APPENDICES

GRANITE TARGET SITE

WHITE SANDS MISSILE RANGE, NEW MEXICO

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Appendix A: Threatened, Endangered and Rare Species

This Appendix contains comprehensive lists of threatened and endangered species, rare plants, and sensitive species. Lists that originated from dated sources have been annotated to reflect the species' current status. The following sources of information were consulted:

- U.S. Fish and Wildlife Service Information, Planning and Conservation System: http://www.fws.gov/ipac/index.html
- Biota Information System of New Mexico (BISON-M): http://www.bison-m.org/
- New Mexico Rare Plant Website (New Mexico Rare Plant Technical Council 1999): http://nmrareplants.unm.edu
- Protected floral species on WSMR (PEIS, Appendix C) (DTRA 2007)
- Protected faunal species on WSMR (PEIS, Appendix D) (DTRA 2007)
- WSMR Integrated Natural Resource Management Plan (INRMP) lists of threatened and endangered species for the Jornada Plain and San Andres Mountains Ecosystem Management Units (NMNHP and WSMR 2001, Chapter 7)

Table A-1 lists rare plants on WSMR requiring environmental coordination, as reported in the WSMR EIS, Vol. II, Table 4-5, and their potential occurrence at the Granite site. Because this is a range-wide list, many of the species do not occur in Socorro County or in the habitats present at the Granite site. Additionally, some of these species are no longer considered rare by the New Mexico Rare Plant Technical Council.

Table A-2 lists rare plants with potential to occur in Socorro County, according to the New Mexico Rare Plant Website. Most of these species have no legal protection and none of them are likely to occur at the Granite site.

Table A-3 contains the official USFWS list of Federal status species based on a polygon drawn around the Granite site and access road. It includes all Federally-listed species in Socorro County, although habitat for most of these species is not present in upland areas such as the Granite site. The potential for these species to occur at in the project area is evaluated in the table.

Table A-4 contains additional state threatened and endangered species for Socorro County. Species already included in Table A-3 are not repeated here.

Table A-5 includes sensitive wildlife species located on WSMR requiring environmental Coordination, as reported in the WSMR EIS, Vol. II, Table 4-6. Similar to the list in Table 1, this is a range-wide list and includes many species that are not expected to occur in Socorro County.

Additionally, the WSMR Integrated Natural Resource Management Plan lists of threatened and endangered species for the Jornada Plain and San Andres Mountains Ecosystem Management Units were consulted (NMNHP and WSMR 2001, Chapter 7). These lists are not reproduced here, but species listed in the INRMP are noted in tables A-4 and A-5.

Table A-1. Rare Plants on WSMR Requiring Environmental Coordination (WSMR EIS, Vol. II, Table 4-5) [***NMRPTC** indicates species on NM Rare Plant Technical Council Socorro Co. list]

Scientific Name	*Common Names*	*Federal Status*	*State Status*	*Natural Heritage NM**	Potential to occur at Granite site?
Agastache cana	Grayish-white giant hyssop	SC	SC	S3	**No**: On granite, but near seeps. Not in Socorro Co.
Apacheria chiricahuensis	Cliff brittlebush	NA	NA	S2	**No**: In Socorro Co. but not in Mockingbirds. On limestone or rhyolite cliffs.
Ayenia microphylla	Dense ayenia	NA	NA	NA	**No**: Not in Socorro Co.
Coryphantha scheeri* var *uncinata	Scheer's pincushion cactus	SC	E	S1	**No**: Taxonomic issues with this species group. Not observed on site visit.
Escobaria organensis	Organ Mt. foxtail cactus	SC	E	S2	**No**: On rocky outcrops in Franklin & Organ Mts., not in Socorro Co.
Escobaria sandbergii	Sandberg pin-cushion cactus	SC	SC	S2	**No**: Not in Socorro Co., on limestone
Hedeoma todsenii	Todsen's pennyroyal	E	E	S2	**No**: In San Andres & Sacramento mts., on gypsum-limestone soils.
Hymenoxys vaseyi	Vasey's bitterweed	SC	SC	S2	**No**: Montane shrub habitat. over 6900' elevation
Mentzelia perennis	Blazingstar	NA	NA	NA	**No**: On gypsum soils.
Oenothera organensis	Organ Mt. evening primrose	SC	SC	S2	**No**: near seeps & springs, on WSMR where Organ Mts drainages extend onto range.
Opuntia arenaria *NMRPTC	Sand prickly-pear	SC	E	S2	**No**: At lower elevations, in sandy soils
Panicum mohavense *NMRPTC	Mohave panicum	SC	SC	S1	**No**: At Oscura Peak on WSMR in Socorro Co., but on limestone.
Peniocereus greggii* var. *greggii	Night-blooming cereus	SC	E	S1	**No**: At lower elevations in desert scrub. Not in Socorro Co.
Penstemon alamosensis	Alamo beardtongue	SC	SC	S3	**No**: In Sacramento & E side of San Andres Mts.; on limestone.
Polygala rimulicola* var. *mescalerorum	Mescalero milkwort	SC	E	S1	**No**: Endemic to San Andres Mts.; in crevices of limestone cliffs.
Pseudoclappia arenaria	TransPecos false clapdaisy	NA	NA	S3	**No:** Near springs & seeps in Tularosa Basin. Clays or gyp soils.
Salvia summa	Supreme sage	SC	SC	S3	**No**: Not in Socorro Co., on limestone cliffs.
Silene plankii *NMRPTC	Plank's campion	SC	SC	S2	**Potential:** In Mockingbird Mts.; but grows on rocky outcrops and cliff faces; not observed on site.
Talinum longipes	Pink flameflower	NA	NA	S2	**No:** On calcareous substrates.

Table A-2. Rare Plants with Potential to Occur in Socorro County (New Mexico Rare Plant Website 2014) http://nmrareplants.unm.edu/ .

Scientific Name	Common Name	Federal Status	State Status	Natural Heritage NM*	Potential to occur at Granite site?
Amsonia fugatei	Fugate's amsonia	SC	SC	S2	**No**: On limy conglomerate ridges and slopes, desert scrub habitat.
Cirsium wrightii	Wright's marsh thistle	C	E		**No:** Requires wetland habitat.
Dalea scariosa	La Jolla prairie clover	SC	SC	S4	**No**: On sandy clay banks and bluffs, at lower elevations
Draba mogollonica	Mogollon whitlowgrass	SC	SC	S3	**No**: On volcanic rock but at higher elevation; cool, moist slopes in montane forests
Draba standleyi	Standley's whitlowgrass	SC	SC	S2	**No**: Potential at higher elevations nearby, but on volcanic cliffs.
Erigeron scopulinus	Rock fleabane	SC	SC	S3?	**No**: At higher elevations in crevices in rhyolitic cliffs, in lower montane coniferous forest
Helianthus paradoxus	Pecos sunflower	T	E	S2	**No:** Requires wetland habitat.
Hymenoxys brachyactis	Tall bitterweed	SC	SC	S3	**No**: At higher elevations in piñon-juniper woodland and lower montane coniferous forest
Mentzelia todiltoensis	Todilto stickleaf	SC	SC	SNR	**No**: On gypsum outcrops
Penstemon pseudoparvus	San Mateo penstemon	SC	SC	S3?	**No**: At higher elevation in spruce-fir forests, montane meadows
Perityle staurophylla* var. *homoflora	San Andres rock daisy	SC	SC	S2	**No**: Grows in San Andres Mts. In crevices in limestone cliffs.
Phacelia sivinskii	Sivinski's scorpionweed	SC	SC	SNR	**No**: Restricted to gypsum habitats
Silene wrightii	Wright's campion	SC	SC	S2	**No**: Higher elevation cliffs and outcrops in montane forests
Talinum brachypodum	Laguna flame flower				**No**: calcareous silt or clay habitat

E = endangered T = threatened C = candidate,
PT =proposed threatened SC = species of concern DL= delisted
(Species of Concern are not included in USFWS official species lists and have no legal protection status.)

*Natural Heritage NM State Ranks: S1 = critically imperiled S2 = imperiled S3 = vulnerable
S4 = apparently secure SNR = rank not yet assessed

Federal and State-listed species

Table A-3. USFWS list. Source: https://ecos.fws.gov/ipac/

Group	Name	Federal Status	State Status	Potential Occurrence?
Amphibians	Chiricahua leopard frog *(Rana chiricahuensis*)	T	s	No (no wetland/riparian habitat on site)
Birds	Yellow-billed Cuckoo *(Coccyzus americanus)*	PT	s	No (no riparian habitat on site)
Birds	Northern aplomado falcon *(Falco femoralis septentrionalis)*	ExpNE	E	**Yes** (occasional, transient)
Birds	Mexican spotted owl *(Strix occidentalis lucida)*	T	s	No (no suitable habitat in Mockingbird Mts.)
Birds	Piping Plover *(Charadrius melodus)*	T	T	No (shorebird; no suitable habitat on site)
Birds	Least tern *(Sterna antillarum)*	E	E	No (shorebird; no suitable habitat on site)
Birds	Southwestern willow flycatcher *(Empidonax traillii extimus)*	E	E	No (no riparian habitat on site)
Birds	Sprague's pipit *(Anthus spragueii)*	C	-	**Yes** (occasional, transient, migration, wintering)
Crustaceans	Socorro isopod *(Thermosphaeroma thermophilus)*	E	E	No (no wetland/spring habitat on site)
Fishes	Rio Grande silvery minnow *(Hybognathus amarus)*	E	E	No (no riverine habitat on site)
Plants	Pecos sunflower *(Helianthus paradoxus)*	T	E	No (no wetland/riparian habitat on site)
Plants	Wright's marsh thistle *(Cirsium wrightii)*	C	E	No (no wetland/riparian habitat on site)
Mammals	New Mexico meadow jumping mouse (Zapus hudsonius luteus)	PE	E	No (no riparian habitat on site)
Snails	Alamosa springsnail (Tryonia alamosae)	E	E	No (no wetland/spring habitat on site)
Snails	Chupadera springsnail (Pyrgulopsis chupaderae)	E	E	No (no wetland/spring habitat on site)
Snails	Socorro springsnail (Pyrgulopsis neomexicana)	E	E	No (no wetland/spring habitat on site)

E = endangered T = threatened C = candidate,
PE = proposed endangered PT =proposed threatened s = sensitive species
DL= delisted ExpNE = Experimental, Non-essential population

Table A-4. Additional* State T&E Species for Socorro County, 2014. http://www.bison-m.org/

(*Species already included in the USFWS list are not repeated here.)

Species	Federal Status	State Status	Potential Occurrence?
Headwater Chub (Gila nigra)	C	E	**No**; no aquatic habitat at site
Peregrine Falcon (Falco peregrinus anatum)	SC	T	**Potential,** transient, foraging; no suitable nesting habitat at or near site. Listed in INRMP for Jornada Plain EM
Arctic Peregrine Falcon (Falco peregrinus tundrius)	SC	T	**Unlikely**; transient only; subspecies breeds in the Arctic,
Common Black-Hawk (Buteogallus anthracinus)	SC	T	**No**; uncommon summer resident; prefers riparian habitat; transient in Socorro Co.
Baird's Sparrow (Ammodramus bairdii)	SC	T	**Potential;** foraging or transient; rare in winter; listed in INRMP for Jornada Plain EMU
Bell's Vireo (Vireo bellii)	SC	T	**No**; **no habitat on site**- riparian: occurs in dense shrubland or woodland along lowland stream courses
Ovate Vertigo Snail (Vertigo ovata)	SC	T	**No;** no aquatic habitat at site.
Spotted Bat (Euderma maculatum)	SC	T	**Potential,** transient, foraging; site lacks water. Cliffs and outcrops exist in area around site; suitability for roosting unknown.

Table A-5. Sensitive Wildlife Species Located on WSMR Requiring Environmental Coordination (WSMR EIS, Vol. II, Table 4-6)

Species	Federal Status	State Status	Notes/ current status/ Potential Occurrence?
American Peregrine falcon (*Falco peregrinus anatum)*	DL	T	**Potential;** transient, foraging; no suitable nesting habitat at or near site. Listed in INRMP for Jornada Plain EMU.
Baird's sparrow *(Ammodramus bairdii)*	SC	T	**Potential**; rare in winter; listed in INRMP for Jornada Plain EMU
Bald eagle (*Haliaeetus leucocephalus)*	DL	T	No suitable habitat on site Not on BISON-M list for Socorro Co.
Bell's vireo (Vireo bellii)	SC	T	Prefer shrubland or woodland along lowland stream courses; no suitable habitat on site
Black-tailed prairie dog (*Cynomys ludovicianus)*	-	DL	Listing not warranted, 2009 Extirpated from WSMR
Brown pelican *(Pelecanus occidentalis)*	DL	E	No suitable habitat on site Not on BISON-M list for Socorro Co.
Costa's hummingbird *(Calypte costae)*	-	T	Not on BISON-M list for Socorro Co. Not known to occur in Socorro County
Desert bighorn sheep (*Ovis canadensis Mexicana)*	-	E	Small population in San Andres Mts., unlikely at site. Not on BISON-M list for Socorro Co.
Gray vireo *(Vireo vicinior)*	-	T	Not on current BISON-M list for Socorro County. Generally prefer shrub habitats with juniper or oak.
Interior Least Tern (*Sterna antillarum athalassos)*	E	E	No suitable habitat on site
Northern aplomado falcon (*Falco femoralis septentrionalis)*	E	ExpN	**Potential;** listed in INRMP for Jornada Plain EMU
Organ mountains Colorado chipmunk (*Tamias quadrivittatus australis)*	SC	T	No suitable habitat on site (occurs at higher elevations in Organ Mts.) Not on BISON-M list for Socorro Co.
Southwestern willow flycatcher (*Empidonax traillii extimus)*	E	E	No suitable riparian habitat on site
Western snowy plover (*Charadrius alexandrinus nivosus)*	- (Former C)	-	No suitable habitat on site (shorebird) Not on BISON-M list for Socorro Co.

E = endangered T = threatened C = candidate,
PE = proposed endangered PT =proposed threatened SC = species of concern
DL= delisted ExpNE = Experimental, Non-essential population
(Species of Concern are not included in USFWS official species lists and have no legal protection status.)

Appendix B: Technical Data for Typical DTRA Tests

This Appendix contains technical data to support the effects analysis.

Tables B-1 through B-3 list detonation by-products for the commonly used explosives Tritonal, C-4, and ANFO under typical field test conditions. Detonation products were estimated using Cheetah 7.0, exp6.v7.1, exp6.

Figures B-1 and B-2 show predictions for seismic and pressure impacts for a range of explosives and thresholds for structural and environmental damage.

Figure B-3 shows actual pressure measurements from a typical DTRA test.

Figure B-4 illustrates safety or surface danger zones (SDZ's) defined by the thresholds for environmental damage.

Table B-1: Tritonal Detonation Products

	Name	Phase	Det. Product Per Pound Tritonal (lbs/lb)	Det. Product Per 150 Pound Tritonal (lbs)
carbon monoxide	**CO**	gas	3.90E-01	**58.560**
nitrogen	N_2	gas	1.47E-01	**22.035**
aluminum oxide	Al_2O_3	solid	1.32E-01	**19.845**
aluminum	Al inert	liquid	1.30E-01	**19.500**
carbon	C	graphite	7.79E-02	**11.684**
carbon dioxide	CO_2	gas	5.32E-02	**7.985**
methane	CH_4	gas	4.49E-02	**6.734**
water	H_2O	gas	1.59E-02	**2.385**
hydrogen	H_2	gas	4.04E-03	**0.607**
ethylene	C_2H_4	gas	1.54E-03	**0.231**
ethane	C_2H_6	gas	1.05E-03	**0.158**
ammonia	NH_3	gas	9.21E-04	**0.138**
hydrogen cyanide	HCN	gas	6.63E-04	**0.099**
acetylene	C_2H_2	gas	1.64E-04	**0.025**
benzene	benzene	gas	6.42E-05	**0.010**
formic acid	CH_2O_2	gas	3.06E-05	**0.005**
propane	C_3H_8	gas	1.88E-05	**0.003**
methyl alcohol	CH_3OH	gas	1.58E-05	**0.002**
hydroxyl radical	*OH	gas	1.48E-06	**0.000**
ethanol	C_2H_6O	gas	5.60E-07	**0.000**
acetone	acetone	gas	2.32E-07	**0.000**
aluminum	Al-inert-g	gas	1.32E-07	**0.000**
hydrazine perchlorate	hp	gas	8.75E-08	**0.000**
hydrogen radical	*H	gas	2.44E-08	**0.000**
nitric oxide	NO	gas	9.46E-10	**0.000**
nitrous oxide	N_2O	gas	2.36E-12	**0.000**
octane	octane	gas	2.35E-12	**0.000**
oxygen radical	*O	gas	1.61E-13	**0.000**
nitrogen radical	*N	gas	1.34E-13	**0.000**
oxygen	O_2	gas	3.59E-14	**0.000**
heptane	heptane	gas	2.83E-16	**0.000**
aluminum	Al	gas	1.68E-16	**0.000**
nitrogen dioxide	NO_2	gas	9.04E-17	**0.000**
carbon	C	gas	4.44E-17	**0.000**

EPA criteria pollutants appear in bold, red text

Table B-2: C-4 Detonation Products

	Name	Phase	Det. Product Per Pound C4 (Lbs)	**Det. Product Per 150 Pound C4 (Lbs)**
nitrogen	N_2	gas	3.18E-01	**47.625**
carbon monoxide	**CO**	gas	1.99E-01	**29.880**
water	H_2O	gas	1.60E-01	**23.985**
carbon dioxide	CO_2	gas	1.44E-01	**21.540**
methane	CH_4	gas	1.35E-01	**20.310**
hydrogen	H_2	gas	2.58E-02	**3.872**
ammonia	NH_3	gas	1.17E-02	**1.749**
ethane	C_2H_6	gas	4.19E-03	**0.628**
ethylene	C_2H_4	gas	2.13E-03	**0.319**
methyl alcohol	CH_3OH	gas	1.82E-04	**0.027**
propane	C_3H_8	gas	1.43E-04	**0.021**
formic acid	CH_2O_2	gas	1.16E-04	**0.017**
benzene	benzene	gas	8.14E-05	**0.012**
hydrogen cyanide	HCN	gas	4.07E-05	**0.006**
acetylene	C_2H_2	gas	3.59E-05	**0.005**
hydrazine perchlorate	hp	gas	2.11E-05	**0.003**
hydroxyl radical	*OH	gas	2.11E-05	**0.003**
ethanol	C_2H_6O	gas	5.93E-06	**0.001**
acetone	acetone	gas	2.51E-06	**0.000**
hydrogen radical	*H	gas	8.22E-08	**0.000**
nitric oxide	NO	gas	4.52E-09	**0.000**
carbon	C	graphite	3.54E-10	**0.000**
nitrous oxide	N_2O	gas	2.33E-11	**0.000**
octane	octane	gas	1.39E-11	**0.000**
nitrogen radical	*N	gas	6.28E-13	**0.000**
oxygen radical	*O	gas	3.87E-13	**0.000**
oxygen	O_2	gas	1.79E-13	**0.000**
heptane	heptane	gas	3.81E-14	**0.000**
nitrogen dioxide	**NO_2**	gas	9.91E-16	**0.000**
carbon	C	gas	1.12E-17	**0.000**

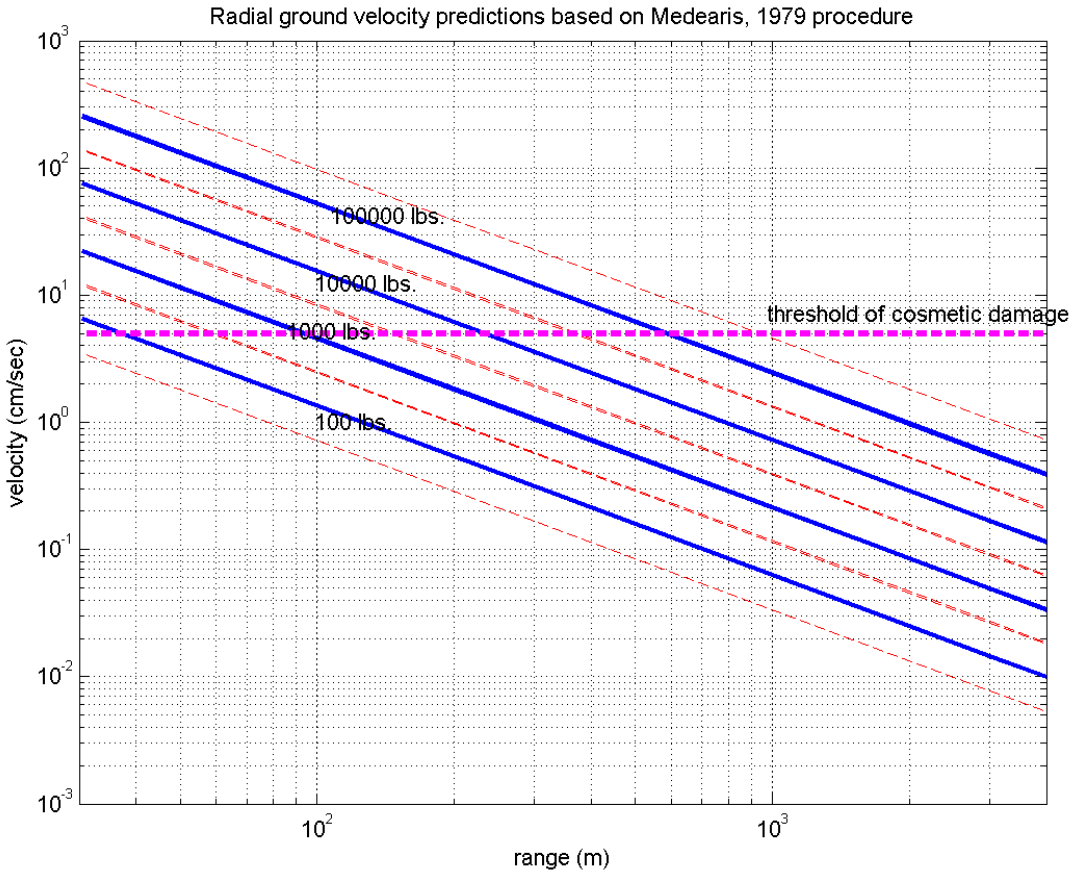
EPA criteria pollutants appear in bold, red text

Table B-3: ANFO Detonation Products

	Name	Phase	Det. Product Per Pound ANFO (Lbs)	**Det. Product Per 900 Pound ANFO (Lbs)**
water	H_2O	gas	4.83E-01	**434.700**
nitrogen	N_2	gas	3.29E-01	**296.100**
carbon dioxide	CO_2	gas	1.78E-01	**160.560**
carbon monoxide	**CO**	gas	8.78E-03	**7.905**
hydrogen	H_2	gas	8.42E-04	**0.758**
ammonia	NH_3	gas	3.19E-05	**0.029**
formic acid	CH_2O_2	gas	6.80E-06	**0.006**
hydrazine perchlorate	hp	gas	5.28E-06	**0.005**
hydroxyl radical	*OH	gas	3.48E-06	**0.003**
nitric oxide	NO	gas	3.93E-07	**0.000**
hydrogen cyanide	HCN	gas	3.37E-08	**0.000**
hydrogen radical	*H	gas	2.48E-08	**0.000**
methane	CH_4	gas	1.82E-08	**0.000**
oxygen	O_2	gas	3.14E-09	**0.000**
methyl alcohol	CH_3OH	gas	1.02E-09	**0.000**
nitrous oxide	N_2O	gas	8.08E-10	**0.000**
oxygen radical	*O	gas	8.60E-11	**0.000**
nitrogen dioxide	NO_2	gas	6.74E-12	**0.000**
nitrogen radical	*N	gas	2.93E-13	**0.000**
acetylene	C_2H_2	gas	5.40E-14	**0.000**
ethylene	C_2H_4	gas	2.29E-14	**0.000**
ethane	C_2H_6	gas	9.09E-16	**0.000**
ethanol	C_2H_6O	gas	8.43E-17	**0.000**
ozone	**O_3**	gas	2.12E-19	**0.000**

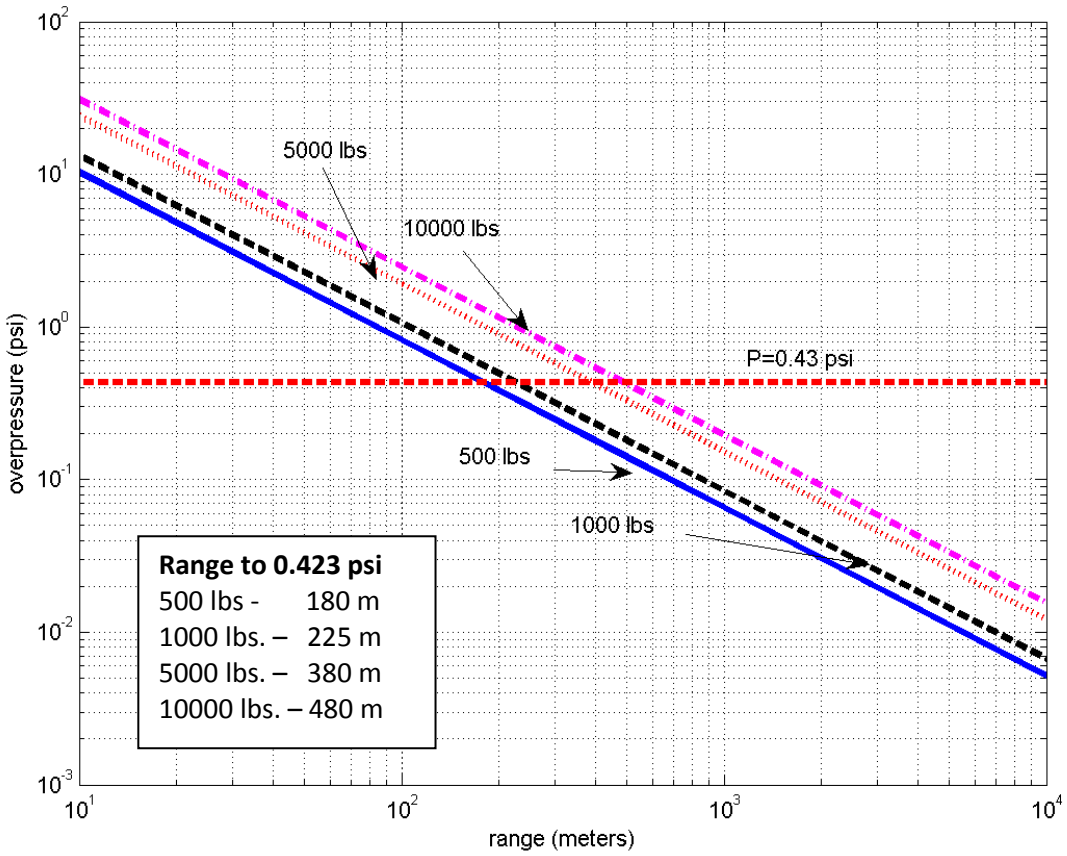
EPA criteria pollutants appear in bold, red text

Figure B-1: Radial ground velocity predictions and threshold of minor structural damage



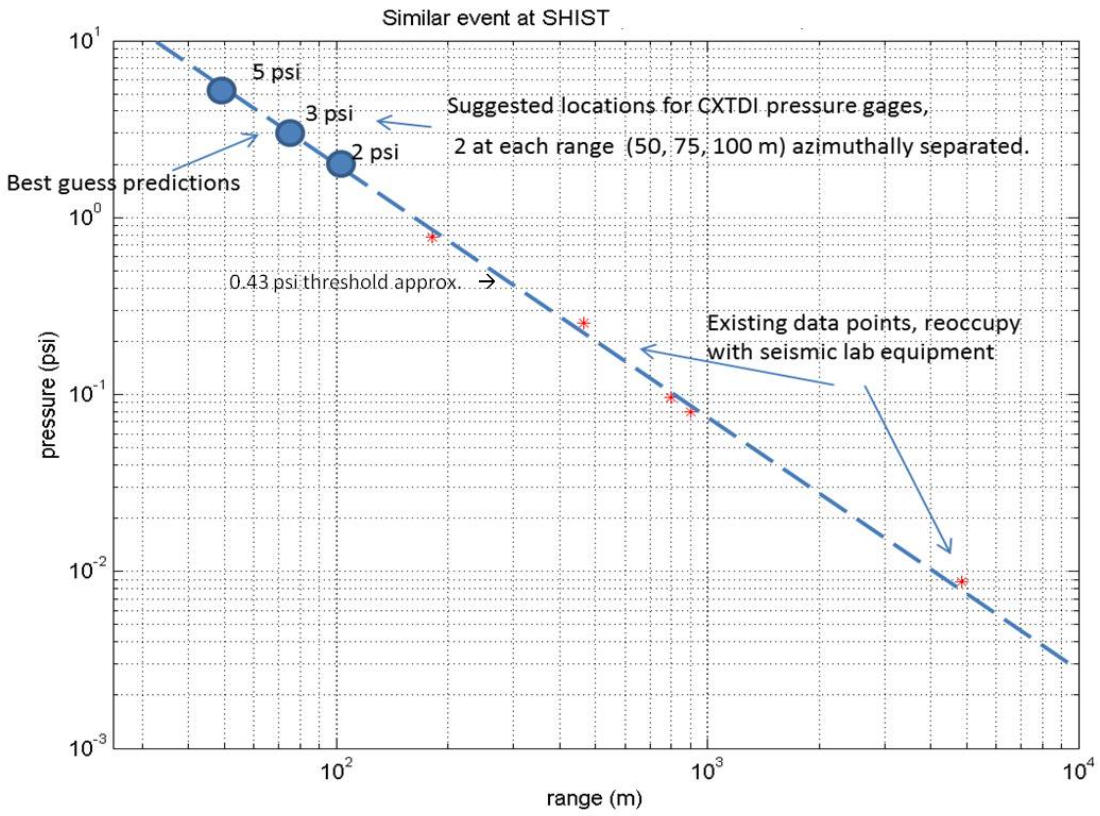
Note that these predictions use a range of explosives much larger than those used by DTRA. The largest conventional bomb currently in the US inventory has less than 5,000 lbs. of explosive (Fraher, personal communication 2014). Typical DTRA tests are conducted with 1,000 to 2,000 lbs. explosive. Minor structural damage such as cracking could occur at distances closer than 100 meters 328 feet) for a 1,000-pound test or approximately 250 meters (820 feet) for a 10,000-pound test. The predictions for even the largest quantity of explosive indicate that structures more distant than 1,000 meters (0.63 mile) would not be affected. There are no known structures within this range. Any DTRA structures constructed at the target site would be reinforced appropriately to withstand expected ground vibrations.

Figure B-2: Overpressure predictions for surface bursts based on ANSI Standard for Single Point Explosions



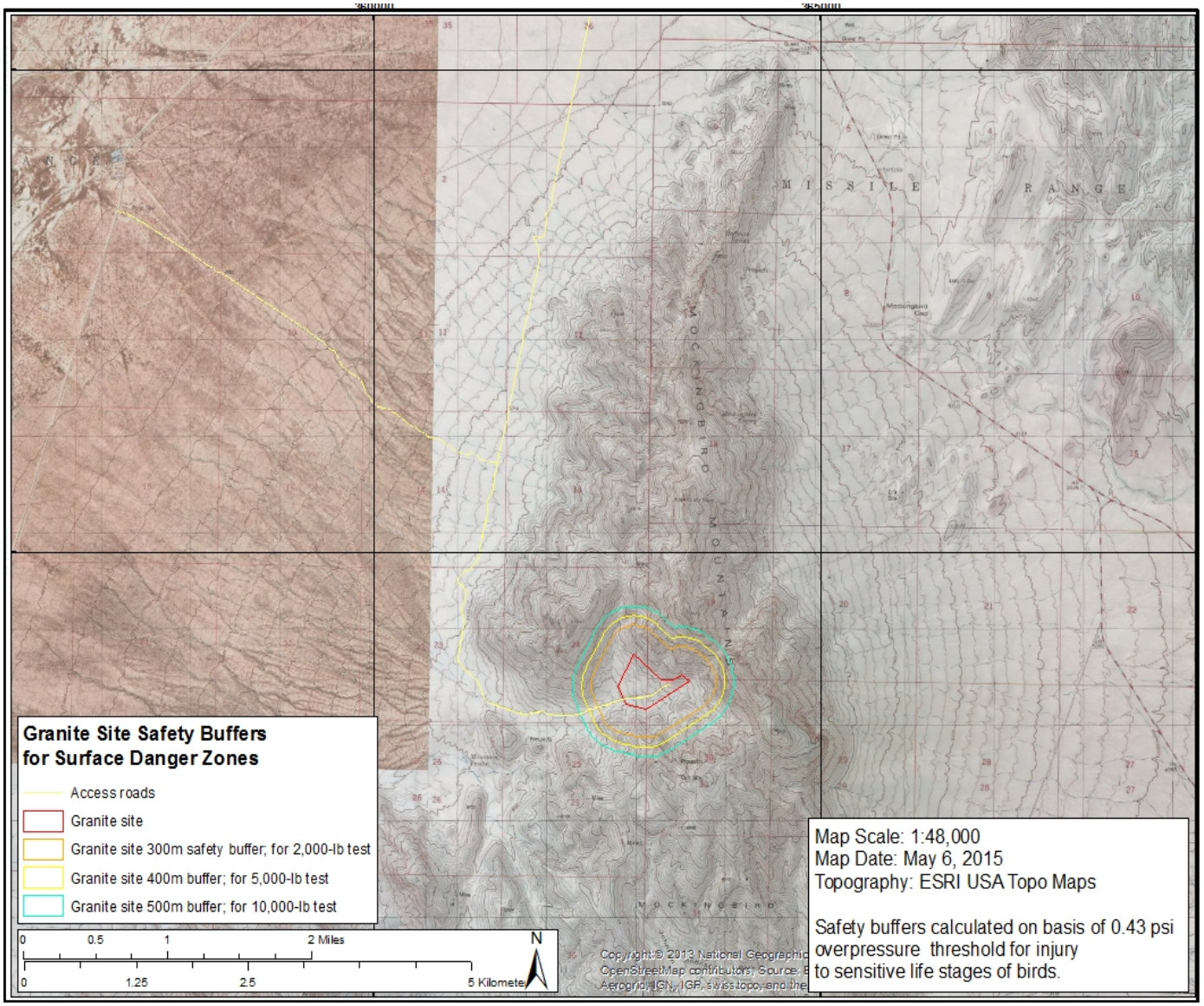
These predictions use a range of explosives larger than those used by DTRA. The threshold 0.43 psi is provided as a threshold for potential injury to sensitive wildlife. As reported in DTRA's PEIS, damage to bird eggs and hatchlings may occur at pressures greater than 3kPa (0.43psi). For a 5,000-pound test event (larger than typical DTRA tests), wildlife within about 380 meters (1,247feet) may be affected, depending on terrain and whether the animal is sheltered in a burrow or crevice. For a more typical 1,000-pound test, wildlife closer than 225 meters (738 feet) could be affected. These calculations form the basis for the recommended safety zones, survey area for migratory birds and area of potential effects to golden eagles.

Figure B-3: Overpressure measurements from a typical DTRA test: air delivered drop into granite at the SHIST site



This figure reports pressures from a typical test drop. For this test, the 0.43 psi threshold for damage to bird eggs and hatchlings was reached at distances closer than 300 meters.

Figure B-4: Safety Buffers for Surface Danger Zones



Appendix C: Golden Eagle Effects Analysis

Golden Eagle Status and Population at WSMR

Golden eagles are protected by the Migratory Bird Treaty Act (16 U.S.C. 703 *et seq*.) and the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq*.). WSMR has a resident population of golden eagles; the birds are not migratory and are present year-round. WSMR conducted range-wide aerial surveys for golden eagle nests in 2013 and 2014. The eagle population at WSMR is currently estimated at 32 adult breeding pairs. As of April 2015, 29 pairs have been confirmed, an additional two territories are occupied but only a single adult eagle was observed, and another territory is still scheduled for survey (P. Juergens, 2015). The large number of adult breeding pairs occupying territories at WSMR indicates a healthy golden eagle population (G. Hunt, personal communication, 2015). Territory size for a breeding pair on WSMR is roughly estimated to be 76 square miles (D. Driscoll, unpublished data 2013).

Four golden eagle nests were found in the Mockingbird Mountains within 1.5 mile of the proposed Granite site during general range-wide surveys conducted by WSMR in 2013-2014. A nest located on the west-facing ridge approximately 0.65 mile (1,050 meters) from the northwestern side of the Granite site was active in 2014, with eggs being incubated in March (P. Cutler, personal communication, 2014). A second nest at this location was not being used; however, golden eagle territories commonly include multiple nests that are likely important to the territory's success (Pagel et al. 2010). Two nests to the east of Granite site are part of a separate territory, and are not likely to be affected by the proposed action due to a ridgeline separating the nests from the site, and due to the distance of the nests from the site.

In January 2015, WSMR biologists identified a new active nest approximately 600 meters (0.37 mile or 1,966 feet) from the northwestern side of the proposed Granite site (P. Cutler, personal communication, 2015a). The female was observed incubating eggs on March 17, 2015 (P. Cutler, personal communication, 2015b) and a nestling was present 15 May (P. Cutler, personal communication, 2015c) (Figure C-1). Because of its proximity to the previously known nests on the ridge northwest of the Granite site, this nest is assumed to be part of the same pair's territory. The previously known nests are separated from the Granite site by ridge lines, whereas the new nest is directly overlooking the site.

Figure C-1: Eagle nestling approximately 6 weeks old in nest near Granite site, 13 May 2015. Photo courtesy of Paul Juergens, Peregrine Fund.

Potential for "Take" or Disturbance

A half-mile (800 meter) buffer free of human intrusion is commonly recommended for golden or bald eagle nest sites during nesting season, December 15 to July 15 (Colorado Division of Wildlife (CDOW) 2008; USFWS 2007). Nevertheless, nesting golden eagles were not disturbed by helicopter flights as close as 100 meters in one study (Grubb et al. 2010). The USFWS interim monitoring protocol for golden eagles (Pagel et al. 2010) recommends monitoring and data collection rather than prescribing a fixed buffer distance. Individual eagles may have different degrees of sensitivity to noise and other disturbance (CDOW 2008).

An 800-meter buffer around the three eagle nests closest to the proposed Granite site was mapped using a geographic information system (GIS). This buffer partly overlaps the Granite site, indicating that activity at the site has the potential to disturb the eagles. Buffers were also mapped around the Granite site at 300 meters, the distance within which damage to eggs or hatchlings may occur using the threshold of 0.43 psi and measurements from a typical DTRA test event. Buffers of 400 and 500 meters were also mapped. Per analysis provided in Appendix B, the largest conventional weapon available (5,000 lbs. explosive) could cause pressure sufficient to damage eggs or hatchlings within 380 meters. If a 10,000-lb weapon were to be

developed and used, it would have the potential to cause damage to eggs or hatchlings within 480m. The closest eagle nest is more than 500 meters from the Granite site. Therefore, test events would not be expected to cause direct mortality of eagles.

Indirect "take" of eagles due to disturbance at the Granite site is possible, depending on the timing of DTRA test events. The sensitivity of this particular pair is not known; therefore it is assumed that the adult eagles could be disturbed or startled from any human activity in their line of sight, potentially causing them to leave the area temporarily. Absence of the adults would leave eggs or young exposed to the elements and may reduce reproductive success. The most vulnerable life stage is during incubation and the first 20 days after hatching because eggs and young hatchlings may become chilled or overheated when an adult is absent. The incubation period of golden eagles ranges from 41-45 days (Kochert et al. 2002). Young eagles are capable of thermoregulation (controlling their own body temperature) at about 3 weeks of age (Driscoll 2010). This is a total of nine or ten weeks during which disturbance is most likely to affect reproductive success. However, it may not be possible to determine precisely when incubation begins for a given pair. Generally, golden eagles in the southwestern US lay eggs in February or March; hatching occurs in mid-March through April and fledging in June (Driscoll 2010).

Conducting a hard rock penetration test involves considerable human activity over a period of two to three weeks, as described in the DEA, Section 2.1.1. Additionally, during final preparation for a test there are people and equipment present until personnel are evacuated. This occurs from one to three hours before the test for an air drop. For a static test, personnel may be on site up to an hour before the actual test. Additionally, for an air drop the aircraft makes one or more dry runs at altitude before dropping the weapon. This activity would be unlikely to disturb birds due to the altitude at which dry runs occur (18,000 feet). The actual test produces a shock wave when the weapon penetrates rock and another if a live weapon is detonated. Pressures are evaluated in Appendix B.

The frequency by month and year and number of weapons used in testing at the existing SHIST site are summarized in Tables C-1 and C-2 for the years 2010-2015. This includes both static and aerial drops using live and inert weapons. Testing occurs most frequently from March to August. However, testing does not occur in each month every year. On average, four tests take place every year with one of those involving multiple weapon drops.

The likelihood of eagles abandoning the nest site and using one of the other two nests in their territory, or abandoning part or all of the territory, is unknown. However, it is possible that the pair could acclimate to the test activity and remain in the territory. Eagle nests occur 2600 m (1.6 miles) from the existing SHIST site and 400 m (0.25 mile) from the existing Capital Peak test site..

Other activities besides test events that would occur at the proposed Granite test site may include: geologic properties testing of granite (drilling); setting up instrumentation; installing temporary facilities such as truck mounted fuel tanks when needed for longer weapon recovery operations.

Table C-1: Frequency of testing and number of events using multiple (>2) weapons by year, 2010-2015

Tests by Year Year	Number of Test Events	Events with Multiple Weapons
2010	4	0
2011	6	3
2012	6	1
2013	2	0
2014	3	1
2015	2	1
total	23	6
mean/year	3.8	1.0

Table C-2: Frequency of testing by month, 2010-2015

Month	Number of Test Events in Month, 2010-2015	Events with Multiple Weapons
Jan	1	0
Feb	0	0
Mar	3	1
Apr	3	1
May	1	1
Jun	3	0
Jul	4	2
Aug	4	0
Sep	2	1
Oct	1	0
Nov	0	0
Dec	1	0

Potential avoidance and mitigation measures

As part of the incidental take permit application process, the following measures are being considered to avoid, minimize, or mitigate for adverse impacts to golden eagles:

- Monitoring of the pair, including presence/absence surveys, nest surveys, nest success, and possibly marking the birds or use of telemetry to track their movements. Removing the empty nest after the 2015 breeding season is over and any young have fledged. This would require a federal take permit for the nest. If the nest is no longer present or rendered unusable, the pair would presumably nest elsewhere, such as one of the two previously existing nests on the west-facing ridge away from the test site. This would

eliminate the possibility that the adult eagles would abandon an active nest with eggs or nestlings.

- Minimizing testing activities during the incubation and nestling period (150 days from egg laying through fledging) in years when this nest is in use. Even with close monitoring of the pair, this would limit DTRA's ability to perform its mission for about five months. Such limitation may not be consistent with DTRA's mission.
- Monitoring eagle behavior during test events using remote cameras. DTRA has the capability to set up cameras focused on the nest site and to use sensors to trigger them when an impact occurs. This is data intensive and behavior could only be recorded for a limited time, however it would be useful to understand the eagles' response.
- DTRA would provide funding to retrofit power poles to prevent raptors from being electrocuted. The number of poles would be determined in the permitting process and would be based on impacts such as nest failure, territory abandonment or mortality.

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Appendix D: Cultural resources

This Appendix contains cultural resource consultation information. The following components are included:

- New Mexico State Historic Preservation Office consultation letters and responses will be inserted when available.
- Tribal consultation letters and responses will be inserted when available.

Appendix E

Vegetation

As described in Section 3.7, an initial visit to the Granite site was conducted on November 3, 2013 by a USACE botanist. Additional visits were made to the area on November 4 and 13, 2014 for the purpose of setting up monitoring plots, and on March 4, 2015 to survey the Pond road and search for additional species at Granite site. WSMR personnel including a botanist, ecologist and wildlife biologist participated in the November 14, 2014 and March 4, 2015 visits.

Two monitoring plots were established for the purpose of long-term vegetation monitoring. The plot locations were selected from general areas that were identified within the grassland using GIS mapping tools. Criteria included proximity to the Granite site (Plot 1) and the access road (Plot 2). Within the preselected mapped areas, random coordinates were selected and navigated to in the field as the center of each plot. Plot centers were marked with T-posts to allow them to be relocated. Figure 1 shows the locations of the two plots established for the Granite site as well as a nearby WSMR monitoring plot, LCTA Plot 323.

At each plot, three randomly drawn compass directions were used to establish 50-meter transects for point intercept and belt transect sampling. Sampling methods followed Herrick et al. (2009) using 50-m transect length and a 2-m width for belt transects for shrubs. Data was recorded using data forms provided by the Jornada experimental range. Point intercept data and shrub density data were recorded to species. For comparison with WSMR LCTA data collected under methods described by Tazik et al. (1992), species were categorized as annual or perennial.

Figure 1: Location of Monitoring Plots near Granite site.

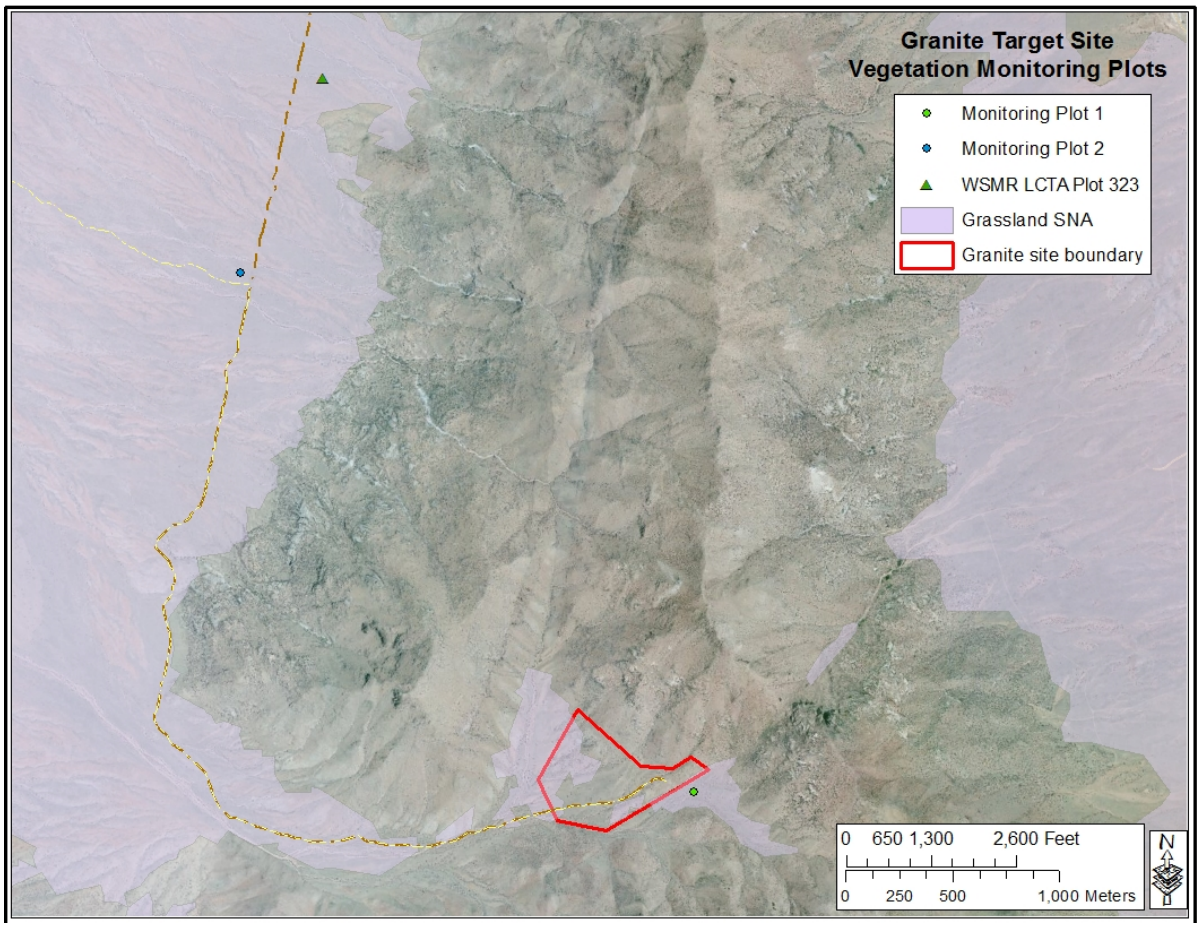


Table 1: Plants Identified from Granite site, November 4, 2013 and March 4, 2015

Habit	Botanical Family	Scientific Name	Common Name
Ferns	Pteridaceae	Astrolepis cochisensis	cloakfern
	Pteridaceae	Notholaena standleyi	Standley's cloakfern
	Pteridaceae	Pellaea wrightiana	cliffbrake
S**hrub**s	Asteraceae	Parthenium incanum	mariola
	Anacardiaceae	Rhus microphylla	littleleaf sumac
	Anacardiaceae	Rhus trilobata	skunkbush sumac
	Fabaceae	Prosopis glandulosa	honey mesquite
	Fagaceae	Quercus turbinella	scrub oak
	Garryaceae	Garrya wrightii	Wright's silktassel
	Rosaceae	Fallugia paradoxa	Apache plume
	Rosaceae	Cercocarpus montanus	mountain mahogany
	Verbenaceae	Aloysia wrightii	Wright's beebrush
Cacti & Succulents	Agavaceae	Dasylirion wheeleri	common sotol
	Agavaceae	Yucca baccata	banana yucca
	Asparagaceae (Agavaceae)	Yucca elata	soaptree yucca
	Asparagaceae (Agavaceae)	Nolina microcarpa	sacahuista
	Cactaceae	Echinocereus triglochidiatus	kingcup cactus
	Cactaceae	Echinomastus intertextus	white fishhook cactus
	Cactaceae	Opuntia imbricata	tree cholla
	Cactaceae	Opuntia sp.	pricklypear
	Fouquieriaceae	Fouquieria splendens	ocotillo
Forbs	Amaranthaceae	Froelichia arizonica	Arizona snakecotton
	Asteraceae	Parthenium confertum	Gray's feverfew
	Asteraceae	Artemisia ludoviciana	white sagebrush
	Asteraceae	Chaetopappa ericoides	rose heath
	Asteraceae	Senicio flaccidus	threadleaf ragwort
	Asteraceae	Senecio riddellii	Riddell's ragwort
	Asteraceae	Gutierrezia sarothrae	broom snakeweed
	Asteraceae	Stephanomeria pauciflora	brownplume wirelettuce
	Asteraceae	Viguiera dentata	toothleaf goldeneye
	Asteraceae	Artemisia dracunculus	tarragon
	Asteraceae	Zinnia acerosa	desert zinnia
	Asteraceae	Pectis filipes	fivebract cinchweed
	Asteraceae	Thymophylla acerosa	pricklyleaf dogweed
	Caryophyllaceae	Drymaria molluginea	slimleaf drymary
	Convolvulaceae	Evolvulus alsinoides	dwarf morning-glory
	Euphorbiaceae	Tragia ramosa	branched noseburn
	Fabaceae	Dalea formosa	featherplume
	Fabaceae	Dalea brachystachya	Fort Bowie prairieclover
	Fabaceae	Dalea wrightii	Wright's Pairieclover

	Fabaceae	Senna bauhinioides	twinleaf senna
	Malvaceae	Sphaeralcea sp.	globemallow
	Nyctaginaceae	Boerhavia sp.	spiderling
	Polygonaceae	Eriogonum wrightii	Wright's buckwheat
	Solanaceae	Solanum elaeagnifolium	silverleaf nightshade
	Zygophyllaceae	Kallstroemia sp.	caltrop
Grasses	Poaceae	Aristida divaricata	poverty threeawn
	Poaceae	Aristida ternipes	spidergrass
	Poaceae	Bothriochloa barbinodis	cane bluestem
	Poaceae	Bothriochloa laguroides	silver beardgrass
	Poaceae	Bouteloua curtipendula	sideoats grama
	Poaceae	Bouteloua eriopoda	black grama
	Poaceae	Bouteloua gracilis	blue grama
	Poaceae	Bouteloua hirsuta	hairy grama
	Poaceae	Digitaria californica	Arizona cottontop
	Poaceae	Eragrostis lehmanniana	Lehmann lovegrass
	Poaceae	Leptochloa dubia	green sprangletop
	Poaceae	Lycurus phleoides	common wolftail
	Poaceae	Muhlenbergia porteri	bush muhly
	Poaceae	Panicum hallii	Hall’s panicgrass
	Poaceae	Setaria leucopila	streambed bristlegrass

1

2

Table 2: Plants identified from Pond Road, March 4, 2015

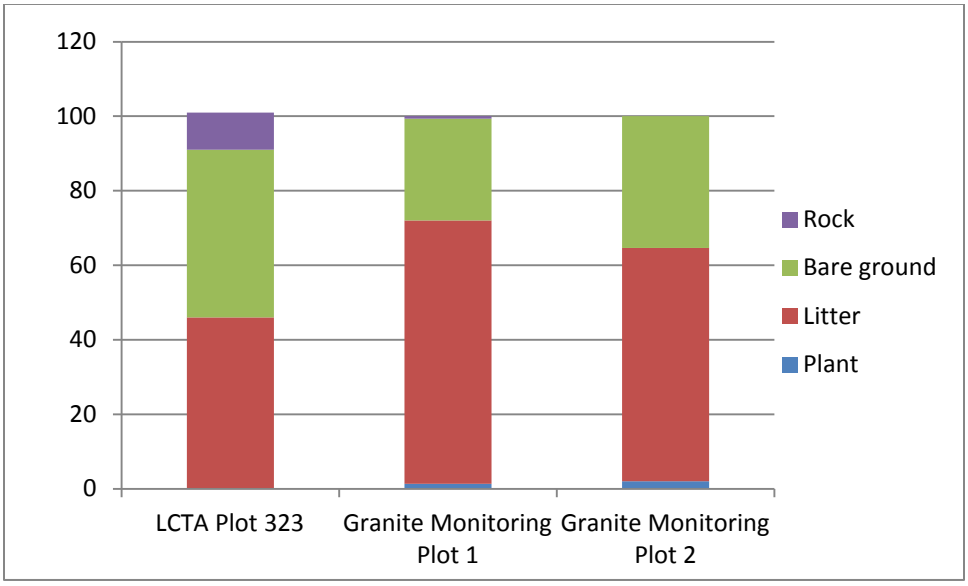
Habit	Botanical Family	Scientific Name	Common Name
Shrubs	Asteraceae	Gutierrezia sarothrae	broom snakeweed
	Asteraceae	Brickellia sp.	brickellbush
	Ephedraceae	Ephedra torreyana	Ephedra, Mormon tea
	Solanaceae	Lycium sp.	wolfberry
	Zygophyllaceae	Larrea tridentata	creosote
Cacti & **Succulents**	Agavaceae	Yucca elata	soaptree yucca
	Cactaceae	Cylindropuntia imbricata	cholla
	Cactaceae	Echinomastus intertextus	white fishhook cactus
	Cactaceae	Grusonia clavata	dagger or club-cholla
Forbs	Asteraceae	Acourtia nana	Desert holly/ dwarf desert-peony
	Asteraceae	Baileya multiradiata	desert marigold
	Asteraceae	Gaillardia sp.	Firewheel, Indian blanket
	Asteraceae	Machaeranthera tanacetifolia	tansyaster
	Asteraceae	Thelesperma megapotamicum	Hopi tea, greenthread
	Asteraceae	Zinnia acerosa	desert zinnia
	Boraginaceae	Cryptantha sp.	Cryptantha, hiddenflower
	Boraginaceae	Cryptantha cinerea	James' cryptantha
	Brassicaceae	Descurainia pinnata	Western tansy-mustard
	Brassicaceae	Lepidium sp.	peppergrass
	Brassicaceae	Selenia dissecta	Texas selenia
	Fumariaceae	Corydalis aurea	golden smoke/ scrambled eggs
	Malvaceae	Sphaeralcea incana	yellow/ soft globe-mallow
	Onagraceae	Oenothera albicaulis	whitest evening primrose
	Solanaceae	Solanum elaeagnifolium	silverleaf nightshade
	Verbeneacea	Glandularia bipinnatifida	Dakota mock vervain
Grasses	Poaceae	Bouteloua eriopoda	black grama
	Poaceae	Dasyochloa pulchella	fluffgrass
	Poaceae	Muhlenbergia porteri	bush muhly
	Poaceae	Pleuraphis mutica	tobosa
	Poaceae	Setaria leucopila	streambed bristlegrass
	Poaceae	Sporobolus airoides	alkali sacaton
	Poaceae	Sporobolus flexuosus	mesa dropseed

Results

Basal Cover

Basal plant cover at all three monitoring plots was low, as is expected with widely spaced desert plants. LCTA Plot 323 had more bare ground and less litter cover than Plots 1 and 2. This difference was not analyzed statistically but can serve as a basis for future trend detection.

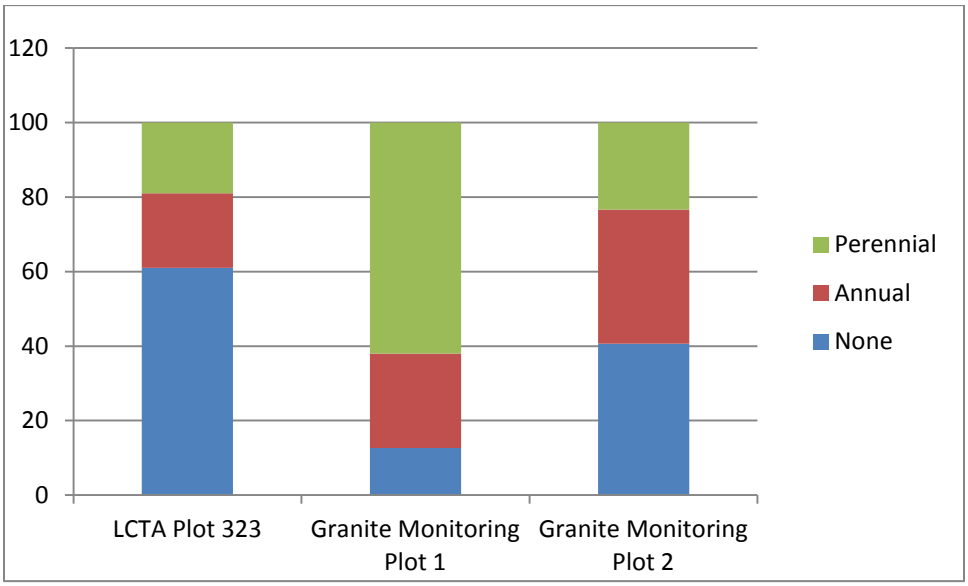
Figure 2: Basal Cover Categories for Monitoring Plots, 2014



Canopy cover

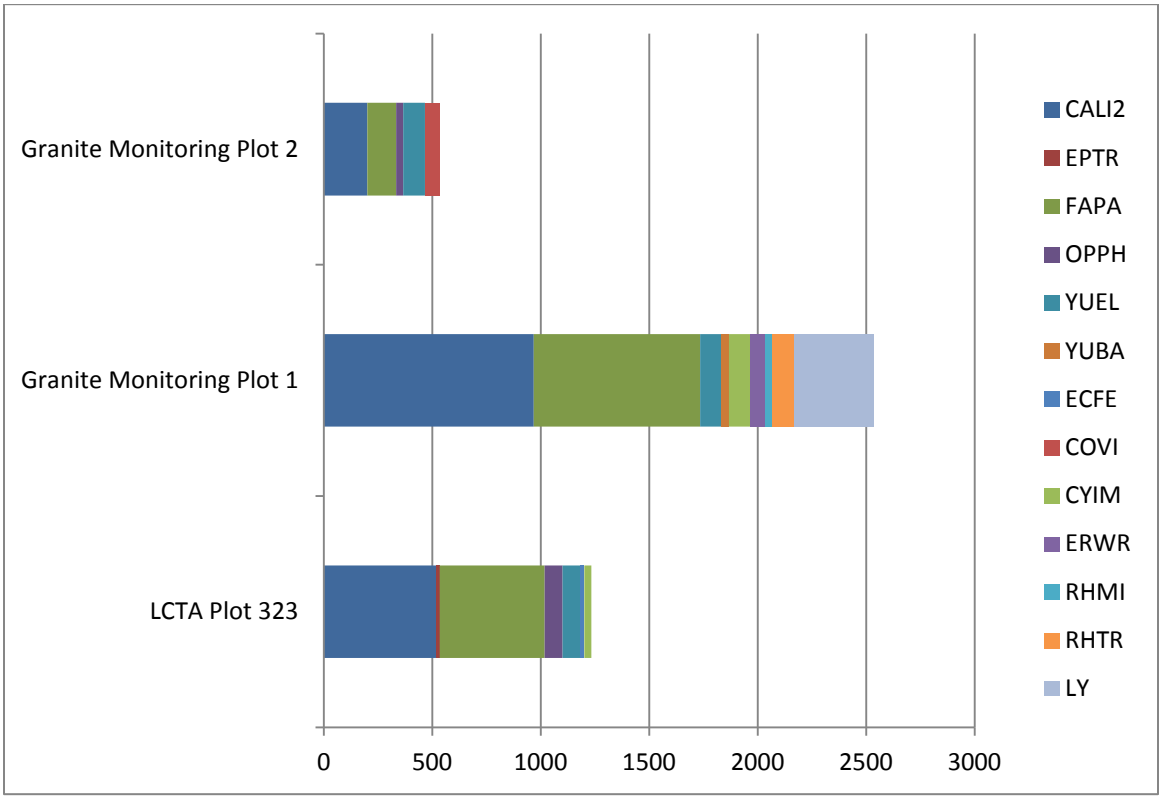
Plot 1 had the highest cover by perennials, mostly grasses. The plot's higher elevation and topographic position near an arroyo may provide this location with more moisture than the other plots. Plots 2 and 323 have more bare ground and annuals.

Figure 3: Canopy Cover Categories for Monitoring Plots, 2014



Shrub Density

Plot 1 had the highest density and diversity of shrubs. This may be due to its position near an arroyo, the shallower soils near the Granite site, and the plot's topographic location on the lower slopes of the Mockingbird Mountains.



Code	Scientific Name
CALI2	*Carlowrightia linearifolia* (Torr.) Gray
CYIM	*Cylindropuntia imbricata* (Haw.) F.M. Knuth var. *imbricata [Opuntia imbricata* (Haw.) DC. *]*
OPPH	*Opuntia phaeacantha Engelm.[O. phaeacantha Engelm.* var. *major* Engelm.*]*
YUEL	*Yucca elata* Engelm.
FAPA	*Fallugia paradoxa* (D.Don) Endl. ex Torr.
EPTR	*Ephedra trifurca* Torr. ex S. Wats.
ECFE	*Echinocereus fendleri* (Engelm.) Engelm. ex Rumpler var.*fendleri*
YUBA	*Yucca baccata* Torr.
COVI	*Coryphantha vivipara* = *Escobaria vivipara* (Nutt.) Buxbaum
ERWR	*Eriogonum wrightii* Torr. ex Benth.
RHMI	*Rhus microphylla* Engelm. ex Gray
RHTR	*Rhus trilobata Nutt.* [*Rhus aromatica var. trilobata* (Nutt.) Gray ex. S. Wats.]
LY	*Lycium* sp.

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