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# DESERT TORTOISE SURVEY REPORT



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## Bonanza Solar Project Clark County, Nevada

Submitted to:  
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&  
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# 1. EXECUTIVE SUMMARY

The following report presents the methods and results of the protocol desert tortoise (*Gopherus agassizii*) survey conducted in October 2021 on the proposed Bonanza Solar Project (Project) in Clark County, Nevada (Figure 1). The Project site is in Indian Springs Valley, approximately 40 miles northwest of Las Vegas, Nevada, south of U.S. Highway 95 between 4 and 15 miles west of Indian Springs. The location is depicted on the Mercury SE 7.5' U.S. Geological Survey (USGS) Topographic Quadrangle.

The purpose of the survey was to document presence and estimate density of desert tortoise on approximately 6,834 acres (protocol survey area, using 10-meter transect surveys), which covered at least 3 times the area needed for the project, anticipated to be less than 2,000-acres. Biologists also investigated the extent of desert tortoise sign south and east of the Project by conducting focused intuitive surveys<sup>1</sup> within a 14,000-acre polygon (Figure 2). Data collection included documenting presence of desert tortoise, including live individuals and all tortoise sign. This report includes summary tables of all desert tortoise sign identified during the survey and supporting maps.

In summary, thirty-eight (38) live individuals (23 adult, 15 sub adult/juvenile) were identified within the 6,834-acre protocol survey area, and 5 tortoises were detected in the 14,000-acre focused intuitive survey area. Based on these findings, the tortoise density of the protocol survey area is estimated to be approximately 1.8 adult tortoises/km<sup>2</sup>, which is comparable to the average density of 1.5 tortoises/km<sup>2</sup> in the Eastern Mojave Desert Tortoise Recovery Unit.

Active tortoise sign was found at elevations up to approximately 4,750 feet south of the proposed Project. These observations indicate that demographic and genetic connectivity likely occurs outside of the corridor depicted in the U.S. Fish and Wildlife Service (USFWS) connectivity model (which depicts areas of contiguous, highest value habitat for the Mojave desert tortoise) and confirmed presence in areas with low modeled habitat suitability values (Nussear et al. 2009). Desert tortoise sign was also detected in the mountains and pass south of Indian springs, indicating connectivity also exists in an east-west direction (south of Hwy 95).

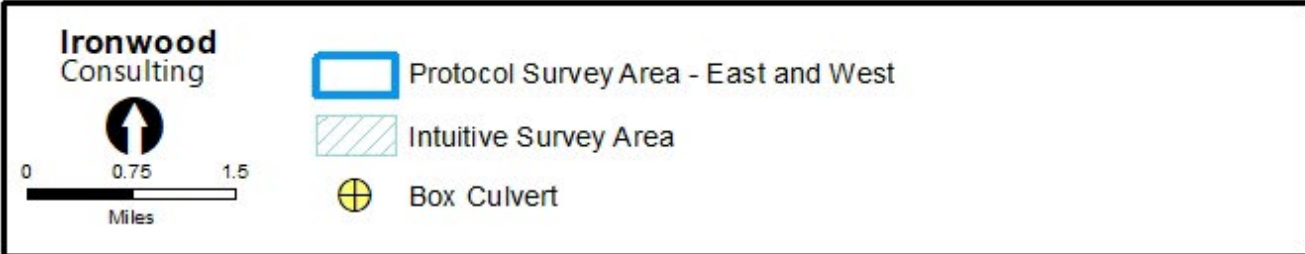
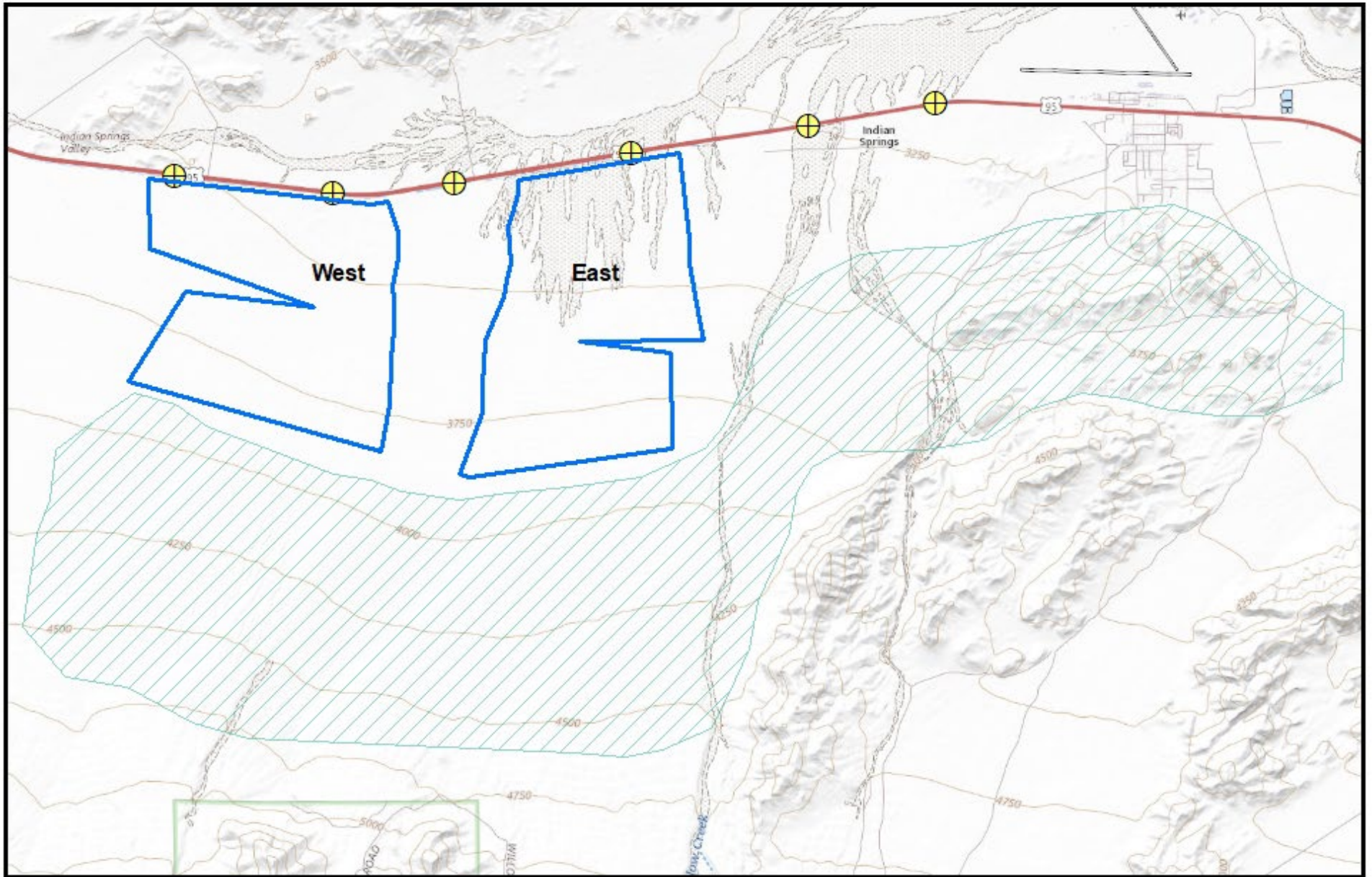
As a result of these findings, the *MDT* [Mojave Desert Tortoise] *Pre-project Survey Protocol 2020* spreadsheet indicates there are an estimated 14.6 adult desert tortoises within an estimated 2,000-acre Project footprint, with a lower 95% confidence value of 8.2 tortoises and an upper 95% confidence value of 26.1 tortoises. The *MDT Pre-project Survey Protocol 2020* spreadsheet estimates 19.0 hatchlings, and 76.1 tortoises <180 mm (excluding hatchlings).

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<sup>1</sup> Focused intuitive surveys target areas most likely to possess tortoise sign. Biologists walk meandering transects with variable spacing and record all tortoise sign encountered. These data were not used to calculate density, but rather provide information on extent of occupied habitat.







**FIGURE 2**  
**Site Location**

Bonanza Solar Project

## 2. METHODS

Field surveys were conducted from October 10 to November 8, 2021, by Heritage Environmental Consultants LLC and Ironwood Consulting Inc. qualified biologists who had previously been approved as Authorized Biologists and/or Biological Monitors by USFWS on prior projects. Temperatures ranged from approximately 6 to 28° Celsius (42 to 82° Fahrenheit) with varying wind speeds between approximately 0 and 10 km per hour, with mostly clear skies. There were four survey days with light rain.

The protocol survey followed the guidelines and requirements in *Desert Tortoise Field Manual* (USFWS 2009) and *Preparing for Any Action that May Occur Within the Range of the Mojave Desert Tortoise (Gopherus agassizii)* (USFWS 2019). The survey crew walked pedestrian transects spaced approximately 10 meters apart and searched for/recorded all signs of desert tortoise including live individuals, scat, burrows, tracks, and eggshell fragments. Biologists walked approximately 2,770 linear km within the 6,834-acre survey area. Sign was classified based on the rating system descriptions in Table 1. Tortoise density (tortoise/km<sup>2</sup>) and 95% confidence interval calculations were performed using *Table 2: MDT Pre-project Survey Protocol 2020* (USFWS 2020).

The focused intuitive survey was conducted by experienced tortoise biologists who completed targeted searches of suitable habitat. The biologists surveyed approximately 450 linear km within the 14,000-acre area. The focused intuitive survey area included habitat south and east of the Project, including the foothills of the Spring Mountains between 4,000 and 4,800 feet above mean sea level (AMSL), and in the hills and passes south of Indian Springs. The meandering transects were spaced approximately 10 to 50 m apart, and all desert tortoise sign was recorded using standardized class descriptions (Table 1).

**Table 1. Desert Tortoise Sign Classification**

	Class	Description
	<b>BURROW PALLET<sup>1</sup></b> or	1
2		Definitely tortoise - good condition
3		Definitely tortoise - deteriorated/collapsed
4		Possibly tortoise - good condition
5		Possibly tortoise - deteriorated/collapsed
<b>SCAT</b>	Class	Description
	1	Wet or freshly dried, obvious odor
	2	Dried, with glaze, some odor, dark brown
	3	Dried, no glaze or odor, dark brown
	4	Dried, light brown - pale yellow, loose material, scaly appearance
5	Bleached, or consisting only of plant fiber	
<b>CARCASS</b>	Class	Description
	1	< 1 year, fresh, putrid, scutes mostly adhered, sheen on exposed bone
	2	1 - 2 years, scutes mostly adhered to bone, exposed scutes pale no sheen, unexposed bone silky
	3	2 - 3 years, scutes peeling off bone, exposed scutes pale and without sheen, no growth ring peeling
	4	4 years, shell bone falling apart, growth rings on scutes peeling, bone fissured
5	> 4 years, disarticulated and scattered	

<sup>1</sup> Pallet: a shallow depression in the soil, usually under cover of vegetation or rock; or a shallow burrow that does not cover the entire shell.

### 3. RESULTS

#### 3.1 Site Characteristics

The site is within Indian Springs Valley, on the alluvial fan characterized by a low gradient, north-facing slope, with elevations between 3,300 and 3,800 feet (1,005 and 1,160 meters) AMSL. Substrate included friable soils, small to medium-sized gravel, cobble, rocky areas, and numerous sand/silt washes running downslope from the foothills of the Spring Mountains towards Hwy 95. The site vicinity was interspersed with numerous washes that supports vegetation characteristic of the Mojave desert in this region. The entire survey area fits best within the *Larrea tridentata* – *Ambrosia dumosa* (creosote-bursage) Shrubland Alliance under the vegetation classification system of the NNHP (Peterson 2008, see Heritage 2021).

The site is primarily undisturbed, with existing anthropogenic impacts associated with two transmission lines, dirt roads, wild horses and burrows, and trash. The site includes suitable desert tortoise habitat within the protocol and focused intuitive survey areas.

#### 3.2 Desert Tortoise

##### 3.2.1 Protocol Survey

Thirty-eight (38) live individuals were detected in the protocol survey area: 23 adults ( $\geq 180$  mm midline carapace length [MCL] and 15 sub-adult/juveniles  $< 180$  mm MCL (Table 2, Figure 3). There were 71 *Class 1 Active condition* burrows identified, which were burrows associated with a live tortoise or recent tortoise sign. A live tortoise will typically use multiple burrows within its home range (Harless, 2009). There were 697 *Class 2 Good condition* burrows which have no sign of recent use and are typically intact and free of vegetation and debris, and 436 *Class 3 Deteriorated condition* tortoise burrows, which were generally partially or wholly collapsed. There were 340 *Class 3 and 4 Possibly tortoise* burrows (Figure 4). There were 167 desert tortoise carcasses where 66 (49 adult, 17 sub-adult/juvenile) carcasses were estimated at  $< 1$  years old. Desert tortoise scat, tortoise tracks, and pallets were additionally identified during the survey (Table 3, Figures 5, 6, 7).

**Table 2. Live Desert Tortoise Record**

Size Class	Protocol Survey Area	Focused Intuitive Survey Area
Juvenile	15	-
Adult	23	5
<b>Total</b>	<b>38</b>	<b>5</b>



**Table 3. Desert Tortoise Sign Records in Protocol Survey Area**

Sign Type	Total	Class 1	Class 2	Class 3	Class 4	Class 5
Burrow	1544	71	697	436	321	19
Desert tortoise carcass	167	66	15	5	29	52
Desert tortoise scat	135	3	46	63	19	4
Tortoise tracks/dig marks	3	-	-	-	-	-
Pallet	130	1	83	43	3	-

### 3.2.2 Focused Intuitive Survey

The surveys in the focused intuitive survey area identified sign which extended to relatively high elevations. Five adult tortoises were observed within the focused intuitive survey area (Table 2) and other detected tortoise sign is presented in Table 4 and Figure 8.

**Table 4. Desert Tortoise Sign Records in Intuitive Survey Area**

Sign Type	Total	Class 1	Class 2	Class 3	Class 4	Class 5
Burrow	182	20	81	36	44	1
Desert tortoise carcass	31	5	7	3	8	8
Desert tortoise scat	61	3	27	26	3	2
Tortoise tracks/dig marks	2	-	-	-	-	-
Pallet	9	-	8	1	-	-

### 3.2.3 Density Estimate

Protocol desert tortoise surveys on 6,834 acres were performed on and around the proposed 2,000-acre Project footprint. The surveys utilized 100 percent coverage of all suitable habitat using 10-meter (30-foot) wide belt transects; the survey identified 23 adult tortoises.

Density estimates were calculated using the imbedded formula in *Table 2 MDT Pre-project Survey Protocol 2020* of the revised protocol, *Preparing for Any Action That May Occur within the Range of The Mojave Desert Tortoise* (USFWS 2019) and are presented in Table 4. Only live adult tortoises ( $\geq 180$  mm MCL) are included in density estimate calculations. Using an average transect length of 5.2 km across the 6,834-ac survey area, the *MDT Pre-project Survey Protocol 2020* spreadsheet indicates there are an estimated 14.6 adult desert tortoises within the Project footprint, with a lower 95% confidence value of 8.2 tortoises and an upper 95% confidence value of 26.1 tortoises. There are an estimated 19.0 hatchlings, and 76.1 tortoises  $<180$  mm (excluding hatchlings, Table 4). This provides a density estimate of 1.8 tortoises/km<sup>2</sup> in the surveyed area (Appendix A).

**Table 5. Desert Tortoise Density Estimates**

Description	Protocol Survey Area	Project Footprint
Acres	6,834	2,000
Number of tortoises > 180 mm MCL (lower – upper 95% CI)	50 (28.0 – 89.2)	14.6 (8.2 – 26.1)
Number of hatchlings (young-of-year) <sup>1</sup>	65	19.0
Number of tortoises < 180 mm MCL, not young-of-year <sup>1</sup>	260.1	76.1
D (tortoises/km <sup>2</sup> )	1.8	
Average Density in Recovery Unit (tortoises/km <sup>2</sup> )	1.5	

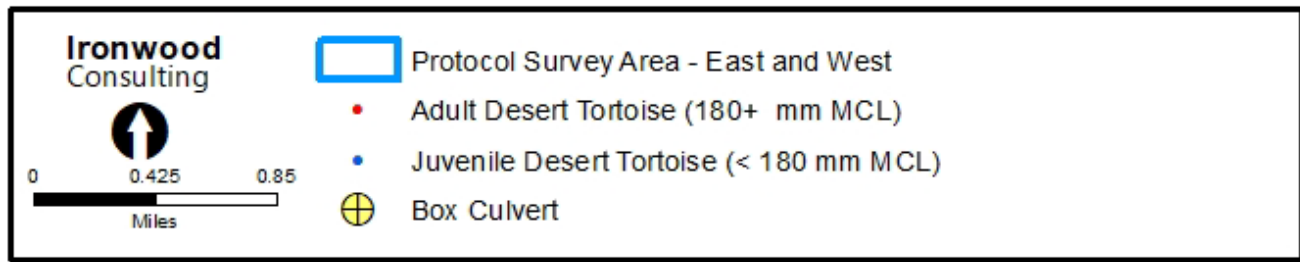
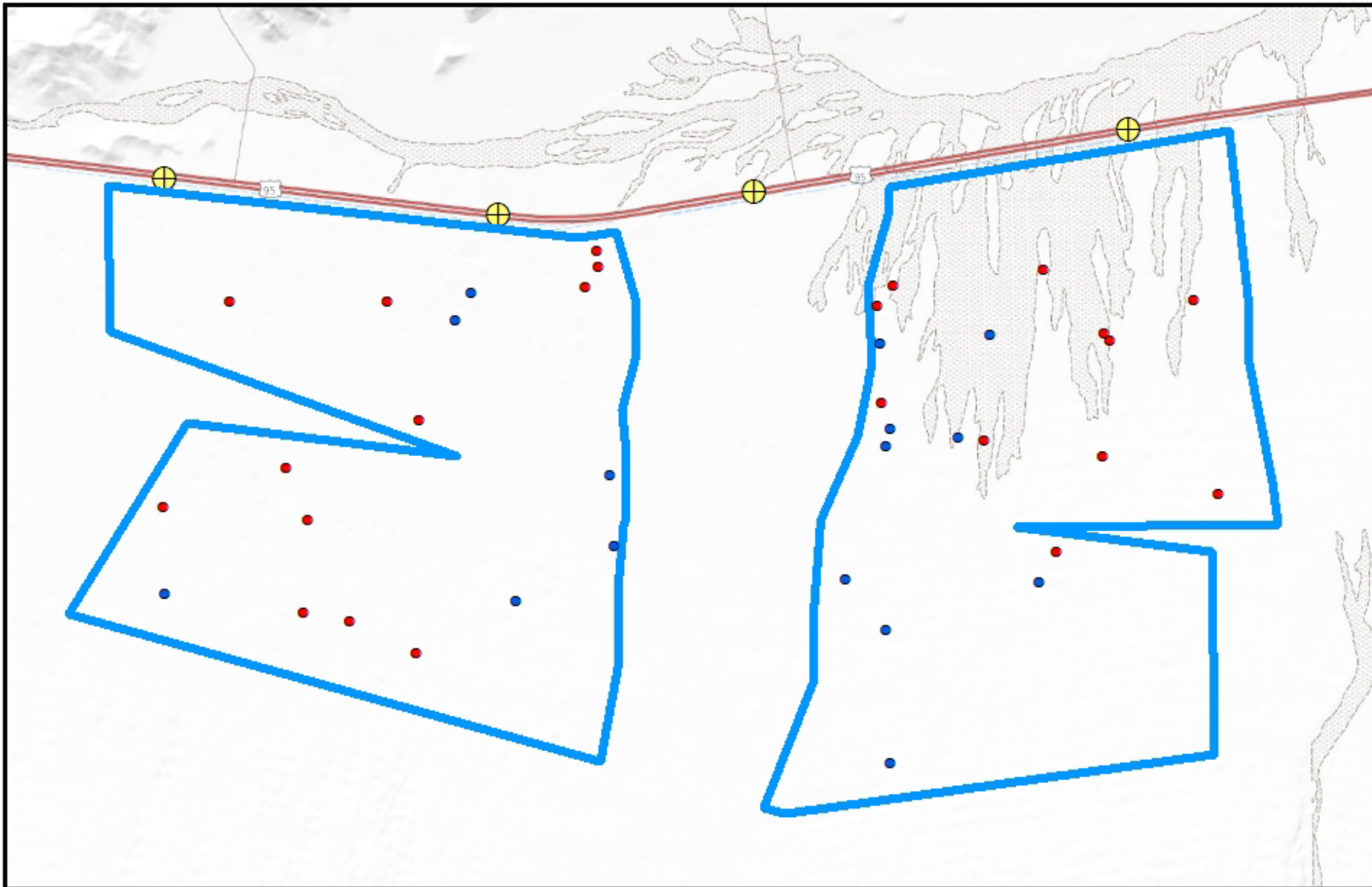
<sup>1</sup> Number of hatchlings and tortoises < 180mm MCL (excluding hatchlings) are calculated based on the estimated number of adults, using multipliers of 1.3 and 5.2 respectively which are embedded into the *Table 2 MDT Pre-project Survey Protocol 2020* formula.

## 4. DISCUSSION

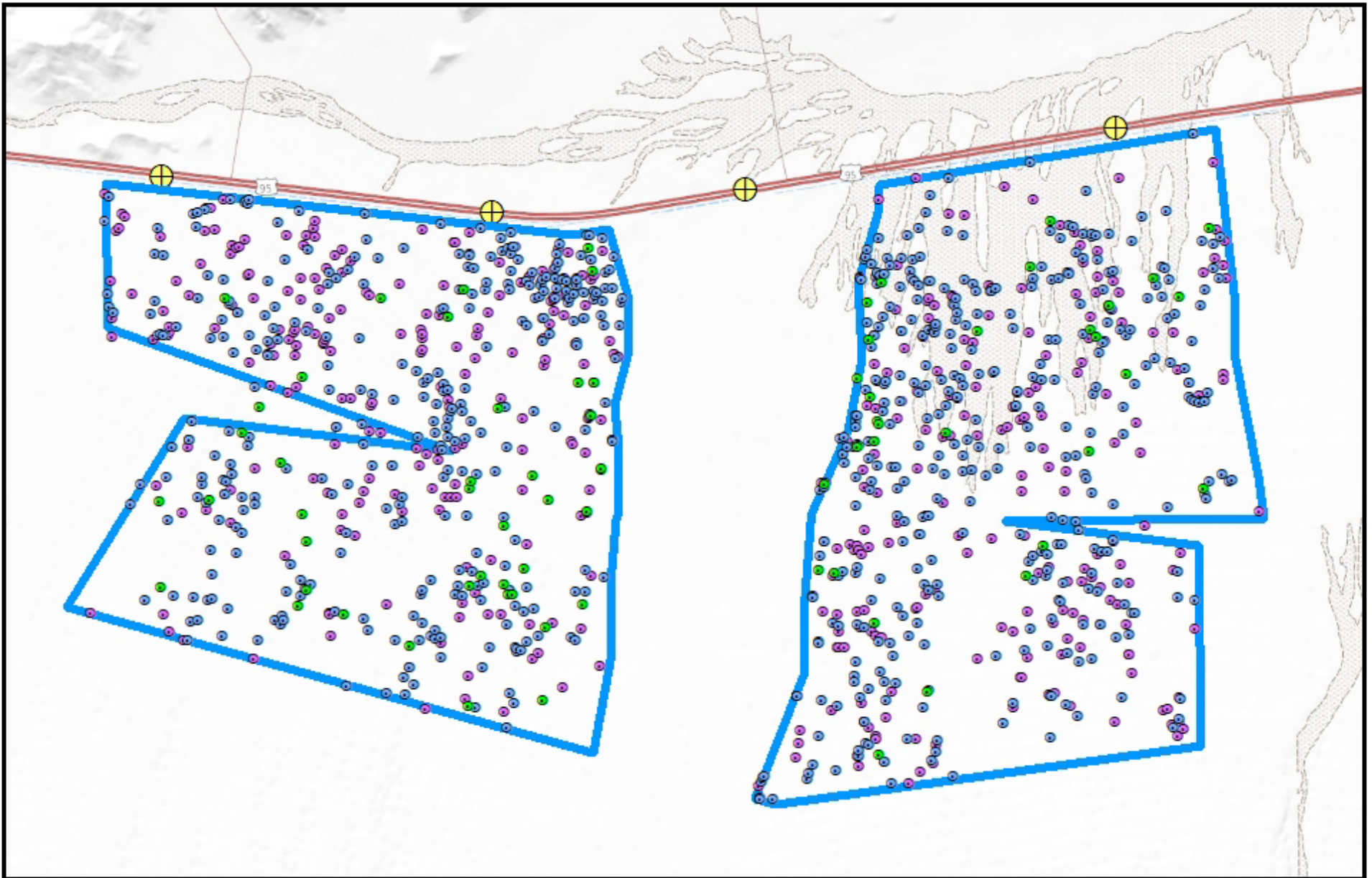
Tortoise density was estimated at 1.8 tortoises/km<sup>2</sup>, which is slightly above the average density of 1.5 tortoises/km<sup>2</sup> in the Eastern Mojave Recovery Unit (USFWS 2020). Historical density was likely higher considering the number of recent carcasses (<1 year old) that were found. Sign of American badger and other canid predation were present across the protocol and focused intuitive survey areas. Recent drought is hypothesized to have contributed to the recent tortoise mortality in the area.

Suitable desert tortoise habitat was present in the protocol and intuitive survey areas. Active tortoise sign was found at elevations up to approximately 4,750 feet south of the proposed Project. These observations indicate that demographic and genetic connectivity likely occurs outside of the corridor depicted in the USFWS connectivity model, which depicts areas of contiguous, highest value habitat (Figure 8), and confirm presence in areas with low habitat suitability model values of < 0.2 (Nussear 2009, Figure 8). Desert tortoise sign was also detected in the mountains and pass south of Indian Springs, indicating connectivity also exists in an east-west direction (south of Hwy 95).


Subsequent analysis will focus on assessing the degree of demographic and genetic connectivity that exist under current conditions within Indian Springs Valley. These data will be synthesized with other relevant models and published data to improve our understanding of connectivity in this region. Permeable, impermeable, and semi-permeable landscape features will be documented. Connectivity within Indian Springs Valley will be analyzed regarding desert tortoise conservation areas in the region and how local connectivity contributes to the larger reserve in terms of large-scale population viability.





**FIGURE 3**  
**Live Desert Tortoise Observations**  
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 Protocol Survey Area - East and West

 Box Culvert

 Class 1

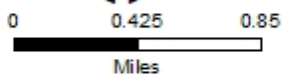
 Class 2

 Class 3

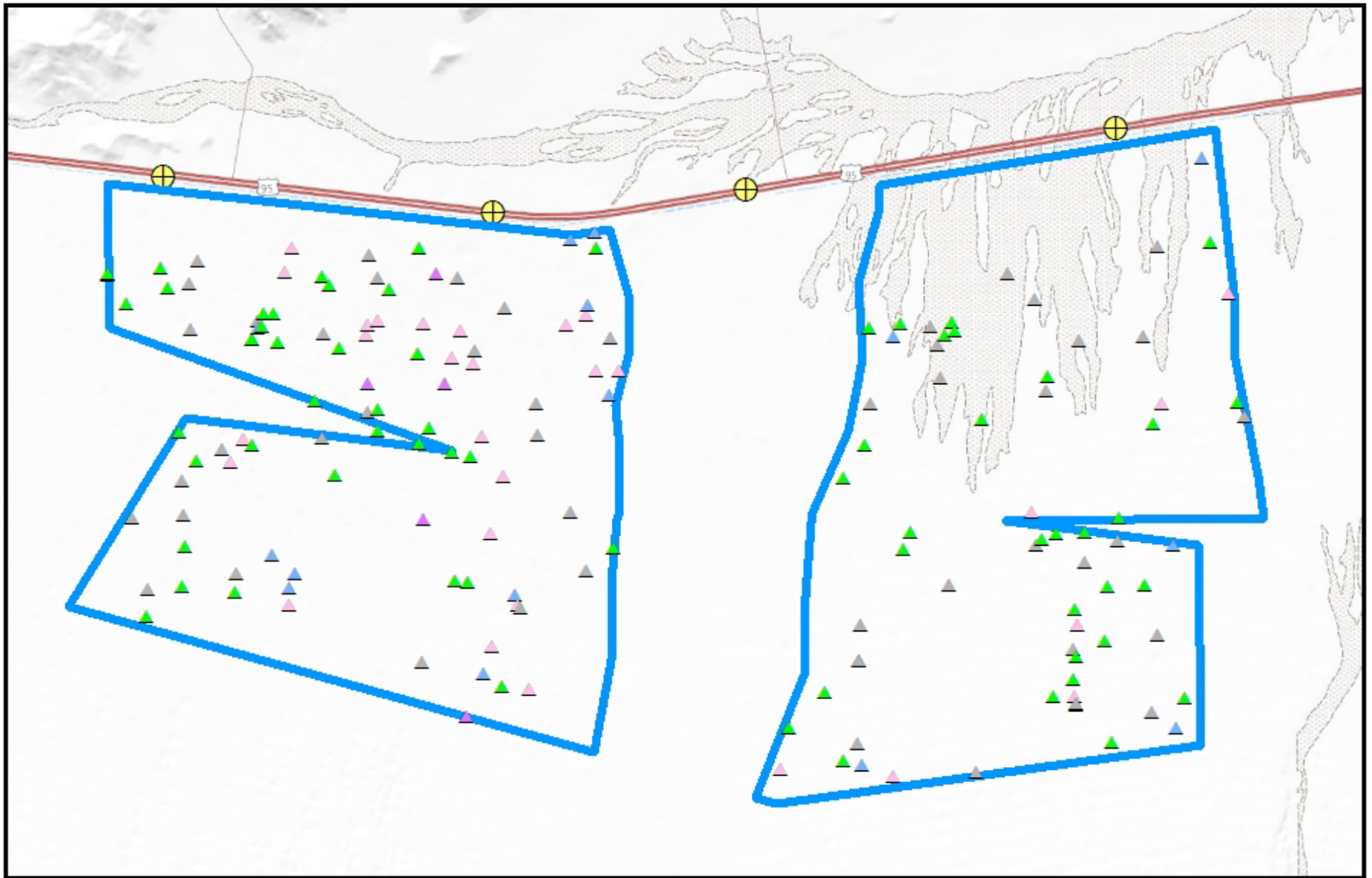
**FIGURE 4**







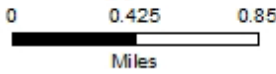


**Desert Tortoise Burrows**  
**Class 1, 2, 3**

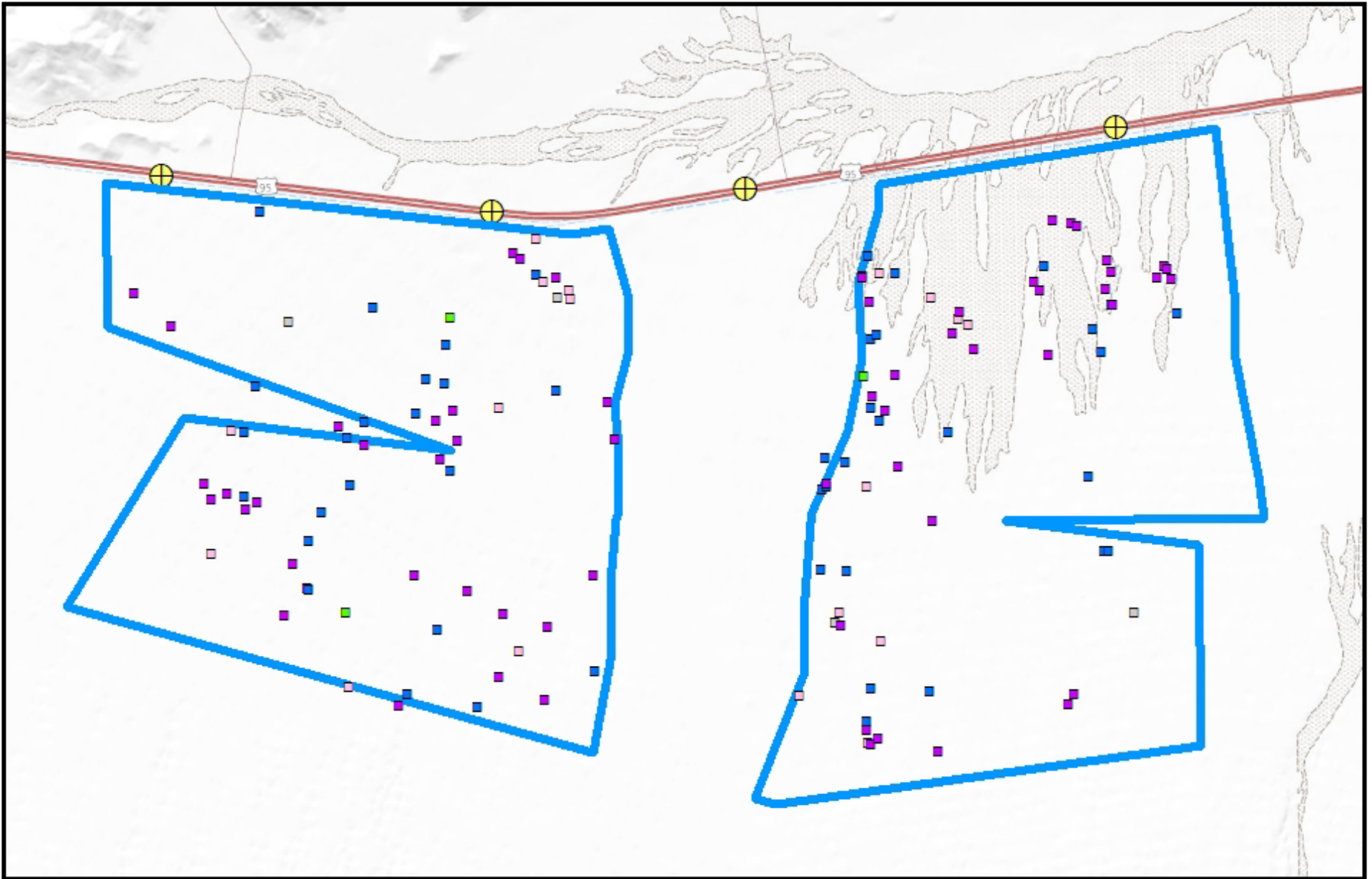
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<p><b>Ironwood Consulting</b></p>	<p> Protocol Survey Area - East and West</p>	<p> Class 1: &lt;1 year</p>	<p><b>FIGURE 5</b></p> <p><b>Desert Tortoise Carcasses</b></p> <p>Bonanza Solar Project</p>
<p> Box Culvert</p>	<p> Class 2: 1-2 years</p>	<p> Class 3: 2 - 3 years</p>	
<p>    Miles</p>	<p> Class 4: 4 years</p>	<p> Class 5: &gt;4 years</p>	



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 Protocol Survey Area - East and West

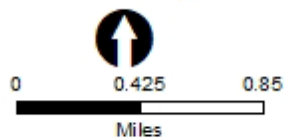
 Box Culvert

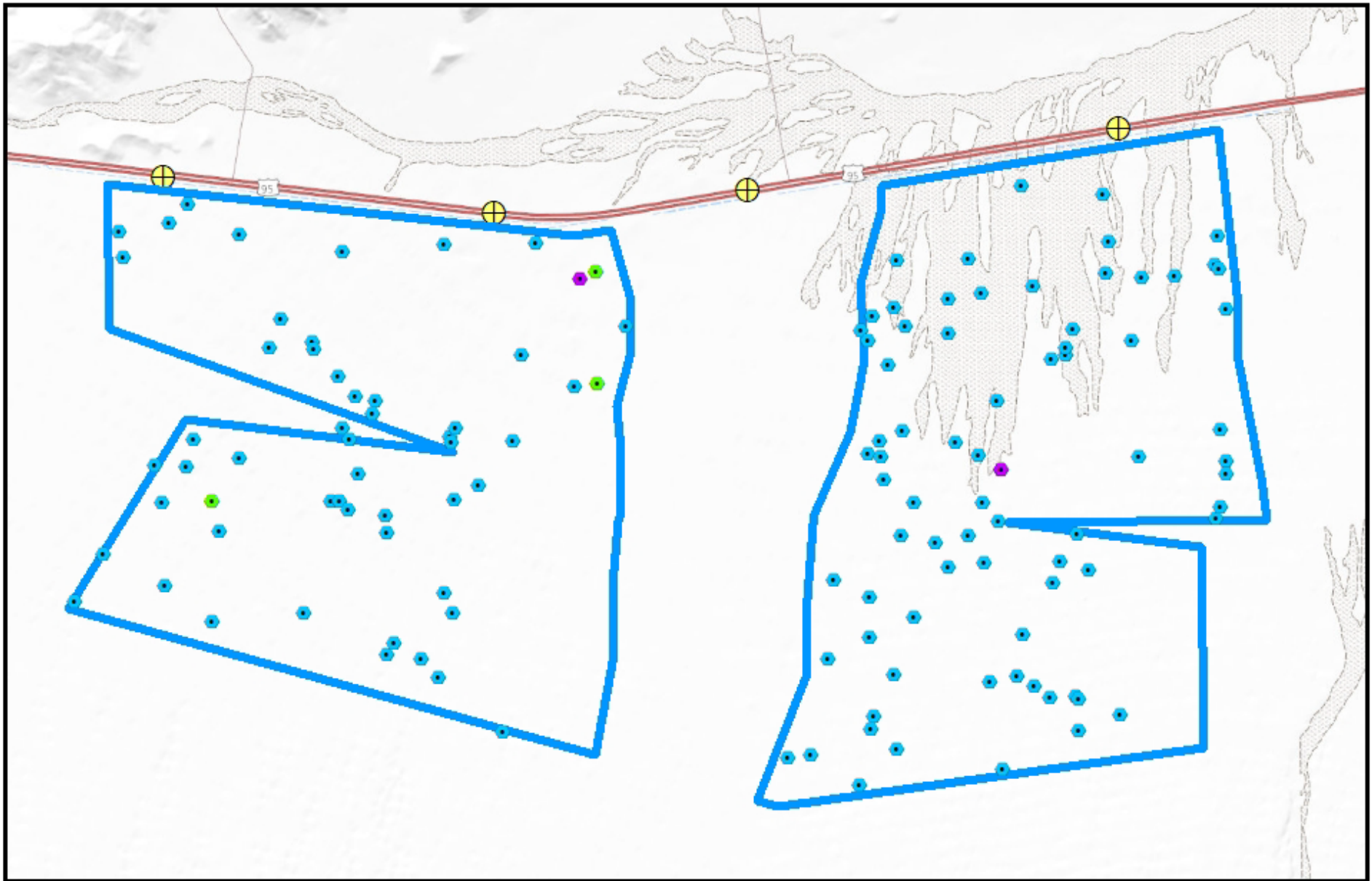
-  Fresh, recent
-  Dried, some odor
-  Dried, no glaze or odor
-  Dried, loose material
-  Bleached, loose material

**FIGURE 6**

**Desert Tortoise Scat**

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0 0.425 0.85  
Miles

 Protocol Survey Area - East and West

 Box Culvert

 Pallet: Class 1, 2, 3

 Dig Marks/Tracks

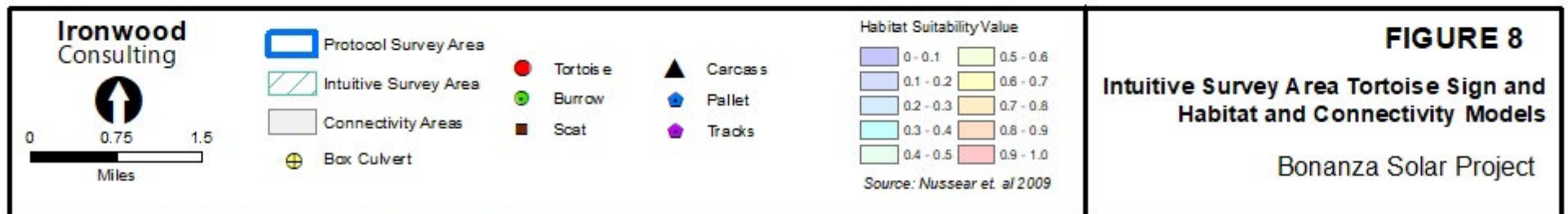
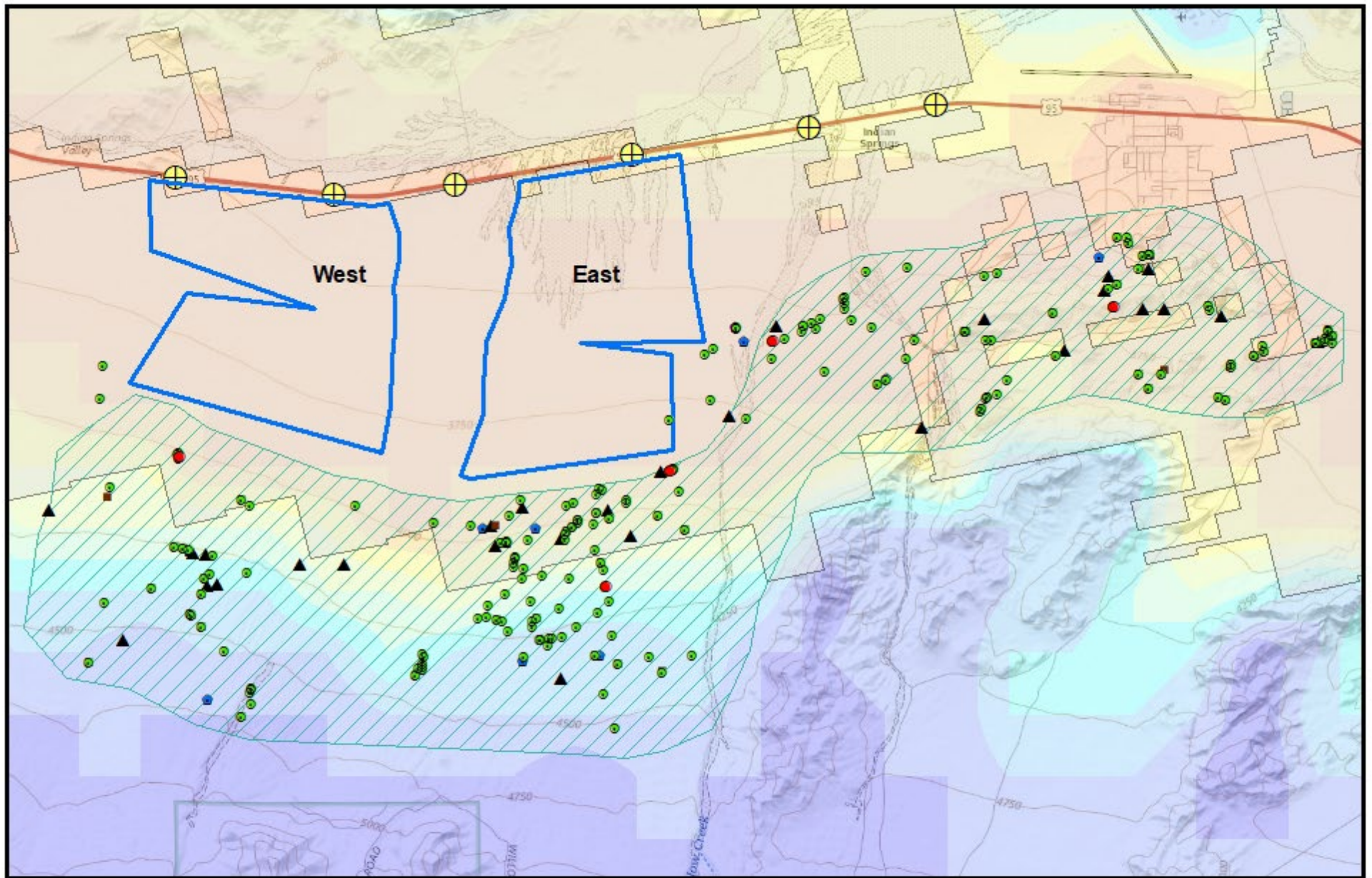
 Eggshells

**FIGURE 7**

**Other Desert Tortoise Sign**

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## **APPENDIX A**

### Desert Tortoise Density Estimates Worksheet

B	C	D	E	F
<b>Table 2. USFWS Desert Tortoise Pre-Project Survey Guidance</b>				
<b>What is the estimated number of tortoises in the action area and project footprint?</b>				
<b>INSTRUCTIONS</b> Use this tab when all your transects were of equal length.				
Enter the appropriate values from the survey into the yellow cells below. The number of tortoises for the action area and project footprint will be calculated.				
			<b>Action area</b>	<b>Project footprint</b>
	<b>Number of tortoises &gt; 180 mm MCL =</b>		<b>50.0</b>	<b>14.6</b>
	<b>Lower 95%CI =</b>		<b>28.02</b>	<b>8.20</b>
	<b>Upper 95%CI =</b>		<b>89.25</b>	<b>26.12</b>
	<b>Number of hatchlings (young-of-gear) =</b>		<b>65.0</b>	<b>19.0</b>
	<b>Number of tortoises &lt; 180 mm MCL, not young-of-gear =</b>		<b>260.1</b>	<b>76.1</b>
<b>Project-impacted area (acres)</b>			<b>6834</b>	<b>2000</b>
	<b>D (tortoises/km2) in surveyed area =</b>		<b>1.8</b>	
	<b>Average density in Recovery Unit =</b>		<b>1.5</b>	
<b>Probability that a tortoise is visible given winter rainfall (Pa in Table 3) =</b>			<b>0.730</b>	
<b>var(Pa) (from Table 3) =</b>			<b>0.013</b>	
<b>Probability of detecting a tortoise, if visible (Pd) =</b>			<b>0.630</b>	
<b>var(Pd) =</b>			<b>0.010</b>	
<b>var(n) (assume all transect lengths equal)</b>			<b>22.036</b>	
<b>var(D)</b>			<b>0.298</b>	
<b>C for N</b>			<b>1.785</b>	
<b>Project/site name</b>		<b>Bonanza Solar Project EDF</b>		
<b>Desert tortoise Recovery Unit</b>		<b>Eastern Mojave</b>		
<b>Survey start date</b>		<b>Oct 4 2021</b>		
<b>Survey end date</b>		<b>November 9 2021</b>		
<b>Pre-survey Oct-March rainfall (mm)</b>		<b>20</b>		
<b>Total length of transects walked (L, km) =</b>			<b>2766</b>	
<b>Transect length (km)</b>			<b>5.259</b>	
<b>Number of transects walked (k) =</b>			<b>526</b>	
<b>Number of tortoises found during surveys (n) =</b>			<b>23</b>	
<i>Transects all the same length</i>				
<b>Number of tortoises ≥ 180 mm MCL (n<sub>i</sub>)</b>	<b>Number of transects on which (n<sub>i</sub>) tortoises were seen</b>			
0	503			
1	23			
2	0			
3	0			
4	0			
5	0			
6	0			
7	0			
8	0			
9	0			