



FINAL REPORT
with Management Plans
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Subterranean Survey of White Sands Missile Range (WSMR), New Mexico

A report on the bat survey of 770 abandoned mine features, caves, and other underground structures located on White Sands Missile Range, New Mexico.



A report submitted to Trish Cutler, White Sands Missile Range

By
Jason Corbett - Bat Conservation International
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June 2014

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All fieldwork was conducted by our experienced team of bat surveyors including Bruce Lynn, Joseph Monfeli, Jim Rolf, Anthony Smith, and Steve Willsey.

Acknowledgements

This project would not have existed without the forethought and direction of senior wildlife biologist Trish Cutler of the White Sand Missile Range. Further support was offered by the WSMR Environmental Group with special thanks to Patrick Morrow and Dave Anderson.

The photo documentation for this project has been a team effort and the entire team deserves collective credit for these informative images. It is for this reason that a specific photographer credit was omitted for each image

Project Overview

The primary mission of the project as a whole, including work on White Sands Missile Range (WSMR) was to locate and survey all subterranean features capable of providing habitat for bats. The vast majority of the WSMR sites were abandoned mine features, but other sites surveyed included caves, shelters, buildings, bunkers, and other miscellaneous military structures. While conducting these surveys our team generated an inventory of nearly all mine features located on the base, as well as documenting significant biologic and historic resources.

The project began by collaborating with the WSMR GIS team to establish a database of known mines and related features. This dataset consisted of 367 sites that were mostly sourced from the USGS mine database. By the end of the project, our team had surveyed 770 separate features on WSMR. Fieldwork for this part of the project consisted of conducting underground surveys of each site over a two-year period. Significant bat sites were visited multiple times throughout the project to determine summer maternity and winter hibernaculum usage. Other data was collected in order to determine which bat species used which sites at varying times of the year.

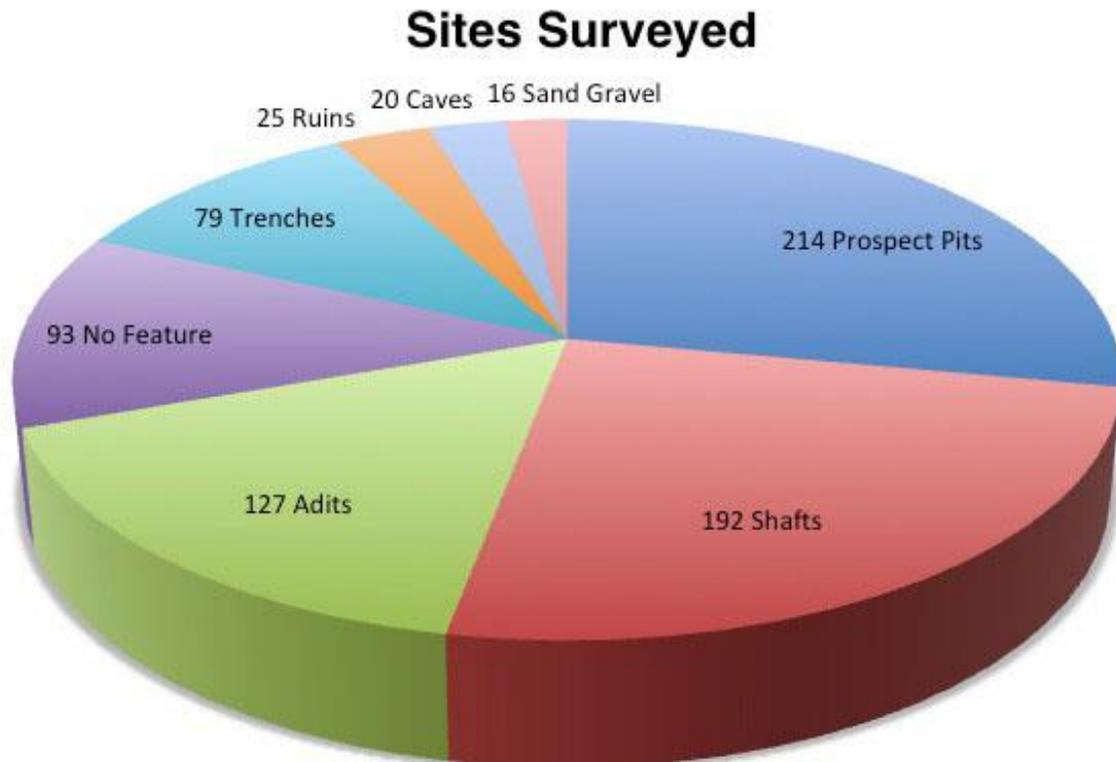
Accessing many of the sites was difficult due to a variety of challenges including site remoteness, long hikes, steep terrain, impassable mining roads, extreme temperatures (both hot and cold), range closures, secure areas, and many other factors. Most of the sites inventoried had original estimated GPS locations, but a small percentage of the target sites were not locatable. Often the sites that weren't locatable were sourced from the USGS dataset and consisted of mining claims that had not been worked and thus had no mining feature to survey. These sites were recorded as "No Feature" or "NF" in our project GIS dataset, which will be useful in updating the original WSMR GIS dataset. In many instances an original GPS location would lead a survey team to a newly discovered group of undocumented mining features. These features were commonly found by hiking to the original GPS point, and then searching the immediate area for the rock dump piles that often denote other mining features.

As a survey team located each specific feature, an area safety inspection was conducted to assess local site risks. Once the assessment was complete, any site risks were mitigated by the team. The site would then be inventoried and assigned a unique ID in the form of a two-letter area acronym and the sequential number of the feature. For example, the nineteen mine features located near Salinas Peak were denoted as "SL1" thru "SL19". This unique ID was recorded into the field GPS unit for later download into our GIS mapping software. The type of feature and optional mine name was then added to this unique ID, such as "SL1 Adit (Salinas Mine)".

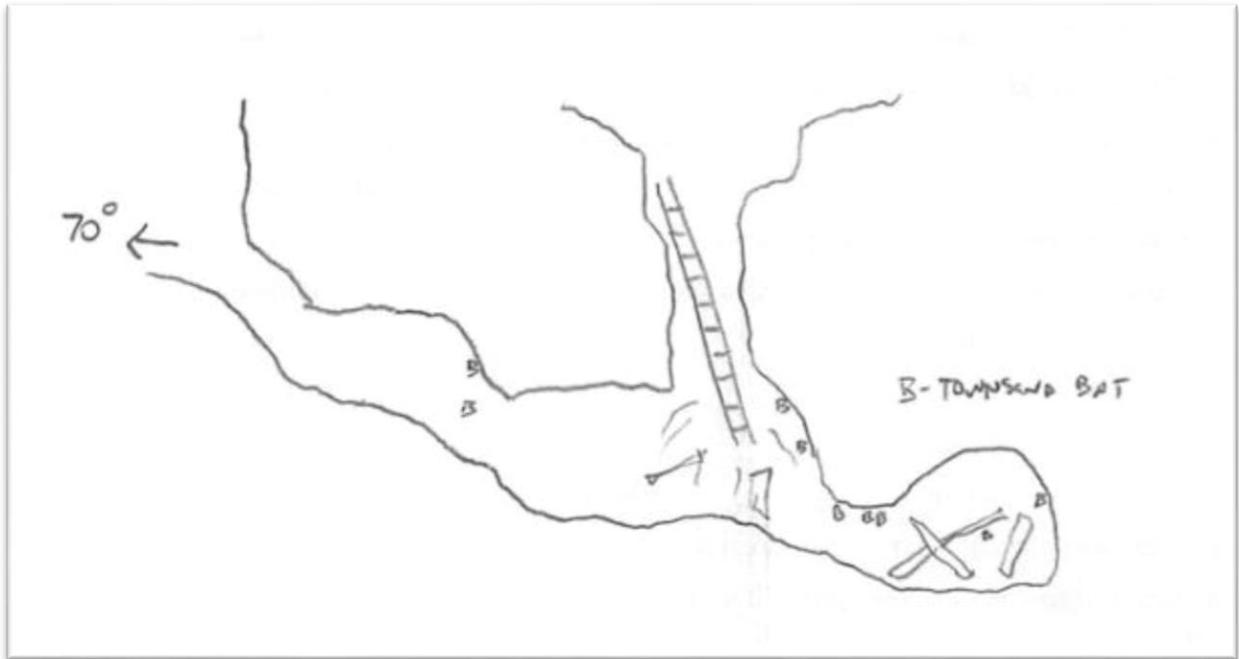
All of the surveyed features were categorized into one of the following eight designations:

- Adit - A horizontal mine passageway.
- Cave - A naturally formed void in the ground.
- Ruin - A partial or complete manmade building or structure.
- NF - No Feature; a site location that has no mining evidence, commonly an unworked mining claim.
- Prospect Pit - A mined hole in the ground that is less than six feet in depth. Often a prospect pit is a hole blasted by a single stick of dynamite.
- Sand Gravel - A mining feature where sand and gravel were extracted.
- Shaft - A vertically oriented mine passageway that exceeds six feet in depth.
- Trench- A shallow and linear mining feature.

A breakdown of the number and types of sites surveyed is represented in the graph below. Note that Adits, Shafts, and Prospect Pits are the most common features on WSMR. Prospect pits and trenches are generally not important biologic sites, but our survey team can't determine what these features are until they hike to the specific site. The "no feature" sites are generally unworked mining claims, or erroneous GIS location data.



With the location recorded, the survey team would take an entrance photo of the site. The survey team then initiated a “quick search” for bats to determine if the site was an active roost. The goal of the “quick search” was to locate and possibly photograph the bats in case they were disturbed during our full survey and moved to another roost site. Once the “quick search” process was complete, the team conducted a methodical survey of the feature looking for bats and bat sign. Temperature, humidity, site dimensions and other data were collected and entered into the Bat Survey Form. On subsequent visits to the same site a new Bat Survey Form would be generated. The following is an example of a Bat Survey Form site sketch, and Bat Survey Form data sheet from SL3 Adit (Salinas Mine).



Example Profile Sketch from SL3 Adit (Salinas Mine).

Bats in Mines Internal Survey Form

Mine name (or GPS name): SL3 ADIT / SHAFT (SL4) Elevation: 6879 FT
 Location: 13S 0354182 3686533 NAD27 WGS84
 Township: — Range: — Section: — Mine is signed: Yes No
 Observers: TOM GILLELAND, JIM ROLF, ANTHONY SMITH
 Date: 1.31.12 Time: 11:01 Temperature (outside in shade): 51 °F
 Human disturbance is: Low Moderate Heavy Mine is fenced: Yes No
 Mine is: Single-level multilevel Simple Moderate Complex Unknown
 Percent of mine included in survey: 100 % Air movement: Yes No
 Number of entrances: 2 Dimensions of largest: 10 FT H (D) 20 FT W
 Mine Length is: < 50 ft 50-100 ft 100-200 ft 200-500 ft 500-1000 ft
 1000-5000 ft > 5000 ft Unknown Or Depth _____
 Dimensions of largest passage: Length 50 FT Height 4 FT Width 10 FT
 Dimensions of largest room: Length 50 FT Height 40 FT Width 30 FT
 Mine is: Dry Damp Contains standing water Flooded Bad air: Yes No
 Mine Stability: Excellent Good Poor Bad Commodity Mined: UNKNOWN
 Temperature in warmest area: 48 °F Temperature in coolest area: 39 °F
 Humidity: 37% Bat Habitat: Good Fair Poor
 Bat droppings are: Scattered In piles Splattered Not present Unknown
 Total number of guano deposits observed: 0 Measurements of four largest guano deposits:
 1. Length _____ Width _____ Depth _____
 2. Length _____ Width _____ Depth _____
 3. Length _____ Width _____ Depth _____
 4. Length _____ Width _____ Depth _____
 Number of individual bats counted: 9 or total area covered by clusters: _____
 Total estimated number of bats in mine (by species if known): _____
7 TOWNSEND ROOSTING SINGLY + 2 TOGETHER
 Comments: _____
TOWNSEND WINTER HIBERNACULUM!

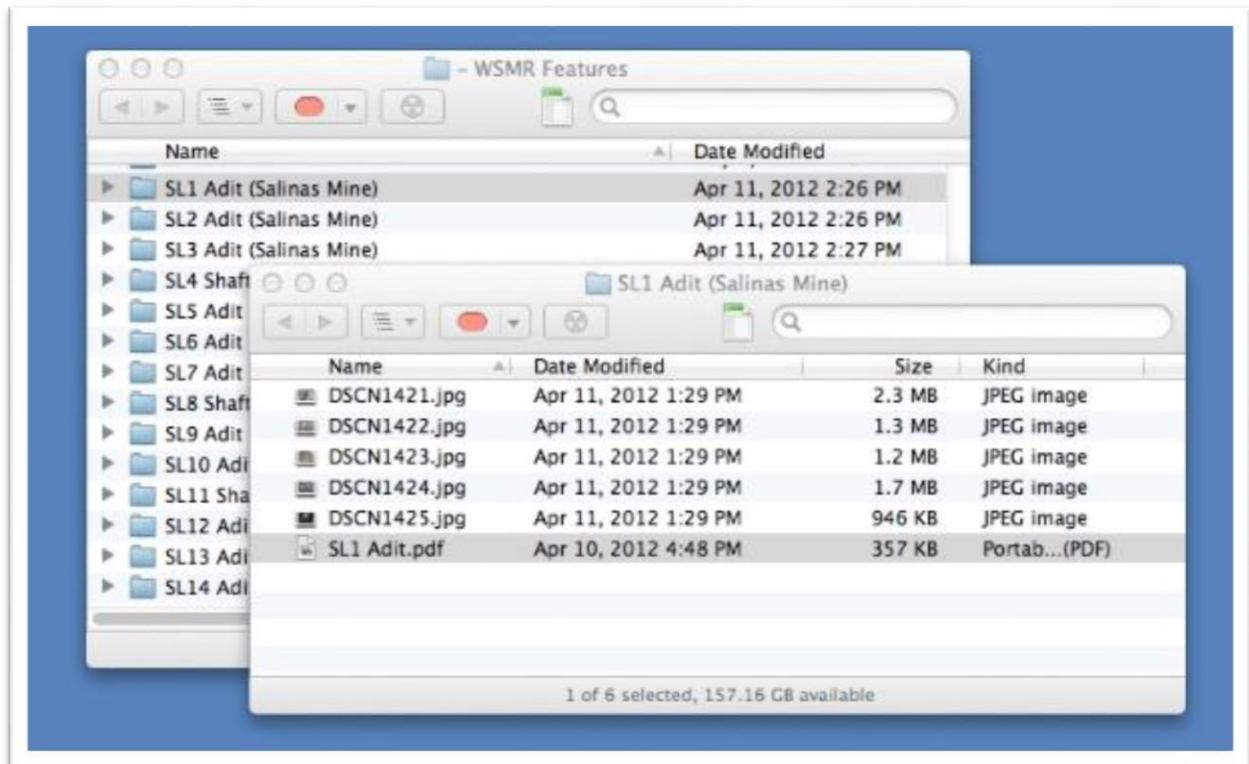
 Photo Numbers: 1427-1433

*Map of workings on reverse

Scanned on _____ by _____

Example Bat Survey Form from SL3 Adit (Salinas Mine).

All field data collected during this project was entered into an Excel spreadsheet, while field GPS locations, measured in field GPS units, were uploaded into a GIS program. This program was used to create the section maps, and also export the location data into a location Excel spreadsheet for loading into the WSMR ArcGIS program. Each of the Bat Survey Forms were scanned as .pdf files and sorted into a digital folder for each feature site. Digital photos were downloaded from cameras and imported into an image management program. These images were then exported and sorted as individual files into specific site folders. An example of the digital file structure is shown below:



Inventory Form and Digital Photo file structure.

Deliverables with this report include a CD-ROM containing a mine feature database in Excel format, and 770 folders including Bat Survey Forms (pdf) and site photos (jpg).

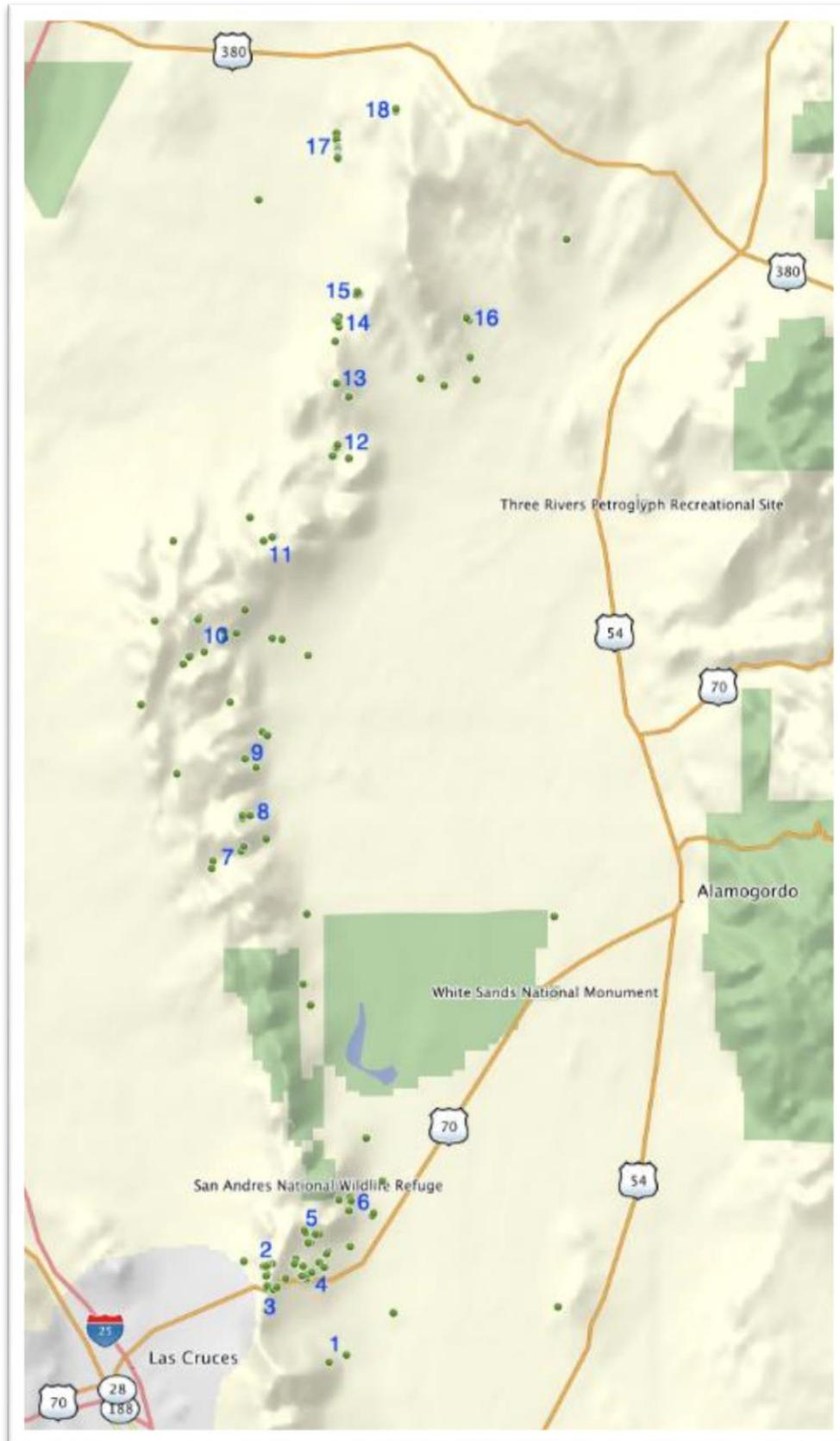
Study Area GIS

White Sands Missile Range is an Army missile range that consists of a 3,200 square mile area located in south central New Mexico. The base is situated in the Tularosa Basin which runs north/south between two series of mountain ranges. A large portion of the western ranges fall within WSMR borders, but the bulk of the base is situated in the basin floor. The rough boundaries missile range are Highway 380 in the north, and Fort Bliss in the south. The east border is near highway 54 and Holloman Air Force Base, and the western border is demarcated by the west most edge of the mountain range. The project did not include the mountainous lands of the San Andres National Wildlife Refuge.

The landforms of WSMR consist of typical basin and range morphology, which presents high mountain ranges separated by low, wide, and flat valleys. Elevations in this region vary from mountain peaks of about 2700 m (8900 ft.), to valley floors of about 1200 m (3900 ft.). This wide variance in elevation results in a large diversity of biota and environmental conditions, which, in turn, create extensive opportunities for different forms of bat habitat.

The following page contains a map of the study area with red dots marking each of the 770 surveyed abandoned mine and other features. Note that this map is scaled to a magnification that results in many of the location dots overlapping. As is clearly presented on the image, most of the mining sites were located in the mountain range. This is due to the fact that the mineralization areas in the geologically active zone of uplifting mountains are located near the surface, and the potential mining sites in the basins are deeply buried in alluvium material. We also found that most mine sites were located at places that were conducive to the miners' access, or their ability to construct roads to the specific site. If they located valuable ore, they would need to be able to transport this ore from the mine to smelters or other processing sites. The oldest mines might only have mule access along trails, but later or larger mines would need more modern and stable roads to transport their ore.

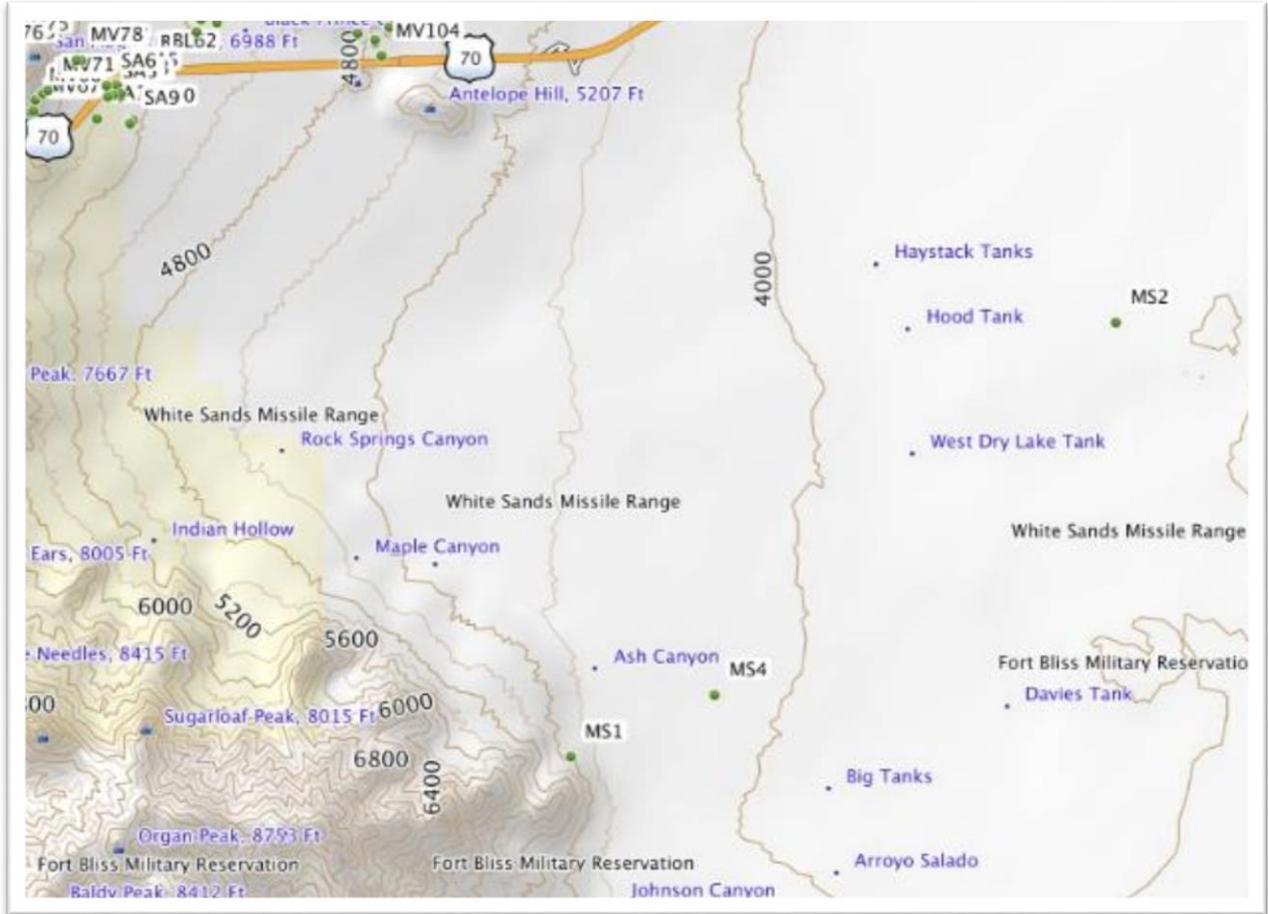
The numbers on the overview map denote each of the 18 areas that are covered in this report. Each area is essentially a grouping of mine features, often organized by geographic structures such as canyons or mountains. Nearly all of the significant sites surveyed during this project reside in one of these 18 areas. There are a few isolated sites that are not located in the main areas, and these are discussed at the end of the area reports.



Overview area number map of the study area.

Mine & Cave Resource Areas with Bat Roosts

Main Base (1)

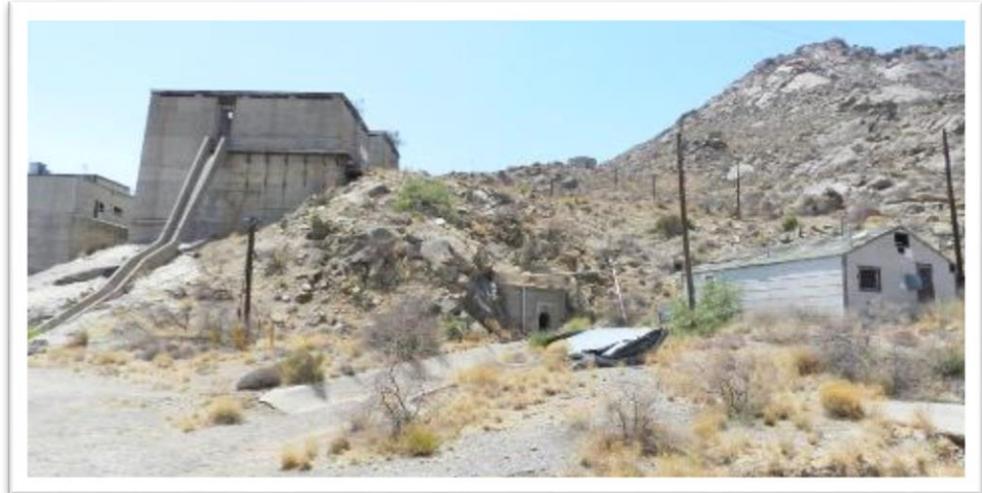


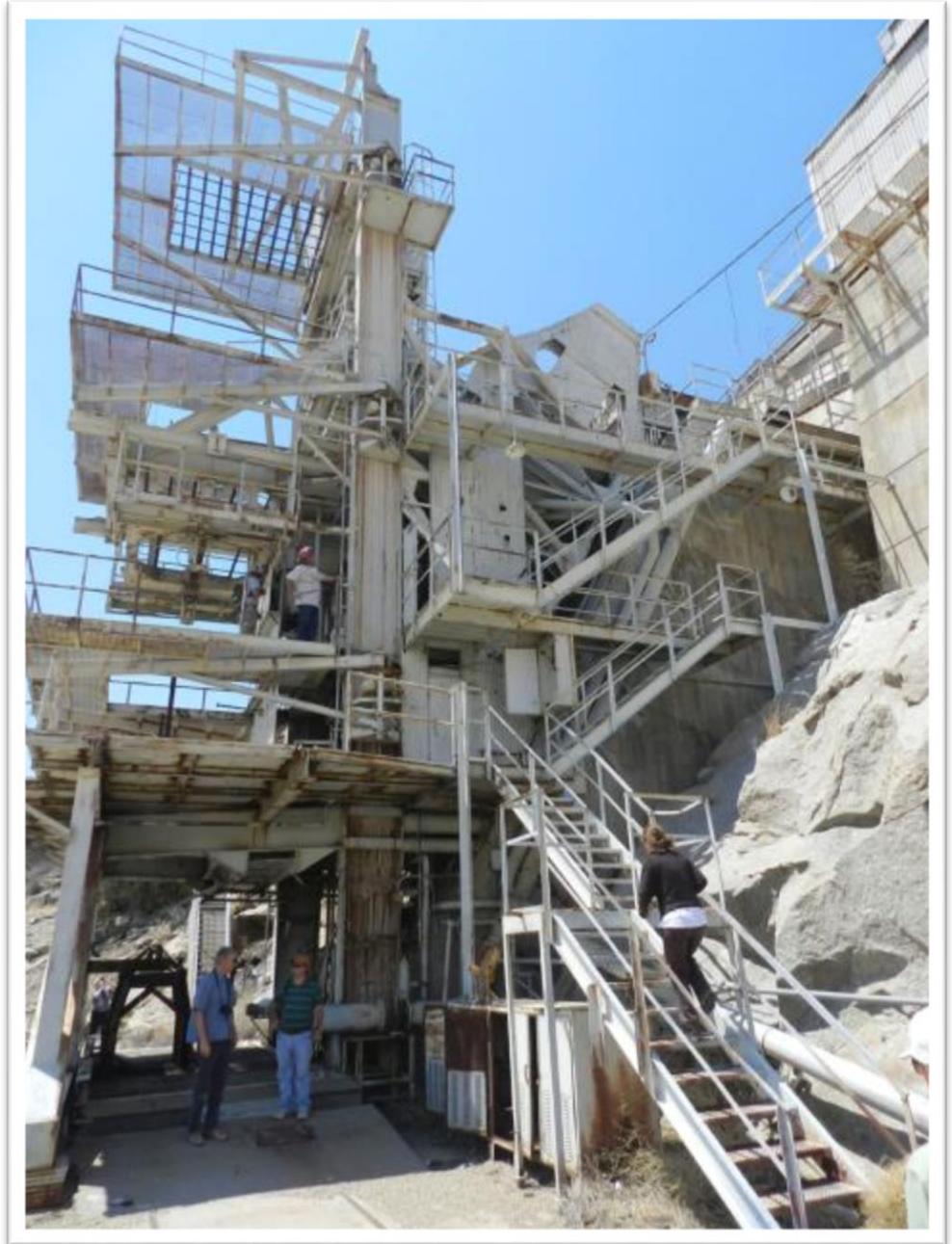
Only four features were surveyed in the area around main post. Two of the sites were marked on maps as mining sites, but were only sand & gravel mining operations. The other two sites were ruins associated with the V2 rocket program conducted in the 1940s.

MS1 Ruin

Date: 6.7.11
Bat Count: 1

This site is the Rocket Testing Lab of Dr. Werner Von Braun. This large concrete and steel complex contains tunnels and other underground structures that are ideal for bat roosts. Our survey identified a single Townsend's big-eared bat (*Corynorhinus townsendii*), and noted scattered and piles of guano in the concrete tunnel. The complex nature of the site offers many opportunities for bats roosts throughout.

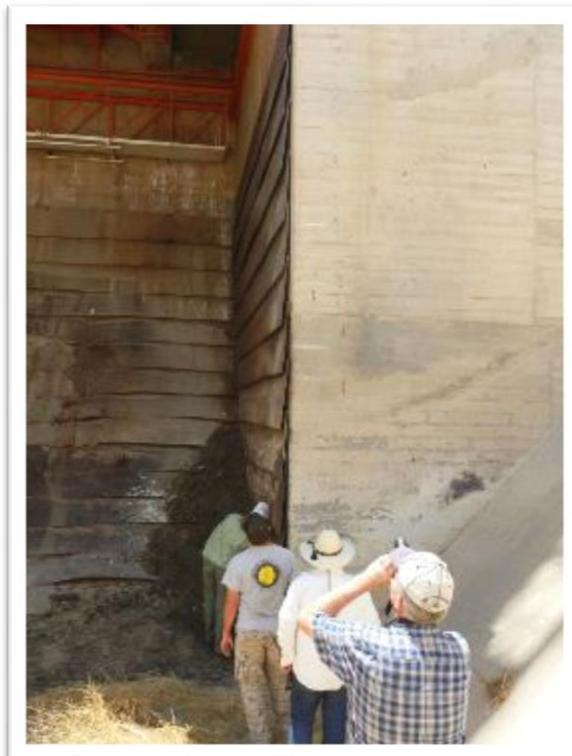
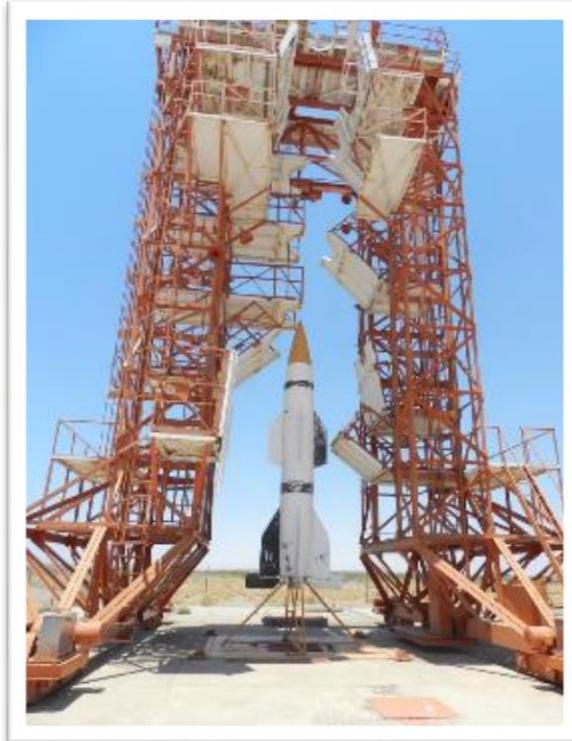


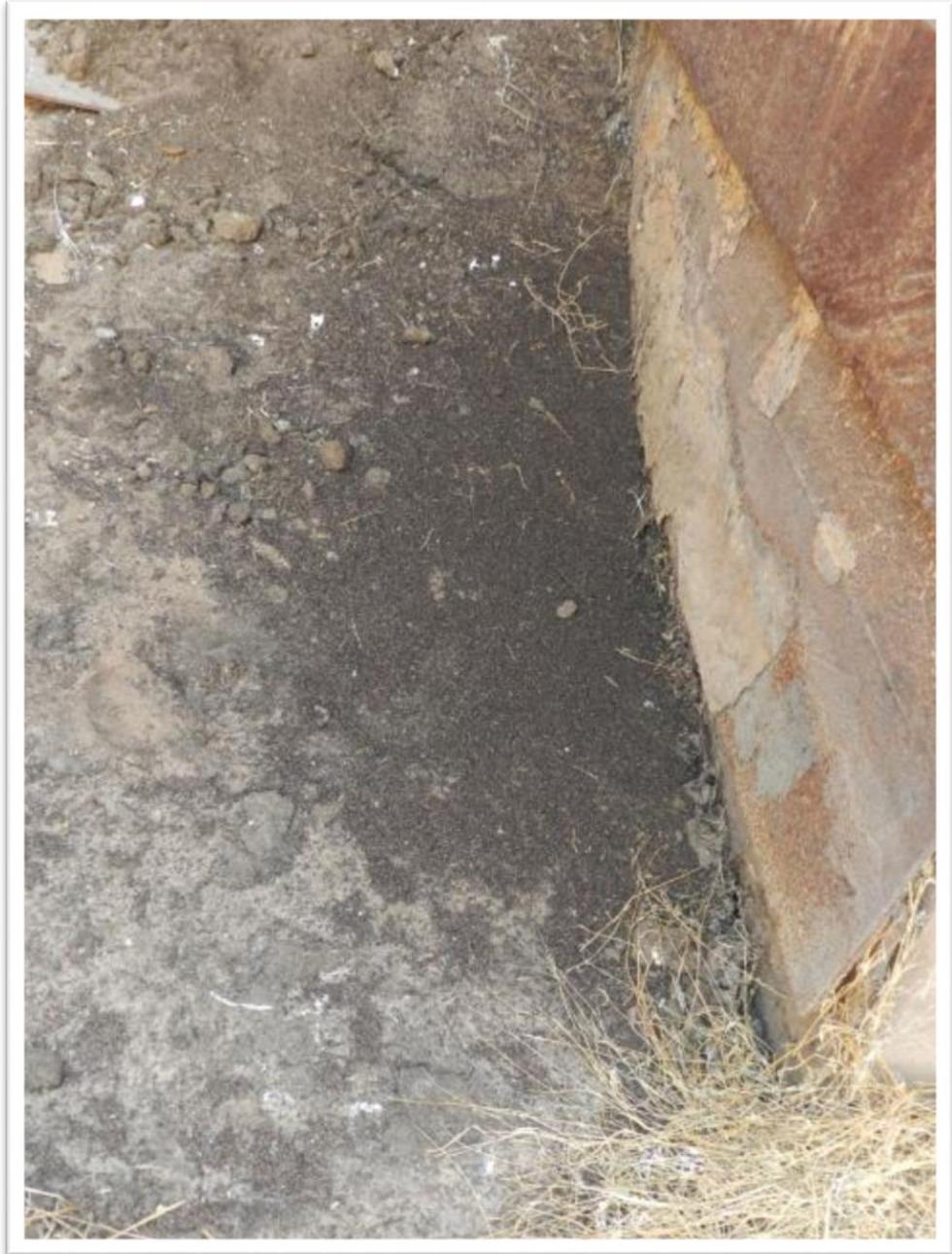


MS2 Ruin
V2 Gantry

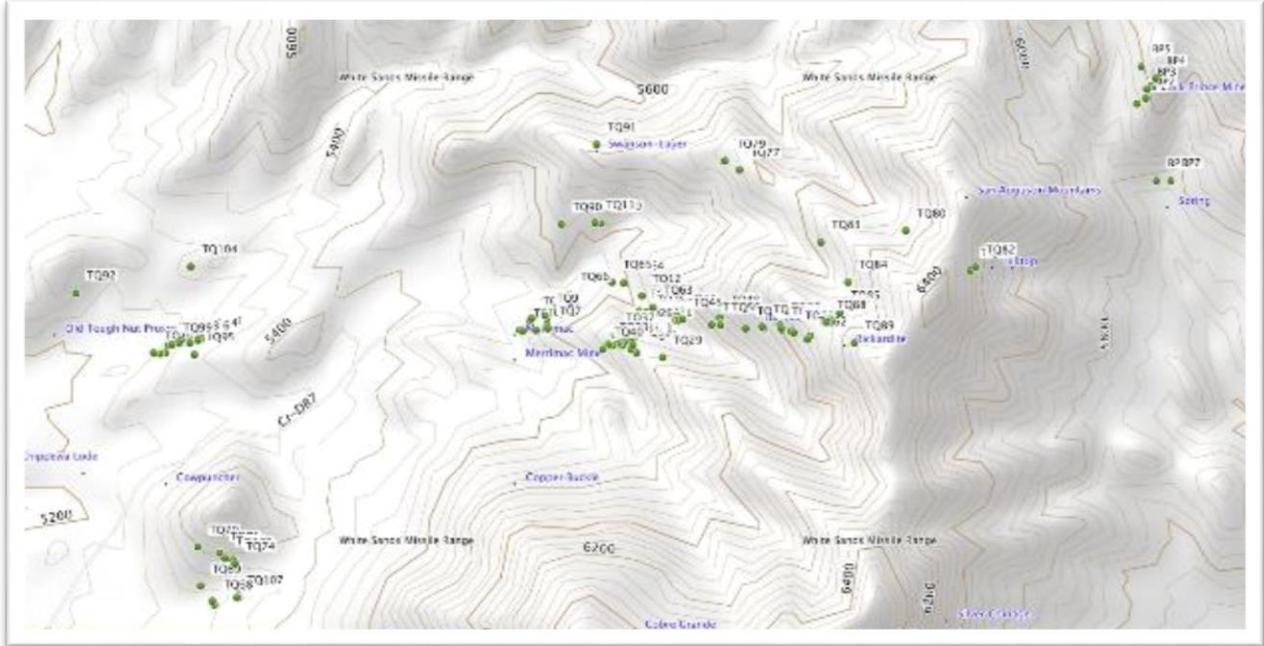
Date: 6.7.11
Bat Count: 200

This unique site was used as a launching pad for the Dr. Von Braun's V2 rockets. The overlapping metal heat shields below the rocket offer ideal habitat for the 200 Mexican free-tailed bats (*Tadarida brasiliensis*) roosting at this site. Note the large guano pile as indicative of a Mexican Free-tailed bat roost.





Organ Mountains (2)



The above area is accessed from the west side of the range, through a privately owned and active rock quarry. Because of this, the area is rarely visited and sees little visitor impact. The manager of the quarry is a mining engineer and is very knowledgeable about the mines in the area (based on personal communications). Most of the 112 mine features in this area consist of short shafts or prospect pits, but a few features are significant sized systems with railed haulage tunnels, headframe remnants, and complex underground workings. These large systems offer ideal bat habitat which was later confirmed by the presence of bat roosts in the mines. The significant features in this area are discussed below.

TQ1 Adit
Davey Jones Mine

Date: 2.3.12
Bat Count: 3

The name of this mine is the Davey Jones, but it is also referenced as the Merrimac Mine. This mine is a medium sized, multilevel, production class system with multiple entrances, drifts and a winze. The mine follows a diagonal outcropping of lead/zinc ore, and contains flooded water at the bottom of the winze. Our winter survey noted three Townsend's big-eared bats (*Corynorhinus townsendii*), but our summer revisit survey noted no bat usage. The local mining engineer has reported large summer colonies in past years.



BP5 Adit

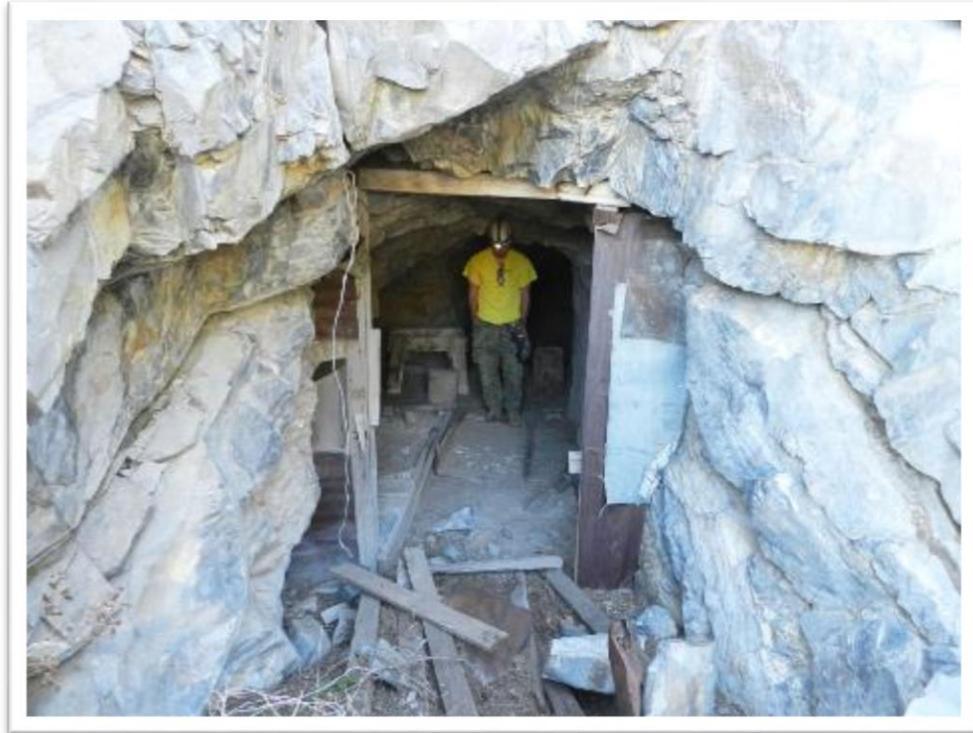
Date: 7.11.12
Bat Count: 1

This simple adit is 100 ft. in length and seasonally contains water. The entrance is obscured by terrain, but the site is used by deer as evident by the numerous tracks in the mud. A single Townsend's big-eared bat (*Corynorhinus townsendii*) was noted during our summer survey.

TQ80 Adit
Hilltop Mine

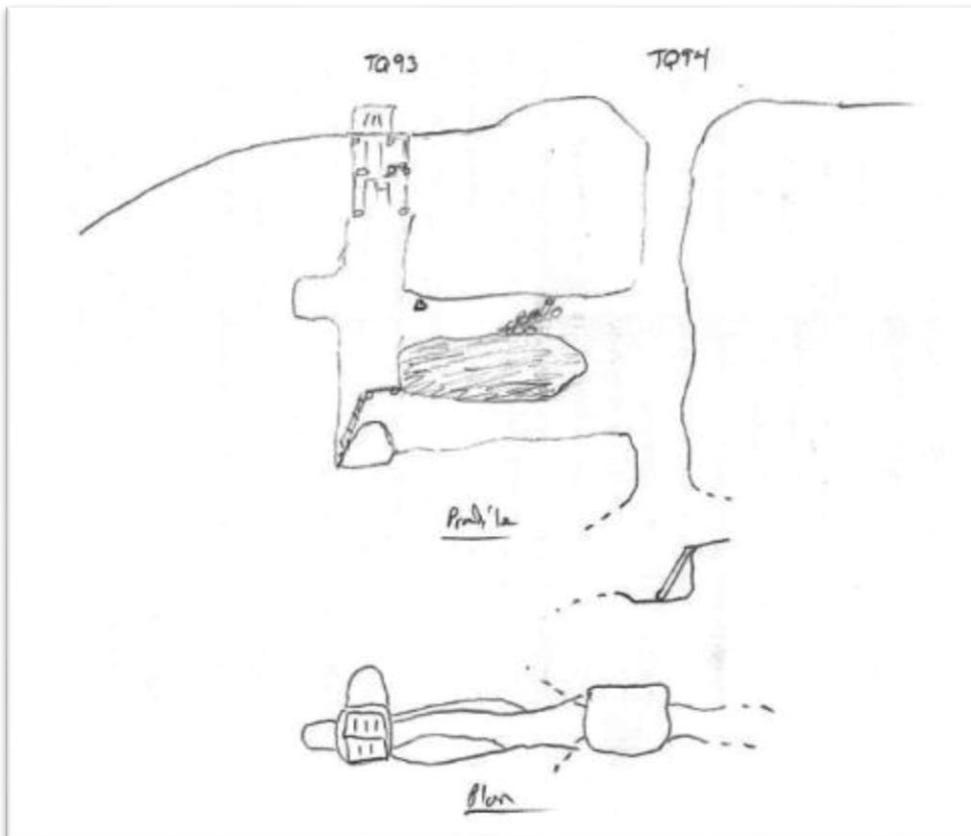
Date: 2.28.12
Bat Count: 14

This site is known as the Hilltop Mine, which is a complex production level mine with three entrances. These entrances create moving airflow conditions that are favored by roosting Townsend's big-eared bat (*Corynorhinus townsendii*) as evidenced by the fourteen bats recorded during our winter survey. A later summer revisit noted only a single Townsend's big-eared bat at the mine. This site also contains a wide variety of mining artifacts and ruins that have not been disturbed due to its remote location.

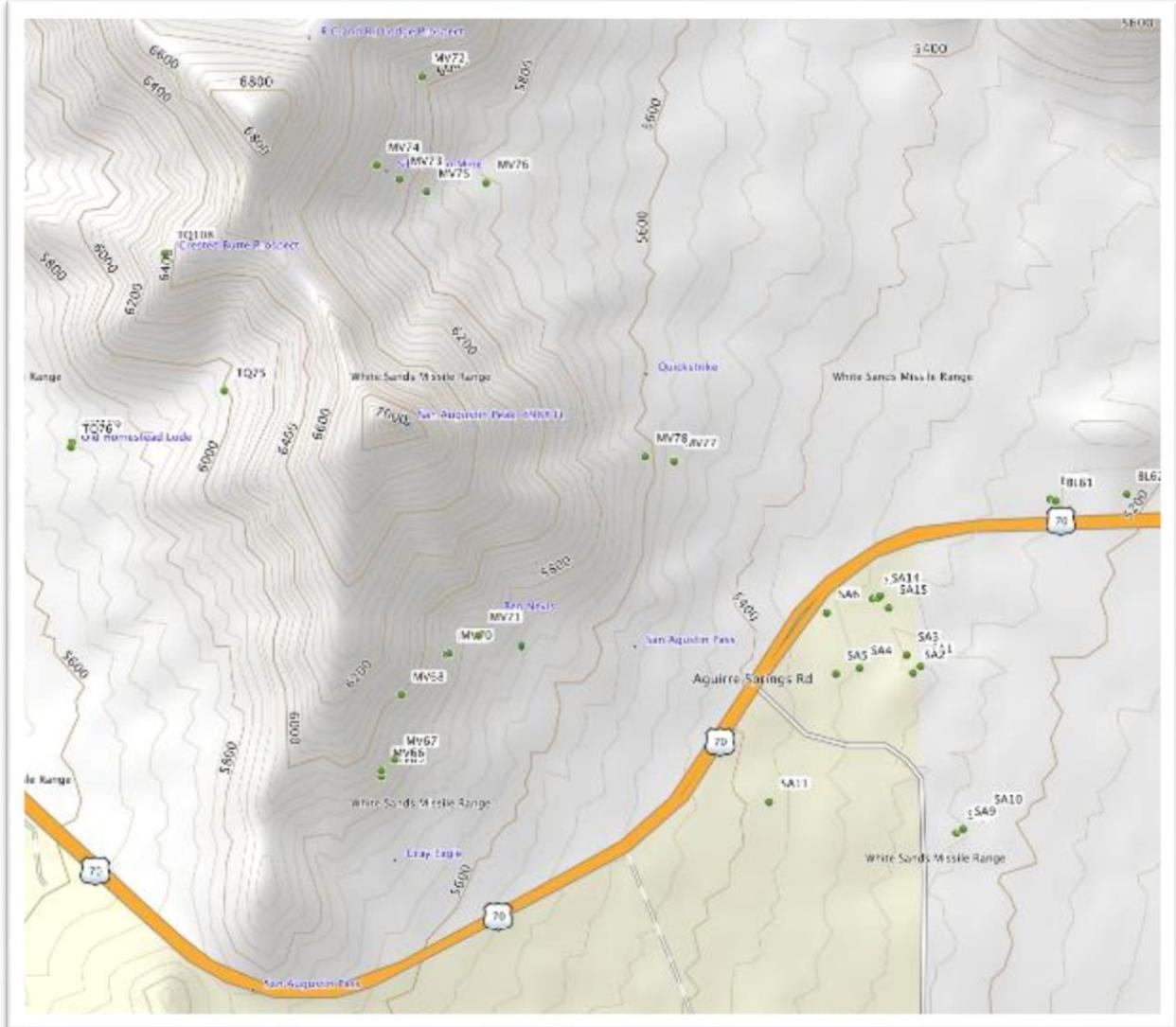


TQ93 Shaft
Date: 3.2.12
Bat Count: 1

This shaft is covered with tin roofing and drops 40 ft. to complex mine workings. A single Townsend's big-eared bat (*Corynorhinus townsendii*) as was noted during the survey.

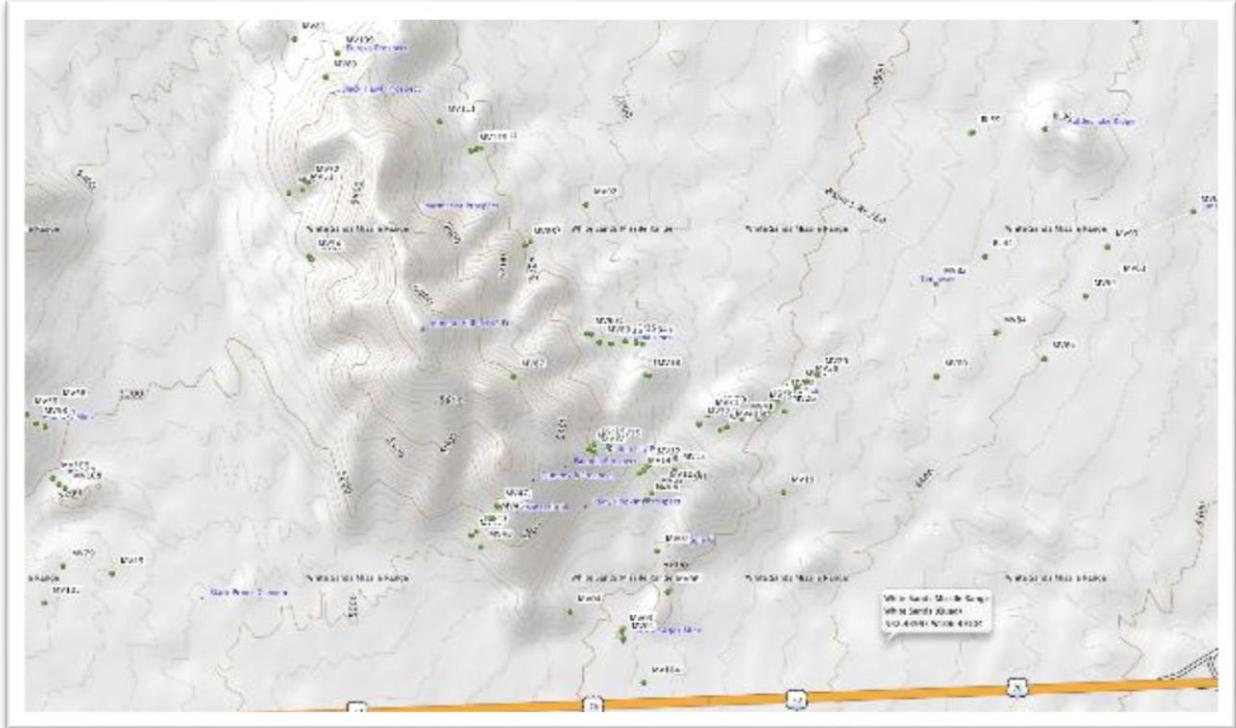


Augustin Peak (3)



The Augustin Peak area mines consist of 34 features, organized into groups of short adits and shallow shafts in decomposing granite. Due to the weak rock, many of the mine features have collapsed, or are in the process of collapsing. This decomposing granite is also porous and supports water flow which results in many of these mines having sections that are flooded. This water source is clearly used by local wildlife as noted by the abundant scat at some of these sites. The MV78 Adit (Quickstrike Mine) and MV72 Adit both have flooded winzes, the MV73 Adit and MV71 Adit (Ben Nevis Mine) both have puddles and a wet floor. The mine features that are not adjacent to the peak are located near Highway 70 on the east side of the map and are mainly short shafts and prospect pits. No bats were noted at any of the sites in this area.

Mineral Hill (4)



This area encompasses a large section with 94 mine features of varying types. Many of the mine features are located around Mineral Hill, and consist of short adits and prospect pits. The SE end of Mineral Hill contains a series of mines that are situated along a NE by SW band of quartz deposits. Most of these mines are shafts and prospect pits dug into the quartz dike. These shafts are normally 30 to 40 feet in depth and located linearly along the dike. As with most shafts on the range these features did not host any bat roosts. The horizontal adits and a single 45 degree decline shaft offered a few bats roost sites. Being somewhat close to the main post, and with easy access from Route 70, this area sees a lot of human activity and it would be appropriate to increase the priority for fencing and closures in this section.

MV59 Adit
H&H Mine

Date: 6.4.11
Bat Count: 1

This mine is known as the H&H Mine which is an abbreviation for the Hammer & House Mine. It consists of a straight-tunneled adit that is dug in granite, and extends 32 feet into the hillside. A single Townsend's big-eared bat (*Corynorhinus townsendii*) was noted during our summer survey.



MV15 Adit

Date: 4.27.11

Bat Count: 2

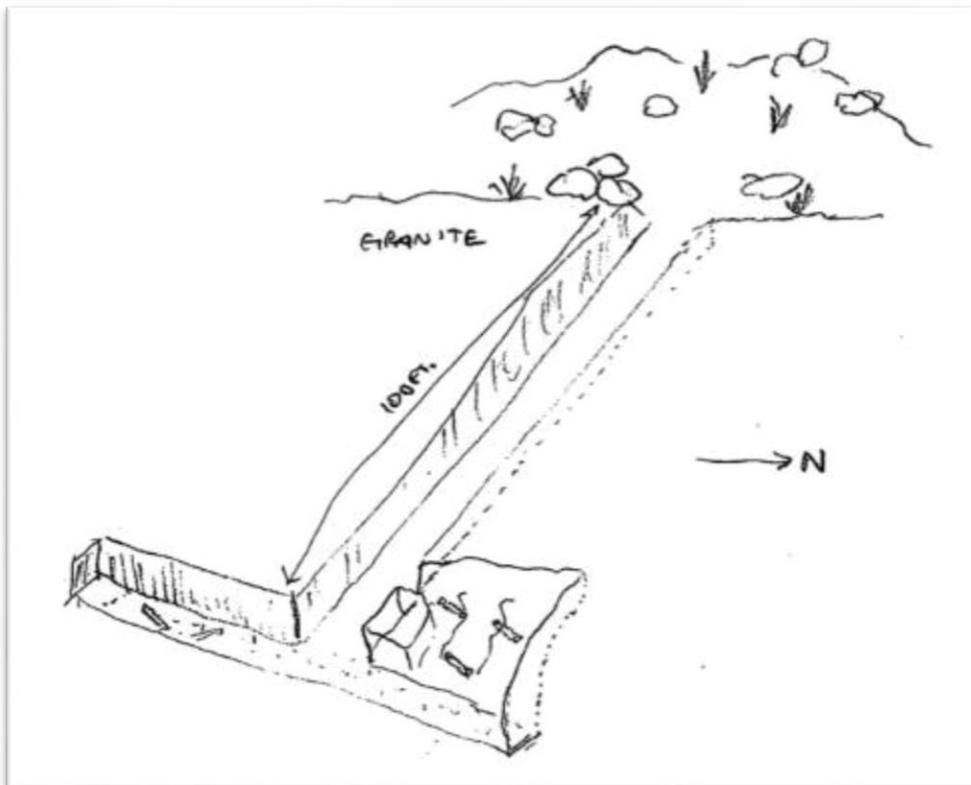
This site is a large production class system with 400 ft. of workings, multiple drifts, and metal railways. A large single piston pump with flywheels dominates the site. There were two cave myotis (*Myotis velifer*) roosting at this mine during our spring survey. This site is an ideal bat roost due to the size of the mine, remote location, and the year-round pool of water in one of the side drifts.



MV01 Shaft
Rock of Ages Mine

Date: 4.27.11
Bat Count: 1

This decline shaft is known as the Rock of Ages Mine, and is located near a commonly used dirt road. This shaft descends 100 ft. to a perpendicular drift extending from both sides of the passage. A ringtail cat was noted at the bottom of the shaft, and a single cave myotis (*Myotis velifer*) was noted roosting midway down the drop.



MV02 Shaft
Rock of Ages Mine
Date: 4.27.11
Bat Count: 1

This decline shaft is part of the Rock of Ages Mine group, and is located adjacent to the main shaft. This shaft descends 50 ft. and contains a drift at the 20 ft. level. A single Townsend's big-eared bat (*Corynorhinus townsendii*) was found roosting in this drift.



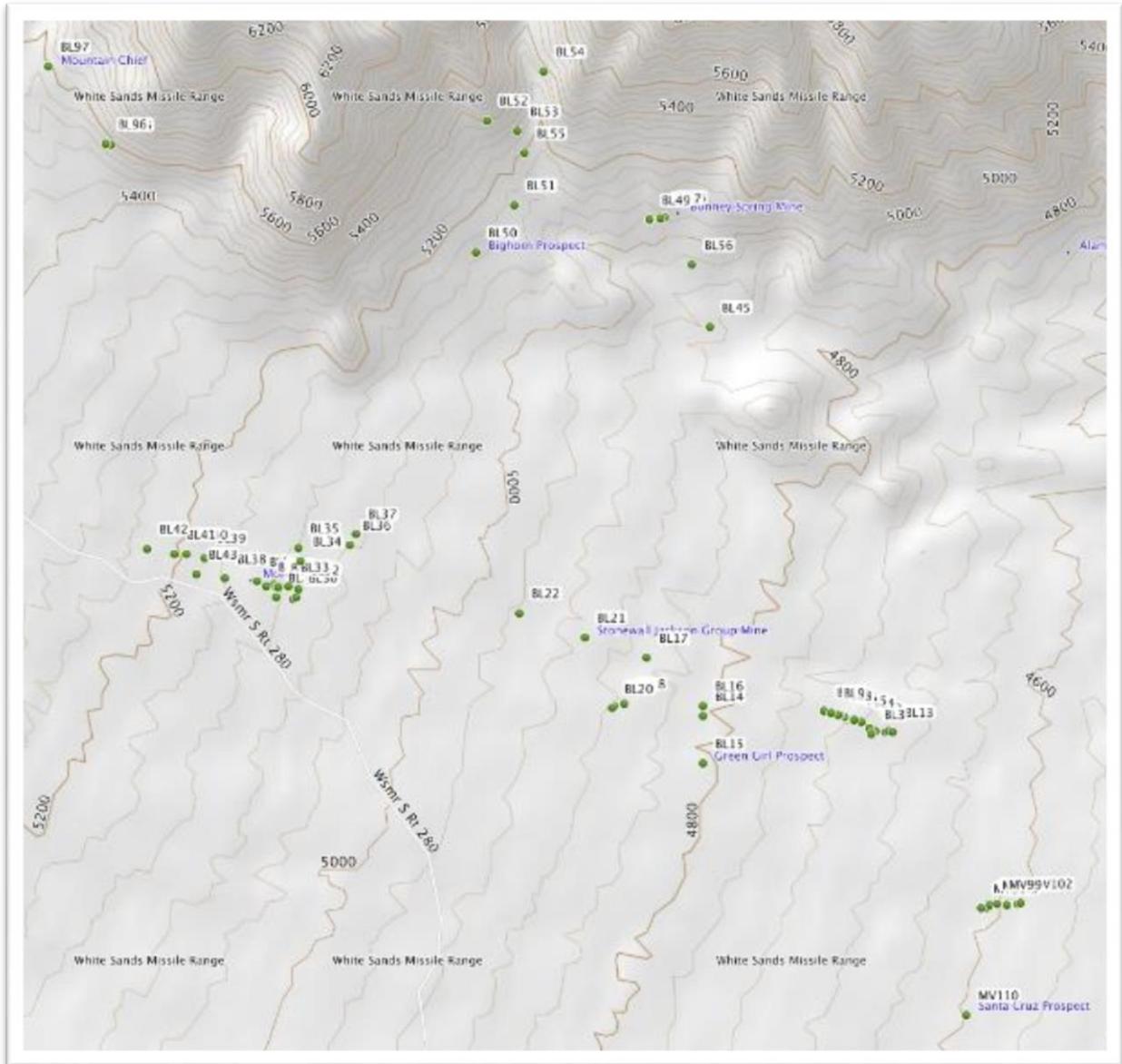
MV35 Adit
Doña Dora Mine

Date: 6.7.11
Bat Count: 1

A large mine with huge dump piles, a haulage tunnel, and connecting shafts. The multiple entrances provide airflow in this mine, which makes this site ideal for the single Townsend's big-eared bat (*Corynorhinus townsendii*) that we recorded in the adit. Multiple large guano piles are evidence of greater seasonal bat usage.



Black Mountain (5)



This section consists of 68 features, organized into groups of adits and shafts on the Black Mountain hillside, and shafts and prospect pits in the valley floor. Most of the hillside sites have no road access and require hiking to reach the features. The valley floor sites are easily accessible from dirt roads, and generally follow east/west bands of mineral deposits.

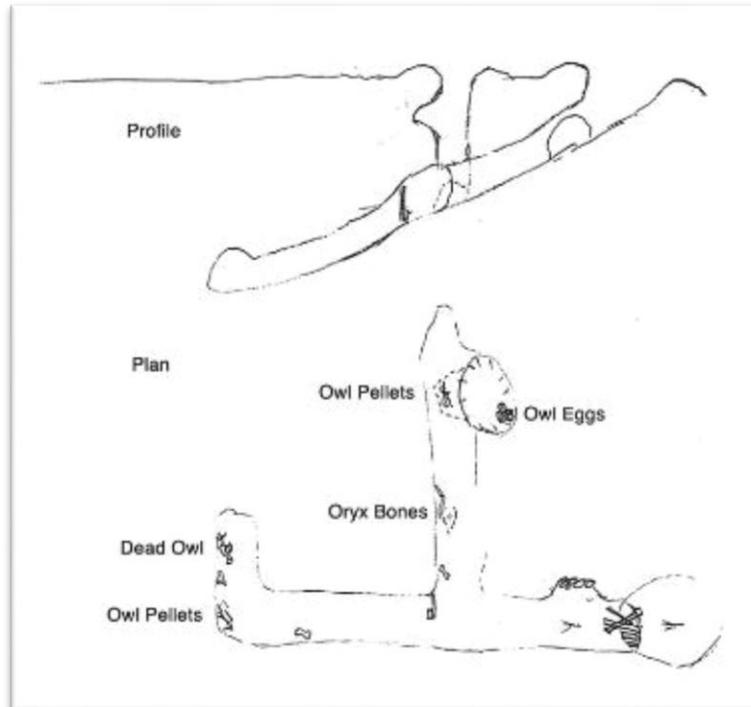
MV97 Shaft

Date: 6.7.11

Bat Count: 1

This decline shaft drops 20 ft. to intersect a horizontal drift, and also connects to MV103 decline shaft. The site is a roost for owls and contained owl eggs during our June survey. The feature also contained a dead Barn Owl (*Tyto alba*) and the remains of a young Oryx (*Oryx gazelle*). A single Townsend's big-eared bat (*Corynorhinus townsendii*) was noted roosting at this site.





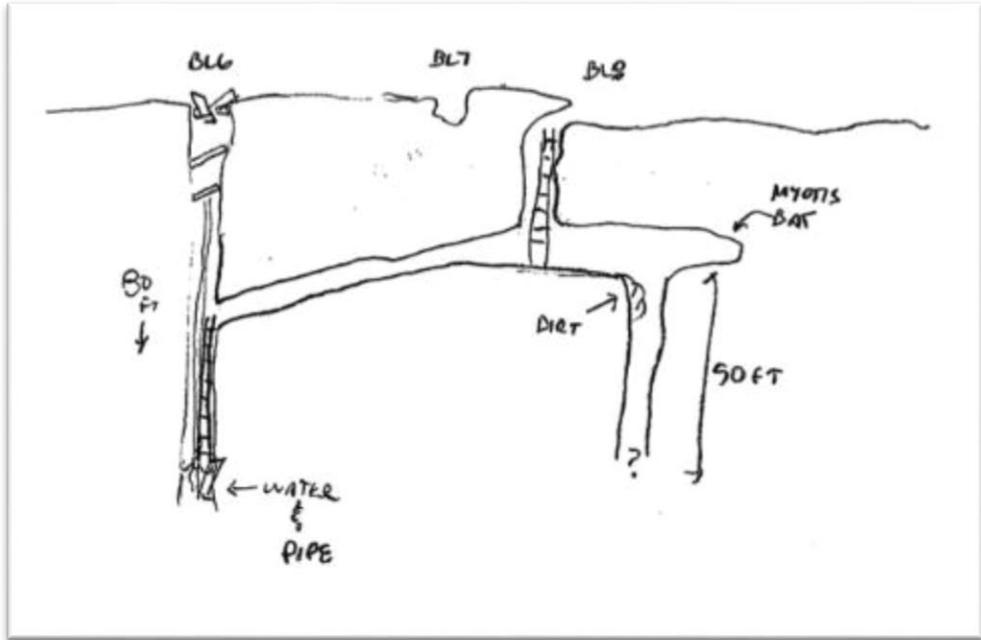
BL8 Shaft

Date: 7.8.11

Bat Count: 1

This shaft is hidden in the the brush and drops down to a horizontal drift that connects to BL6 Shaft, which has collapsing rotten wood at the shaft collar. The mine system contained a single *Myotis* bat (*Myotis* spp.).





BL54 Adit

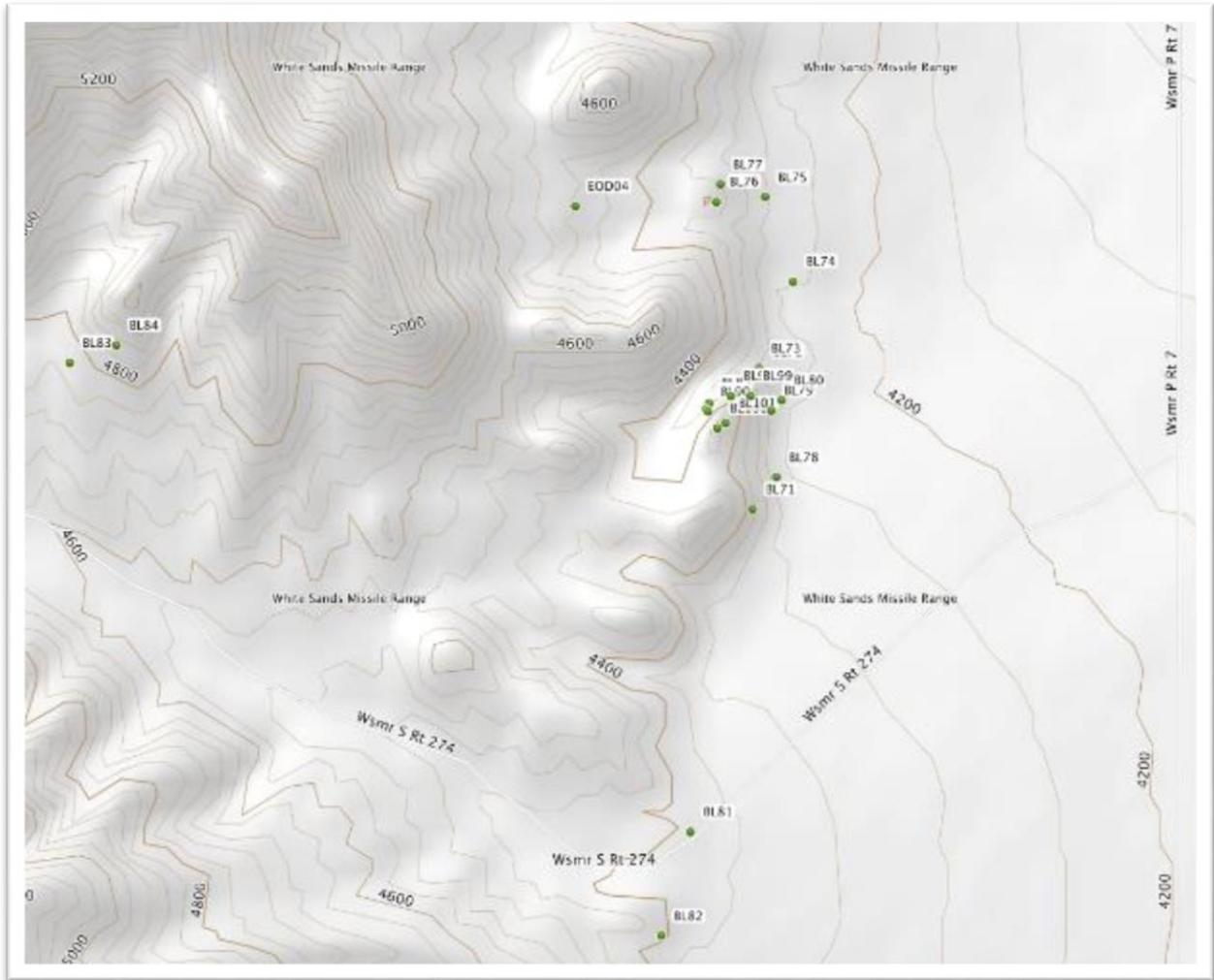
Date: 7.10.11

Bat Count: 1

This horizontal adit is located high up a canyon with no evidence of a road to the site. A large International Harvester engine with a flywheel assembly is located at the entrance. The adit is 375 ft. in length and contained a single Townsend's big-eared bat (*Corynorhinus townsendii*).



Fairview Mining District (6)



This area consists of 22 features, with adits and shafts grouped within three main areas. The western hillside features are simple shafts, the central group are shafts and adits along a ridge, and the northern group consists of an adit and shafts on a single hillside. The central and northern groups have moderated sized mine workings and both areas host important bat habitat sites. Most of the central group of features are located up a small drainage and are hidden from view.

BL75 Adit

Date: 7.11.11
Bat Count: 40

This important site is host to a maternity colony of 40 Townsend's big-eared bats (*Corynorhinus townsendii*). While visiting the site periodically over multiple seasons, our team noted that the bats seem to use this site for pup birthing and then stay at this location until the pups are volant. The colony then moves the roost to BL89 Adit, which is larger and more complex, offering a higher diversity of localized microclimates. This site is visible from a busy paved road, and is at risk of negative impacts from curious base personnel. Our recommendation would be to monitor the site for human disturbance for at least a year and then decide if a gate is warranted. The best option would be to leave the site as-is.



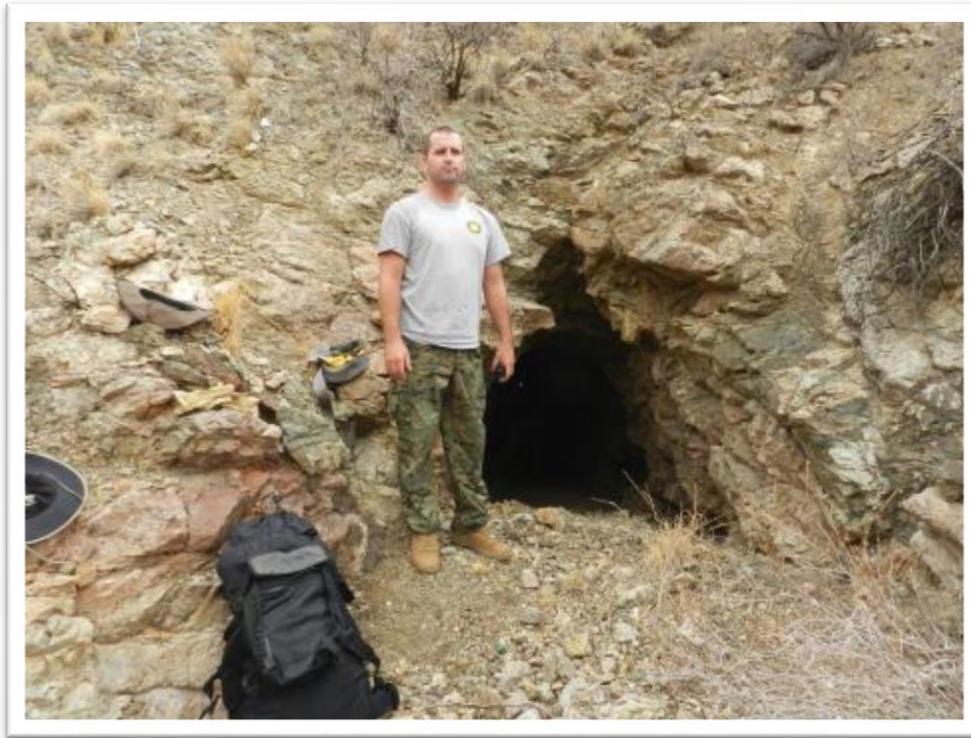


BL88 Adit

Date: 8.7.12

Bat Count: 5

This short adit is one of the roost sites that the Townsend's big-eared bats (*Corynorhinus townsendii*) move to after roosting at the BL75 maternity adit. This mine is also used by Oryx (*Oryx gazelle*), as a summer shade site. During one of our site visits an Oryx charged out this adit just as our survey team approached the entrance. Since this site is one of the alternate roosts of the BL75 adit maternity colony, we recommend that this adit be monitored for human disturbance and left as-is if possible and gated if needed.



BL94 Adit

Date: 8.18.11
Bat Count: 1

This short 27 ft. adit is also one of the roost sites that the Townsend's big eared bats (*Corynorhinus townsendii*) move to after roosting in the BL75 maternity adit.



BL89 Adit

Date: 8.15.11

Bat Count: 40

This adit opens into a medium sized, complex mine system with two entrances (BL90), and a variety of localized microclimates ideal for bat roosts. Most of the Townsend's big-eared bats (*Corynorhinus townsendii*) from the maternity roost in the BL75 adit move to this site after the pups are volant.

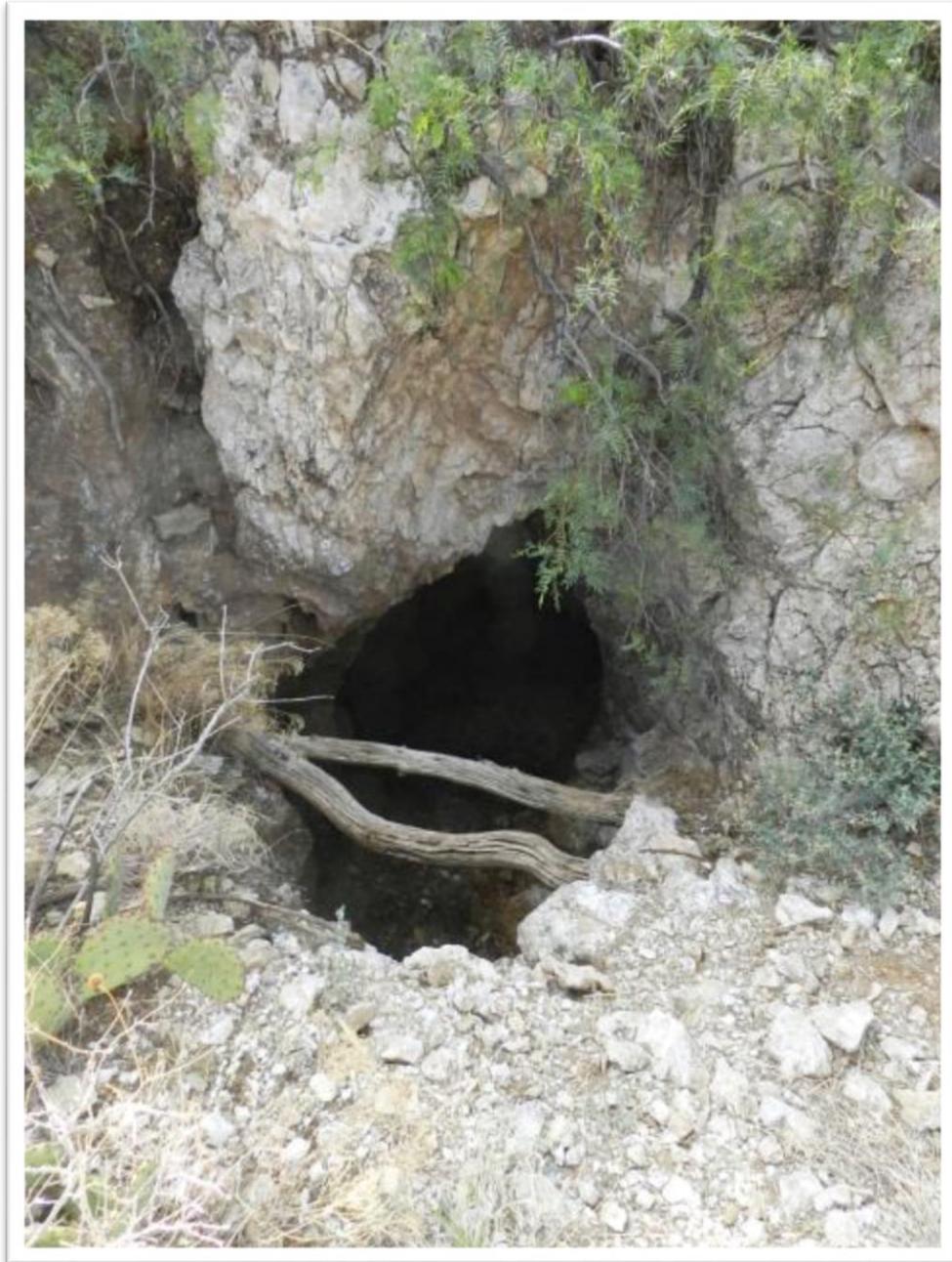


TM14 Adit
Red Rock Mine

This small adit is located far from traveled roads and offers an undisturbed roost site for a single Townsend's big-eared bat (*Corynorhinus townsendii*).

Date: 8.16.11

Bat Count: 1



TM24 Adit
Victorio Peak Mine

Date: 2.1.12
Bat Count: 82

This large and complex mine system has multiple entrances at varying elevations on the hillside. Due to its size and configuration, this site contains a variety of microclimates ideal for bat roosts. This mine is very unique in that no ore was ever mined from the site as all of the tunnels and working were dug looking for lost Spanish treasure. No treasure was ever found at the site and all the money and effort expended at this mine happily resulted in the creation of an excellent bat habitat. The site is protected by a gate at the main culvert adit entrance, but during our surveys we noted that the gate is always unlocked. Other entrances to the mine have coverings that are not bat friendly, and one sheltered entrance has no gate, but opens into high passages that are not easily traversed.

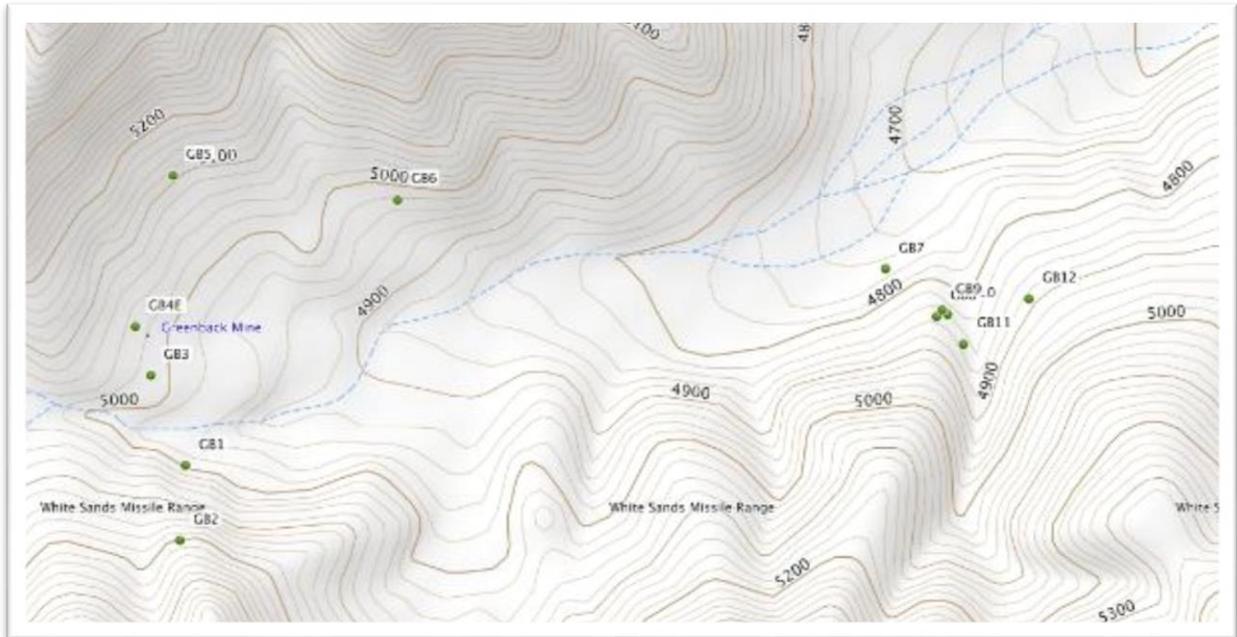
During our survey of Feb. 2, 2012 we recorded 82 Townsend's big-eared bats (*Corynorhinus townsendii*) roosting singularly and in clusters. This site may be one of the largest Townsend winter hibernaculum on WSMR.







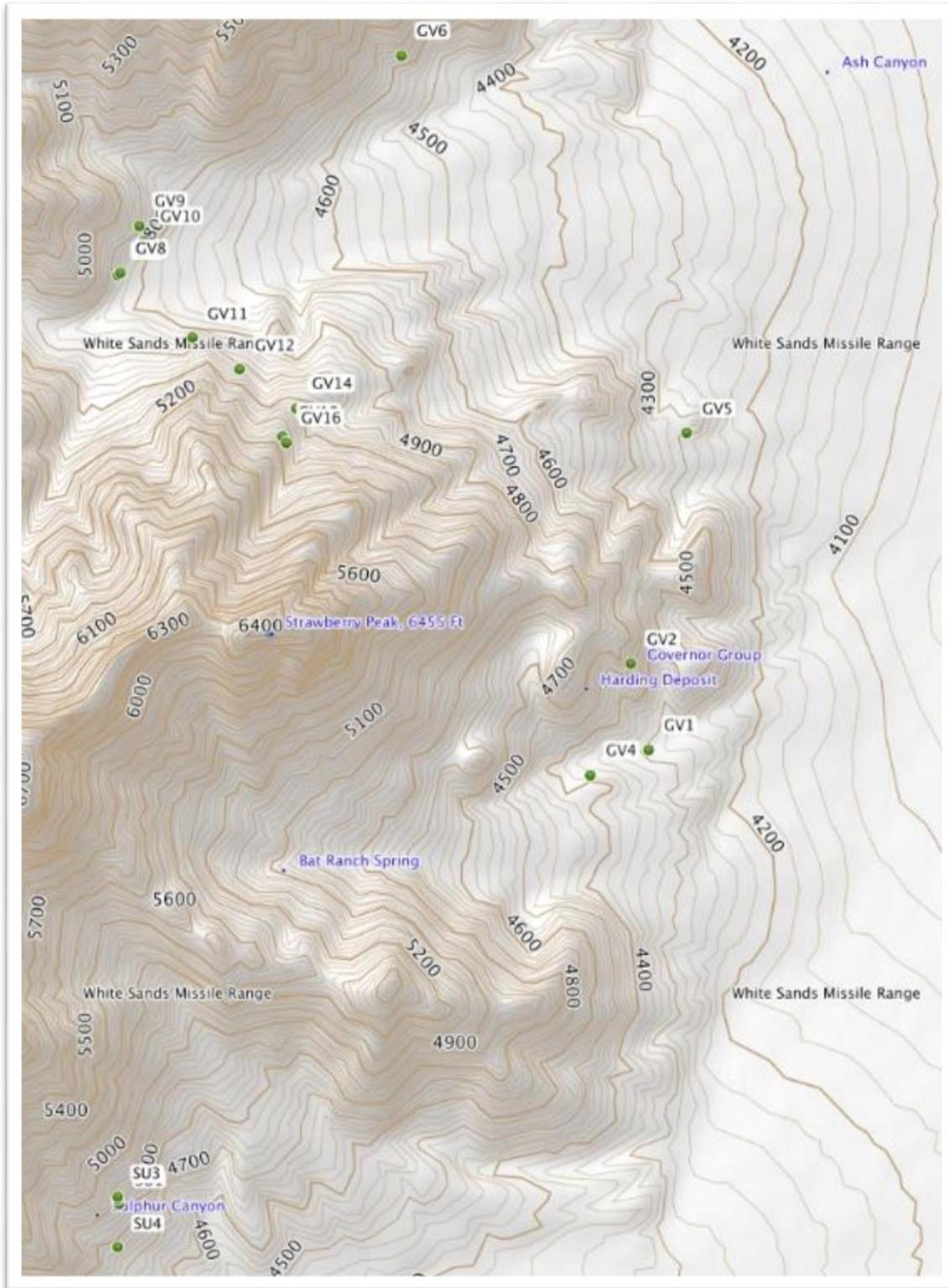
Grandview Canyon (8)



This area contains 16 features consisting of a variety of adits, shafts and prospects pits. All of the features are simple in structure and small in size and offer poor to no bat habitat opportunities. Since access to the site is difficult, the area receiving little traffic, it requires minimal management efforts.



Ash Canyon (9)



This zone contains a variety of 20 mine features that are spread out over a wide area in Sulphur and Ash Canyons. The Sulphur Canyon features consist of a few simple shafts. The Ash Canyon features are mixture of shafts, prospect pits, trenches, and short adits. None of the features in this area showed sign of bat usage.





Salinas Peak (11)



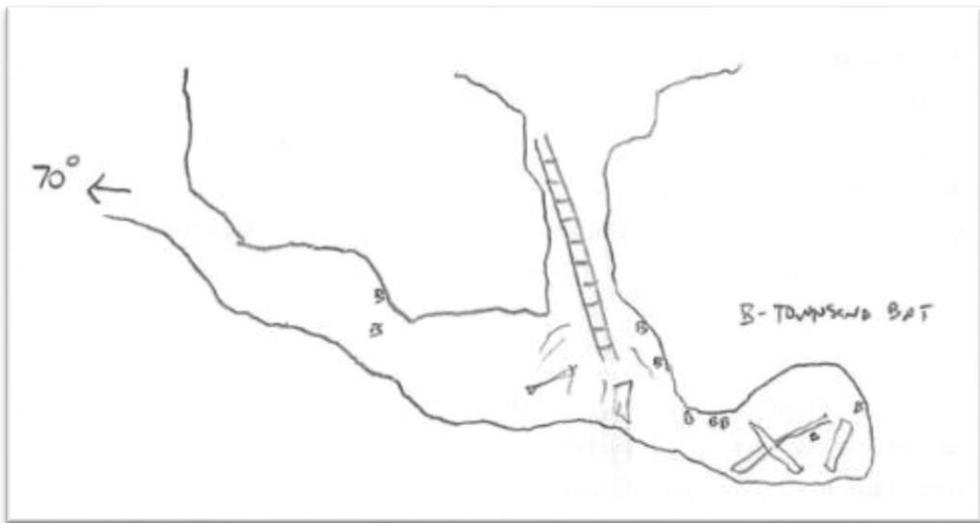
The Salinas Peak area consists of 18 features that are mostly adits, with a few intersecting shafts. These mines have moderate sized workings with complex configurations that produce a variety of microclimates ideal for bat usage. During our winter survey of this area, we noted that a large percentage of these adits contained winter hibernaculum roosts. Many of these mines contain multiple entrances from adits and shafts, and produce the strong airflow that is favored by Townsend's big-eared bat (*Corynorhinus townsendii*) roosts.

SL3 Adit

Date: 1.31.12
Bat Count: 9

This horizontal mine passage extends 100 ft. to a small room, with a vertical shaft intersecting the adit at a point 75 ft. into the passage. This second entrance, at a higher elevation, produces strong airflow in the mine, which is a favored condition of the 9 Townsend's big-eared bats (*Corynorhinus townsendii*) that we noted during our winter survey.





SL9 Adit

Date: 1.31.12

Bat Count: 5

This moderate sized mine has three entrances and complex workings. Many of the passages are shored with cedar timbers, and there are sections of ore cart rails that lead to a moderate sized external rock dump pile. During our winter survey we recorded 5 Townsend's Big-eared bats (*Corynorhinus townsendii*).



SL12 Adit

Date: 1.31.12

Bat Count: 1

This adit extends 100 ft. into the hillside, with a pair of short forking passages at the end. During our winter survey, we recorded a single Townsend's Big-eared bat (*Corynorhinus townsendii*).

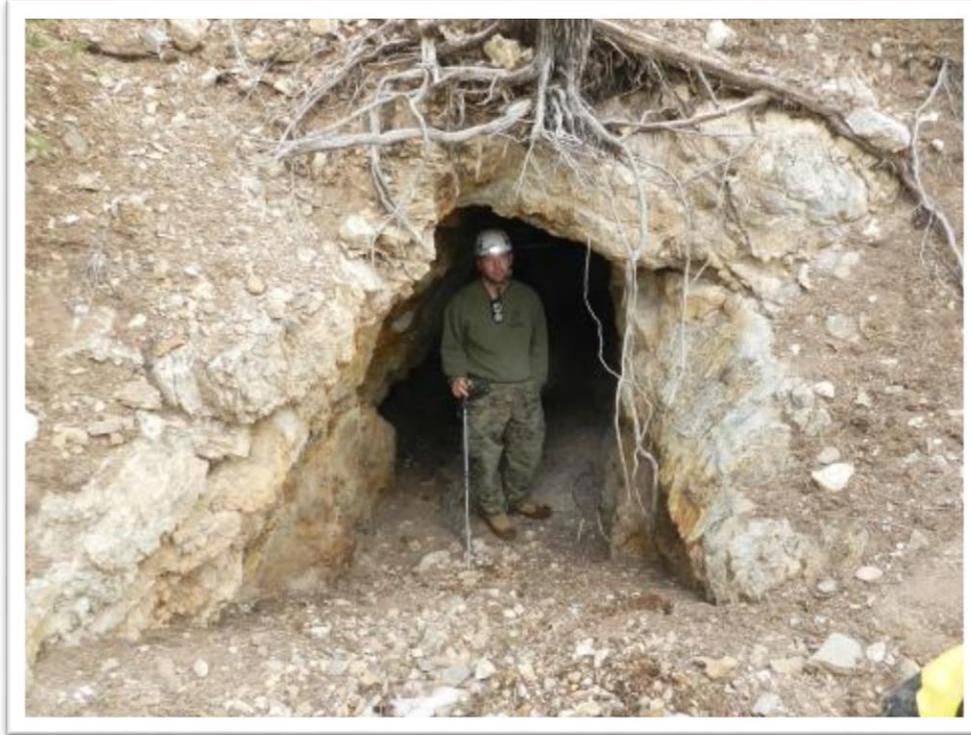


SL15 Adit

Date: 1.13.12

Bat Count: 3

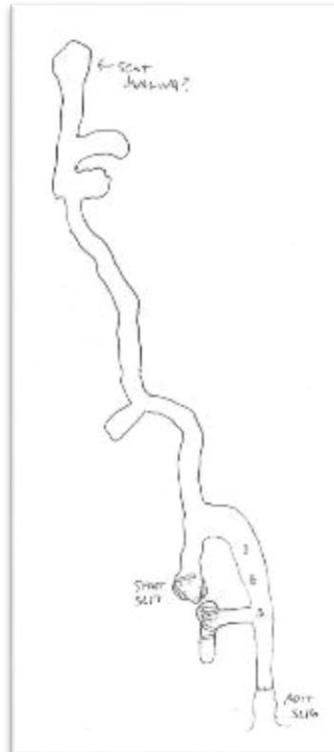
This adit extends 75 ft. into the hillside and terminates in a single room that contains a rat midden, various scat, and a shoring rock wall. Three Townsend's Big-eared bats (*Corynorhinus townsendii*) were present during our site survey.



SL16 Adit

Date: 1.31.12
Bat Count: 3

This adit is 300 ft. in length and has airflow between the main entrance and the intersecting SL17 shaft. The mine uses round log beams for shoring and rail ties, and there is still some rail near the entrance. During our winter survey we recorded 3 Townsend's big-eared bats (*Corynorhinus townsendii*).



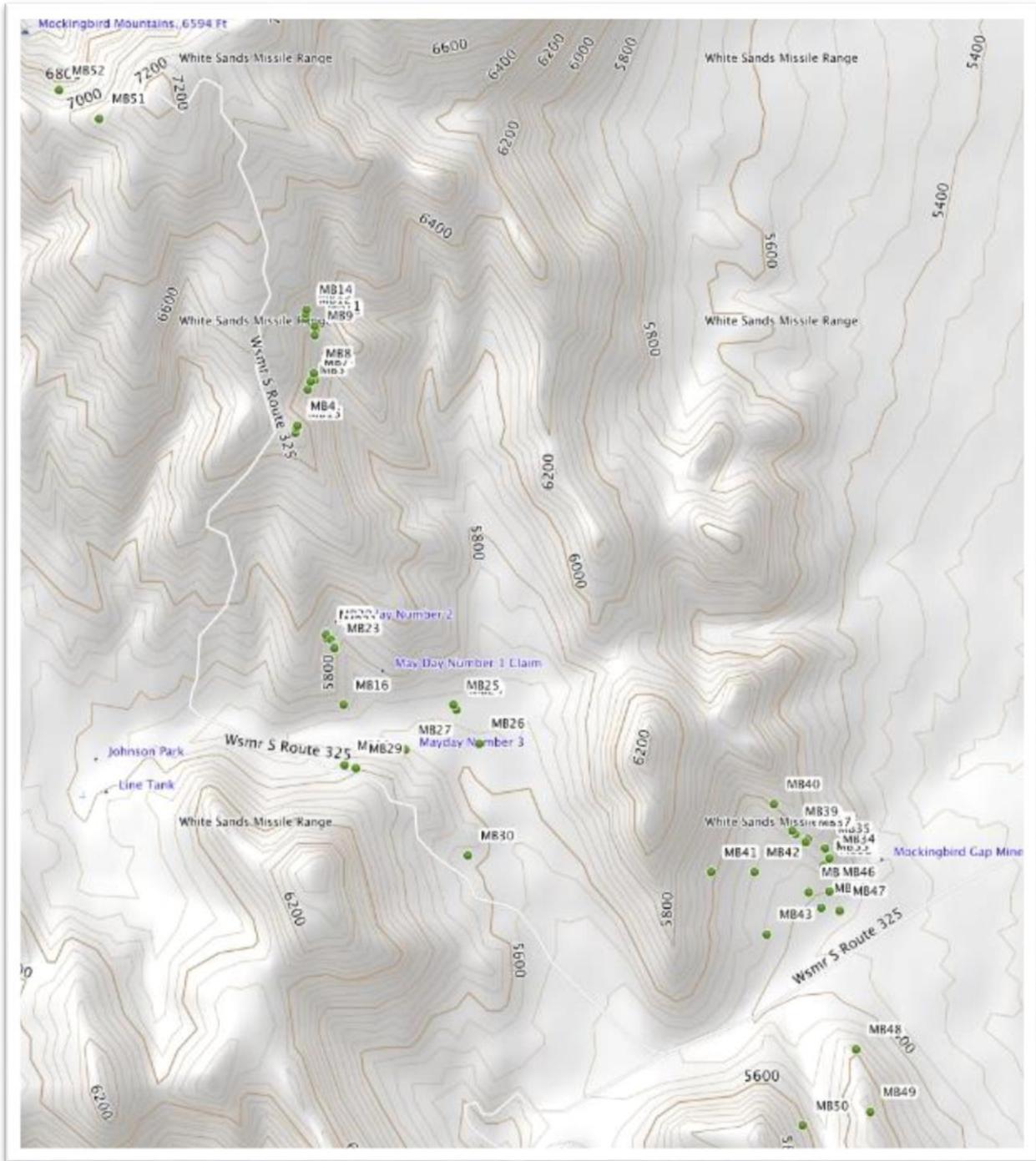
Capitol Peak (12)



This area contains 34 features that reside in the large valley on the west side of Capitol Peak. Most of the features are trenches, prospect pits, shallow shafts and “no feature” locations. Nearly all of these mines are small and simple sites. No bats or bat sign were located in any of the mine features in this area.



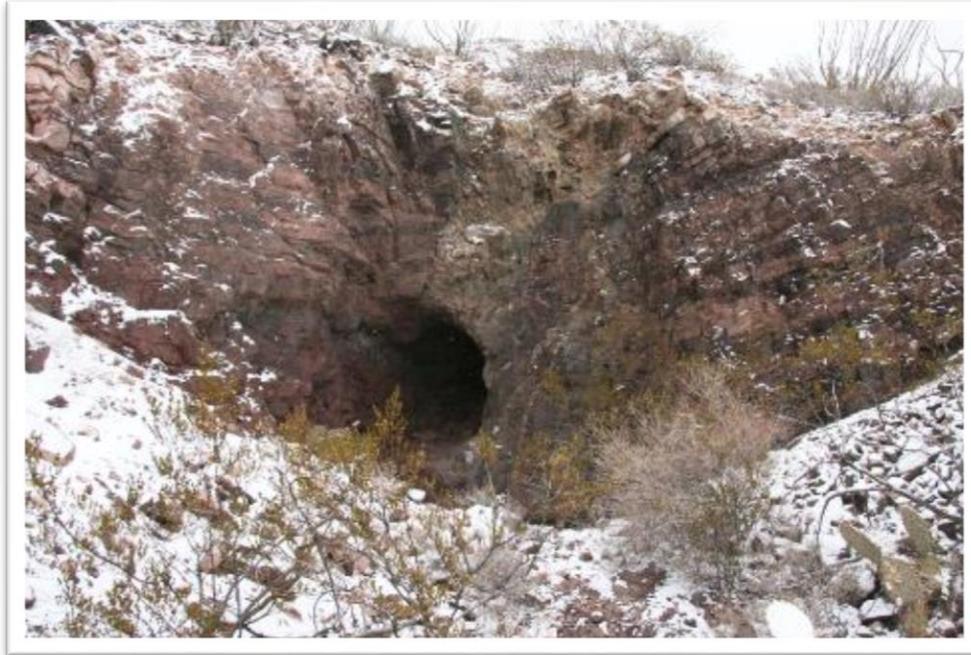
Mockingbird Peak (13)



This area consists of 52 mine features: adits, shafts, prospect pits, and trenches. The lower elevation group contains the important Mockingbird Gap maternity roost. The middle and higher elevation groups consist of simple features of minimal biologic interest.

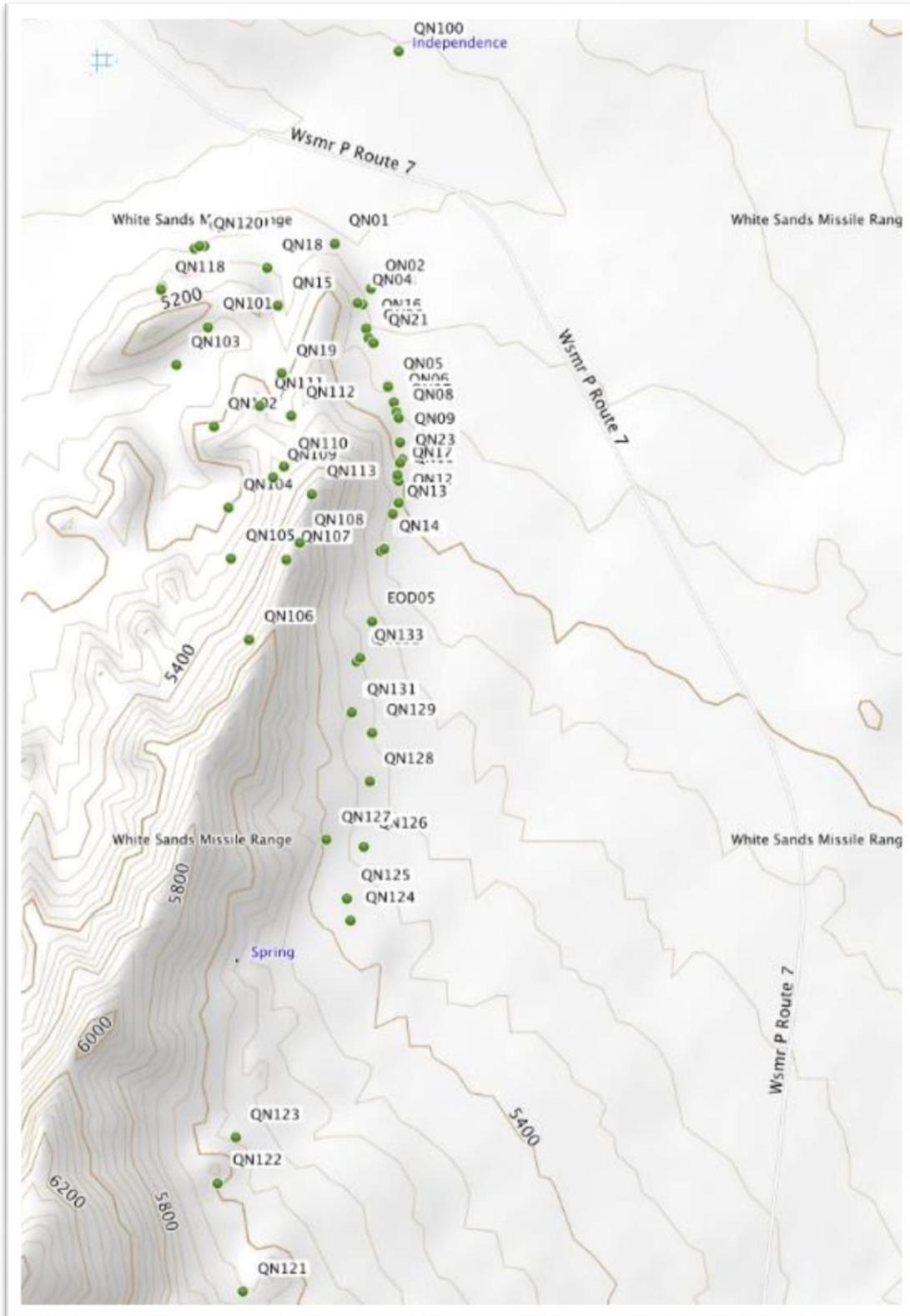
MB31 Adit
Mockingbird Gap
Mine
Date: 7.21.13
Bat Count: 400

This adit consists of a straight passage that extends 130 feet into the hillside. A vertical winze is located 75 ft. from the entrance and drops down 30 ft. along a rickety ladder. A large colony of 400 fringed myotis (*Myotis thysannodes*) uses a spot above the winze for their main roost.





Queen Townsite (14)



This area consists of a group of 59 mine features along the terminus ridge of Little Burro Peak. Most of the features in this area are simple prospect pits, trenches and shallow shafts. Two of the sites have significant workings, but only one feature contained bats.

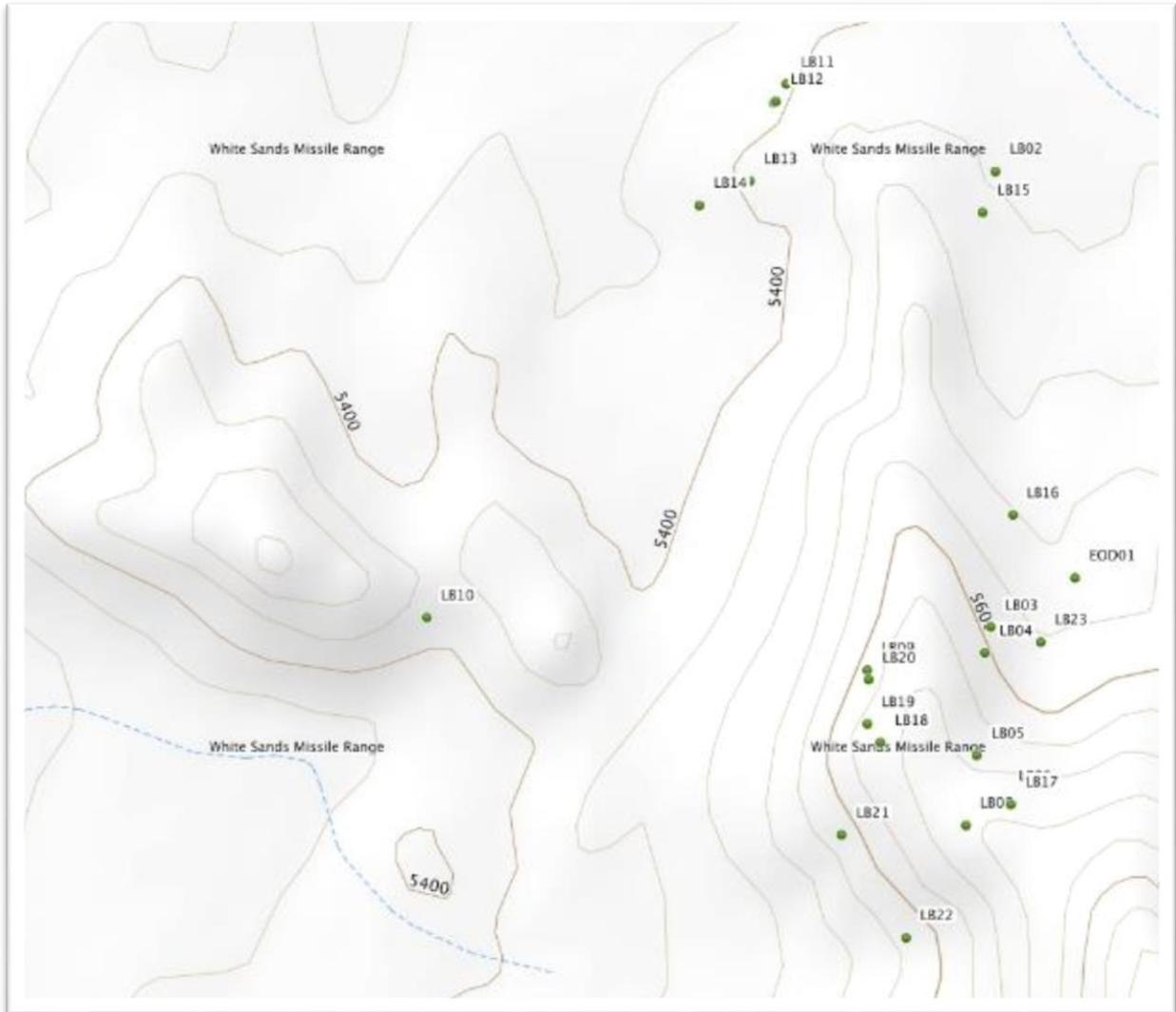
QN21 Adit

Date: 4.6.11
Bat Count: 1

This adit is part of a medium sized production level mine that has two adits and one glory hole entrance. The mine contains a variety of rotting wooden beams and collapsing passageways. Our survey recorded a sole Townsend's big-eared bat (*Corynorhinus townsendii*).

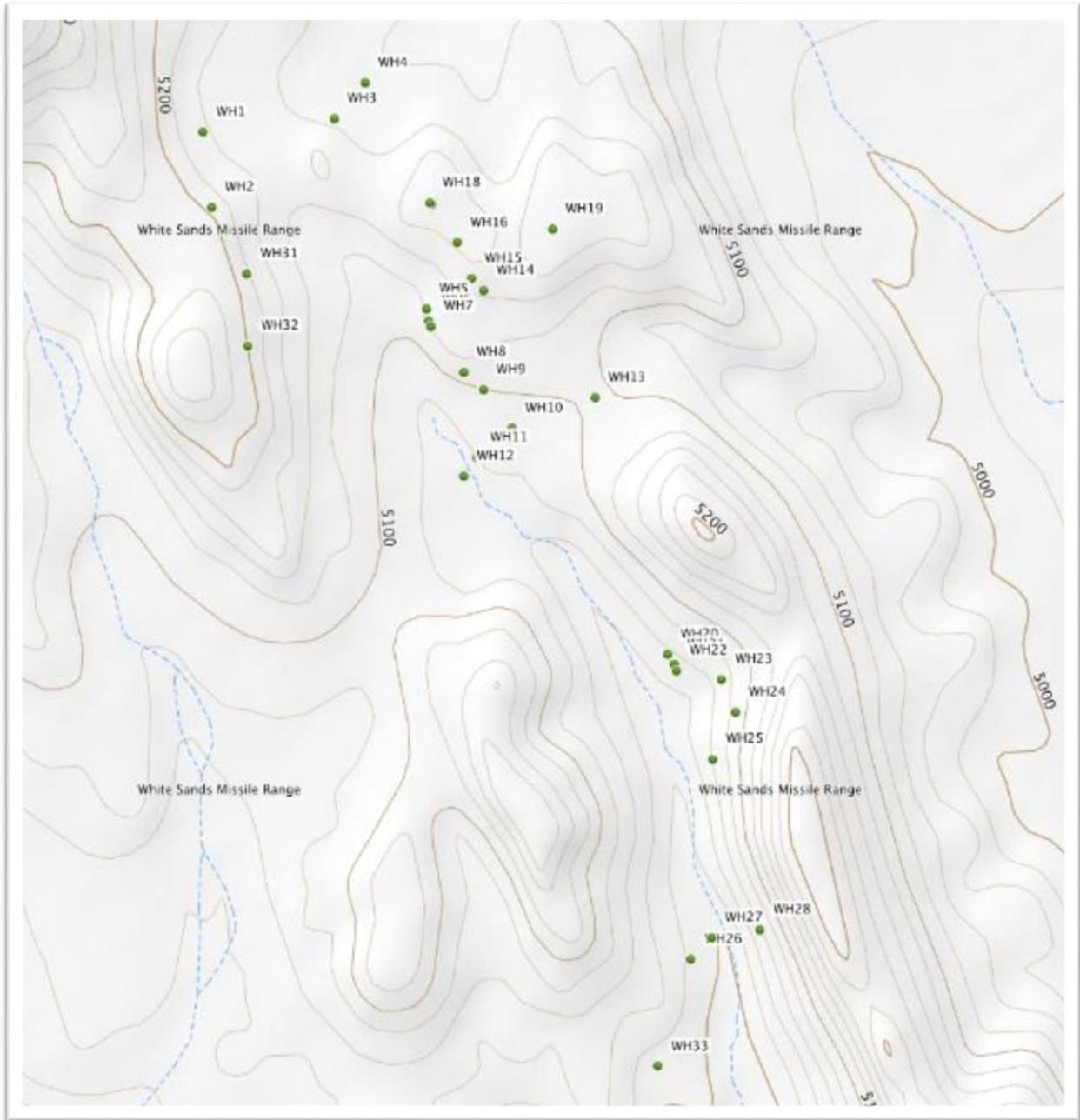


Aerial Tramway (15)



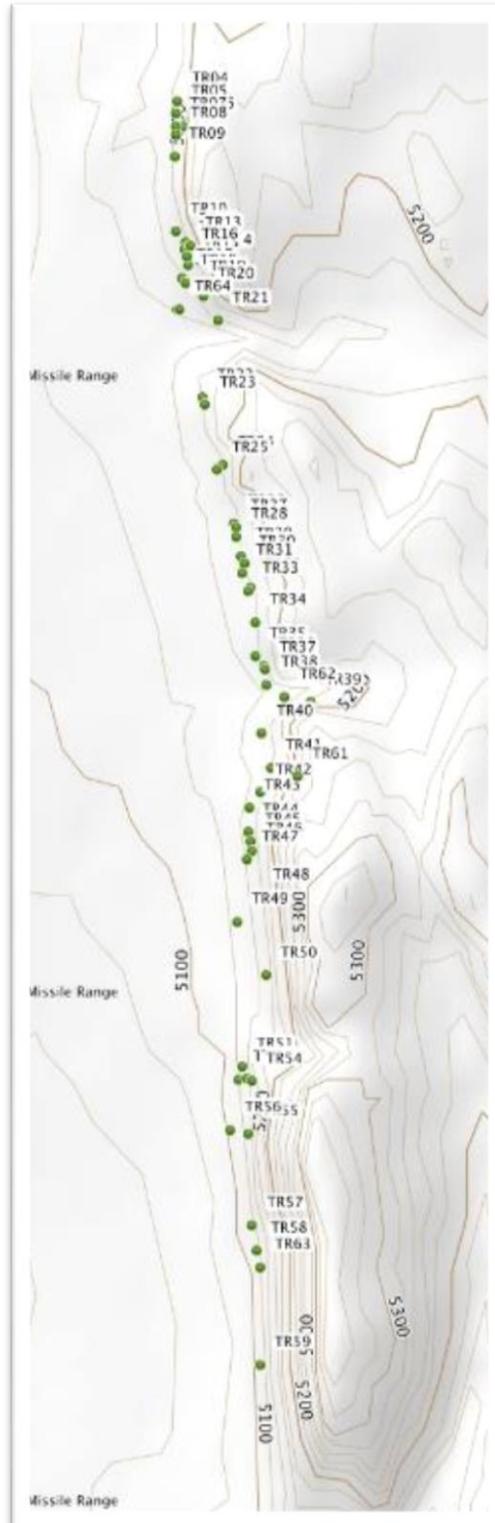
This area contains 24 mine features consisting of short shafts, simple prospect pits and a single adit. Curiously, the LB23 adit had no bats or bat sign, but did contain the articulated skeleton of a deer. No bats or bat sign was located at any of the other sites.

Estey City (16)



This area contains 31 features consisting primarily of prospect pits and shallow shafts. There are many significant mining ruins including a mill and associated artifacts, but no large mine features. The area is based around the ruins of Estey City which was active from 1905 through 1911. No bats or bat sign was located at any of the sites.

Trinity (17)



This area consists of 64 mine features located along a north/south ridgeline. Most of these sites are prospect pits, shallow shafts and trenches. A few natural caves were also located in this area, as well as a variety of ruins and artifacts. During our surveys our team found no bats at any of these sites, but the TR61 Rockwall Cave had significant amounts of guano from past usage.

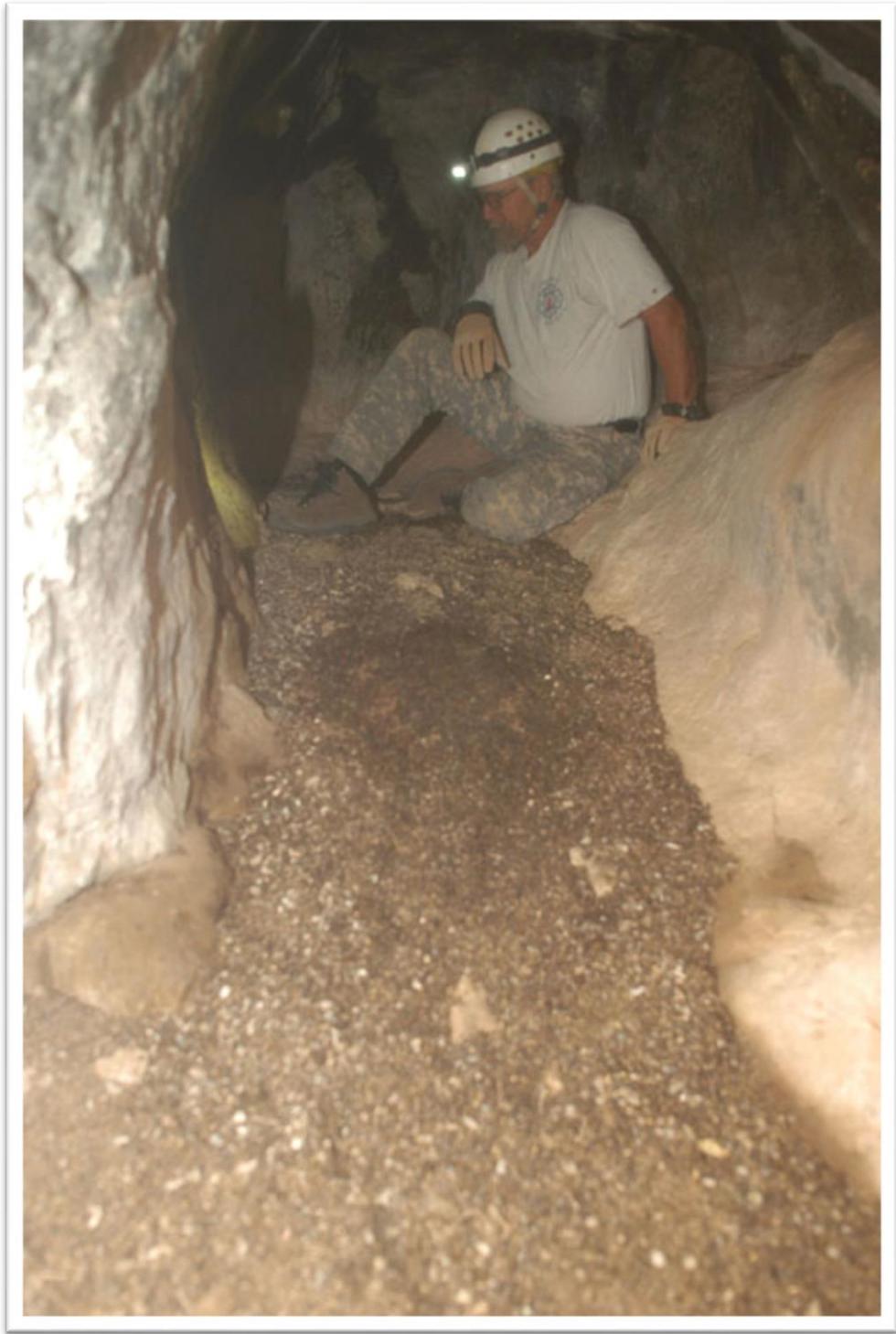
TR61 Cave
Rockwall Cave

Date: 4.26.11

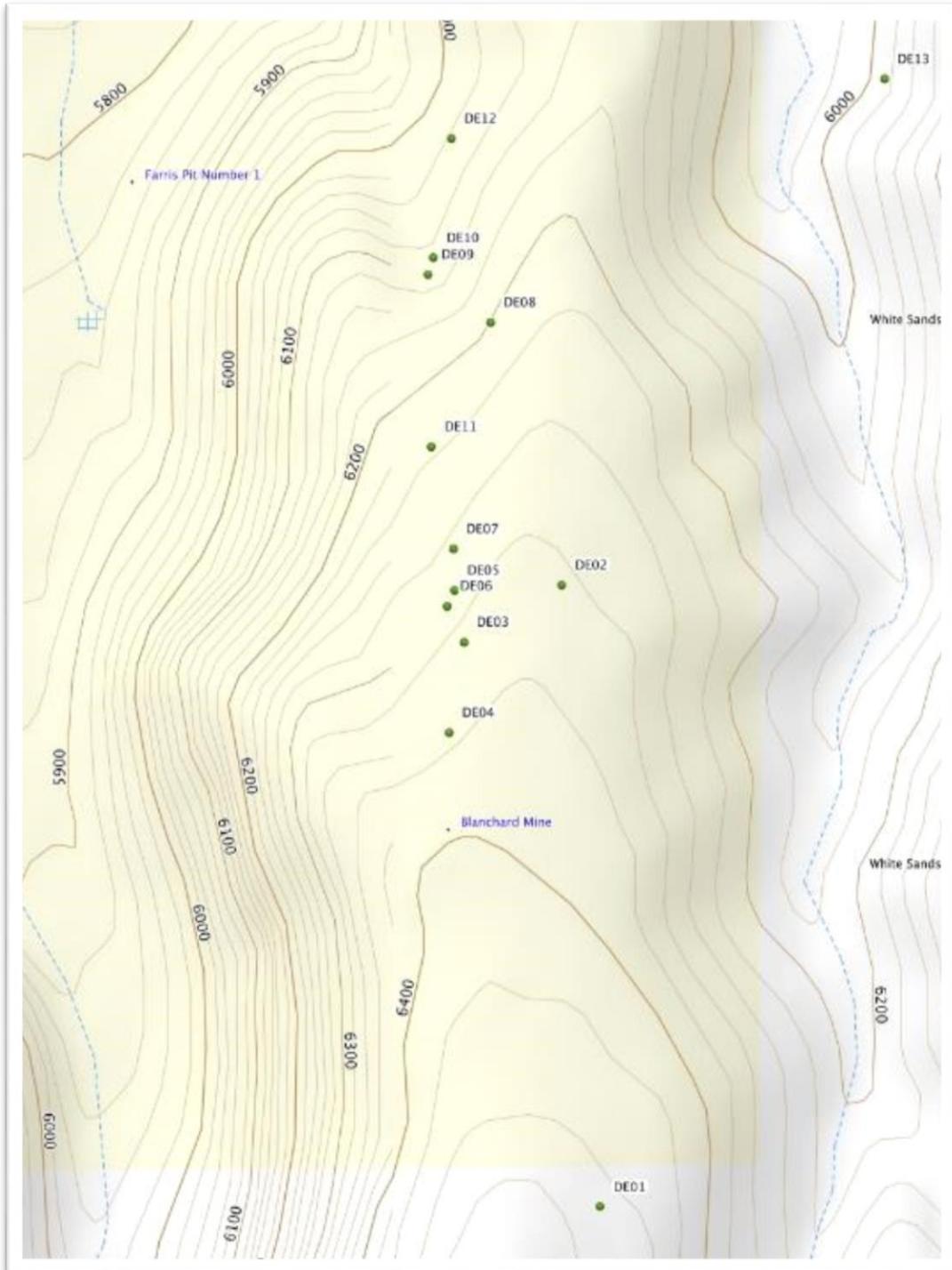
Bat Count: 0

This natural cave extends 60 ft. into the hillside. There is a rock wall at the entrance, and 30 ft. of floor is covered with large amounts of old guano possibly from a Mexican free-tail (*Tadarida brasiliensis*) roost or cave myotis. Our team visited the site on three trips (4.26.11, 6.19.12, 7.21.13), and no bats were noted during these surveys. Due to the caves location near to the Trinity Test Site we took measurements with a radiation dosimeter, but no radiation was detected. This is an interesting site and warrants further monitoring for bat usage.





Oscura Mountains (18)



Technically, this area is located on private mining claims outside of the post, but is surrounded on three sides by WSMR lands. Our team recorded 14 features in this area with 2 of the features on WSMR land, and 12 features on private claims. Many of the mines were gated and signed, so our team took what photos we could from outside. The features in this area consist of adits, shafts, and a single cave. Our survey noted two adits with roosting bats (DE4 & DE9), and two with significant bat sign (DE5, DE10). These mines have a variety of historic surface mining equipment on site.

Isolated Sites (19)

CV4 Cave
Cravens Cave

Date: 2.1.12
Bat Count: 0

This large natural cave has a wide sinkhole ingress that drops down into an entrance room used by owls. The cave has over 1,000 ft. of complex passages and large rooms. No bats were present during our winter survey, but the site has a large roost of cave myotis (*Myotis velifer*) during the summer.

DS2 Adit

Date: 4.26.12
Bat Count: 1

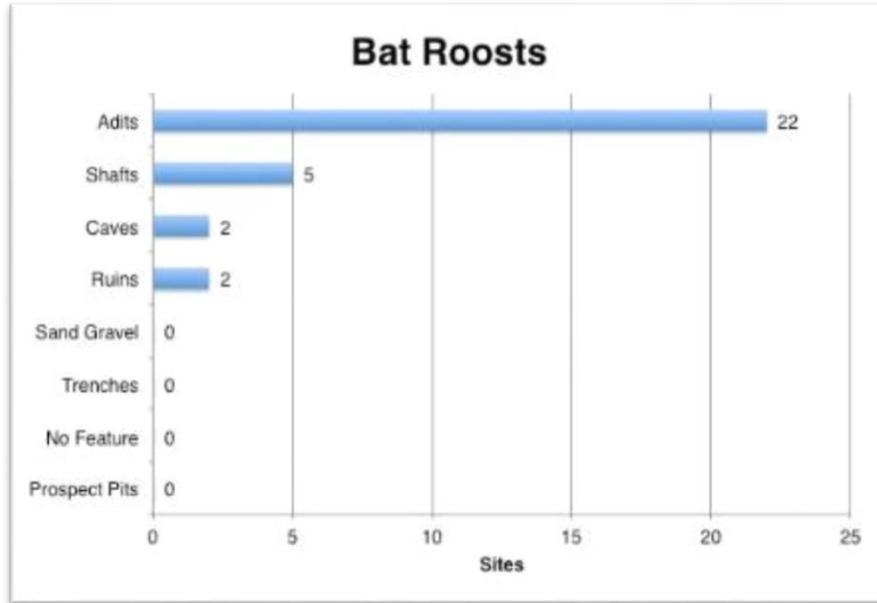
This adit was dug at a seep site also called a water mine. The one foot deep pool is year-round and offers an excellent water source for a variety of wildlife including javelina, ringtail, and bear. A single Townsend's big-eared bat (*Corynorhinus townsendii*) was present at the site during the survey.

Subterranean Biological Resources

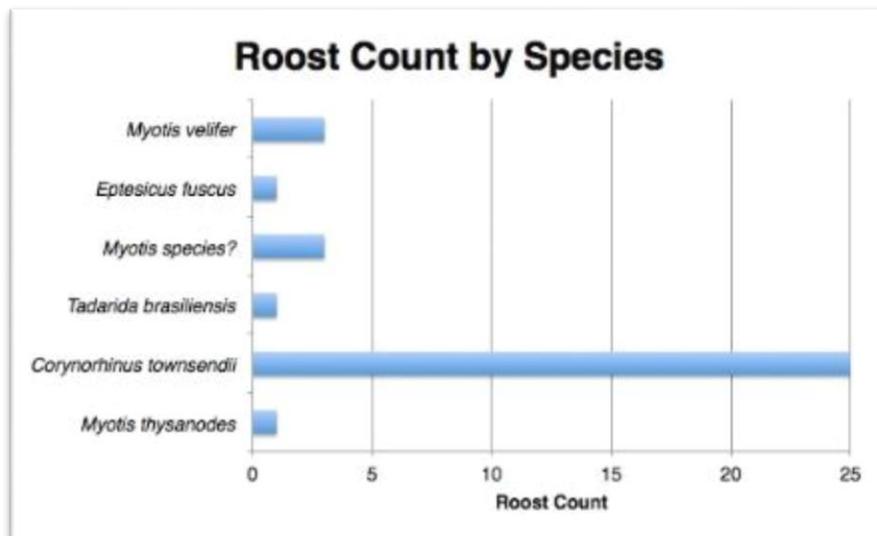
During this project, our team inventoried 770 WSMR mine features, including 46 sites with bat usage. Thirty one (31) sites containing bats during the specific site survey. The following is a list of the sites with observed bat usage.

Name	Mine Name	Type	Elevation	Roost Type	Bats	Species Count
BL54 Adit		Adit	5360	Day Roost	1	1 <i>Corynorhinus townsendii</i>
BL75 Adit		Adit	4285	Maternity Roost	40	40 <i>Corynorhinus townsendii</i>
BL8 Shaft		Shaft	4727	Day Roost	1	1 <i>Myotis species?</i>
BL88 Adit		Adit	4314	Maternity Roost	5	5 <i>Corynorhinus townsendii</i>
BL89 Adit		Adit	4348	Day Roost	40	40 <i>COTO</i> , 1 <i>Myotis species?</i>
BL94 Adit		Adit	4365	Day Roost	1	1 <i>Corynorhinus townsendii</i>
BP1 Adit	Black Prince	Adit	5899	-	0	-
BP5 Adit	Black Prince	Adit	5972	Day Roost	1	1 <i>Corynorhinus townsendii</i>
CV4 Cave	Craven Cave	Cave	4734	Maternity Roost	50	50 <i>Myotis velifer</i>
DE04 Adit	Blanchard Mine	Adit	6496	Winter Hibernaculum	1	1 <i>Corynorhinus townsendii</i>
DE05 Adit		Adit	6283	-	0	-
DE09 Adit		Adit	6512	Winter Hibernaculum	2	2 <i>Corynorhinus townsendii</i>
DE10 Adit		Adit	6122	-	0	-
DS2 Cave	Dripping Springs Cave	Cave		Day Roost	1	1 <i>Corynorhinus townsendii</i>
MB31 Adit	Mockingbird Gap Mine	Adit	5475	Maternity Roost	400	400 <i>Myotis thysanodes</i>
MS1 Ruin	500K Rocket Lab	Ruin	4341	Day Roost	1	1 <i>Corynorhinus townsendii</i>
MS2 Ruin	V2 Gantry	Ruin	4080	Maternity Roost	200	200 <i>Tadarida brasiliensis</i>
MV01 Shaft	Rock of Ages	Shaft	4783	Day Roost	1	1 <i>Myotis velifer</i>
MV02 Shaft	Rock of Ages	Shaft	4783	Day Roost	1	1 <i>Corynorhinus townsendii</i>
MV111 Adit	Eureka Mine	Adit	5311	-	0	-
MV15 Adit	Golden Lily Prospect	Adit	5069	Day Roost	2	2 <i>Myotis velifer</i>
MV35 Adit	Dona Dora	Adi	5007	Day Roost	1	1 <i>Corynorhinus townsendii</i>
MV59 Adit	H and H Mine	Adit	5363	Day Roost	1	1 <i>Corynorhinus townsendii</i>
MV78 Adit	Quickstrike	Adit	5644	-	0	-
MV97 Shaft		Shaft	4596	Day Roost	1	1 <i>Corynorhinus townsendii</i>
QN21 Adit		Adit	5177	Winter Hibernaculum	1	1 <i>Corynorhinus townsendii</i>
QN22 Adit		Adit	5233	-	0	-
SL1 Adit	Salinas Mine	Adit	6834	-	0	-
SL12 Adit		Adit	7129	Winter Hibernaculum	1	1 <i>Corynorhinus townsendii</i>
SL15 Adit		Adit	7135	Winter Hibernaculum	3	3 <i>Corynorhinus townsendii</i>
SL16 Adit		Adit	7092	Winter Hibernaculum	3	3 <i>Corynorhinus townsendii</i>
SL2 Adit	Salinas Mine	Adit	6863	-	0	-
SL3 Adit	Salinas Mine	Adit	6879	Winter Hibernaculum	9	9 <i>Corynorhinus townsendii</i>
SL9 Adit		Adit	7163	Winter Hibernaculum	5	5 <i>Corynorhinus townsendii</i>
TM14 Adit	Red Rock	Adit	5153	Day Roost	1	1 <i>Corynorhinus townsendii</i>
TM24 Adit	Victorio Peak Culvert	Adit	5354	Winter Hibernaculum & Day	82	82 <i>COTO</i> , 14 <i>MYS?</i> , 3 <i>Eptesicus fuscus</i>
TQ1 Adit	Davey Jones Merrimac	Adit	5522	Winter Hibernaculum	3	3 <i>Corynorhinus townsendii</i>
TQ27 Shaft		Shaft	5711	-	0	-
TQ39 Adit		Adit	5650	-	0	-
TQ5 Adit		Adit	5531	-	0	-
TQ8 Shaft		Shaft	5552	-	0	-
TQ80 Adit	Hilltop Mine	Adit	6135	Winter Hibernaculum	14	14 <i>Corynorhinus townsendii</i>
TQ9 Adit		Adit	5539	-	0	-
TQ93 Shaft		Shaft	5274	Winter Hibernaculum	1	1 <i>Corynorhinus townsendii</i>
TR02 Cave	Trinity Cave	Cave	5161	-	0	-
TR61 Cave	Rockwall Cave	Cave	5203	-	0	-

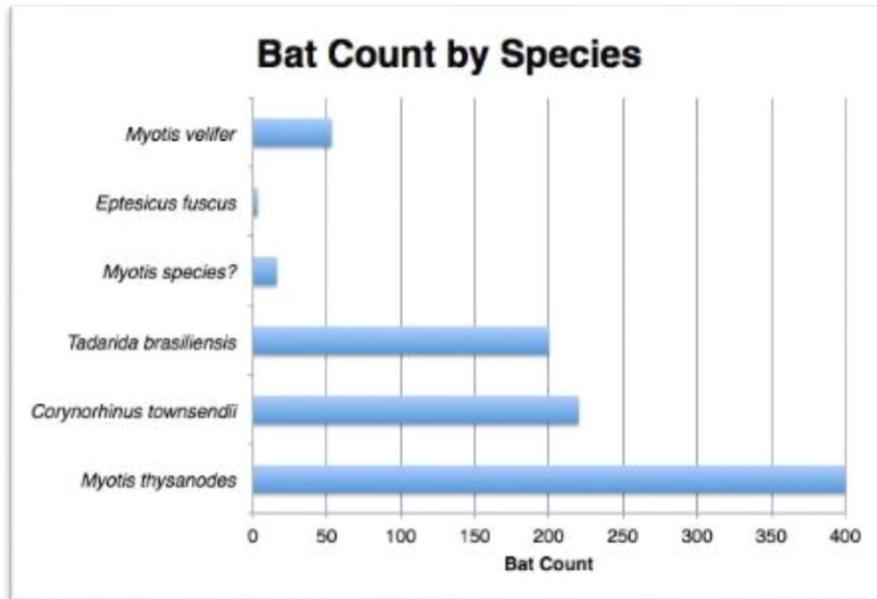
Nearly all of the sites that contained bat roosts were horizontal adits. The small number of shafts that contained bats had horizontal drifts or other horizontal workings. Likewise, only a few of the ruins and caves that were surveyed contained bats or bat sign. There were no bats or bat sign in any of the features designated as sand gravel, prospect pits, trenches and “no feature” sites.



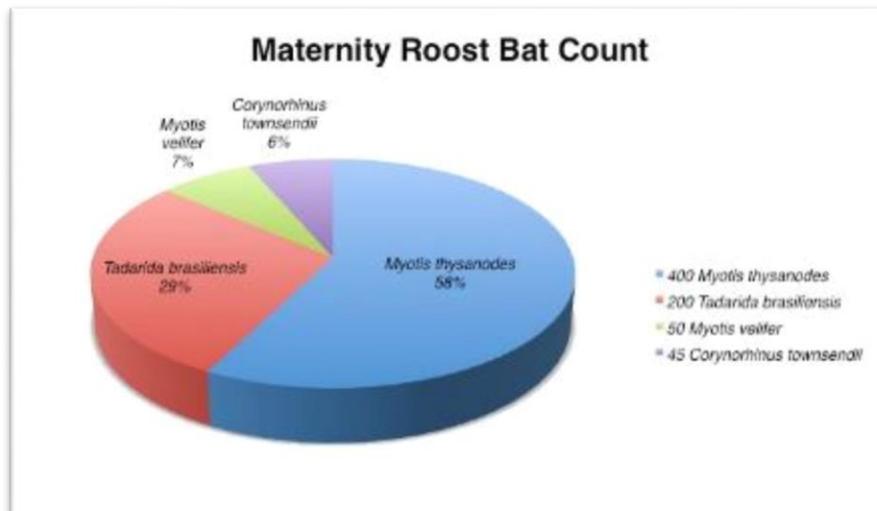
The most common bat species surveyed in each specific roost was the *Corynorhinus townsendii*. This species was found in 25 separate mine features throughout the installation, though many of these roosts contained only a single bat.



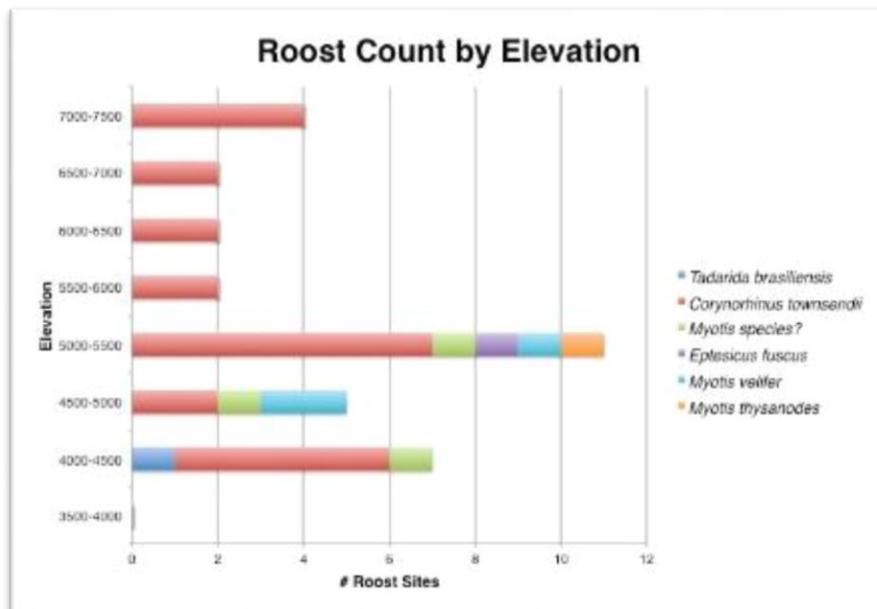
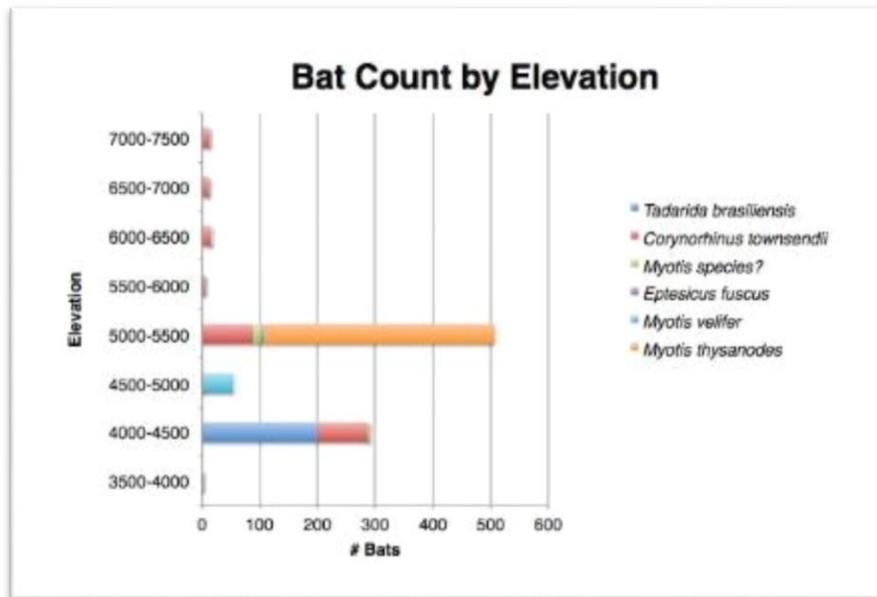
The largest quantity of the same species of bat were the *Myotis thysanodes*. While this species is only represented a single site, it has the largest total number of bats on WSMR. *Tadarida brasiliensis* and *Corynorhinus townsendii* also have a few significant sized roosts, however many *Corynorhinus townsendii* prefer solitary roosts at many mine sites.



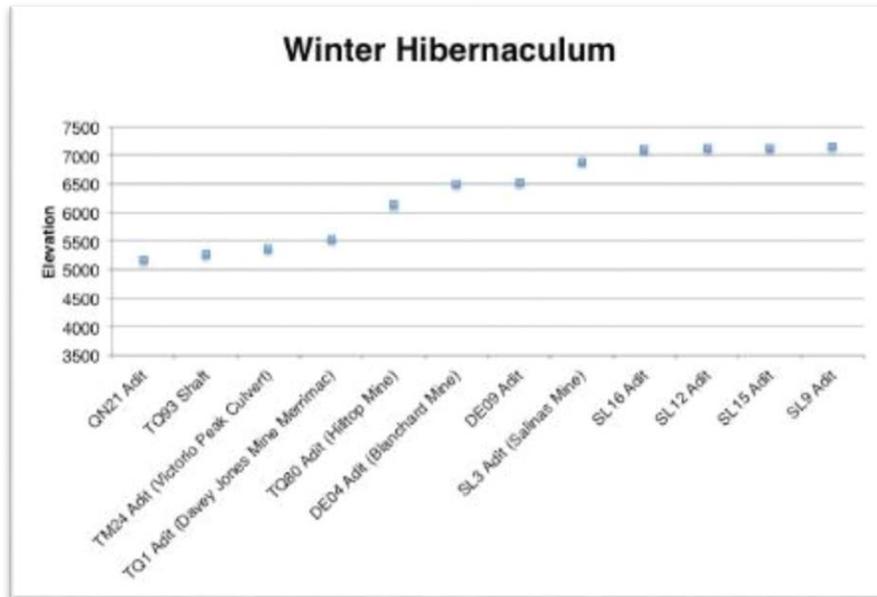
This graph represents the bat counts of maternity roosts. Of the four maternity roosts on WSMR, the largest is the *Myotis thysanodes* site at Mockingbird Gap Mine. The *Tadarida brasiliensis* colony at the V2 Rocket Gantry is the next largest in size. The *Corynorhinus townsendii* colony is located on the Fairview mining district, and the *Myotis velifer* site is in Craven's Cave.



An interesting correlation is the elevation range preferences of the various bat species. These preferences are most likely related to microclimate temperatures of the mine features located at these varying elevations. Note that WSMR has mines at elevations from 3938 to 7440 ft., and there are many opportunities for roosting habitat. The first graph shows that the 5000-5500 range is a popular roosting elevation, but these numbers are boosted by a single large *Myotis thysanodes* roost. The 4000 - 4500 ft. range is also a strong roosting elevation, but these numbers are influenced by a single large *Corynorhinus townsendii* roost. The higher elevations 6000 - 7500 are represented by winter hibernaculum *Corynorhinus townsendii* roosts. As a general trend our data shows that most WSMR bats are roosting in the 4000 - 5500 elevation ranges. This is supported by the second graph showing roost counts by elevation.



This graph shows the elevations of the various winter hibernaculum sites. Note that the sites are located at elevations from 5200 to 7200 ft. These sites are all *Corynorhinus townsendii* roosts, which seem to prefer breezy roost sites in mines with multiple entrances.



Bats Species

During this project our team documented five species of bats in subterranean settings.

Townsend's big-eared bat
(*Corynorhinus townsendii*)



Cave myotis
(*Myotis velifer*)



Fringed myotis
(*Myotis thysanodes*)



Big brown bat
(*Eptesicus fuscus*)



Mexican free-tailed bat
(*Tadarida brasiliensis*)



Other Vertebrate Species

While conducting field surveys of the mines and other subterranean features, our team encountered a variety of animals or animal sign at the WSMR sites. The following is a list of the most common non-bat vertebrates that we physically observed in the mines.

Barn Owl (*Tyto alba*)

Often vertical shafts would contain Barn Owl roosts, and our team found many instances of owl eggs at the very bottom of these shafts. We found only a single occurrences or bat roosts in the same shaft as owl roosts, as owl predation clearly influences bat roost site selection. The owl pictured below is from MV56 shaft near the H and H mine. A video of a Barn Owl flying out of MV73 shaft is included in the data portion of this project.



Turkey Vulture (*Cathartes aura*)

These large birds often nest in mines and our team would often find the large speckled eggs of this species. The adult birds will normally fly away when a team member approached a mine feature. Note that this species will vomit as a defense mechanism, so field surveyors should give these birds a wide berth.

Black-tailed
Rattlesnake
(*Crotalus molossus*)

This rattlesnake was found coiled up along a wall near the gate of TM24 Adit. (Victorio Peak Mine) This species is fairly common in many abandoned mines of the southwest. If the mine is cool and the snake is given a wide berth, this species will not even rattle its tail as you pass.



Western Diamond-
backed Rattlesnake
(*Crotalus atrox*)

This rattlesnake was located at the end of the passage of MV111 adit (Eureka Mine). Our team also noted three specimens of this species in TR02 Cave (Trinity Cave).



Mountain Lion
(*Felis concolor*)

A mountain lion was encountered at the entrance of the MV15 adit. This mine has a flooded drift that offers a year round water supply, and the mountain lion was visiting the site just at dusk. Fortunately, two members of our survey team were deep inside the mine at this time, and did not encounter the mountain lion in close quarters.

Mule Deer
(*Odocoileus hemionus*)

The articulated skeleton of the mule deer shown below was discovered in LB23 adit. Other deer skeletons were noted in BL89 and MB31 adits.



Oryx
(*Oryx gazelle*)

This African ungulate is an odd species to observe in the desert southwest, but our team has encountered two mine adits that had shading Oryx in the underground workings in one case the Oryx charged out of the BL88 adit directly at our team.



Ringtail Cat
(*Bassariscus astutus*)

Many of the mine features of WSMR contain Ringtail scat, but it is rare to see this animal as we did at the bottom of the MV01 decline shaft (Rock of Ages Mine).



Pack Rat
(*Neotoma species?*)

Pack Rats or Wood Rats are very common in the mines, but they are rarely seen. Their nests can be found in most mines, as well as their stick middens, urine trails, and extensive amounts of scat.



Mouse
(*Peromyscus species?*)

Mice are very common but are also rarely seen in mines, Their scat is very similar in size to bat guano, but can easily be tested via the “crush test”. Squeeze a small pellet between your fingers and if it does not crush it is probably mouse scat. If it crushes easily and sparkles with insect parts, it is bat guano.

It was evident from their sign (scat, hair, nests, etc.) that a variety of other vertebrates certainly use the mines none were physically identified during our teams survey. Peccary or javelina (*Pecari tajacu*), black bear (*Ursus americanus*), grey fox (*Urocyon cinereoagenteus*), and bobcat (*Lynx rufus*) sign were all noted at WSMR mines.

Significant Historical Mining Resources

Nearly all of the abandoned mines located on the range have at least some historical importance, but they are too numerous to outline each specific site. While this section highlights some of the more interesting and unique sites it does not cover sites that were already discussed in the section “Mine & Cave Resource Areas with Bat Roosts”. Note that the sites that contain bat roosts are often larger, more complex mine systems and are by definition significant historic sites.

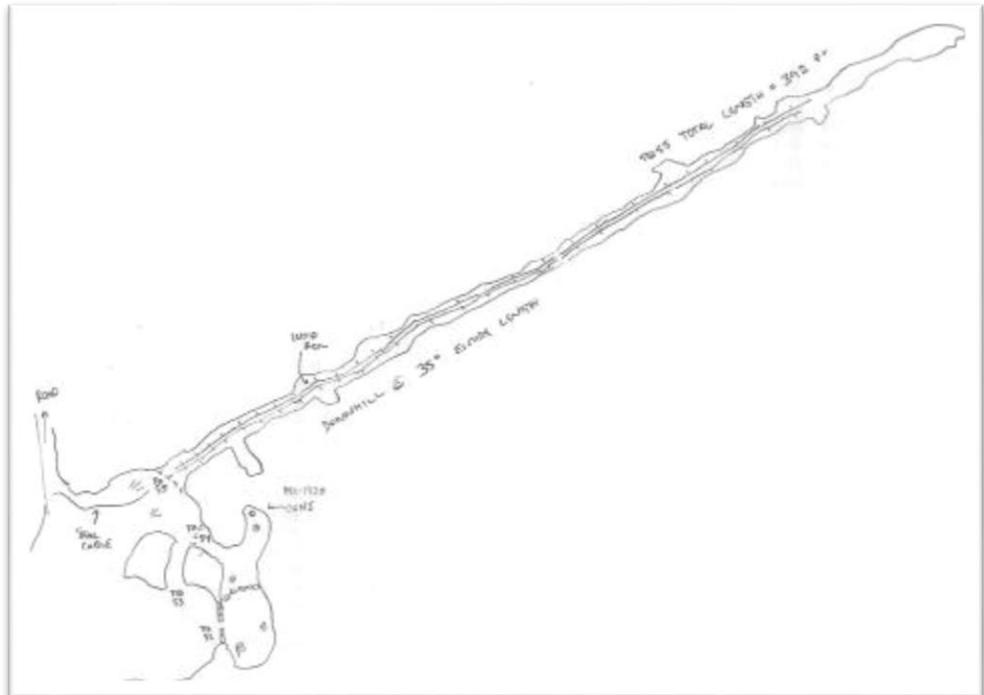
Organ Mountains Area (2)

TQ52 Adit Ruin Located at the end of an overgrown mining road, this site consists of a walled underground room where the miners lived. Pre-1930 solder top cans are strewn across the floor and the ceiling is blackened from a fire pit.



TQ55 Adit

This 392 ft. long adit was unique in that it is the only mine on WSMR that contained wooden rails for ore car movement.



TQ62 Adit

This adit has a rockwall at the entrance that is adjacent to a 1920 signature stone. The mine has a section with wooden floor, a metal stand, and other metal debris from a living quarter's site.



Augustin Peak Area (3)

MV72 Adit

This adit contains a flooded winze topped with a hand cranked wooden hoist drum. Our team noted these wooden hoist drums in three other mines on the base, but in most abandoned mines these items are normally missing from their stands.



MV76 Ruin
Silver King
Mine Camp

This site is the ruin of the Silver King Mining Camp. It consists of several collapsed cabins, an outhouse, rock walls, a large solder-top can dump, car parts, and a variety of other site artifacts.



Mineral Hill Area (4)

BL98 Ruin

Atop a small granite knoll is a single deep mortar.



MV35 Adit
Dona Dora Mine

Ruins of many buildings reside in the area Doña Dora mine. Artifacts from the mining camp can be found throughout this area.



MV26 Ruin
Powder Magazine
Tiberius Mine

This site was an underground bunker for storing blasting materials for the adjacent Tiberius mine. Note the inventories of fuse, caps, and powder, that are recorded on the structure supports. This mine must have been a well-funded and organized operation to have such a powder magazine.



MV29 Shaft
Tiberius Mine

This 40 ft. shaft contains a variety of mining artifacts including a dynamite box, drill steels, a shovel, a pick and a sledge-hammer. During our survey we noted that this shaft also contains two dead Barn Owls (*Tyto alba*), and a third dying owl due to unknown bad air.

This is a very dangerous site and should not be entered.



MV15 Adit
Golden Lily
Prospect

This adit has a historic single piston steam engine with two large flywheels placed next to a water tank. The mine still contains rails throughout the passages and to the surface rock dump pile.



BL44 Shaft

This very short shaft contains an historic screw top can that has 1948 instructions from some cooking or chemical experiment.



Black Mountain Area (5)

BL30 Ruin

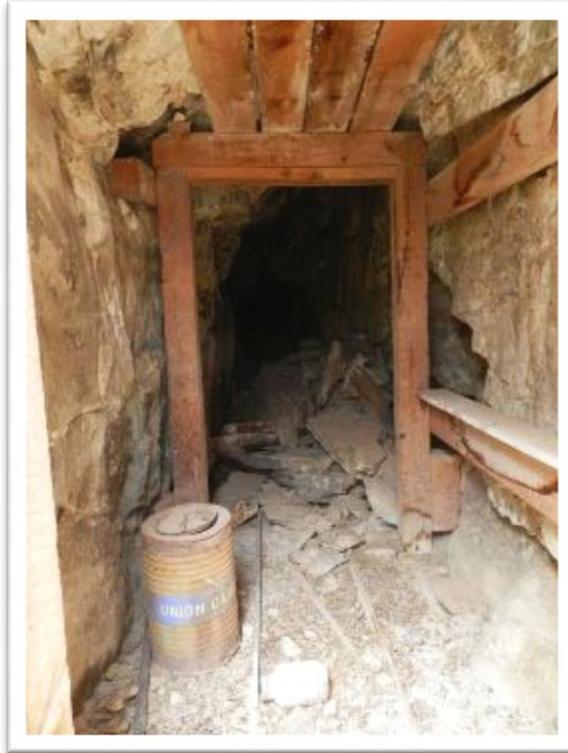
A curious metal cone embedded in a concrete ring is located near the mine workings of the Mormon Mine. The area also contains many artifacts such as the lantern pictured below.



Victorio Peak Area (7)

TM1 Adit
Hembrillo Mine

This adit is collapsed 78 ft. into the mine, and there is a Union Carbide can just inside the entrance. There is also a rare ore bucket located at the bottom of the rock dump below the entrance.



TM14 Adit

This remote location consists of a small group of mines with a small ruin structure and interesting stove parts dating from Jan 11, 1881.



Ash Canyon Area (9)

SU1 Shaft

This 45 ft. deep shaft contains nicely preserved dynamite boxes. Surface debris includes blue glass, and pre-1930 solder top cans.



GV1 Ruin

A rock cairn claim marker at the Governor Group site contained this black on white pottery sherd.



SU4 Ruin

This site contains a wood walled ruin of a structure with bed frames, a steel stove top, metal pans, ceramic shards, and many complete seamed glass bottles.



Salinas Peak (9)

SL5 Adit
Collapsed

A single mine car was discovered near the entrance of the collapsed adit of SL5 during our survey of 1.31.12. This is the only mine cart that was located at any of the mines on WSMR.

Queen Townsite (9)

QN21 Adit

A hoist drum of a whim was discovered to the north of the headframe remains of QN21 Adit. This piece of machinery would have been mounted horizontally near the base of the headframe.



Trinity (17)

TR12 Shaft

This device is an arm bracket portion of a horse-drawn whim for hoisting ore out of the shaft. This piece of machinery may be associated with the hoist drum found at the QN21 Adit, as both parts are needed to hoist ore, and it was common practice for miners to move equipment from mine to mine.



Management Recommendations

Bat Habitat Protection

Many mines offer important biologic habitat to bats, owls, vultures, javelina and a variety of other wildlife. During our survey, we located two adits that had substantial amounts of water that was and is being used by bats and other local wildlife. Animal usage will often dictate whether a mine feature will be completely closed, or whether a wildlife accessible gate should be installed at that site. The species and quantity of wildlife will further dictate which type of gate should be built for that site. Construction budget and site logistics will also play a role in determining the best solution for habitat protection.

During this project our survey team has located many sites that are actively used as bat roosts. Many of these sites are in very remote locations where they will not be disturbed and thus need no additional protections. Other sites that are located near roads or personnel activity areas might only offer occasional roosts for a single bat. With these factors in mind, we recommend no additional protections for these sites. Where sites have significant roosts, or medium sized roosts that are near roads or personnel activity areas, we recommend feature specific protections, such as bat gates or fencing.

Primary Recommendations

This group of adits are used by the same *Corynorhinus townsendii* maternity colony. The bats use BL75 first, and then as the pups are volant the roost moves to BL88, and BL89 & BL90 which are two entrances of a connected mine feature. BL75 is readily visible from a well-traveled road in an active area, and is at risk for negative impact from base personnel.

BL75 Adit	<i>Corynorhinus townsendii</i> maternity colony	Leave as-is or gate
BL88 Adit	<i>Corynorhinus townsendii</i> post-volant roost	Leave as-is or gate
BL89 Adit	<i>Corynorhinus townsendii</i> post-volant roost	Leave as-is or gate
BL90 Adit	<i>Corynorhinus townsendii</i> post-volant roost	Leave as-is or gate

The next two features are connected and produce a strong breezeway that is favored by *Corynorhinus townsendii* roosts. This mine feature is visible from the road, and access to this site is easy using the old mining road.

SL3 Adit	<i>Corynorhinus townsendii</i> winter hibernaculum	Block road access
SL4 Shaft	<i>Corynorhinus townsendii</i> winter hibernaculum	Block road access

The following group of adits are winter hibernaculum sites for *Corynorhinus townsendii*. These adits are easily accessible from a road, and have significant spalling rock fall and collapsing log shoring. These two factors overlapping factors of personnel safety and bat habitat, make these sites ideal for gating.

SL9 Adit	<i>Corynorhinus townsendii</i> winter hibernaculum	Adit Gate
SL12 Adit	<i>Corynorhinus townsendii</i> winter hibernaculum	Adit Gate
SL15 Adit	<i>Corynorhinus townsendii</i> winter hibernaculum	Adit Gate
SL16 Adit	<i>Corynorhinus townsendii</i> winter hibernaculum	Adit Gate

The Victorio Peak Mine is one of the most important bat roost sites on WSMR. The main gate can be easily breached and should be repaired with a proper locking mechanism. Most of the gate is in good repair, but could use some strengthening in weak spots. Or, better yet, completely replace the gate with a bat-specific design.

TM24 Adit	Multiple species winter and summer usage	Gate Repair or gate
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Secondary Recommendations

This site has a significant year-round water source, but the entrance is very small and collapsing. Enlarging and shoring of the adit portal would ensure that this water source is accessible to a wide variety of wildlife.

MV72 Adit	No bats during survey	Shoring
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Safety Closures

During the course of this project, our team located several mine features that would be appropriate for closure. Shafts are the most common feature for closure due to fall hazard. Some horizontal adits are also appropriate for closure, especially in the case of collapsing country rock, or rotten timbering and shoring. Many shallow features such as prospect pits and trenches can be left alone as they generally self-reclaim over time. There are many methods of abandoned mine closures, so it is important to choose the appropriate solution for each site.

Feature location also plays an important role in selecting the type of closure, or prioritizing which sites should have this work done. Some remote sites offer technical challenges that, in most cases, would not be worth the effort and expense. Our team located multiple sites in very remote canyons that would require helicopter support to even build a simple closure. If a mine site is easy to get to, or is easily viewed from well-traveled roads, it should be prioritized for closure.

As a general guideline, we recommend that nearly all vertical shafts should, at minimum, have a fence around the site. Note that a person can be killed just as easily from a fall down a 20 ft. shaft, as a 200 ft. shaft so all of these features should be approached with caution. Safety signs on these fences mixed results. However, for informational and liability reasons these signs are good to install. The drawback of these signs is that the very danger of which the sign warns attracts curious people, and since the signs are interesting looking they are often stolen from the site. A possible solution would be to mount the signs just inside the feature so that they are not visible from afar, but still readable when the feature is approached.



While conducting our survey of the 770 mine features, the survey team only encountered a single mine with bad air. Curiously, the air did not set off any alarms on our four-gas detector, but our field surveyor became nauseous and the shaft was found to contain two dead owls, and a third dying owl. We recommend that the MV29 Shaft be fenced at a minimum, or excluded and covered horizontally with a gate or cable net to prevent access by owls or curious personnel.

The following is a prioritized list of sites that are appropriate for safety closures. Minimum safety procedures would be to fence these sites, but recommended procedures are discussed for the few most dangerous sites listed. Exclusion procedures are discussed in the BCI publication "Managing Abandoned Mines for Bats".

MV29 Shaft	This vertical shaft contains bad air that is killing owls, and poses a risk to curious base personnel. The site should be excluded and closed by any means.
BL24 Shaft (Morman Mine)	This vertical shaft is located near a dirt road with easy access. It has a dangerous ant-lion entrance with loose rock and deteriorating timbers. The site should be excluded and closed by any means.
QN19 Shaft	This deep vertical shaft is located near a dirt road and has a very loose and decaying wooden collar. The shaft is cribbed down at least 20 ft. showing that the site was unstable when they dug it. This site should be excluded and closed by any means.
MV01 & MV02 Shafts	These deep decline shafts should y have proper fences installed, at minimum or since the site is used by bats have grate gates installed. These sites are very visible, and are located adjacent to a commonly traveled road.
All Shafts of 20 ft.+ depth	We recommend that all vertical shafts should be fenced with priorities given to shafts nearest main roads, and shafts with visible structures that attract attention.

Future Site Monitoring

White Sands Missile Range (WSMR) is an ideal place to study bats. The wide range of elevations and habitat types, the diverse mine resources, and the controlled access all combine to make WSMR an excellent bat research area. Our team has been privileged to conduct this project at such ideal region.

A main focus of this project was to locate all bats roosts and to establish baseline data for these important wildlife resource sites. During our survey of 770 sites on WSMR, our team located 46 sites that had sign of bat usage, and 31 sites that had bats present. Future monitoring of these 46 sites during winter and summer periods would provide useful data in roost usage. A total of 15 sites contain more than a single bat, and could be categorized as significant roost sites. A more detailed study of these significant sites would include long-term studies of summer and winter usage patterns.

White-nose syndrome (WNS) is a fungal infection that has killed upwards of 6.7 million bats in the eastern states. The fungus (*Pseudogymnoascus destructans*) is the cause of WNS and has been spreading westward through winter hibernaculum bat roost sites. Fortunately, WNS has only spread westward as far as Missouri. With the western migration of WNS it would be prudent to monitor the higher elevation winter bat hibernation sites that fall into the favored temperature ranges of the fungus.



Site Access Safety

All abandoned mines should be approached as being unsafe, and most federal and state agencies regard these features as being closed to entry. The common signage on many sites states is “Stay Out, Stay Alive!,” but with proper training, equipment, and experience we feel that some abandoned mines can be entered safely. Our team has completed extensive underground training classes and specialized certifications, and we have safely conducted subterranean surveys of thousands of mines and caves. During our survey at WSMR we noted some site-specific risks that are outlined below along with safety questions that should be asked when assessing a site. Note that this list is not inclusive of all Abandoned Mine Lands (AML) safety issues, and anyone visiting these sites should also review the AML Safety Protocols that were submitted at the beginning of this project, as well as other mine safety sources.

Physical Risks

1. Is the mine site clear of unexploded ordnance (UXO)?
The fact that WSMR is a missile range that has been active for over 50 years has resulted in unexploded ordnance spread throughout the entire base. Many of the AML sites are in very remote locations that have not been cleared of possible unexploded ordnance. Survey teams must stay vigilant when traveling to these remote sites, and view any unknown manmade object as a potential bomb rather than an odd mining artifact.
2. Is the mine shoring and timbering strong enough make the mine safe to enter?
Note that most of the mines at WSMR are from 70 to 120 years old. This means that most of the wooden shoring, timbering, and collar are of rotten wood that has little if any structural strength. If a miner installed shoring 50 years ago when they built the mine it is a sign that they had ground control issues at that time. Current conditions should be assumed to be worse.
3. If a mine has no wooden shoring and is dug in hard rock, will it be safe to enter?
Many mines at WSMR are dug in hard rock and may be stable for entry. If a mine has no spalling and the floor is clear from rockfall after 50 years, this mine is more stable for access than the mine with wooden timbering.
4. Does the mine have bad air?
During our survey of 770 mine features at WSMR we only encountered a single shaft with bad air. It is very important that any team entering a mine have a working gas detector which measures at minimum; oxygen, carbon monoxide, and hydrogen sulfide. Our team used a MSA Altair 4X Multigas Detector for our surveys. Also note that a gas detector does not identify every dangerous gas, so the survey team should also be aware of their own physiology and be ready to retreat from a site if they notice any problems.

5. Is the mine site safe from weather events?

Many of the WSMR mine sites are located in steep and remote canyons. During one of our site surveys our team endured a flash flood that had traveled many miles through a steep canyon. This rain deluge had happened out of view on the other side of the mountain range, therefore our team did not notice the storm until they heard the boom of the rushing stream.

Biologic Risks

1. Does the site have a killer bee nest at the entrance?

By quietly approaching a site, a surveyor can look for bees flying in and out of the entrance. Normally beehives will be in cracks along vertical cliff faces, but our team has also observed hives a short distance into vertical shafts. The hives will be within daylight, but shelter under the dripline to protect from rain. Bees defending a hive will fly into surveyors and bump them before stinging ensues. Once a surveyor has been stung they now carry the pheromone that will draw other stinging bees from the hive.

2. Are Rattlesnakes present at the site?

Rattlesnakes are common in abandoned mines and are usually found within 100 feet of a mine entrance, but often very near to the entrance. Rattlesnakes have a keen sense of vibration, so stomping on the ground near an entrance will often trigger the telltale rattle of these snakes.

3. Are mountain lions present at the site?

Lion tracks, scat and deer kills are evidence of periodic usage of mines by mountain lions. Some mines contain flooded passages that offer an ideal water source for these large predators and other animals. At WSMR our team had one lion encounter just at a dusk, at an adit with a flooded passage that is used as a local water source.

4. Are other large mammals present at the site?

WSMR has a large herd of Oryx who occasionally seek out mine adits for shade. Our team has experienced two occasions where a charging oryx has exited a mine as the survey team approached the entrance. Other animal encounters to be wary of are javelina, bears, and Vultures. Note that the turkey vulture species will vomit on the survey team as a defense mechanism.

EOD Sites

During the fieldwork for this project, our survey team located four UXO sites that had significant missile or rocket components. Throughout the project our team located hundreds of metal fragments from missiles and targets, but all of these were inert pieces.

EOD01



EOD02



EOD04 (Matador Missile)



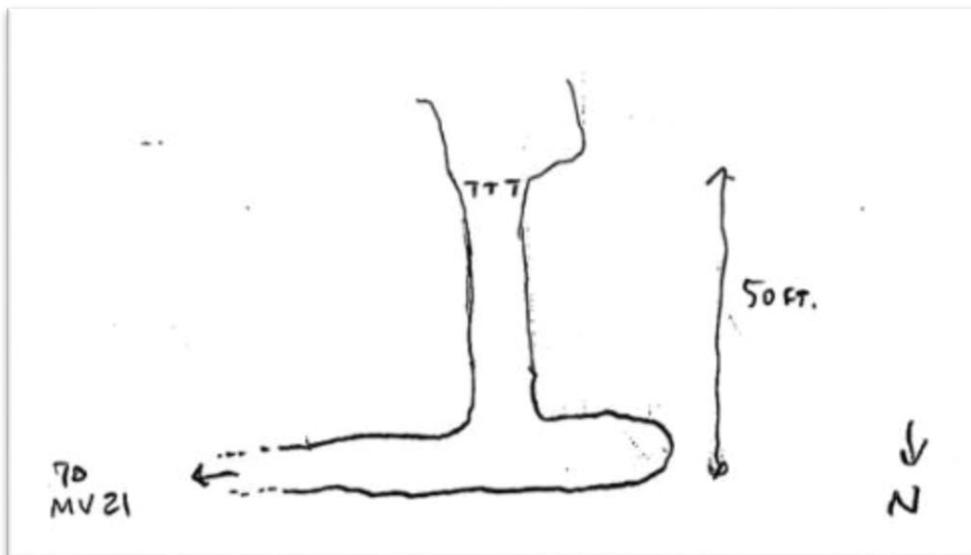
EOD05



Training Site Recommendations

As a general rule, we do not recommend abandoned mines as sites for training. Most of the mines on WSMR are 70 to 120 years old and have unknown integrity. Mines with wooden shoring show that the country rock was unstable at the time the mine was dug, and conditions today have certainly degraded. Mines that do not have shoring and are dug in solid rock are more stable. Do not enter mines that are dug in dirt or other soft materials. It is important to inspect hard rock mines for broken or spalling rock on the mine floor. If a mine has minimal rock fall on the passage floor, it is safer than most other WSMR mines. All sites should be carefully inspected for rattlesnakes when visiting these mines. Also refer to the Site Access Safety section of this report for more information.

MV20 Adit This horizontal mine is dug in solid granite and has minimal rock fall. Access to this site is very easy due to the dirt road that extends directly to the entrance of the mine. This level floored mine is of a simple "T" configuration with no dangerous winzes or other open shafts. The site has minimal wildlife usage so human impact is not a factor.



MV58 Adit This 55 ft. horizontal mine is one of two adits of the H&H Mines. The rock is fairly stable granite, and the mine is of simple configuration with no wildlife usage. Access is via a short hike, but the site is close to an active training area.

LB23 Adit This 40 ft. horizontal mine is also dug in solid granite and has no rock fall or integrity issues. This is a very remote site on the north end of the base that requires hiking to access, but would be ideal for a remote wilderness situation site.

Bibliography

Adams, Rick A., 2003, Bats of the Rocky Mountain West, Natural History, Ecology, and Conservation, 289 pgs.

Burkett, Douglas W., 2008, Amphibians and Reptiles of White Sands Missile Range Field Guide 2008, 65 pgs.

Duran, Meliha S., 1997, Jewels of the Desert, Collections from the First Dump at White Sands Proving Ground, 98 pgs.

Eidenbach, Peter L., 1994, Home on the Range, Oral Recollections of Early Ranch Life on The U.S. Army White Sands Missile Range, New Mexico, 111 pgs.

Eidenbach, Peter L., 1997, School Days, Education During the Ranching Era on The U.S. Army White Sands Missile Range, New Mexico, 87 pgs.

Gilleland, Tom O., 2012, Subterranean Bat Hiberacula Sites of Southeastern Arizona, 89 pgs.

Kingsley, Charles Dunham, 1935, The Geology of the Organ Mountains, 272 pgs.

Merlan, Thomas, 1997, The Trinity Experiments, 101 pgs.

Sagstetter, Bill, 1998, The Mining Camps Speak: A New Way to Explore the Ghost Towns of the American West

Sherwin, Richard E., Altenbach, J. Scott, Waldien, David L., 2009, Managing Abandoned Mines for Bats, 103 pgs.

Snow, Tim, Pictorial Key to the Bats of Arizona, 48 pgs.

Twitty, Eric, 2009, Blown to Bits in the Mine, A History of Mining & Explosives in the United States, 208 pgs.