

**ZEBRA-TAILED LIZARD MONITORING AT
DIAMOND CREEK ON THE HUALAPAI RESERVATION**

2016 ANNUAL REPORT

Grant #R15AP00060

Submitted to:

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Upper Colorado Region
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Introduction

The zebra-tailed lizard (ZTL; *Callisaurus draconoides*) is a characteristic, relatively common Mohave and Sonoran Desert species that occurs throughout the lower elevation deserts of the Southwest (Brennon and Holycross 2006). ZTL are a medium-sized, insectivorous iguanid lizard (Figure 1) that prefers sandy desert habitats, which are often dominated by creosote-bush (*Larrea tridentata*; Figure 2). Female ZTL lay 2-8 eggs in summer in sandy, friable soils; however, this species may be multivoltine. Although widespread, isolated populations may occur in sand dune refugia.

Prior to 1983, zebra-tailed lizards were persistent residents of the sand dune area along the Colorado River in Grand Canyon at the Diamond Creek confluence on the Hualapai Indian Reservation (Tomko 1976; Miller et al. 1981; Figure 3). With the flooding that occurred (approximately 100,000 cfs) on the Colorado River in Grand Canyon in 1983-4 due to unexpectedly high runoff from the Rocky Mountains, river access at Diamond Creek for river rafters was restricted to the dune area, and river traffic drove over the dunes. Off-road vehicular impacts are well-known to negatively affect diurnal reptile species, such as desert tortoise and ZTL (Busack and Bury 1974; Webb and Wilshire 1983). Repeated censuses for ZTL at the mouth of Diamond Creek from the late 1980's through 2010 consistently failed to reveal any of these conspicuous, diurnal lizards, and the population was considered extirpated there (Stevens et al. 2011; Stevens 2012). However, ZTL, are still extant in the middle and upper Peach Springs Canyon, several miles south of the Diamond Creek dunes.

Analysis of missing and at-risk species in the Colorado River ecosystem downstream from Glen Canyon Dam identified ZTL as having high potential for restoration (Stevens et al. 2011). In an effort to re-establish ZTL on the dunes at Diamond Creek, the Bureau of Reclamation, Upper Colorado Region, working through the Glen Canyon Dam Adaptive Management Program, funded a translocation effort working with the Hualapai Tribe and Stevens Ecological Consulting, LLC in 2012.

On August 9 and 10, 2016, there was a large monsoon flood in Peach Springs Canyon that flowed across the Diamond Creek campground and down the wash east of the dune area. This flood deposited fine grain sediments and silt in the campground area and caused a large erosion event in the wash. The effects of the flood are evident in the data presented below.

Following the translocation effort in 2012, monthly surveys (April-October) have been performed annually from 2012 to 2016. This report provides survey results from the 2016 surveys and reviews prior years' survey results and discusses trends in the population status of zebra-tailed lizards at Diamond Creek on the Hualapai Reservation.



Figure 1. A male Zebra-tailed lizard at the Diamond Creek dunes in 2015 (Photo by D. Dupree). Males are identified by the blue/black markings on the sides/underbellies behind the front limbs and a distinctly banded tail.



Fig. 2: A photograph of the top of the Diamond Creek dunes in 2015 (Photo by D. DuPree). Vegetation on the dunes is dominated by creosote bush. The Diamond Creek campground can be seen in the background.



Figure 3. Aerial photograph of the Diamond Creek area of the Hualapai Reservation where the zebra-tailed lizards were released in 2012 and surveyed for subsequently. The dune habitats are in the upper center of the photograph. Lizards have also been found throughout much of the terrestrial areas including the wash habitat to the east of the dunes and in the campground/ramada areas during all of the surveys. In August, 2016, a severe monsoon flood coursed through the campground area and down the wash east of the dunes. These areas were substantially affected by this flood as is reflected in the post August 10 survey results.

Methods

Details of the capture and translocation activities performed in 2012 can be found in the 2013 Final Report, Bureau of Reclamation, Salt Lake City, Utah. This report will provide information on the 2016 survey activities and results and compare these data .

In 2016, from April to October, surveys for zebra-tailed lizards were performed at monthly intervals. Dr. Kerry Christensen and Ms. Sharon Wilder of the Hualapai Department of Cultural Resources performed the zebra-tail surveys at the Diamond Creek area by walking around and through the dune area and adjacent dirt habitats on foot (Figure 3) . The surveys lasted approximately 60 minutes each. We recorded information on behavior, distance to vegetation and vegetation type as well as location when a zebra-tail was encountered. Determinations of adult versus juvenile versus baby lizards is based on size. Photographs of adult male, adult female, juvenile and baby zebra-tails are provided in Figures 4-7.

Locations of all lizards encountered during the survey, including zebra-tailed lizards were plotted on an aerial photograph of the dune area (Figure 8). The Project Manager transposed the field aerial photographs to a computer generated version of the aerial photograph with the lizard locations (Figure 8).



Figure 4. A photograph of a male zebra-tailed lizard with the blue/black patch on the sides and the distinctly banded tail.



Figure 5. A photograph of an adult female zebra-tail lizard (Photo by D. Dupree). Note the lack of a blue/black patch on the side and the presence of yellow arm pits.



Figure 6. A photograph of a juvenile zebra-tailed lizard (center of photograph). This juvenile is about $2/3$ the size of an adult. It is hard to visualize the relative size difference without an object for scale.



Figure 7. A photograph of a baby zebra-tailed lizard (center of photo) born in the summer of 2015. Total length of this individual is less than 2.5 inches.

Results

A good number of zebra-tailed lizards were observed in all of the monthly surveys prior to August, 2016 (Table 1). Following the August flood, however, the numbers of zebra-tailed lizards observed in our surveys dropped dramatically. The average number of zebra-tails observed in the surveys pre-flood surveys was 9.25, but just 5.5 post flood (Table 1). These results will be discussed below.

Figure 9 shows the effects of the flood on the wash adjacent to the dune area. We contacted the USGS web site for stream flow data for the Diamond Creek stream gage. The flow down Peach Springs Canyon began to increase from a base flow of approximately 5.0 cubic feet per second at 6:00PM on August 9 and peaked at 8:00PM August 9 at a flow of 5,090 cubic feet per second. This flow rate was therefore over 1,000 times the normal flow rate. The stream gage at Diamond Creek quit providing data at 16:30 MST on August 10, 2016, and did not provide data again until August 16, 2016. These data show that this was an extreme event that had not been equaled in over 20 years of previous flow (USGS web site).

Table 1 also shows that the number of juveniles found in the surveys was highest early in the season and declined to zero beginning with the July survey. This could reflect maturation of juveniles into adults, but the data could be affected by the flood. The presence of baby zebra-tails in July and after the flood in August and September is encouraging (Table 1). Unfortunately, the October 27, 2016 survey was conducted too late in the season and under conditions unfavorable (72° F) to zebra-tail activity and resulted in zero zebra-tail detections (Table 1).

Table 1. Summary of 2016 Diamond Creek zebra-tailed lizard monitoring results.

Date	# of ztl located/ survey	# juveniles	# Babies	Mean dist. To veg. (m)	Vegetation type(s)
April 26, 2016	10	4	0	0.72	Creosote, baccharis
May 26, 2016	8	3	0	1.39	Brittle bush, creosote
June 30, 2016	10	1	0	0.79	Creosote, brittle bush
July 20, 2016	9 9.25*	0	3	0.51	Mesquite, creosote, brittle bush
August 26, 2016	5	0	1	1.02	creosote
September 16, 2016	6 5.5**	0	2	0.78	Creosote, mesquite
October 27, 2016	0	0	0	0	NA
Average***	7.8	1.33	1.0	0.87	

*average number of zebra-tailed lizards found in pre-flood surveys.

**average number of zebra-tailed lizards found in post-flood surveys.

***The October 27 survey results were not included in calculating the averages.

The average numbers of zebra-tailed lizard recordings in the surveys from 2012 to 2016 (Table 2) show a substantial decline in numbers of zebra-tails in 2016 compared to 2015. Clearly, the 2016 flood affected the average number of zebra-tailed lizards observed overall at Diamond Creek. That the average number observed in 2016 was still greater than in the surveys prior to 2015 shows that the zebra-tailed lizard population was stable prior to the flood.

Table 2. A summary of the results of zebra-tailed lizard surveys from 2012 to 2015.

Year	Mean # of ZTL located	Mean # Juveniles	Mean # Babies	Mean distance to vegetation
2012	4.0	0.6	0.0	1.2
2013	3.5	1.0	0.0	1.3
2014	5.6	2.4	0.13 (3 total)	2.0
2015	11.3	2.7	1.70 (10 total)	0.9
2016	7.8	1.33	1.0 (6 total)	0.87

Figure 8. The locations of lizards (zebra-tail, whiptails and tree lizards) observed on the April, 2016 survey. Zebra-tail lizards are denoted by ZTL, whiptails by W and tree lizards by T. J is for Juvenile, A for adult, F for female and M for male.

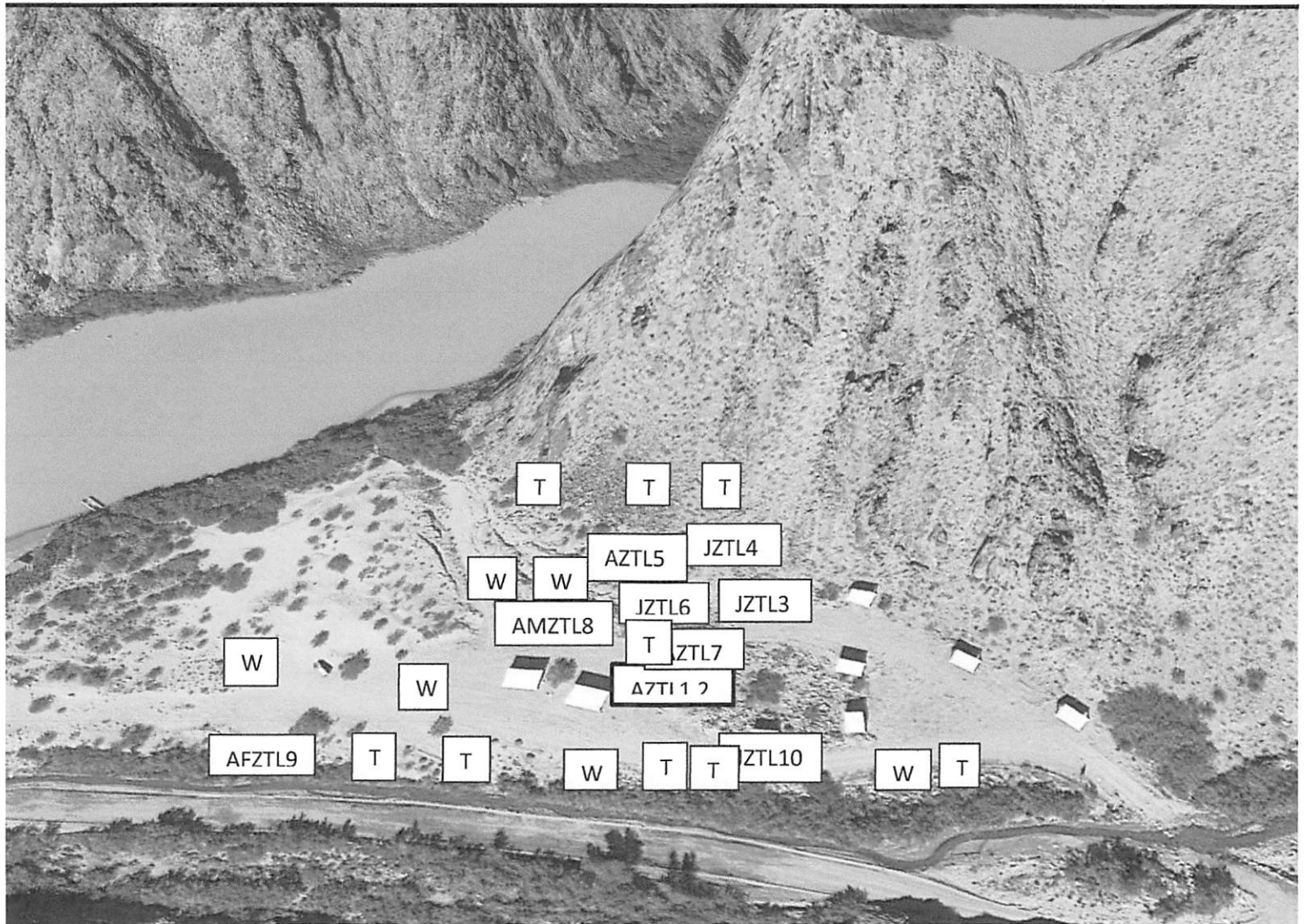




Figure 9. A photograph of the Diamond Creek Wash on the east side of the dune area at Diamond Creek where many zebra-tailed lizards had been found in the past. The August, 2016 monsoon flood eroded a large channel in the middle of the wash. no zebra-tailed lizards were found here in the post-flood surveys in 2016.

Discussion and Recommendations

The zebra-tailed lizard population at Diamond Creek appeared stable prior to the 2016 monsoon flood. Results from surveys prior to the flood in 2016 (Appendices A and B) and in previous years (see 2012-2015 annual reports) show that many zebra-tailed lizards were found in the wash area prior to the 2016 flood. We believe that the flood actually washed away zebra-tailed lizards that were living in the wash area. This is consistent with the data collected post flood.

Additional translocations of zebra-tailed lizards in 2017 could restore the zebra-tailed lizard population at Diamond Creek to the pre-flood level and could be seen as a way to increase the genetic diversity of the Diamond Creek zebra-tailed lizard population. Future translocations should be considered after discussions with the principal investigators, Reclamation, appropriate ecologists and other lizard experts. Following

the 2016 monitoring season, we advocate a meeting among Reclamation staff, interested Glen Canyon Dam Adaptive Management Program Technical Workgroup members and others to discuss the future direction of the project.

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APPENDIX A

2016 Zebra-tailed Lizard Completed Survey Forms

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date April 26, 2016

Start: 10:30A Finish 11:15A

Temperature: 74 – 72° F RH 22-26% Wind: 5-8, 10-12 mph

1st encounter: Behavior: two adults near ramada #8 at end of veg patch

Distance to vegetation: 0.5m Vegetation Type creosote

2nd encounter: Behavior: See #1 above

Distance to vegetation: 0.5m Vegetation Type creosote

3rd encounter: Behavior: Juvenile at top of wash

Distance to vegetation: 0.5m Vegetation Type Baccharis

4th encounter: Behavior: Juvenile next to wash

Distance to vegetation: 0.5m Vegetation Type Baccharis

5th encounter: Behavior: Edge of dune

Distance to vegetation: 1.0m Vegetation Type creosote

6th encounter: Behavior: Juvenile on top of dune

Distance to vegetation: 0.7m Vegetation Type creosote

7th encounter: Behavior: Adult next to last ztl

Distance to vegetation: 1.0 Vegetation Type grass

8th encounter: Behavior: Adult Male top of dune

Distance to vegetation: 1.0m Vegetation Type creosote

9th encounter: Behavior: Adult female at edge of road

Distance to vegetation: 1.0m Vegetation Type creosote

10th encounter: Behavior: Juvenile in road

Distance to vegetation: 0.5m Vegetation Type creosote

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen Date 05/26/2016

Start: 9:52AM Finish 10:45AM

Temperature: 85-87° F RH 10-12% Wind: 2-4 mph

1st encounter: Behavior: Adult in road near second ramada

Distance to vegetation: 3.0 m Vegetation Type brittle bush

2nd encounter: Behavior: Juvenile in road near 1st ztl

Distance to vegetation: 4.0 m Vegetation Type brittle bush

3rd encounter: Behavior: Adult female near end of wash

Distance to vegetation: 0.0 m Vegetation Type brittle bush

4th encounter: Behavior: Juvenile next to ztl #3

Distance to vegetation: 0.5 m Vegetation Type brittle bush

5th encounter: Behavior: Adult male on dune

Distance to vegetation: 0.1 m Vegetation Type creosote

6th encounter: Behavior: Unknown zebra-tail; ran into bush too fast, tail only

Distance to vegetation: 0.5 m Vegetation Type brittle bush

7th encounter: Behavior: Juvenile in open near ramada #6

Distance to vegetation: 1.0 m Vegetation Type sand verbena

8th encounter: Behavior: Adult under cabana #4

Distance to vegetation: 2.0 m Vegetation Type creosote

Comments: lots of foot traffic between the main beach and the porta-potties, two vehicles over-night camping at ramada

#10

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date 6/30/2016

Start: 9:05 Finish 9:55

Temperature: 90-94°F RH 40-30% Wind: 2-5 mph

1st encounter: Behavior: Adult crossing road

Distance to vegetation: 1.0 m Vegetation Type brittle bush

2nd encounter: Behavior: Adult female next to ramada

Distance to vegetation: 2.0m Vegetation Type creosote bush

3rd encounter: Behavior: Adult at the east edge of the dune

Distance to vegetation: 0.5 m Vegetation Type creosote bush

4th encounter: Behavior: Adult at the east edge of the dune

Distance to vegetation: 1.0 m Vegetation Type creosote bush

5th encounter: Behavior: Adult female at east edge of dune

Distance to vegetation: 0.5 m Vegetation Type creosote bush

6th encounter: Behavior: Adult at south end of dune

Distance to vegetation: 0.2 m Vegetation Type creosote bush

7th encounter: Behavior: Juvenile on top of dune

Distance to vegetation: 1.0 m Vegetation Type brittle bush

8th encounter: Behavior: Adult male by ramada

Distance to vegetation: 0.5 m Vegetation Type creosote bush

9th encounter: Behavior: Adult female in wash

Distance to vegetation: 0.5 m Vegetation Type brittle bush

10th encounter: Behavior: Adult female in wash

Distance to vegetation: 0.7 m Vegetation Type arrowweed

Comments:: It had rained hard the day before; ground still moist, water had run down the wash. Moderate traffic in general. High traffic between beach and porta-potties.

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date July 20, 2016

Start: 9:15 AM Finish 10:15 AM

Temperature: 90-101 °F RH 35-20% Wind: 0-2 mph

1st encounter: Behavior: Adult female north end of dune next to mesquite tree

Distance to vegetation: 1.0m Vegetation Type mesquite

2nd encounter: Behavior: Baby next to mesquite by the trail to the beach

Distance to vegetation: 0.1 m Vegetation Type mesquite

3rd encounter: Behavior: Baby in trail by path to porta-potties

Distance to vegetation: 2.0 m Vegetation Type sand verbena

4th encounter: Behavior: Adult at south edge of dune

Distance to vegetation: 0.5 m Vegetation Type creosote

5th encounter: Behavior: Adult female at north end of wash together with #6

Distance to vegetation: 0.5 m Vegetation Type brittle bush

6th encounter: Behavior: Adult male at north end of wash with #5

Distance to vegetation: 0.5 m Vegetation Type brittle bush

7th encounter: Behavior: Adult on dune under a mesquite tree

Distance to vegetation: 0.0 m Vegetation Type mesquite

8th encounter: Behavior: Baby in mesquite between two cabanas

Distance to vegetation: 0.0 m Vegetation Type mesquite

9th encounter: Behavior: Adult female in mesquite next to road

Distance to vegetation: 0.0 m Vegetation Type mesquite

Comments:: Lots of foot traffic at beginning of survey and very few (none for the first 15 minutes) of the survey. A truck was emptying the porta-potties for 15 minutes during the survey and probably affected survey. Many of the zebra-tails were under or next to mesquite trees. The lizards may have been seeking shade?

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date August 26, 2016

Start: 10:30 Finish 11:27

Temperature: 82-93°F RH 38-20% Wind: 3-3 mph

1st encounter: Behavior: Adult between ramadas #3 and #4

Distance to vegetation: 1.0 m Vegetation Type creosote bush

2nd encounter: Behavior: Adult female east side of dune

Distance to vegetation: 0.5 m Vegetation Type creosote bush

3rd encounter: Behavior: Adult on top of dune

Distance to vegetation: 0.5 m Vegetation Type creosote bush

4th encounter: Behavior: Adult male northwest edge of dune

Distance to vegetation: 0.1 m Vegetation Type creosote bush

5th encounter: Behavior: Baby in the path from the beach to the porta potties

Distance to vegetation: 3.0 m Vegetation Type creosote bush

6th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

7th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

Comments: On or about August 10, 2016, a large flood (> 500 cfs) went down Peach Springs Canyon and over/through the campground at Diamond Creek and down the wash on the east side of the dune. Considerable sediment was deposited in the camp area and the wash was scoured to a depth of four feet in some areas. A paucity of zebratails in the camp area may have been due to the flood. We hope to survey again during the week of August 29 to verify or refute the number of zebratails seen during this survey. On aerial photo, bt is baby tree lizard and Bztl is baby zebratail.

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date 9/16/2016

Start: 10:45 AM Finish 11:45 AM

Temperature: 88-90 °F RH 34-25% Wind: 0-1 mph

1st encounter: Behavior: Adult female at the south edge of dune

Distance to vegetation: 0.1 m Vegetation Type creosote bush

2nd encounter: Behavior: Adult female at west edge of dune

Distance to vegetation: 1.0 m Vegetation Type mesquite

3rd encounter: Behavior: Adult female north end of dune

Distance to vegetation: 2.0 m Vegetation Type creosote bush

4th encounter: Behavior: Baby at the west edge of dune

Distance to vegetation: 0.1 m Vegetation Type creosote bush

5th encounter: Behavior: Adult female in road to porta potties

Distance to vegetation: 0.5m Vegetation Type mesquite

6th encounter: Behavior: Baby at top of wash

Distance to vegetation: 1.0 m Vegetation Type arroyweed

7th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

8th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

Comments: One truck, two trucks with trailers and two vans parked at the last ramada. Lots of pedestrian traffic. Definite effects on zebra-tail sightings.

DS = desert spiny lizard (*Sceloporus magister*) on aerial photograph.

Zebra-tailed Lizard Monitoring Form

Monitor(s): Kerry Christensen, Sharon Wilder Date 10/27/2016

Start: 9:00 AM Finish 9:32 AM

Temperature: 72-72 °F RH 52-64% Wind: 2.0-2.0 mph

1st encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

2nd encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

3rd encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

4th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

5th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

6th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

7th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

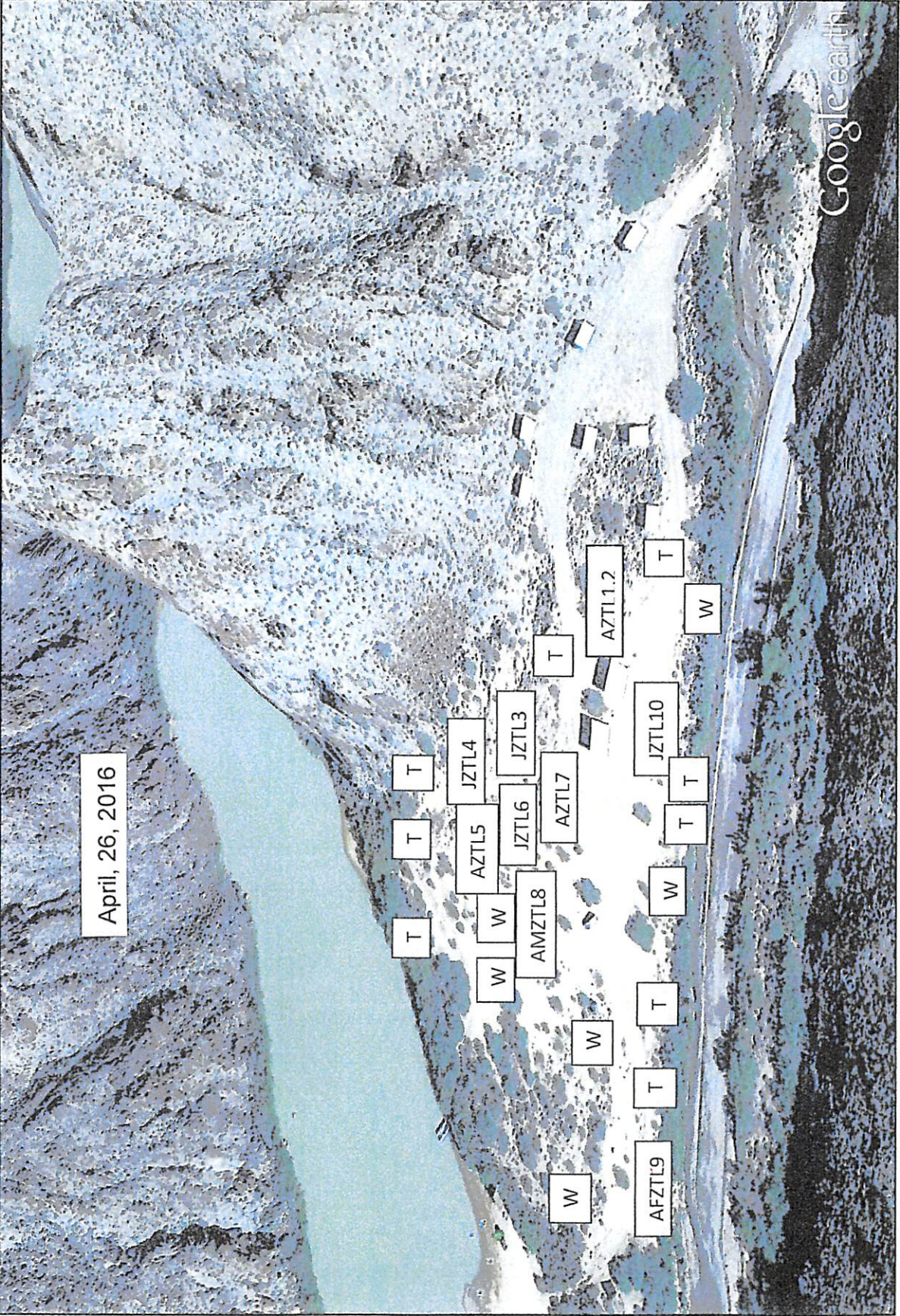
8th encounter: Behavior: _____

Distance to vegetation: _____ Vegetation Type _____

Comments: ants are torpid, hazy sky, evidence of previous foot traffic
widespread, road runner adjacent to the dune

APPENDIX B

2015 Zebra-tailed Lizard Survey Completed Aerial Photographs



April, 26, 2016

Google earth

T T T
W W W
AZTL5 JZTL4
AMZTL8 JZTL6 JZTL3
AZTL7
W AFZTL9 AFZTL10
AZTL1.2 W
T T T
T T T
T T T
T T T

May 26, 2016

JZTL4
AFZTL3

AMZTL5

AZTL8

T

W

W

JZTL2 T

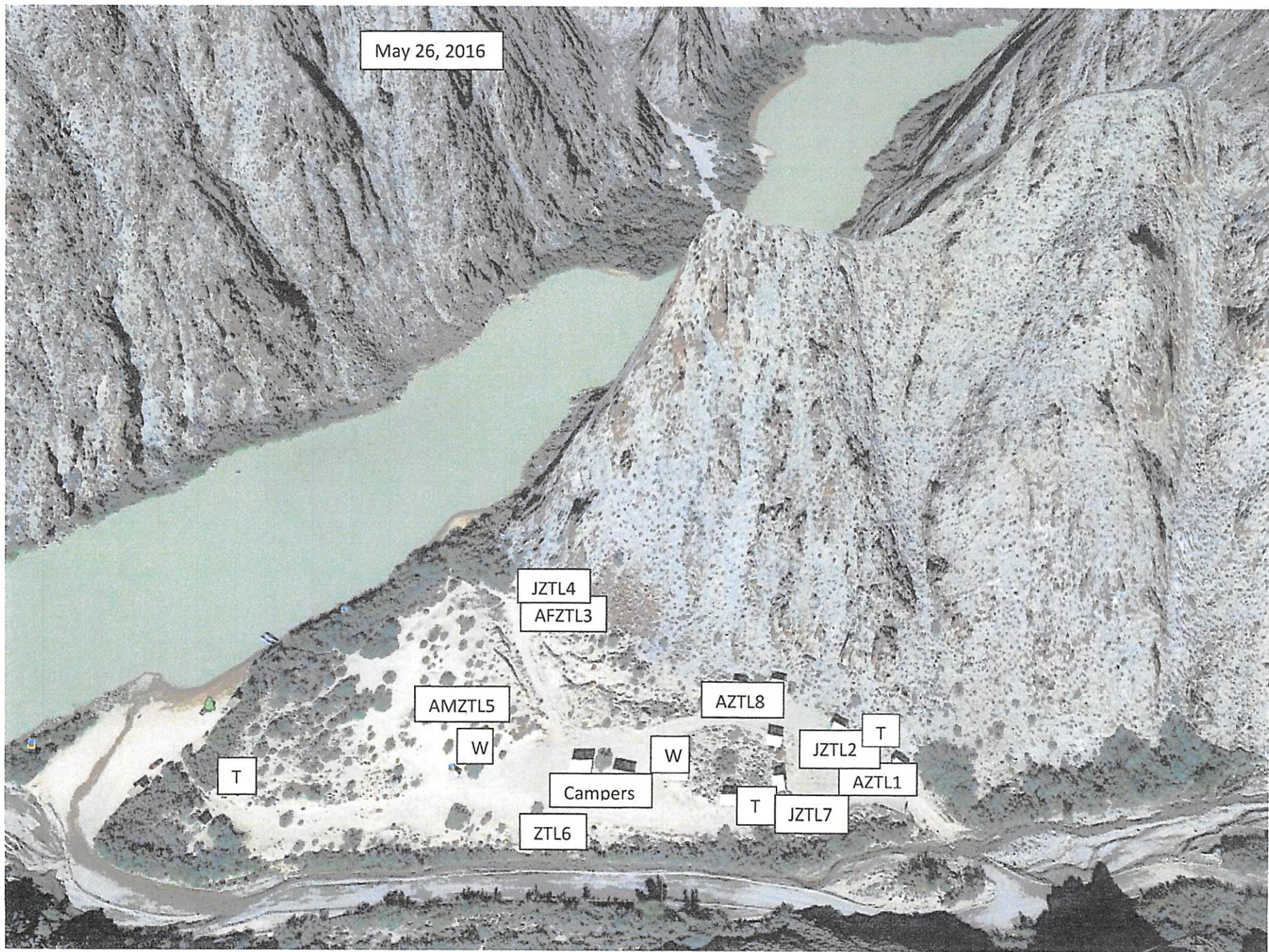
Campers

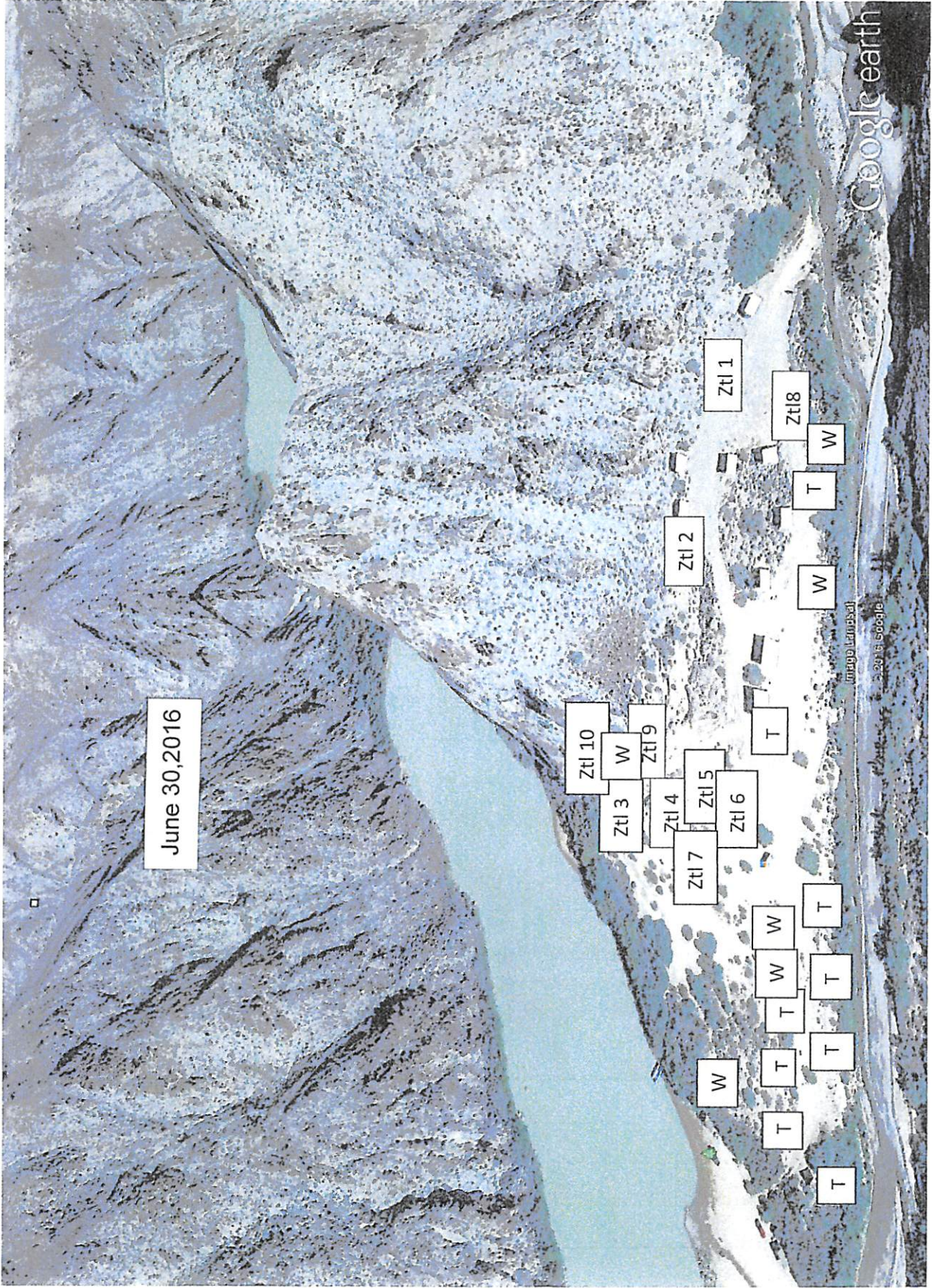
AZTL1

ZTL6

T

JZTL7





June 30, 2016

Ztl 10

Ztl 3

W

Ztl 9

Ztl 4

Ztl 7

Ztl 5

Ztl 6

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W

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Ztl 2

W

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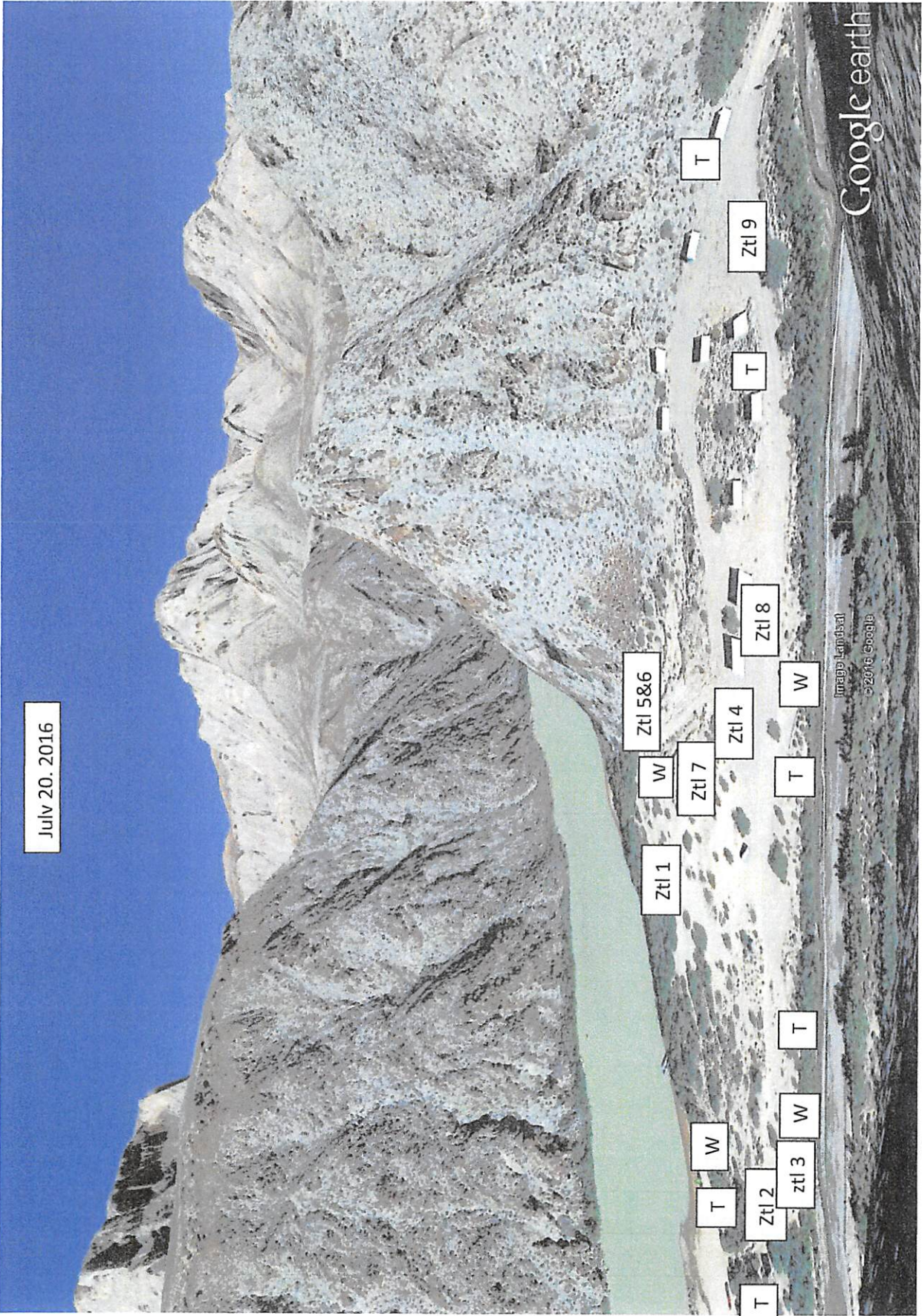
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Google earth

July 20. 2016



Google earth

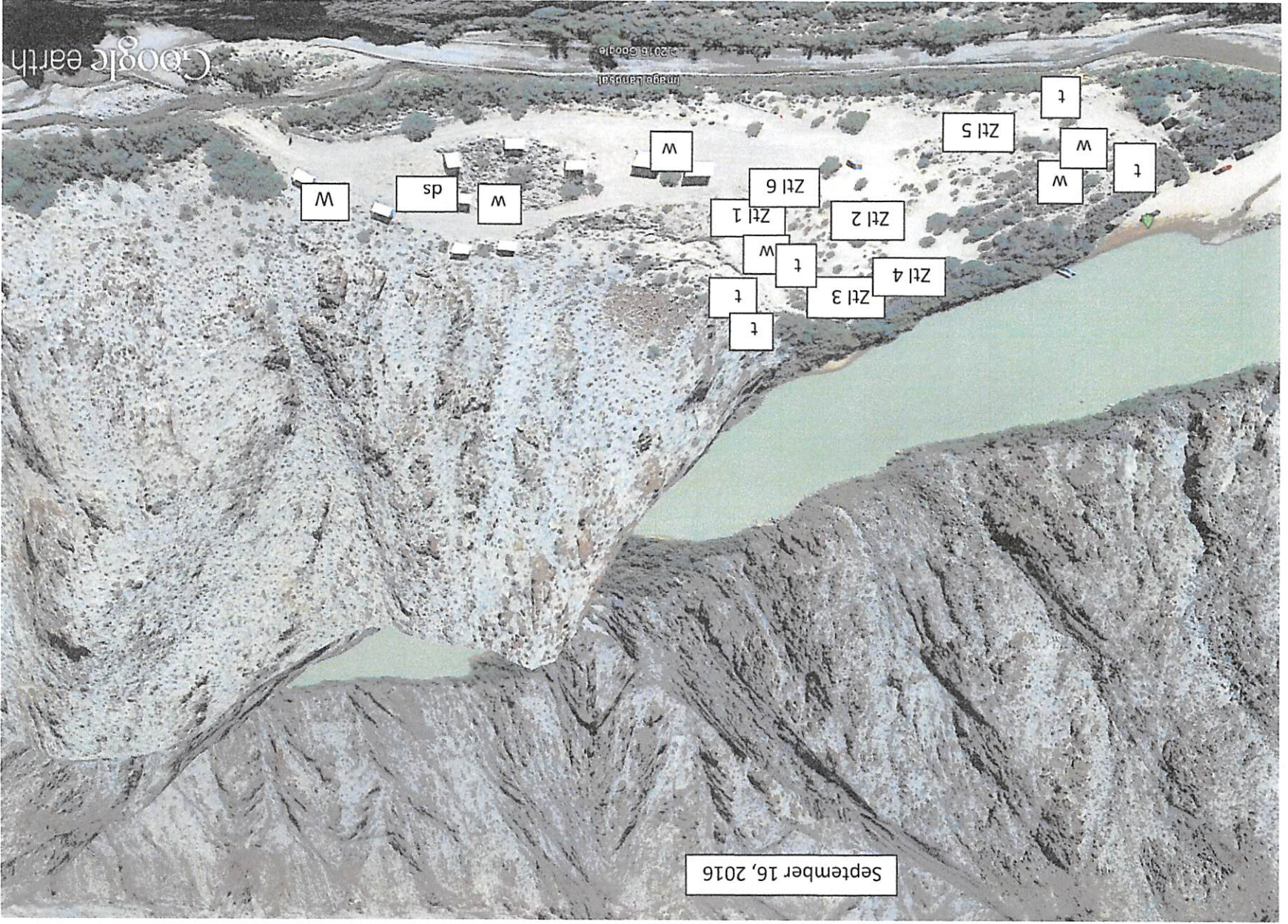
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August 26, 2016



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October 27, 2016



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Image Landsat
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