will be installed in 2015; the culvert crossings at the Rio Hondo are pending approval by the US Forest Service.

The grade will be increased by approximately 1'6"near the location of the existing guard shack.

Construction of the final design is anticipated after the completion of the Parcel G hotel.

- Thunderbird

The developer will asphalt the roadway between curb lines of the Thunderbird Lodge parcel and Parcel D after the temporary commercial building on the old T-Bird lot is completely installed.

Construction of the final roadway is anticipated after the construction of the Parcel D retail and condominium development. Improvements include the raising of Thunderbird at the point of intersection with the new pedestrian "mall" through Parcel D. Additional easements for sidewalks and proper roadway design and intersection alignments will be continued with property owners.

- Ernie Blake

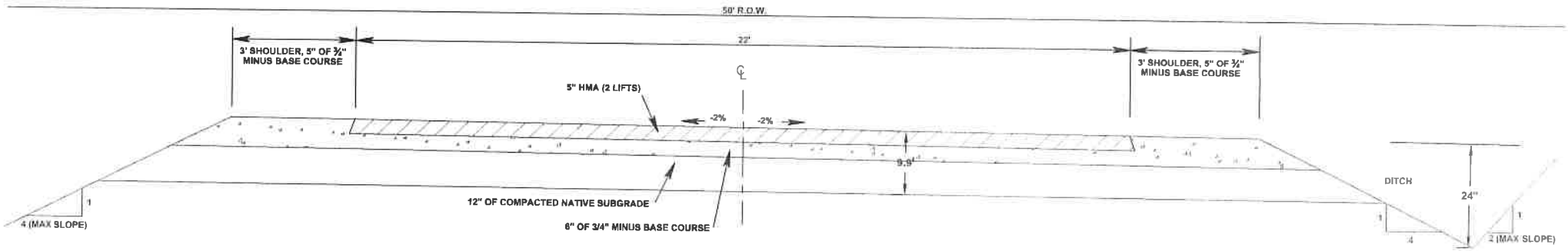
The Village will negotiate the re-alignment of the roadway with adjacent property owners to permit the development of a two-way road that meets the Village's design standards for roadway width, slope, drainage, intersection alignment (with Twining) and to provide adequate pedestrian facilities, signage, access to adjacent properties, snow storage, and underground utilities.

- West Burroughs

The developers are negotiating the design of the culvert crossings at the Lake Fork Creek with the owners of the Sierra del Sol condominium. The developers and the Village must determine if the crossing (roadway, culverts, sidewalk, etc.) at the Lake Fork Creek will be dedicated to the Village or if the developer will retain ownership of the crossing. The Developer will retain ownership of the remaining roadway south of the crossing to provide access to future planned development as proposed in the Parcel Conceptual Plan for Parcels F and E.

- Firehouse Road

The developers will improve the roadway between the Children's Center and the Village offices to provide adequate slope and drainage to provide access to the construction site at Parcel G.



STANDARD 22' ROAD SECTION

N.T.S.

APT-9.145

Appendix C

Communications Master Plan

THE VILLAGE OF
Taos Ski Valley

Planning and Zoning Commission

Resolution 16-285

APPROVING THE WIRELESS COMMUNICATIONS MASTER PLAN

WHEREAS, the Planning and Zoning Commission adopted the Village of Taos Ski Valley Master Plan in November 8, 2010 by Resolution 11-198; and

WHEREAS, Section 3-19-10 of the New Mexico state statutes allow the Planning and Zoning Commission to adopt "a part of the master plan as work progresses on the master plan; provided the part corresponds with one of the functional subdivisions of the subject matter of the plan;" and

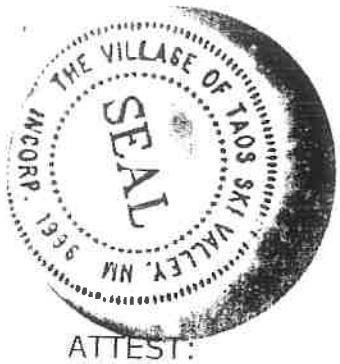
WHEREAS, the Planning and Zoning Commission finds it necessary to adopt the Wireless Communications Master Plan to reflect the most current goals, polices, and objectives for the provisions of safe and reliable wireless communications throughout the Village in order to better serve the safety and overall economy of the Village; and

WHEREAS, the goal, policies, and objectives of the Master Plan are based on careful and comprehensive studies of existing conditions, probable future growth of the Village, and citizen input from Village residents, businesses, and property owners; and

WHEREAS, the Planning and Zoning Commission has reviewed the Wireless Communications Master Plan, together with the accompanying maps, charts, descriptive and explanatory matter; and

Now, be it resolved, that the Planning and Zoning Commission approves the Wireless Communications Master Plan and encourages the Village Council to adopt the Master Plan.

Approved by the Planning and Zoning Commission this 6th day of July, 2015.



Planning and Zoning Commission

Tom Wittman, Chair

ATTEST:

Jim M. Wooldridge

Village Clerk

Vote: For 5 Against 0 Abstain 0

Planning & Zoning Commission
Resolution 15-285
Approving the Wireless Communications Master Plan

APT-9.148

THE VILLAGE OF Taos Ski Valley

Village Council
Resolution 16-290

ADOPTING THE WIRELESS COMMUNICATIONS MASTER PLAN

WHEREAS, the Planning and Zoning Commission approved Resolution 15-286 – Approving the Wireless Communications Master Plan; and

WHEREAS, Resolution 15-286 encourages the Village Council to adopt the Wireless Communications Master Plan; and

WHEREAS, Section 3-19-10 of the New Mexico state statutes allow the Village to adopt "a part of the master plan as work progresses on the master plan; provided the part corresponds with one of the functional subdivisions of the subject matter of the plan;" and

WHEREAS, the Village Council finds it necessary to adopt the Wireless Communications Master Plan to reflect the most current goal, polices, and objectives for the provisions of safe and reliable wireless communications throughout the Village in order to better serve the safety and overall economy of the Village; and

WHEREAS, the goal, policies, and objectives of the Master Plan are based on careful and comprehensive studies of existing conditions, probable future growth of the Village, and citizen input from Village residents, businesses, and property owners; and

WHEREAS, the Village Council has reviewed the Wireless Communications Master Plan, together with the accompanying maps, charts, descriptive and explanatory matter; and

Now, be it resolved, that the Village Council adopts the Wireless Communications Master Plan.

PASSED, ADOPTED AND APPROVED this 14th day of July, 2015.

THE VILLAGE OF TAOS SKI VALLEY

Neal King
Mayor

Attest:

Ann M. Wooldridge
Village Clerk

Vote: For 4 Against 0

THE VILLAGE OF TAOS SKI VALLEY, NM INC. 1976 SEAL

Village Council Resolution 16-290
Adopting the Wireless Communications Master Plan

APT-9.150

Wireless Communications Master Plan
2015

PURPOSES OF THE PLAN

The Village Planning and Zoning Commission and the Village Council have determined that there is a need to enhance wireless communications services in order to increase the safety of Village residents, employees, and visitors and to improve the economic development opportunities in the community. The Planning and Zoning Commission and the Village Council believe that the visual impacts of wireless communications towers must also be minimized in order to preserve the natural beauty of the Village.

The purposes of the Wireless Communications Master Plan is to provide the community and developers with criteria necessary to determine the most suitable locations for wireless communications towers and to define the role of the Village in developing and regulating wireless communications services within the Village boundaries.

EXISTING CONDITIONS

Presently, telephone and internet wireless communication is unreliable and inconsistent within the Village. Although many residents, employees, and visitors have expressed the need for improved services, the Village does not yet regulate the siting and construction of wireless communications towers or antennas. However, the Village Planning and Zoning Commission is considering an amendment to the Zoning Regulations (Ordinance 14-30) to include regulations and approval procedures for constructing a wireless communications tower.

Wireless communications (phone and internet) services are currently provided by Verizon, AT+T, Comnet, and T-Mobile. Taosnet provides internet through a "point to point" wireless system.

Taos Ski Valley, Inc. is working with the Village, Kit Carson Electric Cooperative, and New Mexico Gas Company in digging a utility trench along the entire length of NM 150 to provide broadband internet and to bury the overhead power lines along the highway. This work is estimated to cost approximately $9 million and is expected to be

completed by the end of 2018. The Tax Increment Development District (TIDD), Kit Carson Electric Cooperative, NM Gas Company, and the Village are sharing the costs for the trenching project.

SITE SELECTION CRITERIA

The siting of a tower will be determined by forthcoming zoning regulations. These regulations will include the following criteria for determining the specific location of a wireless tower:

1. **COVERAGE –** The location must provide adequate coverage to prevent the construction of additional towers, thereby protecting the aesthetics of the Village and minimizing the impact to property values. Locations(s) should provide maximum service to all constituents, including residents, visitors, and business.
2. **CAPACITY –** The location of the tower should maximize the amount of data transmittable by the tower. The higher the capacity of the tower, the fewer towers necessary.
3. **CONTINUITY –** The location of the tower should provide uninterrupted service without sacrificing the continuity and integrity of the landscape and natural resources.

GOAL, POLICIES & OBJECTIVES

The Planning and Zoning Commission and the Village Council will utilize the following goal, policies and objectives in order to make informed decisions regarding the siting and construction of wireless communications towers.

GOAL

The Village receives reliable and affordable wireless communications services while protecting the environmental integrity and aesthetic beauty of the Village's landscapes and natural resources.

In furthering this GOAL, the Village will refer to the following POLICY STATEMENTS when considering an application for the construction of a wireless communication tower:

Policies

1. The Village recognizes that wireless communications towers provide a necessary service for emergency circumstances and help to protect public safety.
2. The Village also recognizes the economic benefits of increasing wireless communications services in the Village.
3. The Village further recognizes that the benefits of providing wireless communications services should not compromise the natural beauty and environmental integrity of the community.
4. The Village will encourage the co-location of antennas on existing towers in order to minimize the visual impacts and environmental impacts to the natural resources within the Village.
5. The Village will seek to minimize the total number of towers throughout the community without compromising the quality and reliability of wireless services.
6. The Village will encourage and require designers and developers of towers and antennas to minimizes the adverse visual impact of the towers and antennas through careful design, siting, landscape screening, and innovative camouflaging techniques.
7. The Village seeks to enhance the ability of the providers of telecommunications services to provide such services to the community quickly, effectively, and efficiently.
8. The Village recognizes that private developers may need to construct wireless communications towers on properties located outside of the Village jurisdiction (e.g. – the US Forest Service), and, in recognizing the relationship between the US Forest Service and private developers, the Village will assist in any negotiations for utility access or other easements that may be necessary to facilitate the appropriate siting and construction of a tower.
9. The Village will require that any new tower be designed to avoid potential damage to adjacent properties from tower failure through engineering and careful siting of tower structures.
10. The Village will require that every new tower comply with applicable federal laws, including, but not limited to, the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA) and those regulations administered by the Federal Aviation Administration (FAA) and Federal Communications Commission (FCC).
11. The Village will require the proper management of the number and location of towers, antennas and related infrastructure such that ongoing maintenance of these structures does not impede residents, businesses and visitors.
12. Each applicant for a tower shall provide a performance bond in the form and amount acceptable to the Village to ensure the proper and timely removal of the tower to be constructed and for the removal of any and all facilities related to the wireless tower and antennas associates with the application.

Objectives

The Village will accomplish the following objectives in conformance with policies and regulations that address the following:

1. Adopt regulations for the siting and construction of wireless communication towers and antennas. This objective will be completed by the end of 2015. The Planning and Zoning Commission will review a draft of the regulations prior to adoption by the Village Council. The regulations should give discretion to the Planning and Zoning Commission to deny an application for the construction of a new wireless communications tower based on the relative conformity of the application to the Master Plan and any other application policy or regulation.
2. Work with private developers and property owners in constructing a wireless communication tower in the Kachina area. To be completed by the end of 2016.
3. Work with private developers and property owners in constructing a wireless communication tower in the Bull-of-the-Woods area. To be completed by the end of 2017.
4. Work with Taos Ski Valley, Inc. and the US Forest Service to construct a tower near the top of lift #6. To be completed by the end of 2017.
5. Work with private developers and property owners in constructing a Distributed Antenna System between Amizette and Arroyo Seco. This objective will be completed by the end of 2018.

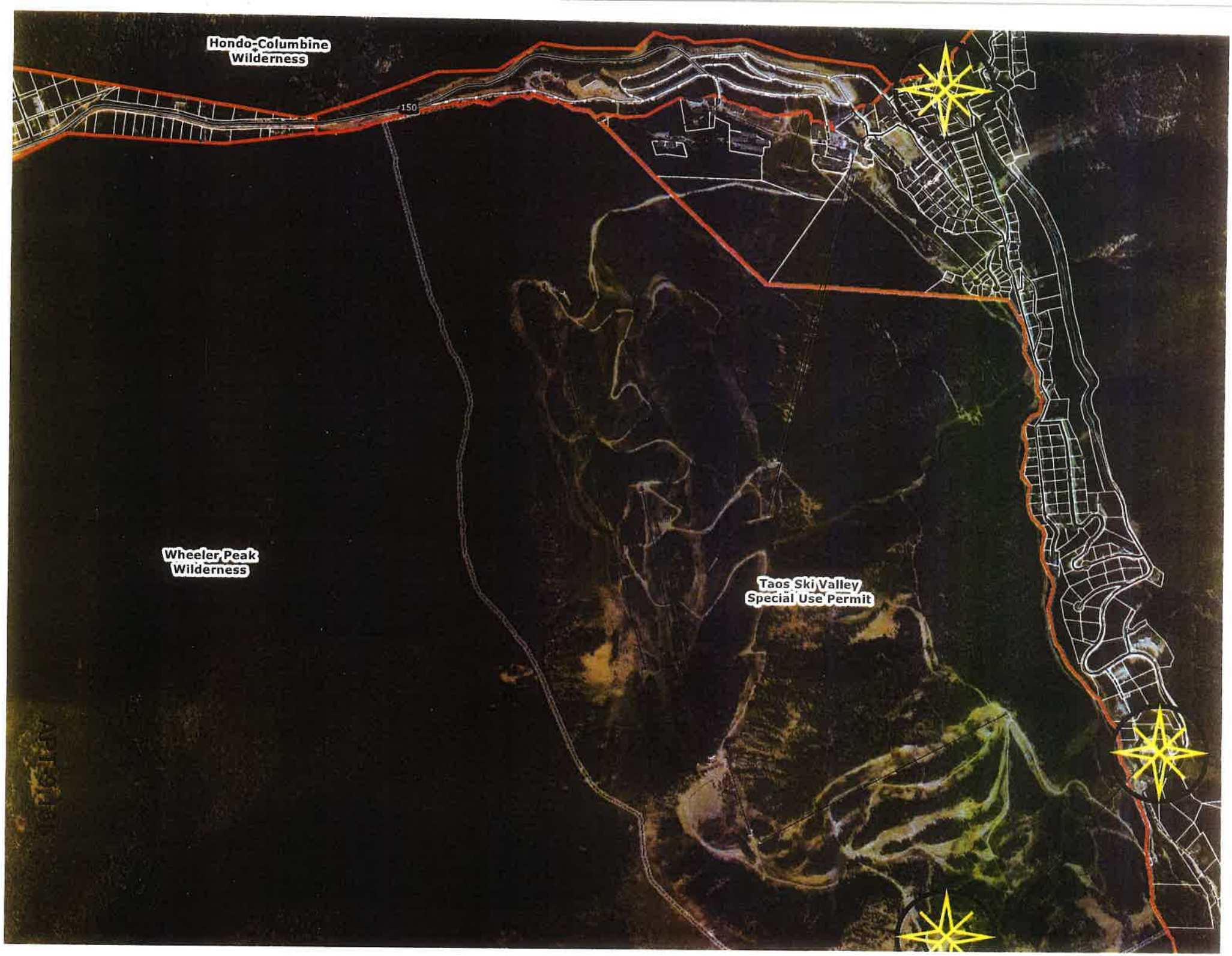
IMPROVEMENTS PLAN & FACILITIES MAP

The Village worked with VIAM consultants who studied the most feasible and unobtrusive locations for the construction of wireless communications towers across the Village. The **Wireless Communications Tower Master Plan Map** identifies the preferred locations for the construction of new towers. The locations were selected based on the potential coverage, capacity, and continuity of the system.

CONCLUSIONS

The elected and appointed leadership of the Village believe it is necessary to adopt a Master Plan specific to the preferred locations of wireless communications towers in order to provide the community with the goals, policies, and objectives for increasing mobile phone services while protecting the beautiful landscapes within the Village.

Although the Master Plan does not identify a specific property for the preferred location of a new tower, the Master Plan does include specific selection criteria to be used for selecting a specific location. The Master Plan also includes a map which identifies the preferred locations for new towers. The Village believes these preferred locations will increase the reliability of service while minimizing the environmental and aesthetic impacts to the community.


Hondo-Columbine
Wilderness
150
Wheeler Peak
Wilderness
Taos Ski Valley
Special Use Permit

Appendix D

Village of Taos Ski Valley

2016 Community Open House Q&A

These notes from the Questions and Answers sessions:

SATURDAY, JANUARY 2

Q: Are trails included in the master plan?

A: Yes. The Master Plan calls for a trails plan throughout the entire Village. The Planner applied for a grant to fund a river restoration plan. including new trails. from Amizette to the Village core area. The Master Plan will not recommend alignment of any new trails. Identifying a new trail will be included in a more specific master plan for trails with outreach to all property owners prior to "putting pencil to paper" to recommend specific locations for a trial on private property.

Q: What is the status of provide fiber optic services?

A: A fiber optic cable was partially installed along NM 150 and is scheduled to be fully installed by the end of 2016. A fiber cable was installed in Kachina Road in fall of 2015. Other specific installation schedules are uncertain. The Planner encouraged property owners to contact Kit Carson.

Q: What is the status of improving wireless telephone coverage?

A: The Village Council adopted a master plan for improving services. The master plan included the preferred locations of three towers to be installed that will provide enhanced coverage. The Planner referred to a recent email that was distributed by the Village giving information about various problems with the service. The Village also adopted an ordinance that regulated the location and size of a tower. Developing new towers requires coordination between a private land owner, a developer of towers, the Village, and the mobile service provider.

Q: What is the process for deciding the priorities of the master plan?

A: Everyone is encouraged to provide comments to the Planner and particularly to the members of the Planning & Zoning Commission and the Village Council. The Planner will ask the Planning & Zoning Commission to determine the priorities and recommend them to the Village Council. The Planner will ask the Commission to select their priorities from each of the elements, then he will compile the list of priorities and perhaps assign a point system for determining the top priorities among all of the 80 objectives that were selected by the Commissioners.

Q: How would the Village like to receive comments? What happens to the comments?

A: Email is a good way to provide comments. Personal meetings or phone calls are also encouraged. Anyone is also welcome to write comments on the document and send them to the Planner. The comments will be incorporated into the Master Plan as much as possible. Comments will be provided to the Planning & Zoning Commission. The Commission will be asked to endorse the Plan, recommend the priorities, and request the Village Council to adopt the Master Plan.

Q: What can be done about dust control on Village roads?

A: The Master Plan calls for the application of bionic soil on test areas. This type of soil can be effective in rural areas and for gravel roads to increase durability and reduce dust.

SUNDAY, JANUARY 3

Q: **What needs to happen to open Sutton Place to pedestrian traffic during the hotel construction?**

A: The Planner and Councilman Tom Wittman will discuss this issue with Taos Ski Valley, Inc. to see if it can be done.

Q: **Can helicopters land on the new helipad for emergency medical evacuation?**

A: This is unknown. The Planner will ask about the status of the helipad.

Q: **What is the status of improving Ernie Blake Road and Thunderbird Road?**

A: The Council approved a new alignment for Ernie Blake Road. The alignment requires acquisition of some land from the adjacent property owner. The completion of the design for Thunderbird Road greatly depends on completing Ernie Blake as a tow way road from Thunderbird to the intersection of Ernie Blake and Twining.

There was more discussion of the pedestrian safety and signage issues and concerns about the proliferation of temporary signs and the number of falls and rips on the sidewalk.

Q: **What is envisioned for future development in the Kachina area?**

A: The Master Plan calls for a more specific development plan in the Kachina area. The Planner prepared a scope of work to be completed by a consultant along with stakeholders and property owners.

Q: **What can be done about dust control on Village roads?**

A: Same as above.

Q: **Has the Village considered a gondola between the core area and Kachina?**

A: The Master Plan adopted by the Village Council in 2010 considered a gondola. The current draft of the new Master Plan does not.

Q: **Has the Village considered a ladder truck for greater fire suppression for the new hotel and other multi-story buildings?**

A: Yes. The Village's Infrastructure Capital Improvements Plan (ICIP) includes the purchase of a ladder truck. The ICIP is a list of unfunded projects. One of the limiting factors in purchasing a truck is the requirements to have a permanent place to store the truck inside.

Q: **What is the status of improving the entry road into the Village?**

A: A new entry road is planned under the Tax Increment Development District to be completed in 2017. The design of the new road is intended to reduce the slope at the main village entrance and to provide quicker access to the skier drop off and Twining Road. Parking will not be permitted.

A few of the attendees discussed the open space parcels along the Lake Fork Creek and potential connections to the wetlands park in Kachina.

Appendix E

Comments Table

Page #	Comment	Answer/Action
Executive Summary	Apparently, you don't intend to present these in this order in the element write-ups. Each seems to be different. Some are omitted and the order changes.	Each Element has: Existing Conditions, Existing Ordinances and then Proposed actions from Previous Plans, then Goals, Objective and Strategies. So the order is incorrect on the Executive Summary. I will verify the order in each Element. The order has been changed to reflect your comment in the Executive Summary.
Executive Summary	"The Plan will be updated when appropriate and completely revised after twenty years." Seems too long, five to ten years seems better.	Changed to five years.
Executive Summary	Add "...prepare an updated Comprehensive Plan".	Completed
Table of Contents	Add page numbers	This cannot be completed until all comments are in and revisions made.
Demographics and Economics Page 5	With the redevelopment in the ski valley and new part time, full time job opportunities, the need for affordable workforce housing will rise. While there is no doubt some demand for affordable workforce housing in the Village, the short commute to housing in Taos and intervening communities will severely mitigate this need. In addition, the lack of shopping (especially groceries), entertainment, etc. significantly reduce the attractiveness of residing in the ski valley for employees, especially those with families. This is a stark contrast to other resorts such as Vail or Aspen which are substantial population and commercial centers that would be attractive to ski area employees except for their insane prices.	Statement
Demographics Page 7	Add, " Taos County agreed to dedicate 35% of its increment of property tax above the baseline to the TIDD.	Completed
VTSV Planning Staff, Page 9, last sentence	Is it worth saying something about the Fire Department and Emergency Medical Treatment before going on with the planning process?	A detailed description of the Volunteer Fire Department and EMS is described on page 54-55. But information has been added on these two services to the Municipal Staff on page 9.

Page #	Comment	Answer/Action
Land Use and Natural Resources Page 12	Neighborhood District This includes the residential subdivisions and homes along Twining, Zap and Porcupine Roads. These are single family houses, which are mostly second homes. They may be used as rental properties for visitors, primarily during the ski season. I was told a couple of years ago that a fair number of the older houses in this district are three season structures and are not really suited for winter use. To the extent this statement is true, the fraction that are three-season should be noted here, as there are not useful for winter rentals and in fact raise other issues.	Deleted "...primarily during ski season." But this section is not meant to serve as a housing inventory.
Land Use and Natural Resources Page 18	"...the following development criteria and other yet undetermined criteria..."	Completed
Land Use and Natural Resources Page18-19	The list of development criteria does not include compliance with Dark Sky ordinances. VTSVs high elevation and dark sky ordinances make it a highly attractive site for astronomy, which is a potential marketing opportunity, esp. in the off-season. (Dark skies are mentioned as "sky clarity" on page 24).	Night Sky Protection is mentioned on page 24 as a Strategy. But it will certainly be added to the "Development Criteria".
Land Use and Natural Resources Page 18-19	The dark sky ordinance. This is a tremendous feature of the ski valley that seems to be violated more and more lately. One of the first things I noticed when I first bought my house here was the amazing number of visible stars at night. I would love to see this re-emphasized in the Plan.	Night Sky Protection is mentioned on page 24 as a Strategy. But it will certainly be added to the "Development Criteria".
Land Use and Natural Resources Page 19	Land Use Recommendations: While I have no particular objection to the goal of "attract younger residents to the Village", I'm not sure I would consider this to be particularly important. The resort nature of the Village and the associated costs of living in a resort, as well as the isolation, will lead to an atypical population, esp. in terms of age distribution (and income/wealth). I don't think this has a particularly adverse effect on the health of the community. In addition, developing a younger population with school age children will create additional challenges for the Village. I think the list would benefit from a mention of wildfire management (although there are mentions later in the document)	Wildfire is covered thoroughly in the chapter on Hazard Mitigation.

Page #	Comment	Answer/Action
Land Use Page 19	"2006 and 2010 Master Plan" information- Seems unnecessary to include all this here. Could just say they were considered w/o listing them.	The Master Plan criteria listed is intended to demonstrate the continuity in concepts through the years, demonstrating validity in perpetuating these ideas.
Land Use Page 21	Does not seem to follow the element format. No Existing conditions, Proposed actions..., Existing Ordinances, Goals. Seems to jump right to Objectives and Strategies.	Existing Conditions begins on page 11. Proposed Actions begins on page 14. The Natural Resource Goal in the former plan was "Land use and development activity sustain and enhance the Village economy and natural resources", which seemed false. Please see the new Goal on page 21.
Land Use Page 24	There are a large number of strategies here. Too many?	Not all strategies have to be achieved, they are meant as actions to aspire to and inform.
Land Use, page 15	Please provide clarification on the purpose of the design capacities, how these capacities will be used; and whether the stated design capacities will be used in future development.	After research, it was determined that develop capacity table was not based on in depth analysis. The table has been removed from the document with accompanying text. In the future the Village will work with property owners to create master development plans to develop accurate and feasible analysis of the total development analysis.
Land Use, page 15	Please provide clarification on how the design capacities were calculated for all the village sites listed on the Development Capacity table in the Land Use and Natural Resources Section of the Village Comprehensive Plan.	After research, it was determined that develop capacity table was not based on in depth analysis. The table has been removed from the document with accompanying text. In the future the Village will work with property owners to create master development plans to develop accurate and feasible analysis of the total development analysis.

Page #	Comment	Answer/Action
Land Use Pages 5 and 19	Though I agree with the need for workforce housing will rise and there is a need to attract younger residents. I think there is a need to differentiate between single -family home neighborhoods and core village/condo areas. Most of the single -family homes in my immediate neighborhood are vacation homes, with a couple occupied full time and only a couple used for rentals. Sometimes renters can be noisy and problematic, but we know they will be gone within a few days. I have a concern with houses being bought up for workforce housing. People don't buy 5-bedroom houses to have a 5-bedroom house next door converted to group housing for young employees. I think a better approach would be to encourage remodeling and upgrading older single-family homes rather than using them as inexpensive employee housing. Perhaps we could see the core village emphasized for workforce housing.	The zoning approved for the Village of Taos Ski Valley permits only single-family residences for the majority of Twining Road towards Kachina. (Please refer to the Zoning Map). The area closest to the Commercial Business Core or the Core Village Zone, allows multi family. A large section of Amizette is also zoned Commercial which would allow for multi-family. While no areas have been designated for work force housing, the zoning would indicate the multi family housing (Commercial, Commercial Business). Workforce housing requires public transit and other amenities that would not be practical further up Twining in the quieter residential neighborhoods.
Utilities Page 27	The communications section mentions the in-trench fiber, but says nothing about plans to use it to provide decent internet access in the Village.	Internet connection/schedule is determined by Kit Carson Telecom, not by the Village.
Utilities Page 27	"The Village suffers from power outages due to fallen trees in the canyon along Highway 150". Still true now that line is underground? Maybe so, Kit Carson reliability is probably still less than in Santa Fe or Albuquerque.	There are still active above ground lines along 150. Kit Carson determines when they are no longer needed.
Utilities Page 28	Change "Gas Services are currently provided by individual liquid propane tanks." To " The alternative to natural gas is electricity and liquid propane."	
Utilities Page 33	Is there a demonstrated need for a new wastewater treatment plant? Page 26 suggests that the current plant peak use is barely above 50% of peak capacity. Do we anticipate almost a doubling in demand in the next 20 years?	Existing Plant has experienced exceedances in the past due to clarifier capacity limitations, demonstrating the need for alternative treatment method to handle future demand and water quality standards.
Utilities Page 36	Energy conservation, renewable energy: Should the strategies include lower impact fees for construction that has lower impact on Village infrastructure?	To be discussed by Commission

Page #	Comment	Answer/Action
Utilities Page 38	"The North Central Regional Transit District (RTD) took over bus services from the Town of Taos Chile Line in 2015. The RTD provides bus services to the Village during the regular ski season. In addition, the Village subsidizes a transit service provided by TSV, Inc. that provides free shuttle service primarily to anyone who works in the Village." Why is the Village subsidizing this service since it is primarily to the benefit of TSVI and a few other merchants? Furthermore, this subsidy appears to be paid from the lodger tax revenues. This use of lodger tax revenues to support free shuttle service for skiers lodging in the town of Taos puts lodging owners in the position of subsidizing their competition.	The Village is not actually subsidizing the service, it is the Lodgers Tax Fund. It was voted on by the Lodgers Tax Board and the Village Council approved.
Utilities Page 45	I don't understand the table. Twining Rd is listed 7 times. I assume these refer to different sections, but they are not designated in a way they could be shown on a map.	That is correct- a map showing these sections- going from the Village, toward Kachina, should be added at a later date.
Utilities Page 50	The TIDD described under the Utilities Element. It is pretty important to several Elements. Maybe it should be described before we get to the Elements.	The TIDD is described on page 7 in the Economic Development Section before any of the other Sections or Elements
Transportation Page 38	TSV Inc. provides daily shuttle service to Albuquerque and Santa Fe Airports during ski season. All information is available on the website, skitaos.org.	Completed
Community Services Page 64	"Most recently in 2015, the Village purchased software that will send a text message to anyone within range of cell towers in the Village...." who has signed up for the service.	Wording change. Insert "who has registered for the service" instead of "...anyone within range..."
Recreation Page 81 and 82	This table seems out of place. This stuff is expensive, isn't it?	Agree that it needs explanation. Inserted "The Village Park and Recreation Committee prioritized the following improvements to a recreational Trail System;" and put it directly under the first "Strategy"?
Village Character Page 84	"The Blake Hotel and Plaza is complete and Parcel D will begin groundwork in 2017." Delayed a year?	Best current estimate by TSVI is groundwork for Parcel D will start in 2018.

Page #	Comment	Answer/Action
Village Character Page 89	I find the comment about "...historic Building from the Mining era..." confusing. Most of the buildings in the core village have an alpine look to them, including the newest addition, the Blake. Many of the remainder has either an alpine look or wilderness lodge look (take the Burroughs subdivision, for example). I see very few houses that have a mining look to them. It seems strange that this is the emphasis. The alpine buildings came along with the Blakes well after the mining era. My concern is; if I tore my house down and rebuilt my house to modernize that I would be told that my preferred style (alpine) isn't a "mining era "style. Can you clarify this page?	The historic era comment relates more to the scale, rooflines and materials that were used in the historic photo shown. I have removed that sentence regarding the "mining era" and you will see the category "Alpine Rustic", with the housing examples shown. The intent, whatever it may be called, is to suggest rather than dictate what style is consistent with the Village Character. Natural materials, 2-3 story scale, gabled roofs that evoke a rustic style are appropriate to the Village character.
General	Not in the plan: The TIDD anticipates dedication of certain improvements to the Village (e.g., Sutton Place, proposed Strawberry Hill Bridge and plaza). Should the criteria for acceptance of proposed dedications be contained in the planning document?	The Commission considers this to be too complex and singularly focused to create general criteria.

Acknowledgments

The following individuals deserve acknowledgments for the completion of the Comprehensive Plan:

Village Council

Kathy Bennett

Christof Brownell

Chris Stagg

Tom Wittman

Mayor

Neal King

Planning & Zoning Commission

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Bill Jones, Building and Construction

Contracting

Jim Corbett, Graphic Design

Special Thanks to Matthew Foster for his research.

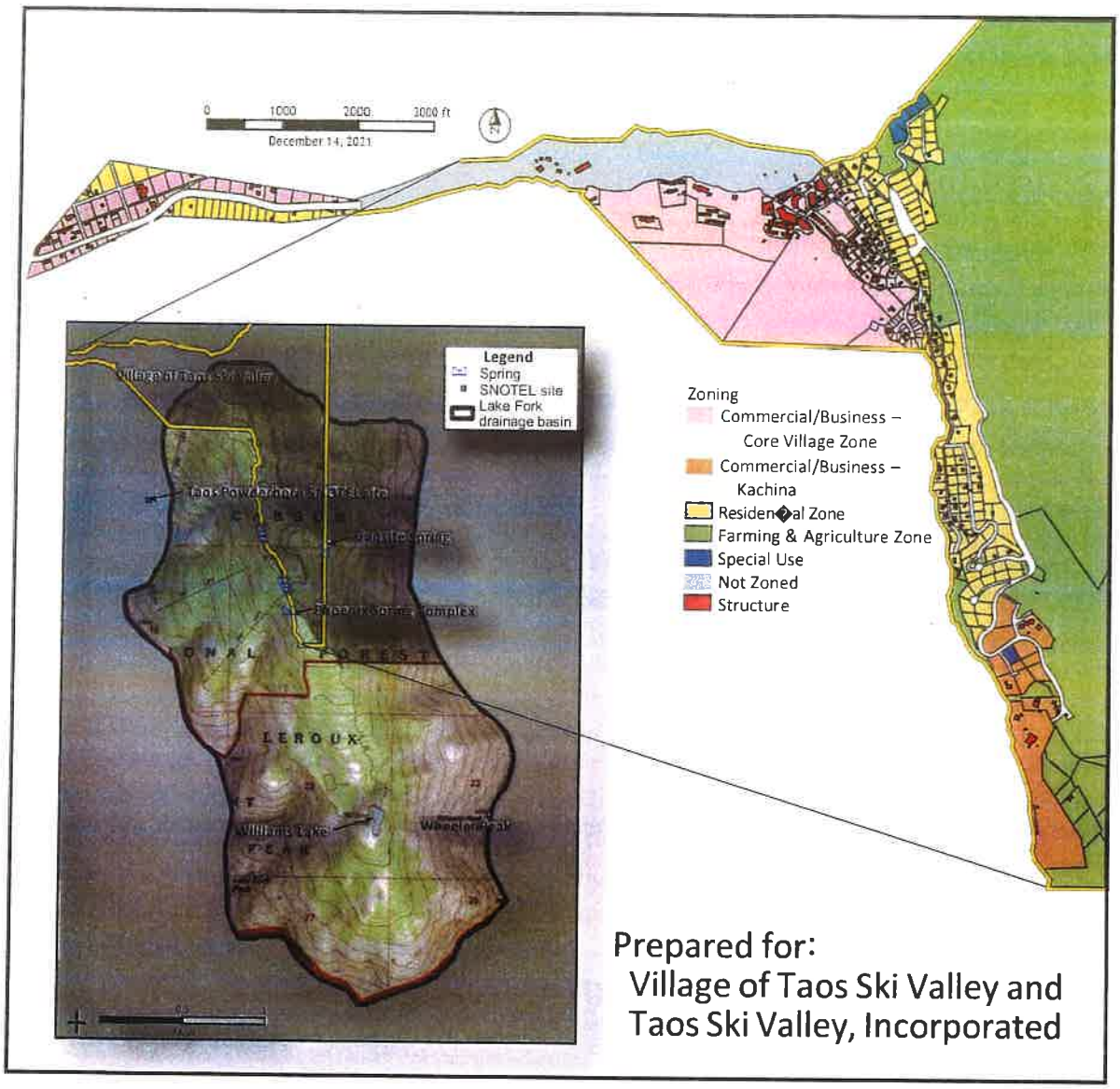
The Village of Taos Ski Valley

Final Draft Comprehensive Plan

June 2017

Village of Taos Ski Valley, NM

Water Master Plan



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DENNIS ENGINEERING COMPANY

December 16, 2021

TAOS SKI VALLEY WATER MASTER PLAN EXECUTIVE SUMMARY

Glorieta Geoscience, Inc. (GGI) and Dennis Engineering Company (DEC) have conducted a geohydrologic analysis of the Phoenix Spring and Lake Fork drainage basin (Figure ES1), and an engineering analysis of the Village of Taos Ski Valley (VTSV) water distribution system, respectively.

- The goal of the geohydrology investigation was to evaluate sources and timing of recharge to the Phoenix Spring Complex and develop a methodology for estimating future minimum spring flows based on historic data.
- The focus of the engineering analysis was to evaluate the water distribution system, current and projected system demand and related infrastructure to recommend improvements to provide VTSV with a more reliable water distribution system.
- The overarching goal of the two studies was to evaluate the ability of VTSV to meet future water demands, especially during periods of peak use around the winter holidays and spring break, given natural (spring flow) and engineering (distribution system) constraints.

The primary conclusions of this investigation are presented below. The detailed analysis, methodologies, and conclusions are presented in the attached reports from GGI and DEC.

HYDROLOGY AND WATER SUPPLY SUMMARY (GGI REPORT)

The Phoenix Spring Complex discharges at a bedrock constriction, which reduces cross sectional area of the aquifer in glacial deposits. Winter precipitation contributes ~55-88% of recharge to springs, with the balance coming from (primarily monsoonal) rainfall. Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old).

Based on metering data collected by VTSV over the past eight years from the Phoenix Spring Complex, analysis of data from the Powderhorn Snotel site from 2010 to 2021, and analysis of data from the USGS Rio Hondo at Valdez gage from 1934 to 2021, the following are minimum flows predicted for the Phoenix Spring Complex:

- The lowest projected monthly average flow is 144 gallons per minute (gpm), equivalent to 207,360 gallons per day (gpd)
- The lowest projected 5-day average spring flow is 126 gpm/181,440 gpd
- The lowest monthly average flow will likely occur in March, whereas the lowest 5-day average flow may occur in March or April

These values do not include flow from the Gunsite Spring, which is also a permitted point of diversion for VTSV. Flows were measured by VTSV from Gunsite Spring during Summer and early Fall of 2019 and 2020, and have been measured weekly by GGI beginning in February, 2021. During the period of weekly flow measurements, Gunsite spring discharge ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) in August, 2021.

It is extremely important that the Village continue to carefully monitor (meter) flows from the Phoenix Springs Complex, including tracking the timing and duration of bypass flows, and revisit the baseline flow evaluation every 5 years. Projections of future water supply should be adjusted as appropriate to incorporate continued and improved data collection.

Ongoing statewide water supply and climate change studies being conducted by various state agencies have found that:

1. In the last 20 years there are only 5 years where NM has not been in drought conditions
2. At present, NM is in the deepest drought in the last 20 years
3. In the last 4 decades, temperatures have risen and precipitation has remained about the same State-wide
4. It will get warmer in NM as CO_2 concentrations in the atmosphere increase
5. There will be decreased snowpack but more winter precipitation in the Northern Mountains
6. Snowpack and streamflow will decrease
7. Snow will melt earlier and there will be less runoff

To accommodate potential reductions in spring flows arising from climate change, an annual reduction in spring flows of 0.5% per year was applied to the projected values presented above over a 25-year planning horizon. Incorporating this climate-induced flow reduction results in the following estimated minimum values for discharge from the Phoenix Spring Complex that should be used for planning purposes:

Minimum monthly average flow: 126 gpm / 182,000 gpd
Minimum 5-day average flow: 111 gpm / 159,000 gpd

Applying a 0.5% per year reduction to the measured flow from the Gunsite Spring results in projected minimum flows of 26 gpm / 38,000 gpd. Additional data collection is required to confirm the Gunsite Spring minimum flows. If connected to the VTSV system, the Gunsite Spring has the potential to compensate for most or all of the declines in Phoenix Spring flow arising from the effects of climate change.

Water Demand and Infrastructure Needs (DEC Report)

The Water Service Area is a defined term referencing that portion of the Village which is serviced by the municipal water system. This area and the corresponding 2019 Metered Gallons establish the Base Line documentation of usage within the Village. Figure ES2 shows the VTSV municipal water service area, as well as those portions of the Village which are not served, and delineates usage by zone and type of dwelling. This is the basis for evaluating existing water consumption, and from which projected growth and future usage are derived. As part of that projected growth, it is assumed that water service will be provided to Amizette in addition to growth in the existing Water Service Area. A detailed assessment of baseline conditions and growth projections can be found in the DEC Water Master Plan Technical Memorandum – Appendix E: TSVI Baseline and Estimated Future Demand, and a summary is provided here in Table ES1.

Peak system demand typically occurs in December through March of each year, with the greatest demand in January. VTSV metered records indicate that, during periods of peak demand, unaccounted water is 74%, meaning that system customers only utilize approximately 26% of the water metered at the Phoenix Spring chlorination station. Approximately 80,000 gpd, or 60% of all unaccounted-for water, is lost between the chlorination station and the 250,000 gallon 'Green Tank'.

The demand analysis, combined with the future water supply projection outlined in the GGI report, indicate that if no improvements are made to the water distribution system, supply could potentially be

Table ES-1. Baseline and estimated future (25-year) water demand and water supply.

Growth Scenario:	Water Service Baseline	Existing + 20%	Base Village & Kachina	Amizette (existing)	Amizette (expansion)
Land Use Assumption (see note A)					
Single Family Homes	103	-	106	21	41
Hotels	108	-	78	90	-
Multi-Family	276	-	323	36	-
Total Lodging Units	487	-	507	147	41
Total - Cumulative Units	487	487	994	1,141	1,182
Non-Residential Space (SF)	155,272	-	50,300	-	-
Cumulative (SF)	155,272	155,272	205,572	205,572	205,572
Water Demand ('000 gal) (see note B)					
Baseline (2019 data)	1,553	-	-	-	-
Growth	-	311	1,749	223	56
Total Demand (Cumulative)	**1,553**	**1,863**	**3,612**	**3,835**	**3,891**
Water Capacity Scenarios ('000 gal) (see note C)					
1. Current Capacity w/75% leakage	**1,599**	**1,599**	**1,599**	**1,599**	**1,599**
Surplus/(Shortfall) – thousand gallons	*46*	*(264)*	*(2,013)*	*(2,236)*	*(2,292)*
Surplus/(Shortfall) - %	*3%*	*-14%*	*-56%*	*-58%*	*-59%*
2. 50% leakage + 12.5% climate loss	**2,812**	**2,812**	**2,812**	**2,812**	**2,812**
Surplus/(Shortfall) – thousand gallons	*1,259*	*949*	*(800)*	*(1,023)*	*(1,079)*
Surplus/(Shortfall) - %	*81%*	*51%*	*-22%*	*-27%*	*-28%*
3. 35% leakage + 12.5% climate loss	**3,656**	**3,656**	**3,656**	**3,656**	**3,656**
Surplus/(Shortfall) – thousand gallons	*2,103*	*1,793*	*44*	*(179)*	*(235)*
Surplus/(Shortfall) - %	*135%*	*96%*	*1%*	*-5%*	*-6%*
4. 25% leakage + 12.5% climate loss	**4,218**	**4,218**	**4,218**	**4,218**	**4,218**
Surplus/(Shortfall) – thousand gallons	*2,665*	*2,355*	*606*	*383*	*327*
Surplus/(Shortfall) - %	*172%*	*126%*	*17%*	*10%*	*8%*

(A) See Figure ES-2 Land Use Assumption schedule for details.

(B) Based on 2019 data from VTSV with reductions for Pizza Shack, Terry Sports, Phoenix Grill leak and Hotel St. Bernard which are non-recurring or incorporated into the future growth projection.

(C) Climate change is assumed to reduce water capacity by one-half percent (.5%) annually for a 12.5% loss over the next 25 years.

insufficient to meet existing demand in 2022, if in 2022 the Phoenix Springs Complex has historically low flows (equivalent to the lowest projected flow from the GGI report). If no improvements are made to the distribution system to reduce line losses, then it will be impossible to demonstrate that water will be available for any future development, including extending service to Amizette. If, however, system losses are reduced to 25% (a reasonable, but still relatively high number), then the water use projections indicate the VTSV system will be able to provide water for all proposed future development in the Base Area, Kachina Village, and Amizette, with an estimated 8% surplus at full build out. This projection takes into account a 20% increase in visitations/occupancy (relative to 2019 values), a 0.5% per year decline in flow from the Phoenix Springs Complex (relative to the lowest projected flow value), and does not include connecting Gunsite Spring to the VTSV system.

As these numbers indicate, it is critical that VTSV undertake immediate action to reduce water losses in the system to ensure that sufficient supply is available to meet existing and projected future demand.

Recommended Action Plan

- Continue to carefully monitor (meter) flows from the Phoenix Springs Complex, including the timing and duration of bypass flows.
- Continue to record flows from the Gunsite Spring.
- Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate ongoing and improved spring flow data.
- Bring the Kachina water tank on-line and connect it to the system.
- **Isolate locations and extent of water losses**
    - Replace the mechanical inlet and outlet meters at the Green Tank with electromagnetic flow meters and install in separate vaults to ensure manufacturer clear distances are satisfied. This will confirm the extent of water loss between the chlorination station and the Green tank.
    - Install master meters at strategic locations in the system (delineated in the DEC report) to isolate specific segments of the distribution and pinpoint where water losses are occurring.
    - Target meter installation by summer of 2022 (prior to 2022/2023 peak demand)
- **Replace leaking water lines:** Future line replacement projects should focus on areas of maximum water loss as determined from the master metering program.
- Evaluate areas where 4-inch water mains are utilized for fire protection to determine if these lines are adequate to provide fire protection, and replace these lines if they are not.
- Replace all galvanized water lines in the system with adequately sized ductile iron water lines.
- Replace all customer meters and begin a meter replacement program to ensure that all customer meters are scheduled to be replaced prior to the end of their service life.

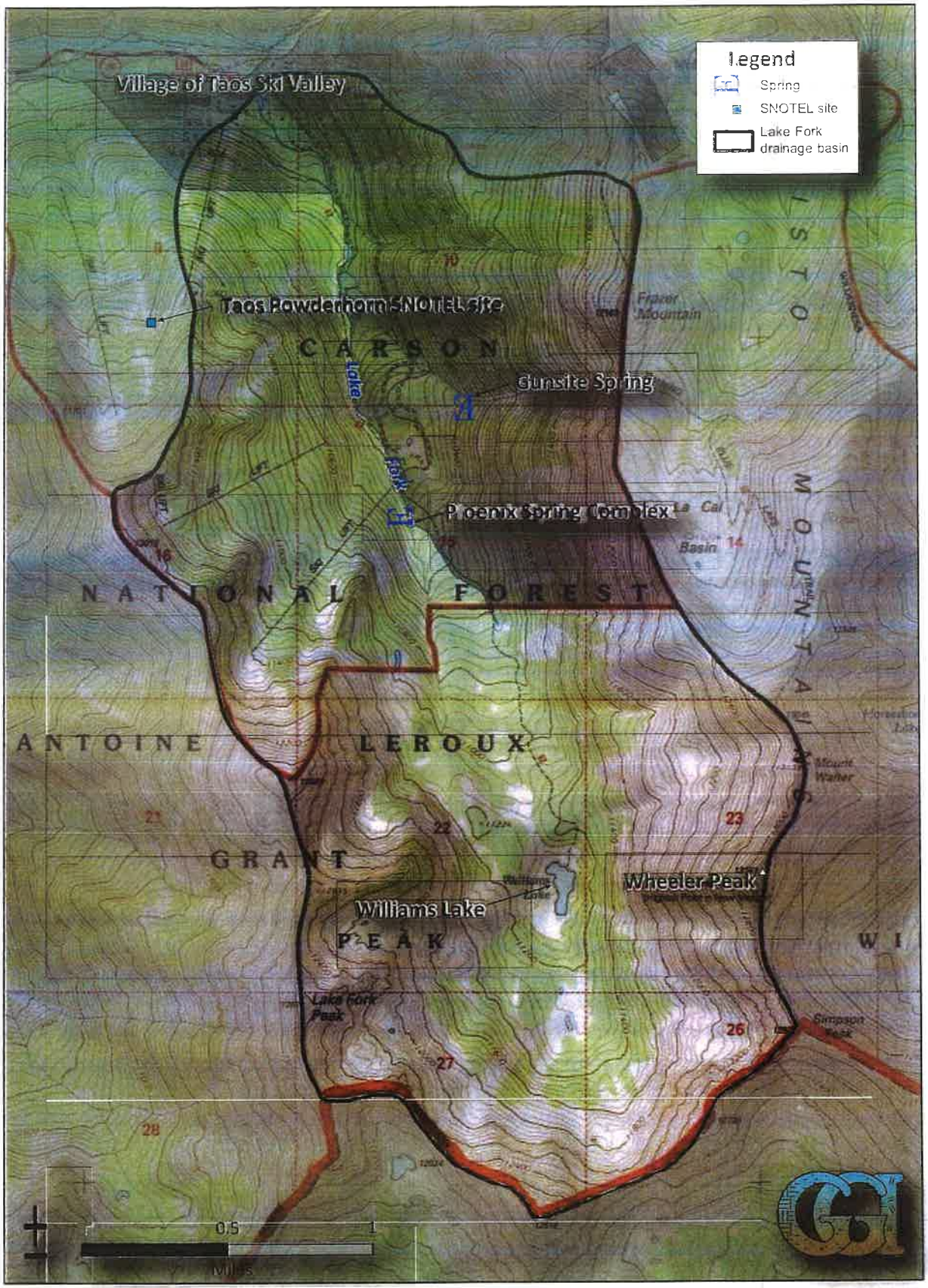
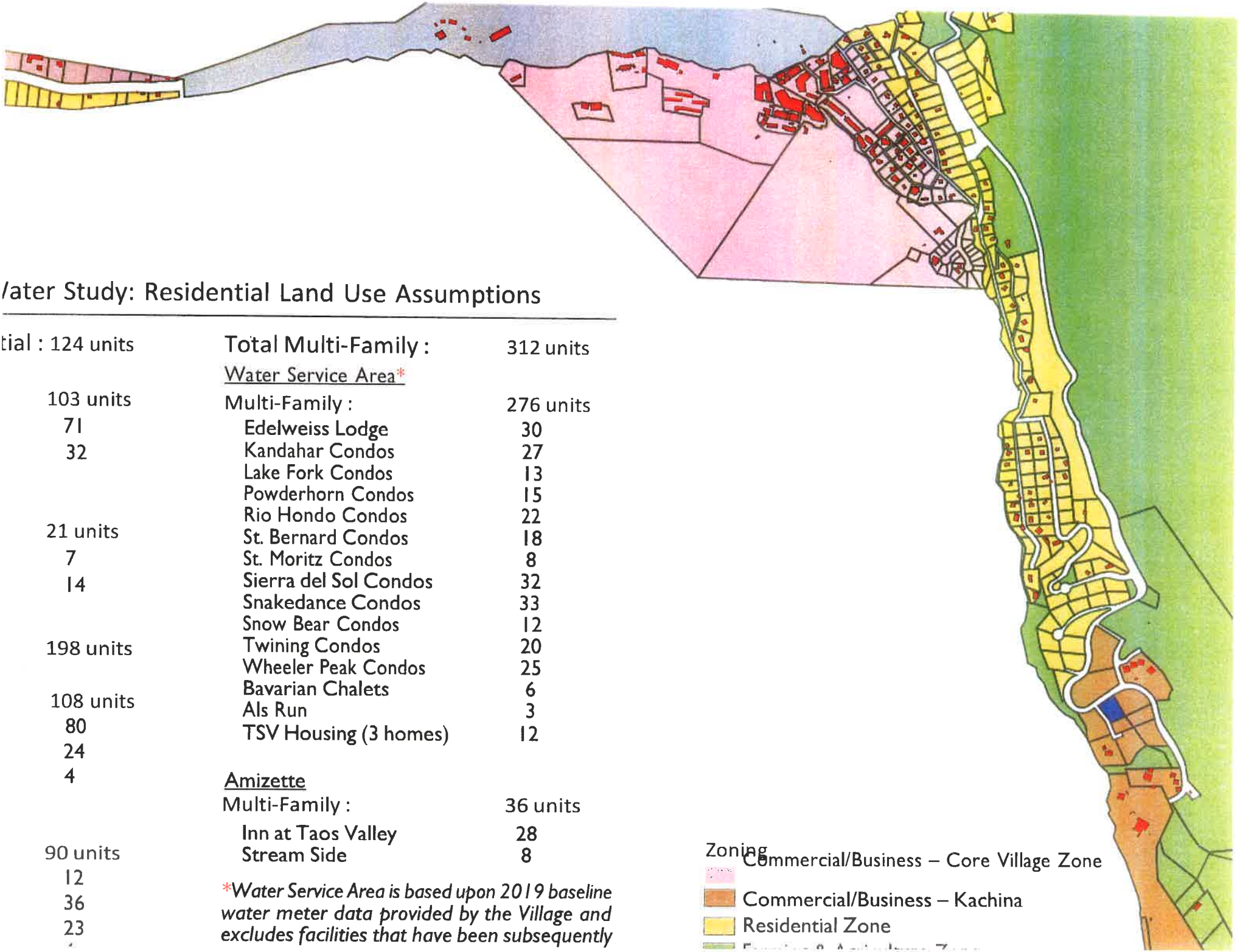


Figure ES1. Map of the Lake Fork drainage basin showing location of the Phoenix Spring Complex, Gunsite Spring, and the Taos Powderhorn SNOTEL site



/ater Study: Residential Land Use Assumptions

tial : 124 units	Total Multi-Family :	312 units
	Water Service Area*	
103 units	Multi-Family :	276 units
71	Edelweiss Lodge	30
32	Kandahar Condos	27
	Lake Fork Condos	13
	Powderhorn Condos	15
	Rio Hondo Condos	22
21 units	St. Bernard Condos	18
7	St. Moritz Condos	8
14	Sierra del Sol Condos	32
	Snakedance Condos	33
	Snow Bear Condos	12
198 units	Twining Condos	20
	Wheeler Peak Condos	25
	Bavarian Chalets	6
108 units	Als Run	3
80	TSV Housing (3 homes)	12
24		
4	Amizette	
	Multi-Family :	36 units
	Inn at Taos Valley	28
90 units	Stream Side	8
12		
36	*Water Service Area is based upon 2019 baseline	
23	water meter data provided by the Village and	
	excludes facilities that have been subsequently	

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Village of Taos Ski Valley, NM

Water Master Plan - Hydrologic Assessment

Historic and Projected Flows from the Phoenix Springs Complex

Prepared for:

Village of Taos Ski Valley
and
Taos Ski Valley Incorporated

Prepared by: Jim Riesterer, P.G., Paul Drakos, P.G. and Jay Lazarus

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December 16, 2021

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FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
CS	Chlorination Station
DWB	Drinking Water Bureau (NMED)
GGI	Glorieta Geoscience, Inc.
gpd	gallons per day
gpm	gallons per minute
LRE	Leonard Rice Engineers, Inc.
MGD	Million gallons per day
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMED	New Mexico Environment Department
SNOTEL	SNOwpack TELemetry
std dev	Standard Deviation
SWE	Snow Water Equivalent
TSVI	Taos Ski Valley Incorporated
VTSV	Village of Taos Ski Valley
WY	Water Year (October 1 to September 30)

UNIT CONVERSIONS

Multiply	By	**To Get**	**Rule of thumb conversions**
gpm	**1440**	**gpd**	1 gpm = 1440 gpd
gpd	0.000694	gpm	
cfs	449.23	gpm	1 cfs ~ 450 gpm
gpm	0.0022	cfs	
cfs	646,891	gpd	1 cfs ~ 650,000 gpd
gpd	1.55×10^{-6}	cfs	

EXECUTIVE SUMMARY

Taos Ski Valley, Inc. (TSVI) and the Village of Taos Ski Valley (VTSV) have undertaken a water master planning effort to quantify future water supply needs and the water available to meet those needs. This report has been prepared by Glorieta Geoscience, Inc. (GGI) as part of the larger water master planning effort and summarizes the results of efforts to quantify current and projected water supply from the springs that are currently the Village's sole source of municipal water supply. The data included in this report build on previous studies of the geology and hydrology of the Taos Ski Valley area conducted by GGI on behalf of both VTSV and TSVI, copies of which are included as appendices to this report. These previous studies found:

- Phoenix spring discharges at a bedrock constriction, which reduces cross sectional area of the aquifer in glacial deposits
- Winter precipitation contributes ~55-88% of recharge to springs, with the balance coming from (primarily monsoonal) rainfall
- Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)
- The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) or 1,950,000 gallons per day (gpd) from Phoenix Spring to the East Fork confluence during low flow conditions

Data and conclusions from these previous studies are updated here with more recent spring flow metering data and additional analyses of the relationships between snow pack, precipitation, stream flows, and spring discharge. These relationships are used to project minimum anticipated future spring flows for utilization as a planning tool by VTSV.

Metered spring flow data, provided by VTSV, are available for the period from February 2014 to April 2021. The lowest monthly average flows occur during March, when demand in VTSV is typically high, and in April. From the available meter data:

- The lowest recorded monthly average flow was 158 gallons per minute (gpm, equivalent to 227,520 gallons per day [gpd]) in March, 2021
- The lowest recorded 5-day average flow was 140 gpm/201,600 gpd from April 11 to April 15, 2014

Stream flow records are available for the Rio Hondo from 1935 to 2021. Using relationships between spring flows and Rio Hondo flows that were established during evaluation of the data, historic spring flows are extrapolated for this entire period. From the projected spring flow data:

- The lowest projected monthly average flow is 144 gpm/207,360 gpd
- the lowest projected 5-day average spring flow is 126 gpm/181,440 gpd

These values are conservative to take into account the uncertainties associated with the relatively short period of spring flow meter data and incomplete records of when the Side Spring and Schreiber Spring were being metered.

These values do not include flow from the Gunsite Spring, which is a permitted point of diversion for VTSV. Flows were measured by VTSV from Gunsite Spring during Summer and early Fall of 2019 and 2020, and have been measured weekly by GGI beginning in February, 2021. During the period of weekly flow

measurements, Gunsite spring discharge ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) as of August 19, 2021.

Ongoing statewide water planning studies suggest that climate change impacts in the VTSV planning area will likely include increasing temperatures, decreased snowpack, and earlier runoff, all of which may affect the quantity and timing of discharge from the Phoenix Springs Complex and Gunsite Spring. To account for the potential future decrease in spring flows arising from climate change, the projected low flow values were further reduced by 0.5% per year for a 25-year planning period.

Based on the findings of this study, GGI recommends the following:

1. **For planning purposes, a minimum monthly average flow of 126 gpm / 182,000 gpd and a minimum 5-day average flow of 111 gpm / 159,000 gpd should be used for the Phoenix Springs Complex.** These values incorporate a 0.5% per year decrease in spring flows attributable to effects of climate change.
2. Continue metering flows from the Phoenix Springs complex, including improved record keeping regarding when the Side Spring and Schreiber Spring are turned in to the chlorination station and when they are bypassing the chlorination station meters.
3. Install meters on the bypass pipelines and record bypass flows to allow for a full accounting of all spring discharge, including high flows, that are not currently metered. This metering will allow for better correlation of snowpack (snow water equivalent) to spring flows and could provide a useful future planning tool to allow for early warning of upcoming periods of low spring discharge based on snow water equivalent.
4. Continue monitoring Gunsite Spring flows to better constrain the range of flows that can be expected from this source.
5. Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate continued and improved data collection. The current projections include several assumptions to keep the estimates conservative for planning purposes. Continued collection and re-evaluation of the data will allow projected flow estimates to be adjusted up or down, as appropriate, to assist in ongoing planning efforts.
    a. Once Gunsite Spring flows are better understood, it may be advisable for VTSV to consider connecting Gunsite Spring to the municipal distribution system.
6. Implement policies and practices to reduce the impacts of climate change, including continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses, continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

1 INTRODUCTION

The Village of Taos Ski Valley (VTSV/the Village) utilizes water from the Phoenix Springs Complex, which includes the Phoenix Spring and two nearby hydrologically connected springs ('Side Spring' and 'Schreiber Spring') as its sole sources of municipal water supply. Water from Phoenix Spring is collected in an infiltration gallery and piped into the VTSV chlorination facility (commonly referred to as the chlorination station, CS) before being put into the municipal distribution system. During the low spring-flow period from December/January through March/April (depending on the year), the Side Spring and Schreiber Spring may also be directed into the CS via a system of valves and pipelines, described in section 4 below. Collectively, these three springs will be referred to in this report as the *Phoenix Springs Complex* (Figure 1). VTSV has a second permitted point of diversion, the Gunsite Spring (Figure 1), that is listed on the New Mexico Environment Department (NMED) Drinking Water Bureau (DWB) Drinking Water Watch website. This water source is listed as "Inactive" on the Water Watch Website and is not currently utilized as part of the VTSV water system. The focus of this report is therefore the Phoenix Springs Complex; however, it is GGI's recommendation that VTSV pursue development of the Gunsite Spring as an additional water source.

In order to plan responsibly for future growth in VTSV it is critical for the Village to understand the water supply that can be reliably obtained from these springs. The Village has undertaken a water master planning effort to identify and quantify both the potential future water demand resulting from proposed or potential development and the available water (spring) supply to accommodate that demand. Of specific interest to planning efforts is obtaining a reliable estimate of the minimum flow that can be expected from the Phoenix Springs Complex during peak demand season (December through early April) in future years.

This report has been prepared by GGI to address the spring-supply portion of the water master planning effort and is focused on providing VTSV with a reliable minimum spring flow number to use for future planning efforts. GGI has been conducting hydrogeologic studies in the VTSV area and the surrounding Lake Fork and Rio Hondo watershed since 1990. The studies of springs, groundwater, and surface water resources in this and other watersheds throughout the southwestern US are resources that GGI has drawn upon to better understand the hydrologic system that sustains the Phoenix Springs Complex, and the VTSV water supply.

2 HYDROGEOLOGIC SETTING AND PREVIOUS INVESTIGATIONS

The Phoenix Springs Complex is one of the primary sources of stream flow in the upper reaches of the Lake Fork of the Rio Hondo. Phoenix Spring is situated at an elevation of 10,310 ft in the Lake Fork Valley, a glacial valley draining the Williams Lake cirque and Wheeler Peak in northern New Mexico (Figure 1). The Lake Fork Valley is underlain by rock glaciers and thick valley bottom till. Recharge occurs both in the Williams Lake Cirque and along the Lake Fork Valley, with snowmelt and monsoonal precipitation infiltrating directly into the glacial deposits. No surface water flow leaves the cirque; rather groundwater discharges further down the valley through springs and directly to the Lake Fork. Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss and schist.

Figure 1. Map of the Lake Fork drainage basin showing location of the Phoenix Springs Complex, Gunsite Spring, and the Taos Powderhorn SNOTEL site

TSVI, VTSV, and GGI conducted a hydrogeologic investigation of Phoenix Spring and the upper Rio Hondo drainage from 2016-2019.[1] This investigation included collection of precipitation and snowpack samples for tritium and stable isotope analyses, piezometer installation and water level monitoring upgradient of the Phoenix Springs Complex, and gaging of stream flows. Significant findings of this investigation included:

- Phoenix spring discharges at bedrock constriction, which reduces cross sectional area of aquifer in glacial deposits
- Stable isotopes show that winter precipitation contributes ~55-88% of recharge to springs[2]
- Shallow groundwater is recharged by monsoonal precipitation with an approximate two-week lag time as seen in piezometer water level data (see piezometer installation report and water level data included in Appendix A)
- Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)[2]
- The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) from Phoenix Spring to the East Fork confluence during low flow conditions (equivalent to approximately 1.94 million gallons per day, MGD)
- Spring discharge is typically highest in May, June, and July, the result of an initial rapid response to snowmelt recharge
- March-April low discharge base flow conditions are controlled by the previous winter's snowpack, or snow water equivalent (SWE). This is consistent with recharge to high-hydraulic conductivity coarse sediments (talus, rock glaciers, and moraines) in the Williams Lake Cirque and Lake Fork Valley above the Phoenix Springs Complex. These types of aquifers have fast responses to snowmelt and storm events, yet they sustain steady discharge for many months (Hayashi, 2020).

The Drakos et al. (2020) presentation summarizing these studies is included in Appendix B.

3 UNCERTAINTIES

As with any hydrogeologic investigation, there are a number of uncertainties associated with the current study. These uncertainties are primarily related to:

1. Limited period of record for metered spring flows (8 years)
2. Gaps in 2020 spring flow records
3. Incomplete records of when the Side Spring and Schreiber Spring were turned into/out of the CS
4. Reliability/accuracy of climate change forecasts
5. Natural variability in a complex hydrogeologic system

While it is not possible to eliminate all uncertainty from an analysis of the factors contributing to spring flow, GGI has attempted to identify and discuss the sources of uncertainty in this report. Where

[1] The results of these studies and other similar spring investigations have been presented in technical conferences (e.g. Drakos et al., 2020), provided to TSVI, presented to the VTSV Source Water Protection Stakeholders group, and are referenced in the Source Water Protection Plan (SWPP).

[2] Additional isotope samples have been collected from Phoenix Spring, East Fork Lake Fork Spring, Gunsight Spring, and Simpson Spring as part of the current study. Samples have been submitted for laboratory analyses and results are pending.

uncertainty exists, we have taken a conservative approach to the data analysis in order to provide VTSV with a projection of future spring flow that is both defensible and reasonable for planning purposes.

4 SPRING FLOWS

4.1 SPRING FLOW METERING DATA

Spring flow metering records were provided by VTSV for the period covering February 7, 2014 through April 30, 2021. The records include both instantaneous readings and totalizer meter readings for flows into the chlorination chamber and the overflow that is returned to the river. Combined flow from the two meters (overflow + chlorination chamber) represent the total amount of spring production being directed into the CS. This flow does not necessarily represent the total flow being produced by the Phoenix Springs Complex due to controls on the distribution upstream of the chlorination station that may allow some flow to bypass the chlorination station entirely, as described below and shown schematically in Figure 2. Hand-drawn schematics of the spring flow controls, prepared by the former system operator, are included for reference in Appendix C.

4.1.1 Main Bypass Line

The main pipeline from the Phoenix Spring infiltration gallery to the CS includes a 10-inch overflow line that can allow spring flow to be directed into the Lake Fork upstream of the CS (Figure 2). This connection between the overflow line and the main line does not have a valve. Flows are directed to the overflow pipeline by restricting flow into the CS using a valve located at the CS, which creates back-pressure in the main line and forces water out the overflow. During periods of peak flow in the late spring and early to mid-summer, the excess spring flows are discharged directly to the Lake Fork via this 10-inch bypass line, and the meters in the CS only record the portion of total flow that is not bypassed to the Lake Fork. In 2016 VTSV staff identified times in 2015 when the flows were being bypassed, shown in blue text on Figure 3.

4.1.2 Scheiber Spring

Scheiber Spring is located between the main Phoenix Spring and the CS (Figure 2). Flow from Scheiber Spring can be directed to the CS or directly to the Lake Fork via an 8-inch bypass line. This bypass, similar to the upper 10" bypass, is controlled by a valve in the discharge line that can be opened to allow flow to the CS or throttled back to direct flows to the Lake Fork during times of high spring flows. No records have been identified to indicate when this bypass has been opened and closed but, presumably, operation of this bypass would result in the same types of spikes/reductions in metered flows at the CS as are induced by the operation of the upper bypass. Discussions with VTSV staff indicate that flows from Scheiber Spring are always utilized (directed to the CS) during the low flow winter months, typically beginning in December.

4.1.3 Side Spring

In addition to Phoenix and Schreiber Springs, there is a third spring referred to as the Side Spring (formerly known as Mickey's Spring), which can be diverted into the CS when Phoenix Spring flows are low (Figure 2). The Side Spring is owned by Taos Ski Valley, Inc. (TSVI) and flows from the spring can only be utilized by VTSV to augment Phoenix Springs flows with the permission of TSVI. Since 2016 records of when the

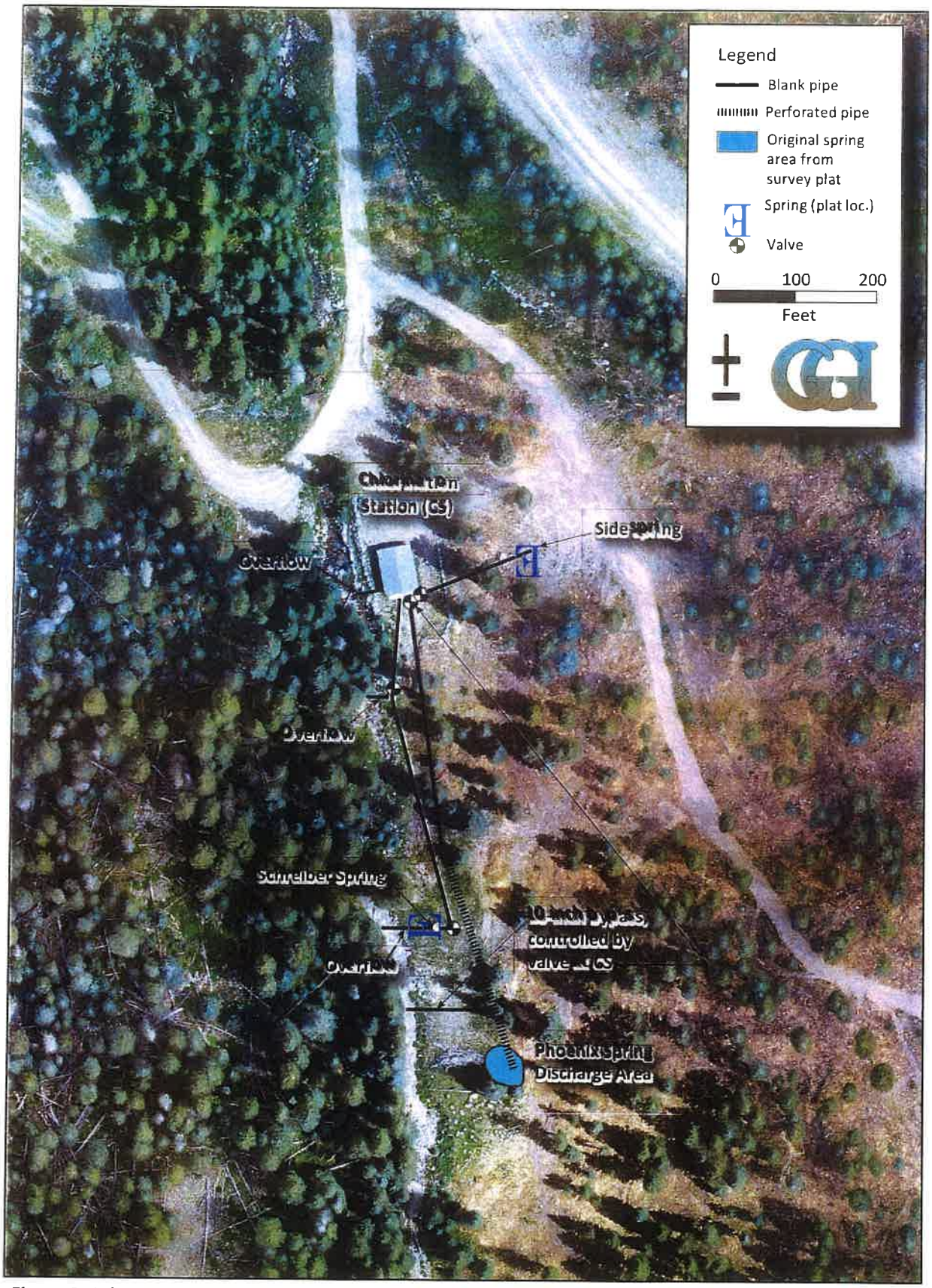


Figure 2. Schematic overview of spring flow collection and control system. Reconstructed from survey plats made prior to chlorination station construction and from schematic drawings of valve controls from VTSV staff (see Appendix C).

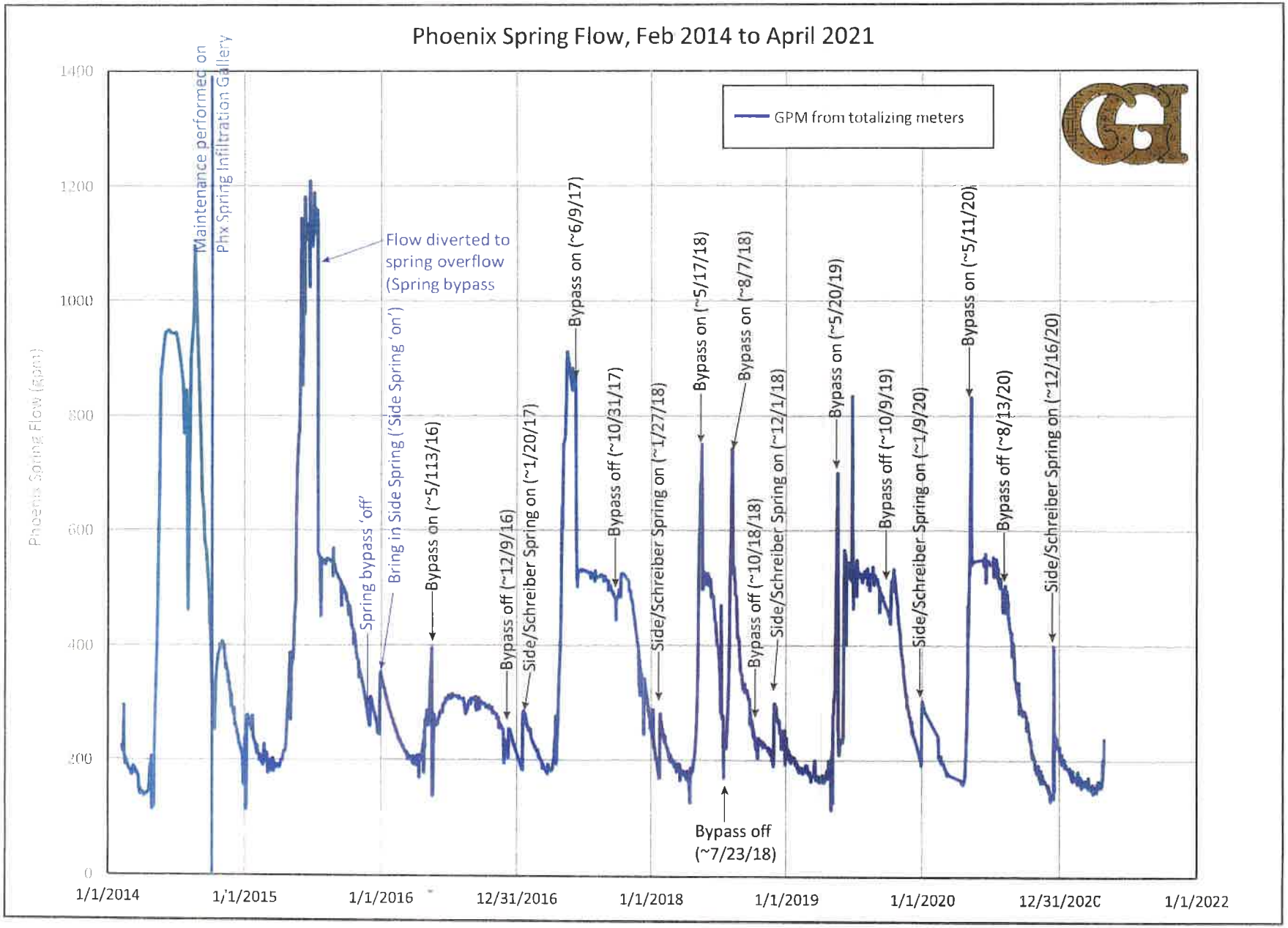


Figure 3. Annotated graph of Phoenix Spring metered flows. Notes in blue text are information provided by Village staff in 2015-2016. Notes in black are GGI' s interpretation of possible operational changes made that influence the spring flow meter readings.

Side Spring was turned in to the system have not been identified by VTSV, but discussions with VTSV staff indicate that the Side Spring is typically turned into the system in January.

In 2016 VTSV staff identified when the Side Spring was turned in to the chlorination station, shown in blue text on Figure 3. Spikes in metered spring flow that likely represent either the Side Spring or Schreiber spring being turned into the CS are labeled in black on Figure 3 for the years after 2016. It is possible that in some years only one of the secondary springs was turned into the system, but lack of records for when the Schreiber and Side Springs have been turned in make it impossible to know for certain. If this has been the case in some years, then the metered flow values under-represent the total flow available from the entire spring complex in those years.

4.2 Data Compilation and QA/QC

Data provided by VTSV were compiled and assessed to identify and address any apparently erroneous data points. In most cases data entry errors were easily identified by large one-day spikes or drops in recorded spring flows. The meter entries on these days were checked and, in most instances, a numeric transposition error was the cause, resulting in a very high meter reading one day followed by a very low reading the next day (or vice-versa). These entries were manually corrected to eliminate the spikes and troughs. In other instances, there were one-day spikes or drops in the flow data that couldn't be explained by an obvious transposition error in the data entry. In these cases, the values were compared to the instantaneous meter readings and the adjacent totalizer flow values and, where appropriate, a manual adjustment was made to the data to provide a reasonable flow value for the day in question. In relatively rare instances the anomalous data from the totalizer (one-day spikes) matched the instantaneous reads very closely, and no adjustment was made. Overall, from 2014 to 2019 and from June 2020 to April 2021 only a small percentage of the metered values required modification.

4.2.1 2020 DATA

In 2020 there were three large gaps in spring flow data. No data were recorded between January 9 and February 20, between March 11 and April 15, and between May 14 and June 13. The data were apparently measured, but the paper records were incomplete. To adjust for the incomplete data, the days between when the last recorded measurement was taken and the subsequent measurement was recorded were assigned a flow rate equal to the prior days reading plus (or minus) an incremental flow amount equal to the total difference between the two readings and the number of missing days. This results in a smoothed transition of flow between the measurements that provides a good approximation of the natural decline in spring flows that would be expected over the missing time periods. The shape of the interpolated low-flow curve over the period from March 11 to April 15 2020, when daily data are missing, compares favorably to the shape of the continuously recorded flow data from 2014-2019 and 2020 (Figure 4), and the interpolated data are considered useable for inclusion in analysis of the period of record flow data.

4.3 Spring Flow Data Evaluation

Figure 4 shows year-over-year 5-day average spring flow measurements for each 'water year' from May 1 to April 30. The abrupt and dramatic changes in metered flows during the high-runoff period from May through August or September is indicative of measurements largely controlled by operation of the bypass

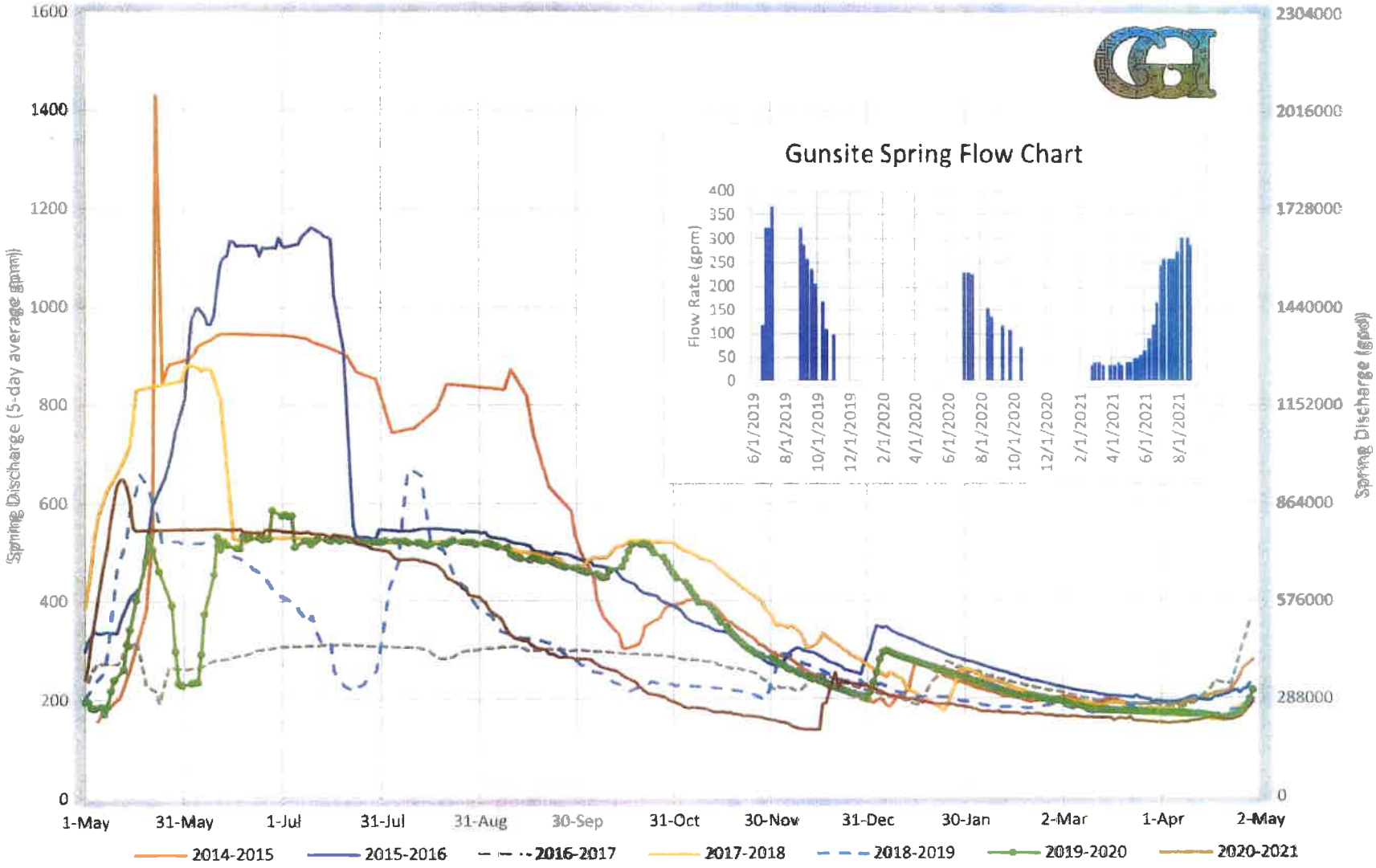


Figure 4. Phoenix Spring Discharge - May 1 to April 30 'water year', 5-day average flow. Inset shows Gunsite Spring flow measurements from 2019, 2020, and 2021

valve(s) as described above. Data from each year also show abrupt increases in metered flows that occur in December or January (depending on the year) that are the result of the Side Spring and/or Schreiber Spring being turned in to the system. It is only after the Side Spring and Schreiber Spring have been turned in to the chlorination station that year-to-year flows can be directly compared because, at that point, everything that is being produced by the spring complex (Phoenix Spring, Schreiber Spring and Side Spring) is measured and no water is being returned to the river prior to metering (see discussion in section 4.4 below).

Figure 5 shows year-over-year 5-day average flows during the low-flow months of December through April, which includes all of the spring flow data during February, March, and April when flows from the entire spring complex are being metered (see discussion in section 4.4 below). Overall, mean monthly flows are lowest in March, but the single lowest flows averaged over a five-day period (five-day trailing average) typically occur in early- to mid-April (Table 1). The discrepancy in mean monthly versus five-day average flows is due to the rapid rise in spring flow that occurs beginning in mid- to late-April (Figure 5). **The lowest recorded 5-day average flow was approximately 140 gpm (201,500 gpd) in April, 2014. The lowest monthly average flow was approximately 158 gpm (227,000 gpd) in March, 2021.**

Table 1. Summary of low-flow measurements

Year	Mean Feb-March flow (gpm/gpd)	Mean March Flow (gpm/gpd)	Lowest 5-day ave. flow (gpm/gpd)	Dates of 5-day ave. low flow
2014	190.4 / 274,200	169.8 / 244,500	139.9 / 201,500	4/11-4/15
2015	198.0 / 285,100	191.0 / 275,000	186.7 / 268,800	3/5-3/9
2016	224.1 / 322,700	206.2 / 296,900	191.8 / 276,200	4/2-4/6
2017	215.2 / 309,900	195.1 / 280,900	181.8 / 261,800	4/2-4/6
2018	202.2 / 281,200	186.3 / 268,300	169.3 / 243,800	4/13-4/17
2019	179.2 / 258,000	174.8 / 251,700	165.0 / 237,600	4/13-4/17
2020	192.4 / 277,100	175.9 / 253,300	159.2 / 229,200	4/17-4/21
2021	163.4 / 235,300	157.8 / 227,200	148.1 / 213,300	3/31-4/4

4.4 Reliability of Flow Measurements

The calibration of the meters installed in the chlorination station were checked and validated by Yukon and Associates, Ltd. on 7/19/2021. Because the meters are confirmed to have been reading accurately, the meter values represent the minimum possible flow from the Phoenix Springs Complex at any given time. Because there are no records of when the Side Spring and Schreiber Spring were turned into/out of the CS, it is possible that at certain times the combined flow of the springs was more than the metered amount (if one or both of the ancillary springs was being bypassed). The minimum flow numbers reported in Table 1 assume that both the Side Spring and Schreiber Spring were being directed to the CS during low-flow periods, but the lack of records of when the bypasses were operated after 2016 make it possible that one or both were being bypassed in any given year after 2016. **It is therefore possible that the Phoenix Springs Complex produced more water than is reflected in Table 1, but it is not possible that the combined flow of the springs was less than the metered amount shown in Table 1**. The metered values can be relied upon to provide a conservative estimate of minimum monthly and five-day average flows.

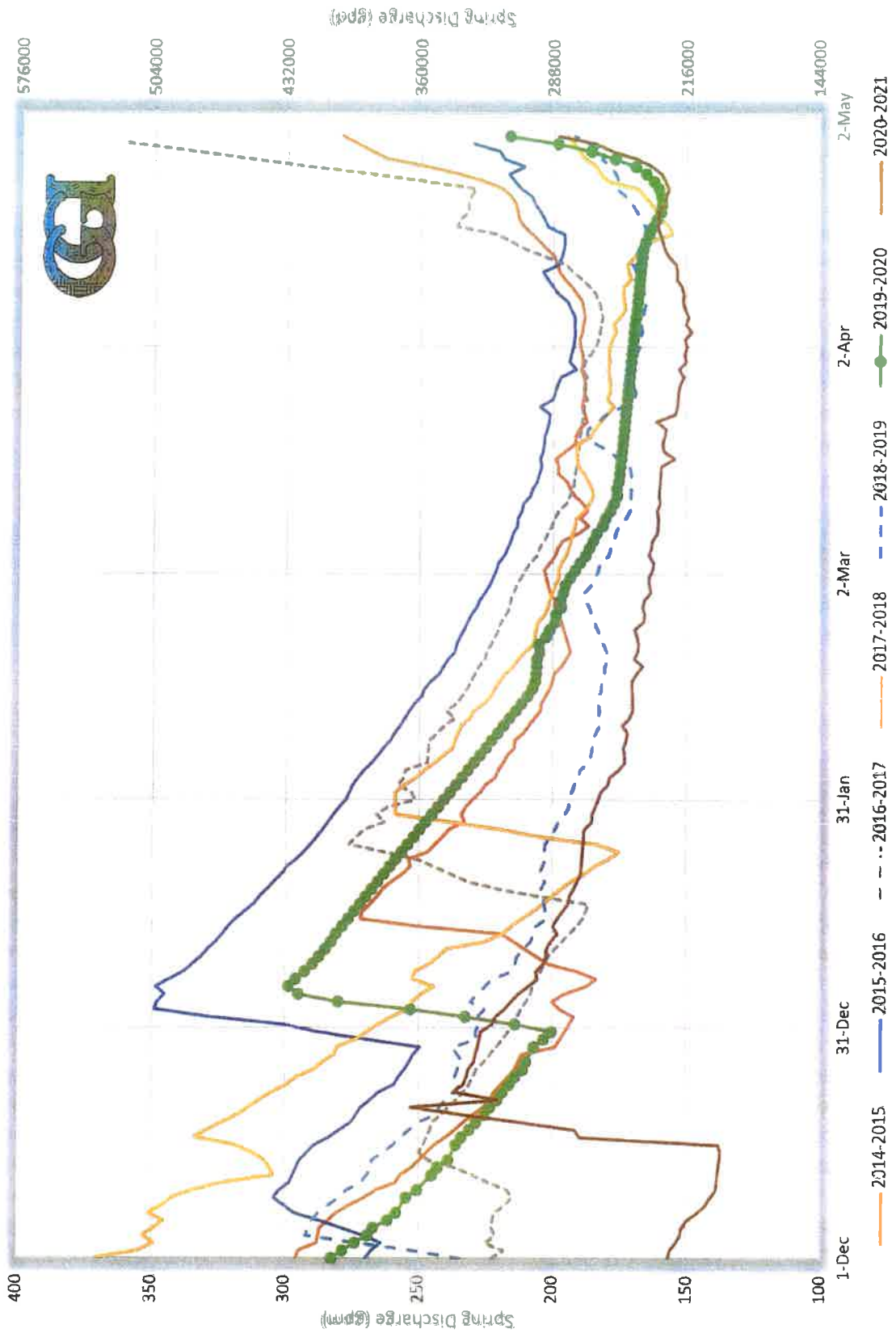


Figure 5. 5-day average discharge from Phoenix Springs Complex during low flow period, Dec 1 to May 1

5 GUNSITE SPRING PRELIMINARY DATA

A 3-inch Parshall flume was installed at Gunsite Spring by VTSV and Leonard Rice Engineers, Inc. (LRE) in June 2019. The flume measures flow from the main Gunsite spring source, but does not measure flow from a significant secondary spring discharge point that is part of the Gunsite spring. VTSV and LRE measured flows during Summer and early Fall 2019 and 2020 (LRE, 2020). Flows measured by LRE ranged from a maximum of 365 gpm (525,600 gpd) on July 19, 2019 to a minimum of 69 gpm (99,360 gpd) on October 10, 2020 (Figure 4). The property where Gunsite Spring is located was subsequently purchased by Mr. Bob Corroon of Taos Land and Cattle Company I, LLC. GGI located and dug out the flume from beneath approximately 5 feet of snow in February, 2021. To determine Gunsite spring flow during low-flow conditions and throughout the year on behalf of Mr. Corroon, GGI has measured spring discharge on a weekly basis beginning on February 24, 2021. During this time period, Gunsite spring discharge (exclusive of the secondary spring discharge source) ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) as of August 19, 2021 (Figure 4). Although it is not known at present whether this source would be classified by NMED as groundwater or groundwater under the influence of surface water, it is GGI's recommendation that VTSV pursue development of the Gunsite Spring as an additional water source. Continued monitoring of flows is also recommended to better quantify potential flow available from Gunsite Spring.

6 SNOTEL DATA

Climate data (temperature, snow depth, snow water equivalent, and accumulated precipitation) are available from the Powderhorn SNOTEL site from August 8, 2009 to present[3]. Data from the SNOTEL site was downloaded and compiled for comparison to spring flows. Precipitation at the SNOTEL site occurs predominantly as snow from October/November to April/May and as rain for the remainder of the year. From 2011 to 2020 the average precipitation over a water year (WY; October 1 to September 30) has been 36.4 inches, ranging from 19.1 inches in WY 2018 to 47.7 inches in WY 2017. The SNOTEL station records snow depth but, more importantly, records snow water equivalent (SWE) which is the moisture content of the snow recorded as inches of water. The accumulated moisture content of the snow pack is not available as potential recharge to the aquifer/springs until the snow melts and releases the liquid water. To evaluate how the timing of potential recharge corresponds to changes in spring discharge the data were processed to calculate cumulative recharge as the snow pack melts.

Figure 6 is a compilation of total annual precipitation (blue circles), cumulative annual snow (as SWE; grey circles) and total annual potential recharge (purple line). The timing and amount of total annual potential recharge was calculated as the daily decline in SWE (representing melting snow) plus the daily precipitation occurring as rainfall. The resulting value is the amount of liquid water added to the system and is termed potential recharge (rather than actual recharge) because some water may run off as overland flow, evaporate, or be lost through other processes. The maximum potential recharge occurs each year during the spring snowmelt, generally between April and June, resulting in the maximum spring flow during the same period.

[3] https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=1168

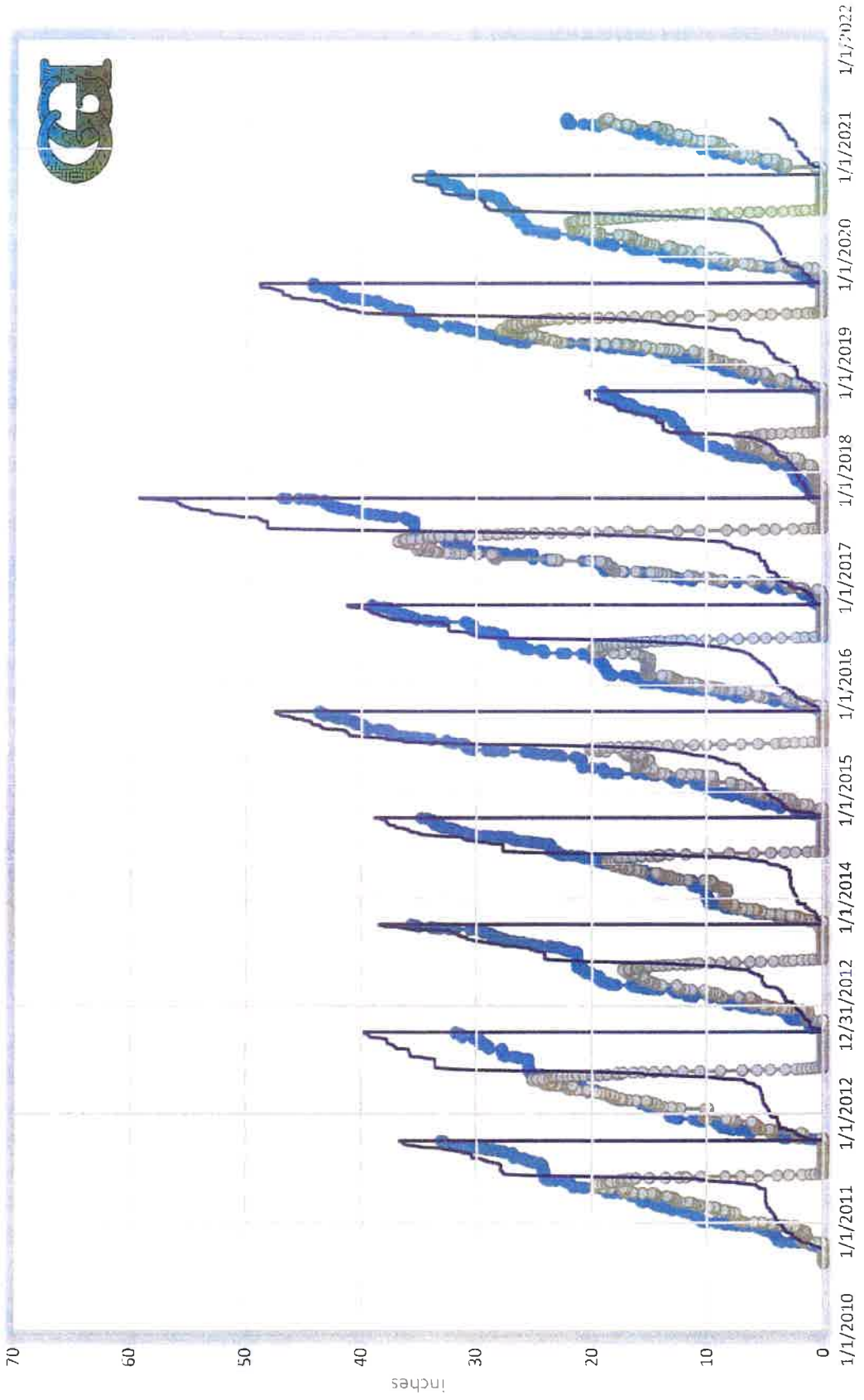


Figure 6. Precipitation, Snow Water Equivalent (SWE) and Cumulative Potential Recharge from the Powderhorn SNOTEL site for the period of record.

7 RECHARGE AND SPRING FLOWS

Figure 7 includes graphs allowing a visual comparison of total annual potential recharge to mean monthly spring flow (February and March combined [top] and just March [bottom]) for 2014 through 2021. Graphs on the left are for the one-year prior recharge and graphs on the right are the cumulative recharge for the previous three years. Note that the potential recharge covers the period from April 1 of the prior year to March 31 of the year in which the spring flows are reported[4]. Similar graphs were created using the prior two and four years of cumulative potential recharge, but the one- and three-year totals provided the closest visual match. As can be seen on Figure 7, there is general agreement between potential recharge and spring flows, with wetter years (greater total potential recharge) corresponding to higher spring discharge. The exceptions to this general correspondence are:

1) 2018, when the high potential recharge, representing primarily melting of the large 2017 snow pack, did not result in a corresponding increase in spring flows
2) 2019, when the extremely low potential recharge, resulting from the historically low snowpack in 2018, did not result in drop in spring flow of a corresponding magnitude, although there was a decline in flow.

While the visual comparison of potential recharge to spring flow suggests a direct relationship between the two, scatter plots of potential recharge vs. spring flow (March and Feb-March combined) show a relatively weak correlation (r^2 ranging between 0.23 and 0.37, depending on the date ranges being compared). There is a slightly better correlation between the three-year cumulative potential recharge and spring flow than the single-year potential recharge and spring flow (Figure 8).

There is clearly a causal relationship between recharge from snowmelt and monsoonal precipitation and spring flow that can be assessed qualitatively with existing data. Spring flows increase as a direct result of snowmelt and large rainfall events (see Appendix B). Although the relationship between SWE from the preceding one to three years' snowpack and Phoenix spring flows cannot be quantified using the existing eight years of spring flow records, continued collection of spring and SNOTEL flow data should allow the relationship between potential recharge and spring flow to be better refined/quantified during low flow periods. Installation of meters on all of the bypass lines shown on Figure 2 is necessary before a quantitative relationship can be established between recharge events and high spring flow rates.

7.1 PIEZOMETER DATA

In addition to the SNOTEL and Spring flow data described above, water level data are available for the period of September 2017 to September 2019 from five piezometers completed in the area above the Phoenix Springs Complex (Figure 9). Data from the piezometers show that the lowest water levels, which correlate with lowest spring flows, were observed in February through April, followed by a period of recharge/higher water levels in May through July and generally declining water levels thereafter (Figure 10). Strong summer or fall monsoonal precipitation events also provide transient recharge to the shallow aquifer and the Phoenix Springs Complex, with an approximately 2-week lag time between precipitation events and groundwater elevation rise/increased spring discharge (e.g. Sept-October 2017). This pattern is similar to displays of fast response to snowmelt and rainfall, followed by much slower, steady groundwater discharge observed in other alpine regions such as the European Alps, North American Cordillera, and Himalayas (Hayashi, 2020).

[4] For example, 2014 potential recharge is the total potential recharge from April 1, 2013 to March 31, 2014.

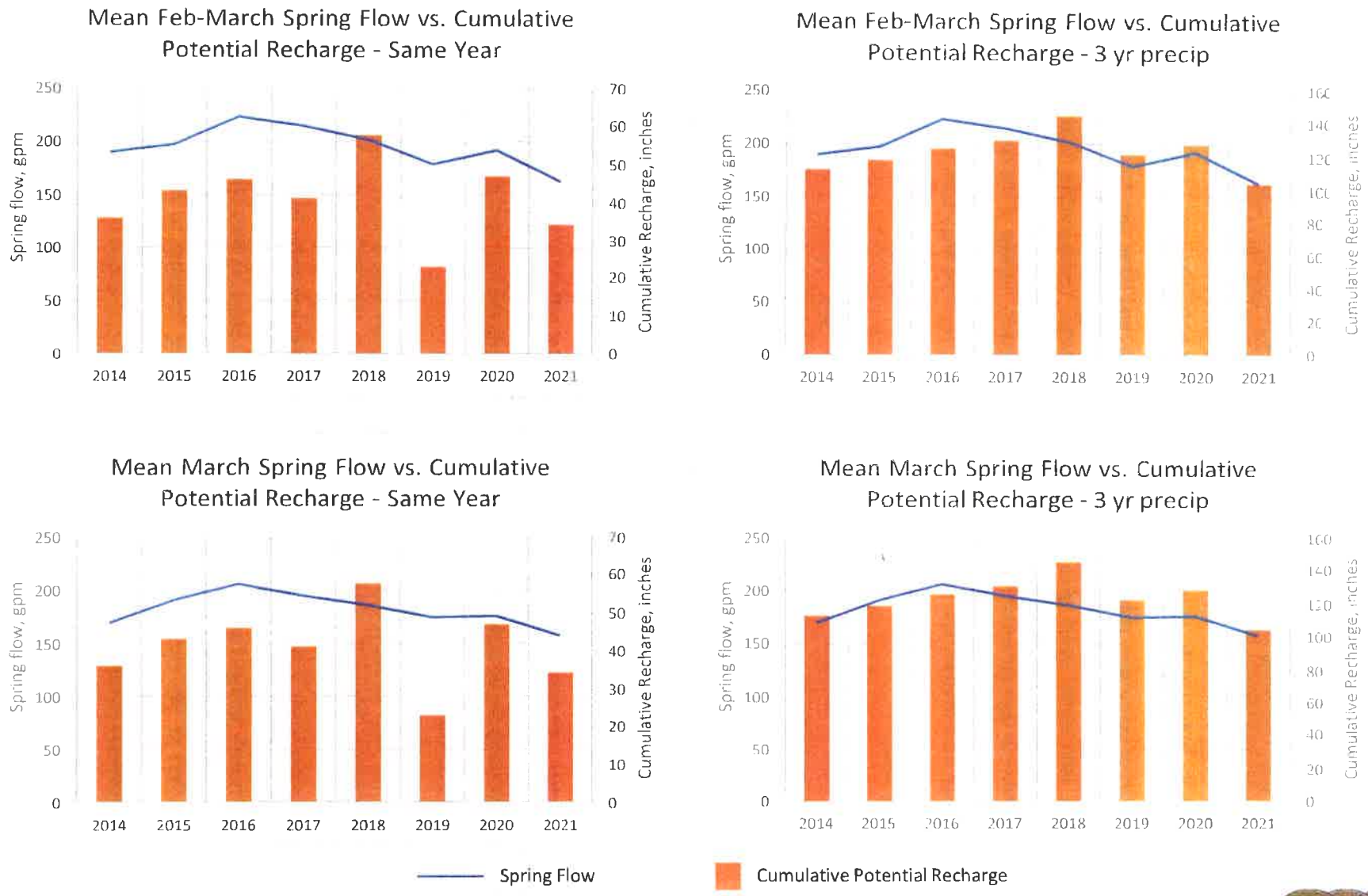
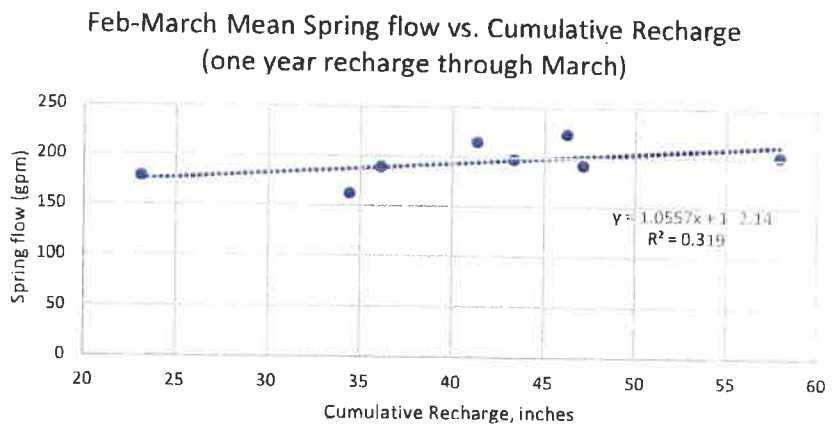
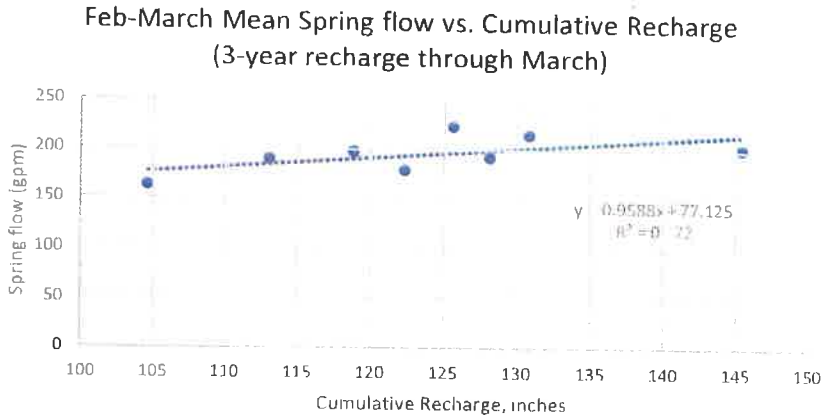
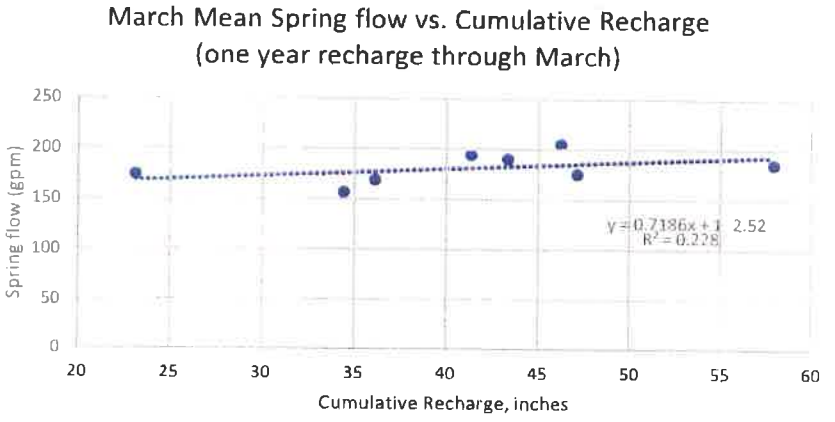


Figure 7. Annual cumulative potential recharge compared to Phoenix Spring flows for February and March combined (top) and March only (bottom), looking at same year potential recharge (left) and three-year cumulative potential recharge (right).







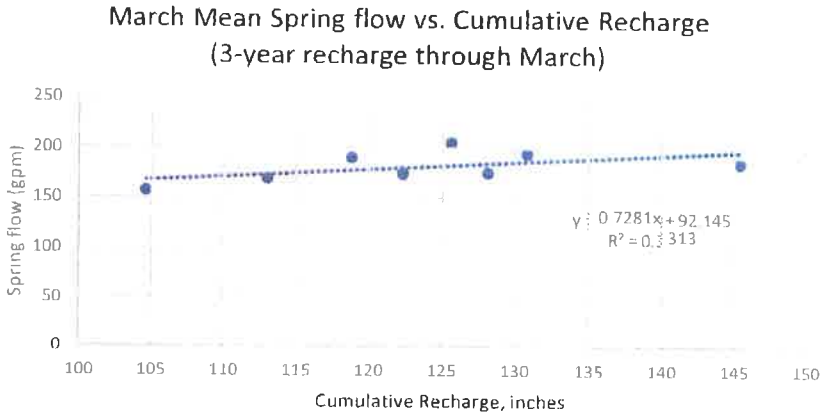


Figure 8. Annual cumulative potential recharge compared to Phoenix Spring flows for February and March combined (top) and March only (bottom), looking at same year potential recharge (left) and three-year cumulative potential recharge (right).

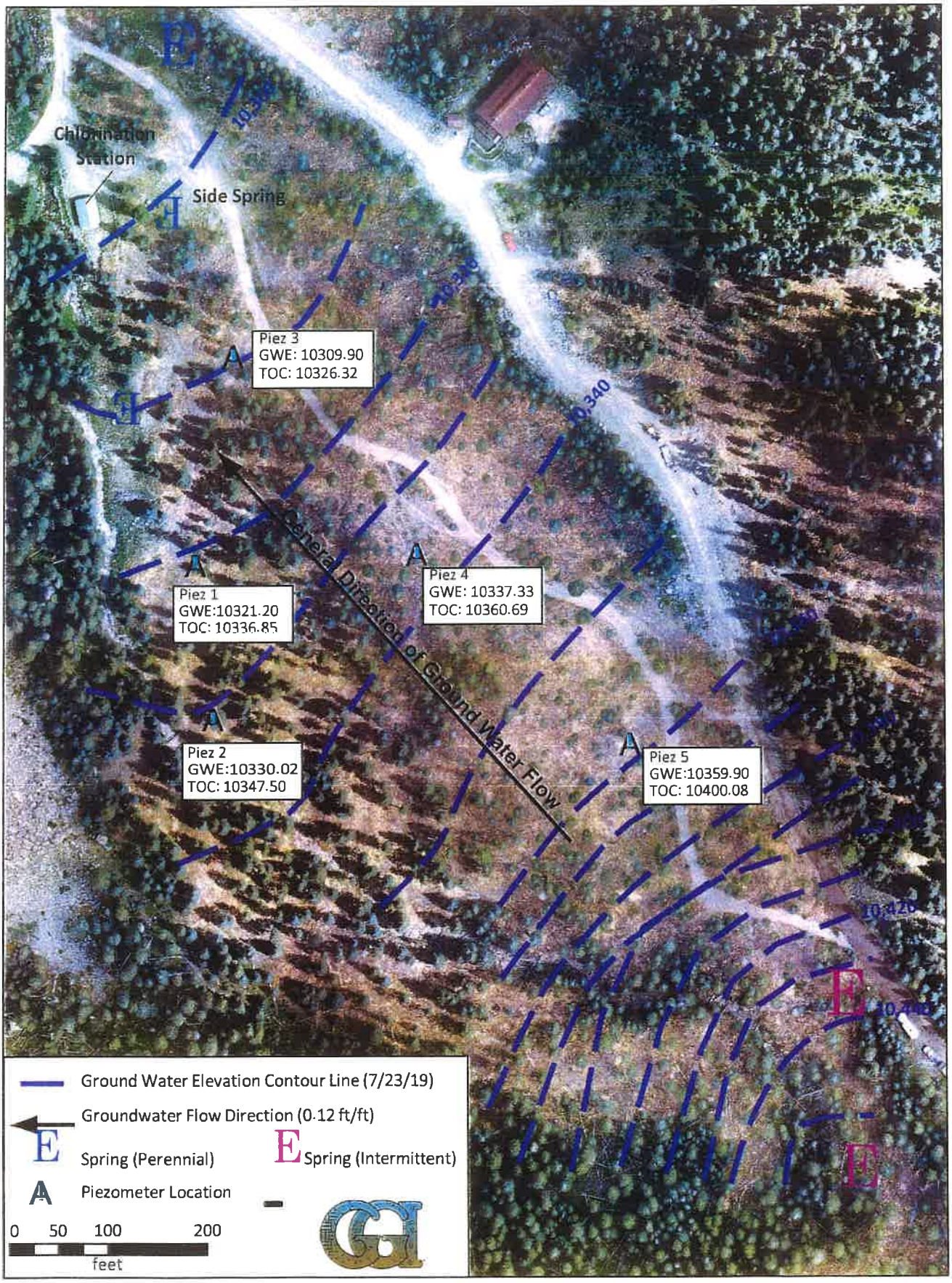


Figure 9. Piezometer locations showing groundwater flow direction measured on 7/23/2019

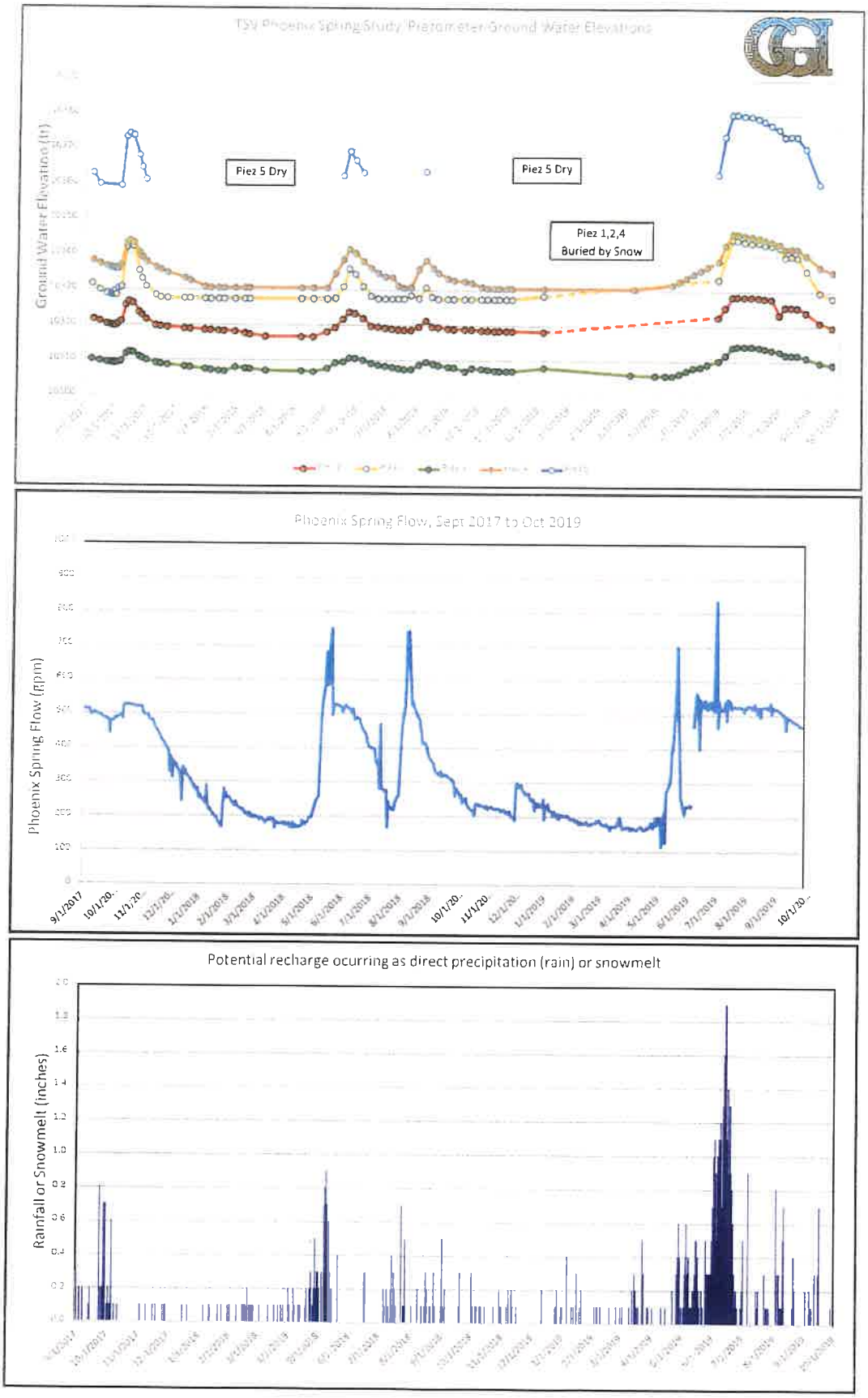


Figure 10. Piezometer water levels (top), Phoenix Springs Complex discharge (middle), and recharge data (bottom) from 9/1/17 to 9/30/19.

8 SPRING FLOW VS. RIO HONDO FLOW

8.1 MONTHLY AVERAGE FLOWS (LOW FLOW PERIODS)

The USGS maintains a gage on the Rio Hondo near Valdez (USGS Site No. 08267500 - Rio Hondo Near Valdez, NM) that has a continuous period of record from 1934 to present. Over the period of record, Hondo flows are lowest, averaging 11 cfs (equivalent to approximately 4,900 gpm or 7.1 MGD), in January and February (Table 2).

Table 2. Mean monthly flows for USGS Site No. 08267500 (Rio Hondo Near Valdez, NM) for the period of record from 1934 to 2001

Month	Mean cfs/MGD	Month	Mean cfs/MGD	Month	Mean cfs/MGD
January	11 / 7.1	May	92 / 59.5	September	21 / 13.6
February	11 / 7.1	June	107 / 69.2	October	18 / 11.6
March	14 / 9.0	July	45 / 29.1	November	14 / 9.1
April	33 / 21.3	August	28 / 18.1	December	12 / 7.8

During the low flow months, the base flow in the Rio Hondo is sustained by groundwater discharge, with little or no snowmelt or direct precipitation runoff contributing significantly to overall flow. The same factors influencing groundwater discharge at the Phoenix Springs Complex (previous years' snowpack, monsoonal precipitation, antecedent soil moisture conditions, etc.) would also influence groundwater-controlled base flow in the Rio Hondo. A comparison of annual low flow (March) from the Phoenix Springs Complex to February low flow in the Rio Hondo shows that there is a moderate correlation (r^2=0.675) between these flows (Figure 11). This relationship suggests that in years when the Rio Hondo flows are relatively low, the Phoenix Springs Complex flows will also be relatively low. This relationship can be utilized to allow historic spring flows to be estimated from the much longer Rio Hondo gage period of record.

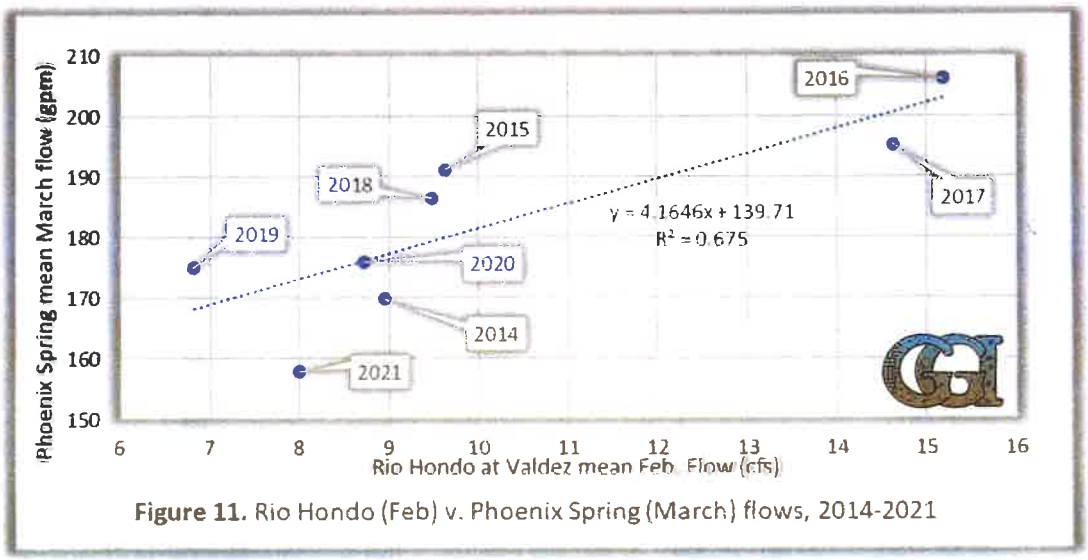


Figure 11. Rio Hondo (Feb) v. Phoenix Spring (March) flows, 2014-2021

Using the relationship shown in Figure 11, spring flows were estimated for the period 1934 to 2013 (Figure 12). In addition to the calculated spring flow value, Figure 12 also shows a range of calculated values representing 2 standard deviations from the trend line shown in Figure 11. These values were calculated by detrending the data shown on Figure 10 and determining the standard deviation of that data variation (std. dev. = 8.8). Therefore, the values shown on Figure 12 as two standard deviations represent the calculated spring flow plus or minus 17.7 gpm, and this range encompasses all of the variability seen in the available data.

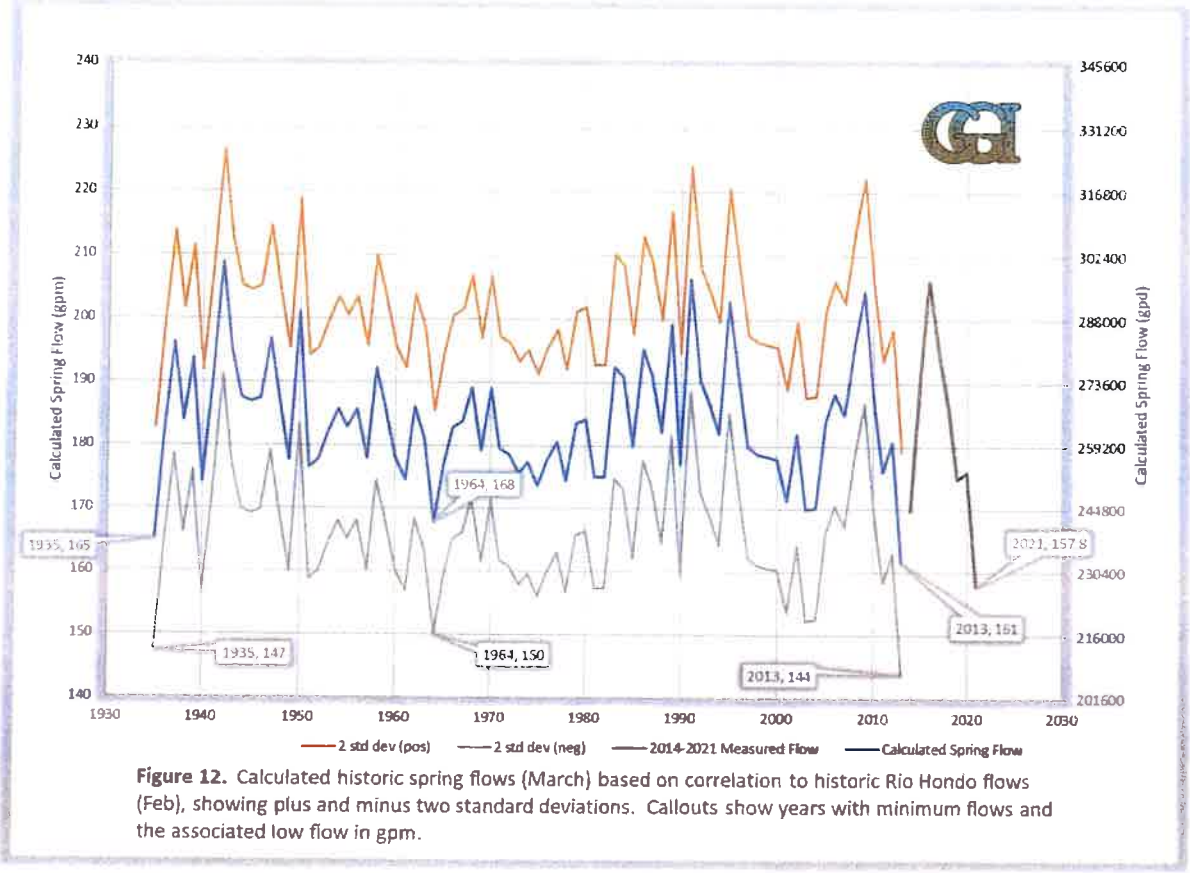


Figure 12. Calculated historic spring flows (March) based on correlation to historic Rio Hondo flows (Feb), showing plus and minus two standard deviations. Callouts show years with minimum flows and the associated low flow in gpm.

8.2 5-DAY AVERAGE FLOWS (LOW FLOW PERIODS)

While the calculated monthly flows are useful, understanding minimal flows that may be expected over a shorter duration is also critical for planning purposes. Figure 13 is a comparison of the lowest 5-day average spring flow to the mean monthly spring flow from 2014 to 2021. There is a good correlation (r^2=0.84) between the mean monthly flow and the 5-day minimum flow for a given year. Using the relationship between mean monthly flow and 5-day minimum flow shown on Figure 13, the 5-day minimum flow that would be associated with the calculated historic low flow values can be approximated. Table 3 provides estimates of the lowest 5-day average flow values that would have been expected in the three calculated lowest flow years of 1935, 1964, and 2013 for both the calculated monthly flow value and the calculated value minus two standard deviations.

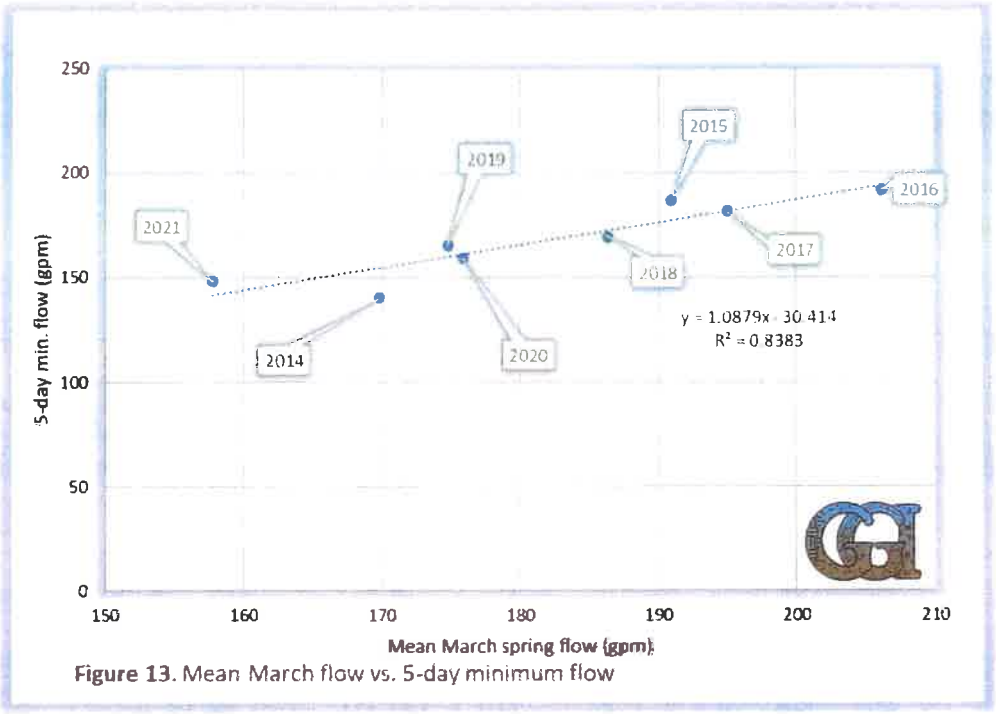


Figure 13. Mean March flow vs. 5-day minimum flow

Table 3. Five-day average spring flow estimated from monthly average flows in low-flow years

Year	Calculated Phocnix Monthly flow (gpm/gpd)	Calculated Phoenix 5-day average flow (gpm/gpd)	Calculated Phoenix Monthly flow minus 2 Std. Dev. (gpm/gpd)	Calculated Phoenix 5-day average flow (gpm/gpd) from 2 Std. Dev. Calc.
1935	165 / 237,600	149 / 214,600	147 / 211,700	130 / 187,200
1964	168 / 241,900	152 / 218,900	150 / 216,000	133 / 191,500
2013	161 / 231,840	145 / 208,800	144 / 207,400	126 / 181,400

The lowest estimated monthly average flow projection projected from the historic data is approximately 144 gpm (207,400 gpd) in March, 2013.

The lowest estimated 5-day average flow projected from the historic data is approximately 126 gpm (181,440 gpd) in 2013.

9 CLIMATE FORECAST

The State of New Mexico is in the process of preparing a 50-year water plan to assess projected effects of climate change on water availability. GGI, on behalf on TSVI, is an active participant in the State of New Mexico's 50 Year Water Planning efforts, especially on climate-change related issues. We participate in the Climate and Water Science Advisory Team meetings and webinars and provide input into the State's

Water Resiliency Assessment forum. These studies by our in-State subject matter experts represent the cutting-edge status of climate change research available in New Mexico.

The 50-year water plan is scheduled for completion in April, 2022. A draft report was released for public comment on September 16, 2021. GGI reviewed the public comment draft, and a summary is provided in Appendix D. Interim conclusions of the plan, presented on July 21, 2021 include:

1. In the last 20 years there are only 5 years where NM has not been in drought conditions
2. As of July, 2021, NM was in the deepest drought in the last 20 years
3. In the last 4 decades, temperatures have risen and precipitation has remained about the same State-wide
4. It will get warmer in NM as CO_2 concentrations in the atmosphere increase
5. There will be decreased snowpack but more winter precipitation in the Northern Mountains
6. Snowpack and streamflow will decrease
7. Snow will melt earlier and there will be less runoff

Along with a summary of the climate studies, and potential water supply impacts, Appendix D includes recommendations to both TSVI and VTSV to increase water efficiency, water supply, and reduce carbon footprints. These recommendations included continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses, continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

It remains to be seen how accurate these predictions will be and, assuming they are accurate, how these predicted changes will impact Phoenix Springs Complex flows. While the total snow pack is predicted to be less, the total amount of precipitation is not expected to change. Exactly how the change in the form of winter precipitation (rain vs. snow) will impact Phoenix Springs Complex flows is uncertain. The predicted transition to earlier runoff could result in higher flows from the Phoenix Springs Complex during the high demand period in March. However, planning for lowest predicted flows based on the historic record is prudent, given the predictions of decreased snowpack and stream flows resulting from climate change.

9.1 Estimated Reductions in Minimum Flows Arising from Climate Change Effects

To accommodate potential future reductions in flow arising from climate change, the projected minimum monthly and 5-day average flows presented in Section 8 above have been further adjusted to include a 0.5% annual decline in flows, as summarized in Table 4. The starting values used in the projections of flow reduction for the Phoenix Springs represent an initially conservative value that includes a two standard deviation variation from the minimum projected flow. The added 0.5% per year reduction in projected flows adds an additional layer of conservatism into the Phoenix Springs Complex flow projections for use in future growth planning.

Table 4 also includes flow reductions at the Gunsite Spring projected as a decrease of 0.5% per year as a result of climate change. The starting value for the Gunsite Spring projections is the low flow of 30 gpm observed in late March and early April, 2021. Because there are limited data (less than one year) available from Gunsite Spring, it is not possible to calculate a standard deviation for flow values measured over a longer period of record. However, average Phoenix spring flows measured in March 2021 were the lowest measured over the period of record, and it is reasonable to assume that the lowest 2021 flow values measured at the Gunsite spring are also on the low end of expected flow. Applying a 0.5% per year reduction to the 2021 measured values gives a reasonable approximation of

expected low flow values adjusted for climate change. Continued monitoring of flows at Gunsite Spring is required if a better estimate of the expected variability of Gunsite Spring flows is desired for planning purposes.

Table 4. Spring flows projected for 25 years assuming 0.5% per year decrease in flows

	Phoenix Springs Complex				Gunsite Spring	
	GPM		GPD		GPM	GPD
Year	Monthly Ave.	5-Day Ave.	Monthly Ave.	5-Day Ave.		
2022	143.3	125.4	206,323	180,533	29.9	42,984
2027	139.7	122.3	201,216	176,064	29.1	41,920
2032	136.3	119.2	196,236	171,707	28.4	40,883
2037	132.9	116.3	191,379	167,457	27.7	39,871
2042	129.6	113.4	186,642	163,312	27.0	38,884
2047	126.4	110.6	182,023	159,270	26.3	37,921

The lowest estimated monthly average flow projection for the Phoenix Springs Complex, projected to the year 2047 from the historic data and incorporating a 0.5% annual decline in flow arising from climate change effects, is approximately 126 gpm (182,000 gpd).

The lowest estimated 5-day average flow projection for Phoenix Springs Complex, projected to the year 2047 from the historic data and incorporating a 0.5% annual decline in flow arising from climate change effects, is approximately 111 gpm (159,000 gpd).

10 VTSV Water Rights

A summary of VTSV's water rights is provided in Table 5. The diversion amount shown in Table 5 includes return flow credit from the VTSV wastewater treatment plant. Potential treated wastewater reuse will need to be evaluated in the context of the return flow credit currently built in to the Village's water rights.

Table 5. VTSV Water Rights Summary

Permit No.	Date of Approval	Div. AFY	C.U. AFY	Purpose of Use, Notes	Priority Date	OSE Filings
0444-A	March 2002	178.2	8.91 afy	Domestic & sanitary	1808	COO Pattison Trust to VTSV filed March 2004
0444-AA	June 1992	40	2.0 afy	Domestic, residential, municipal, commercial, snowmaking*	1808	COO Twining Water to VTSV filed April 2015
3751 (San Juan Chama)	January 1978	200 Nov 1- Apr 11	15 afy - SJC carriage loss		1978	COO Twining Water to VTSV filed April 2015

**If entire SJC water right is diverted for snowmaking, 41.67 AFY can be diverted (not counting carriage loss).*

11 SUMMARY

- The Phoenix Springs Complex consists of three springs: Phoenix Spring, Schreiber Spring, and Side Spring.
- Previous studies of the Phoenix Spring / Upper Lake Fork drainage have determined that:
  - Phoenix spring discharges at a bedrock constriction, which reduces cross sectional area of aquifer in glacial deposits
  - Winter precipitation contributes ~55-88% of recharge to springs in the Lake Fork basin, with the balance coming from (primarily monsoon) rainfall
  - Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)
  - The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) from Phoenix Spring to the East Fork confluence during low flow conditions
- Phoenix Springs Complex flow data are available from February 2014 to present. Over this period the lowest average monthly flows typically occur in March when demand is historically highest.
  - The lowest recorded monthly average flow was 157.8 gpm (227,200 gpd) in March, 2021
  - The lowest recorded 5-day average flow was 139.9 gpm (201,500 gpd) from April 11 to April 15, 2014
- The Gunsite Spring is a second permitted point of diversion for VTSV, but it is not currently utilized as a municipal water source and lacks infrastructure
- Gunsite spring flow has been measured on a weekly basis beginning in late February, 2021. The flow during this period of measurement has ranged from a minimum of 30 gpm in late March and early April to a maximum of 300 gpm as of August 19, 2021.
- Uncertainties associated with the available data include:
  - Lack of data on when the Side Spring and Schreiber Spring were bypassing the chlorination station
  - Incomplete meter records from 2020
  - Relatively short period of spring flow records (8 years)
- Despite the limitations on the available data, there is sufficient information available to make reasonable and conservative estimates of anticipated low flows for planning purposes
- Available metering data from the springs represent minimum values; it is possible that combined flow from the entire Phoenix Springs Complex was greater than what was recorded if some flows were being bypassed.
- Calibration testing of the meters demonstrates that it is not possible that spring flow was less than was recorded by the meters.
- Available data show that years with low spring flows correlate to years with low flow in the Rio Hondo.
- The relationship established between average flows in the Rio Hondo and average Phoenix Springs Complex flows was used to estimate spring flows from 1935 to 2013.
  - The lowest calculated monthly average spring flow was 161 gpm (231,800 gpd) in March, 2013
    - Subtracting two standard deviations, the lowest monthly average flow in March 2013 was calculated as 144 gpm (207,400 gpd).

    - The lowest 5-day average spring flow in March, extrapolated from historic Rio Hondo data, was approximately 145 gpm (208,800 gpd) in 2013.
        - Subtracting two standard deviations, the lowest 5-day average spring flow in March 2013 was calculated as approximately 126 gpm (181,400 gpd).
- Preliminary results of climate studies and water supply forecasts being undertaken by the State of New Mexico indicate that future snowpack will be less, but total winter precipitation will not change significantly.
    - It is uncertain how the reduction in snow pack/increase in winter rainfall may impact Phoenix Spring flows, and it is possible that the predicted changes could result in higher spring flows in March
- Low-end (conservative) projections of future spring flow should be utilized for planning purposes to accommodate the uncertainties associated with climate change and gaps in the available data.
- To address the potential for reduced flows in March as a result of climate change impacts, projected flows were reduced by 0.5% per year. This results in projected (year 2047) low monthly average flow of 126 gpm (182,000 gpd) and a low 5-day average flow of 111 gpm (159,000 gpd).

12 RECOMMENDATIONS

1) Continue to carefully monitor (meter) Flows from the Phoenix Springs Complex
    a) The timing of when Schreiber Spring and the Side Spring are turned into and out of the chlorination station should be carefully documented to remove uncertainty from the metered flow values.
    b) Install meters on the bypass pipelines and record bypass flows to allow for a full accounting of all spring discharge, including high flows, that are not currently metered. This metering will allow for better correlation of snowpack (snow water equivalent) to spring flows and could provide a useful future planning tool to allow for early warning of upcoming periods of low spring discharge based on snow water equivalent.
2) Continue to monitor Gunsite Spring flows to establish a range of expected flow variability that can be used for future flow estimates.
3) **For planning purposes the following projected flows from Phoenix Spring should be utilized:**
    a) Low monthly average flow of approximately 126 gpm (182,000 gpd)
    b) Low 5-day average flow of 111 gpm (159,000 gpd)
4) Continue monitoring Gunsite Spring flows to better constrain the range of flows that can be expected from this source.
5) Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate continued and improved data collection.
    a) The current projections include several assumptions to keep the estimates conservative for planning purposes. Continued collection and re-evaluation of the data will allow projected flow estimates to be adjusted up or down, as appropriate, to assist in ongoing planning efforts.
    b) Once Gunsite Spring flows are better understood, it may be advisable for VTSV to consider connecting Gunsite Spring to the municipal distribution system.
6) Implement policies and practices to reduce the impacts of climate change, including continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses,

continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

13 REFERENCES

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APPENDIX A. GEOLOGIC AND ISOTOPIC INVESTIGATION OF PHOENIX SPRING, TAOS SKI VALLEY, NM – INTERIM REPORT

GEOHYDROLOGIC AND ISOTOPIC INVESTIGATION OF PHOENIX SPRING, TAOS SKI VALLEY, NM

Interim Report

Prepared for Taos Ski Valley, Inc.

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Introduction

Glorieta Geoscience, Inc. (GGI) has initiated a hydrogeologic investigation of the Phoenix Spring area in the Village of Taos Ski Valley (VTSV), NM, on behalf of Taos Ski Valley, Inc. (TSV). This investigation was undertaken at the request of VTSV as part of an evaluation of a proposed 250,000 gallon water storage tank site proposed by TSV. The investigation conducted thus far has included collection of precipitation samples for tritium and stable isotope analysis, sampling of the Phoenix Spring, the Hillslope Spring, and Williams Lake for general chemistry and stable isotopes, drilling and installation of five piezometers, collection and analysis of geotechnical samples from two piezometers, and sampling of three piezometers for geochemical analysis. Sampling locations, piezometers, and the proposed tank site are shown on Figures 1 and 2. Following installation, piezometers were surveyed Redtail Survey and water levels were measured one to two times each week through September and October 2017. The frequency of water level measurements was reduced to weekly in November and December 2017, and January, 2018.

Hydrogeologic and Isotopic Characterization of Phoenix Springs

Hydrogeologic Setting

Phoenix Spring is situated in the Lake Fork valley, a north-to-northwest-trending glacial valley draining the Williams Lake basin (Figure 1). The Lake Fork valley is underlain by glacial deposits including rock glacier and thick valley bottom till (Lipman and Reid, 1989; Figure 3). Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss (Figure 3). The Lake Fork above Phoenix spring is an intermittent stream that flows during spring runoff in response to discharge from South Fork Lake Fork and East Fork Lake Fork springs (Figure 2a and 2b). These springs both discharge at a rate of several cubic feet per second (cfs) during peak spring runoff, but are typically dry by August of each year.

Drilling Program

Five piezometers (Piez 1 – 5) were drilled and completed by Geomechanics, Southwest at the direction of GGI, using a CME-75 HD drill rig equipped with a 6" Tubex casing advance (rotary percussion) system. This method was selected to drill through coarse, unconsolidated glacial deposits comprising sandy pebble-to-cobble gravel that underlie the site. The piezometers were drilled under New Mexico Office of the State Engineer (OSE) Permit RG-96901 POD1 through POD6. The OSE permits were issued August 29, 2017, and drilling commenced September 6, 2017. Proposed piezometer locations were reviewed by VTSV staff prior to drilling. Two locations were modified in response to a request made by VTSV during a site visit at the start of drilling on September 6, 2017. VTSV requested that the locations of the closest piezometers be moved further from the infiltration galley. In response to this request Piez 3 was moved and original Piez 4 (RG-96901 POD3) was eliminated. One location (Piez 1) was subsequently moved closer to the infiltration gallery due to rig access issues with approval from VTSV staff on September 8, 2017.

Piezometers were installed to total depths (TD) ranging from 18 to 45 ft below ground surface (bgs). Piezometers 1, 2, and 3 were completed with 5 ft of screen and a bottom cap, and piezometers 4 and 5 were completed with 10 ft of screen and bottom caps (Table 1; Appendix A). The annular space was filled with pea gravel from TD to a minimum of 5 ft above the top of the screened interval, and the

annular space above the pea gravel was sealed with bentonite grout (hydrated pellets) (Table 1; Appendix A). Where the bentonite seal did not reach the ground surface (Piez 1, 3, and 5) the remaining annular space was sealed with neat cement during the surface completion (Table 1; Appendix A). The surface completion consisted of a 1 ft x 1 ft concrete pad and locking steel shroud.

Table 1. Piezometer completion information, Phoenix Spring Investigation

Well	TD (Ft)	Diameter (in.)	Screened Interval (Ft)*	Gravel Pack (Ft)	Bentonite (Ft)	Casing Stick-up (Ft)	Initial DTW BGS (Ft)	DTW Date
Piez 1	18.6	2.0	13.2-18.2	8.0-18.6	0.5-8	1.6	13.50	9/8/2017
Piez 2	18.0	2.0	13.0-18.0	6.5-18.0	0.0-6.5	1.8	13.93	9/6/2017
Piez 3	19.7	2.0	14.7-19.7	6.5-18.0	0.0-8.0	2.0	14.02	9/6/2017
Piez 4	28.4	2.0	18.0-28.0	8.0-28.4	1.0-8.0	1.8	20.60	9/7/2008
Piez 5	45.0	2.0	29.8-39.8	10.0-45.0	2.0-10.0	1.9	35.20	9/7/2008

* All piezometers completed with 0.010 slot screen

Lithology

All borings encountered coarse, sandy, poorly sorted pebble to boulder gravel consisting of amphibolite, granite, quartzite, vein quartz, and phyllite. Bedrock was not encountered in any of the borings. Lithologic logs and completion diagrams are presented in Appendix A. OSE well records are presented in Appendix B.

Geotechnical Sampling

Geotechnical samples were collected during drilling Piez 1 and Piez 4 from 0-18 in., 5 - 6.5 ft, and 10 - 11.5 ft. Blow counts and lithologic characteristics were recorded, and samples were placed in zip lock plastic bags. Samples were submitted to Geo-Test, Inc., Santa Fe, NM for analysis of moisture content, grain size, and Atterberg limits tests. The geotechnical engineering report prepared by Geo-Test is included in Appendix C.

Water Level and Precipitation Monitoring

Water levels were measured upon completion of drilling, once each week for the next two weeks, and then two times each week for the next four weeks (until the end of October). Water levels have been measured once each week during November, December (2017) and January (2018). Precipitation has been measured manually using a rain gage installed near the base of Strawberry Hill at an elevation of approximately 9360 ft from July 27 through October 6, and precipitation data were downloaded from the Powderhorn Snotel site (https://wcc.sc.egov.usda.gov /nwcc/site?sitenum=1168), at an elevation of 11,057 ft, through January 14.

Precipitation Sampling

A precipitation sampler and rain gage were installed by GGI on July 27 at the Pit House, and moved to the west end of the boardwalk northeast of the Pit House at the base of Strawberry Hill on August 9, 2017 (Figure 1). Precipitation samples were collected from July 27 to October 6, 2017. Eleven samples

have been submitted to the University of Arizona Environmental Isotope Laboratory for oxygen ($\delta^{18}O$) and deuterium ($\delta^{2}H$) analyses, and two of the samples will analyzed for tritium (^{3}H) (Table 2). These samples will be added to a data set previously compiled for snow samples collected from the Lake Fork and Williams Lake basin, and used to construct a Local Meteoric Water Line (LMWL).

Table 2. Summary of Precipitation, Spring, and Surface Water Samples

Date	Time	Sample Site	Sample Name	Analytes
7/31/2017	7:40	TSV Pit House	Precip07312017	^{18}O, ^{2}H
8/7/2017	7:30	TSV Pit House	Precip08072017	^{18}O, ^{2}H
8/15/2017	7:00	TSV Pit House	Precip08152017	^{18}O, ^{2}H
8/24/2017	16:45	TSV Pit House	Precip08242017	^{18}O, ^{2}H, ^{3}H
8/28/2017	7:30	TSV Pit House	Precip08282017	^{18}O, ^{2}H
9/7/2017	7:00	TSV Pit House	Precip09072017	^{18}O, ^{2}H
9/15/2017	8:20	TSV Pit House	Precip09152017	^{18}O, ^{2}H
9/25/2017	7:40	TSV Pit House	Precip09252017	^{18}O, ^{2}H
9/28/2017	7:00	TSV Pit House	Precip09282017	^{18}O, ^{2}H, ^{3}H
10/4/2017	7:00	TSV Pit House	Precip10042017	^{18}O, ^{2}H
10/6/2017	7:00	TSV Pit House	Precip10062017	^{18}O, ^{2}H
10/17/2017	13:15	TSV Phoenix	Piez 4	^{18}O, ^{2}H, cation - anion balance
10/17/2017	15:30	TSV Phoenix	Piez 3	^{18}O, ^{2}H, cation - anion balance
10/17/2017	16:20	TSV Phoenix	Piez 1	^{18}O, ^{2}H, ^{3}H, cation - anion balance
10/26/2016	16:40	TSV	Phoenix Spring	^{18}O, ^{2}H, ^{3}H
11/3/2017	17:20	TSV	Hill Slope Spr	^{18}O, ^{2}H, cation - anion balance
11/3/2017	18:01	Williams Lk	Williams Lk	^{18}O, ^{2}H, cation - anion balance

Groundwater and Surface Water Sampling

Piezometers 1, 3, and 4 were purged and sampled on October 17, 2017. The informally named Simpson Spring (also known as "Hill Slope Spring") and Williams Lake were sampled on November 3, 2017. Samples were submitted to Hall Environmental Analysis Laboratory (HEAL) for cation-anion balance and to U of A for isotope geochemistry analyses (Table 2). A sample was collected from the Phoenix Spring overflow on October 26, 2016, and this sample was also submitted for isotope geochemistry analyses. In addition, Phoenix, Blue Jay Ridge, Fraser, Gunsight, East Fork Lake Fork, South Fork Lake Fork, and Side Spring were sampled in June, 2014 as part of an earlier investigation (Drakos and Tafoya, 2016). These data will be included with isotopic and general geochemistry results from the current investigation.

Preliminary Results

Water Level Trends

The shallow aquifer in the vicinity of Phoenix Spring is unconfined. Water levels did not rise above the level at which they were encountered during drilling, except in response to recharge events. The aquifer matrix comprises unconsolidated, poorly sorted coarse sandy gravels that represent Pleistocene glacial deposits.

Water level and precipitation data are shown in Figure 4 (plot of groundwater elevation and precipitation-versus time) and Figure 5 (plot of depth to water and precipitation-versus time). These data show an approximately two-week lag between summer monsoonal precipitation and shallow groundwater recharge. Water levels show a generally declining trend from September 8 through 30, then groundwater recharge (e.g. rise in water levels) was observed October 6 through 20 following a series of 0.5 inch or greater precipitation events from September 22 through October 6. These recharge events were observed as a water level rise ranging from 3 feet (Piez 3) to 16 ft (Piez 2), with a 7 to 8 ft water level rise in Piez 1 and 4. Water levels show a declining trend from October 13, 2018 through January 12, 2018 with the lowest groundwater elevations measured in January for Piez 1 – Piez 4; Piez 5 was unable to be measured as it has been dry since November, 2017.

Water levels fluctuated between 8 and 16 ft bgs in Piez 1, 12 and 17 bgs in Piez 3, 15 and 28 ft bgs in Piez 4, and 24 and >38 ft bgs in Piez 5 (Figure 5). Depth to water in Piez 2, the piezometer located closest to the Lake Fork (20 ft from the stream bank), fluctuated between 2 and 18 ft bgs with the shallowest water levels recorded when the Lake Fork was flowing from October 10-17. The large recharge event observed in Piez 2 is tied to flow in the Lake Fork, whereas recharge to the other piezometers, while coincident with this event, appear to reflect areal recharge to the shallow groundwater system. This recharge may occur in the Williams Lake basin and/or throughout the Lake Fork basin.

Groundwater Flow Direction

Shallow groundwater flows from southeast to northwest, parallel to the trend of the Lake Fork valley in the site vicinity, at a gradient of 0.09 ft/ft (September 14, 2017) to 0.10 ft/ft (October 13, 2017; January 12, 2018) (Figures 2a, 2b and 2c). The gradient apparently steepens during recharge events as a result of the large water level rise observed in the southeastern most piezometer (Piez 5). This larger magnitude recharge in Piez 5 relative to Piez 1, 3, and 4 could be due to the presence of a buried channel at the Piez 5 location, a buried bedrock high in the vicinity of South Fork Lake Fork and East Fork Lake Fork springs that extends toward Piez 5, or recharge from the steep hillslope east of Piez 5.

Geotechnical Investigation

Based on an analysis of geotechnical samples collected by GGI, Geo-Test, Inc. recommended overexcavation of existing soils at the site throughout the area of a proposed 250,000 gallon, 43 ft diameter tank (Appendix C). This overexcavation will provide for at least 2.0 ft of properly compacted, structural fill below a reinforced concrete ring-wall footing (see Appendix C). Additional recommendations for site grading and moisture protection are provided in the Geo-Test, Inc. report in Appendix C.

GGI constructed a cross section through the tank site using water level data from Piezometers 4 and 1, projected onto the line of section (Figure 6). The elevation profile along the line of section was developed using 1-ft contours generated from LiDAR data. The tank location, 93 ft diameter area of disturbance and depth of the excavation were provided by Craig Taggert, Trinchera Ranch (personal communication, 2017). The cross section through the proposed tank site indicates that the highest water level observed during late summer and fall, 2017 (resulting from a 7 to 8 ft water level rise in Piez 1 and 4 following heavy late September/early October precipitation) would result in a water level 3.5 ft below the bottom of the deepest part of the tank excavation (Figure 6). Continued water level monitoring in late spring/summer 2018 will provide additional information on high water table conditions at the proposed tank site.

Excavation and placement of the tank will not affect the hydrogeology of the Phoenix Spring, even in the event that high water table conditions cause water to rise to the base of the proposed excavation. Boulders are present in the glacial deposits underlying the valley floor, and the tank would essentially act as another large boulder sitting at the surface of these deposits. Phoenix Spring discharge would not be affected.

Geochemistry

Analytical results for isotope geochemistry are pending. These results, along with general chemistry data, will be compiled in the final report following 2018 water level monitoring and used to evaluate relative contributions of summer and winter precipitation to Phoenix Spring discharge. Tritium data will be compiled to evaluate the timing of recharge to the shallow aquifer system and Phoenix Spring.

Phoenix Spring Discharge

A plot of Phoenix Spring discharge from September 1 through November 20 is shown in Figure 7. Data were provided by VTSV staff. The plot is "combined flow," which is the sum of flow into the Village system and flow that is diverted back into the Lake Fork and bypasses the chlorination station. Some additional flow bypasses the collection system, discharging at the spring north of the infiltration gallery (Figure 2). The total volume of flow from the spring north of the infiltration gallery and other seeps below is unknown, but may be in the range of 100 ± 50 gpm during September-November flow conditions. The total flow measured at the chlorination station recorded from September through November, 2017 peaked around October 6 through 20, and shows a two-week time lag following the series of late September precipitation events that is similar to the recharge event observed in the piezometers installed upgradient of the Phoenix spring.

Preliminary Conclusions

- The shallow aquifer in the vicinity of Phoenix Spring is unconfined. The aquifer matrix comprises unconsolidated, poorly sorted coarse sandy gravel that represent Pleistocene glacial deposits. Bedrock was not encountered in any of the borings; therefore, total thickness of glacial deposits is unknown.
- Shallow groundwater measured in piezometers installed south and upgradient of the Phoenix Spring ranged from less than 5 ft (in Piez 2 during the mid-October recharge event) to greater

than 38 ft (in Piez 5 during dry low precipitation periods) below ground surface during late summer-fall, 2017.

- An approximate two-week lag was observed between late summer monsoonal precipitation events and recharge to shallow piezometers (water level rise).
- A similar two-week lag was observed between late summer monsoonal precipitation events and an increase in discharge at Phoenix Spring.
- Water level rises ranging from 3 feet (Piez 3) to 16 ft (Piez 2) were observed in response to the late September/early October recharge event.
- Summer/fall monsoonal precipitation events appear to result in transient recharge events, which temporarily increases the discharge in downgradient springs and ultimately increases flows in the Lake Fork.
- An analysis of the proposed 250,000 gallon tank site indicates that the highest water level observed during the late summer and fall of 2017 would result in a water level 3.5 ft below the bottom of the deepest part of the proposed tank excavation. This relatively high water table condition was a result of a recharge event causing a water level rise of 7 to 8 feet in the vicinity of the proposed tank site.
- The proposed 250,000 gallon tank will not have an effect on Phoenix Spring discharge.
- Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss. The resulting decrease in cross sectional area of the alluvial aquifer underlying the site likely causes groundwater flowing northwest down the Lake Fork Valley to discharge at the land surface.

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Figures Follow Text

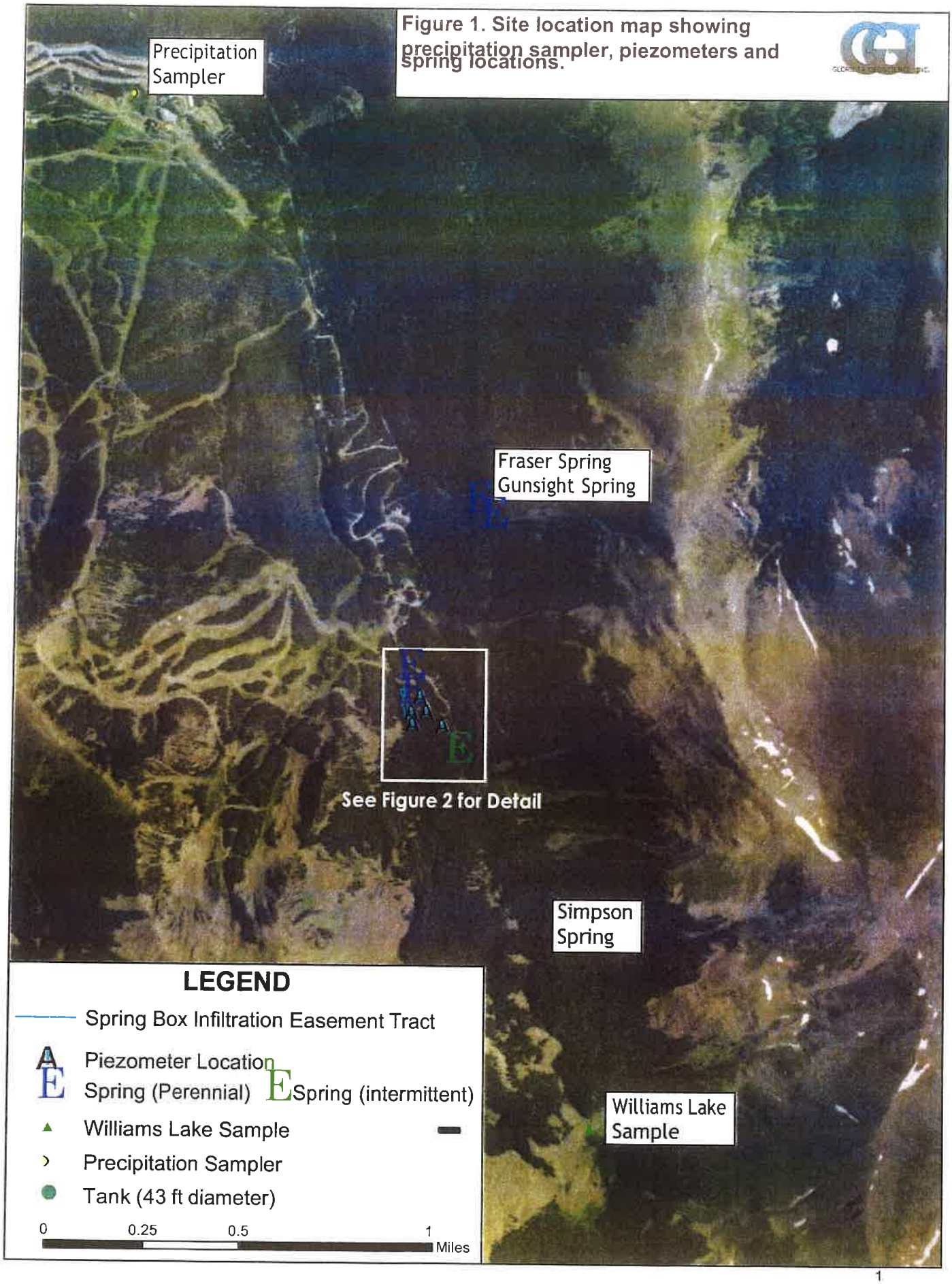


Figure 1. Site location map showing precipitation sampler, piezometers and spring locations.

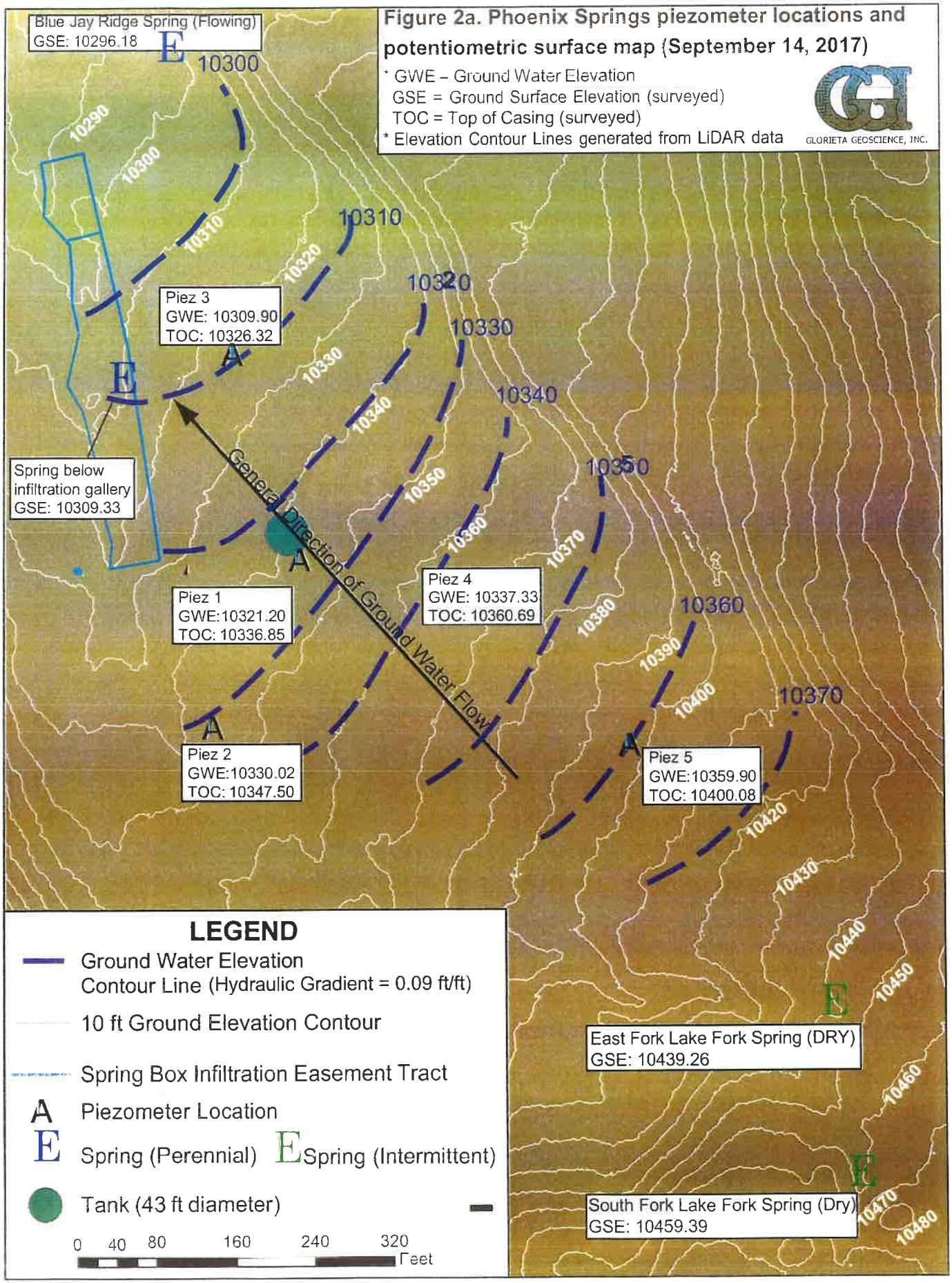


Figure 2a. Phoenix Springs piezometer locations and potentiometric surface map (September 14, 2017)
* GWE – Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data
GLORIETA GEOSCIENCE, INC.
Blue Jay Ridge Spring (Flowing)
GSE: 10296.18
Piez 3
GWE: 10309.90
TOC: 10326.32
Spring below infiltration gallery
GSE: 10309.33
Piez 1
GWE:10321.20
TOC: 10336.85
Piez 4
GWE: 10337.33
TOC: 10360.69
Piez 2
GWE:10330.02
TOC: 10347.50
Piez 5
GWE:10359.90
TOC: 10400.08
General Direction of Ground Water Flow
East Fork Lake Fork Spring (DRY)
GSE: 10439.26
South Fork Lake Fork Spring (Dry)
GSE: 10459.39
LEGEND
Ground Water Elevation Contour Line (Hydraulic Gradient = 0.09 ft/ft)
10 ft Ground Elevation Contour
Spring Box Infiltration Easement Tract
Piezometer Location
Spring (Perennial)
Spring (Intermittent)
Tank (43 ft diameter)
0 40 80 160 240 320
Feet

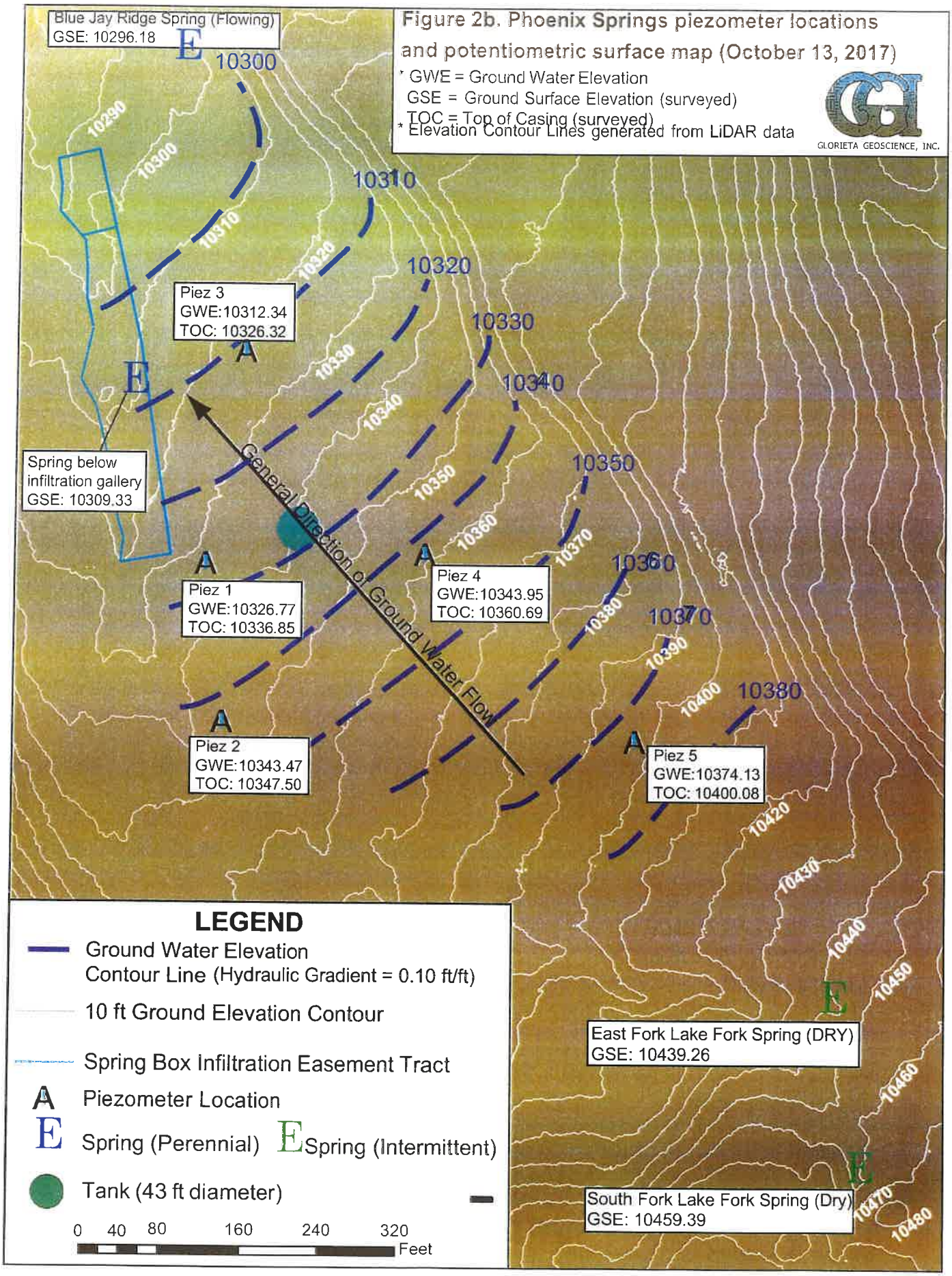


Figure 2b. Phoenix Springs piezometer locations and potentiometric surface map (October 13, 2017)
* GWE = Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data
GLORIETA GEOSCIENCE, INC.
Blue Jay Ridge Spring (Flowing)
GSE: 10296.18
Piez 3
GWE:10312.34
TOC: 10326.32
Spring below infiltration gallery
GSE: 10309.33
Piez 1
GWE:10326.77
TOC: 10336.85
Piez 2
GWE:10343.47
TOC: 10347.50
Piez 4
GWE:10343.95
TOC: 10360.69
Piez 5
GWE:10374.13
TOC: 10400.08
General Direction of Ground Water Flow
East Fork Lake Fork Spring (DRY)
GSE: 10439.26
South Fork Lake Fork Spring (Dry)
GSE: 10459.39
10290
10300
10310
10320
10330
10340
10350
10360
10370
10380
10390
10400
10420
10430
10440
10450
10460
10470
10480
LEGEND
Ground Water Elevation Contour Line (Hydraulic Gradient = 0.10 ft/ft)
10 ft Ground Elevation Contour
Spring Box Infiltration Easement Tract
Piezometer Location
Spring (Perennial)
Spring (Intermittent)
Tank (43 ft diameter)
0 40 80 160 240 320
Feet

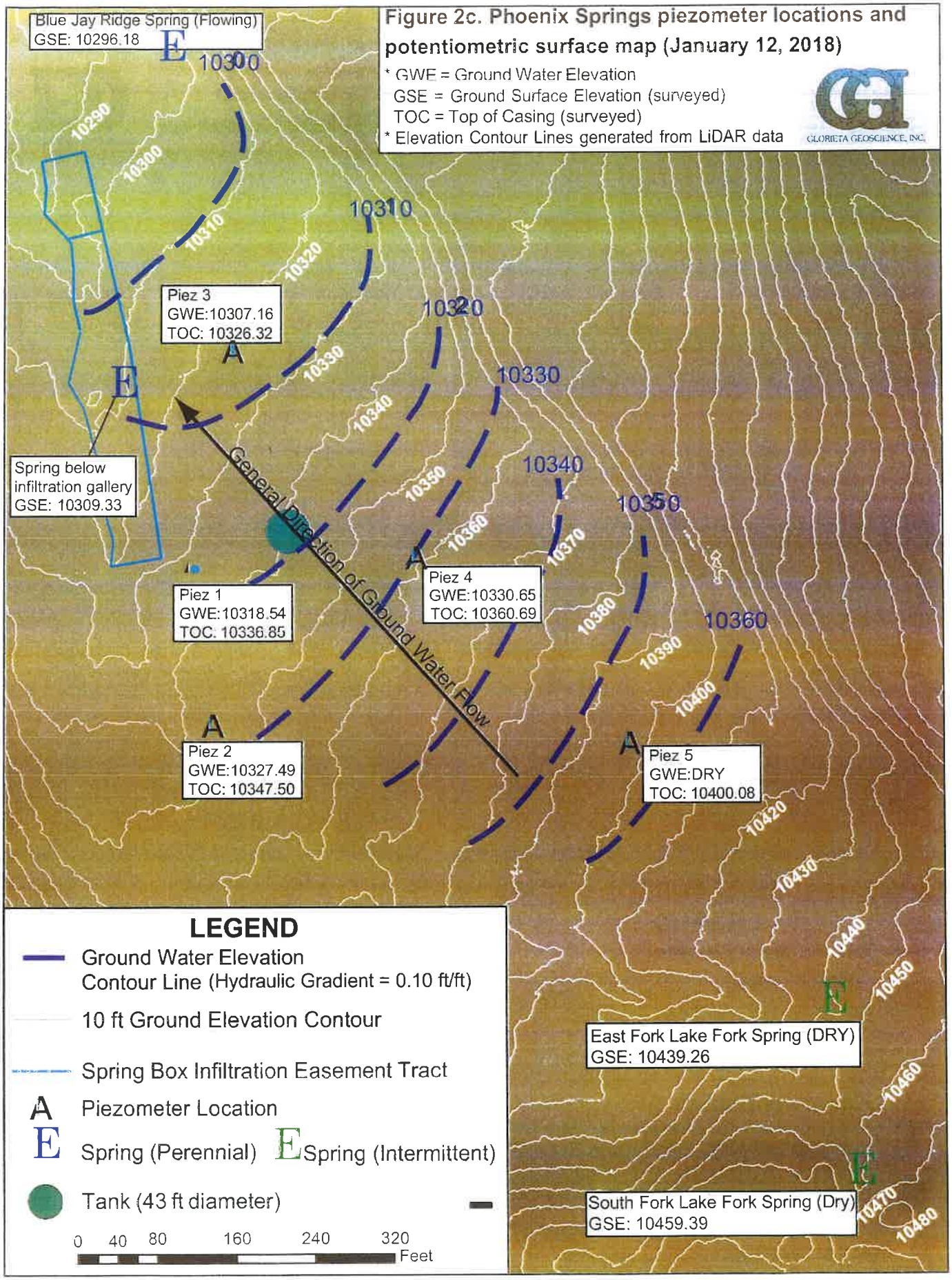


Figure 2c. Phoenix Springs piezometer locations and potentiometric surface map (January 12, 2018)
* GWE = Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data
GLORIETA GEOSCIENCE, INC.
Blue Jay Ridge Spring (Flowing)
GSE: 10296.18
Piez 3
GWE:10307.16
TOC: 10326.32
Spring below infiltration gallery
GSE: 10309.33
Piez 1
GWE:10318.54
TOC. 10336.85
Piez 4
GWE:10330.65
TOC: 10360.69
Piez 2
GWE:10327.49
TOC: 10347.50
Piez 5
GWE:DRY
TOC: 10400.08
General Direction of Ground Water Flow
East Fork Lake Fork Spring (DRY)
GSE: 10439.26
South Fork Lake Fork Spring (Dry)
GSE: 10459.39
LEGEND
Ground Water Elevation Contour Line (Hydraulic Gradient = 0.10 ft/ft)
10 ft Ground Elevation Contour
Spring Box Infiltration Easement Tract
Piezometer Location
Spring (Perennial)
Spring (Intermittent)
Tank (43 ft diameter)
0 40 80 160 240 320
Feet

Figure 3. Geolgoic Map of the Lake Fork Valley and Vicinity (geology from Lipman and Reed, 1989

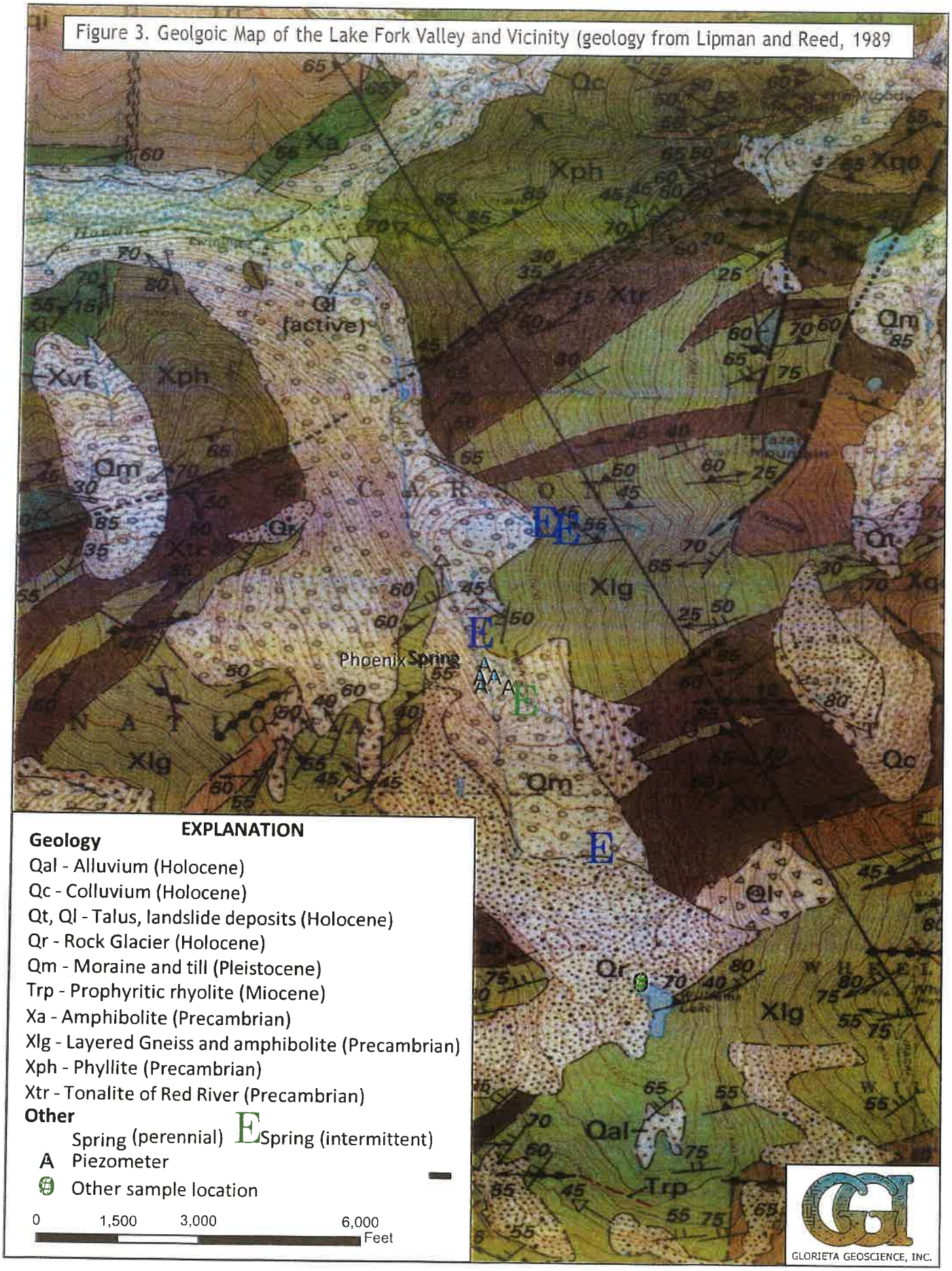


Figure 4. TSV Phoenix Spring Study, Piezometer Ground Water Elevations and Precipitation Data

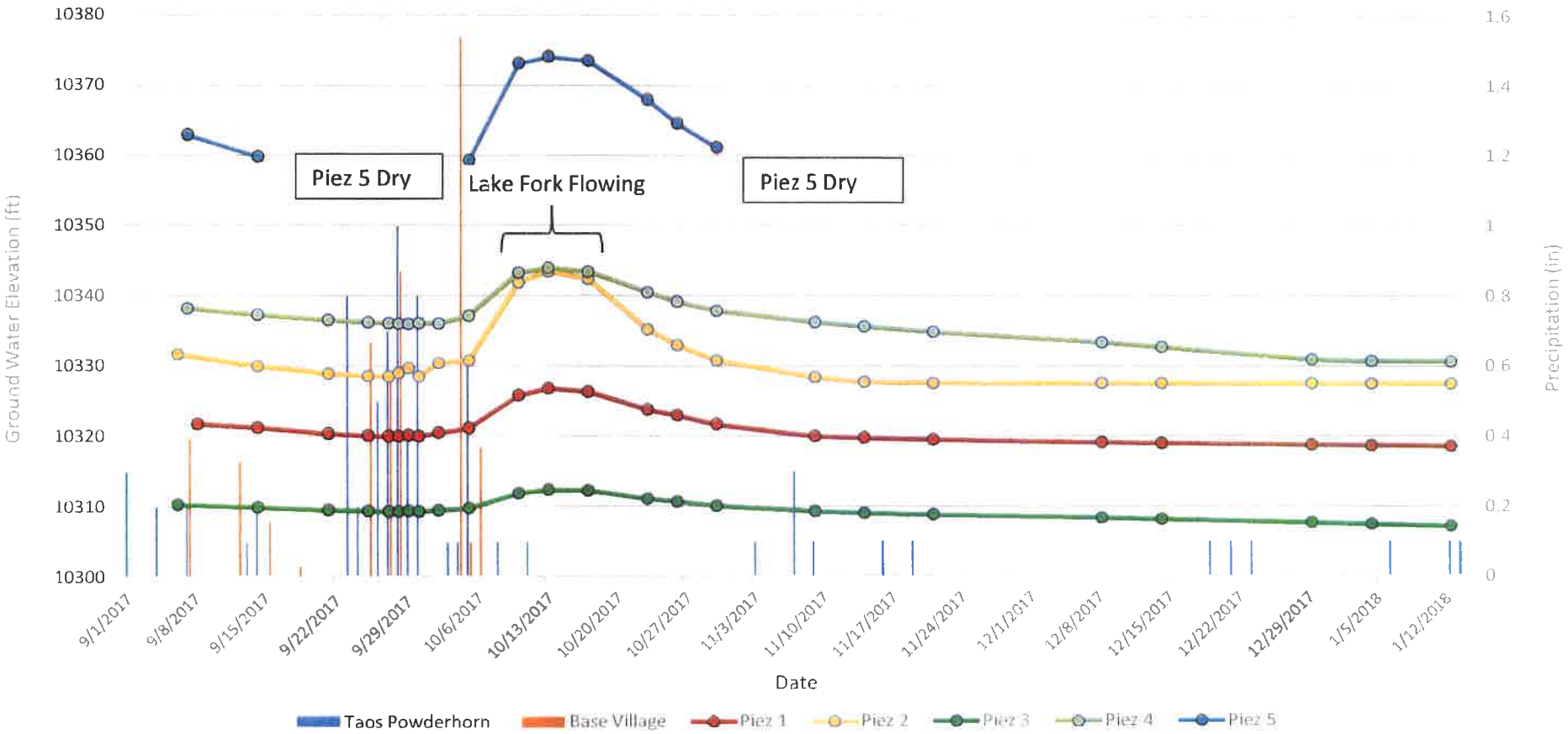


Figure 5. TSV Phoenix Spring Study, Piezometer Depth to Water Measurements and Precipitation Data

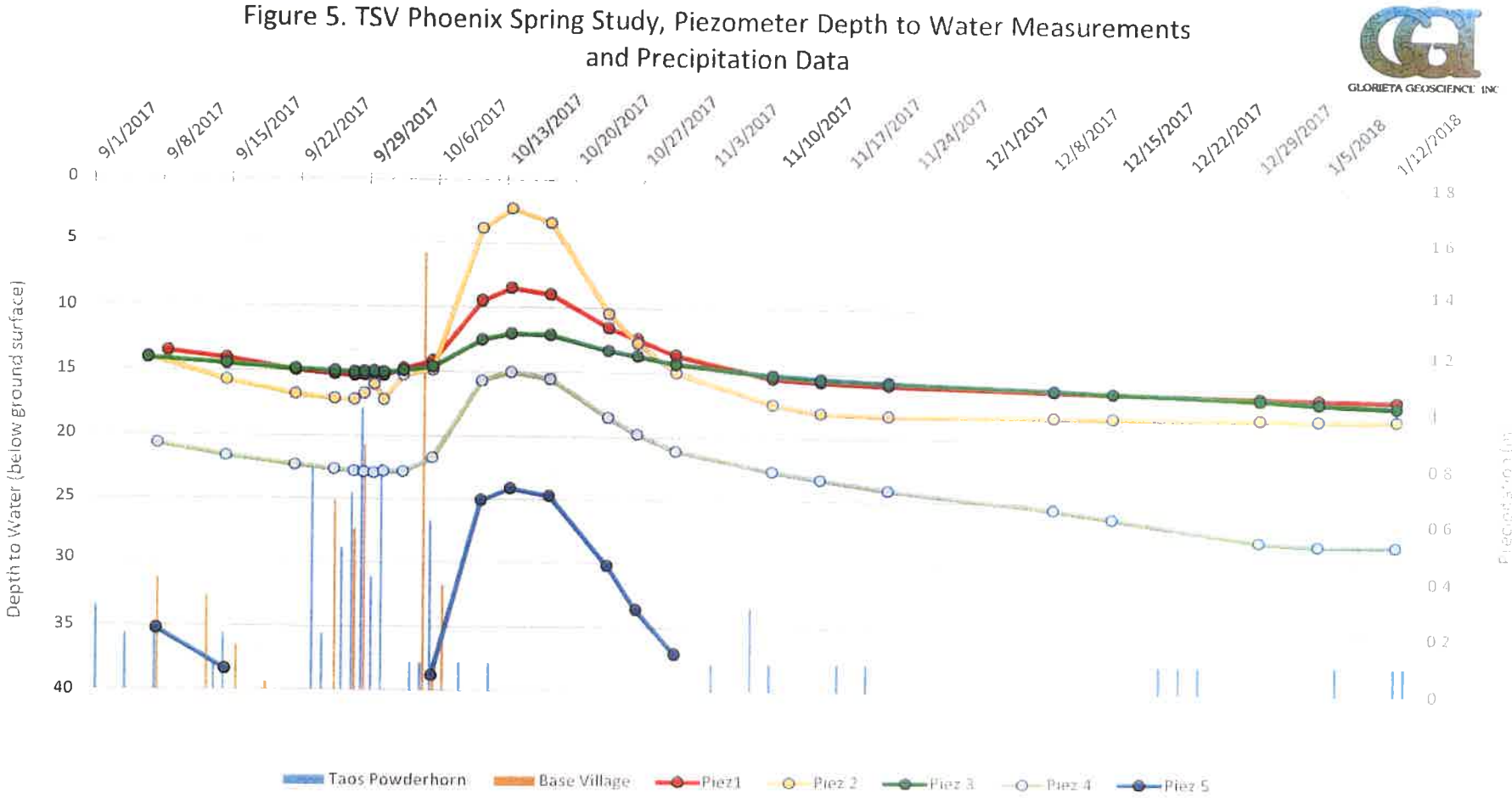
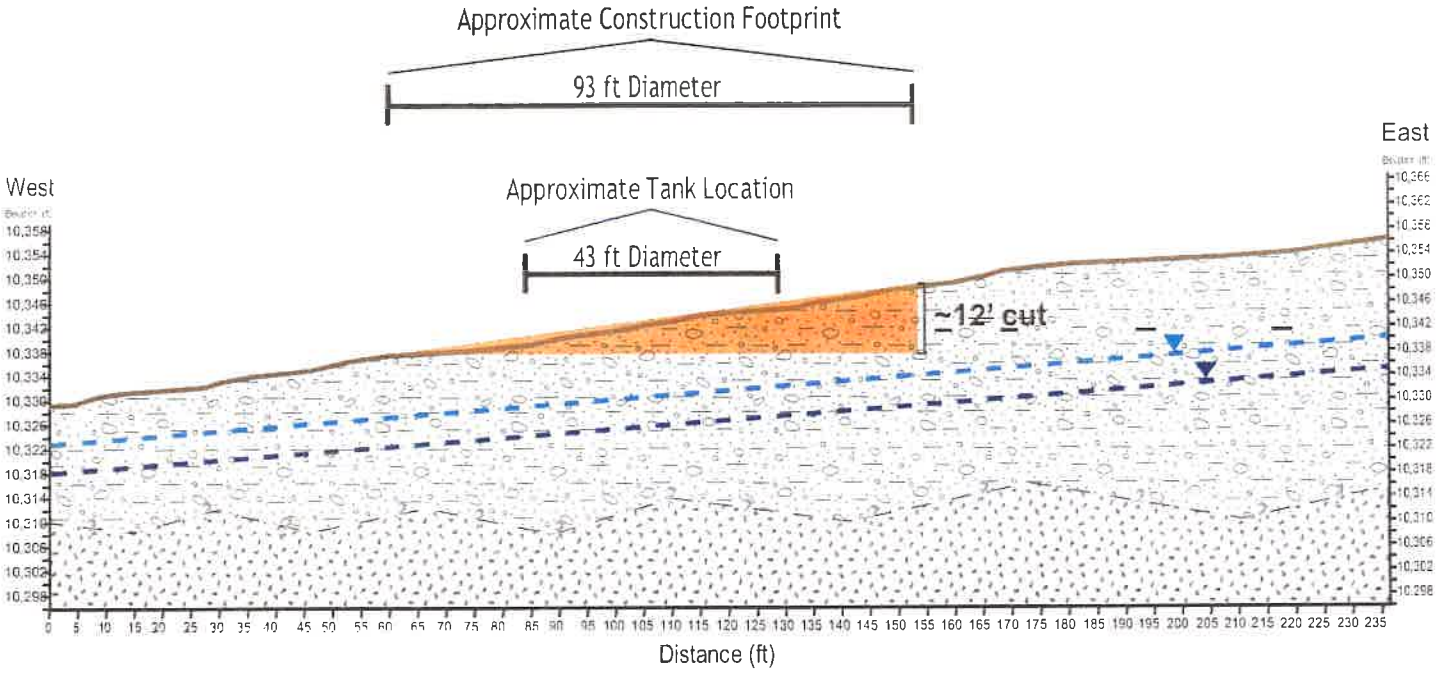


Figure 6. Cross section (A - A') through proposed 250,000 gallon tank site.

Legend

- Ground Surface derived from 2014 LiDAR
- Groundwater Elevation (projected) September 14, 2017
- Groundwater Elevation (projected) October 13, 2017
- 1' Contour produced from 2014 LiDAR
- Sandy gravel with minor clay
- Bedrock, depth unknown
- Approximate excavation

GLORIETA GEOSCIENCE, INC.



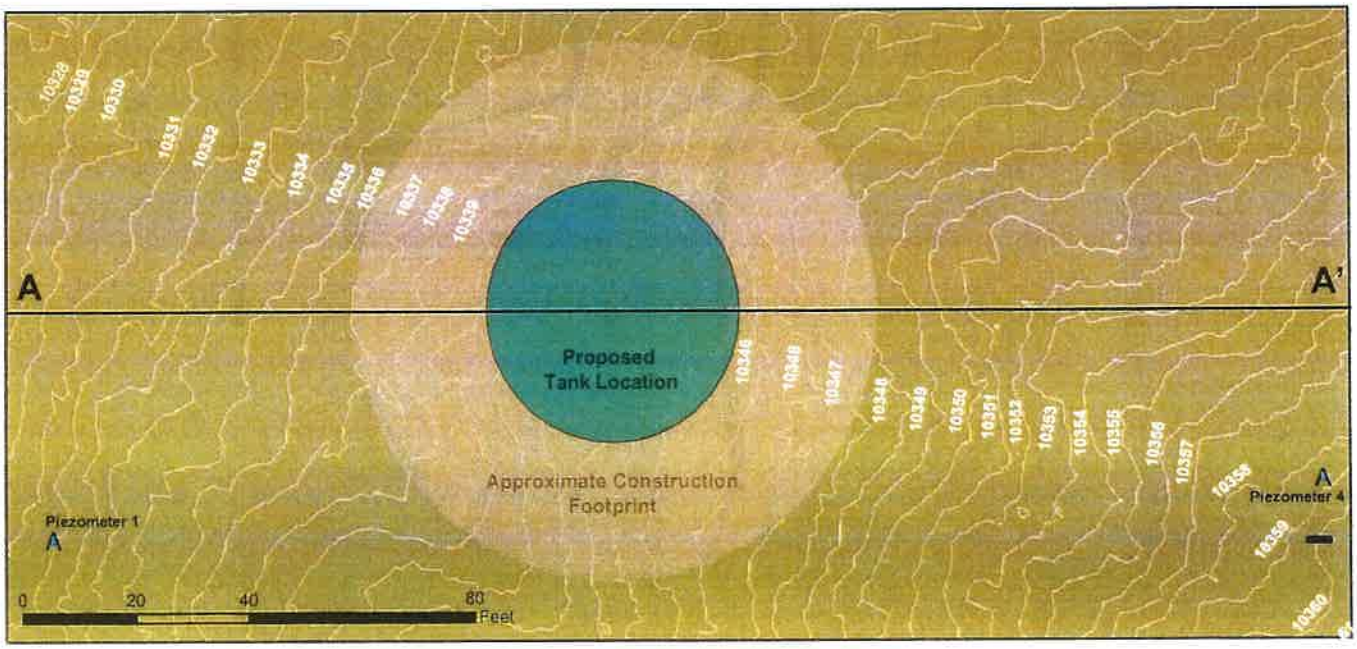


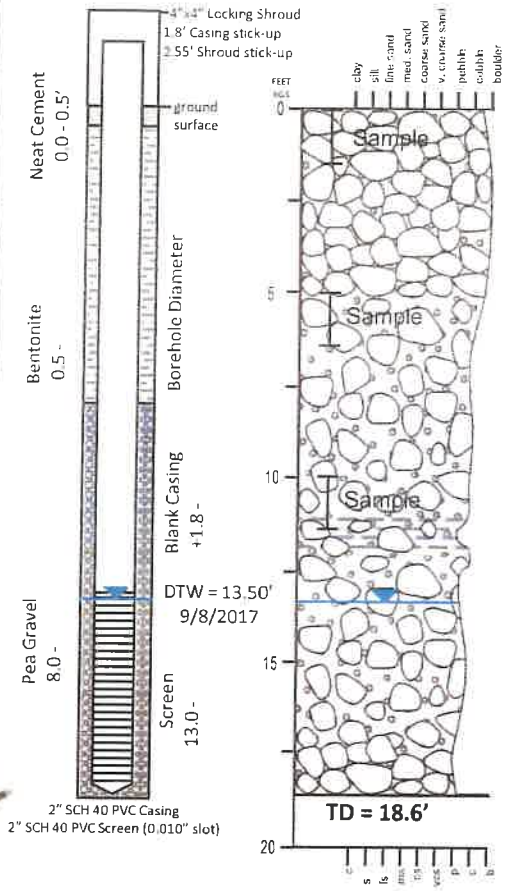
Figure 7. Phoenix Spring Discharge Measured at Chlorination Station

Appendix A: Piezometer Lithologic Logs and Completion Diagrams

Piezometer Completion Piez 1

Lithologic Description

Lithologic Log



0-5.0 ft: Angular cobble-boulder gravel composed of granite and amphibolite, minor vein quartz, +/- phyllite; 0-1.5 ft split spoon sample 14" recovery, 0-2" darkened soil horizon, brown, silty fine sand; 2-9" oxidized loose sandy angular gravel; 9-14" granite boulder

5.0-11.0 ft: Loose very coarse sandy, angular pebble-cobble-gravel, composition same as above; 5-6.5 ft split spoon 12" recovery, 0-12" granite and amphibolite cobbles, angular pebbles, coarse to very coarse sand

11.0-11.5 ft: Angular-subangular pebble-cobble-gravel, composed of granite and amphibolite; light brown poorly sorted, slightly clayey medium-very coarse sand; 10-11.5 ft split spoon sample 8" recovery, angular-subangular pebble-cobble, granite and amphibolite gravel, light brown poorly sorted slightly clayey medium-very coarse sand matrix

12.0-15.0 ft: Subrounded-subangular loose sandy pebble-gravel composed of amphibolite, granite, vein quartz, and phyllite. Water at ~13.5 feet

15-17.5 ft: Same as above, poor recovery

17.5-18.6 ft: Amphibolite boulder

Surveyed Location: 460783 mE, 4047592 mN
NAD83 UTM Zone 13S

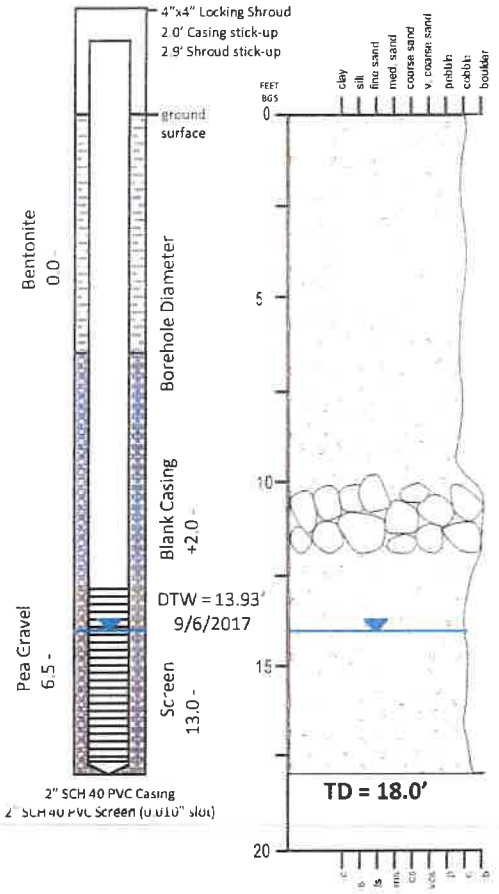
Piez 1 (RG-96901-POD1): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 1 . Logged by Paul Drakos, P.G. on 9/8/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Piezometer Completion Piez 2

Lithologic Description

Lithologic Log



0-5.0 ft: Brown course angular sandy gravel; granite (~80%) and amphibolite (~20%)

5.0-10.0 ft: Brown sandy pebble-cobble-gravel, mostly subrounded, comprising granite, amphibolite and felsic gneiss

10.0-12.0 ft: Amphibolite boulder

12.0-15.0 ft: Brown sandy gravel comprising felsic gneiss, amphibolite, and granite; angular-subrounded, water at ~14.0'

15.0-18.0 ft: Course-very coarse, subrounded quartz and K-feldspar sand; subrounded and subangular gravel

Surveyed Location: 460787 mE, 4047542 mN
NAD83 UTM Zone 13S

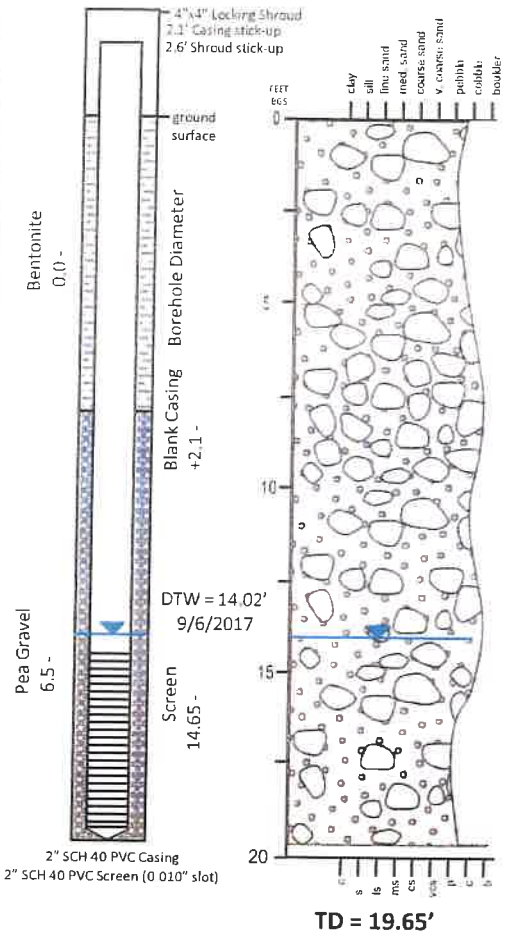
Piez 2 (RG-96901-POD2): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 2. Logged by Paul Drakos, P.G. on 9/6/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Piezometer Completion Piez 3

Lithologic Description

Lithologic Log



TD = 19.65'

0-5.0 ft: Subrounded-subangular pebble-cobble-gravel comprising felsic gneiss, amphibolite, granite and very coase sand

5.0-10.0 ft: Course, angular cobble boulder gravel comprising gneiss, amphibolite, and granite; plus quartzite, vein quartz pebbles

10.0-15.0 ft: Course sandy subrounded-angular gravel and very coarse sand, composition same as above

15.0 - 20.0 ft: Subrounded-angular pebble-cobble-gravel and lithic very coarse sand; gravel composition includes amphibolite, vein-quartz, felsic gneiss, minor granite DTW ~ 15'

Surveyed Location: 460795 mE, 4047655 mN
NAD83 UTM Zone 13S

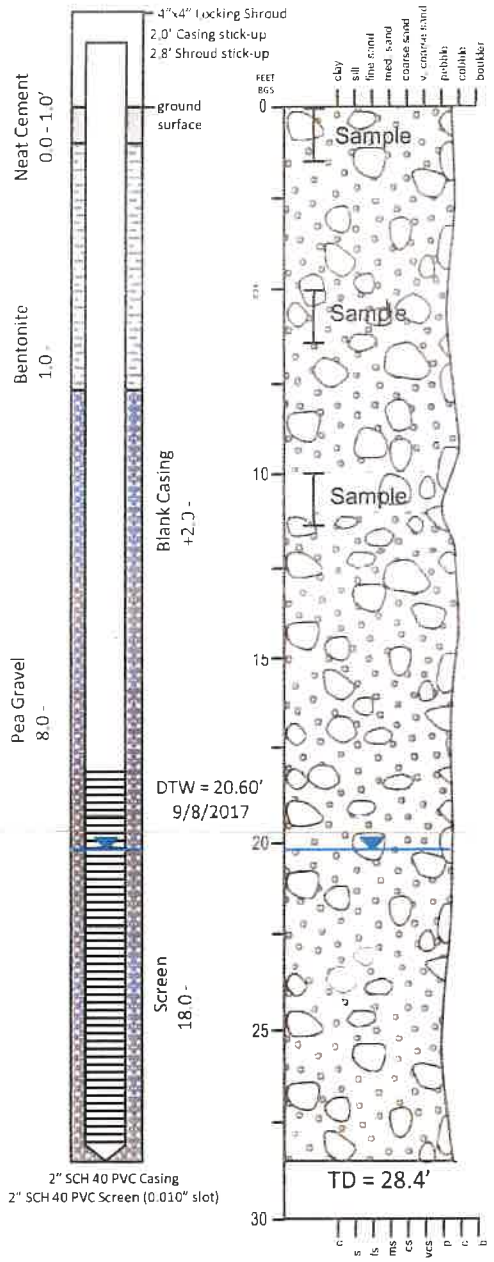
Piez 3 (RG-96901-POD4): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 3 l. Logged by Paul Drakos, P.G. on 9/6/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Piezometer Completion Piez 4

Lithologic Description

Lithologic Log



0-5.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite-quartz lithic very coarse send; 0-1.5 ft split spoon sample 12" recovery, 0-6" brown slightly clayey soil horizon, 6-12" brown, loose sand and angular gravel

5.0-10.0 ft: Same as above plus vein-quartz gravel, more very coarse sand than above, 5-6.5 ft split spoon 7" recovery, 0-7" loose angular amphibolite and minor granite gravel

10.0-15.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite quartz lithic very coarse send; 10-11.5 ft split spoon sample 9" recovery, course, loose granite gravel, 7 - 9" moist, brown, medium to course sand

15.0-20.0 ft: Same as above, slightly more rounded

20.0-25.0 ft: Same as above, more amphibolite than granite

25.0-28.4 ft: Same as above

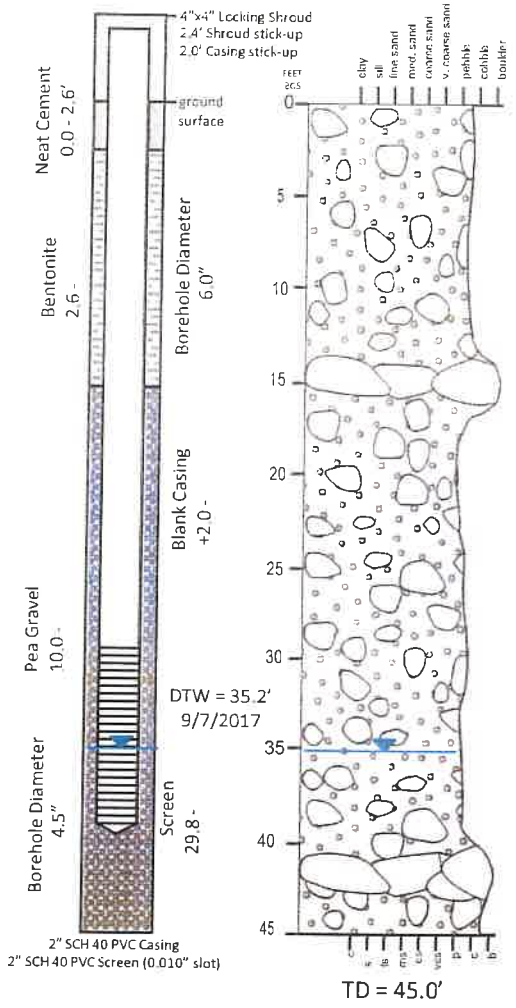
Surveyed Location: 460851 mE, 4047594 mN
UTM NAD83 Zone 13S

Piez 4 (RG-96901-POD5): Piezometer Lithology and Completion

Lithologic log and completion schematic of Piez 4. Logged by Paul Drakos, P.G. and April Jean Tafoya on 9/7 - 9/8/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Piezometer Completion Piez 5



Lithologic Description

Lithologic Log

0-4.0 ft: Loose brown sandy pebble-cobble gravel, composition = angular granite, amphibolite, felsic gneiss, phyllite

4.0-9.0 ft: Same as above, plus quartzite gravel

9.0-14.0 ft: Angular-subrounded granite, amphibolite, felsic gneiss, phyllite pebble-cobble-gravel, slightly clayey brown sand; lesser granite than above

14.0-15.0 ft: Boulder

15.0-19.0 ft: Granite and quartz subrounded lithic very coarse sandy, subrounded pebble gravel; composition = granite, amhibolite, phyllite and minor vein quartz

19.0-24.0 ft: same as above, gravel subangular

24.0-29.0 ft: coarse to very coarse sandy, subrounded pebble gravel and angular cobble fragments comprising granite, amphibolite and phyllite

29.0-30.0 ft: Subrounded-angular granite, amphibolite and vein quartz pebble to cobble gravel

35.0-40.0 ft: Subrounded-angular granite, amphibolite and vein quartz pebble to cobble gravel, DTW ~38'

40.0-41.0 ft: Same as above

41.0-43.0 ft: Amphibolite boulder

43.0-45.0 ft: Subangular-angular course granite, amphibolite, gneiss, vein-quartz pebble to boulder gravel

Surveyed Location: 460917 mE, 4047535 mN
NAD83 UTM Zone 13S

Piez 5 (RG-96901-POD6): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 5. Logged by Paul Drakos, P.G. and April Jean Tafoya on 9/7/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Appendix B: OSE Well Logs

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

GENERAL AND WELL LOCATION

OSE POD NO (WELL NO.): POD-1	WELL TAG ID NO:		OSE FILE NO(S): RG-96901
WELL OWNER NAME(S): Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)			PHONE (OPTIONAL):
WELL OWNER MAILING ADDRESS: 200 W. De Vargas St Suite 7, PO Box 8980			CITY: Santa Fe; STATE: NM; ZIP: 87504
WELL LOCATION (FROM GPS)	LATITUDE: DEGREES 36; MINUTES 34; SECONDS 22.1; N		* ACCURACY REQUIRED: ONE TENTH OF A SECOND
	LONGITUDE: 105; 26; 18.3; W		* DATUM REQUIRED: WGS 84
DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE: Taos Ski Valley			

WELL DRILLING & CASING INFORMATION

LICENSE NO: WD-1522	NAME OF LICENSED DRILLER: Branden L. Sanders		NAME OF WELL DRILLING COMPANY: Geomechanics Southwest, Inc.
DRILLING STARTED: 9-6-17	DRILLING ENDED: 9-6-17	DEPTH OF COMPLETED WELL (FT): 18'	BORE HOLE DEPTH (FT): 18 ft.
DEPTH WATER FIRST ENCOUNTERED (FT): 13.2			
COMPLETED WELL IS: LJ ARTESIAN; 0 DRY HOLE; RJ SHALLOW (UNCONFINED)			STATIC WATER LEVEL IN COMPLETED WELL (FT): 13.2
DRILLING FLUID: ☐ AIR; DRILLING METHOD: ROTARY; 0n MUD; D ADDITIVES - SPECIFY: CABLE TOOL; 0 OTHER - SPECIFY: Hammer - tubex casing advance HAMMER			

CASING INFORMATION

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	13	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
13	18	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	.154"	0.010

ANNULAR MATERIAL INFORMATION

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	2	6	neet cement	.3	tremmie
2	7	6	3/8" bentonite chips	.8	tremmie
7	18	6	1/4" #2." grvcl	1.8	tremmie

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO | POD NO | TRN NO

LOCATION | WELL TAG ID NO | PAGE 1 OF 2

DEPTH (feet bgl) FROM	TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES/NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	15	15	Sand/Gravel/cobbles	/Y N	
15	18	3	boulders	/Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT [2]BAILER ☐ OTHER - SPECIFY

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST | TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: B aT mg was to c can up we[ll] a[ft]er insta[ll] [u] na[bl]e to d[o] tain an estimate [o] we[ll] yi[eld]

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

U Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE POD NO. (WELL NO.): POD-2	WELL TAG ID NO.:	OSE FILE NO(S.): RG-96901
WELL OWNER NAME(S): Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL):
WELL OWNER MAILING ADDRESS: 200 W. DeVargas St Suite 7, PO Box 8980		CITY: Santa Fe; STATE: NM; ZIP: 87504
WELL LOCATION (FROM GPS): LATITUDE	DEGREES: 36; MINUTES: 34; SECONDS: 23.0 N	* ACCURACY REQUIRED: ONE TENTH OF A SECOND
LONGITUDE	105; 26; 16.2 W	* DATUM REQUIRED: WGS 84
DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE: Taos Ski Valley		

LICENSE NO.: WD-1522	NAME OF LICENSED DRILLER: Branden L. Sanders			NAME OF WELL DRILLING COMPANY: Geomechanics Southwest, Inc.
DRILLING STARTED: 9-8-17	DRILLING ENDED: 9-8-17	DEPTH OF COMPLETED WELL (FT): 18'	BORE HOLE DEPTH (FT): 18 ft.	DEPTH WATER FIRST ENCOUNTERED (FT): 14.2
COMPLETED WELL IS: n ARTESIAN 0 DRYHOLE RI SHALLOW (UNCONFINED)				STATIC WATER LEVEL IN COMPLETED WELL (FT): 14.2
DRILLING FLUID: DRILLING METHOD: D AIR ROTARY; ☐ MUD; H HAMMER; ☐ ADDITIVES - SPECIFY; CABLE TOOL; D OTHER - SPECIFY: Hammer - tubex casing advance				

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	13	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
13	18	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	154"	0.010

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	2	6	neat cement	.3	tremmie
2	8	6	3/8" bentonite chips	1	tremmie
8	18	6	1/4" pea gravel	1.6	tremmie

DEPTH (feet bgl) FROM	TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES /NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	10	10	Sandy Gravel	y N	
10	12	2	boulder	y N	
12	18	6	Sandy Gravel	Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT (2)BAILER ☐ OTHER - SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST / TEST RESULTS. ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after installation to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

//lfl- Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

SECTION 1 GENERAL AND WELL LOCATION

OSE POD NO. (WELL NO.): POD-4	WELL TAG ID NO.	OSE FILE NO.(S): RG-96901
WELL OWNER NAME(S): Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL):
WELL OWNER MAILING ADDRESS: 200 W. DeVargas St Suite 7, PO Box 8980		CITY: Santa Fe; STATE: NM; ZIP: 87504

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	36	34	25.1	N
	LONGITUDE	105	26	16.9	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE: Taos Ski Valley

SECTION 2 DRILLING & CASING INFORMATION

LICENSE NO.	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1522	Branden L. Sanders	Geomechanics Southwest, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
9-6-17	9-6-17	20'	20 ft.	14

COMPLETED WELL IS: [J] ARTESIAN [n] DRYHOLE [J] SHALLOW (UNCONFINED) — STATIC WATER LEVEL IN COMPLETED WELL (FT): 14

DRILLING FLUID: [7] AIR [Q] MUD ADDITIVES - SPECIFY:

DRILLING METHOD: [J] ROTARY [0] HAMMER [J] CABLE TOOL [0] OTHER - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	15	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
15	20	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	.154"	0.010

SECTION 3 ANNULAR MATERIAL

DEPTH (feet bgl) FROM	TO	BORE HOLE DIAM, (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	2	6	neat cement	.3	tremmie
2	8	6	3/8" bentonite chips	1	tremmie
8	20	6	1/4" pea gravel	2	tremmie

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO. — POD NO. — TRN NO.

LOCATION — WELL TAG ID NO.

DEPTH (feet bgl) FROM	TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES /NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	20	20	Sand/Gravel/cobbles	Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT [2]BAILER ☐ OTHER - SPECIFY

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

U Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

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SECTION 1 OF 3 — PLUGGING INFORMATION

OSE POD NO (WELL NO)	WELL TAG ID NO	OSE FILE NO(S)
POD-5		RG-96901

WELL OWNER NAME(S)	PHONE (OPTIONAL)
Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)	

WELL OWNER MAILING ADDRESS	CITY	STATE	ZIP
200 W. DeVargas St Suite 7, PO Box 8980	Santa Fe	NM	87504

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	36	34	22.9	N
	LONGITUDE	105	26	16.1	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE

Taos Ski Valley

SECTION 2 OF 3 — DRILLING INFORMATION

LICENSE NO	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1522	Branden L. Sanders	Geomechanics Southwest, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
9-7-17	9-8-17	28'	28 ft.	20.6

COMPLETED WELL IS: n ARTESIAN ☐ DRYHOLE [7] SHALLOW (UNCONFINED) — STATIC WATER LEVEL IN COMPLETED WELL (FT): 20.6

DRILLING FLUID: 0 AIR 0 MUD — DRILLING METHOD: [R] HAMMER 0 CABLE/TOOL ☐ OTHER - SPECIFY — ADDITIVES - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (Add coupling diameter)	CASING INSIDE DIAM (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	18	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
18	28	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	.154"	0.010

SECTION 3 OF 3 — ANNULAR MATERIAL INFORMATION

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	2	6	neet cement	3	tremmie
2	8	6	3/8" benlonite chips	1	tremmie
8	28	6	1/4" pea gravel	3.2	tremmie

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO — POD NO — TRN NO.

LOCATION — WELL TAG ID NO — PAGE 1 OF 2

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES/NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	28	28	Sand/Gravel	Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT [2JBAILER ☐ OTHER - SPECIFY

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST TEST RESULTS ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after installation. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

/u, Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO POD NO TRN NO

LOCATION WELL TAG ID NO PAGE 2 OF 2

WELL RECORD & LOG

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OSE POD NO (WELL NO.): POD-6	WELL TAG ID NO:	OSE FILE NOS.: RG-96901
WELL OWNER NAME(S): Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL):
WELL OWNER MAILING ADDRESS: 200 W. De Vargas St Suite 7, PO Box 8980		CITY: Santa Fe; STATE: NM; ZIP: 87504
WELL LOCATION (FROM GPS)	LATITUDE: DEGREES 36, MINUTES 34, SECONDS 24.2 N	• ACCURACY REQUIRED: ONE TENTH OF A SECOND • DATUM REQUIRED: WGS 84
	LONGITUDE: 105, 26, 12 W	
DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE: Taos Ski Valley		

LICENSE NO: WD-1522	NAME OF LICENSED DRILLER: Branden L. Sanders		NAME OF WELL DRILLING COMPANY: Geomechanics Southwest, Inc.
DRILLING STARTED: 9-7-17	DRILLING ENDED: 9-7-17	DEPTH OF COMPLETED WELL (FT): 40'	BORE HOLE DEPTH (FT): 45 ft.
DEPTH WATER FIRST ENCOUNTERED (FT): 35.2			
COMPLETED WELL IS: ☐ ARTESIAN [J DRY HOLE f7l SHALLOW (UNCONFINED)			STATIC WATER LEVEL IN COMPLETED WELL (FT): 35.2
DRILLING FLUID: [J AIR ☐ MUD ADDITIVES – SPECIFY:			
DRILLING METHOD: [J ROTARY 0 HAMMER D CABLE TOOL [J OTHER - SPECIFY: Hammer - tubex casing advance			

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	30	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
30	40	6	3d1 40 PVC SCICCII	tlu5h thread w/ O-ring		.154"	0.010

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
0	2	6	neet cement	.3	tremmie
2	10	6	3/8" bentonite chips	1.3	tremmie
10	40	6	1/4" pea gravel	5	tremmie

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO: ____ POD NO: ____ TRN NO: ____

LOCATION: ____ WELL TAG ID NO: ____ PAGE 1 OF 2

DEPTH (feet bgl) FROM	TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED- INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES /NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	14	14	Sand/Gravel	y {N	
14	15	1	boulder	y {N	
15	40	25	gravel	{Y N	
40	43	3	boulder	{Y N	
43	45	2	gravel	{Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT OBAILER ☐ OTHER-SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm) 0.00

WELL TEST TEST RESULTS-ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: B at mg was to c can up we ll a ter insta ll U na bl e to o tain an estimate o we ll yte id.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING JS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WJLL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

/.U Branden L. Sanders 9-27-17

SIONATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO. POD NO TRNNO

LOCATION WELL TAG ID NO PAGE20F2

Appendix C: Geo-Test, Inc. Geotechnical Engineering Services Report

GEO-TEST

GEOTECHNICAL ENGINEERING SERVICES REPORT
JOB NO. 1-71005
250,000 GALLON WATER TANK
TAOS SKI VALLEY, NEW MEXICO

PREPARED FOR

TAOS SKI VALLEY, INC.
C/O
GLORIETA GEOSCIENCE, INC.

GEO-TEST, INC.
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GEO-TEST

October 31, 2017
Job No. 1-71005

Taos Ski Valley, Inc.
C/o Glorieta Geoscience, Inc.
1723 2nd Street
Santa Fe, New Mexico 87505

Attn: Paul Drakos, P.G.

RE: Geotechnical Engineering Services
250,000 Gallon Water Tank
Taos Ski Valley, New Mexico

Dear Mr. Drakos:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our laboratory testing, and recommendations for tank foundation design, as well as criteria for site grading.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Patrick R. Whorton, EI

Reviewed by:

Robert D Booth, P

ROBERT D. BOOTH
NEW MEXICO
5711
LICENSED PROFESSIONAL ENGINEER

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GEO-TEST

Table of Contents

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INTRODUCTION

This report presents the results of the geotechnical engineering services investigation performed by this firm to aid in the design of the proposed 250,000 gallon steel water storage tank to be located near Blue Jay Ridge within the Taos Ski Valley, New Mexico.

The objectives of this investigation were to:

1) Evaluate the nature and engineering properties of the subsurface soils underlying the proposed tank site.

2) Provide recommendations for the design and construction of tank foundations as well as the required site grading.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the construction of a new 250,000 gallon, welded steel water storage tank 43 feet in diameter and 24 feet in height. Unit loading at the base of the tank will be on the order of 1,500 pounds per square foot.

Should project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

FIELD EXPLORATION

Two (2) borings were drilled near the proposed location of the water tank to install piezometers. The borings were drilled under the supervision of Glorieta Geoscience, Inc. and logged and sampled by Paul Drakos, P.G. with that firm. This report was prepared using the data gathered from those borings, piezometers 1 and 4. The locations of the borings/piezometers are shown on the Boring Location Map, Figure 1. Standard penetration tests were performed at the surface and at depths of 5 and 10 feet in the borings and the samples were delivered to the Geo-Test, Inc. Santa Fe laboratory by Glorieta Geoscience, Inc. Piezometer/boring lithology logs prepared by Glorieta Geoscience, Inc. are presented in a following section of this report along with logs derived by this firm to present standard penetration data and USCS soil classifications. Geo-Test, Inc. did not perform a field investigation at the proposed tank site.

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LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. The results of these tests are shown in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SITE CONDITIONS

The tank site is located within an undeveloped area with the Taos Ski Valley. The site is located near the end of Blue Jay Ridge Road and Williams Lake Trail. The site is in a wooded area and generally slopes down from east to west.

SUBSURFACE SOIL CONDITIONS

As indicated by the boring data and laboratory testing, the soils underlying the site consist of a surficial layer of silty sand and gravels with interspersed cobbles and boulders which extends to a depth of approximately 5 feet below existing site grades. Below the surficial layer, well graded gravel with silt, sand and cobbles was encountered to the full depths explored.

Free groundwater was encountered at depths of about 13 to 21 feet below grade. The groundwater level may fluctuate seasonally and could be higher or lower during certain times of the year. Soil moisture contents above the water table were relatively low near the surface but became moist with depth.

CONCLUSIONS AND RECOMMENDATIONS

The subsurface soils encountered at the site vary considerably in both gradation and density. Based on these results and general experience in the area it is believed that the subsurface soils encountered consist of alluvium resulting from higher elevation erosion and possibly landslides or glacial activity. As such, void space and buried debris may exist within the soils. Foundations bearing on these soils would be susceptible to excessive differential settlements. Accordingly, the existing near surface native soils are not considered suitable in their present condition to provide reliable support of the proposed tank.

However, with special site preparation, the proposed tank can be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on properly compacted, non-expansive structural fill. The special site preparation

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would involve overexcavation of the existing soils throughout the area of the tank to such an extent as to provide for at least 2.0 feet of properly compacted, non-expansive structural fill below the ring-wall footing and the tank bottom. The limits of the overexcavation should also extend laterally from the footing perimeter a distance equal to the depth of fill beneath its base. The exposed native soils at the base of the excavation should be densified prior to placement of structural fill. The overexcavated soils will not be suitable for use as structural fill and should be wasted or placed in non-structural areas of the site or processed to meet the specification for structural fill outlined in the Site Grading section of this report. Detailed recommendations for foundation design, along with the required earthwork, are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils could cause some differential foundation movements. Therefore, moisture protection is considered an important design consideration and should be reflected in overall site grading and drainage details as recommended in the Moisture Protection section of this report.

FOUNDATION

The proposed water tank may be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on a minimum of 2.0 feet of properly compacted, non-expansive structural fill. The footing should be designed using an allowable soil bearing pressure not exceeding 3,000 pounds per square foot. The recommended bearing pressure applies to full dead plus live loads and may be increased by one-third for total loads including wind and seismic forces. The ring-wall footing should be established a minimum of 3.0 feet below the lowest adjacent finished grade. The minimum recommended width of the ring-wall footing is 16 inches. The floor of the tank should be supported on a sand cushion at least 3 inches thick placed directly on structural fill.

ESTIMATED SETTLEMENTS

It is estimated that total settlement of the tank and ring-wall footing, designed and constructed as recommended herein, will not exceed about 1.0 inch. Differential movement, or tilt across the entire tank bottom, is estimated to be less than 0.5 inches.

The above settlement estimates are based upon the soil moisture contents encountered during test drilling or moisture contents introduced during construction. Post construction soil moisture increases could create additional movements and, thus, the moisture protection procedures as recommended in a following section of this report are considered important for the satisfactory performance of the tank structure.

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LATERAL LOADS

Resistance to lateral forces will be provided by passive earth resistance against the sides of the ring-wall footing and by soil friction between the base of the footing and the tank and the soil. A coefficient of friction of 0.45 is recommended when calculating lateral resistance between base of the footing and the tank and the soil. A passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

SITE GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

1) The existing site soils throughout the tank site should be over-excavated to such an extent as to provide for at least 2.0 feet of properly compacted non-expansive structural fill beneath the ring-wall footing and the tank bottom. The overexcavation limits should extend laterally beyond the footing perimeter equal to the depth of fill beneath the base of the footing.

2) After the required overexcavation, the exposed cut surface should be densified. Densification of the exposed native soils should consist of moisture conditioning to the optimum moisture content or above and compacting the subgrade to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D-1557. It is anticipated that the bottom of the excavation may be uneven, rocky and difficult to grade and compact. If these conditions exist it is recommended that a thin approximately 2 inch thick layer of structural fill be spread across the bottom of excavation and compacted in order to create a level workable surface prior to the placement structural fill.

3) The results of this investigation indicate that the overexcavated soils will not be suitable for use as structural fill as is and should be wasted or placed in non-structural areas of the site. The onsite material may be processed and used as structural fill provided the processed material meets the specifications for structural fill outlined below. Imported material must also meet the criteria for structural fill outlined below.

4) All structural fill should be free of vegetation and debris, and contain no rocks larger than 3 inches. Gradation of the material, as determined in accordance with ASTM D-422, should be as follows:

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Size	Percent Passing
3 inch	100
¾ inch	75 – 100
No. 4	40 – 70
No. 200	5 – 15

5) The plasticity index of the structural fill and backfill should be no greater than 10 when tested in accordance with ASTM D-4318.

6) On site material may be used as general fill within non-foundation areas and as trench backfill. All pipe embedment and bedding materials should conform to the pipe manufacturer specifications.

7) Fill or backfill, consisting of soil approved by the geotechnical engineer, shall be placed in 8 inch loose lifts and compacted with approved compaction equipment. Loose lifts should be reduced to 4 inches if hand held compaction equipment is used. All compaction of structural fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be within 2 percent of the optimum moisture content.

8) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be performed during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

MOISTURE PROTECTION

Proper drainage maintenance is required to preclude accumulation of excessive moisture in the soils below the tank. Accumulations of excessive moisture can weaken or cause other changes in the soils supporting the foundations. This can cause differential movement of foundations and can result in structural damage to the tank. Positive drainage should be established away from the exterior walls of the tank. The slope away from the perimeter of the tank should be a minimum of 5 percent for a minimum distance of 10 feet and be sloped to provide positive drainage beyond those points to natural water courses.

All backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. All utility trenches leading into the tank should be backfilled with compacted fill. If any water line or tank leaks are detected, they should be promptly repaired. In addition, if any

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depressions develop from settlement of soils in utility trenches or other areas, they should be backfilled to maintain the grade so that surface water drains rapidly away from the tank.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted to provide more detailed grading and drainage recommendations.

FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer. Variations from soil conditions presented herein may be encountered during construction of the tank.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended soils.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.

2) Based upon an interpolation of soil conditions between and beyond the explorations.

3) Subject to confirmation of the conditions encountered during construction.

4) Based upon the assumption that sufficient observation will be provided during construction.

5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

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