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Ecological Monitoring and Compliance Program

2012 REPORT

July 2013

Nevada National Security Site

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Ecological Monitoring and Compliance Program

2012 REPORT

Derek B. Hall, David C. Anderson, Paul D. Greger, W. Kent Ostler, and Dennis J. Hansen

July 2013

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P.O. Box 98518
Las Vegas, Nevada 89193-8518

By:
National Security Technologies, LLC
Ecological and Environmental Monitoring
P.O. Box 98521
Las Vegas, Nevada 89193-8521

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EXECUTIVE SUMMARY

The Ecological Monitoring and Compliance Program (EMAC), funded through the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO, formerly Nevada Site Office), monitors the ecosystem of the Nevada National Security Site (NNSS) and ensures compliance with laws and regulations pertaining to NNSS biota. This report summarizes the program's activities conducted by National Security Technologies, LLC (NSTec), during calendar year 2012. Program activities included (a) biological surveys at proposed construction sites, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive plant species monitoring, (e) sensitive and protected/regulated animal monitoring, (f) habitat restoration monitoring, and (g) monitoring of the Nonproliferation Test and Evaluation Complex (NPTEC). During 2012, all applicable laws, regulations, and permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

Sensitive and protected/regulated species of the NNSS include 42 plants, 1 mollusk, 2 reptiles, 236 birds, and 27 mammals. These species are protected, regulated, or considered sensitive according to state or federal regulations and natural resource agencies and organizations. The desert tortoise (*Gopherus agassizii*) is the only species on the NNSS protected under the *Endangered Species Act*. Biological surveys for the presence of sensitive and protected/regulated species and important biological resources on which they depend were conducted for 20 projects. A total of 145.17 hectares (ha) was surveyed for these projects. Sensitive and protected/regulated species and important biological resources found during these surveys included Joshua trees (*Yucca brevifolia*) and cacti. NSTec provided to project managers a written summary report of all survey findings and mitigation recommendations, where applicable. All flagged desert tortoise burrows were avoided during project activities.

Of the 18 projects on the NNSS, 13 occurred within the range of the threatened desert tortoise. No desert tortoises were accidentally killed or captured during project activities. One desert tortoise was injured by a vehicle along Jackass Flats road in Area 25. The tortoise walked away from the site, so the injury did not appear to be life-threatening. Seven tortoises were removed from roads to avoid being killed or injured. Approximately 6.17 ha of desert tortoise habitat were disturbed. Eleven desert tortoises were captured, radio-transmittered, and tracked as part of a study to understand how they interact with roads and to learn more about their fine-scale habitat use.

From 1978 until 2012, there has been an average of 11.7 wildland fires per year on the NNSS with an average of about 84.6 ha burned per fire. There were 11 wildland fires documented on the NNSS during 2012. Seven fires were caused by lightning, burning a total of 206.0 ha; two fires were caused by ordnance, for a total of 6.5 ha; one fire was caused by high winds, burning 4 ha; and one was caused by a vehicle, which burned about 0.4 ha. Total area burned was approximately 217 ha.

West Nile virus surveillance continued in 2012, but because of moldy samples, no mosquitoes were tested. Selected natural water sources were monitored to assess trends in physical and biological parameters. Several plastic-lined sumps were visited, and no dead animals were found in the sumps. In order to minimize the impact to wildlife from drying up four well ponds as a water conservation measure, five water troughs were installed. Motion-activated cameras were set up at each trough to document wildlife use.

A new site-specific ranking system for sensitive plants on the NNSS was developed. Field surveys in 2012 focused on rock purpusia (*Ivesia arizonica* var. *saxosa*) and white bearpoppy (*Arctomecon merriamii*). New populations of both species were documented. Kingston Mountains bedstraw (*Galium hilendiae* ssp. *kingstonense*) was verified as the subspecies that occurs on the NNSS, and two new populations were documented during other monitoring activities. Several new locations of Pahute green gentian (*Frasera pahutensis*) were also documented during other monitoring activities. No long-term monitoring plots were sampled this year.

Surveys of sensitive and protected/regulated animals during 2012 focused on bats, wild horses (*Equus caballus*), mule deer (*Odocoileus hemionus*), and mountain lions (*Puma concolor*). The wild horse population is stable at about 35 individuals, with very few foals surviving through the year. Mule deer abundance and density measured with standardized deer surveys showed a 50% decline. A total of 124 mountain lion images (i.e., photographs or video clips) were taken during 163,487 camera hours at 22 of 33 sites sampled. Information about other noteworthy wildlife observations, bird mortalities, Migratory Bird Treaty Act compliance, and a summary of nuisance animals and their control on the NNSS are also presented.

A mountain lion telemetry study continued in 2012 with the capture of three males and a female in May and June. All four (NNSS4, NNSS5, NNSS6, and NNSS7) were tracked using global positioning system satellite transmitters to determine food habits, home range, and habitat use during 2012. Combining data from all four mountain lions, a total of 54 prey items were found, including 42 mule deer, 5 wild horse foals, 3 desert bighorn sheep (*Ovis canadensis nelsoni*), 2 carnivores, 1 pronghorn antelope (*Antilocapra americana*), and 1 unknown ungulate. NNSS6, the female, was found dead during early August. Cause of death is unknown but may be disease-related.

Two previously revegetated sites on the NNSS and two on the Tonopah Test Range (TTR) were monitored in 2012. The cover cap on the U-3ax/bl disposal unit, revegetated in 2000, and the Control Point (CP) waterline, revegetated in 2009, were the restoration sites monitored on the NNSS. The Corrective Action Unit (CAU) 400-Five Points Landfill site, revegetated in 1997, and the CAU 407 Rollercoaster RADSAFE site, revegetated in 2000, were the restoration sites monitored on the TTR. Plant cover and density were recorded at the sites and where applicable reclamation success standards were evaluated. The 92-Acre Site at the Radioactive Waste Management Complex was revegetated to establish an evapotranspirative cover over buried waste. Revegetation included site preparation, seeding, mulching, crimping, and irrigating four areas, totaling 18 hectares (ha).

One chemical spill test plan was reviewed in 2012, but no baseline monitoring was needed or conducted at NPTEC.

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ACRONYMS AND ABBREVIATIONS

AIC	Akaike's Information Criterion
CAU	Corrective Action Unit
CI	Confidence Interval
cm	centimeter(s)
CORA-EPNE	*Coleogyne ramosissima–Ephedra nevadensis* Shrubland
CP	Control Point
DAF	Device Assembly Facility
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EEM	Ecological and Environmental Monitoring
ELU	Ecological Landform Unit
EM	Environmental Monitor
EMAC	Ecological Monitoring and Compliance Program
ESA	Endangered Species Act
ESW	Effective Strip Width
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
g	gram(s)
GIS	Geographic Information System
GPS	Global Positioning System
ha	hectare(s)
ICR	San Diego Zoo Institute for Conservation Research
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
LANL	Los Alamos National Laboratory
m	meter(s)
m^2	square meter(s)
MCL	Midline carapace length
mm	millimeter(s)
N	Sample Size
NAC	Nevada Administrative Code
NNHP	Nevada Natural Heritage Program
NNPS	Nevada Native Plant Society

ACRONYMS AND ABBREVIATIONS (continued)

NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NOAA	National Oceanic and Atmospheric Administration
NPTEC	Nonproliferation Test and Evaluation Complex
NSTec	National Security Technologies, LLC
NTTR	Nevada Test and Training Range
pCi/L	picocurie(s) per liter
PIMO/ARNO	*Pinus monophylla*/*Artemisa nova* Woodland
PIMO/ARTR	*Pinus monophylla*/*Artemisa tridentata* Woodland
PLS	Pure Live Seed
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
RWMC	Radioactive Waste Management Complex
SNHD	Southern Nevada Health District
SOC	Special Operations Center
spp.	species
ssp.	subspecies
TBD	To be determined
TTR	Tonopah Test Range
USGS	U.S. Geological Survey
var.	variety
VHF	Very High Frequency
W_i	habitat use index
WNV	West Nile Virus

1.0 INTRODUCTION

In accordance with U.S. Department of Energy Order DOE O 231.1B, "Environment, Safety, and Health Reporting," the Office of the Assistant Manager for Environmental Management of the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO, formerly Nevada Site Office) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada National Security Site (NNSS). National Security Technologies, LLC (NSTec), Ecological and Environmental Monitoring (EEM) has implemented the Ecological Monitoring and Compliance Program (EMAC) to provide this support. EMAC is designed to ensure compliance with applicable laws and regulations, delineate and define NNSS ecosystems, and provide ecological information that can be used to predict and evaluate the potential impacts of proposed projects and programs on those ecosystems. During 2012, all applicable laws, regulations, and permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

This report summarizes the EMAC activities conducted by NSTec during calendar year 2012. Monitoring tasks during 2012 included seven program areas: (a) biological surveys, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive plant monitoring, (e) sensitive and protected/regulated animal monitoring, (f) habitat restoration monitoring, and (g) biological monitoring at the Nonproliferation Test and Evaluation Complex (NPTEC). The following sections of this report describe work performed under these seven areas.

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2.0 BIOLOGICAL SURVEYS

Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species (Table 2-1), their associated habitat, and other important biological resources. Sensitive species are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern. They include species on the Nevada Natural Heritage Program (NNHP) Animal and Plant At-Risk Tracking List (NNHP 2013) and bat species ranked as moderate or high in the Revised Nevada Bat Conservation Plan Bat Species Risk Assessment (Bradley et al. 2006). Protected/regulated species are those that are protected or regulated by federal or state law. Many species are both sensitive and protected/regulated (Table 2-1). Important biological resources include cover sites, nest or burrow sites, roost sites, or water sources important to sensitive species. Survey reports document species and resources found and provide mitigation recommendations.

2.1 Sites Surveyed and Sensitive and Protected/Regulated Species Observed

During 2012, biological surveys for 18 projects were conducted on the NNSS (Figure 2-1 and Table 2-2). Two surveys were conducted off the NNSS (Table 2-2). One project had multiple site locations. Scientists surveyed a total of 145.17 hectares (ha) for the projects (Table 2-2). Fifteen projects were within the range of the threatened desert tortoise (*Gopherus agassizii*). Sensitive and protected/regulated species and important biological resources found included Joshua trees (*Yucca brevifolia*) and cacti (Table 2-2). NSTec provided written summary reports to project managers of survey findings and mitigation recommendations, where applicable (Table 2-2).

2.2 Potential Habitat Disturbance

Surveys are conducted for all activities that would disturb habitat, including new projects, routine maintenance activities, or cleanup activities at old industrial or nuclear weapons testing sites. These surveys are required whenever vegetation has re-colonized old disturbances and sensitive or protected/regulated species are known to occur in the area. For example, desert tortoises may move through revegetated earthen sumps and may be concealed under vegetation during activities where heavy equipment is used. Biological surveys and tortoise clearance surveys are conducted to ensure that desert tortoises are not in harm's way. Burrowing owls frequently inhabit burrows and culverts at disturbed sites, so surveys are conducted to ensure that adults, eggs, and nestlings are not harmed.

Of the 20 projects surveyed, 15 were within sites previously disturbed (e.g., road shoulders, old building sites, industrial waste sites, or existing well pads) (Table 2-2). Five projects were located totally or partially in areas that had not been previously disturbed. These projects could potentially disturb 7.59 ha of land that were previously considered undisturbed (some projects have been proposed, but the construction activity has not yet occurred). Two projects occurred in areas designated as important habitats (Table 2-3 and Figure 2-2). During vegetation mapping of the NNSS (Ostler et al. 2000), Ecological Landform Units (ELUs) were evaluated for importance. Some ELUs were identified as *Pristine Habitat* (having few man-made disturbances), *Unique Habitat* (containing uncommon biological resources such as a natural wetland), *Sensitive Habitat* (containing vegetation associations that recover very slowly from direct disturbance or are susceptible to erosion), and *Diverse Habitat* (having high plant species diversity) (U.S. Department of Energy, Nevada Operations Office [DOE/NV] 1998). A single ELU could be classified as more than one type of these four types of important habitats.

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS

Plant Species	Common Names	Status[a]
Moss Species		
Entosthodon planoconvexus	Planoconvex cordmoss	S, H
Flowering Plant Species		
Arctomecon merriamii	White bearpoppy	S, M
Astragalus beatleyae	Beatley milkvetch	S, H
Astragalus funereus	Black woollypod	S, H
Astragalus oophorus var. *clokeyanus*	Clokey eggvetch	S, W
Camissonia megalantha	Cane Spring suncup	S, M
Cymopterus ripleyi var. *saniculoides*	Sanicle biscuitroot	S, M
Eriogonum concinnum	Darin buckwheat	S, M
Eriogonum heermannii var. *clokeyi*	Clokey buckwheat	S, W
Frasera pahutensis	Pahute green gentian	S, M
Galium hilendiae ssp. *kingstonense*	Kingston Mountains bedstraw	S, H
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	S, W
Ivesia arizonica var. *saxosa*	Rock purpusia	S, H
Penstemon fruticiformis ssp. *amargosae*	Death Valley beardtongue	S, H
Penstemon pahutensis	Pahute Mesa beardtongue	S, W
Phacelia beatleyae	Beatley scorpionflower	S, M
Phacelia filiae	Clarke phacelia	S, M
Phacelia mustelina	Weasel phacelia	S, Ma
Agavaceae	Yucca (3 species), Agave (1 species)	CY
Cactaceae	Cacti (18 species)	CY
Juniperus osteosperma	Juniper	CY
Pinus monophylla	Pinyon	CY

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

Animal Species	Common Name	Status[a]
Mollusk Species		
Pyrgulopsis turbatrix	Southeast Nevada pyrg	S, A
Reptile Species		
Plestiodon gilberti rubricaudatus	Western red-tailed skink	S, IA
Gopherus agassizii	Desert tortoise	LT, S, NPT, A
Bird Species[b]		
Accipiter gentilis	Northern goshawk	S, NPS, IA
Alectoris chukar	Chukar	G, IA
Aquila chrysaetos	Golden eagle	EA, NP, IA
Buteo regalis	Ferruginous hawk	S, NP, IA
Callipepla gambelii	Gambel's quail	G, IA
Coccyzus americanus	Western yellow-billed cuckoo	C, S, NPS, IA
Falco peregrinus	Peregrine falcon	S, NPE, IA
Haliaeetus leucocephalus	Bald eagle	EA, S, NPE, IA
Ixobrychus exillis hesperis	Western least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS, IA
Oreoscoptes montanus	Sage thrasher	NPS, IA
Phainopepla nitens	Phainopepla	S, NP, IA
Spizella breweri	Brewer's sparrow	NPS, IA
Toxostoma bendirei	Bendire's thrasher	S, NP, IA
Toxostoma lecontei	LeConte's thrasher	S, NP, IA
Mammal Species		
Antilocapra americana	Pronghorn antelope	G, IA
Antrozous pallidus	Pallid bat	M, NP, A
Cervus elaphus	Rocky Mountain elk	G, IA
Corynorhinus townsendii	Townsend's big-eared bat	S, H, NPS, A
Equus asinus	Burro	H&B, A
Equus caballus	Horse	H&B, A
Euderma maculatum	Spotted bat	S, M, NPT, A

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

Animal Species	Common Name	Status[a]
Lasionycteris noctivagans	Silver-haired bat	M, A
Lasiurus blossevillii	Western red bat	S, H, NPS, A
Lasiurus cinereus	Hoary bat	M, A
Lynx rufus	Bobcat	F, IA
Microdipodops megacephalus	Dark kangaroo mouse	NP, A
Microdipodops pallidus	Pale kangaroo mouse	S, NP, A
Myotis californicus	California myotis	M, A
Myotis ciliolabrum	Small-footed myotis	M, A
Myotis evotis	Long-eared myotis	M, A
Myotis thysanodes	Fringed myotis	S, H, NP, A
Myotis yumanensis	Yuma myotis	M, A
Ovis canadensis nelsoni	Desert bighorn sheep	G, IA
Odocoileus hemionus	Mule deer	G, A
Pipistrellus hesperus	Western pipistrelle	M, A
Puma concolor	Mountain lion	G, A
Sylvilagus audubonii	Audubon's cottontail	G, IA
Sylvilagus nuttallii	Nuttall's cottontail	G, IA
Tadarida brasiliensis	Brazilian free-tailed bat	NP, A
Urocyon cinereoargenteus	Gray fox	F, IA
Vulpes velox macrotis	Kit fox	F, IA

[a]Status Codes:

Endangered Species Act, U.S. Fish and Wildlife Service

LT - Listed Threatened
C - Candidate for listing

U.S. Department of Interior

H&B - Protected under *Wild Free Roaming Horses and Burros Act*
EA - Protected under *Bald and Golden Eagle Act*

State of Nevada – Animals

S - Nevada Natural Heritage Program – Animal and Plant At Risk Tracking List
NPE - Nevada Protected-Endangered, species protected under Nevada Administrative Code (NAC) 503
NPT - Nevada Protected-Threatened, species protected under NAC 503
NPS - Nevada Protected-Sensitive, species protected under NAC 503

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

NP - Nevada Protected, species protected under NAC 503
G - Regulated as game species under NAC 503
F - Regulated as fur-bearer species under NAC 503

State of Nevada – Plants
S - Nevada Natural Heritage Program – Animal and Plant At-Risk Tracking List
CY - Protected as a cactus, yucca, or Christmas tree

NNSS Sensitive Plant Ranking
H - High
M - Moderate
W - Watch
Ma - Marginal

Long-term Animal Monitoring Status for the NNSS
A - Active
IA - Inactive

The Revised Nevada Bat Conservation Plan – Bat Species Risk Assessment
H - High
M - Moderate

[b] All bird species on the NNSS are protected by the *Migratory Bird Treaty Act* except for chukar, Gambel's quail, English house sparrow, Rock dove, and European starling.

Sources used: NNHP 2013, Nevada Native Plant Society (NNPS) 2013, NAC 2013, U.S. Fish and Wildlife Service (FWS) 2013, Bradley et al. 2006

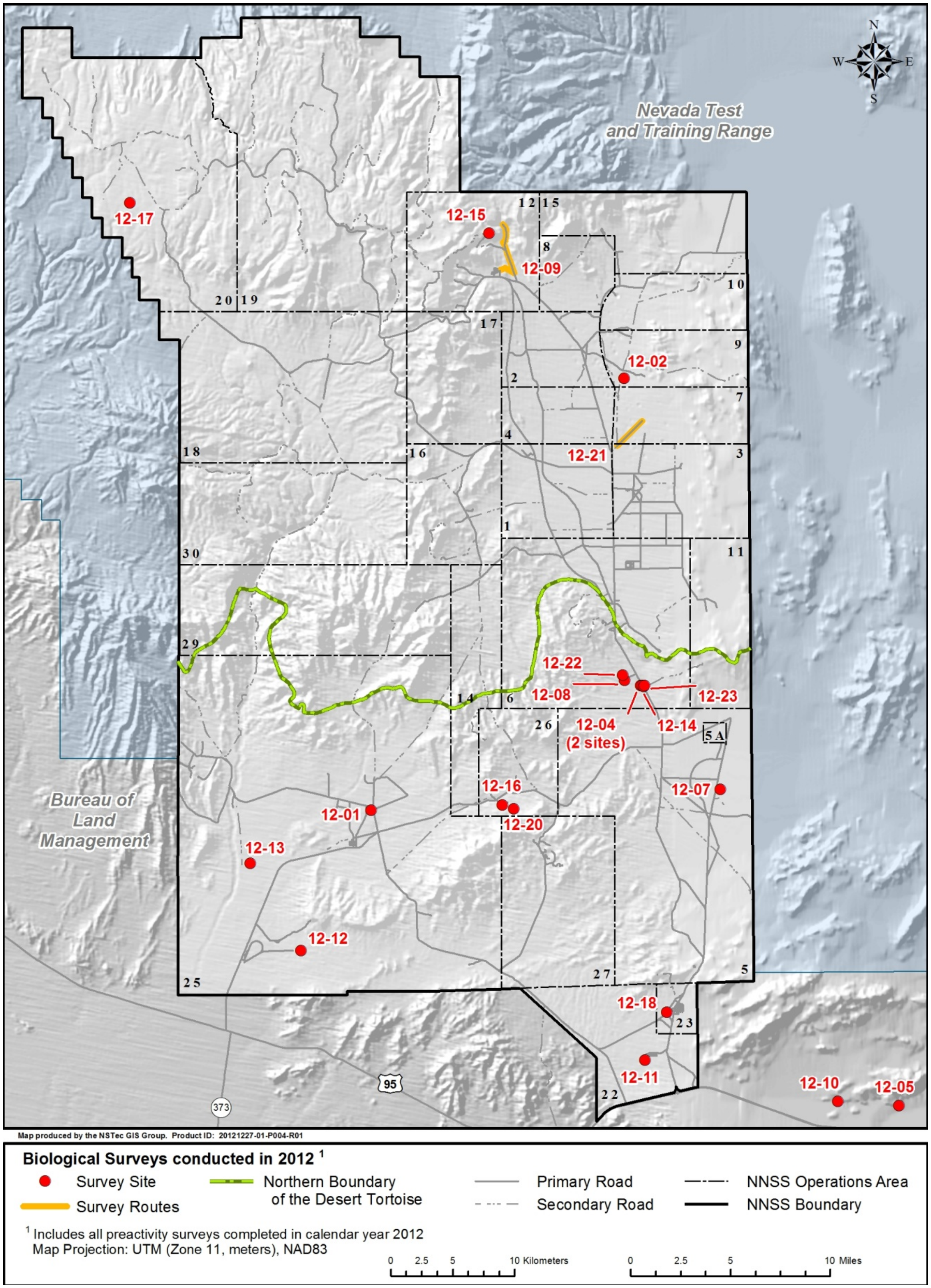

Figure 2-1. Biological surveys conducted on or near the NNSS during 2012

Table 2-2. Summary of biological surveys conducted on or near the NNSS during 2012

Project No.	Project	Important Species/Resources Found	Area Surveyed (ha)	Proposed Project Area in Undisturbed Habitat (ha)	Mitigation Recommendations
12-01	Corrective Action Unit 562	None	0.02	0	None
12-02	Corrective Action Unit 547	None	0.22	0	None
12-04	RNCTEC Expansion (Security ditch)	None	0.78	0.78	Mitigation required, EM needed
12-04	RNCTEC Expansion (Spoil pad)	Joshua trees	4.23	4.23	Mitigation required, EM needed
12-05	Plugback	None	0.11	0	None
12-07	Particle Release experiments	None	50.05	0	TCS required
12-08	Device Assembly Facility Barriers	None	1.61	0	TCS required
12-09	P-tunnel pad	None	13.20	0	None
12-10	Plugback	None	0.28	0	None
12-11	Sign installation	None	0.25	0	TCS required
12-12	Area 25 blast pad	None	1.69	0	TCS required
12-13	Water line break	None	0.50	0	TCS required
12-14	Wackenhut security training	None	1.25	0	TCS required
12-15	Particle Release experiments	None	38.80	0	None
12-16	Port Gaston Neptune	None	0.73	0	TCS required, EM needed
12-17	Salut	None	15.50	0	None
12-18	Re-sag power line	None	10.03	0	None

Table 2-2. Summary of biological surveys conducted on or near the NNSS during 2012 (continued)

Project Number	Project	Important Species/Resources Found	Area Surveyed (ha)	Proposed Project Area in Undisturbed Habitat (ha)	Mitigation Recommendations
12-20	Neptune 5a	Cacti	1.74	1.74*	Mitigation required, EM needed
12-21	Corrective Action Unit 104	None	2.92	0	None
12-22	Device Assembly Facility power poles	Joshua trees/cacti	0.56	0.28	Mitigation required, EM needed
12-23	RNCTEC Expansion (conex pad)	Joshua trees/cacti	0.70	0.56	Mitigation required, EM needed
		Total ha	**145.17**	**7.59**	

*Project not completed, actual area may vary.
EM – Environmental Monitor
RNCTEC – Radiological/Nuclear Countermeasures Test and Evaluation Complex
TCS – Tortoise Clearance Survey

Table 2-3. Total area disturbed in hectares within important habitats in 2012 and cumulative over the past 12 years

Project No.	Project Name	Pristine Habitat	Unique Habitat	Sensitive Habitat	Diverse Habitat
12-04	RNCTEC Expansion (Security ditch)	0	0	0.78	0
12-04	RNCTEC Expansion (Spoils pad)	0	4.23	0	0
12-22	Device Assembly Facility power poles	0	0.28	0	0
	2012 Total: 5.29	0	4.51	0.78	0
	1999–2012 Grand Total: 450.40	9.46	17.31	337.80	85.83

Figure 2-2 shows the distribution of these important habitats, ranked so that pristine habitat overlays unique habitat, which then overlays sensitive habitat, which then overlays diverse habitat. The expected area disturbed in important habitats due to 2012 projects is 5.29 ha (Table 2-3). Since 1999, the total area of important habitat disturbed by NNSA/NFO activities is 450.40 ha. This tally is used to document the loss of important habitat.

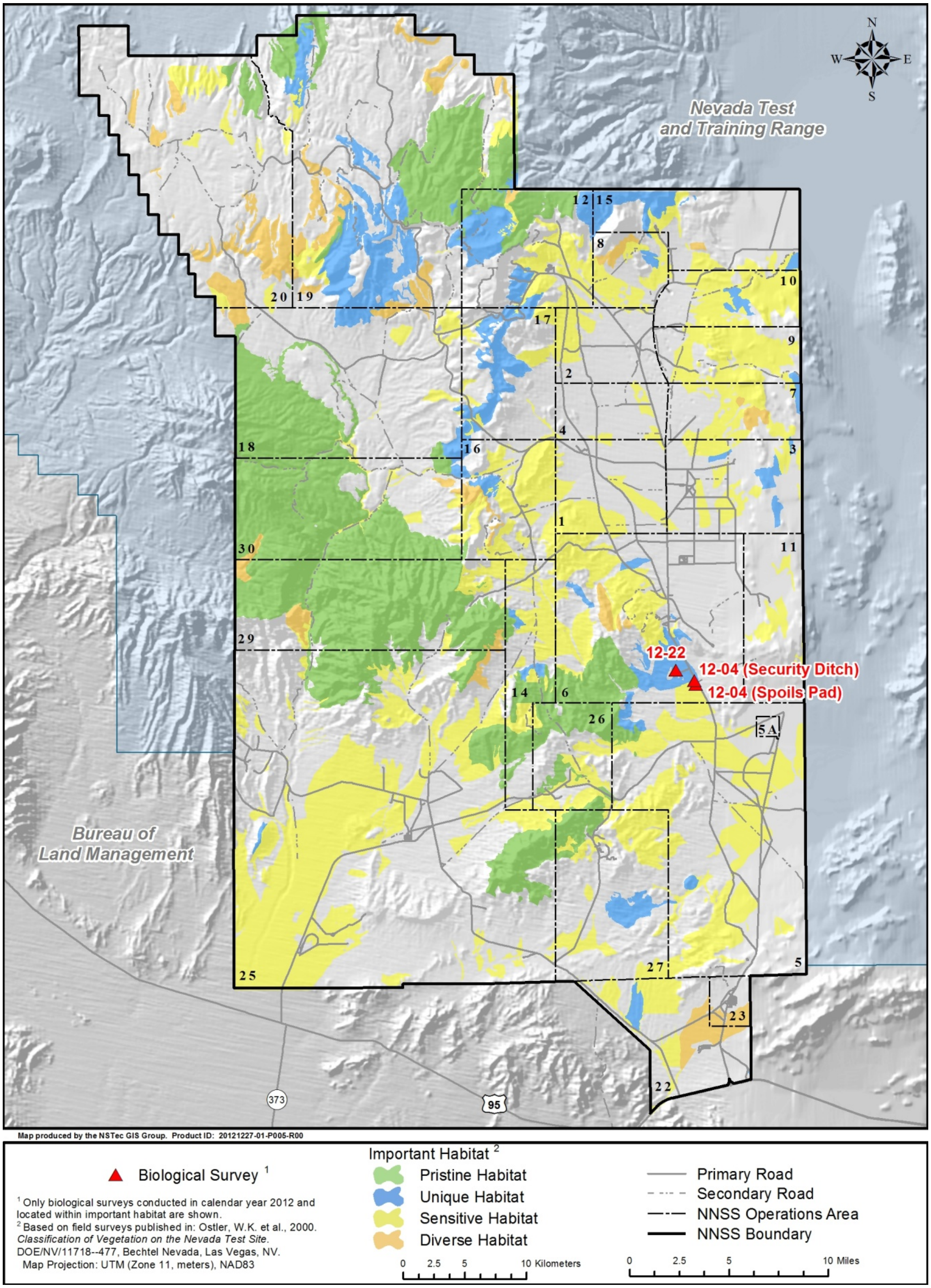

Figure 2-2. Biological surveys conducted in important habitats of the NNSS during 2012

3.0 DESERT TORTOISE COMPLIANCE

Desert tortoises occur within the southern one-third of the NNSS. This species is listed as threatened under the *Endangered Species Act* (ESA). In December 1995, NNSA/NFO completed consultation with the U.S. Fish and Wildlife Service (FWS) concerning the effects of NNSA/NFO activities, as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV 1996), on the desert tortoise. NNSA/NFO received a final Biological Opinion (Opinion) from FWS in August 1996 (FWS 1996). On July 2, 2008, NNSA/NFO provided FWS with a Biological Assessment of anticipated activities on the NNSS for the next 10 years and entered into formal consultation with FWS to obtain a new Opinion for the NNSS. NNSA/NFO received the final Opinion on February 12, 2009 (FWS 2009). This Opinion covers the anticipated activities at the NNSS until 2019.

The Desert Tortoise Compliance task of EMAC implements the terms and conditions of the 2009 Opinion, documents compliance actions taken by NNSA/NFO, and assists NNSA/NFO in FWS consultations. All of the terms and conditions listed in the Opinion were implemented by NSTec staff biologists in 2012, including (a) conducting clearance surveys at project sites within 1 day from the start of project construction, (b) ensuring that project managers have environmental monitors on site during site clearing and heavy equipment operation, (c) developing effects analysis for proposed disturbances to append to the Opinion, and (d) preparing an annual compliance report for NNSA/NFO submittal to the FWS.

3.1 Project Surveys and Compliance Documentation

During 2012, biologists conducted desert tortoise clearance surveys prior to ground-disturbing activities for 13 proposed projects within the range of the desert tortoise on the NNSS. Two other projects have been submitted to FWS for approval to append to our Opinion (Table 3-1 and Figure 3-1). Two projects were located off the NNSS; after reviewing the projects, it was determined that they would not impact desert tortoises, so they were not included in this section. Most of these projects were in, or immediately adjacent to, roads, existing facilities, or other disturbances. No desert tortoises were observed in project areas, and six tortoise burrows found during tortoise clearance surveys were flagged (Project No. 11-34). Three of the burrows were scoped and collapsed because they were within the project area and could not be avoided. The other three burrows were blocked during the project activities.

Four projects were initiated that disturbed previously undisturbed desert tortoise habitat. Projects 11-37, 12-04, 12-22, and 12-23 disturbed 6.17 ha of desert tortoise habitat in 2012 (Table 3-1). The Substation expansion and power line (11-37) resulted in a loss of 0.32 ha. The anticipated loss for this project was 0.38 ha, and a mitigation fee of $769.50 was paid on July 16, 2012. The Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC) Expansion - security ditch and spoils pile (12-04) disturbed 5.01 ha of ground. The power line for Device Assembly Facility (DAF) barriers (12-22) disturbed 0.28 ha, which was less than the 0.56 ha approved by the Service. The mitigation fee of $1,117.80 was paid on November 1, 2012. The fourth project, RNCTEC Expansion - conex pad (12-23), disturbed 0.56 ha. Payment for all of the RNCTEC Expansion projects was made in 2011.

Post-activity surveys to quantify the acreage of tortoise habitat actually disturbed were conducted for 13 projects during this reporting period (Table 3-1). All projects stayed within proposed project boundaries. Post-activity surveys are generally not conducted if the projects are located within previously disturbed areas or if the environmental monitor documented that the project stayed within its proposed boundaries.

Table 3-1. Summary of tortoise compliance activities conducted by site biologists during 2012

Project Number	Project	Compliance Activities 100% Coverage Clearance Survey	Tortoise Habitat Disturbed (Ha)
11-34	BREN Tower removal	Yes, post-activity survey completed	0
11-37	Substation expansion and power line	Yes, post-activity survey completed	0.32
12-01	Corrective Action Unit 562	Yes, post-activity survey completed	0
12-04	RNCTEC Expansion (Security ditch and spoils pad)	Yes, post-activity survey completed	5.01
12-07	Particle release experiments	Yes, post-activity survey completed	0
12-08	DAF barriers	Yes, post-activity survey completed	0
12-11	Sign Installation	Yes, post-activity survey completed	0
12-12	Area 25 blast pad	Yes, post-activity survey completed	0
12-13	Water line repair	Yes, post-activity survey completed	0
12-14	Wackenhut security test	Yes, post-activity survey completed	0
12-16	Port Gaston Neptune/Leo	Yes, post-activity survey completed	0
12-20	Third blasting pad at Port Gaston	Project ongoing	TBD
12-22	Power line for DAF	Yes, post-activity survey completed	0.28
12-23	RNCTEC Expansion (conex pad)	Yes, post-activity survey completed	0.56
12-24	Valley Electric Association power line	Activity not started	TBD
		TOTAL	6.17

TBD = to be determined

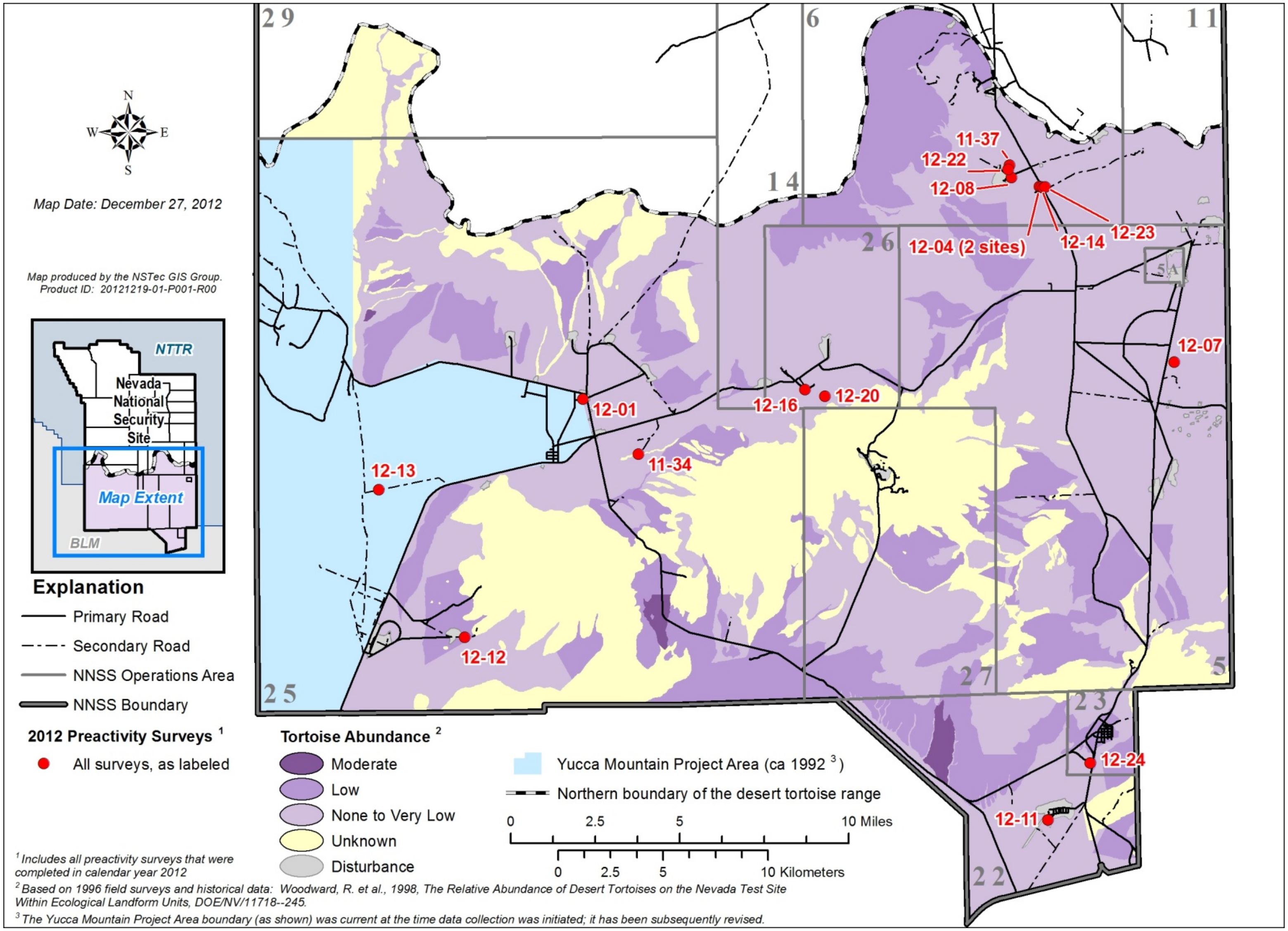

Figure 3-1. Biological surveys conducted in desert tortoise habitat on the NNSS during 2012

In January 2012, the annual report that summarized tortoise compliance activities conducted on the NNSS from January 1 through December 31, 2011, was submitted to the FWS. This report, required under the Opinion, contains (a) the location and size of land disturbances that occurred within the range of the desert tortoise during the reporting period; (b) the number of desert tortoises injured, killed, or removed from project sites; (c) a map showing the location of all tortoises sighted on or near roads on the NNSS; and (d) a summary of construction mitigation and monitoring efforts.

Compliance with the Opinion ensures that the desert tortoise is protected on the NNSS and that the cumulative impacts on this species are minimized (DOE/NV 1998). In the Opinion, the FWS determined that the "incidental take" of tortoises on the NNSS and the cumulative acreage of tortoise habitat disturbed on the NNSS are parameters that should be measured and monitored annually. During this calendar year, the threshold levels established by the FWS for these parameters were not exceeded (Table 3-2). No desert tortoises were accidentally injured or killed by project activities. One desert tortoise was injured by a vehicle along Jackass Flats road in Area 25 in 2012. The tortoise walked away from the site, so the injury did not appear to be life-threatening. Seven tortoises were removed from roads to avoid being killed or injured and are reported in the "Other" column of Table 3-2. Eleven desert tortoises were captured as part of the road mitigation study on the NNSS and transmitters were attached so their movements could be tracked. This brings the total number of tortoises taken under the "Other" category to 45 for the 4 years under the current Opinion.

Table 3-2. Cumulative incidental take (2009–2012) and maximum allowed take for NNSA/NFO programs

Program	**Number of Hectares Impacted** (maximum allowed)	**Number of Tortoises Anticipated to be Incidentally Taken (maximum allowed)**	
		Killed/Injured	**Other**
Defense	2.27 (202)	0 (1)	0 (10)
Waste Management	0 (40)	0 (1)	0 (2)
Environmental Restoration	0 (4)	0 (1)	0 (2)
Nondefense Research and Development	0 (607)	0 (2)	0 (35)
Work for Others	10.19* (202)	0 (1)	0 (10)
Infrastructure Development	0.66 (40)	0 (1)	0 (10)
Roads	0 (0)	5 (15)	45 (125)
Totals	**13.12 (1,095)**	**5 (22)**	**45 (194)**

*One project is not yet completed but is anticipated to disturb 42.2 hectares. The actual amount disturbed will be reported in the 2013 report.

3.2 Mitigation for Loss of Tortoise Habitat

Mitigation for the loss of tortoise habitat is required under the terms and conditions of the Opinion. The Opinion requires NNSA/NFO to perform one of two mitigation options: (a) prepay funds into the Desert Tortoise Mitigation Funds (current 2012 rate is $2,000.70 per ha of habitat disturbed), or (b) prepay mitigation funds at the current rate, then revegetate disturbed habitat following specified criteria; once the revegetation is successful, the money paid for mitigation will be refunded. Three projects (11-34, 11-37, and 12-22) paid a total of $2,818.80 into the Desert Tortoise Mitigation Fund to mitigate the 0.60 ha of land that was disturbed in 2012. The other 5.57 ha disturbed as part of the RNCTEC Expansion were paid for in 2011.

3.3 Conservation Recommendation Studies

One of the conservation recommendations of the Opinion (FWS 2009) states that NNSA/NFO:

> ***should develop a strategy to minimize road mortalities on the NNSS by focusing efforts on roads that have a history of mortality or that traverse higher density desert tortoise areas (page 29 of the Opinion).***

In order to address this conservation recommendation, results from prior desert tortoise surveys and historic roadside observation/mortality data were analyzed using a Geographic Information System (GIS) to identify areas with higher densities of desert tortoises and areas that may be at higher risk for tortoise mortalities caused by vehicles along NNSS roads. This analysis suggested a need for a better understanding of desert tortoise activity near roads with high desert tortoise use and the effects of the zone of depression (up to ¼ mile) on tortoise abundance in order to better develop the strategy to minimize road mortalities.

Desert tortoises may be drawn to roads to forage and drink, especially after summer rains when water collects in depressions on or along roads, thus creating a short-term source of drinking water that may be critical to their survival. Further, roadside vegetation is typically more succulent than non-roadside vegetation due to a water-harvesting effect and roadside maintenance activities such as mowing or blading, which typically stimulates plant growth. In addition, while some efforts to model desert tortoise habitat in the Mojave Desert have been made (Weinstein 1989, Andersen et al. 2000, Nussear et al. 2009), knowledge about fine-scale patterns of habitat use is still lacking.

3.3.1 Road Study

In 2010, NNSA/NFO began talks with the FWS and personnel from San Diego Zoo's Institute for Conservation Research (ICR) to assess research that may assist NNSA/NFO in reducing or mitigating desert tortoise take on roads. On March 15, 2012, NNSA/NFO requested FWS to approve a research plan to assess desert tortoise movements near roads on the NNSS. On April 13, 2012, FWS appended this action to the Opinion, which allows NNSA/NFO authorized biologists to place transmitters on up to 20 desert tortoises found near roads and study their movements through 2014. The main objectives of this study are to (a) determine fine-scale patterns of habitat use of desert tortoises found near roads on the NNSS, and (b) assess the risk of desert tortoise road mortality on the NNSS. A secondary objective is to assess the health and condition of desert tortoises on the northern periphery of their range.

A total of 11 desert tortoises (4 males and 7 females) were captured on or near roads on the NNSS during 2012 (Figure 3-2). Global Positioning System (GPS) and Very High Frequency (VHF) transmitters were attached to their carapaces or shells by trained personnel following approved protocols (Figure 3-3).

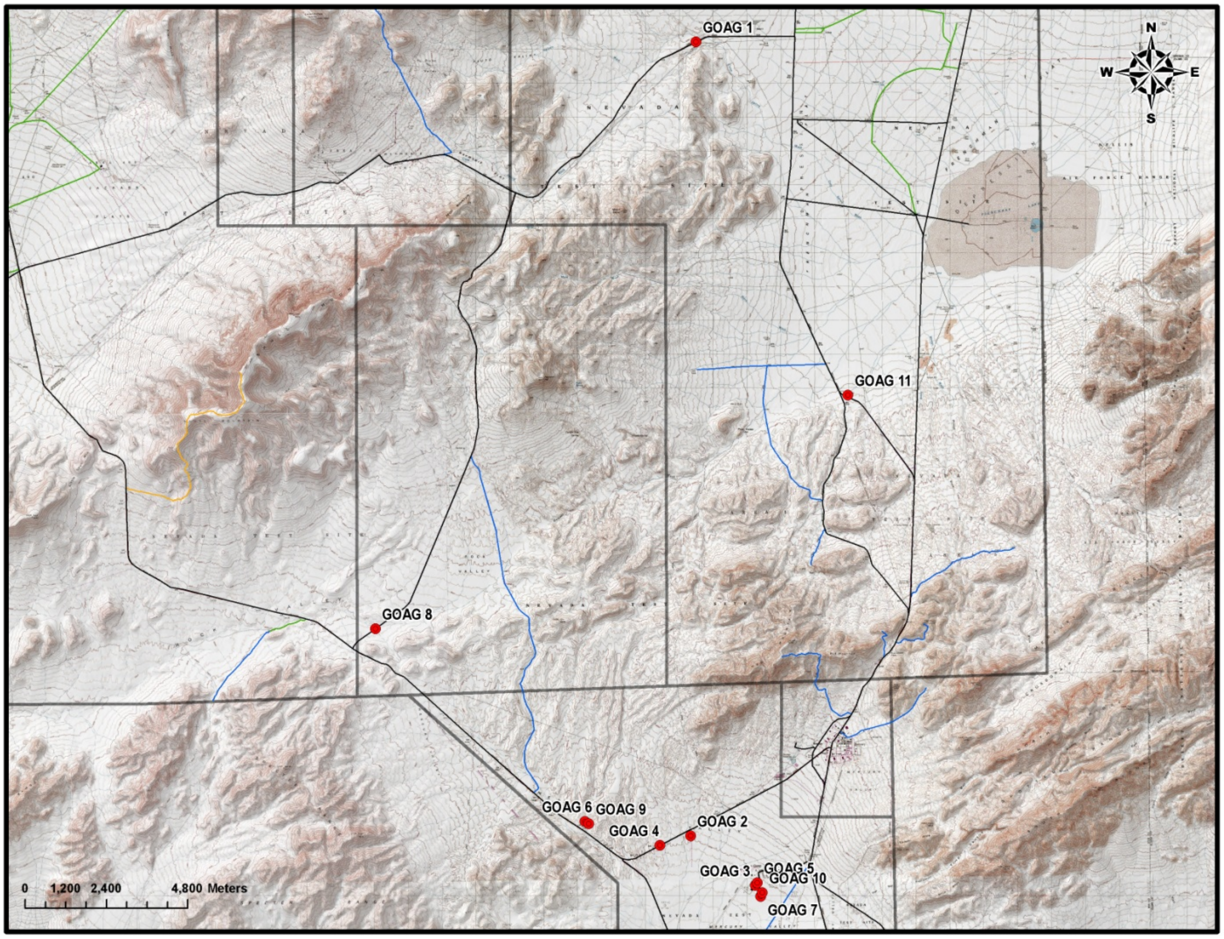

Figure 3-2. Initial desert tortoise capture locations during 2012 at the NNSS

Figure 3-3. Desert tortoise (GOAG 3) with transmitters attached
(Photo taken by D. B. Hall, May 17, 2012)

Seven of the tortoises were captured as a result of opportunistic observations along roads. One tortoise, designated as GOAG 6, was captured when biologists walked transects adjacent to paved roads, and three tortoises (GOAG 7, 9, and 10) were found while conducting routine telemetry to determine tortoise locations. Table 3-3 provides information on the captured tortoises.

Table 3-3. Data on desert tortoises captured for the NNSS road study during 2012

Tortoise ID	Capture Date	Capture Time	Body Condition Score	Sex	Weight (g)	Size MCL (mm)
GOAG 1	5/10/2012	1110	4	F	4450	285
GOAG 2	5/15/2012	0900	6	F	2664	233
GOAG 3	5/17/2012	0945	5	M	4714	288
GOAG 4	5/24/2012	1100	4	F	2964	257
GOAG 5	5/29/2012	1100	4	F	2320	243
GOAG 6	6/01/2012	0645	5	M	2140	227
GOAG 7	6/11/2012	1055	5	F	2450	238
GOAG 8	6/13/2012	1000	4	F	3050	258
GOAG 9	6/26/2012	0825	4	F	2520	251
GOAG 10	7/12/2012	0922	5	M	2300	230
GOAG 11	9/27/2012	1220	5	M	3350	257

GPS transmitters were generally set to record data every 15 minutes during daylight hours. Tortoises were tracked via VHF transmitter generally once a week. GPS transmitters were changed out every 1–2 months (depending on battery life and tortoise accessibility) during the active season. During early October, GPS units were changed to record data only three times a day (1000, 1200, and 1400) for the inactive season.

An initial body size and health evaluation was performed on each tortoise when it was captured. This included weight, midline carapace length (MCL), width, height, body condition, shell abnormalities, skin lesions, respiration, and nares and eye assessments for discharge. On July 16, 2012, formal health evaluations including a blood sample for disease testing was conducted on several tortoises by trained personnel from the ICR. Because of time/temperature constraints, only seven tortoises received this evaluation and disease testing.

The processing and analysis of data from the GPS transmitters attached to the tortoises is ongoing. An example of movement patterns of GOAG 4 are shown in Figure 3-3. Tortoise locations for this figure are in 15-minute increments during daylight hours starting on May 24 and continuing through July 31, 2012.

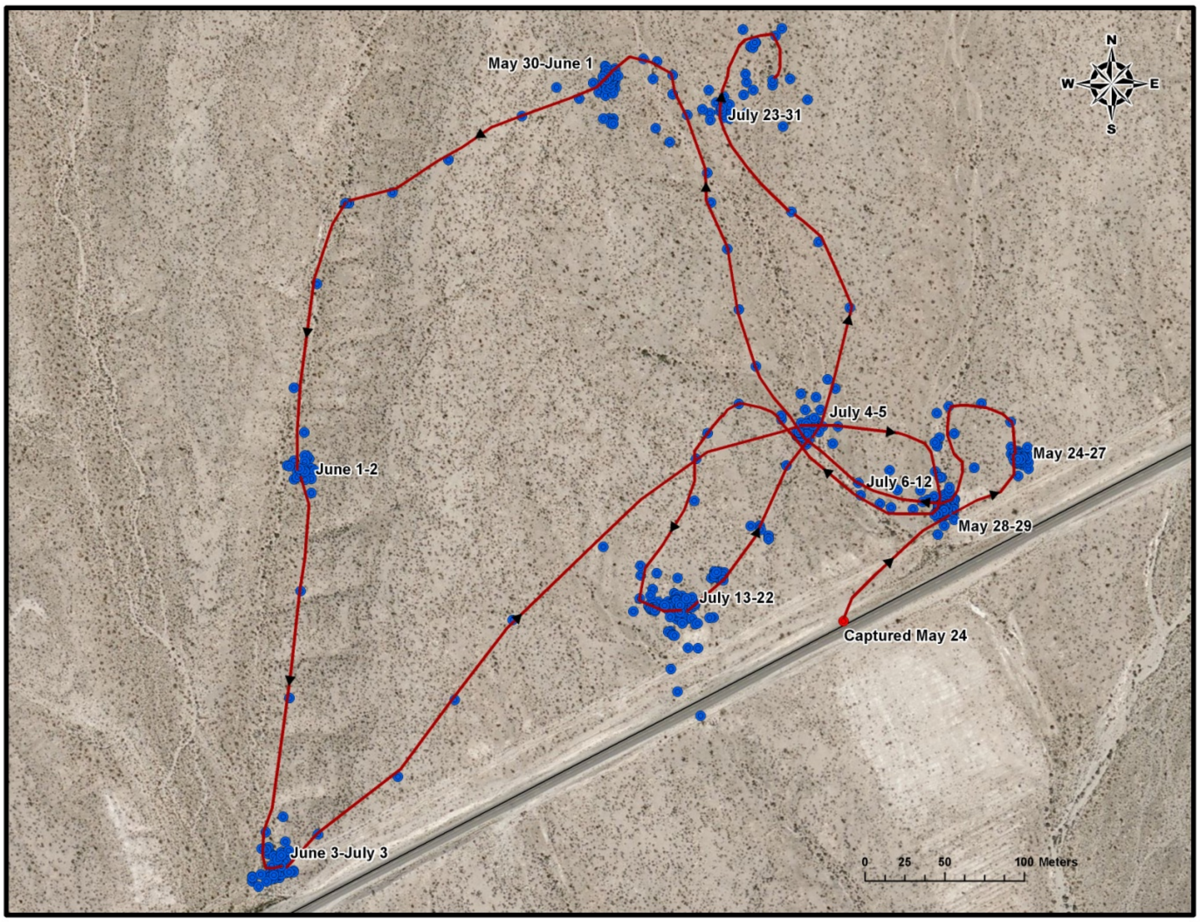

Figure 3-4. Movement data collected from GPS transmitters for GOAG 4 during part of 2012

3.3.2 Traffic Counters

Ten traffic counters were placed on major roads within desert tortoise habitat on the NNSS in 2012 (Table 3-4). Traffic counters were checked every 2 weeks, and the number of vehicle passes was recorded. Traffic counts were initiated on April 2, 2012, and continued for 26 weeks. The traffic counters were removed on October 16, 2012. Not all of the traffic counters functioned properly over that 6-month period. In some instances, missing data could be estimated from counts along other road segments. When this was not possible, the missing data were omitted from the analysis. Traffic volumes are reported in Table 3-4. Mercury Highway 200 Hill location had the highest daily passes at 647.0 vehicles per day. H Road had the least number of passes at 15.5 per day. Traffic volumes on roads varied a great deal between road segments but not as much seasonally on any individual road segment. There appears to be four natural clusters of road segments based on traffic volume. The most traffic was recorded on the two segments of the Mercury Highway (Frenchman Flats and 200 Hill), which averaged 601 passes per day. The second cluster is a single segment (Jackass Flats Road) with 136 passes per day, which was roughly one-quarter of the daily passes as Mercury Highway. The third cluster consisted of four road segments (Area 27 Road, Rock Valley, Cane Spring east, and 5-01 Road), which averaged 76 passes per day, which was roughly one-half the volume of Jackass Flats Road. The final cluster of three segments averaged 22 passes per day, which was roughly one-third the volume of the third cluster.

3.4 Coordination with Other Biologists and Wildlife Agencies

During February 17–19, 2012, an NSTec biologist attended the Desert Tortoise Council's 37th annual meeting and symposium. This meeting was held in Las Vegas, Nevada, and included numerous presentations on desert tortoise biology, ecology, and recovery efforts.

Several times during the spring of 2012, NSTec biologists were trained at the Desert Tortoise Conservation Center in various tortoise handling procedures, including how to attach and remove transmitters. On April 3, 2012, five NSTec scientists attended the FWS lecture on tortoise handling and biosecurity as part of the health assessment training. One NSTec scientist received the entire health assessment training.

During 2012, NSTec scientists assisted ICR personnel in setting up a research study to investigate the survival of translocated juvenile desert tortoises. Translocation sites were selected on the NNSS in Area 22. On September 19, 2012, 60 juvenile tortoises were released. Each tortoise had a VHF transmitter attached to its shell and was tracked daily for the first week following release and weekly thereafter by ICR personnel.

Table 3-4. Traffic counter data for the ten locations on NNSS roads within desert tortoise habitat. Values are the number of vehicle passes in the 2-week period.

Date	Jackass Flats Rd	Area 27 Road	Rock Valley	Lathrop Wells Road	H Road	Cane Spring Road west	Cane Spring Road east	Mercury Highway Frenchman Flats	Mercury Highway 200 Hill	5-01 Road
4/2/2012	0	0	0	0	0	0	0	0	0	0
4/16/2012	1370	733	333	301	213	334	910	7831	8817	986
4/30/2012	1209	737	472	294	300	327	1071	7473	8565	1061
5/14/2012	1414	718	950	450	164	508	1090	8069	9011	978
5/29/2012	2106	858	1228	235	198	432	1072	7904	8910	1152
6/11/2012	2239	1012	1201	275	253	344	1449	6111	8415	1119
6/25/2012	2169	916	1345	210	264	440	1863	9053	10646	1730
7/9/2012	1940	740	989	200	156	332	963	6659	7482	823
7/23/2012	2012	974	1038	512	221	509	987	8013	9050	1037
8/6/2012	2191	917	1013	541	165	543	1002	7056	8799	1743
8/20/2012	2697	1187	1265	379	NA	127	1141	5436	7063	1627
9/4/2012	1875	1128	1041	NA	NA	136	NA	12020	13438	1418
9/18/2012	1852	1030	884	NA	NA	NA	NA	8589	9494	905
10/2/2012	1851	1056	684	NA	NA	396	1100	7362	8709	1347
Total	24925	12006	12443	3397	1934	4428	12648	101576	118399	15926
Daily passes	**136.2**	**65.6**	**68.0**	**24.3**	**15.5**	**26.2**	**81.6**	**555.1**	**647.0**	**87.0**

4.0 ECOSYSTEM MONITORING

Ecological Services began comprehensive mapping of plant communities and wildlife habitat on the NNSS in 1996. Data were collected, describing selected biotic and abiotic habitat features within field mapping units called ELUs. ELUs are landforms (Peterson 1981) with similar vegetation, soil, slope, and hydrology. Boundaries of the ELUs were defined using aerial photographs, satellite imagery, and field confirmation. ELUs are considered by site biologists to be the most feasible mapping unit by which sensitive plant and animal habitats can be described. In 2000 and 2001, topical reports describing the classification of vegetation types on the NNSS were published and distributed (Ostler et al. 2000, Wills and Ostler 2001). Ten vegetation alliances and 20 associations were reported to occur on the NNSS.

Efforts are made to update and collect new habitat data when possible. Efforts during 2012 focused on the following tasks in support of ecosystem monitoring:

- **Wildland fire fuels surveys –** A vegetation survey was conducted in the spring to determine wildland fire hazards due to the accumulation of woody and fine fuels.
- **West Nile virus (WNV) surveillance** – Fifteen surveys at seven sites were conducted to detect WNV.
- **Reptile Sampling–** Trapping occurred at more than 20 sites to try to capture uncommon snakes and lizards and fill in data gaps in reptile distributions.
- **Natural wetlands monitoring** – Seventeen natural wetlands were monitored in 2012.
- **Constructed water source monitoring** – Twenty-three sites containing constructed water sources were monitored in 2012, and five water troughs were installed at various sites to help mitigate the loss of well ponds.
- **Offsite coordination –** NSTec biologists coordinated with ecosystem management agencies and scientists.

4.1 Vegetation Survey for Wildland Fire Hazard Assessment

Wildland fires on the NNSS require considerable financial resources for fire suppression and mitigation. For example, costs for fire suppression on or near the NNSS can cost as much as $198 per hectare (Hansen and Ostler 2004). Costs incurred from the Egg Point Fire in August 2002 (121 ha) were well over $1 million to replace 1 mile of burned power poles, and more than $200,000 for soil stabilization and revegetation of the burned area.

From 1978 until 2012, there has been an average of 11.7 wildland fires per year on the NNSS with an average of about 84.6 ha burned per fire (Table 4-1). Historically most wildland fires are caused by lightning and do not occur randomly across the NNSS, but occur more often in particular vegetation types (e.g., blackbrush [*Coleogyne ramosissima*] plant communities). These types have sufficient woody and fine-textured fuels that are conducive to ignition and spread of wildland fires. Once a site burns, it is much more likely to burn again because of the invasive annual plants that quickly colonize these areas (Brooks and Lusk 2008).

The year 2012 was considered normal for wildland fires, with 11 wildland fires on the NNSS. Seven fires were caused by lightning, burning a total of 206.0 ha; two fires were caused by ordnance for a total of 6.5 ha; one fire was caused by high winds, burning 4 ha; and one was caused by a vehicle, which burned about 0.4 ha (Table 4-2). Fire names were assigned by the first firefighter to arrive at a fire. Some fires are unnamed except for the name of the general area. Locations of fires on the NNSS in 2012 are shown in Figure 4-1. Not all fires had their perimeters mapped because they were inaccessible due to rugged terrain or lacked post-fire aerial photography to determine the GPS coordinates of the fire perimeter.

Beginning in 2004, and in response to DOE O 231.1B, surveys were initiated on the NNSS to identify wildland fire hazards. Vegetation surveys were conducted in April and May 2012 at sites located along and adjacent to major NNSS corridors to estimate the abundance of fuels produced by native and invasive plants. Information about climate and wildland fire-related information reported by other government agencies was also identified and summarized as part of the wildland fire hazards assessment. Survey findings and fuels assessment maps were compiled and reported to NNSS Fire and Rescue Department.

4.1.1 Survey Methods

The abundance of fine-textured (grasses and herbs) and coarse-textured (woody) fuels were visually estimated on numerical scales using an 11-point potential scale: 0 to 5 (in 0.5 increments, where 0.0 is barren and 5.0 is near maximum biomass encountered on the NNSS). Details of the methodology used to conduct the spring survey for assessing wildland fire hazards on the NNSS are described in a report by Hansen and Ostler (2004).

Photographs of sites typifying these different scale values are found in Appendix A of the *Ecological Monitoring and Compliance Program Calendar Year 2005 Report* (Bechtel Nevada 2006). Additionally, the numerical abundance rating for fine fuels at a site was added to the numerical abundance rating of woody fuels to derive a combined fuels rating for each site that ranged from 0 to 10 in one-half integer increments. The index ratings for fuels at these survey sites were then plotted on a GIS map and color-coded for abundance to indicate the wildland fire fuel hazards at various locations across the NNSS.

Table 4-1. Number and area of wildland fires on the NNSS, 1978–2012

Year	Fires	Hectares
1978	10	3,197
1979	6	1
1980	26	5,465
1981	13	3
1982	6	1
1983	16	7,402
1984	17	458
1985	11	651
1986	12	96
1987	14	86
1988	23	332
1989	15	131
1990	7	3
1991	4	2
1992	12	97
1993	7	3
1994	8	6
1995	8	1,864
1996	2	688
1997	6	6
1998	9	1,044
1999	7	20
2000	11	61
2001	8	198
2002	7	146
2003	4	2
2004	8	3
2005	31	5,261
2006	16	3,486
2007	15	6
2008	20	1
2009	17	95
2010	3	<0.4
2011	20	3,636
2012	11	216.9
35-Year Total	**410.0**	**34,666.9**
Average Per Year	**11.7**	**990.5**
Average Per Fire		**84.6**

Source: Hall (2013)

Table 4-2. Date, location, acreage, and cause of wildland fires on the NNSS in 2012

Incident No.	Date-Time	Location (Name of Fire)	Hectares Burned	Cause
12-134	01/28/12-1411 hrs	Stockade Wash Road (Area 12 Fire)	6.1	Ordnance
12-261	04/18/12-1515 hrs	Area 23 WSI "C" Range (12-261 Fire)	<0.4	Ordnance
12-300	05/29/12-0957 hrs	Area 29 40 Mile Canyon (12-300 Fire)	4.0	High Winds
12-301	05/31/12-1600 hrs	Area 25 (12-301 Fire)	<0.4	Driver mishap
12-351	07/12/12-1030 hrs	Area 20, 20-01 Road (Rain Fire)	<0.4	Lightning
12-353	07/12/12-1545 hrs	Area 19, 19-03 Road (Moses Fire)	<0.4	Lightning
12-381	07/23/12-0426 hrs	Area 18 18-05 Road (12-381 Fire)	<0.4	Lightning
921 Entry	08/17/12-unknown	Area 20 (921 Fire)	1.6	Lightning
12-460	08/30/12-1343 hrs	Area 15, Argillite Wash (Area 12 Fire)	202.3	Lightning
12-468	09/11/12-1210 hrs	Area 19 (Memorial Fire)	<0.4	Lightning
13-014	10/11/12-1605 hrs	Area 06, Control Point (Yucca Command Fire)	<0.4	Lightning
Source: Hall (2013)		**Total ha Burned**	216.9	

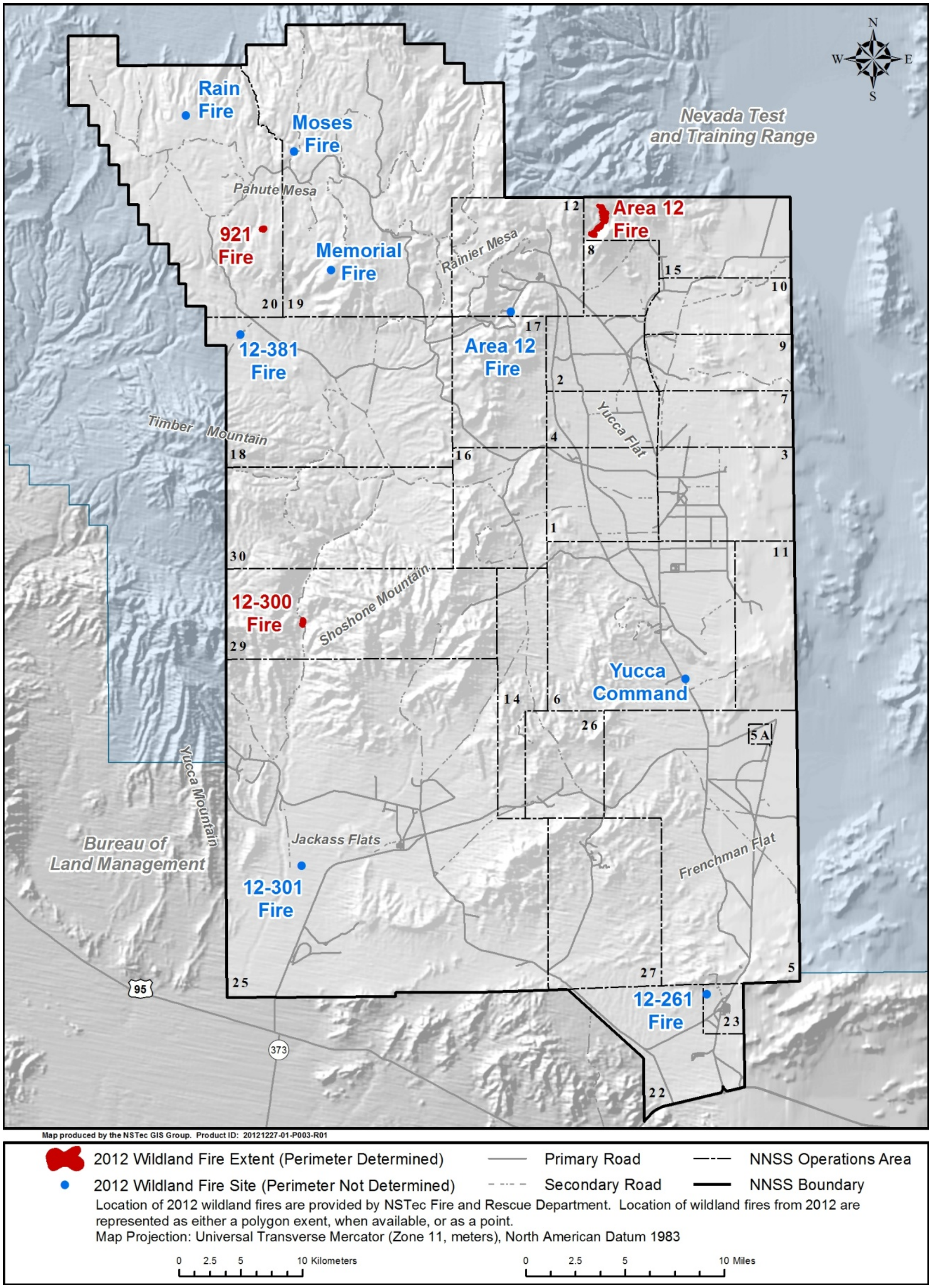

Figure 4-1. Location of wildland fires on the NNSS during 2012

4.1.2 Survey Results

4.1.2.1 Climate

There are 17 rain gauges on the NNSS (Hansen and Ostler 2004) that have been used historically to measure precipitation. Data from these weather station gauges extends back more than 30 years (National Oceanic and Atmospheric Administration [NOAA] 2011). In the fall of 2011, most of the rain gauges on the NNSS were upgraded from weighing gauges to tipping-bucket style gauges with data transmitted directly to NOAA via telecommunications, rather than manually retrieving and processing the data (Hansen 2012). In most cases, the new gauges were relocated nearby to facilitate data collection. The changes were made to reduce costs, improve data reliability, and improve access time to the data after precipitation events. As a result of these modifications, only 13 rain gauges remain from the original gauge stations. The Cane Spring, Tippipah Spring, Little Feller 2, and Rock Valley gauge stations were decommissioned. The Jackass Flats gauge was moved to Port Gaston in Area 26. The rain gauge at Mid Valley was not functional during the month of March, and the rain gauge at Port Gaston was not functional during the month of April. Precipitation data collected in 2012 reflect these changes and attempt to match, as closely as possible, data collected historically. Mean values were recalculated to account for months when gauges were not functional.

In order to determine whether the spring of the year was a relatively wet, normal, or a dry year, a simple measure of precipitation was needed. Precipitation during the months of January, February, March, and April was selected because of its simplicity and ease of calculation. While it is recognized that precipitation from other months is also important (and in some cases may be more important), as is the influence of temperature, winds, and relative humidity, these months represent the period of most plant growth observed along the survey route during the spring and before the beginning of the fire season in June. During many years, the mean precipitation during these 4 months appears to be correlated with production of vegetation that produces most fine and some woody fuels. The total accumulated precipitation during this period was observed to be correlated with fine fuels biomass production during this winter/spring period as reported by Hansen and Ostler (2004).

During 2012, the average precipitation from the remaining 13 rain gauges of the original 17 rain gauge stations on the NNSS during January–April was 4.01 centimeters (cm), or about 45.8% of the normal amount (i.e., the average precipitation for the last 30 years—8.86 cm). Temperatures were also cooler than normal during these months.

4.1.2.2 Fuels

Because of the below-normal precipitation that occurred during the spring of 2012, few annual or perennial plant seeds germinated. Even perennial herbaceous grasses and forbs had little, if any, production during the spring of 2012.

There was a decrease in the woody fuels index value in 2012 (2.43) compared to 2011 (2.58), as foliar canopy cover decreased slightly (Table 4-3). This was the lowest ranking since 2004 when index values were initiated. The fine fuels index also decreased in 2012 (1.75) compared to 2011 (2.56), ranking the second lowest since 2004 (Table 4-3).

Table 4-3. Woody fuels, fine fuels and combined fuels index values for 2004–2012

Year	Average Woody Fuels Index	Average Fine Fuels Index	Average Combined Fuels Index
2004	2.75	2.13	4.88
2005	2.80	2.83	5.64
2006	2.80	2.46	5.26
2007	2.62	1.52	4.13
2008	2.59	2.23	4.81
2009	2.63	1.95	4.52
2010	2.61	2.27	4.89
2011	2.58	2.56	5.14
2012	2.43	1.75	4.17

The combined index values (fine fuels plus woody fuels) for 2012 corresponds to the potential for fuels on the NNSS to support wildland fires once fuels are ignited. The higher the index, the greater the potential for wildland fires to spread. The NNSS average combined index value for fine fuels and woody fuels for 2012 was 4.17, the second lowest since 2004 (Table 4-3), suggesting below normal fuels for the NNSS. However, most fuels in the spring of 2012 appeared to be well cured and highly susceptible to ignition due to the low moisture content in the residual fuels and the low relative humidity of air from the below-normal precipitation on the NNSS.

The fine fuels documented during the spring of 2012 were predominantly remnants of plant growth formed during the spring of 2011. It was estimated that about 40% of the fine fuels produced during 2011 persisted into the spring of 2012. This percentage appears to be high compared to years with more precipitation (e.g., about 30% residual fuels). Precipitation aids in the decomposition and weathering of the fuels.

Figure 4-2 shows a comparison in trends of mean precipitation and mean combined fuel index values. The droughts of 2007 and 2012 significantly reduced fine fuels and to a lesser extent woody fuels. The locations and results of the fine fuels, woody fuels and combined fuels surveys at 106 stations on the NNSS inspected during 2012 are shown in Figures 4-3, 4-4, and 4-5, respectively. High combined index values occurred in Fortymile Canyon and Big Burn Valley.

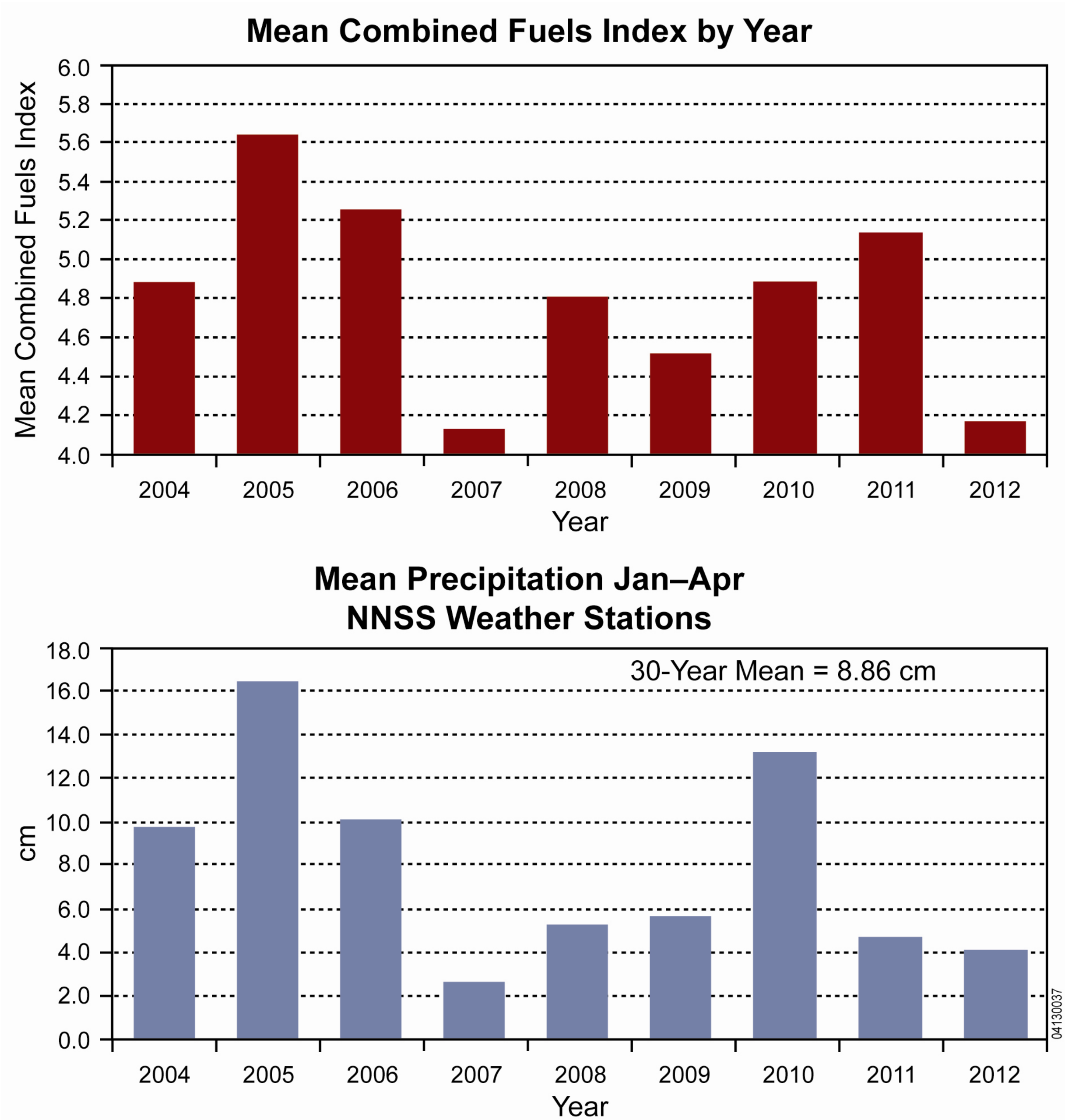

Figure 4-2. Mean combined fuels index (top) and total precipitation for January through April (bottom) for the years 2004 to 2012

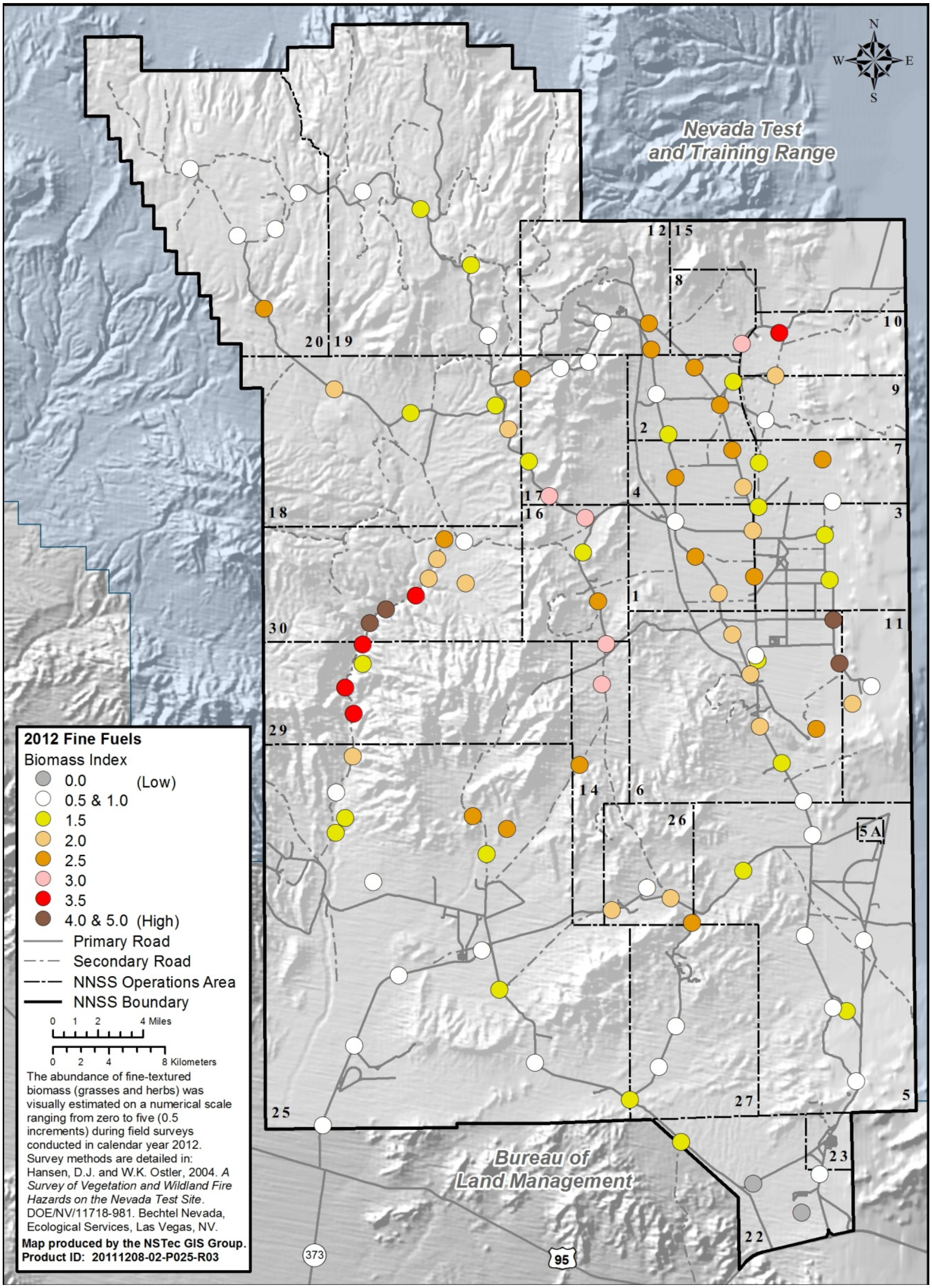

Figure 4-3. Index of fine fuels for 106 survey stations on the NNSS during 2012

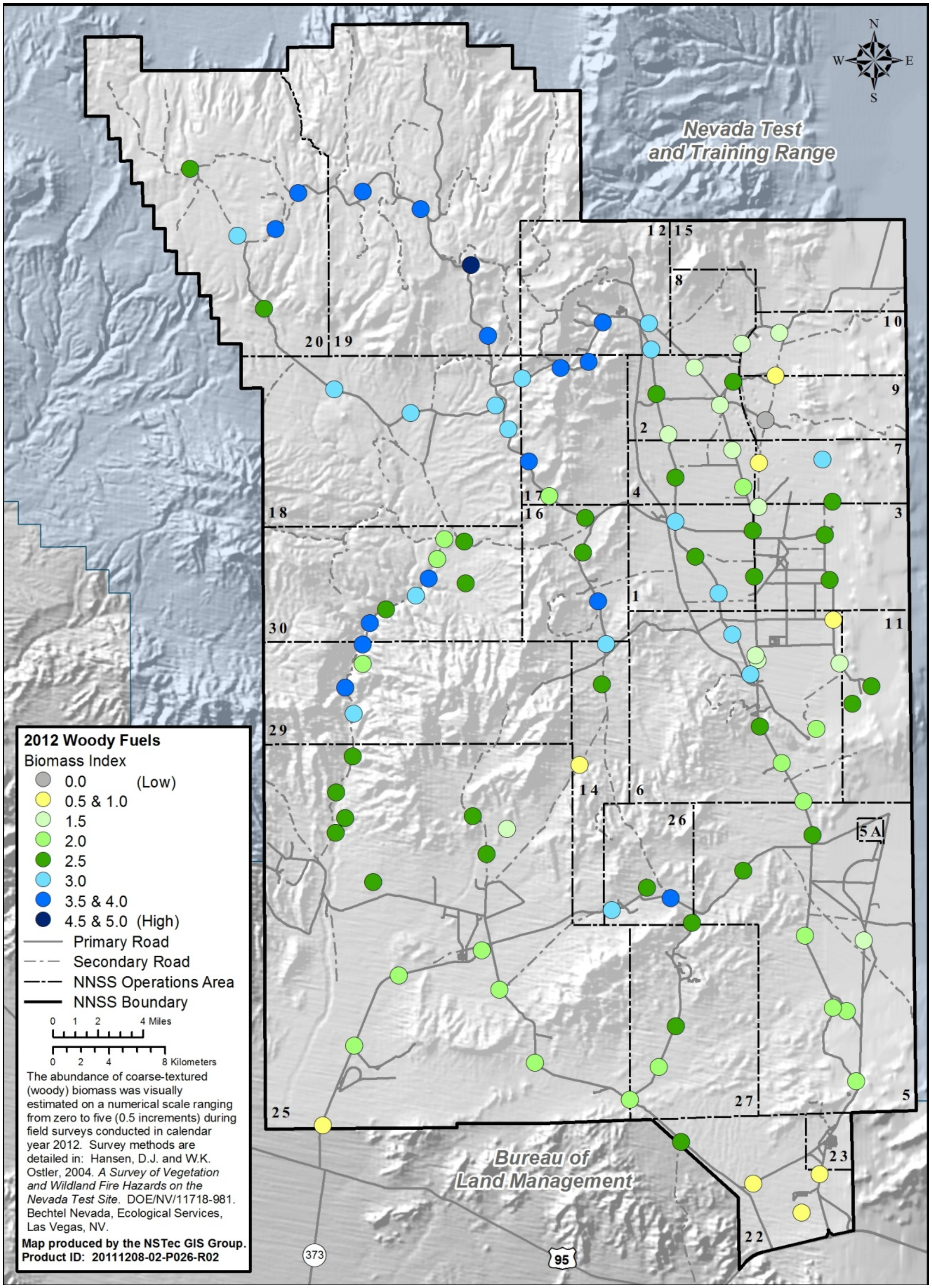

Figure 4-4. Index of woody fuels for 106 survey stations on the NNSS during 2012

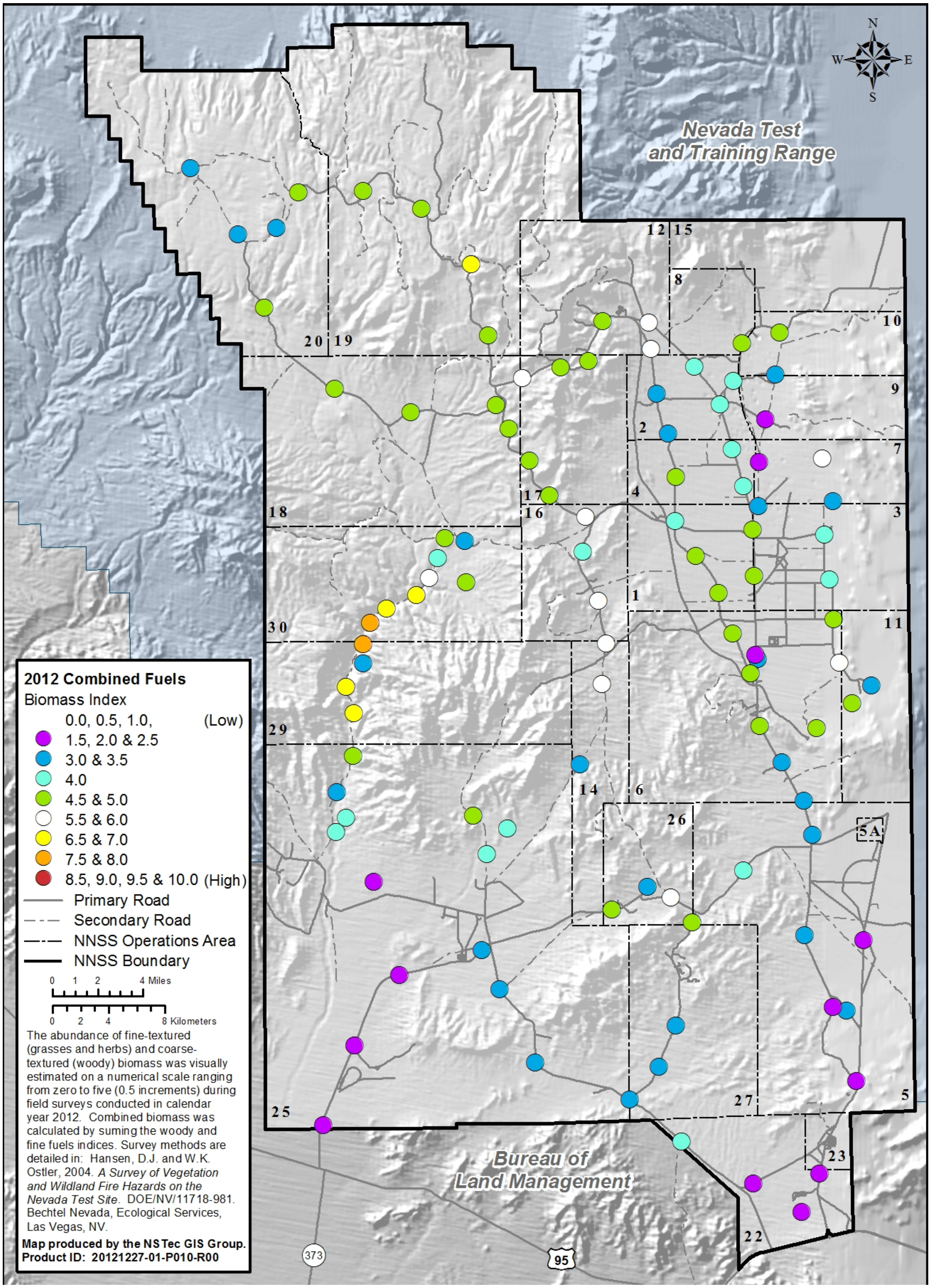

Figure 4-5. Index of combined fine fuels and woody fuels for 106 survey stations on the NNSS during 2012

Photographs were taken from permanent locations for all 106 sites during the past 8 years. Figure 4-6 shows photographs of Site 99 in Yucca Flat for the last 4 years. These photographs are valuable for many reasons, including providing a permanent record of previous site conditions, comparing site conditions among sites and years, and evaluating current year production with residual fuels from previous years.

As in past years, sites dominated by blackbrush and annual grasses appeared to respond to precipitation with greater variation in the amount of fine fuels and woody fuels than other vegetation community types (e.g., *Larrea tridentata* [creosote bush] or *Pinus monophylla*/*Juniperus osteosperma* [pinyon/juniper communities]), resulting in increases in fine fuels at these sites more than sites in the Mojave Desert (southern one-third of the NNSS) or the Great Basin Desert (northern one-third of the NNSS).

Fine fuels produced in 2012 were almost completely lacking in most areas of the NNSS due to drought conditions. Overall, the hazards of residual fuels contributing to wildland fires are lower than average, but the dry condition of both fine and woody fuels make them more susceptible to ignition by lightning or other sources. Once ignited, high ambient temperatures and high winds contribute to the spread of fire in areas where the abundance of fuels is sufficient to carry the flames of the fire. Rapid response by NNSS Fire and Rescue after fires are ignited is a key factor in minimizing wildland fire spread and severity.

4.1.2.3 Invasive Plants

The three most commonly observed invasive annual plants to colonize burned areas on the NNSS are *Schismus arabicus* (Arabian schismus), found at low elevations; *Bromus rubens* (red brome), found at low to moderate elevations; and *Bromus tectorum* (cheatgrass), found at middle to high elevations (Table 4-4). Most of the invasive annual plants failed to germinate during the spring of 2012. *B. tectorum* was present at only 17% of the sites. No living plants of *B. rubens* and *S. arabicus* were observed at any of the sampling sites. Precipitation history (Figure 4-2, shown previously) is also important in determining the percent presence of species across the NNSS. During periods of low precipitation, most annual species have low percent presence (i.e., the number of sites in which the plant was observed to be present and growing). Percent presence is generally greatest during periods of high precipitation, and appears to be a good indication of germination. Higher percent presence is also expected to occur when regional storms provide precipitation to a greater number of operational areas across the NNSS. However, the responses of some species, both invasive and native species, suggest that other variables, such as the timing of precipitation or temperatures required for germination, may also be contributing to plant response. For example, *Mentzelia albicaulis* (whitestem blazingstar) had only 8.1% presence in 2005 (the wettest year), but 51.9% presence in 2010, even though there was less precipitation during the same time period of that year, suggesting that temperature patterns may have been different in the 2 years.

Colonization by invasive species increases the likelihood of future wildland fires because they provide abundant fine fuels that are more closely spaced than native vegetation. *C. ramosissima* vegetation types appear to be the most vulnerable plant communities to fire, followed by *P. monophylla*/*J. osteosperma*/*Artemisia* species (spp.) vegetation types. Wildland fires are costly to control and to mitigate once they occur. Revegetation of severely burned areas can be very slow without reseeding or transplanting with native species and other rehabilitation efforts. Untreated areas become much more vulnerable to future fires once invasive species, rather than native species, colonize a burned area.

Figure 4-6. Site 99 on the west side of Yucca Flat in 2009–2012
(Photos by W. K. Ostler, April 30, 2009 [top left]; May 3, 2010 [top right]; April 26, 2011 [bottom left]; and April 10, 2012 [bottom right])

Table 4-4. Precipitation history and percent presence of key plant species contributing to fine fuels at 106 surveyed sites

Precipitation History	2004	2005	2006	2007	2008	2009	2010	2011	2012
Mean Precipitation (cm)* (January–April)	9.70	16.36	10.06	2.62	5.26	5.64	13.16	4.60	4.01
Invasive Introduced Species									
Bromus rubens (red brome)	51.7	64.4	67.8	0	63.0	63.2	58.5	62.3	0
Bromus tectorum (cheatgrass)	40.3	54.0	60.7	0	59.2	66.0	67.0	79.2	17.0
Erodium cicutarium (filaree or redstem stork's bill)	5.2	6.2	24.6	0	21.3	27.4	33.0	42.4	0.9
Schismus arabicus (Arabian schismus)	4.7	2.8	5.2	0	11.4	9.4	3.8	11.3	0
Native Species									
Amsinckia tessellata (bristly fiddleneck)	34.0	62.0	16.1	0	63.0	48.1	67.9	63.2	1.8
Mentzelia albicaulis (whitestem blazingstar)	49.8	8.1	0	0	2.4	18.9	51.9	16.0	3.7
Chaenactis fremontii (pincushion flower)	27.0	8.0	0	0	1.4	11.3	13.2	0.5	0

*30-year mean precipitation for the historical 17 rain gauges on the NNSS for the period of January–April 1981–2011 is 8.86 cm.

Germination of fine fuels produced by invasive, introduced annual species (especially *B. tectorum*) and other native annual species was second lowest since 2004. Only 2007 had lower germination and percent presence of annual and perennial herbaceous species. Germination during 2012 was lowest at lower elevations and greatest at higher elevations, reflecting the general trend of increasing precipitation with elevation. At higher elevations on the NNSS (e.g., Rainier and Pahute Mesas), much of the precipitation occurs as snow and is retained longer in the soil due to the lower temperatures. This lack of germination resulted from drought conditions experienced during 2012 (January through April).

4.2 West Nile Virus Surveillance

WNV is a potentially serious illness that spreads to humans and other animals through mosquito bites. It was first discovered in Uganda in 1937 and was not detected in North America until 1999. In southern Nevada, it was not detected until the spring of 2004. WNV surveillance on the NNSS continued in 2012 for the ninth consecutive year. WNV surveillance consists of setting mosquito traps baited with dry ice overnight at sites where standing water provides potential breeding sites for mosquitoes. As the dry ice sublimates, it produces carbon dioxide, which attracts mosquitoes. Seven sites were sampled during 15 surveys from May to September (Table 4-5). Mosquitoes collected during the surveys were taken to the Southern Nevada Health District (SNHD) for species identification and WNV testing. The six samples that contained mosquitoes were moldy, so they could not be identified or tested for WNV. Future samples will be dried before being placed into vials and taken to SNHD sooner, preferably within 2 weeks of collection. To date, WNV has not been detected conclusively on the NNSS, although two samples were suspect for WNV in 2005 and 2006 (Bechtel Nevada 2006, NSTec 2007). This suggests that the risk of NNSS workers being exposed to WNV on site is low.

Table 4-5. Results of West Nile virus surveillance on the NNSS in 2012

Location	Date	Number Captured	Species	WNV
Camp 17 Pond, Area 18	5/23/12	0	NA	NA
Well 5B Pond, Area 5	5/23/12	0	NA	NA
Mercury SOC Park, Area 23	5/23/12	0	NA	NA
Camp 17 Pond, Area 18	6/20/12	0	NA	NA
LANL Pond, Area 6	6/20/12	0	NA	NA
Mercury Sewage Lagoons, Area 23	6/20/12	0	NA	NA
Mercury SOC Park, Area 23	7/30/12	0	NA	NA
Well 5B Pond, Area 5	7/30/12	Unknown	Unknown	Not tested
Well 5C, Area 5	7/30/12	0	NA	NA
LANL Pond, Area 6	8/29/12	Unknown	Unknown	Not tested
Well C1 Pond, Area 6	8/29/12	Unknown	Unknown	Not tested
Well 5C, Area 5	8/29/12	Unknown	Unknown	Not tested
Well C1 Pond, Area 6	9/10/12	Unknown	Unknown	Not tested
Well 5C, Area 5	9/10/12	Unknown	Unknown	Not tested
Mercury SOC Park, Area 23	9/10/12	0	NA	NA

LANL: Los Alamos National Laboratory
SOC: Special Operations Center
WNV: West Nile virus

4.3 Habitat Monitoring: Additional Reptile Sampling

The field mapping effort for reptile distributions continued with additional trapping at 20 sites and recording opportunistic observations at the NNSS during 2012. The technique involved setting 15 unbaited funnel traps at a site and trapping for 2 to 4 weeks. Additionally, species observations were recorded during site visits and opportunistically during other field activities. Spring trapping occurred during May at six sites in Mercury Valley. The effort (550 trap nights) targeted several species of snakes and one lizard historically known from this region but rarely captured. Species included the blind snake (*Leptotyphlops humilis*), leaf-nosed snake (*Phyllorhynchus decurtatus*), lyre snake (*Trimorphodon biscutatus*) and the Yucca Night lizard (*Xantusia vigilis*). None of these four species were captured in 2012. The last known Yucca Night lizard was captured in Mercury in 1992. Fourteen additional sites were trapped during July and August in Areas 12, 17, 18, 19, and 20 (970 trap nights). Several roadside sites were trapped, specifically for skinks, as well as areas away from roads (rocky areas and washes) where data gaps in reptile distribution were known.

Results identified 16 species at 27 new locations. Overall, 102 captures of nine species, and observations of 7 additional species were made in 2012. Notable captures included a Great Basin skink (*Plestiodon skiltonianus*) in Area 19 and a western red-tailed skink (*Plestiodon gilberti rubricaudatus*) in Area 18. Both skinks were caught along paved roads in thick roadside patches of *Ericameria nauseosa* (Rubber rabbitbrush), which suggests this habitat type may be important for these species.

Other species captured included the common side-blotched lizard (*Uta stansburiana*), the western banded gecko (*Coleonyx variegatus*), western whiptail (*Cnemidophorus tigris*), yellow backed spiny lizard (*Sceloporus magister*), Great Basin fence lizard (*S. occidentalis*), striped whipsnake (*Masticophis taeniatus*), and red racer (*Masticophis flagellum*). Observations were also made of the leopard lizard (*Gambelia wislizenii*), horned lizard (*Phrynosoma platyrhinos*), gopher snake (*Pituophis catenifer*), sidewinder rattlesnake (*Crotalus cerastes*), and speckled rattlesnake (*Crotalus mitchellii*). Both rattlesnake species were observed in Mercury. The rarely observed ring-necked snake (*Diadophis punctatus*) was opportunistically observed in Area 19 at a mountain lion (*Puma concolor*) trapping site. All data were entered into the reptile database, now containing over 6,000 records.

4.4 Natural Water Source Monitoring

4.4.1 Existing Water Sources

Water sources were monitored this year to characterize physical and biological parameters. Eleven water sources were visited at least once during 2012 to record wildlife use, the presence/absence of land disturbance, water flow rates when applicable, and surface area of standing water (Table 4-6).

Flow was estimated by collecting a known volume of water from a permanently installed pipe over a known time period. This method yields an approximate measurement and is generally an underestimate of true flow. At some sites, water collects, but there is no way to estimate flow, which was the situation at Gold Meadows Spring, Pahute Mesa Pond, and Yucca Playa Pond. Flow occurs as seepage through the local sediments or by overland flow into the pond collection area. Because monitoring of wetlands is qualitative, the objectives are to identify large or obvious changes over time. Smaller, subtle changes in flow are not readily detectable from this method. Sizes of the monitored water sources varied greatly from very small areas (<1 square meter [m^2]) to moderately sized springs (180–600 m^2) to large temporary playa pools (28,000 m^2). Surface flow rates were typically low (<5 liters per minute) at most water sources where flow was measurable. Disturbance from horses was noted at three sites and some forms of natural change (dense spread of wetlands plants) occurred at another site (Table 4-6). Locations of natural water sources on the NNSS are shown in Figure 4-7.

Wildlife use data recorded during site visits are summarized in Table 4-7. Mule deer (*Odocoileus hemionus*), antelope (*Antilocapra americana*), and horses (*Equus caballus*) benefit significantly from the water sources. Overall in 2012, few birds including Chukar (*Alectoris chukar*) and mourning doves (*Zenaida macroura*) were observed throughout the NNSS (Table 4-7), indicative of a dry year. An extensive trapping effort for another project yielded only two individual dove captures. Observations of two short-eared owls (*Asio flammeus*) at Whiterock Spring were also documented during trapping.

The use of motion-activated cameras can be a useful tool for more detailed information than site visits alone (see Section 6.4.1, Motion-Activated Cameras). For example, two Steller's Jays (*Cyanocitta stelleri*) were observed with a camera at Topopah Spring on September 13, 2012. This was the first record of this species since 1962. Previously, Hayward et al. (1963) had listed only eight historical sight records on the NNSS for August 22–23 and October 25. They stated that the Steller's Jay appears to be uncommon in the Pinion Juniper and Oakbrush communities. It has also been reported more recently from southern Nevada in Ponderosa and Bristlecone pine forests (Greene et al. 1998). The lack of sightings over the last 20 years at NNSS, however, suggests it may not be very abundant here and likely may be an irregular migrant.

Monitoring for the presence of the Southeastern Pyrg snail (*Pyrgulopis turbatrix*) at Cane Spring continued in 2012. It was found in the outflow about 10 meters (m) from the cave pool near cattails. The species was present on September 26, 2012, and will be monitored to see if it spreads downstream to the watering trough located about 50 m away. It is considered a sensitive species in Nevada (Table 2-1) and occurs at only eight springs in southern Nevada.

Table 4-6. Hydrology and disturbance data recorded at natural water sources on the NNSS during 2012

Spring	Date	Surface Area of water (m^2)	Flow rate (L/min)	Impacts at Spring
Cane Spring	9/26/2012	30	NM	Heavy growth of cattails, Installed a watering trough
Captain Jack Spring	8/19/2012	20	NM	None
Captain Jack Spring	11/16/2012	25	NM	None
Gold Meadows Spring	9/9/2012	300	NA	Horse grazing and trampling of vegetation
Little Wildhorse Seep	12/6/2012	1	NA	Horse trampling and horse trails
Pahute Pond	6/14/2012	0	NA	None
Tippipah Spring	8/25/2012	140	NM	None
Topopah Spring	9/18/12	5	NM	Installed a watering trough
Twin Spring	11/13/2012	0.1	NA	None
Whiterock Spring	8/17/2012	5	NM	None
Whiterock Spring	9/15/2012	8	1.5	None
Wildhorse Seep	12/6/2012	5	NA	Horse trampling and horse trails
Yucca Playa Pond	12/8/2012	28,000	NA	None
NA = not applicable due to diffuse flow				
NM = flow present but not measured				

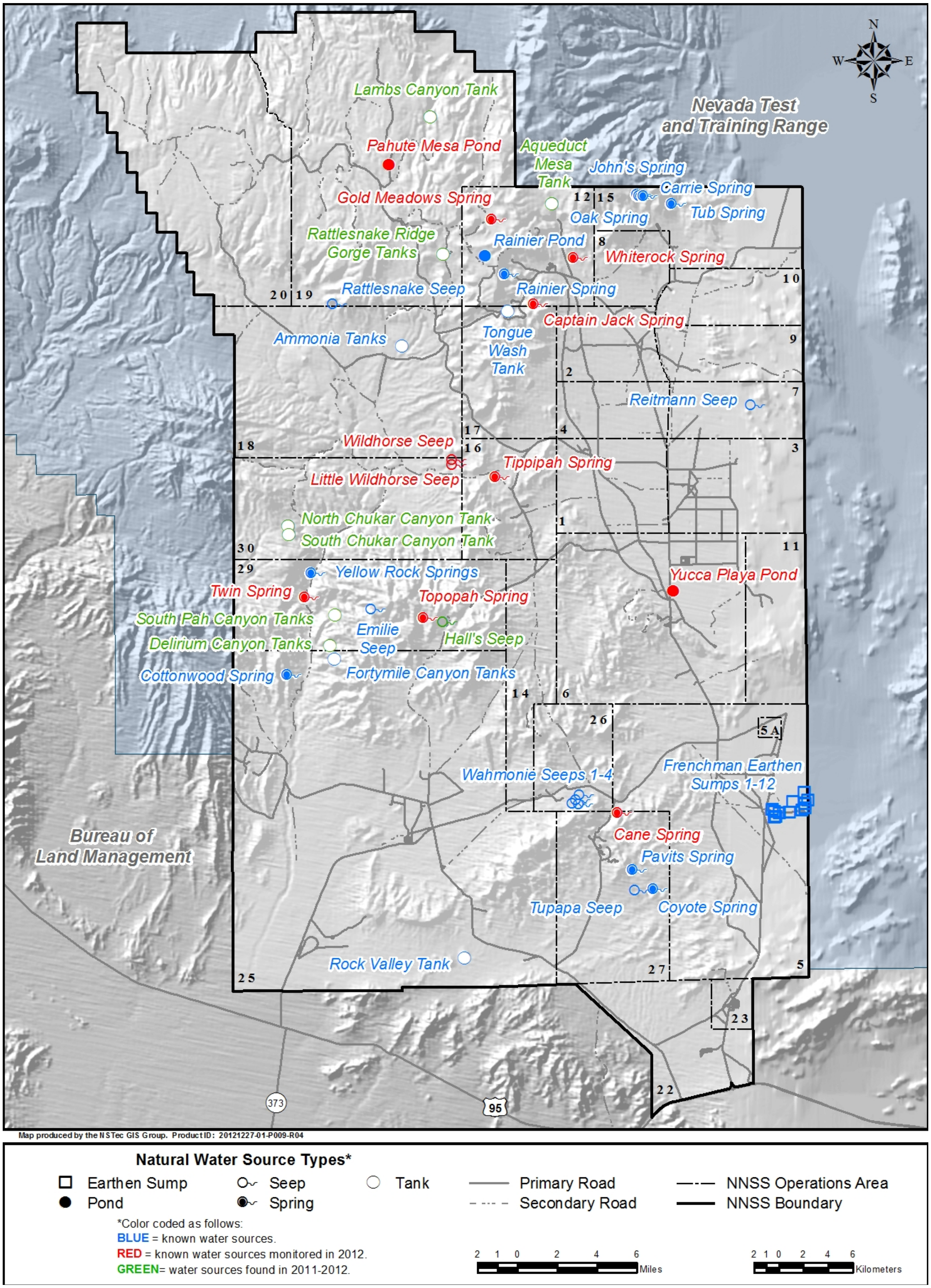

Figure 4-7. Natural water sources on the NNSS, including those monitored in 2012

Table 4-7. Number of wildlife species observed or inferred (P = Present) at NNSS natural water sources in 2012

Wildlife Species Observed	Cane Spring	Captain Jack Spring	Gold Meadows Spring	Little Wildhorse Seep	Pahute Pond	Tippipah Spring	Topopah Spring	Twin Spring	Whiterock Spring	Whiterock Spring	Wildhorse Seep	Yucca Playa Pond
Date Observed (month/day)	**9/26**	**11/19**	**8/15**	**12/06**	**9/29**	**7/21**	**9/13**	**11/17**	**9/15**	**12/15**	**12/6**	**12/8**
Mammals												
Coyote (*Canis latrans*)	P	P	P	P	P	P	P	P	P	P	P	P
Feral horse (*Equus caballus*)			5	P							P	
Mule deer (*Odocoileus hemionus*)	P	P	P	P	P	P	P	P	P	P	P	P
Birds												
Chukar (*Alectoris chukar*)	P			P		5			6		P	
House finch (*Carpodacus mexicanus)*						4						
Horned Larks (*Eremophila alpestris)*												40
Long-eared Owl *(Asio otus*)	1											
Mourning dove *(Zenaida macroura)*	2	3				2			1			
Northern Harrier (*Circus cyaneus*)	2											
Scrub jay (*Aphelocoma coerulescens*)		2										
Short-eared Owl (*Asio flammeus*)									2	2		
Number of bird species detected:	**4**	**2**	**0**	**1**	**0**	**3**	**0**	**0**	**3**	**1**	**1**	**1**

4.4.2 New Water Sources

Eight new water sources were discovered during 2011–12 on the NNSS during mountain lion monitoring (Table 4-8, Figure 4-7). Seven of these are rock tanks and one is a seep. Tanks collect water from overland flow after precipitation events (e.g., runoff from rain or melting snow). Depending on the depth and size of the tank, rock type, surrounding topography, and timing of precipitation, these tanks may hold water for a few weeks to several months. These are important, albeit ephemeral, sources of water for several species of wildlife (see Section 6.4.1, Motion-Activated Cameras, Table 6-4). Hall's Seep (Figure 4-8) was found in August while searching for mountain lion kills. It was revisited in November and still had water, suggesting this is a permanent water source. Previous human use was evident with the presence of some old metal pipes used to direct flow down slope and other artifacts.

Figure 4-8. Hall's Seep, a newly discovered small seep in Area 29, Topopah Valley
(Photo by D. B. Hall, August 1, 2012)

Table 4-8. New water sources detected during mountain lion monitoring in 2011–12 on the NNSS

Name	Date Found	Surface Area (m^2)	Elevation (m)	Major Vegetation Alliance
Rattlesnake Ridge Gorge Tanks	1/7/2011	10	1982	Pinion Juniper
South Pah Canyon Tanks	3/1/2011	25	1341	Nevada Jointfir
Delirium Canyon Tanks	4/25/2011	30	1296	Nevada Jointfir
North Chukar Canyon Tank	10/19/2011	2	1600	Sagebrush
Aqueduct Mesa Tank	6/12/2012	1	1884	Pinion Juniper
Lambs Canyon Tank	6/13/2012	18	1884	Pinion Juniper
South Chukar Canyon Tank	11/27/2012	2	1612	Sagebrush
Hall's Seep	8/1/2012	0.5	1811	Blackbrush

4.5 Constructed Water Source Monitoring

4.5.1 Plastic Sump Monitoring

Site biologists conducted quarterly monitoring of selected constructed water sources. These sources, located throughout the NNSS (Figure 4-9), include plastic-lined sumps at 23 sites. Several ponds or sumps may be located next to each other at the same project site. Many animals rely on these human-made structures as sources of water. However, wildlife and migratory birds have drowned under certain conditions in steep-sided plastic-lined sumps from entrapment. Therefore, ponds are monitored to assess their use and impacts to wildlife. Over time, mitigation measures, such as the emplacement of sediment ramps, have been recommended to prevent entrapment or significant harm to wildlife.

During March, July, October, and December 2012, biologists visited 44 constructed water sources (Table 4-9). At each site, the presence or absence of standing water and the presence of animals or their sign around the water source were recorded. Sediment ramps or plastic ladders, which allow animals to escape if they fall in, have been installed at many plastic-lined sumps. The presence, absence, and condition of these structures were also noted. All dead animals in or adjacent to a human-made water source were recorded (Table 4-9). Monitoring frequency was low in 2012 because many of the older sumps appear to have very low risk of entrapping animals. Older liners become less slippery over time due to weathering, thus allowing animals to escape. During 2012, no dead animals were detected in sumps on the NNSS. Most sumps were dry from spring to midsummer. Substantial rainfall events occurred in July, August, and September, and water accumulated in many sumps during this time period. Most sumps accumulated additional water from the first snows in mid- to late December. Wildlife use documented during site visits was limited to common species of passerine birds, ducks, and shorebirds.

Sediment ramps are still missing in many sumps on the NNSS. Where they have been installed, they have been very effective in allowing animals to exit sumps under conditions of deep water. Sediment ramps that are used by wildlife (typically coyotes and deer) have fresh tracks. In the future, sediment ramps should be emplaced in new sumps when they are constructed, especially if water is deep.

4.5.2 Mitigating Water Loss for Wildlife

Water conservation measures were implemented on the NNSS during 2012 at four sites: Area 6 Construction Yard (Area 6, LANL Pond), Well C1 Pond, Well 5B Pond, and J11 Pond. In order to conserve millions of gallons of water being lost to drainage and evaporation, pumping water to fill these ponds was stopped. Wildlife observation data gathered over several decades documented more than 100 species of wildlife using these artificial water sources. These included carnivores, ungulates, rabbits, bats, and dozens of species of waterfowl, passerines, and other birds.

Drying these ponds up would result in the loss of valuable wildlife habitat, so a decision was made to install water troughs to help mitigate the loss of the well ponds. The water troughs were not meant to replace the well ponds as wildlife habitat, but were meant to provide at a minimum some supplemental water in areas with very limited perennial water sources and at sites where animals had become accustomed to finding water. Water troughs were installed adjacent to the Area 6 Construction Yard and Well C1 Pond to mitigate the loss of these ponds, at Well 5A (Well 5C) to mitigate the loss of the Well 5B Pond, and at Cane Spring and Topopah Spring to mitigate the loss of the J11 Pond (Figure 4-9).

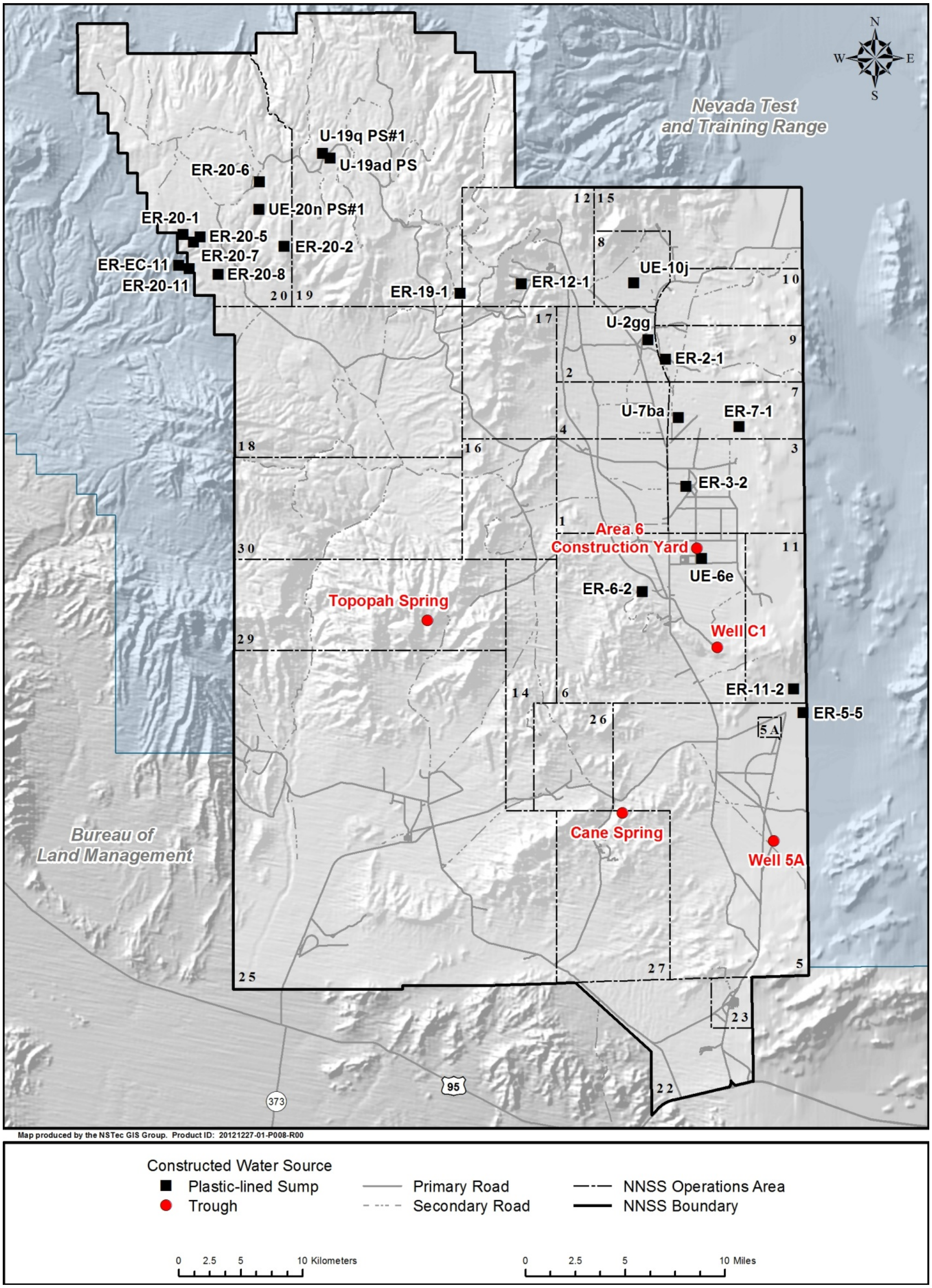

Figure 4-9. Constructed water sources monitored for wildlife use and mortality and locations of newly installed water troughs on the NNSS during 2012

Table 4-9. Results of monitoring plastic-lined sumps for wildlife mortality on the NNSS for 2012

Months	Number of Ponds Monitored	Number of Ponds with Water	Surface Area (m^2)	Number of Sediment Ramps	Number of Dead Animals Detected
Jan–Mar	3	0	0	2	0
Apr–Jun	5	0	0	2	0
Jul–Sep	13	7	550	6	0
Oct–Dec	23	10	3500	13	0

Motion-activated cameras were set up at each trough in September and November to document wildlife use and were also added to the network of cameras used for monitoring mountain lions. Wildlife use documented by cameras already set up at Cane Spring and Topopah Spring will be used to compare use at the spring to use at the water troughs. Detailed results of wildlife use at the troughs are found in Section 6.4.1, Table 6-4. The trough at Well 5C is being used regularly by wild burros (*Equus asinus*) (Figure 4-10) and pronghorn antelope (Figure 4-11). The trough near Topopah Spring has been used by mule deer (Figure 4-12) and a red-tailed hawk (*Buteo jamaicensis*) (Figure 4-13). There was still water present in all the sumps at the end of 2012. As these sumps completely dry up in the future, it is anticipated that more wildlife use will be recorded at the troughs.

4.6 Coordination with Scientists and Ecosystem Management Agencies

Site biologists interfaced with other scientists and ecosystem management agencies in 2012 for the following activities:

- Participated in a meeting of the Mojave Desert Initiative designed to address research needs in the areas of wildfires and reclamation of Mojave Desert lands.
- Assisted field crews from the Rocky Mountain Research Station (Ogden, Utah) in conducting forest inventory and analysis for the U.S. Forest Service.

Figure 4-10. Wild burro at water trough near Well 5C, Area 5
(Photo taken September 12, 2012, by motion-activated camera)

Figure 4-11. Pronghorn antelope drinking from water trough at Well 5C, Area 5
(Photo taken September 25, 2012, by motion-activated camera)

Figure 4-12. Mule deer drinking from water trough near Topopah Spring
(Photo taken November 24, 2012, by motion-activated camera)

Figure 4-13. Red-tailed hawk perched on water trough near Topopah Spring
(Photo taken November 21, 2012, by motion-activated camera)

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5.0 SENSITIVE PLANT MONITORING

The list of sensitive plants on the NNSS is reviewed annually to ensure that the appropriate species are included in the NNSS Sensitive Plant Monitoring Program. The review takes into consideration information gathered on sensitive plants during the current year by NSTec botanists as well as input from regional botanists with expertise or knowledge with particular species. As part of the Adaptive Management Plan for Sensitive Plant Species (Bechtel Nevada 2001), the status of each plant is monitored periodically to ensure NNSS activities are not impacting the species. Field surveys are also routinely conducted to verify previously reported locations, to better define population boundaries, and to identify potential habitat for sensitive plant species known to occur on or adjacent to the NNSS. Information gathered during the year on sensitive plants is disseminated to state and federal agencies and other interested entities.

5.1 List of Sensitive Plant Species on the NNSS

The sensitive plants included in the NNSS Sensitive Plant Monitoring Program are included on the list of At-Risk species published by the NNHP and the status list prepared by the Nevada Native Plant Society (NNPS). Currently there are 17 vascular plants and 1 non-vascular plant considered sensitive and warrant inclusion in the NNSS Sensitive Plant Monitoring Program. There was a pending taxonomic issue with one species on the list that was resolved. A major accomplishment this year was a re-evaluation of the ranking of sensitive plants on the NNSS. The status of each sensitive plant was evaluated based on its overall distribution, abundance, and rarity.

Taxonomy – In 2011 (Hansen et al. 2012), the occurrence of *Galium hilendiae* subspecies (ssp.) *kingstonense* (Kingston Mountains bedstraw) on the NNSS was undetermined. In 2011, plant specimens were collected at a reported site of *G. hilendiae* ssp. *kingstonense* in the Kingston Mountains. The specimens appeared to be different from the *Galium* found on the NNSS, which also had been reported as *G. hilendiae* ssp. *kingstonense*. In an attempt to verify the taxonomy of the species of *Galium* found on the NNSS, specimens collected from the NNSS and from the Kingston Mountains were sent to the Rancho Santa Ana Botanic Garden, in Claremont, California, for positive identification.

Botanists at the Rancho Santa Ana Botanic Garden confirmed that the specimens collected on the NNSS were indeed the ssp. *kingstonense,* whereas the one collected in the Kingston Mountains was *G. matthewsii*. The personal communication from Duncan S. Bell, Field Botanist at the Rancho Santa Ana Botanic Garden in Claremont, California, reads as follows:

> Your *Galium* collections from the Kingston mountains were *Galium matthewsii* and your *Galium* collection from Nevada do appear to be *Galium hilendiae* ssp. *kingstonense*. This is a great find and a range extension as this plant was endemic to the Kingston range. . . . I'm sure other botanists will be stopping by our herbarium soon to see them as I believe these are the first collections to come out of Nevada. As far as I know these are the first physical records from Nevada and a new addition to the flora of Nevada. I wouldn't be surprised if they are also found in some of the other ranges in the area that haven't been explored.

Based on these findings the Galium found on the NNSS has been confirmed to be that of the rare subspecies *G. hilendiae* ssp. *kingstonense*. This plant was previously only known from the type locality in the Kingston Mountains, but now is known to occur on the NNSS (see Section 5.4.2 for additional information).

Plant Ranking – Over the years there have been various classifications or rankings of the sensitive plants found on the NNSS. The first lists developed close to 40 years ago classified plants as threatened, endangered, or "watched." With the ESA came official classification/designation as listed endangered, listed threatened, proposed endangered, proposed threatened, or a candidate for listing as either threatened or endangered. Internal ranking of sensitive plants on the NNSS typically followed the aforementioned designations. Currently, no sensitive plants known to occur on the NNSS have been listed under the ESA.

When the Adaptive Management Plan for Sensitive Plant Species (Bechtel Nevada 2001) was prepared, sensitive plants on the NNSS plants were categorized as active, inactive, or evaluate. Later in 2008, sensitive plants on the NNSS were grouped into two categories: those monitored every 5 years and those monitored every 10 years (Hansen et al. 2009). The NNPS's classification was adopted in 2010 in which plants were either listed as threatened or on a watch list.

Over the last decade, monitoring under the Adaptive Management Plan's guidelines has focused on delineating the extent of the distribution of sensitive plants on the NNSS and verifying previously reported locations. Currently, sufficient information has been gathered to facilitate a site-specific ranking for the sensitive plants that occur on the NNSS. Such a ranking was completed in 2012. The ranking followed a ranking system used by the Utah Native Plant Society (Fertig 2009), which was modified to be more representative of the sensitive plants found on the NNSS. The ranking is based on several criteria, including the number of populations throughout its range, within Nevada, and on the NNSS; global and local abundance; habitat specificity; intrinsic rarity; threats; and population trends (Table 5-1). The criteria used are based on the biology and ecology of the species rather than from a management or administrative perspective.

A numerical value was assigned to each ranking criteria. The values were summed for each sensitive plant and assigned to one of four rankings or priorities. Sensitive plant species with a total numerical rating of 11 or greater were assigned as a High priority species; those scoring between 8 and 10 were assigned to a Moderate ranking; those with a rating of 4 to 7 were assigned as Watch; and those with a rating of less than 4 were considered a Marginal species (Table 5-2).

Six of the 18 sensitive plants that occur on the NNSS are ranked in the High priority category. These six species are known from just a few populations and in several cases are only known from the NNSS or within the immediate vicinity of the NNSS. *Ivesia arizonica* variety (var.) *saxosa* (Rock purpusia), ranked the highest of the ten species, is known from two sites on the NNSS and from the North and South Pahroc mountains in Lincoln County, Nevada, the type locality. There are fewer than 6,000 individuals on the NNSS, and the Pahroc Mountains population, although not thoroughly surveyed, appears to be about twice the size of the NNSS population. The other five High priority species are known from less than three locations on the NNSS and an equally small number of locations off the NNSS.

Seven species are ranked Moderate. The two highest rated species within this group are *Eriogonum concinnum* (Darin buckwheat) and *Camissonia megalantha* (Cane Spring suncup), both originally named from collections on the NNSS and less common than the other species in this group. Other species in this group include *Arctomecon merriamii* (White bearpoppy) and two annual plants, *Phacelia filiae* (Clarke phacelia) and *P. beatleyae* (Beatley scorpionflower). These species are locally abundant when growing conditions are favorable, and almost completely absent in dry years. Populations of *A. merriamii* have been impacted by development in and around the Las Vegas metropolitan area. Populations on the NNSS are generally in isolated areas and unaffected by NNSS operational activities, but some populations in Mercury have been impacted.

Table 5-1. Criteria used in ranking sensitive plants known to occur on the NNSS

Criteria	Description	Numerical Rating
Nevada's Relationship to Global Range	Locally Endemic range <16,500 km^2	2
	Regionally Endemic, range 16,500–250,000 km^2 ; Disjunct, Peripheral, or Patchy	1
	widespread, >5% of state	0
Populations in Nevada	<10	2
	10–25	1
	>25	0
Populations on NNSS	2/3 of populations on NNSS	2
	1/3 to 2/3 of populations on NNSS	1
	<1/3 of populations on NNSS	0
Abundance-Nevada	low <30,000 individuals or 3,000 acres	1
	>30,000 individuals or 3,000 acres	0
Abundance-NNSS	Low <1,000 individuals	2
	Moderate 1,000–5,000 individuals	1
	Higher >5,000 individuals	0
Habitat Specificity	Few specialized geologic substrates, soil types, or vegetation types	2
	Some, not many, geologic substrates, soil types, vegetation types	1
	Numerous substrates	0
Intrinsic Rarity	High (dependence, poor dispersal, survival)	2
	Moderate dependence	1
	Low	0
Threats-Nevada	High-significant, far reaching	1
	Low-minor, small percentage	0
Threats-NNSS	High-significant, far reaching	1
	Low-minor, small percentage	0
Population Trends	Decreasing	1
	Increasing/stable	0

The Watch list includes four plant species that are common on the NNSS as well as at other locations in southern Nevada. *Astragalus oophorus* var. *clokeyanus* (Clokey eggvetch) was originally considered quite rare with a few scattered occurrences reported in the Spring Mountains to the south of the NNSS and in the Belted Range north of the NNSS. Currently, over 1,500 plants have been located at nine different locations on the NNSS. There is the possibility of encountering even more populations because much of the potential habitat for this species is in remote areas and has not been surveyed. *Hulsea vestita* ssp. *inyoensis* (Inyo hulsea) and *Penstemon pahutensis* (Pahute Mesa beardtongue) do not occur in large numbers on the NNSS but are found over most of the northern mesas of the NNSS. Both species are known to occur in nearby mountain ranges as well. In recent years, the abundance of *Eriogonum heermannii* var. *clokeyi* (Clokey buckwheat) has been well documented on the NNSS. Over

5,000 individuals have been located along Mercury Ridge in the Spotted Range, which is the only known location of the species on the NNSS. Major populations of this species are found in the Spring Mountains and Sheep Mountains to the south and east of the NNSS.

Phacelia mustelina (Weasel phacelia) was the single species ranked as Marginal. In recent years, this species has been found at numerous locations on the NNSS. It does not occur in large numbers but does occur over most of the NNSS as well as at many locations off the NNSS.

Table 5-2. Ranking of sensitive plants known to occur on the NNSS

Rank	Species	Populations	Abundance	Habitat	Rarity	Threats	Trends	Total
High	*Ivesia arizonica* var. *saxosa*	6.0	3.0	2.0	2.0	0.0	0.0	13.0
	Galium hilendiae ssp. *kingstonense*	6.0	3.0	1.0	2.0	0.0	0.0	12.0
	Entosthodon planoconvexus	6.0	3.0	1.0	2.0	0.0	0.0	12.0
	Astragalus beatleyae	5.0	2.0	2.0	2.0	0.0	0.0	11.0
	Astragalus funereus	4.0	3.0	2.0	2.0	0.0	0.0	11.0
	Penstemon fruticiformis ssp. *amargosae*	5.0	3.0	1.0	2.0	0.0	0.0	11.0
Moderate	*Camissonia megalantha*	5.0	3.0	1.0	1.0	0.0	0.0	10.0
	Eriogonum concinnum	5.0	3.0	1.0	1.0	0.0	0.0	10.0
	Frasera pahutensis	4.0	3.0	1.0	1.0	0.0	0.0	9.0
	Arctomecon merriamii	3.0	1.5	2.0	1.5	1.0	0.0	9.0
	Cymopterus ripleyi var. *saniculoides*	3.5	3.0	1.0	1.0	0.0	0.0	8.5
	Phacelia beatleyae	5.0	1.0	1.0	1.0	0.0	0.0	8.0
	Phacelia filiae	4.0	2.0	1.0	1.0	0.0	0.0	8.0
Watch	*Astragalus oophorus* var. *clokeyanus*	2.0	2.0	1.0	1.0	0.0	0.0	6.0
	Hulsea vestita ssp. *inyoensis*	1.0	3.0	1.0	1.0	0.0	0.0	6.0
	Eriogonum heermannii var. *clokeyi*	3.0	2.0	0.0	0.0	0.0	0.0	5.0
	Penstemon pahutensis	3.5	1.0	0.0	0.0	0.0	0.0	4.5
Marginal	*Phacelia mustelina*	1.0	1.0	0.0	0.0	0.0	0.0	2.0

Monitoring and field surveys in future years will consider these new rankings when scheduling and conducting sensitive plant monitoring activities. The database set up for recording locations of all sensitive plants on the NNSS will continue to be updated with all sensitive plant species on the NNSS (see Table 2-1). Rankings may be re-applied over time not only to those currently being included in the NNSS Sensitive Plant Monitoring Program but other plant species that may warrant closer attention.

5.2 Program Awareness

The annual Rare Plant Workshop, sponsored by NNHP and the NNPS, was held October 1–2, 2012, at the Springs Preserve in Las Vegas, Nevada. There were no actions or recommendations from the participants of the workshop that affected the sensitive plants that are listed for the NNSS.

As part of the state-wide effort to disseminate information throughout the botanical community, NSTec prepared site-specific data for all 18 sensitive plants and provided it to the NNHP for incorporation into their databases. The data included approximately 20,500 locations of sensitive plants on the NNSS or within the immediate vicinity of the NNSS. For some species, such as *Camissonia megalantha* (Cane Spring suncup) and *Astragalus funereus* (Black woollypod), as little as 10 locations were provided, whereas data for other species included thousands of locations.

5.3 Monitoring

Monitoring sensitive plant populations on the NNSS was scheduled for *C. megalantha* and for *A. funereus* and *E. concinnum*, which had been re-scheduled from 2011. Growing conditions were less than optimal again this year, and no monitoring was completed for these species. Monitoring will be conducted when growing conditions are favorable.

A map was prepared this year delineating the geographical regions on the NNSS (Figure 5-1). The names of the geographic regions, as well as features within each region, are based on information from U.S. Geological Survey (USGS) topographic maps. Previous descriptions of the locations for many sensitive plants were based on man-made facilities that no longer exist or are not associated with a particular area on the NNSS. The description of the location of sensitive plant populations on the NNSS have been or will be renamed to reflect geographical regions and features within each region.

5.4 Field Surveys and Opportunistic Sightings

The lack of precipitation on the NNSS resulted in less than optimal growing conditions again this year, and field surveys were limited. Surveys were conducted for *Ivesia arizonica* var. *saxosa* on Pahute Mesa and *A. merriamii* along Mercury Ridge. In spite of the poor growing conditions, this year both were locally abundant and field surveys provided valuable information on their distribution and abundance. Field activities associated with other environmental monitoring tasks occur over much of the NNSS, and the opportunity for opportunistic sightings is always present. Such was the case this year. *Frasera pahutensis* (Pahute green gentian) was found at several locations on Pahute Mesa, primarily within current known population boundaries. The most significant opportunistic sighting was the location of two populations of *G. hilendiae* ssp. *kingstonense*.

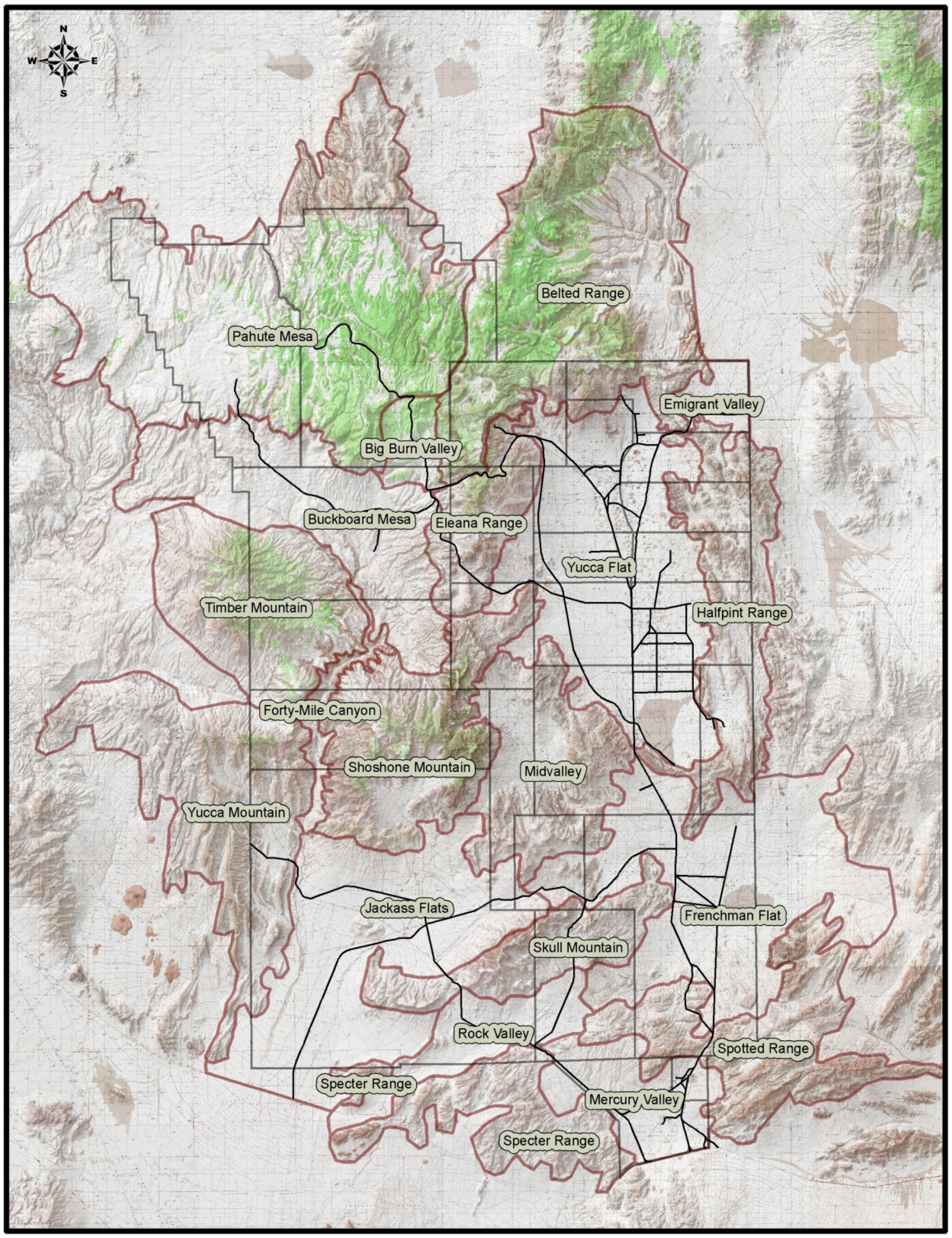

Figure 5-1. Geographical regions on the NNSS

5.4.1 Ivesia arizonica *var.* saxosa*, Rock Purpusia*

Field surveys for *I. arizonica* var. *saxosa* prior to 2012 resulted in multiple disjointed populations. This year surveys focused on areas between those populations. Originally 100–150 plants were reported in the Columbine Canyon area (Anderson and Ostler 2009) on Pahute Mesa (Figure 5-2, blue outline). In 2011, 400-plus individuals were found in similar habitat south of Columbine Canyon (Figure 5-2, yellow). This year surveys were conducted from the area around Columbine Canyon south through several canyons with potential *I. arizonica* var. *saxosa* habitat. The surveys resulted in the documentation of over 5,000 new individuals in this area (Figure 5-2, brown). The number of individuals of *I. arizonica* var. *saxosa* on the NNSS is estimated to be in excess of 5,500, covering approximately 28 ha.

The only other location of *I. arizonica* var. *saxosa* on the NNSS is in Pah canyon, where only a few individual plants have been reported. A reconnaissance survey at the type locality for this species in the Pahroc Mountains in Lincoln County confirmed that the variety of *I. arizonica* found on the NNSS is indeed the variety *saxosa.* Numerous other areas with similar habitat have been surveyed on the NNSS, but to date *I. arizonica* var. *saxosa* has not been found, only *I. arizonica* ssp. *arizonica*.

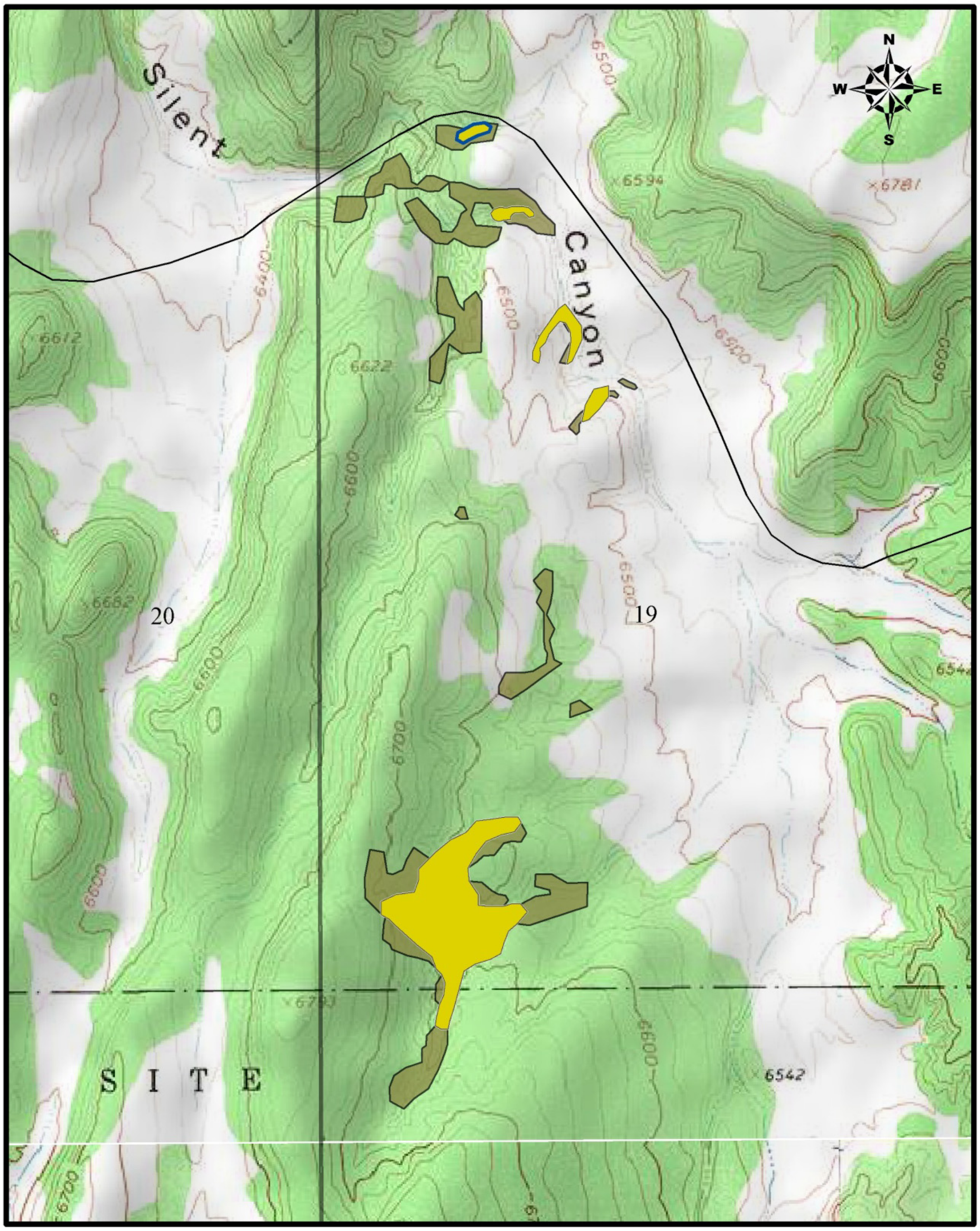

Figure 5-2. Comparison of original reported location (outlined in blue) of *I. arizonica var. saxosa* and locations found between 2007 and 2011 (yellow) to current known distribution (brown)

5.4.2 Arctomecon merriamii

There have been no surveys on the NNSS for *A. merriamii* conducted since the early 1990s. *A. merriamii* was unexpectedly abundant this year in spite of the poor growing conditions, and, although not planned, field surveys were scheduled and conducted. Several new locations were found along Mercury Ridge and several more at lower elevations around the Mercury townsite (Figure 5-3). As with recent surveys for other species, the boundaries of the populations, previously plotted on field topographic maps, were better-defined using GPS devices and mapping software.

Comprehensive surveys for *A. merriamii* conducted in the early 1990s (Blomquist et al. 1995) reported 13 locations of the species and an estimate of about 3,000 individuals on the NNSS. Surveys conducted this year from mid-April to mid-May found 15 new locations (Figure 5-4) and redefined the boundaries of several of the populations identified in 1995 (Anderson and Ostler 2009). Based on this year's surveys, the number of individuals of *A. merriamii* on the NNSS is estimated to be in excess of 4,500 and covering approximately 53 ha.

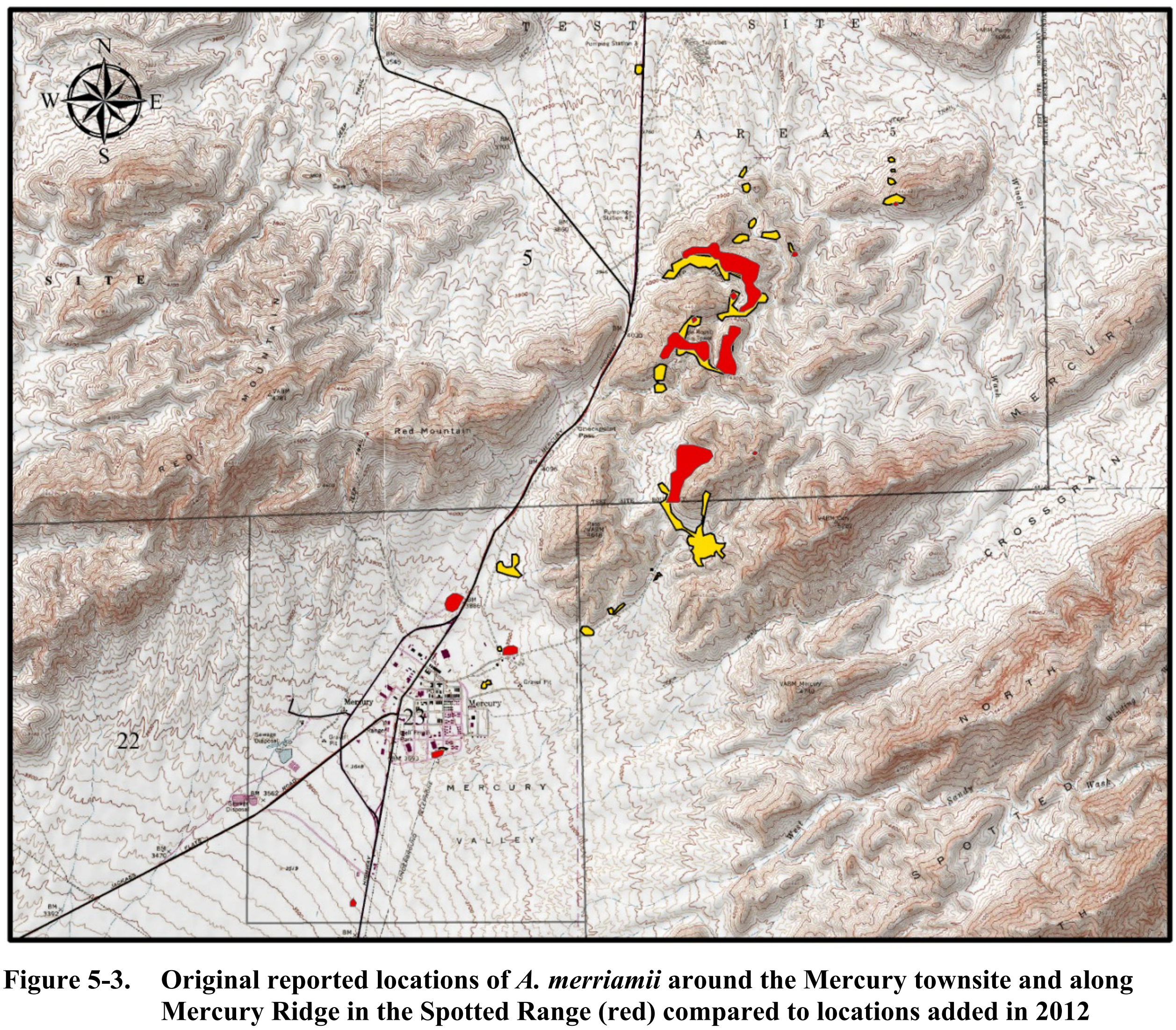

Figure 5-3. Original reported locations of *A. merriamii* around the Mercury townsite and along Mercury Ridge in the Spotted Range (red) compared to locations added in 2012 (yellow)

Figure 5-4. ***A. merriamii*** **in full flower along the side hills of Mercury Ridge in the Spotted Range** (Photo by D. Anderson, April 18, 2012)

5.4.3 Galium hilendiae *ssp.* kingstonense*, Kingston Mountain bedstraw*

Even though no field surveys were planned for *G. hilendiae* ssp. *kingstonense* this year, two significant populations were found during other field activities. One population was found in the southeastern region of Gold Meadows and another in Oak Canyon, just north of Oak Spring Butte (Figure 5-5). Both populations were located late in the season, yet plants were in flower and fruit.

The population found at Gold Meadows is the largest found so far on the NNSS. More than 1,300 individuals were located in the understory of pinyon, interspersed within oak thickets or at the base of large rocks or boulders. The area is an open woodland on a steep north facing slope with most plants found mid-slope to upper slope (Figure 5-6). This population was encountered in mid-September, but even at this late date, most plants were in flower due to monsoon rains that came in late July and August.

A second population of *G. hilendiae* ssp. *kingstonense* was found on a steep north facing slope in Oak Canyon, which is located a few hundred meters north of the NNSS boundary on the north side of Oak Spring Butte. This population was found in October and plants had set seed. Approximately 300 plants were located within the estimated 8,000 m^2 that were surveyed. Potential habitat at this site would be close to 150,000 m^2. Slopes were steeper than at the Gold Meadows site, but like the population at Gold Meadows, plants were found in the understory of pinyon, in oak thickets, or at the base of large rocks or boulders.

The two populations of *G. hilendiae* ssp. *kingstonense* located this year have the highest density of plants encountered for this species so far. About 300 plants were reported at the site just west of Oak Spring Butte. This site covered about 4 ha, suggesting a plant density at this site of about 75 plants/ha. East of Oak Spring Butte at Tub Spring, only 50 plants were reported over an area less than a hectare, or a plant density of about 50 plants/ha. The density of plants at the Tongue Wash location was approximately 100 plants over 2 ha, or an estimated plant density of 50 plants/ha. The estimated plant density at Gold Meadows was about 325 plants/ha (1,300 plants over 4 ha). The density of *G. hilendiae* ssp. *kingstonense* at this site is probably higher than reported because a 100% survey was hindered by steep, rugged terrain. It was equally difficult to determine a density for the Oak Canyon population. Access was limited at this site and only a small portion of the site was surveyed, leaving some uncertainty as to whether it occurs over the entire slope. The portion of the slope surveyed was estimated to cover 0.8 ha. Within that area 300 plants were found, suggesting a density of around 375 plants/ha.

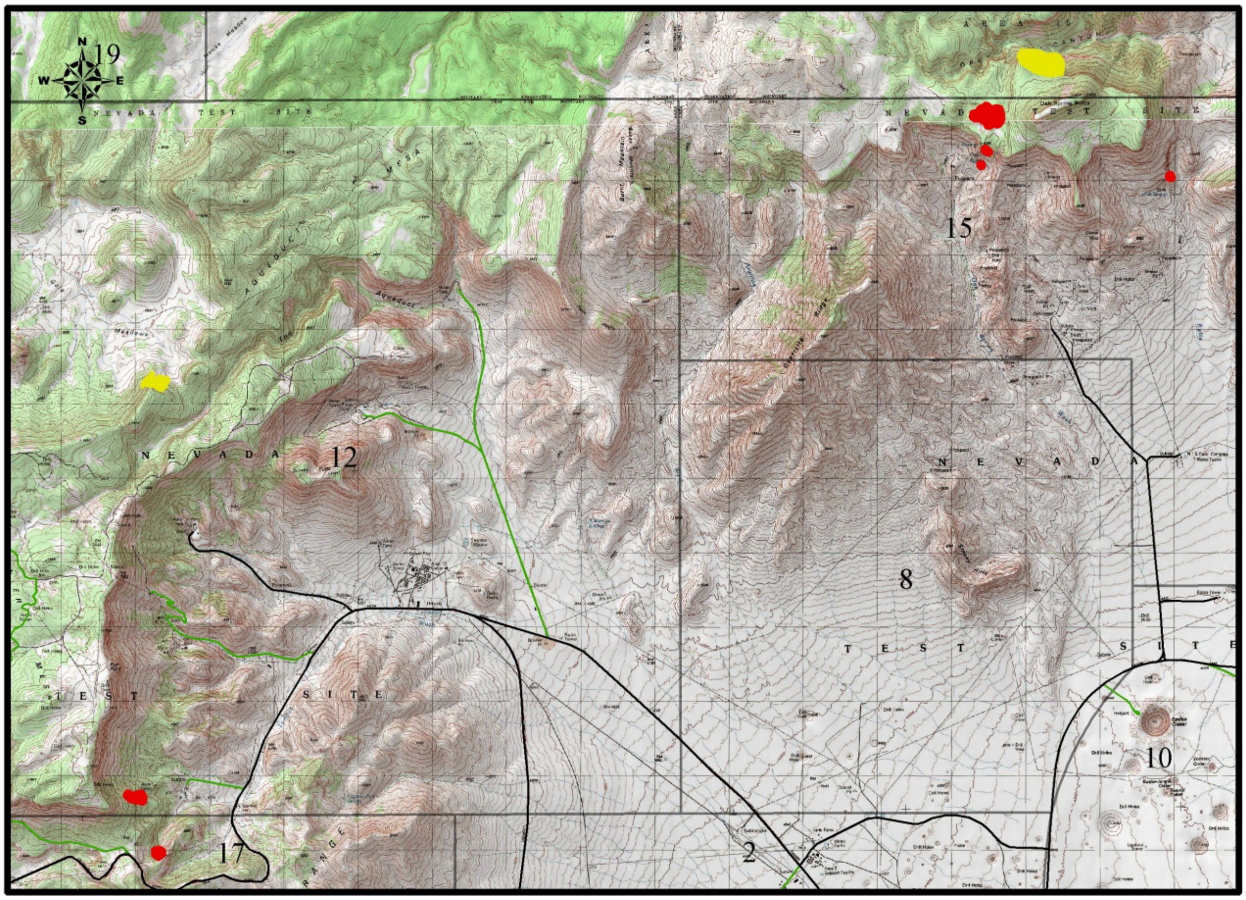

Figure 5-5. Known distribution of *G. hilendiae* ssp. *kingstonense* on NNSS: original locations highlighted in red, new populations recently located highlighted in yellow

Figure 5-6. Typical habitat for *G. hilendiae* ssp. *kingstonense* on the NNSS
(Photo by D. Anderson, September 19, 2012)

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6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NNHP Animal and Plant At-Risk Tracking List; NAC 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures"; and other sources were reviewed to determine if any changes had been made to the status of animal species known to occur on the NNSS. Three changes to the status of NNSS species were noted. A change was made for the western red-tailed skink from "Evaluate" status to "Inactive" status because enough information was obtained from the distribution study to warrant this change, and desert tortoise and wild burro were changed to "Active" status. The complete list with current designations is found in the Sensitive and Protected/Regulated Animal Species List (Table 2-1, shown previously).

Surveys of sensitive and protected/regulated animals during 2012 focused on (a) bats, (b) wild horses, (c) mule deer, and (d) mountain lions. Information about other noteworthy wildlife observations, bird mortalities, and a summary of nuisance animals and their control on the NNSS are also presented.

6.1 Bat Surveys

In 2012, bat monitoring focused on passive acoustic monitoring of bat activity at Camp 17 Pond, and removing bats from buildings and documenting bat roosts.

6.1.1 Passive Acoustic Monitoring System at Camp 17 Pond

To learn more about long-term bat activity through different seasons and years, a passive acoustic monitoring system (Anabat II) was installed at Camp 17 Pond on September 22, 2003. Hundreds of thousands of electronic files containing bat calls have been recorded and are being analyzed by O'Farrell Biological Consulting as funding becomes available. Bat vocalizations and climatic data (e.g., temperature, humidity, wind, barometric pressure) were recorded again in 2012, but no analysis was performed due to a limited budget.

6.1.2 Bats at Buildings

During 2012, site biologists responded to six nuisance bat calls. All six were at buildings around Mercury (one at the Mercury cafeteria, two at Building 143, one at Building 751, one at Building 117, and one at Building 1001). Three of the bats were California myotis (*Myotis californicus*) (two adult females and one adult male), one was an adult female pallid bat (*Antrozous pallidus*), and two were not identified to species. One bat was found dead and the other bats were removed and released or flew off on their own. Roost site locations were entered in the Ecological Geographic Information System faunal database.

6.2 Wild Horse Surveys

Horse monitoring provides information on the abundance, recruitment (i.e., survival of horses to reproductive age), and distribution of the horse population on the NNSS. Annual monitoring of individual horses at NNSS began in 1989 and has continued through 2012. In 2012, NSTec biologists determined horse abundance and recorded horse sign (e.g., droppings and hoof prints) along roads. Some of the natural and human-made water sources were visited in the summer of 2012 to assess their influence on horse distribution and movements and to document the impact horses are having on NNSS water sources. Important information on horse abundance and recruitment from 1990 to 1998 is found in Greger and Romney (1999).

6.2.1 Abundance

In 2012, counts of horses were made during 26 non-consecutive days between May and November. A standard road course was driven to locate and identify horses. Motion-activated cameras at Camp 17 Pond, Gold Meadows Spring, and Captain Jack Spring were also used to photograph horses (see Section 6.4.1, Motion-Activated Cameras). Individuals were identified by their unique physical markings (facial blazes) and classified as foal, yearling, or older when possible. Excluding foals, 35 horses were counted in 2012. This is a close approximation to the actual number of horses that are present. About seven horse bands were detected, which were composed of stallions, subordinate males, females, and their offspring. The NNSS horse population in 2012 is stable at about 35 individuals. Survival of yearlings and foals was low in 2012, as in previous years (Figure 6-1).

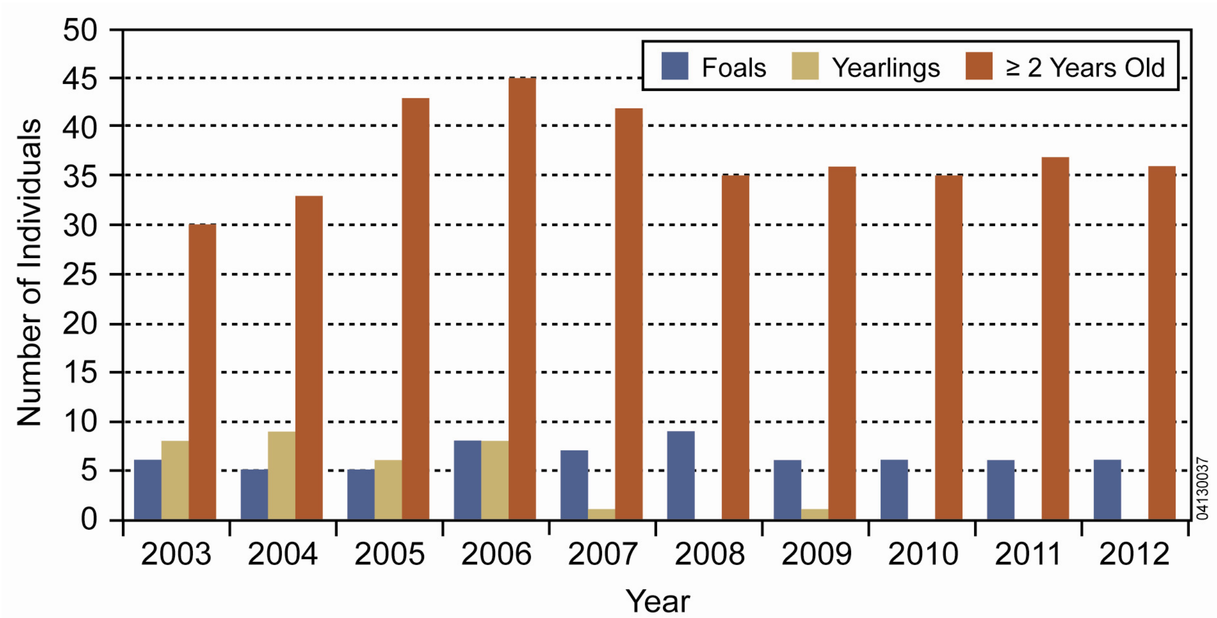

Figure 6-1. Trends in the age structure of the NNSS horse population from 2003 to 2012

Observations and photos taken indicate that at least six foals were born in 2012 (Figure 6-1), and as in other years most disappeared during the summer. Greger and Romney (1999) found that over 60 healthy foals were lost over a 5-year period at the NNSS, and hypothesized that mountain lion predation was the primary cause. Foal losses are a significant factor in controlling the size of the herd of horses on the NNSS, and the horse population has declined in size by about 40% since 1989 when horse population monitoring began. Four foals were killed on the NNSS by a radio-collared mature male mountain lion (NNSS4) between July 17 and December 6, 2012. This provides strong empirical evidence that supports the hypothesis of Greger and Romney (1999) that mountain lion predation on horse foals is controlling the horse population on the NNSS. Kills were located within 1–3 kilometers (km) of Camp 17 Pond and Gold Meadows Spring, critical water sources for horses (Figure 6-2).

6.2.2 Annual Range Survey

During 2012, selected roads were driven within the NNSS, and all band sightings and fresh sign (estimated to be <1 year old) were recorded (Figure 6-2). Walking surveys were also done occasionally away from roads to document horse activity. Horse sign data collected during the road and walking surveys indicate that the horse range on the NNSS during 2012 included Gold Meadows, Eleana Range, the southwest foothills of the Eleana Range, the Echo Peak region of Pahute Mesa, and Wildhorse Seeps

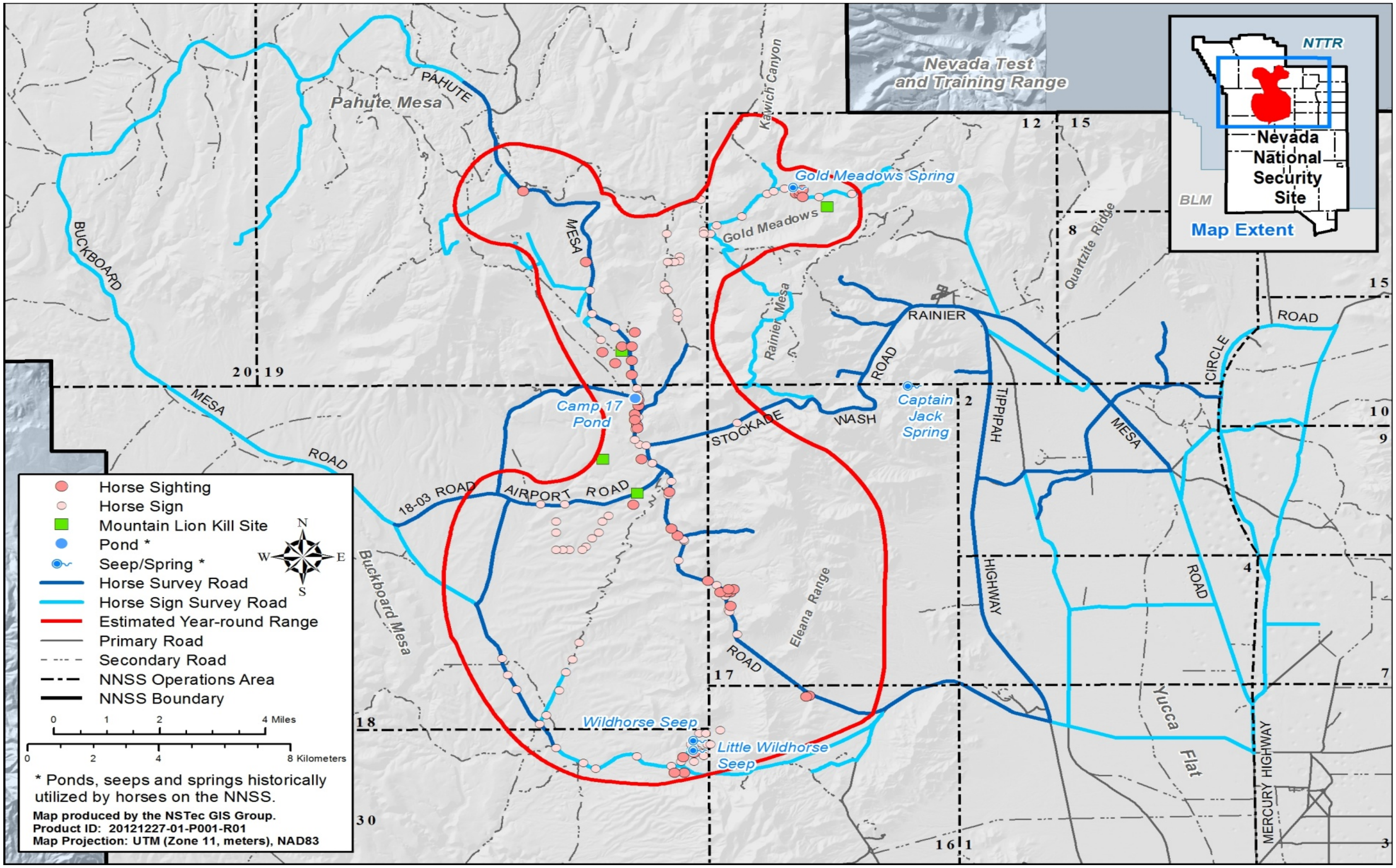

Figure 6-2. Feral horse sightings, horse sign, and mountain lion kills observed on the NNSS during 2012

in Area 30 (Figure 6-2). Overall, the estimated annual horse range in 2012 (206 square kilometers [km^2]) is about 10% smaller in size than 2011. The horse range boundary line was approximated using the locations of horses and fresh horse sign documented for 2012. Overall, horse use has declined in the hills surrounding the Eleana Range and the Captain Jack Spring area and southward. Annual monitoring of horse use at springs indicates that the range is now smaller on the NNSS. This fact is consistent with declining population size of this herd. The herd, once numbered up to about 65 horses, has declined by nearly half in 10–12 years. Horses were commonly seen on Yucca Flat (Areas 8, 9, 12, and 2) during previous times and now seem restricted to the western edge of the Eleana Range and north into Areas 30, 17, and 18. These areas are characterized by rather rugged topography and rolling hills with pinion-juniper and sagebrush and are limited to a radius of approximately 8–11 km from any permanent water source. Horse activity was heaviest along roads from Camp 17 Pond in all directions as shown by the concentration of points in Figure 6-2. The preferred horse range seems to be above 1,524 m (5,000 ft) elevation, especially during the summer months.

6.2.3 Horse Use of Water Sources

Camp 17 Pond and Gold Meadows Spring were two primary water sources used in 2012 by horses, as in previous years. Camp 17 Pond is permanent, and horse use generally begins in March and extends through November. Gold Meadows Spring is temporary, and usage is from about April until it dries out in the fall. Wildhorse seeps in Area 30 are also temporary water sources in slick rock areas (Figure 6-2) containing several water tanks on the southern edge of the horse range. They are used mostly in fall and winter. Captain Jack Spring was not used by horses during 2011 or in 2012. None of the plastic-lined sumps within or near the horse range were used by horses this year.

6.3 Mule Deer

Initial studies of mule deer at the NNSS were conducted by Giles and Cooper (1985) from 1977 to 1982 when they performed mark and recapture studies on about 100 marked deer. They estimated the population to be about 1,500–2,000 deer. Spotlighting surveys for deer on the NNSS were conducted in 1989–1994, 1999–2000, and 2006 to the present. The monitoring effort has emphasized estimating relative abundance and density.

6.3.1 Mule Deer Abundance

Mule deer abundance on the NNSS was measured by driving two standardized (74 km total length) road courses (Figure 6-3) to count and identify mule deer. One route was centered around Rainier Mesa and the second was centered around Pahute Mesa, following advice that there are two main deer herd components in these regions on the NNSS (Giles and Cooper 1985).

Locations of mule deer and selected predators were recorded with a GPS from the road centerline. Perpendicular distance from the road to each deer group was measured with a laser range finder. Locations of deer groups were displayed using GIS methodology (see Hansen et al. 2009).

During nine surveys conducted in 2012, total observations were made of only 179 deer, which equates to an average of 20 deer per night. The deer counts in 2012 were 50% lower than counts in 2011 and about 40% lower than the long-term average of 32 deer per night. Possible reasons for the decline include drought conditions, predation, or a combination of factors. There appears to be no distinctive long-term trend in deer numbers on the NNSS (Figure 6-4).

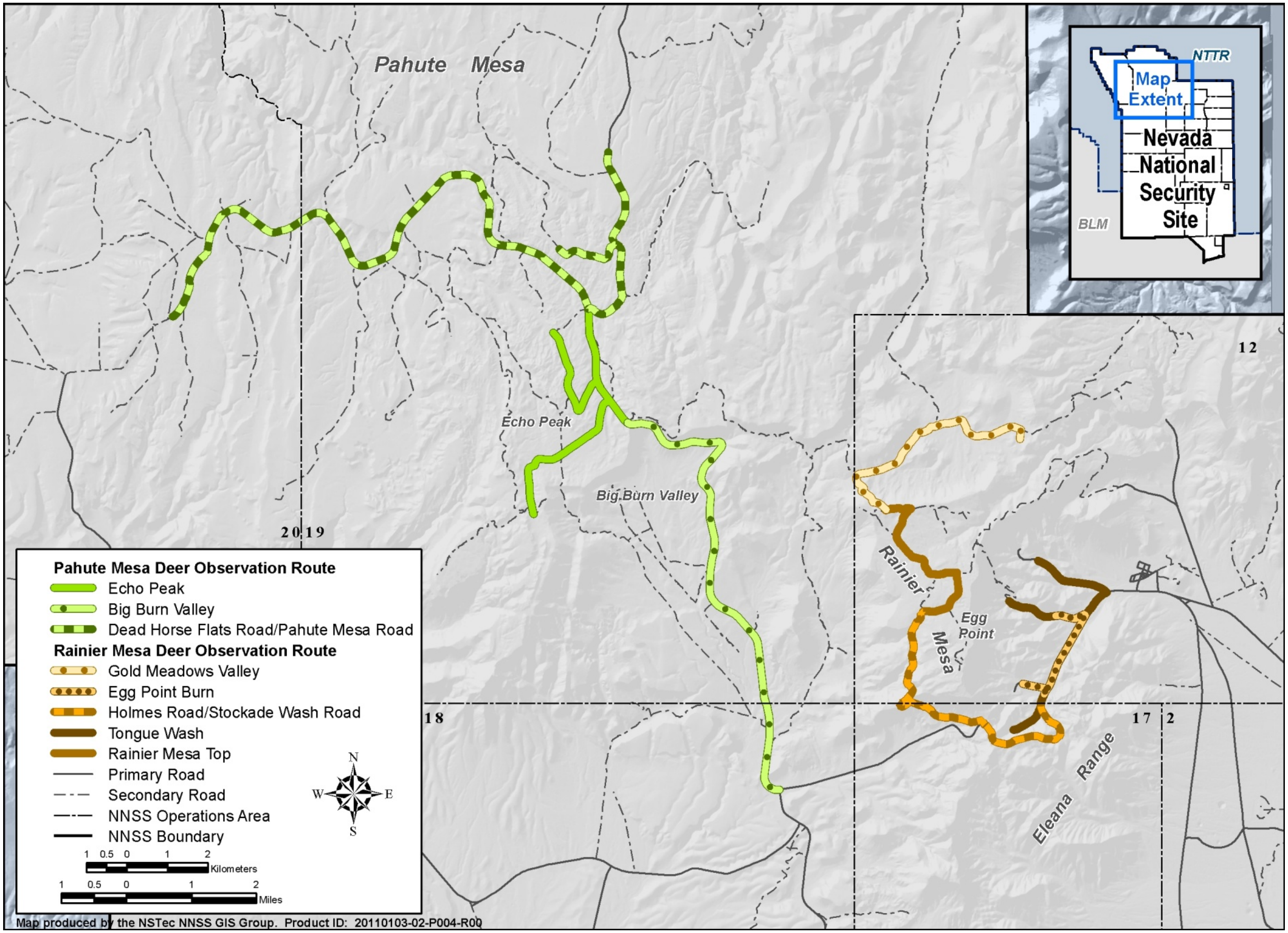

Figure 6-3. Road routes and sub-routes of two NNSS regions driven to count deer

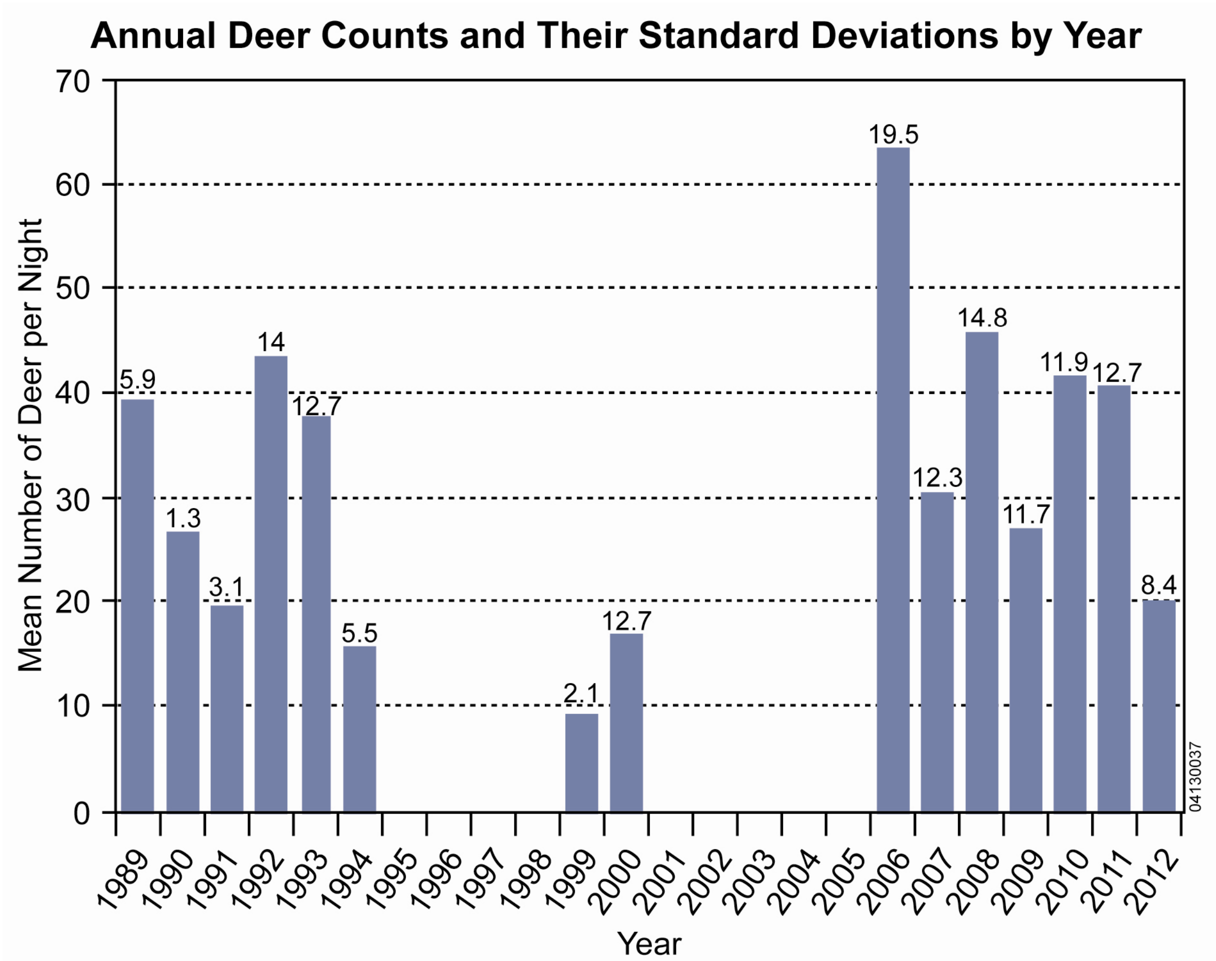

Figure 6-4. Trends in total deer count per night from 1989 to 2012 on the NNSS (surveys were not conducted during 1995–1998 or 2001–2005)

Overall, from 2006 to 2012, there were significantly higher deer numbers detected per distance (Analysis of variance, $F = 16.8$, d.f. = 129, $P = 0.00001$) on the Rainier Mesa route than on the Pahute Mesa route (Figure 6-5). In addition, there was a significant increase in the number of deer on the Rainier Mesa section during 2006 to 2012 compared to the number of deer on the same section during 1989–1994, while numbers of deer on the Pahute Mesa route were similar between the same time periods. Reasons for the increased number of deer on the Rainier Mesa route are not known but may be related to decreased human activity or number and distribution of water sources in these areas.

6.3.2 Mule Deer Density

Densities of deer were calculated using the software program DISTANCE (Thomas et al. 2006) on two routes and several sub-routes (Figure 6-3). Stratification of the data was based mostly on differences in topography and elevation. A statistic called Akaike's Information Criterion (AIC) is used to assess model fit. The procedure involves running several models simultaneously on the data set and choosing the model with the lowest AIC to calculate density. A series of tests such as likelihood ratios and goodness of fit tests are also used along with visual inspection to evaluate the overall fit. In DISTANCE, the model fit closest to the centerline is the most important area to be concerned about, and agreement here allows the best fit (i.e., lowest AIC value).

The effective strip width (ESW) or (half width) is an important parameter in DISTANCE that is used to calculate *density* (D), with n = the number of animals counted (mean cluster size × cluster density) in area (A) sampled, A = 2 × ESW × L, with L as the transect length.

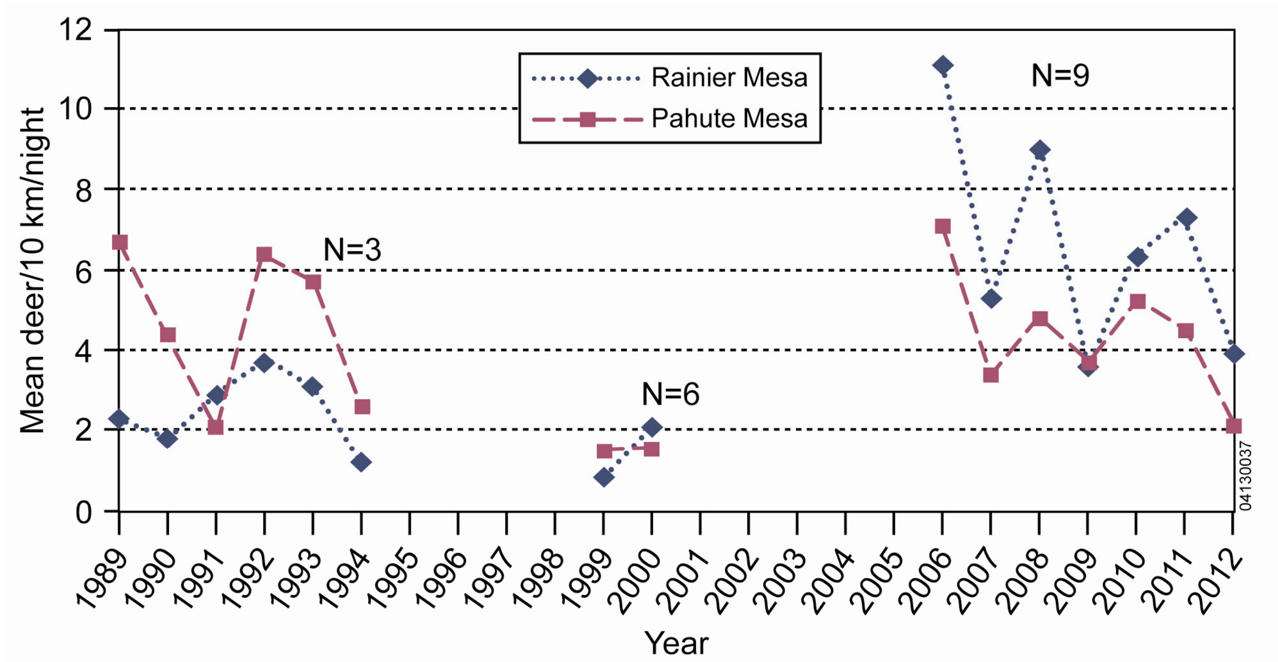

Figure 6-5. Mean number of mule deer per 10 km per night, counted on two routes (N = number of survey nights; for 2012, N = 9)

During the nine surveys conducted in September and October 2012, 96 observations (deer groups) were detected. Group size varied from one to five animals, and mean cluster size was 1.5 and 1.4 deer for the Rainier Mesa and Pahute Mesa routes, respectively. Density estimates for the Pahute Mesa route and Rainier Mesa route and sub-routes were low on the NNSS, averaging about 1 deer per km^2 (Table 6-1). There were few significant differences in density between any route or sub-route (most 95% confidence intervals overlapped). As in previous years, the two areas with the highest deer density were Gold Meadows and Echo Peak (1.8 and 2.1 deer per km^2, respectively). Egg Point Burn also had a density of 1.8 deer per km^2. Some areas with very low sample size had very high coefficients of variation. Roads and trails have numerous blind areas near the centerline; when surveys are conducted in these areas, animals will generally be undercounted (Buckland et al. 2001), resulting in an underestimate of density. Inspection of DISTANCE deer detection curves in 2012 as in previous years suggests that some undercounting of deer near the centerline is likely. The problem encountered in 2012 was that counts were very low, making it difficult to fulfill most assumptions of distance modeling. Some sub-routes therefore had counts that were too low to calculate density (Table 6-1), namely Holmes Road/Stockade Wash and Tongue Wash. Not unexpected, relative mule deer density trends across years (2007–2012) have been very similar to counts per night with no definitive trend.

Table 6-1. Deer density estimates, confidence intervals, and other parameters for two routes and sub-routes of the NNSS for 2012 using Program DISTANCE software

Survey Routes/Sub-routes[a]	Route length (Km)	Total observations	Deer density D^b, n/Km^2	95% lower confidence interval of D	95% upper confidence interval of D	Coefficent of variation of D
Pahute Mesa Total	**45.5**	**58**	**0.8**	**0.6**	**1.2**	**0.17**
Big Burn Valley	13.0	20	0.9	0.5	1.7	0.31
Echo Peak	10.0	29	2.1	1.3	3.2	0.22
Dead Horse Flat Road/Pahute Mesa	22.5	9	0.2	0.1	0.6	0.45
Rainier Mesa Total	**28.5**	**38**	**1.2**	**0.7**	**2.0**	**0.26**
Tongue Wash Area	4.9	4	NE			
Egg Point Burn	3.7	7	1.8	0.6	6.1	0.585
Holmes Road/Stockade Wash Road	7.5	1	NE			
Rainier Mesa Top	5.8	7	1.3	0.6	3.0	0.39
Gold Meadows	6.6	19	1.8	0.9	3.8	0.36

[a]Conventional distance sampling with major key, with cosine adjustments, 1 observer, and 1 parameter

[b]Number of surveys is 9 for all estimates

NE=No estimate due to low counts

6.3.3 Sex and Fawn/Doe Ratios

The sex of some deer could not be determined during surveys. The percentage of deer whose sex could not be determined ranged from 15% in 2009 to 21% in 2007 and 2012; therefore, calculated sex ratios are likely to have some error. Sex ratios (number of males/female) have fluctuated from 0.89 in 2010 to 2.18 in 2007 (Table 6-2) but are often near 1, as was the case in 2012 with a ratio of 0.97. Generally, deer populations in hunted areas in the western U.S. have fewer males compared to females in the population than is measured on the NNSS. Giles and Cooper (1985) attributed the higher number of males to a lack of hunting on the NNSS.

The number of fawns detected in 2012 was 19, which was low, as in previous years, but total deer counts were also low in 2012. Giles and Cooper (1985) conducted fawn/doe surveys from July to October (1977–1981) and determined fawn/doe ratios ranged from 0.34 to 0.73. These values have always been much higher than those determined in more recent years on the NNSS (0.0 to 0.32; Table 6-2).

Table 6-2. Mule deer sex ratios, fawns, and fawn to doe ratios across years on the NNSS

Year	Male	Female	Unclassified Sex	Male/Female Ratio	Fawns	Fawns/Doe
2006	224	222	96	1.01	31	0.14
2007	148	68	59	2.18	0	0
2008	164	147	50	1.12	47	0.32
2009	98	102	35	0.96	7	0.07
2010	133	150	50	0.89	32	0.21
2011	189	184	67	1.03	37	0.19
2012	65	67	28	0.97	19	0.3

6.3.4 Mule Deer Habitat Use

Deer habitat use was calculated again in 2012 similarly as in previous years, using associations and alliances described by Ostler et al. (2000). Details of the field methodology were reported in 2011

(Hansen et al. 2012). Deer habitat use indices (Table 6-3) were calculated by the quotient of percentage of deer habitat use and the percentage of available vegetative habitat (Stapp and Guttilla 2002). Confidence intervals of selection coefficients were calculated after Krebs (1999) to examine statistical differences (Table 6-3).

Two woodland associations, *Pinus monophylla*/*Artemisa tridentata* Woodland (*PIMO/ARTR*) and *Pinus monophylla*/*Artemisa nova* Woodland (*PIMO/ARNO*) comprise about 42% of the habitat where deer observations were made (Table 6-3). The *Artemisia* spp. Shrubland Alliance (*Artemisia* spp.) (29%) and the Miscellaneous/disturbed habitats (20%) were also substantial components of the habitat. However, *Coleogyne ramosissima–Ephedra nevadensis* Shrubland (*CORA-EPNE*) and the Egg Point Burn comprised minor components of the habitats on the deer routes (Table 6-3). The miscellaneous/disturbed category is composed of several elements, both minor vegetation types and land previously disturbed by NNSA/NFO activities. Minor vegetation types included *Cercocarpus* spp. and the *Chrysothamnus-Ericameria* Shrubland Alliance.

The most heavily used habitat for deer was the *Artemisia* spp. Alliance, as in most previous years. In 2012 due to low counts, the standard errors of the habitat use index (W_i) were all higher, resulting in no positive selectivity values (Table 6-3). Only the *CORA-EPNE* Shrubland and the Miscellaneous-disturbed habitats appeared to be avoided (W_i <1.0) relative to availability in 2012.

Numbers of deer observed in most years are typically highest along the *Artemisia* spp. Alliance and the *PIMO/ARTR* Woodland boundary on the NNSS (Figure 6-6), with mostly higher selection values for the *Artemisia* spp. Alliance habitat. This is an important habitat ecotone for mule deer because they thrive in "edge" habitat (i.e., wooded areas interspersed with open sagebrush meadows). Explaining the difference in deer use among habitats is not possible at this time. Differential use may be due to detectability issues, such as good or poor visibility for observers based on habitat and topography, or this habitat may in fact be better for deer. There may be other factors like food quality that are presently unknown that could better explain deer use or presence at night.

Table 6-3. Habitat use index, W_i, from spotlighted mule deer on the NNSS during 2012

Habitat	Km of deer route in habitat type	Percent of available habitat (A)	Observed number deer groups	Percent deer use by habitat (B)	Habitat Use Index W_i = B/A	95% CI of W_i
PIMO/ARTR Woodland	18.1	24.50	25	26.00	1.06	(0.8,1.42)
PIMO/ARNO Woodland	12.6	17.10	15	15.60	0.91	(0.48,1.34)
Artemisia spp. Alliance[1]	21.5	29.00	36	37.50	1.29	0.96,1.62)
Miscellaneous-disturbed	14.8	20.00	11	11.50	0.58	(0.27,0.90)*
CORA-EPNE Shrubland	3.8	5.10	2	2.10	0.41	(-0.10,0.97)*
Egg Point Burn	3.2	4.30	7	7.30	1.69	(0.5,2.9)
Total	**74**	**100**	**96**	**100**		

[1]*Artemisia* spp. Alliance = *ARNO-ARTR*, *ARNO-CHVI*, and *ARTR-CHVI* Shrubland Associations

* Habitats are denoted by an asterisk where selection is significant from 1.0 (i.e., confidence intervals [CIs] did not include 1.0).

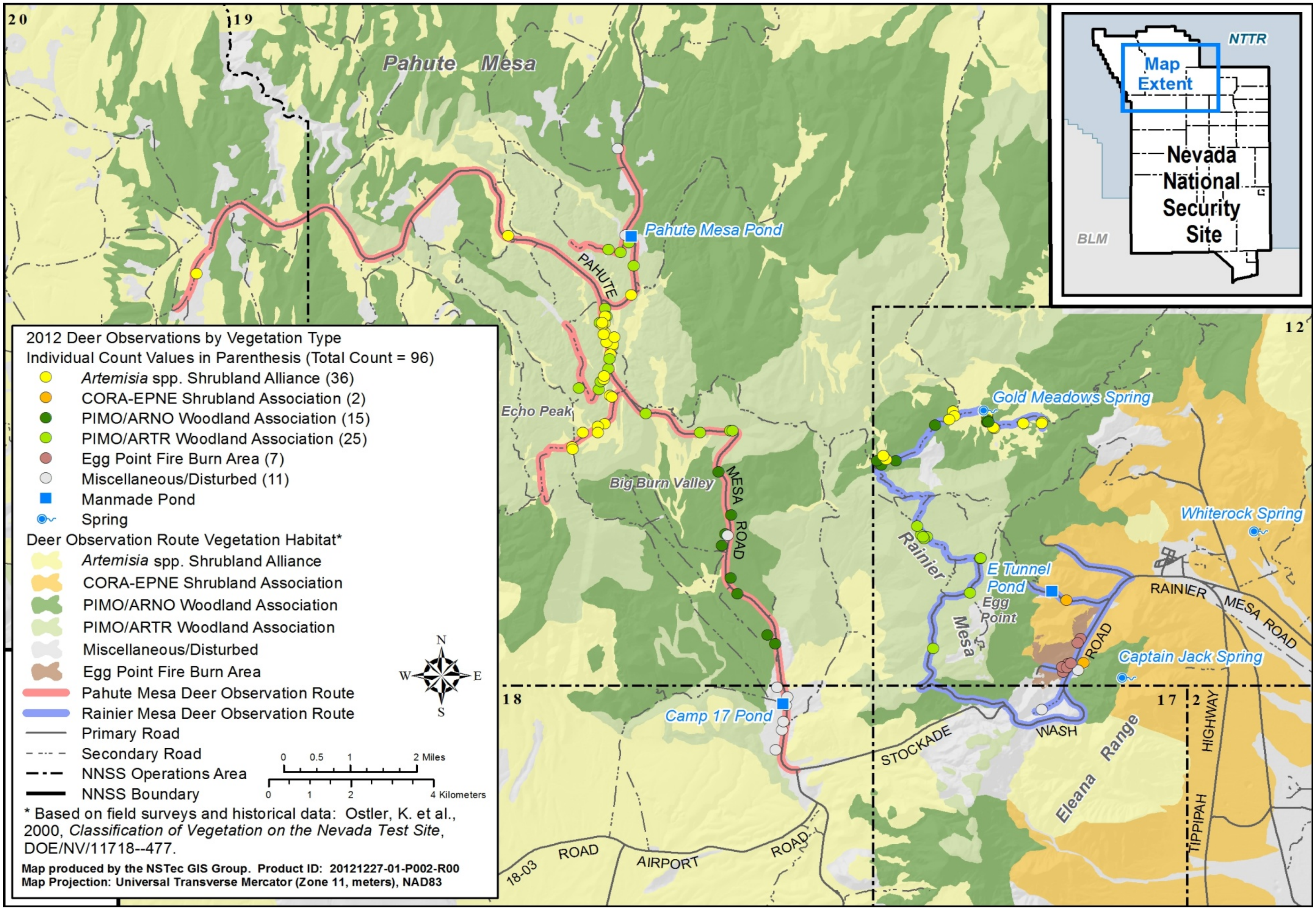

Figure 6-6. Mule deer observations by vegetation type on the NNSS

6.3.4.1 Mule Deer Habitat Use Trends

Trends in the four major habitats used by deer are shown with tendencies for selection and avoidance where Selection = S > 1 and Avoidance = S < 1, with values of W_i significantly different from 1 (Figure 6-7). All other habitats were used relative to availability ($W_i = 1$).

There is a strong tendency for the *Artemisia* spp. habitat to be selected in multiple years (three cases in 5 years). In two cases selection was not significantly greater than 1, but deer use was still considerable (Figure 6-7). There is also a strong tendency for the *PIMO-ARNO* habitat to be avoided over time (four cases in 5 years). The *Miscellaneous-disturbed* and *PIMO-ARTR* habitats show no consistent pattern of use over time. They are both moderately used by deer, often with selection values (three cases for each habitat in 5 years) not different than 1. Trend data suggest that the *Artemisia* spp. habitat is used more consistently over time than the *PIMO-ARTR* habitat; therefore, it may be better deer habitat.

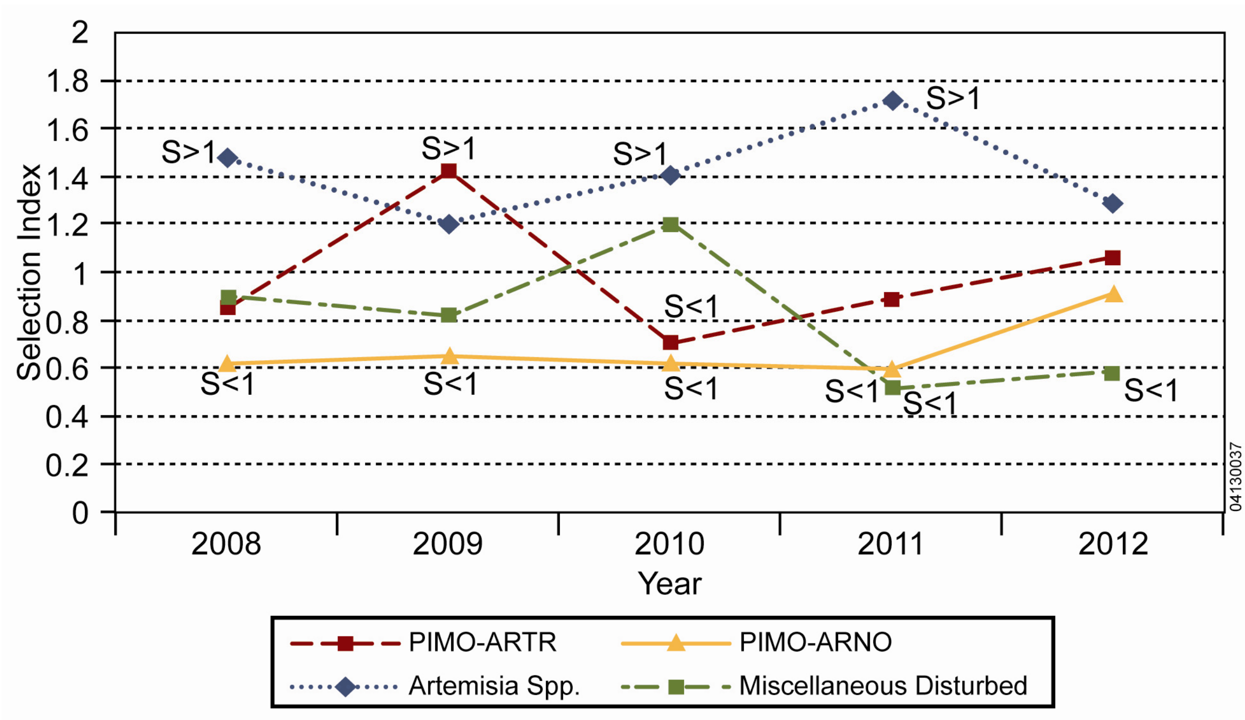

Figure 6-7. Trends in significant habitat selection S > 1, and avoidance S < 1, by deer at the NNSS from 2008 to 2012 (all other points are equivalent to 1 in use)

6.4 Mountain Lion Monitoring

6.4.1 Motion-Activated Cameras

Little data exist for mountain lion numbers and their distribution in southern Nevada, including the NNSS. Since 2006, site biologists have collaborated with Dr. Erin Boydston, a research scientist with USGS, to use remote, motion-activated cameras to determine the distribution and abundance of mountain lions on the NNSS. Cameras used this way are referred to as camera traps. Camera traps have also been used the last few years to assist with the capture effort for the telemetry study by identifying where mountain lions occur as well as the frequency of occurrence at those sites. Additionally, camera traps were used during 2012 to assess the number of un-collared and collared mountain lions to estimate their relative abundance.

Remote, motion-activated cameras were used at 33 sites, including 17 new sites (Figure 6-8 and Table 6-4). Sites were selected at locations with previous or new mountain lion sightings or sign, on roads that are potential movement corridors from one area to another, and in areas of good mule deer habitat (mule deer are a primary prey species for mountain lions). The number of images reported is based on a 1-minute interval between images taken during a single episode.

A total of 124 mountain lion images (i.e., photographs or video clips) were taken during 163,487 camera hours across all sites. This equates to about 0.8 mountain lion images per 1,000 camera hours (Table 6-4). Mountain lions were detected at 22 of the 33 sites, including nine canyons, eight dirt roads, one paved road, and four water sources (Figure 6-8).

Table 6-5 gives the camera trap results by month, location, and radio-collared animal, when it was possible to determine which animal was being photographed. All four radio-collared mountain lions captured during 2012 (NNSS4, NNSS5, NNSS6, and NNSS7) were detected with camera traps. Although not conclusive, a photo of NNSS1 (captured during 2011) may have been taken at Gold Meadows Spring during January 2012. The mountain lion in the photograph appears to have a white ear tag in its right ear, which would identify it as NNSS1. This is the same female that had the cub and whose radio collar failed during September 2011. The notch-eared male that had been detected on multiple cameras during 2011 was captured during May 2012 and designated NNSS4. On three occasions, pairs of mountain lions were detected, including two instances where NNSS7 and an un-collared female were traveling together on the same night within 1.5 hours of each other (Site #16 and Site #1). The video clip of the third event (East Gold Meadows Pass, Site #13) was too dark to tell if the two individuals were collared or not. It is difficult to tell individual mountain lions apart in the images and therefore determine the exact number of mountain lions on the NNSS. However, based on the four collared mountain lions and at least two un-collared ones detected with the camera traps, a minimum of six adult mountain lions were detected between June 21 and August 21, 2012, within a relatively small area of 90 km^2 encompassing the eastern portion of Pahute Mesa (Lambs Canyon and Pahute Mesa Road Summit), Rainier Mesa, Gold Meadows, and Aqueduct Mesa.

In order to investigate temporal activity of mountain lions, camera detection data from all 7 years (2006–2012) were combined. Mountain lions were detected every month with peak occurrences during November (N = 80), and twice as many images during summer and fall (N = 83) compared to winter and spring (N = 41) (Figure 6-9). Mountain lions were detected most frequently between 1700 and 0800 hours, during which more than ten times as many images were recorded (N = 326) compared to between 0800 and 1700 hours (N = 29) (Figure 6-10).

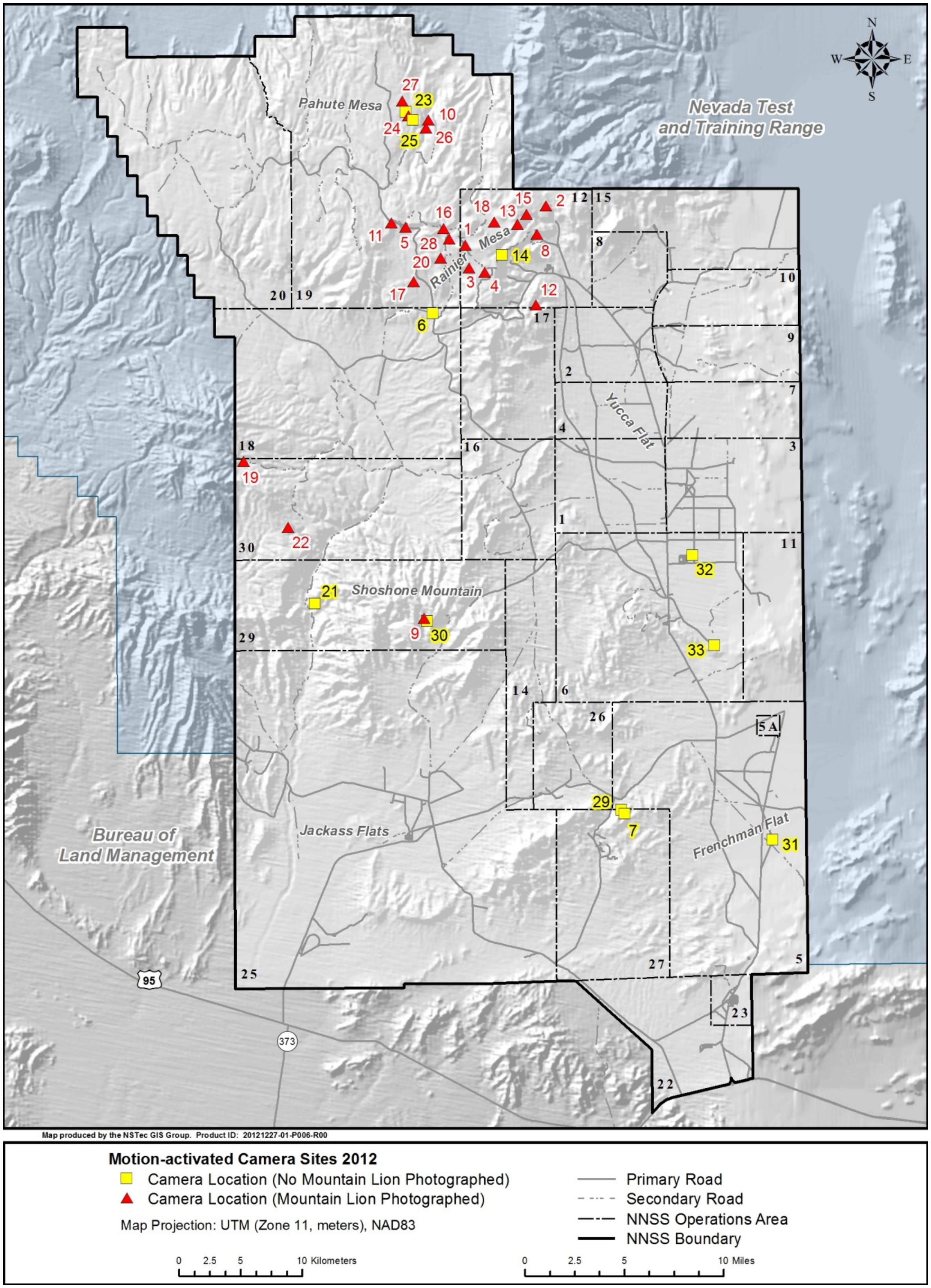

Figure 6-8. Locations of mountain lion photographic detections (N = 22) and motion-activated cameras (N = 33) on the NNSS during 2012

Table 6-4. Results of mountain lion camera surveys during 2012

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Topopah Spring (#9)	12/21/11–12/20/12[b]	7,023	30 (4.3)	Bobcat (5), gray fox (4), coyote (43), desert bighorn sheep (17), mule deer (521), black-tailed jackrabbit (1), rock squirrel (1), golden eagle (7), red-tailed hawk (1), chukar (1278), mourning dove (90), Steller's jay (1), scrub jay (12), pinyon jay (152), western tanager (1), common flicker (24), rufous-sided towhee (1), black-headed grosbeak (15), brown-headed cowbird (11), house finch (3)
Aqueduct Mesa Area (#2)	6/12/12–12/12/12	3,371	14 (4.1)	Gray fox (1), coyote (1), mule deer (7), black-tailed jackrabbit (2), jay (1)
Rainier Mesa West Rim (#4)	6/5/12–12/12/12[b]	1,355	4 (3.0)	Badger (2), cottontail rabbit (2), rock squirrel (2)
Lambs Canyon Tank (#10)	6/13/12–10/1/12	2,640	6 (2.3)	Coyote (42), desert bighorn sheep (40), mule deer (131), cliff chipmunk (7), rock squirrel (3), golden eagle (93), red-tailed hawk (7), turkey vulture (39), mourning dove (9), brown-headed cowbird (33), house finch (10), common raven (4), sharp-shinned hawk (2), black-headed grosbeak (12), western tanager (4), flycatcher (1)
Captain Jack Spring[a] (#12)	12/19/11–12/20/12[b]	7,149	9 (1.3)	Bobcat (4), gray fox (1), coyote (9), mule deer (2,057), rock squirrel (24), chukar (10), scrub jay (1), hawk (1)
East Gold Meadows Pass (#13)	12/19/11–12/12/12[b]	7,831	9 (1.1)	Bobcat (2), coyote (6), badger (1), mule deer (59), black-tailed jackrabbit (6)
Chukar Canyon (#22)	1/2/12–12/11/12[b]	5,657	6 (1.1)	Bobcat (2), coyote (3), mule deer (1), rock squirrel (9), golden eagle (10), turkey vulture (1), chukar (26), mourning dove (23), scrub jay (1)
Rattlesnake Ridge Gorge (#20)	12/21/11–1/8/13	9,218	9 (1.0)	Bobcat (1), gray fox (1), rock squirrel (4)

Table 6-4. Results of mountain lion camera surveys during 2012 (continued)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Water Bottle Canyon (#17)	12/20/11–12/13/12[b]	5,980	6 (1.0)	Gray fox (1), mule deer (3), cottontail rabbit (2), cliff chipmunk (1)
12T-26, Rainier Mesa (#1)	12/19/11–12/12/12	8,615	5 (0.6)	Bobcat (3), coyote (15), mule deer (13), horse (1), black-tailed jackrabbit (12), rock squirrel (1), rabbit (3)
Pahute Mesa Summit, Road[a] (#11)	12/20/11–12/13/12[b]	6,410	4 (0.6)	Coyote (1), pronghorn antelope (1), mule deer (42), horse (1), common raven (1)
Lambs Canyon #4 (#26)	12/8/11–4/11/12; 6/13/12–10/1/12[b]	5,350	3 (0.6)	Bobcat (4), gray fox (1), coyote (1), ringtail cat (1), cottontail rabbit (2), scrub jay (1)
Dick Adams Cutoff Road, Rainier Mesa (#3)	12/19/11–12/12/12	8,615	4 (0.5)	Bobcat (2), gray fox (1), coyote (5), mule deer (38), black-tailed jackrabbit (29), cottontail rabbit (2)
Gold Meadows Spring (#18)	12/19/11–12/12/12[b]	6,595	3 (0.5)	Coyote (7), pronghorn antelope (33), mule deer (88), horse (152), black-tailed jackrabbit (31), brown-headed cowbird (2)
Lambs Canyon #2 (#24)	12/8/11–4/11/12; 6/13/12–10/1/12[b]	3,893	2 (0.5)	Gray fox (1), coyote (1), mule deer (2), black-tailed jackrabbit (1), cottontail rabbit (9), scrub jay (1)
Aqueduct Mesa Road (#15)	6/11/12–12/12/12	4,414	2 (0.5)	Bobcat (2), gray fox (11), coyote (5), mule deer (9), desert cottontail (8), black-tailed jackrabbit (9), rock squirrel (11), pinyon jay (1)
East 19-01 Road (#16)	6/15/12–1/8/13	4,970	2 (0.4)	Bobcat (3), coyote (6), badger (1), mule deer (5), desert cottontail (1), rock squirrel (5)
Lambs Canyon #5 (#27)	12/8/11–4/10/12	2,687	1 (0.4)	Bobcat (3), coyote (1), badger (1), cottontail rabbit (7)

Table 6-4. Results of mountain lion camera surveys during 2012 (continued)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Road above T Tunnel (#8)	12/19/11–3/21/12	2,229	1 (0.4)	Bobcat (1), coyote (1), mule deer (1)
East Cat Canyon (#19)	1/2/12–12/11/12	7,201	2 (0.3)	Bobcat (1), coyote (10), mule deer (33), black-tailed jackrabbit (2)
19-01 Road, 19T-47, (#5)[a]	12/20/11–11/19/12[b]	3,594	1 (0.3)	Mule deer (8)
Back Mesa Road Upper Wash (#28)	6/15/12–1/8/13	4,970	1 (0.2)	Bobcat (1), mule deer (3), mountain cottontail (11), rock squirrel (1)
Camp 17 Pond[a] (#6)	12/21/11–1/8/13[b]	5,458	0	Coyote (5), mule deer (766), horse (87), bat (1), great blue heron (5), golden eagle (4), red-tailed hawk (2), turkey vulture (63), pinyon jay (3), common raven (6), duck (1)
Lambs Canyon #1 (#23)	12/8/11–4/11/12	3,000	0	Gray fox (2)
Lambs Canyon #3 (#25)	12/20/11–4/11/12	2,712	0	Mule deer (1)
Twin Spring (#21)	1/2/12–12/20/12	8,469	0	Coyote (1), mule deer (560)
Rainier Mesa Top, Above B Tunnel (#14)	12/19/11–12/12/12[b]	8,109	0	Bobcat (2), gray fox (6), coyote (2), mule deer (23), rock squirrel (3)
Cane Spring (#7)	12/21/11–12/17/12[b]	7,562	0	Bobcat (8), coyote (15), mule deer (71), chukar (12), mourning dove (1), desert cottontail (2)
Cane Spring Trough (#29)	9/18/12–12/17/12	2,160	0	Mule deer (1)

Table 6-4. Results of mountain lion camera surveys during 2012 (continued)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Topopah Spring Trough (#30)	9/18/12–12/20/12[b]	2,235	0	Coyote (4), mule deer (41), red-tailed hawk (2)
Well 5C Trough (#31)	9/5/12–12/17/12	2,479	0	Bobcat (1), coyote (2), pronghorn antelope (25), mule deer (6), burro (104), common raven (1)
Area 6, LANL Pond Trough (#32)	11/15/12–12/17/12	768	0	Common raven (4)
Well C1 Pond Trough (#33)	11/15/12–12/17/12	768	0	None

[a] Camera hours not known for some time periods.

[b] Non-continuous operation due to camera problems, dead batteries, full memory cards, etc.

Table 6-5. Number of mountain lion images taken with camera traps by month, location, and animal number, if known

Camera Location (Site number)	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Topopah Spring (#9)		1	1	1	2	6	9 (2NNSS7)					10-NNSS4	
Chukar Canyon (#22)							NNSS7				2	2-NNSS7	NNSS7
East Cat Canyon (#19)			1										NNSS7
Captain Jack Spring (#12)			1			3			4		1		
Water Bottle Canyon (#17)			NNSS4	2	NNSS4				1		1		
Rattlesnake Ridge Gorge (#20)			1	NNSS4	2 (1NNSS4)	NNSS4		NNSS4	3				
Road above T Tunnel (#8)	1												
Aqueduct Mesa Area (#2)							4 (2NNSS4)	2 (NNSS4, NNSS5)	3 (2NNSS4, NNSS5)	2 (1NNSS4)	NNSS4	2	
Aqueduct Mesa Road (#15)											1	1	
East Gold Meadows Pass (#13)	1	1		1			NNSS4	2-NNSS4, pair	NNSS4		2		
Gold Meadows Spring (#18)		NNSS1?			1		NNSS4						
12T-26, Rainier Mesa (#1)				1	1	1			2 (1NNSS7 w/female)				
Dick Adams Cutoff Road (#3)							1		2		NNSS4		
Rainier Mesa West Rim (#4)							2 (1NNSS4)			2			
Back Mesa Road Upper Wash (#28)											1		
East 19-01 Road (#16)									NNSS7 w/female			1	
19-01 Road, 19T-47 (#5)				1									
Pahute Mesa Summit Road (#11)								NNSS4	2	NNSS7			
Lambs Canyon #5 (#27)		NNSS4											
Lambs Canyon #2 (#24)		1		1									
Lambs Canyon #4 (#26)		1					2 (1NNSS6)						
Lambs Canyon Tank (#10)							6 (4NNSS6, 1NNSS4)						

Number of mountain lion images by animal number (if known) and observed pairs
Camera operational, no mountain lions detected
Camera not operational or unchecked

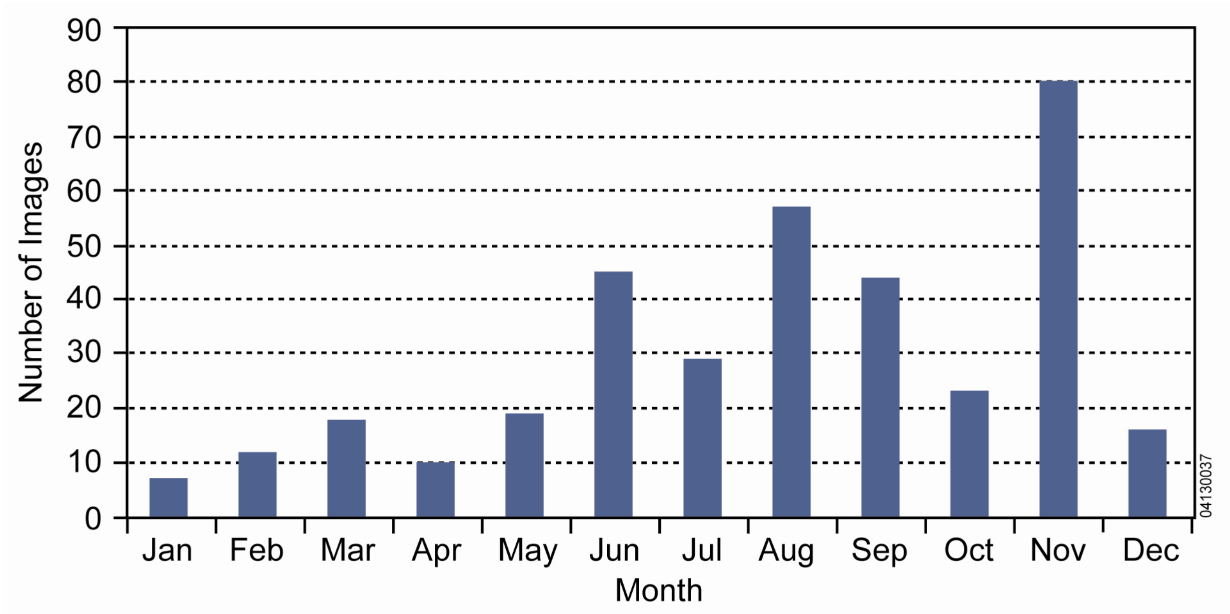

Figure 6-9. Number of mountain lion images by month for camera sites where mountain lions were detected from 2006 through 2012 (N = 360)

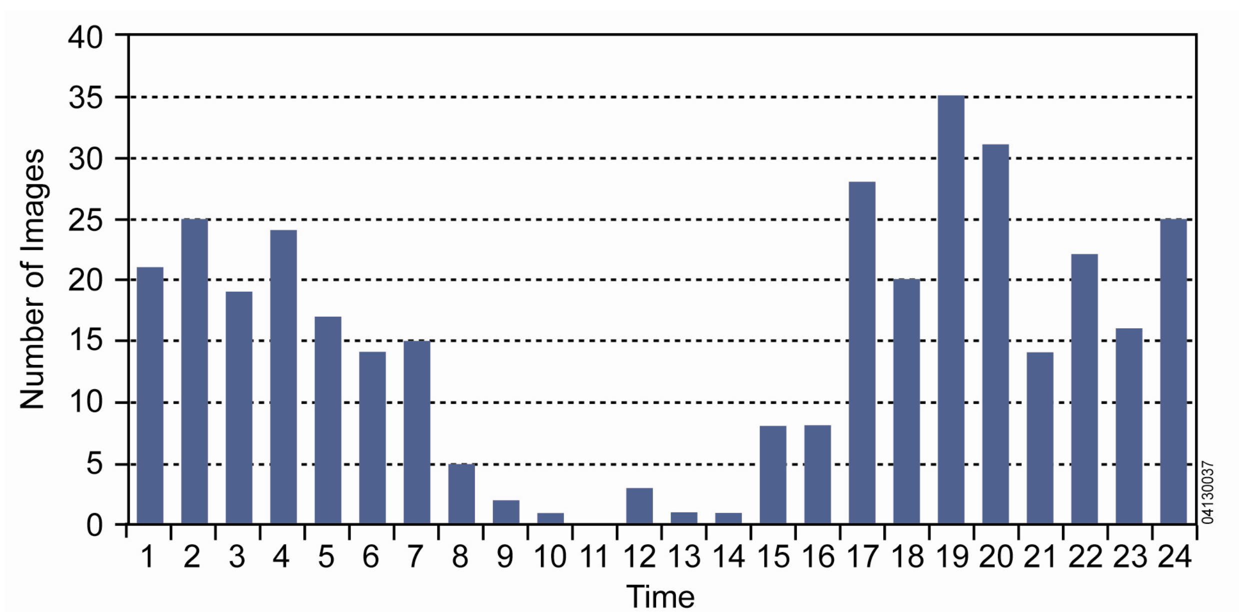

Figure 6-10. Number of mountain lion images by time of day (Pacific Standard Time) for camera sites where mountain lions were detected from 2006 through 2012 (N = 355)

A secondary objective of the camera surveys is to detect other species using these areas to better define species distributions on the NNSS. A total of 7,431 images of at least 34 species other than mountain lions were taken during 163,487 camera hours across all sites (Table 6-4). This is about 45 images per 1,000 camera hours. The most prevalent species photographed (60% of all images) was mule deer (4,490 images at 26 of 33 sites). Over 2,000 images of mule deer were taken at Captain Jack Spring. Also noteworthy is 1,278 images of chukar that were taken at Topopah Spring. Some of the rarer, more elusive species documented during camera surveys were desert bighorn sheep (see Section 6.6), bobcat (found at 17 of 33 sites), gray fox (*Urocyon cinereoargenteus*), badger (*Taxidea taxus*), ringtail cat (*Bassariscus astutus*), wild burro, Steller's jay (see Section 4.4), and great blue heron (*Ardea herodias*). Most (88%) of the photos (6,553 images) were taken at six sites: Gold Meadows Spring (#18), Topopah Spring (#9), Captain Jack Spring (#12), Twin Spring (#21), Camp 17 Pond (#6), and Lambs Canyon Tank (#10). A majority of images were taken during the summer and fall, which emphasizes the importance of these water sources for several wildlife species, especially during the drier months.

6.4.2 Mountain Lion Telemetry Study

A collaborative effort between Dr. David Mattson (USGS), Brian Jansen (trapper), and site biologists continued during 2012 to provide information to assess the risk of human encounters with mountain lions on the NNSS and determine what mountain lions eat and where they make their kills. Information from this effort provides information about their natural history and ecology as well. The NNSS and surrounding areas encompassing the Nevada Test and Training Range (NTTR), Tonopah Test Range, and Desert National Wildlife Range constitute one of the largest areas (over 15,540 km^2 [6,000 square miles]) in North America where human-caused mountain lion mortality is extremely low, and the size of area is large enough to allow for the emergence of population dynamics likely to typify an unexploited population of lions. This area is also located in some of the driest ecosystems in North America with relatively low prey densities. The goal for 2012 was to capture and radio-collar four mountain lions and track them for approximately 1 year.

Mountain lion trapping occurred from May 17 to June 17. Total trapping effort was 357 trap nights with 1–19 traps each night, with an average of 71 trap-nights per capture. Four mountain lions (three males and one female) were captured and GPS collared, and one male was unintentionally recaptured, for a total of five capture events. Trapping occurred in areas of Rainier Mesa, Pahute Mesa, and Timber Mountain.

A radio collar set to record six locations per day (every 4 hours starting at noon) was fitted on each animal. Body measurements, blood and hair samples (DNA and radiological testing), and a Nebuto strip sample (plague testing) were also taken. Mountain lions were designated as NNSS4, NNSS5, NNSS6, and NNSS7 in order of capture date and were tracked using the satellite GPS radio collars. Locations were recorded by the GPS unit on the radio collar and uploaded via satellite during a certain window of time each day. The data were processed and then sent to site biologists via email. Data were converted to Universal Transverse Mercator coordinates and plotted in ArcMap Version 10.0. Data were searched to identify clusters of locations that were within 100 m of each other typically over a minimum 12-hour period. Coordinates and maps were printed and taken to the field to search for kill sites. For purposes of this report, a kill site is defined as the area where a mountain lion killed and/or cached its prey. It was difficult to ascertain the exact spot where the prey was killed, but evidence of the kill such as burial sites, the carcass, bone fragments, rumen contents, and hair quite often remained. Once a kill site was found, information about the kill, such as prey species, sex, age, amount consumed, marrow color and consistency, number of burial sites, and dimensions of burial sites, was recorded. Habitat data such as elevation, aspect, slope, landscape position, vegetative cover, and dominant plant species were also documented. Additionally, the number of latrines, scats, and beds was recorded. A field sketch was made detailing where key features were located, and any other pertinent notes were made.

6.4.2.1 NNSS4

NNSS4 was captured on May 23, 2012, near Lambs Canyon on Pahute Mesa (Figure 6-11). It was a healthy, mature 7–9-year-old male that weighed 65 kilograms. It had a notch in its right ear, probably from fighting with another male, which helped biologists determine that this is the same animal as the notch-eared male detected by camera traps during 2011.

NNSS4's movements were tracked from May 23 to December 31, 2012 (Figure 6-12). The collar was still functioning at this point and data beyond this date will be included in the 2013 annual report. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS4's home range is 1,030 km^2. A study conducted in eastern Nevada between 1972 and 1982 found an average home range size of 580 km^2 for males (Ashman et al. 1983). NNSS4's home range is 1.8 times greater than the average found in eastern Nevada. From late May until late October, NNSS4 spent a majority of his time on east Pahute Mesa, Rainier Mesa, Big Burn Valley, the southern Belted Range, Gold Meadows, and Oak Spring Butte. These are the higher elevation areas dominated by single-leaf pinyon pine (*Pinus monophylla*), Utah juniper (*Juniperus osteosperma*), basin big sagebrush (*Artemisia tridentata tridentata*), antelope bitterbrush (*Purshia tridentata*), and Gambel oak (*Quercus gambelii*).

Figure 6-11. NNSS4 with notch in right ear, yellow ear tag in left ear, and radio collar. Also pictured is Brian Jansen.

(Photo taken by W. K. Ostler, May 23, 2012)

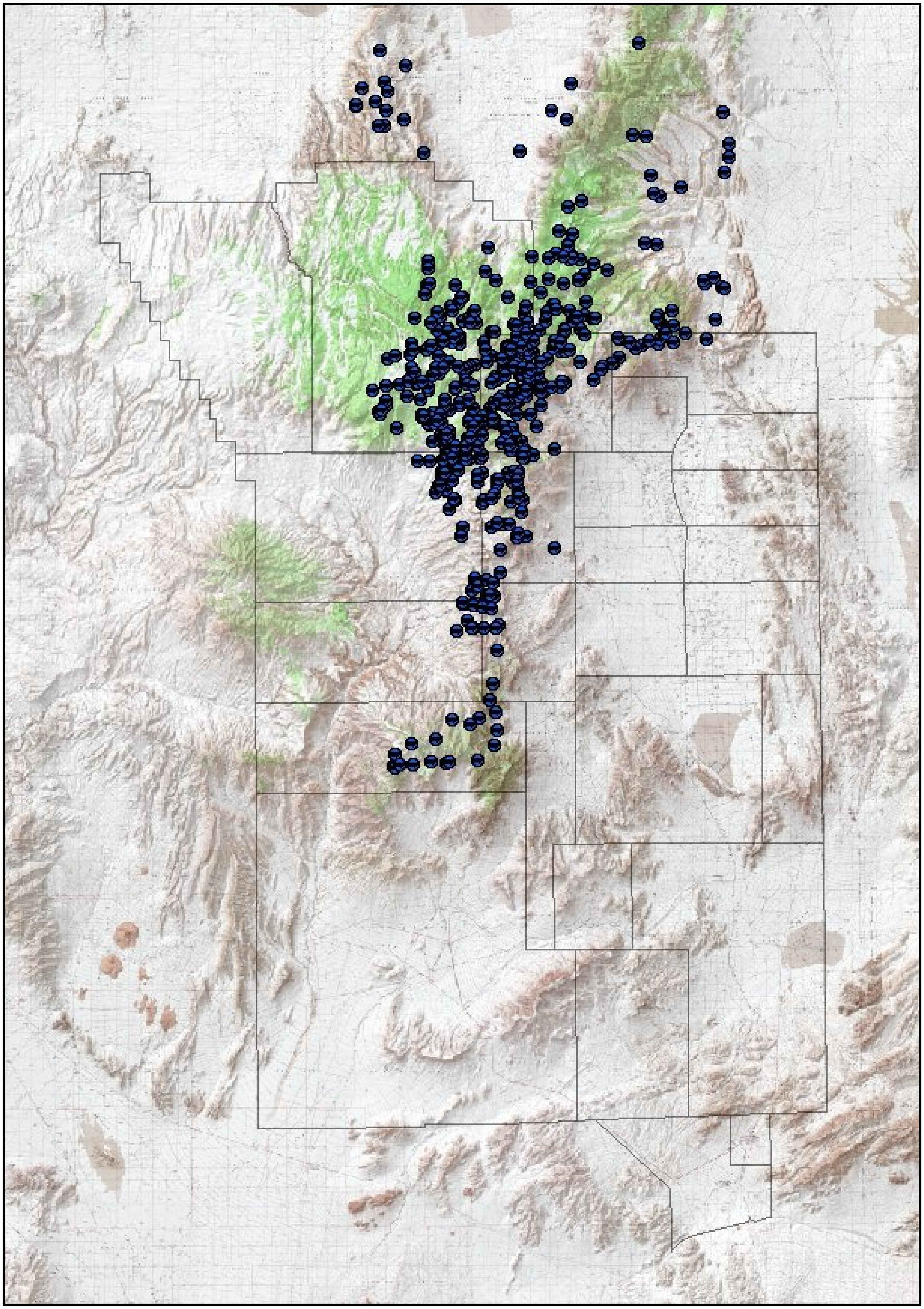

Figure 6-12. Documented locations of NNSS4 (May 23 to December 31, 2012)

These areas are also prime mule deer summer habitat. From late October to late December, NNSS4 shifted to lower elevation habitat on Shoshone Mountain, Eleana Range, Argillite Wash, east and west flank of the Belted Range, southern end of Kawich Range, and around the Wildhorse seeps; NNSS4 made one foray during mid-November to Rainier Mesa, Gold Meadows, and the Belted Range. These lower elevation areas contain pockets of high elevation habitat but are dominated by blackbrush, black sagebrush (*Artemisia nova*), rabbitbrush species (*Ericameria* and *Chrysothamnus* spp.), and desert bitterbrush (*Purshia glandulosa*). This shift to lower elevation corresponds with the timing of migration of mule deer off the mesas to their lower elevation winter range (Giles and Cooper 1985).

Of 49 clusters investigated, prey remains were found at 20 sites (Figure 6-13). A total of 20 individual prey were found, including 14 mule deer (6 bucks, 2 does, 4 fawns, 2 unknown), 5 horse foals (Figure 6-14), and 1 gray fox over a 219-day period from May 23 to December 28, 2012. Two clusters in the Belted Range were not checked due to access restrictions and remoteness. Of these two, one was most likely a mule deer (based on the habitat) kill site because NNSS4 stayed there for a week. The other cluster was considered a possible kill site, and NNSS4 was there for about 16 hours. Taking into account only visited clusters, NNSS4 made a kill, on average, every 11 days with time between kills ranging from 1 to 22 days. Assuming the two non-visited clusters were kills, NNSS4 made a kill, on average every 10 days. Of the 20 kills documented, one was found at a 2-point daytime cluster, one at a 2-point nighttime cluster, two at 3-point nighttime clusters and 16 at ≥4-point clusters. In order to detect all kills, all ≥2-point clusters would need to be checked. In order to detect 90% of kills, ≥3-point nighttime clusters would need to be checked. Time and logistic restraints make it difficult to visit all ≥2-point clusters, so it is suggested that these clusters be visited if feasible with a focus primarily on ≥3-point nighttime clusters.

6.4.2.2 NNSS5

NNSS5 was captured on June 3, 2012, east of Gold Meadows near Rainier Mesa (Figure 6-15). It was a healthy, 3–4-year-old male that weighed 55 kilograms. NNSS5's movements were tracked from June 3 to November 14, 2012 (Figure 6-16), when the collar malfunctioned and stopped transmitting data. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS5's home range is 760 km^2. This is about 1.3 times greater than the average male home range documented in eastern Nevada (Ashman et al. 1983). From early June until mid-November, NNSS5 spent a majority of his time at higher elevations of the Belted Range, Groom Range, east Pahute Mesa, Gold Meadows, and Oak Spring Butte. During mid-September and mid-October, he used lower elevation habitats on the eastern slope of the Belted Range. The last known location before the collar malfunctioned was at a kill site in Mouse Meadow, just north of Gold Meadows.

Due to logistical constraints and remoteness, only 22 of NNSS5's clusters were investigated. Kills were found at 14 sites including one double kill (mule deer doe and fawn). Twelve mule deer (two bucks, two does, seven fawns, one unknown), one pronghorn antelope (Figure 6-17), one unknown ungulate (most likely mule deer), and one unknown carnivore (most likely coyote) were documented (Figure 6-13). The pronghorn antelope kill is of interest because it is the first documented kill of this species on the NNSS, and it is not a very common prey item for mountain lions. An additional four clusters were most likely kill sites as well but could not be checked.

6.4.2.3 NNSS6

NNSS6 was captured on June 10, 2012, in the upper portion of Kawich Canyon (Figure 6-18). It was a 3–4-year-old female in fair body condition that weighed 34.6 kilograms. Her movements were tracked from June 10 to the first part of August (Figure 6-19) when she was found dead near Pillar Spring on the NTTR. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS6's home range for the brief time she was tracked is 257 km^2, which is 1.4 times greater than the average female home range documented in eastern Nevada (Ashman et al. 1983). The estimated

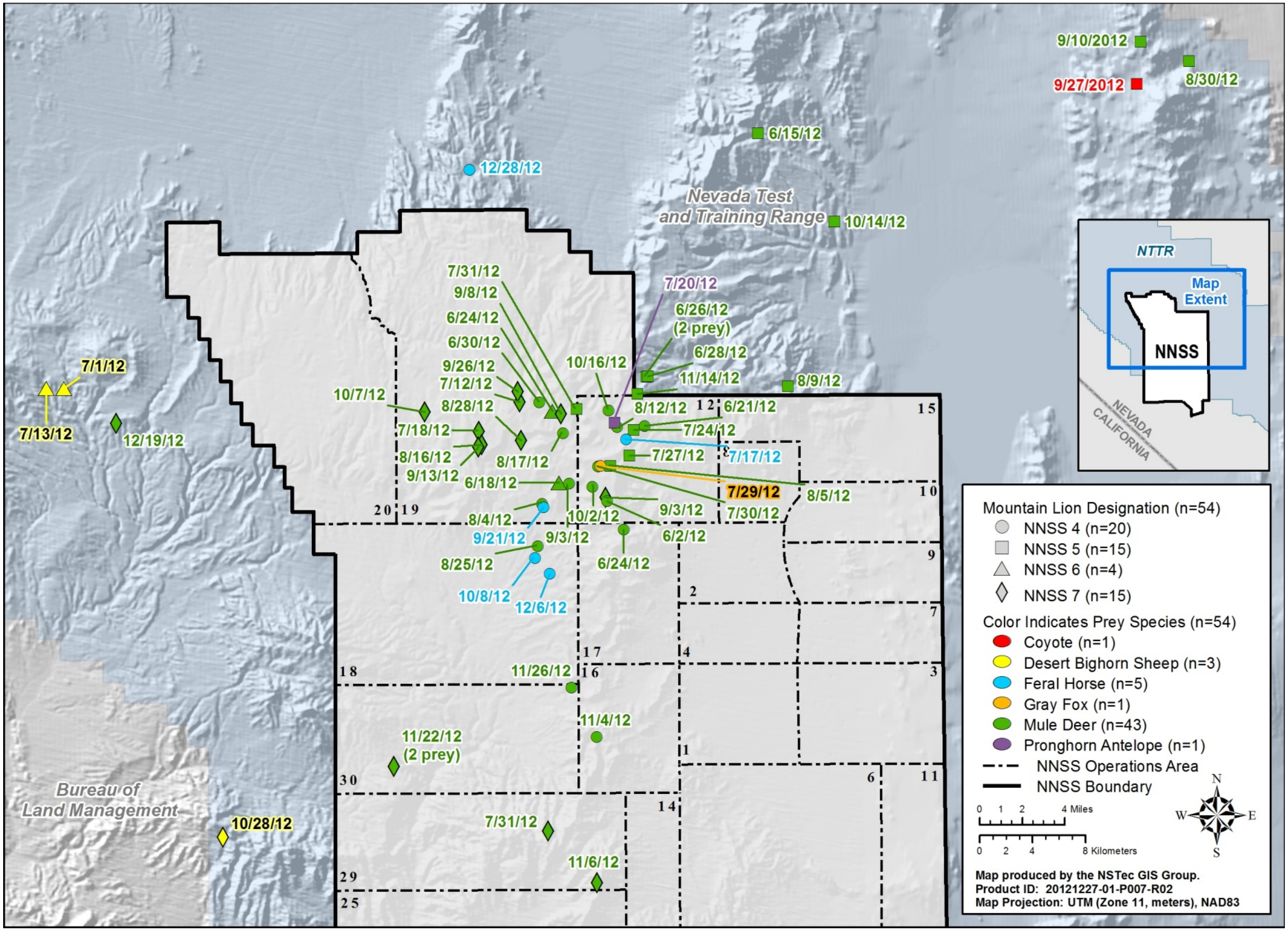

Figure 6-13. Kill site locations for NNSS4, NNSS5, NNSS6, and NNSS7 by prey type

Figure 6-14. Wild horse foal remains at mountain lion kill site, Area 18
(Photo by D. B. Hall, December 13, 2012)

Figure 6-15. NNSS5 with radio collar and orange ear tag in right ear. Also pictured is Brian Jansen.
(Photo by B. Jansen, June 3, 2012)

Figure 6-16. Documented locations of NNSS5 (June 3 to November 14, 2012)

Figure 6-17. Pronghorn antelope kill near Gold Meadows Spring, Area 12
(Photo taken by D. B. Hall July 31, 2012)

Figure 6-18. NNSS6 with pink ear tag in left ear and white ear tag in right ear and radio collar. Also pictured is Brian Jansen.
(Photo by B. Jansen, June 10, 2012)

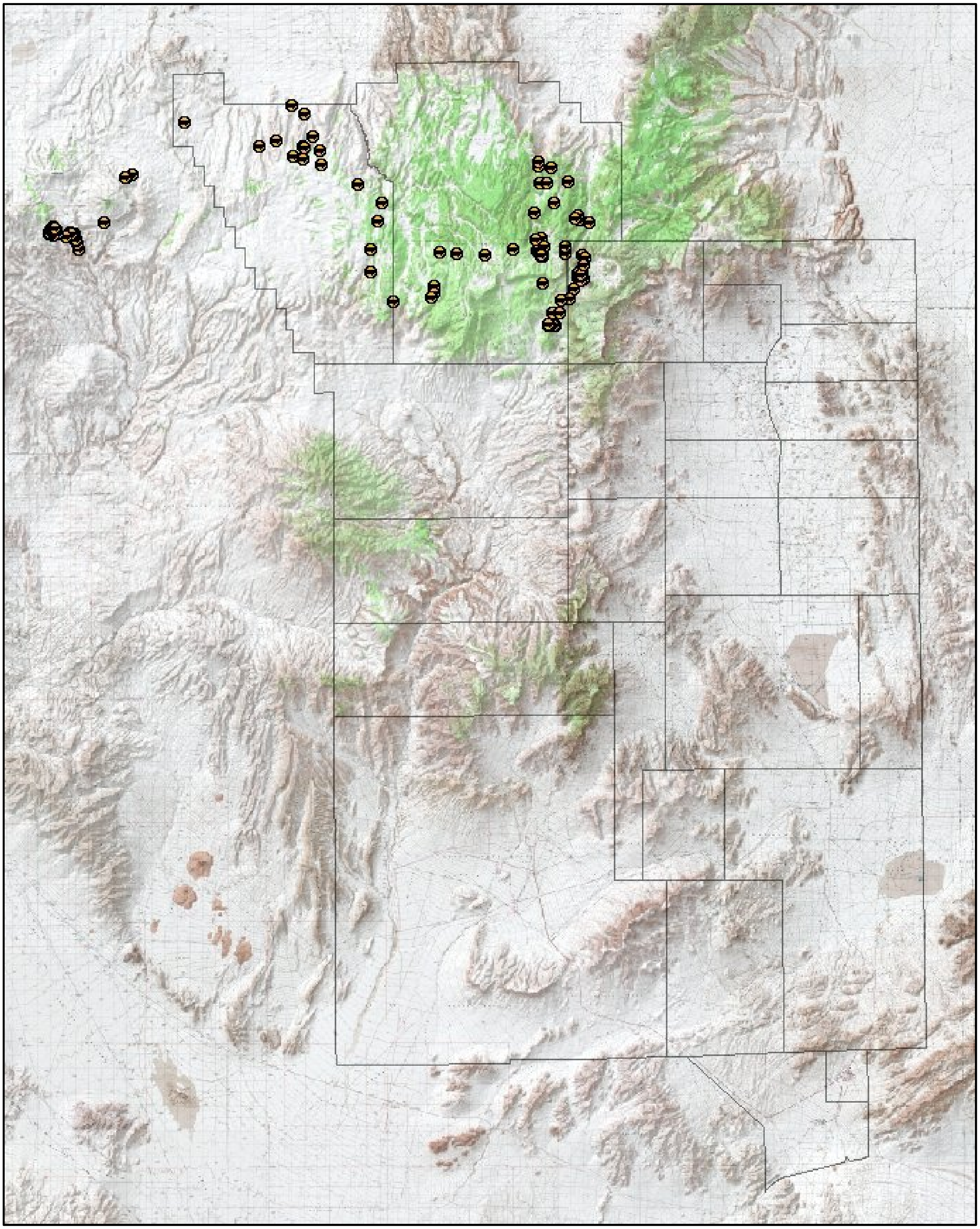

Figure 6-19. Documented locations of NNSS6 (June 10 to August 2, 2012)

date of death was August 2, 2012, based on movement data from the retrieved GPS radiotransmitter. During June she spent most of her time around Gold Meadows and on Rainier and Pahute Mesas. At the end of June, she headed west and spent the month of July and first couple of days in August in the vicinity of Thirsty Canyon and Pillar Spring. The exact cause of death may never be known. However, it does not appear that she starved to death because she killed at least two mule deer does (June 18 and 24) and two young bighorn sheep (July 1 and 13) at four of the fifteen clusters checked (Figure 6-13). The carcass did not show signs of being attacked by another mountain lion. Results from plague testing at the time of capture were negative, and radiological results at time of capture and post mortem did not show any elevated levels of tritium. The carcass was collected, and it is anticipated that the Nevada Department of Wildlife veterinarian will conduct a necropsy to help determine cause of death.

6.4.2.4 NNSS7

NNSS7 was captured June 17, 2012, on Timber Mountain just west of the NNSS boundary (Figure 6-20). It was a 3–4-year-old male in excellent condition that weighed 56 kilograms. His movements were tracked from June 17 to December 31, 2012 (Figure 6-21). The collar was still functioning at this point and data beyond this date will be included in the 2013 annual report. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS7's home range is 894 km^2, which is 1.5 times greater than the average male home range documented in eastern Nevada (Ashman et al. 1983). NNSS7 spent mid-June through late October on Timber Mountain, Yucca Mountain, Shoshone Mountain, and Rainier and Pahute Mesas. From late October through the end of December, he moved off the mesas and shifted to lower elevation habitat on Yucca Mountain, Shoshone Mountain, Timber Mountain, and Thirsty Canyon.

Figure 6-20. NNSS7 captured on Timber Mountain
(Photo taken by B. Jansen, June 17, 2012)

A total of 30 clusters were investigated and prey remains were found at 14 sites (Figure 6-13). At one site, two mule deer bucks had been killed (Figure 6-22). Fifteen prey items were documented including 14 mule deer (9 bucks, 1 doe, 2 fawns, 2 unknown) and 1 desert bighorn sheep over a 197-day period from June 17 to December 31, 2012. Large gaps in data acquisition occurred between June 18 to June 22, June 29 to July 6, and November 9 to 18, which could have resulted in missing clusters to check. Accounting for only visited clusters, NNSS7 made a kill, on average, every 13 days with time between kills ranging from 5 to 26 days. Assuming four kills were missed during 20 days of missing data, time between kills is 10 days. Of the 15 kills documented, at least 14 were found at ≥4-point clusters and one had missing data for 12 hours after the start of the cluster, so it may have been a ≥4-point cluster as well.

6.4.2.5 Risk to Humans

Only one observation of a mountain lion was reported to NNSS biologists by NNSS workers during 2012. It was seen along Tippipah Highway (Area 12) at 6:30 a.m. on December 11 in an area with several deer. Based on recorded locations for all four radio-collared mountain lions (Figure 6-23), it is evident that these animals prefer rugged, mountainous, typically forested habitat. It is also noteworthy that portions of each collared animal’s home range overlapped on Rainier and Pahute Mesas. From mid-May to late October, they used the higher elevation areas and then moved to lower elevations during November and December and presumably remain there through April or May. This coincides with the migration pattern of mule deer, their primary prey. Very few active projects occur in these areas, so the overall risk of human encounters with mountain lions on the NNSS appears to be quite low. However, at least six individual mountain lions (not necessarily all at the same time) were known to occur on Rainier Mesa and the eastern portion of Pahute Mesa between June and August, and at least two mountain lions used Shoshone Mountain for part of the year. Facilities in these areas include the Calico Hills firing range (Area 25), several tunnel complexes in Area 12 (e.g., G, V, and P Tunnels), and communication towers and power substations in Area 19 (Echo Peak and Pahute Mesa), Area 12 (DOE Point), and Area 29 (Shoshone Mountain). Personnel who work in these mountainous, remote areas (communication and power system maintenance workers, military personnel, etc.), especially at night, are most at risk and should be aware that mountain lions do occur around these facilities.

6.4.2.6 Plague and Radiological Testing

Bubonic plague can be a serious health issue if people are exposed to it. Mountain lions are known to carry the disease and, on rare occasions, have transmitted it to humans. In order to determine if mountain lions on the NNSS carried plague, Nebuto strips blotted with blood taken from NNSS4, NNSS5, NNSS6, and NNSS7 were submitted to the SNHD for plague testing. All samples tested negative for plague.

Blood samples from all four mountain lions were also tested for the presence of tritium, a human-made radionuclide persisting in some portions of the NNSS as a result of nuclear weapons testing. Site biologists wanted to know if mountain lions were being exposed to harmful doses of radiation on the NNSS and the potential dose to a human in the event the mountain lion left the NNSS and was shot and eaten. Detectable levels of tritium (14,491 picocuries/liter [pCi/L]) were only found in NNSS5. This is below the drinking water standard (20,000 pCi/L) set for safe human consumption by the Environmental Protection Agency and should not be harmful to the animal or someone eating the animal (Code of Federal Regulations 2010).

In addition, samples were taken from the remains of nine mule deer and two horses killed by mountain lions and analyzed for tritium content. Two mule deer samples had enough muscle tissue to be analyzed for cesium-137 in addition to tritium. No detectable cesium-137 was found in the two samples, and no detectable tritium was present in either of the horses sampled. Detectable amounts of tritium were found in three mule deer killed by three different mountain lions, NNSS4, NNSS5, and NNSS7. Of most interest is the 7-5 sample killed by NNSS7. The deer was a mature female killed north of the 19-01 Road

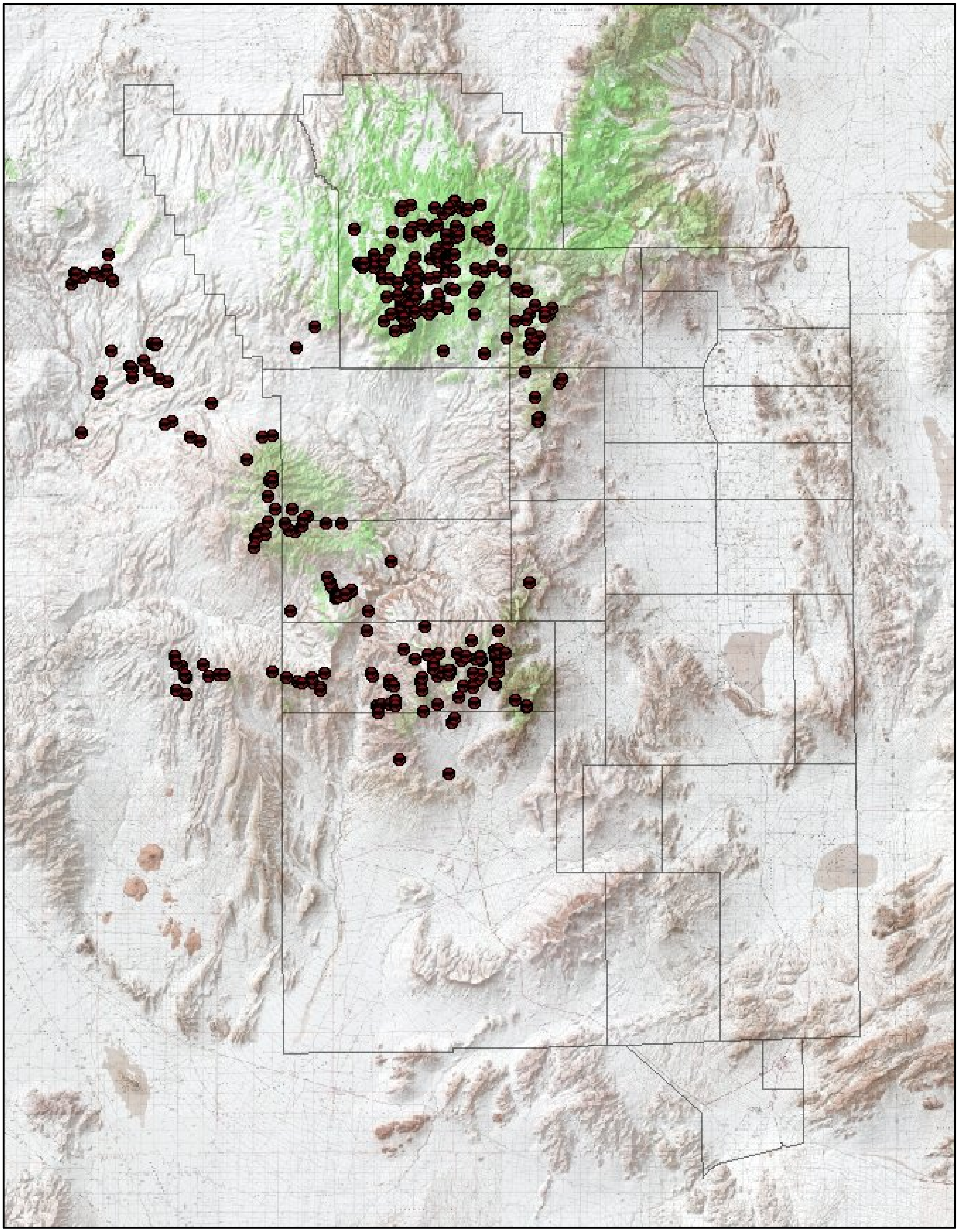

Figure 6-21. Documented locations of NNSS7 (June 17 to December 31, 2012)

Figure 6-22. Two mature bucks killed by NNSS7, Chukar Canyon (Area 30)
(Photo by D. B. Hall, November 27, 2012)

(Area 19) on July 12, 2012 (Figure 6-13). It contained 425,000 pCi/L of tritium, which is more than 20 times the drinking water standard. Although this is a relatively high concentration, the dose received by this animal or any animals eating it is well below any dose expected to be harmful (U.S. Department of Energy 2002). Based on the spatial configuration and timing of deer migration movements relative to known tritium concentrations, the likely source of tritium was UE-20N #1 because more than 61,000 liters of contaminated water was pumped into a sump in late May 2012 with a tritium concentration of 42,836,666 pCi/L. Sample 5-5 was a 2–3-year-old buck killed by NNSS5 in Gold Meadows (Area 12) on July 24, 2012 (Figure 6-13). It contained 26,300 pCi/L of tritium, slightly more than the drinking water standard. Sample 4-11 was a mature mule deer killed north of the 19-01 Road (Area 19) on June 30, 2012 (Figure 6-13). It contained 1,190 pCi/L of tritium, well below the drinking water standard.

These results indicate that mountain lions and mule deer can uptake detectable levels of tritium from the environs of the NNSS by drinking contaminated water or eating contaminated plants and animals. These data also suggest that during dry periods, when animals partially rely on stored water (e.g., contaminated sumps), uptake of tritium can be more prevalent than during wetter periods when ephemeral water is more readily available across the landscape. It is important to underscore the fact that even though tritium was detected in some of the animals sampled, the potential dose to both the animal or other animals, including people, eating it is well below levels considered harmful (U.S. Department of Energy 2002).

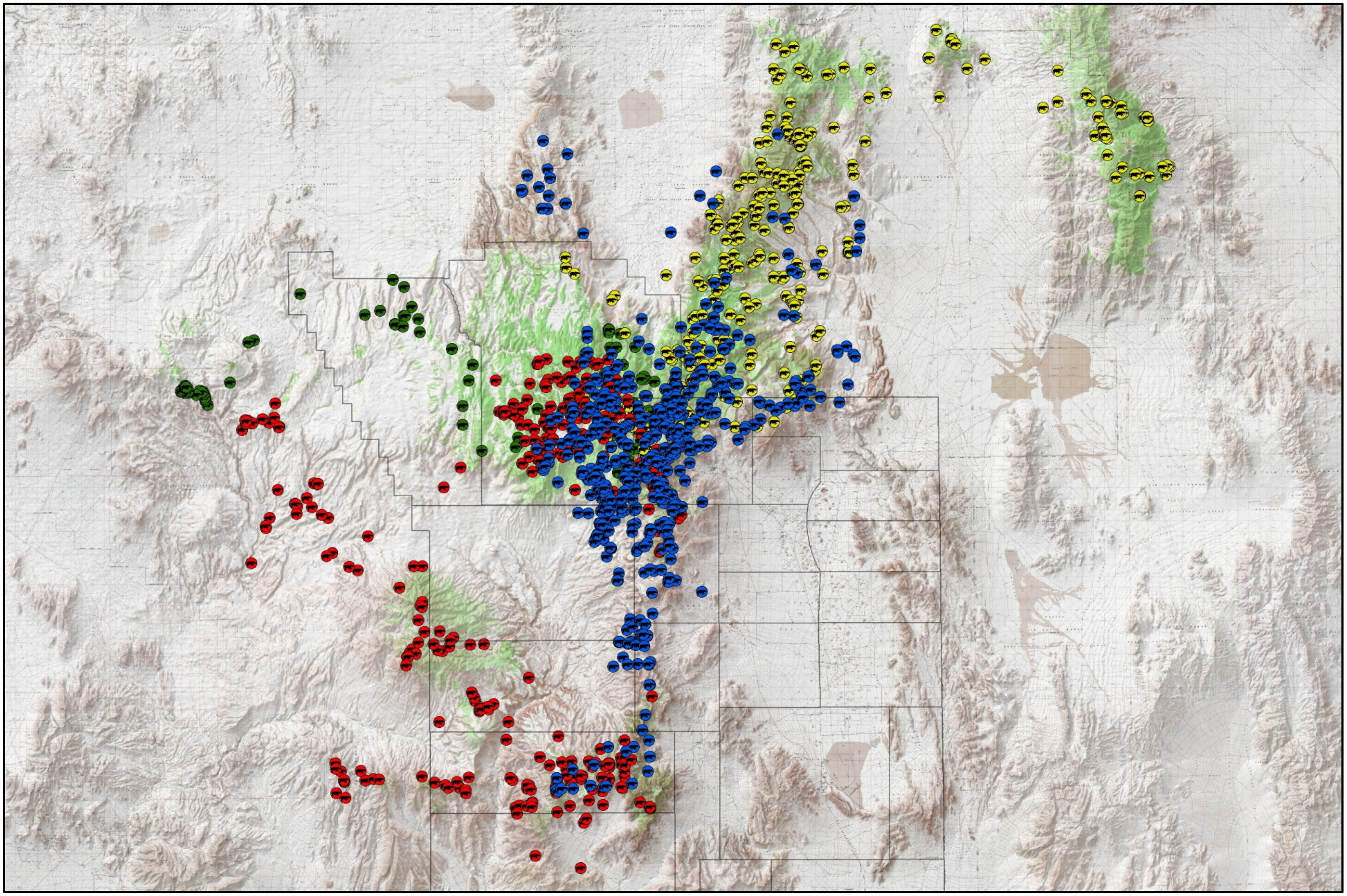

Figure 6-23. Recorded locations for NNSS4 (blue dots), NNSS5 (yellow dots), NNSS6 (green dots), and NNSS7 (red dots), May 23 through December 31, 2012

6.5 Raptors and Bird Mortality

6.5.1 Raptors

Historically, 16 species of raptors have been recorded on the NNSS. Raptors include vultures, hawks, kites, eagles, ospreys, falcons, and owls. All are protected/regulated under the *Migratory Bird Treaty Act* and/or Nevada State law. Because these birds occupy the higher trophic levels of the food chain, they are regarded as indicators of ecosystem stability and health. There are nine raptor species known to breed on the NNSS, including the western burrowing owl (Hunter 1994).

6.5.2 Bird Mortality and Compliance with the Migratory Bird Treaty Act

Bird mortality is a measure of impacts that NNSA/NFO activities may have on protected bird species. NNSA/NFO activities that have affected birds typically have been of three types: collisions with buildings, electrocution from power lines, and vehicle mortalities. Workers are relied on to observe and report mortalities. Historically, reported deaths of birds are sometimes numerous, with episodes of predation and disease outbreaks involving larger numbers of dead birds often during wet years (Figure 6-24).

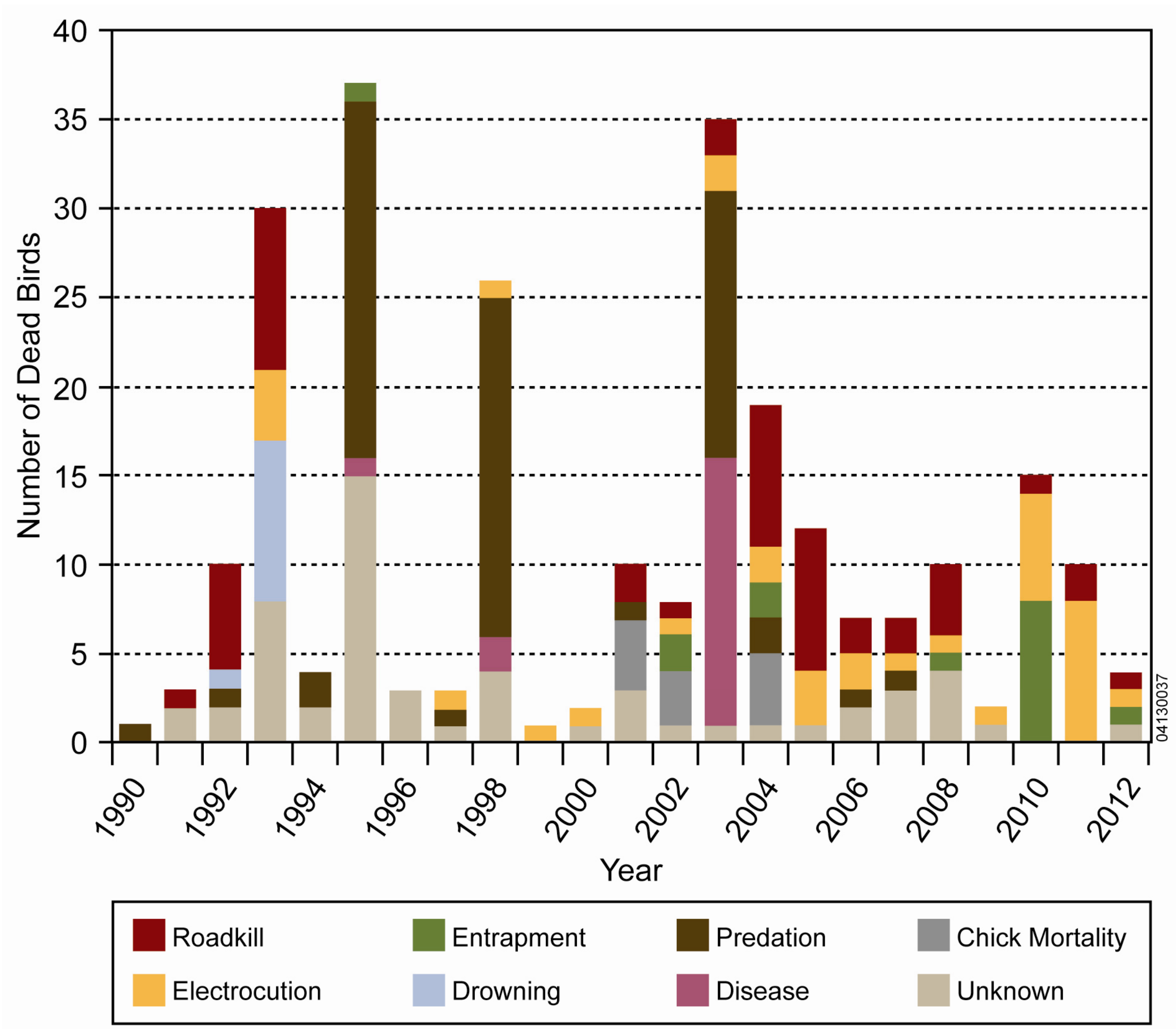

Figure 6-24. Historical records of reported bird deaths on the NNSS through 2012

There were only four reported bird mortalities in 2012; one common raven (*Corvus corax*) was electrocuted by power lines, one great horned owl (*Bubo virginianus*) was killed by a vehicle, one sharp-shinned hawk (*Accipiter striatus*) was found dead of unknown causes, and one brown-headed cowbird (*Molothrus ater*) died from getting stuck on a glue trap placed on the floor for pest control. It was concluded that pole lines could be surveyed for bird use prior to the nesting season to help prevent problems from nesting alone. Overall, few impacts to birds were observed and few mortalities were reported from onsite project activities. Impacts to bird populations from NNSA/NFO activities at the NNSS appear to be low.

On December 10, 2012, a raptor nest on a power line pole located in Area 1 was visited and recommended for removal or protection. On December 31, the Power Utilities group, led by Mr. Robert Gang and Facility Manager Michelle Kelly, retrofitted several exposed electrical lines within 1–1.5 m of the previously occupied red-tailed hawk nest. They installed extra electrical insulation on the three energized drop down lines to the transformer boxes (Figure 6-25). This is an example of mitigating a situation where raptors and eagles are at risk of electrocution. This action is the first of its kind and may be recommended at other power poles on the NNSS with nests.

Figure 6-25. Photo of red-tailed hawk nest in Area 1 retrofitted with insulation bushings (top) on electrified lines to reduce electrocution risk

(Photo by R. Gang, December 31, 2012)

To reduce electrocutions of eagles and raptors on power line systems, the Avian Power Line Interaction Committee (2006) recommends that the vertical and horizontal distance between any grounded element and any energized element on a power line system be limited to 102–152 cm depending on the position of the elements in question. These recommendations are based on the wingspans, more specifically wrist-to-wrist distance, of raptors and especially eagles, which can reach up to 152 cm length when extended for flight. When raptors land or attempt to fly from a nest/perch, their wings may connect any available ground-to-power or power-to-power elements, which can cause electricity to flow through the bird, causing death. In addition, these situations can also result in costly power outages in the system or even wildland fires. Reducing the number of exposed grounding and electrified elements near bird perching situations should prove to be a win-win situation for the raptors and humans.

6.6 Desert Bighorn Sheep and Elk Sightings

Up until a few years ago, desert bighorn sheep appeared to be rare on the NNSS with only eight recorded observations of their presence on or near the NNSS between 1963 and 2009. These observations were recorded in the southern part of the NNSS (Areas 5, 23, and 25). Motion-activated cameras set at various locations to monitor mountain lions have detected one to three rams at Topopah Spring (Figure 6-8, Site #9) during 2009, 2010, and 2011 and one ram at Chukar Canyon (Figure 6-8, Site #22) on October 26, 2011. Additionally, data from the mountain lion telemetry study documented the presence of ewes and lambs in the Yucca Mountain and lower Fortymile Canyon area during 2011, which suggests there is a previously undetected, resident, reproducing herd of desert bighorn sheep on the NNSS. Between December 25, 2011 and January 2, 2012, 14 photos of three rams were taken by a motion-activated camera at Topopah Spring (Figure 6-8, Site #9). Additional photos, also of a ram, were taken on June 25 (one photo) and September 22 (two photos, one with a mule deer). At a tank in Lambs Canyon on north Pahute Mesa (Figure 6-8, Site #10), a motion-activated camera took 40 pictures of a ram between June 16 and July 4, 2012 (Figure 6-26). On April 18, 2012, six rams were seen in the Mercury Pass area on 200 Hill. These new data have expanded the known distribution of desert bighorn sheep on the NNSS. It is unknown if they have always occurred and just went undetected or if they are colonizing new areas on the NNSS. No desert bighorn sheep were documented to have been killed by radio-collared mountain lions on the NNSS, but NNSS6 killed two young bighorns near Pillar Spring on the NTTR, and NNSS7 killed a bighorn on the west side of Yucca Mountain.

In the future, surveys may be conducted to census the population and determine the residency status of this species on the NNSS. Periodic population counts after getting the baseline population may be used to determine trends in desert bighorn sheep. Desert bighorn sheep are a major game species in Nevada, and hunting units are in close proximity to the NNSS. Characterizing radionuclide burdens of sheep found on site and determining their movement patterns off site into huntable areas is important to assess as a potential dose pathway to humans.

During mountain lion trapping efforts in 2012, Brian Jansen found a partial bull elk skull in the upper portion of Lambs Canyon on May 25. No other elk sightings were documented. Further monitoring will be conducted to determine if elk return to the NNSS.

Figure 6-26. Desert bighorn sheep ram at Lambs Canyon Tank
(Photo by motion-activated camera, June 16, 2012)

6.7 Nuisance and Potentially Dangerous Wildlife

During 2012, site biologists responded to 25 calls regarding nuisance, injured, or potentially dangerous wildlife in or around buildings, power lines, and work areas. Problem or injured animals included bats (6 calls), birds (11 calls), coyotes (4 calls), venomous snakes (3 calls), and swarming bees (1 call). Mitigation measures taken usually involved moving the animal away from people or disposing of dead animals. On several occasions, coyotes were chased out of facilities with an air-soft rifle to try to instill fear of humans in animals that were too comfortable around people because they had been fed. Notices were also communicated via radio, e-mail, safety meeting presentations, and various company publications to alert people to potentially dangerous situations involving wildlife and to remind employees not to feed wild animals on the NNSS.

6.8 Coordination with Biologists and Wildlife Agencies

A site biologist attended the annual Nevada Bat Working Group in December. He is also serving on the White Nose Syndrome Committee of the Western Bat Working Group, which is implementing an action plan to try to prevent White Nose Syndrome from spreading to the western United States, and the Bat Conservation Assessment Committee of the Western Bat Working Group to re-assess the conservation status of bat species in western North America. A site biologist attended the Southwest Partners in Amphibian and Reptile Conservation meetings in Las Vegas in October and presented a paper on western red-tailed skink distribution on the NNSS. A similar paper on western red-tailed skink distribution was also presented at the Nevada Chapter meeting of The Wildlife Society in Reno, Nevada, in January.

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7.0 HABITAT RESTORATION MONITORING

7.1 CAU 110, U-3ax/bl Closure Cover

The closure cover for Corrective Action Unit (CAU) 110, U-3ax/bl, located in Area 3 of the NNSS, was completed in the fall of 2000. Following completion, actions were taken to reestablish a cover of native vegetation on the closure cover. Revegetation activities were completed in December 2000. The plant community on the closure cover has been monitored annually since the spring of 2001. Monitoring is performed to document the establishment of a native plant community and to identify any remedial actions that may be necessary to ensure the plant community persists.

Growing season precipitation, which includes precipitation recorded between October 2011 and May 2012 at the BJ Wye weather station, is 4.6 cm or about one-third the average precipitation for this period. This compares to a previous low growing season precipitation of 4.3 cm in 2007 and 4.1 cm in 2002. There were no major precipitation events during the 2012 growing season. The most precipitation received was a 2-day storm in April when about 1.5 cm of precipitation was recorded.

Precipitation amounts recorded during the first part of the growing season (October to December 2011) was 24% of the average precipitation received during this period. There was a little more precipitation during the next 5 months (January to May 2012), but it was still only 44% of the average amount of precipitation received during this period.

7.1.1 Cover

Plant cover on the closure cover this year was 13% (Table 7-1). *Atriplex confertifolia* (Shadscale saltbush) cover was 12.6% and *Ephedra nevadensis* (Nevada jointfir) was 0.4%, accounting for 100% of the total plant cover this year. There were no perennial grasses, forbs, or invasive plants on the closure cover in 2012.

Total plant cover in 2012 was the second lowest recorded over the last 5 years. The 13% shrub cover this year actually represents the second highest cover recorded for shrubs over the last 5 years. Even though plant cover was relatively low this year, it still exceeds the reclamation success standard of 10.2%.

Table 7-1. Percent plant cover and density (plants/m^2) on the U-3ax/bl closure cover in 2012. The success standard represents 70% of the cover or density reported for the reference area.

	Plant Cover		Plant Density	
Lifeform	**Closure Cover**	**Standard**	**Closure Cover**	**Standard**
Shrubs	13.0	10.2	1.3	0.5
Grasses	0.0	0.0	0.0	0.1
Forbs	0.0	0.0	0.0	0.0
Invasives	0.0	0.0	0.0	0.0
Total	**13.0**	**10.2**	**1.3**	**0.6**

7.1.2 Density

Plant density this year averaged 1.3 shrubs/m^2 (Table 7-1) and was composed of three perennial native shrubs: *A. confertifolia*, *E. nevadensis*, and *Krascheninnikovia lanata* (winterfat). As in past years *A. confertifolia* was the most abundant species present. The only other plants encountered this year were Nevada jointfir and winterfat. A single *K. lanata* plant was encountered during sampling; however, several others were observed on the closure cover. Perennial grasses have been absent from the closure cover the last 5 years. Forbs and invasive plants are typically present when precipitation is more abundant.

This year is a good example of the importance of the perennial plants on the closure cover. Even in times of extreme drought conditions, perennial plants persist. Total plant density in 2012 was 1.3 plants/m^2, which is the lowest total density recorded at the U-3ax/bl closure cover site. The highest plant density of 125 plants/m^2 was recorded just 2 years ago. The average plant density since the site was revegetated is 46 plants/m^2, and over the last 5 years, plant density has averaged slightly below 36 plants/m^2. The plant density of 1.3 plants/m^2 in 2012 exceeds the reclamation success standard (Table 7-1).

7.1.3 Species Richness

The average species richness values over the last 5 years on the closure cover have ranged from a low this year of 1.0 species/quadrat to a high of 7.5 species/quadrat in 2010. This year shrubs accounted for 100% of the 1.0 species/quadrat. There were no perennial grasses on the closure cover this year nor have there been any the last 5 years. Species richness values for forbs have ranged from 0 this year to 4.9 species/quadrat in 2010. It is obvious that the variation in total species richness values over the last 5 years is directly correlated with the presence of forbs (Table 7-2). *A. confertifolia* and *E. nevadensis* are the most common shrubs encountered.

Table 7-2. Average species richness for the closure cover and reference site in 2012. Species richness is defined as the average number of different species found within a m^2 quadrat.

	Closure Cover	Standard
Shrubs	1.0	0.5
Grasses	0.0	0.1
Forbs	0.0	0.0
Invasive	0.0	n/a
Total Species	**1.0**	**0.6**

The average species richness value for the reference area averaged for 2010 and 2011 is 4.5 species/quadrat, including 0.7 shrub species/quadrat, 0.2 grass species/quadrat, and 3.6 forb species/quadrat.

The standard for reclamation success based on species richness values in 2012 takes into account values for shrubs and grasses only, because there were no forbs on the reference area this year or on the closure cover. Based on shrubs and grasses, the revegetation success standard would be 0.6 species/quadrat. Species richness values for the closure cover (Table 7-2) exceed the revegetation success standard in 2012.

7.1.4 Remedial Revegetation

The survival of the 125 shrubs planted at three small areas on the eastern edge of the closure cover was evaluated in May 2012. As of May 2012, 26% of the transplants planted in March 2010 have survived. *K. lanata* survival had the highest survival percentage at 45%, followed by *Eriogonum fasciculatum* (Eastern Mojave buckwheat) (40%) and *E. nevadensis* (30%). *Grayia spinosa* (Spiny hopsage) and *Chrysothamnus viscidiflorus* (yellow rabbitbrush) showed the lowest percentage survival.

7.1.5 Summary/Recommendations

The plants that have established on the CAU 110, U-3axbl closure cover continue to show signs of stability. Perennial plant, mainly shrub, cover and density have maintained at essentially the same levels over the last 5 years (Figure 7-1). No significant declines have been noted nor have there been significant increases in shrub cover and density. This year was a unique year in that little precipitation was received at the closure site and there were declines in overall plant cover. The decrease however was due to the complete absence of annual forbs. Shrub cover and density have maintained at about the same levels for the last 5 years. Overall, there are no major concerns for the plant community that has established on the U-3ax/bl closure cover.

Revegetation success this year was based primarily on the cover, density, and species richness for shrubs because they were the only plants present on the closure site and on the reference site. As has been the case in previous years, plant cover on the closure cover exceeded revegetation success standards in 2012. The same held true for plant density and species richness. Revegetation success was based solely on values for shrub cover, density, and species richness. The lack of perennial grasses continues to be the most obvious difference between the plant community on the reference site and on the closure cover. Perennial grasses were present the first few years after the site was revegetated but have not persisted since then. Grasses are not a major component of the native plant community but they are present.

Invasive weeds can be a concern but not this year. There were no invasive weedy species present on the closure cover or on the reference site this year. There was an absence of annual plants in 2002 and 2007 also.

A few of the transplants used in the revegetation of the new disturbances on the eastern edge of the closure cover are becoming established, although a number of them were lost during additional work at the site.

7.2 CAU 400, Five Points Landfill

In 1997, CAU 400, Five Points Landfill, on the Tonopah Test Range (TTR) was seeded with a mix of native shrubs and grasses. The site was mulched with straw, which was crimped into the soil. The site was protected from grazing animals (e.g., horses and rabbits) with a 1.2-m barbed wire fence and 0.6 m of chicken wire along the base of the fence. A flash flood swept through the site in 2003. The fence was damaged, and much of the vegetation through the center of the site was lost. The fence was repaired, and the site was re-seeded in 2004. The site flooded again in 2006, and much of the lower portion of the site was covered with several inches of sediment. No remedial action was taken.

Monitoring was performed on June 5, 2012. Plant cover and density were recorded, wildlife usage was noted, and erosion was evaluated. Species richness was calculated from density data. The number of different plant species within each quadrat was averaged over all quadrats. This provides an indication of the diversity or heterogeneity of the plant community. Wildlife usage was determined from the presence of animals, burrows, or scat, and browsing by animals. Erosion was measured by observing erosion channels or exposed plant roots.

In 2012, five transects were sampled, two in the area that had not flooded (staging area) and three in the area that was flooded and re-seeded in 2004. The reference area was sampled from 2000 to 2010, and data collected during that period were averaged to determine reclamation success standards.

Figure 7-1. Perennial plant cover on the U-3 ax/bl closure cover. *E. nevadensis* and *A. confertifolia* are the most common shrubs.
(Photo taken by D. Anderson, May 23, 2012)

7.2.1 Plant Cover

Total plant cover on the staging area was a mix of perennial shrubs and grasses (Table 7-3). *Atriplex canescens* (Fourwing saltbush) was the single shrub species and made up approximately 86% of the total plant cover. *Achnatherum hymenoides* (Indian ricegrass), a perennial grass, made up the remaining 14% of the plant cover. There were no forbs or invasive weedy species on the site this year. Plant cover on the flooded and re-seeded area was 9% and was made up of one perennial shrub species, *A. canescens*. There were no perennial grasses or annual forbs, including invasive weeds, on the re-seeded area this year.

The 10-year average for plant cover on the reference area was 17%, which included 8% shrubs, 5% grasses, and 4% forbs. *Chrysothamnus greenei* (Greene's rabbitbrush) and *A. canescens*, two perennial shrubs, made up all the shrub cover. *A. hymenoides,* the only perennial grass, made up approximately 28% of total plant cover. Although non-invasive forbs and invasive weeds typically make up 23% of total plant cover, there were no forbs or invasive species on the reference area this year.

7.2.2 Plant Density

Total plant density on the staging area was 0.96 plants/m^2, including 0.73 shrubs/m^2, 0.20 grasses/m^2, and 0.03 forbs/m^2 (Table 7-4). Four perennial species, *A. canescens*, *Picrothamnus desertorum* (bud sagebrush), *A. hymenoides*, and *Pleuraphis jamesii* (James' galleta grass), were encountered on the staging area. Forb density, represented by a few *Mentzelia albicaulis* (whitestem blazingstar) plants, was 0.03 plants/m^2, indicative of a dry year.

Table 7-3. Percent plant cover on CAU 400, Five Points Landfill

		Staging	Re-Seeded	Reference	Standard
SHRUBS	*Atriplex canescens* (Fourwing saltbush)	7.7	9.3	1.6	
	Chrysothamnus greenei (Greene's rabbitbrush)	0.0	0.0	6.6	
	Total Shrub Cover	**7.7**	**9.3**	**8.2**	**5.7**
GRASSES	*Achnatherum hymenoides* (Indian ricegrass)	1.3	0.0	4.9	
	Sporobolus cryptandrus (Sand dropseed)	0.0	0.0	0.1	
	Total Grass Cover	**1.3**	**0.0**	**5.0**	**3.5**
FORBS	*Eriogonum* species (Buckwheat)	0.0	0.0	0.2	
	Cryptantha species (Cryptantha)	0.0	0.0	0.1	
	Eriastrum eremicum (Desert woollystar)	0.0	0.0	0.2	
	Nama pusillum (Eggleaf fiddleleaf)	0.0	0.0	0.2	
	Chaenactis stevioides (Esteve's pincushion)	0.0	0.0	1.0	
	Eriogonum deflexum (Flatcrown buckwheat)	0.0	0.0	0.1	
	Lupinus species (Lupine)	0.0	0.0	0.1	
	Gilia nyensis (Nye gilia)	0.0	0.0	0.7	
	Cymopteris species (Springparsley)	0.0	0.0	0.1	
	Oenothera caespitosa (Tufted evening primrose)	0.0	0.0	0.3	
	Descurainia pinnata (Western tansymustard)	0.0	0.0	0.1	
	Mentzelia albicaulis (Whitestem blazingstar)	0.0	0.0	1.1	
	Total Forb Cover	**0.0**	**0.0**	**4.2**	**2.9**
INVASIVE WEEDS	*Salsola iberica* (Prickly Russian thistle)	0.0	0.0	0.3	
	Total Invasive Weed Cover	**0.0**	**0.0**	**0.3**	
TOTAL PLANT COVER		**9.0**	**9.3**	**17.7**	**12.1***
Bare Ground		60.2	74.8	68.2	
Litter		30.8	15.9	14.5	

* Does not include invasive weeds

Total plant density on the re-seeded area was 0.33 plants/m^2. Shrub density was 0.30 plants/m^2. There were no perennial grasses and 0.03 forbs/m^2. *A. canescens* was the only shrub present. The only forbs present were a few *Sphaeralcea ambigua* (desert globemallow) plants.

The 10-year average density on the reference area was 25.43 plants/m^2. There were 0.82 shrubs/m^2. *C. greenei* had the highest density, followed by *A. canescens* and *K. lanata*. Grass density was 1.61 grasses/m^2 and was predominantly *A. hymenoides* with a few isolated *Elymus elymoides* (squirreltail), *Sporobolus cryptandrus* (sand dropseed), and *P. jamesii* plants. Forb density was 21.4 forbs/m^2.

7.2.3 Species Richness

Species richness varies based on the timing and amount of precipitation. Precipitation was below average this year, resulting in a decrease and near absence of forbs. On the staging area, there was an average of 0.8 species per quadrat (Table 7-5). Two shrubs, *A. canescens* and *P. desertorum*, and two grasses, *A. hymenoides* and *P. jamesii*, were encountered on the staging area. Forbs are typically common on the staging area, but there was only one species, *M. albicaulis*, this year.

Table 7-4. Plant density (plants per m^2) on CAU 400, Five Points Landfill

		Staging	Re-Seeded	Reference	Standard
SHRUBS	*Picrothamnus* desertorum (Bud sagebrush)	0.03	0.0	0.0	
	Atriplex canescens (Fourwing saltbush)	0.7	0.3	0.1	
	Chrysothamnus greenei (Greene's rabbitbrush)	0.0	0.0	0.7	
	Krascheninnikovia lanata (Winterfat)	0.0	0.0	0.02	
	Total Shrub Density	**0.73**	**0.3**	**0.82**	**0.6**
GRASSES	*Achnatherum hymenoides* (Indian ricegrass)	0.1	0.0	1.6	
	Pleuraphis jamesii (James' galleta grass)	0.1	0.0	0.01	
	Total Grass Density	**0.2**	**0.0**	**1.61**	**1.1**
FORBS	*Sphaeralcea ambigua* (Desert globemallow)	0.0	0.03	0.7	
	Mentzelia albicaulis (Whitestem blazingstar)	0.03	0.0	0.9	
	Other forbs	0.0	0.0	19.8	
	Total Forb Density	**0.03**	**0.03**	**21.4**	**15.0**
INVASIVE WEEDS	**Total Invasive Weed Density**	0.0	0.00	1.6	
TOTAL PLANT DENSITY		**0.96**	**0.33**	**25.43**	**16.7***

* Does not include invasive weed density

Species richness on the re-seeded area was 0.2 species per quadrat (Table 7-5). *A. canescens* was the only perennial shrub species found on the re-seeded area. The only other species on the re-seeded area was *S. ambigua*, a perennial forb.

Table 7-5. Species richness (species per m^2 quadrat) on CAU 400, Five Points Landfill

	Staging	Re-Seeded	Reference	Standard
Shrubs	0.5	0.2	0.6	0.4
Grasses	0.2	0.0	0.9	0.6
Forbs	0.1	0.03	2.6	1.8
Total Species	**0.8**	**0.23**	**4.1**	**2.8**

Species richness on the reference area averaged 4.1 plants per quadrat. *C. greenei* and *A. canescens* were the common shrubs found. *A. hymenoides* is the most common grass. Typically forbs make up over 60% of the species richness, averaging 2.6 forbs per quadrat, but this year there were no forbs on the reference area.

7.2.4 Revegetation Success

Staging Area – Revegetation is considered successful when a pre-determined percentage of plant cover and density on an adjacent area that represents an undisturbed plant community is achieved. A typical percentage used to determine success is 70%.

The plant community on the Five Points Landfill staging area shows no signs of plant die-off, but there was little evidence of plant growth this year (Figure 7-2). This was most evident by plant cover. Total plant cover was only 9%, which is the lowest recorded on the site. Shrub cover was the lowest it has been since 2002, but only 0.4% lower than the average shrub cover over the last 4 years. Grass cover was lower than last year, but over the last 5 years, there have been 2 years when there was no grass cover and 1 year when grass cover was half the amount found this year. There were no forbs this year, which is not unusual at this site; there was no forb cover in 2002 and 2007, which is typical of years when winter and early spring precipitation rates are below average. Shrubs and grasses were present, but there was a minimal amount of growth for both life forms.

Figure 7-2. Overview of establishment of vegetation on the re-seeded area (foreground center) and staging area (right center) at CAU 400, Five Points Landfill

(Photo by D. Anderson, June 5, 2012)

Plant density, like cover, was the lowest ever recorded on the staging area, averaging just 0.96 plants/m^2. Total plant density did not meet the standard for reclamation success (Table 7-4). Shrub density did exceed the standard, but grass density was a sixth of the standard. Shrubs accounted for most of the total density, even though it was the second lowest shrub density recorded for the staging area. *A. canescens* was the most common shrub. The only other shrub found on the site was *P. desertorum*, which is uncommon. Grass density was 0.2 grasses/m^2, which was the same as 2008 and 2010, and the lowest recorded for the site. *A. hymenoides* was the most common grass, although *P. jamesii* is becoming more common.

M. albicaulis was the only forb present on the site this year, and it was rarely encountered. Typically, there are several forbs present on the site, but this year was similar to 2007 when there were no forbs present. An absence of forbs is directly related to the lack of winter and early spring precipitation.

Overall species richness on the staging area was less than the standard for reclamation success. Species richness values for shrubs exceeded the success standard but grasses did not, which was the situation in previous years. Species richness values were the lowest experienced over the last 5 years. Species richness values for shrubs over the last 5 years ranged from 0.4 to 0.6 species per quadrat, with an average for the same period of 0.5 species per quadrat, which is the value for 2012. *A. canescens* was by far the most abundant.

Species richness values for grasses over the last 5 years ranged from a low of 0.1 in 2008 to a high of 0.4 species per quadrat last year. The species richness for grasses was equal to the average species richness values for grasses over the last 5 years, 0.2 species per quadrat. Three species of grasses occur on the site. The most common is *A. hymenoides*. *E. elymoides* has been common in previous years but has declined in abundance the last few years. More recently, *P. jamesii* has occurred more frequently on the site.

Species richness values for forbs vary the most of the three life forms. The species richness for forbs of 0.1 species per quadrat recorded this year was the second lowest ever recorded on the site. There was only one forb, *M. albicaulis*, present on the site. Over the last 5 years, species richness values for forbs ranged from the 0.1 species per quadrat recorded this year to over 5 species per quadrat in 2009 and 2010. Over the last 5 years, *Eriastrum eremicum* (desert woollystar), *Gilia* species (gilia), *Salsola iberica* (Russian thistle), and *M. albicaulis* have been the most persistent species. *Cryptantha circumscissa* (Cushion cryptantha), *Machaeranthera canescens* (hoary tansyaster), and *Chaenactis stevioides* (Esteve's pincushion) are less persistent and may not be found every year; however, when present they have shown some of the highest densities for forbs.

Re-seeded Area – Overall, plant cover was below the standard for reclamation success. However, plant cover on the re-seeded area at the Five Points Landfill has improved the last few years. There were bursts of forb cover in 2008 and 2010. Shrub cover has shown a steady increase over the last 5 years, doubling from 2010 to 2011 and then again from 2011 to this year. *A. hymenoides* was present right after the site was re-seeded, but it has not persisted. Forb cover has fluctuated dramatically over the last 5 years. It made up more than half of the total plant cover in 2006 and more than 85% in 2010, but, like 2007, forbs were completely absent this year.

Plant density was the lowest it has been at this site, primarily due to the absence of grasses and forbs. However, shrub density continued to improve and increased almost fourfold from last year. *A. hymenoides* and *E. elymoides* have been common on the site but absent the last 2 years. Even with the increase in shrub density this year, it is still only approximately half of the reclamation success standard (Figure 7-2).

Except for the 2 years when there was an abundance of annual forbs, species richness values for the re-seeded area have been low compared to the staging area and the reference site. Species richness values for shrubs were only half of the standard for reclamation success, and because there were no grasses and only one forb this year, overall species richness values were less than 10% of the standard.

7.3 Rollercoaster RADSAFE CAU 407 Survey Results

After CAU 407 (TTR) was revegetated in 2000, cover repairs resulted in the loss of vegetation. In 2004, erosion channels on the cover were repaired, and the site was re-seeded. An erosion blanket was used to minimize erosion. Three transects were sampled in 2012. Reclamation success standards were determined by averaging data collected at a reference site from 2000 to 2009. The reference site is located less than 2 km north of CAU 407.

7.3.1 Plant Cover

Total plant cover at CAU 407 was 11.7% (Table 7-6) in 2012. Only shrubs were present. *A. confertifolia* was the only shrub contributing to plant cover this year. *A. canescens* commonly contributed to plant cover previously. Forbs have not been common at this site in the past and were absent this year, as were invasive species.

Average total plant cover on the reference area was 13.2% (Table 7-6). Shrub cover was 9.4%, grass cover was 1.8%, forb cover was 1.9%, and invasive weed cover was 0.1%. *P. desertorum* was the most common species and accounted for over half of total shrub cover. *A. canescens* accounted for 40% of total shrub cover. There was a good mix of grasses on the reference area. *P. jamesii* was the most common and accounted for over half of total grass cover. *A. hymenoides* accounted for 40% of total grass cover, and *Dasyochloa pulchella* (woolly tuftgrass) made up the balance. Three forbs contributed to plant cover on the reference area. *C. stevioides* was the most common. *Halogeton glomeratus* (Halogeton), an invasive weed, was present at 0.1% cover.

Table 7-6. Percent plant cover on CAU 407, Rollercoaster RADSAFE closure cover

		Cover	Reference	Standard
SHRUBS	*Picrothamnus desertorum* (Bud sagebrush)	0.0	5.3	
	Atriplex canescens (Fourwing saltbush)	0.0	3.8	
	Atriplex confertifolia (Shadscale saltbush)	11.7	0.0	
	Chrysothamnus viscidiflorus (Yellow rabbitbrush)	0.0	0.1	
	Krascheninnikovia lanata (Winterfat)	0.0	0.2	
	Total Shrub Cover	**11.7**	**9.4**	**6.6**
GRASSES	*Achnatherum hymenoides* (Indian ricegrass)	0.0	0.7	
	*Dasyochloa pulchella (*Woolly tuftgrass)	0.0	0.1	
	Pleuraphis jamesii (James' galleta grass)	0.0	1.0	
	Total Grass Cover	**0.0**	**1.8**	**1.3**
FORBS	*Chaenactis steviodes* (Esteve's pincushion)	0.0	1.5	
	Erodium cicutarium (Filaree)	0.0	0.2	
	Astragalus species (Milkvetch)	0.0	0.2	
	Total Forb Cover	**0.0**	**1.9**	**1.3**
INVASIVE WEEDS	*Halogeton glomeratus* (Halogeton)	0.0	0.1	
	Total Invasive Weed Cover	**0.0**	**0.1**	
TOTAL PLANT COVER		**11.7**	**13.2**	**9.2***
Bare Ground		67.5	69.6	
Litter		20.8	17.2	

* Does not include invasive weeds

7.3.2 Plant Density

Total plant density at CAU 407 was 8.5 plants/m^2 this year and was all perennial shrubs (Table 7-7). The most abundant shrub was *A. confertifolia*. The only other plant found on the site this year was *A. canescens*. Average plant density on the reference area was 16 plants/m^2. There was a more even distribution of life forms on the reference area than on the CAU 407 cover. There were 4.03 shrubs/m^2, 1.74 grasses/m^2, and 9.84 forbs/m^2. The most abundant shrub was *P. desertorum*, followed by *A. confertifolia*. *P. jamesii* was the most common grass species, followed by *D. pulchella* and *A. hymenoides*. *C. stevioides* had the highest density of all species.

Table 7-7. Plant Density (Plants per m^2) on CAU 407

		Cover	Reference	Standard
SHRUBS	*Picrothamnus desertorum* (Bud sagebrush)	0.0	3.1	
	Atriplex canescens (Fourwing saltbush)	0.3	0.0	
	Atriplex confertifolia (Shadscale saltbush)	8.2	0.8	
	Opuntia pulchella (Sagebrush cholla)	0.0	0.03	
	Krascheninnikovia lanata (Winterfat)	0.0	0.1	
	Total Shrub Density	**8.5**	**4.03**	**2.8**
GRASSES	*Achnatherum hymenoides* (Indian ricegrass)	0.0	0.4	
	Dasyochloa pulchella (Woolly tuftgrass)	0.0	0.4	
	Elymus elymoides (Squirreltail grass)	0.0	0.04	
	Pleuraphis jamesii (James' galleta grass)	0.0	0.9	
	Total Grass Density	**0.0**	**1.74**	**1.2**
FORBS	*Eriogonum* species (Buckwheat species)	0.0	0.1	
	Sphaeralcea ambigua (Desert globemallow)	0.0	0.3	
	Chaenactis steviodes (Esteve's pincushion)	0.0	8.7	
	Astragalus lentiginosus (Freckled milkvetch)	0.0	0.1	
	Sphaeralcea grossulariifolia (Gooseberryleaf globemallow)	0.0	0.1	
	Macheaeranthera canescens (Hoary tansyaster)	0.0	0.04	
	Chenopodium album (Lambsquarter)	0.0	0.1	
	Astragalus species (Milkvetch)	0.0	0.2	
	Lepidium species (Pepperweed)	0.0	0.2	
	Total Forb Density	**0.0**	**9.84**	**6.9**
INVASIVE WEEDS	*Halogeton glomeratus* (Halogeton)	0.0	0.3	
	Total Invasive Weed Cover	**0.0**	**0.3**	
TOTAL PLANT DENSITY		**8.5**	**15.91**	**10.9***

* Does not include invasive weeds

7.3.3 Species Richness

There was an average of 0.9 species encountered per quadrat on the CAU 407 cover (Table 7-8). This was the lowest value recorded at the site. Species richness, like cover and density, was all shrubs. There were no grasses or forbs on the site this year.

7.3.4 Revegetation Success

Total plant cover continued to exceed the reclamation success standard due to the abundance of *A. confertifolia*. Shrub cover declined the last 3 years but still remained higher than the native plant community. Grasses were present the first few years after the site was re-seeded but have been absent the last 3 years. Forb cover was minimal, and when forbs do contribute to plant cover, it is from either *C. stevioides* or *H. glomeratus*.

Like plant cover, plant density was composed entirely of shrubs. The 8.5 shrubs/m^2 recorded this year was less than the 5-year average of 14.5 plants/m^2 and approximately half the shrub density reported for 2011. Even with the decline from last year, shrub density still exceeded the reclamation success standard. With no grasses present on the CAU 407 cover this year, grass density did not meet the reclamation success standard.

Species richness values this year were the lowest recorded since 2008 but not significantly different from last year. The only species encountered this year were *A. confertifolia* and *A. canescens*, and the species richness values for those species was approximately 0.9 shrubs per quadrat, lower than the standard of 1.1 shrubs per quadrat. When only using perennial shrubs and grasses for the reclamation success standard, the total species richness value this year fell short of the standard of 1.5 plants per quadrat.

Table 7-8. Species Richness (Species per m^2) on CAU 407

	Cover	Reference	Standard
Shrubs	0.9	1.6	1.1
Grasses	0.0	0.5	0.4
Forbs	0.0	1.1	0.8
Total Species	**0.9**	**3.2**	**2.3**

7.4 Control Point (CP) Waterline

An underground waterline was installed in 2009, which resulted in the surface disturbance of approximately 15 ha. Approximately 2.2 ha were revegetated in December 2009. Plant density data was estimated by recording data within 24 m^2-quadrats on the revegetated portion.

Nine different shrub species were encountered on the revegetated portion of the waterline this year. *E. nevadensis*, the most common shrub on the site this year, was the only shrub that increased in density from 2011 to 2012 (Table 7-9). Other common shrubs included *C. ramosissima*, *K. lanata*, *A. canescens*, and *A. confertifolia*. The density for all of the shrubs was about two-thirds of what it was last year.

E. elymoides and *A. hymenoides* are the only perennial grasses present on the site. Combined density for these two species has declined from a high of 16 plants/m^2 in 2010 to just 1 plant/m^2 this year. There were very few forbs on the site this year compared to previous years, which is common during drought conditions such as was experienced this year. There were four forbs encountered this year on the site. *Erodium cicutarium* (filaree) and *Linum lewisii* (Lewis flax) were the most common. *S. iberica* and *H. glomeratus* were the only invasive weeds encountered on the site this year, and density for the two species was 5% of what it was last year.

Table 7-9. Density (plants/m^2) of seeded species on the CP Waterline in Area 6 of the NNSS

	Seeded		
Plant Species/Lifeform	**2010**	**2011**	**2012**
Shrub			
Coleogyne ramosissima (Blackbrush)	**9.0**	**6.5**	**2.6**
Encelia virginensis (Brittlebush)	**0.0**	**0.0**	**0.2**
Hymenoclea salsola (Cheesebush)	**0.0**	**1.0**	**0.2**
Atriplex canescens (Fourwing saltbush)	**3.3**	**2.1**	**1.9**
Ephedra nevadensis (Nevada jointfir)	**7.9**	**7.5**	**9.5**
Ericameria nauseosa (Rubber rabbitbrush)	**3.7**	**2.1**	**0.6**
Atriplex confertifolia (Shadscale saltbush)	**3.1**	**3.9**	**1.8**
Krascheninnikovia lanata (Winterfat)	**4.4**	**5.2**	**2.4**
Chrysothamnus viscidiflorus (Yellow rabbitbrush)	**0.0**	**2.1**	**0.4**
Grass			
Achnatherum hymenoides (Indian ricegrass)	**11.0**	**2.8**	**0.4**
Elymus elymoides (Squirreltail)	**5.3**	**4.4**	**0.7**
Forb			
Baileya multiradiata (Desert marigold)	**1.3**	**1.0**	**0.2**
Erodium cicutarium (Filaree)	**2.6**	**8.9**	**4.0**
Linum lewisii (Lewis' flax)	**2.5**	**5.6**	**0.9**
Sphaeralcea ambigua (Desert globemallow)	**1.0**	**1.0**	**0.2**
Halogeton glomeratus (Halogeton)	**0.0**	**3.0**	**0.6**
Salsola iberica (Prickly Russian thistle)	**2.0**	**0.0**	**0.1**
Total Shrub Density	**32.3**	**30.3**	**19.5**
Total Grass Density	**16.3**	**7.2**	**1.1**
Total Forb Density	**225.1**	**31.9**	**5.3**
Total Invasive Weed Cover	**4.0**	**12.0**	**0.7**
TOTAL PLANT DENSITY	**77.7**	**81.4**	**26.5**

7.5 92-Acre Site Revegetation

7.5.1 Background

A "92-Acre" Area encompassing the southern portion of the Area 5 Radioactive Waste Management Complex (RWMC) was recently designated for final closure operations. The closure cover designed for the Area 5 RWMC is a vegetated monolayer that incorporates an evapotranspirative technique to meet cover performance objectives, minimizes the migration of water off and through the cover, requires minimal maintenance, maintains the integrity of the cover over time, and meets U.S. Department of Energy performance objectives.

The establishment of a vegetative cover at the 92-Acre Site presents unique challenges. The site is located in the harsh Mojave/Great Basin Transition Desert, which is characterized by extreme temperatures and limited, erratic precipitation. Under natural conditions the establishment of perennial plants on the site may require decades (Romney et al. 1980, Wallace et al. 1980, Webb and Wilshire 1980, Carpenter et al. 1986, Angerer et al. 1995) and typically includes several years of only annual plant cover, which does not maximize evapotranspiration nor is it effective in controlling wind and water erosion.

Perennial plant establishment occurs primarily when favorable rainfall conditions occur (Wallace and Romney 1972, Beatley 1975, Romney et al. 1980, Anderson and Ostler 2002), which may happen 1 out of 5 years. This low and unpredictable precipitation is almost without exception the factor limiting successful revegetation in the arid/semi-arid west (May 1975).

The strategy to establish a native perennial plant community on the closure covers at the 92-Acre Site incorporated proven reclamation techniques and included site preparation, seeding with species adapted to local environmental conditions, mulching to conserve soil moisture, and irrigation to ensure seed germination and plant establishment (Ostler et al. 2002, Anderson and Ostler 2002).

The 92-Acre Site is composed of four semi-rectangular areas separated by drainage channels and access roads. For reference purposes only, they have been designated as Pit 3, North Cover, South Cover, and West Cover. Although referred to as the “92-Acre” Site, only about 18 ha were revegetated. Pit 3 was approximately 2.0 ha in size, North Cover 3.4 ha, South Cover 6.9 ha, and West Cover 5.4 ha.

7.5.2 Methods

Site Preparation – Construction of the engineered covers for the four areas was completed in May 2011. During construction the surface soils were compacted to a point that would impede any revegetation efforts. Soil compaction was alleviated by ripping the soils to a depth of approximately 30 cm in two perpendicular directions. The surface soils were then slightly compacted by “walking” the area with a rubber-tracked bulldozer.

Seeding was scheduled to occur between October and December, so in order to protect the newly ripped soils from the erosive forces of both wind and water, a chemical soil stabilizer (Soiltac®) was applied to the exposed soils. The soil stabilizer was applied over 3 days beginning April 26 and ending April 28. Approximately 18,300 liters of SoilTac® were applied at a rate of 1,031 liters/ha (Figure 7-3), which per manufacturer’s specification would remain effective for up to 12 months.

Figure 7-3. Application of Soiltac® on the 92-Acre Site following deep ripping in April 2011
(Photo by D. Anderson, April 28, 2011)

Final site preparation occurred just prior to seeding. The surface soils were scarified with one pass of a disk, which broke up soil crusting or compaction to a depth of 7–15 cm, allowing good seed-to-soil contact. Disking began October 10 and was completed October 19.

Seeding – Seeding started on October 19 and was completed on October 27. The seed mix included ten shrubs, three grasses, and three forbs (Table 7-10). All species used in the seed mix are native not only to the NNSS but to the immediate area. A Tye rangeland drill seeder was modified so the seed was broadcast-seeded over the site. The drill seeder was calibrated the previous week to achieve the desired seed application rate. A rake harrow was attached to the rear of the rangeland drill seeder to cover the seed.

Mulching – A certified weed-free straw mulch was applied immediately following seeding. The straw mulch was applied at a rate of 4,485 kilograms (kg)/ha or a total of 79,350 kg for all four areas. The mulch was immediately crimped into the soil using a Finn disk crimper (Figure 7-4). Mulching began October 31 and was completed on November 9. Straw mulching was performed when wind speeds were less than 25 km/hour.

Supplemental Watering – Seed germination and plant growth typically occur during a good growing season. A good growing season is characterized by increased precipitation from October through June. Good growing seasons are rare at the NNSS. Since 1960, seven good growing seasons have been noted. Average precipitation for those 7 years was 181 mm. From October to December 2011, 9.5 mm of precipitation was recorded at the 92-Acre Site, less than 25% for this same period during a good growing season. Natural precipitation from January to June 2012 was 32.6 mm, for a combined total of 42.1 cm for this year's growing season, which is less than one-fourth received during a good growing season (Table 7-11).

Table 7-10. Plant species included in seed mix and seeding rates (Pure Live Seed [PLS]), including a 10% contingency, for each species used to seed the 92-Acre Site

	KG of PLS SEED BY SPECIES					
	Rate	Area				
Common Name	PLS kg/ha	Pit 3	North	South	West	Total
Ambrosia dumosa (White bursage)	5.3	11.2	18.9	37.9	29.9	97.9
Atriplex canescens (Fourwing saltbush)	1.7	1.8	3.0	6.0	4.7	15.5
Atriplex confertifolia (Shadscale saltbush)	1.4	0.0	0.0	0.0	0.0	0.0
Encelia virgensis (Brittlebush)	0.8	1.8	3.0	6.0	4.7	15.5
Ephedra nevadensis (Nevada jointfir)	3.9	3.5	6.0	12.0	9.4	30.9
Eriogonum fasciculatum (Eastern Mojave buckwheat)	0.0	7.7	13.0	25.9	20.5	67.0
Hymenoclea salsola (Burrobush)	0.8	1.2	2.0	4.0	3.1	10.3
Krascheninnikovia lanata (Winterfat)	1.7	0.2	0.4	0.8	0.6	2.1
Larrea tridentata (Creosote)	3.6	3.5	6.0	12.0	9.4	30.9
Lycium andersonii (Desert Thorn)	1.1	2.9	5.0	10.0	7.9	25.8
Achnatherum hymenoides (Indian ricegrass)	1.4	8.2	13.9	27.9	22.0	72.1
Elymus elymoides (Squirreltail)	0.3	2.4	4.0	8.0	6.3	20.6
Pleuraphis jamesii (James' galleta grass)	0.6	2.9	5.0	10.0	7.9	25.8
Baileya multiradiata (Desert marigold)	0.1	0.6	1.0	2.0	1.6	5.2
Penstemon palmeri (Palmer's penstemon)	0.1	0.2	0.4	0.8	0.6	2.1
Sphaeralcea ambigua (Desert globemallow)	0.1	0.2	0.4	0.8	0.6	2.1
Totals	**23.1**	**48.4**	**81.9**	**163.8**	**129.4**	**423.5**

Figure 7-4. Straw mulcher followed by tractor with Finn crimper used to secure the blown straw
(Photo by D. Anderson, November 9, 2011)

An irrigation system was designed and constructed to provide a means of supplementing natural precipitation. All irrigation equipment was staged the first part of November 2011 (Figure 7-5), construction began November 15, and the system was completed January 6, 2012. Supplemental watering occurred 58 days between January 9 and June 11. During this period, approximately 96.6 mm of supplemental water was applied. Combined with the 42.1 mm of natural precipitation received during this period, a total of 138.7 mm, or about 75% of the amount of precipitation received for the same period during a good growing season, was received or applied at the site.

Over a 7-day period in December 2012, an additional 12.7 mm of supplemental water was applied to all four sites with the objective of increasing the potential for additional seed germination. Between January and December 2012, 109 mm or 14,020,750 liters of supplemental watering was applied to the four areas within the 92-Acre Site. Combined with the 56 mm of natural precipitation, a total of 165 mm of water was applied or received at the site to promote seed germination and enhance plant establishment.

Monitoring – No monitoring was completed in 2012. The presence of several plants was noted during supplemental watering in December. Several shrubs were observed as well as a few grasses and forbs. Shrubs included *Ambrosia dumosa* (white bursage), *E. nevadensis*, *A. canescens*, *A. confertifolia*, and *Larrea tridentata* (creosote) (Figure 7-6). The only perennial grass seen on site was *A. hymenoides*, and one forb, *Baileya multiradiata* (desert marigold), was occasionally found.

Table 7-11. Amount of natural and supplemental water (mm) applied to 92-Acre revegetation site from January to December 2012

Month	Natural Precipitation	Supplemental Water	Total	Average of seven "Good Growing Seasons"
Oct. 2011	4.5	None	4.5	12.6
Nov. 2011	1.1	None	1.1	11.2
Dec. 2011	3.9	None	3.9	18.0
Fall Totals	**9.5**	**-**	**9.5**	**41.8**
Jan. 2012	3.2	20.3	23.5	37.9
Feb. 2012	2.6	22.9	25.5	50.5
Mar. 2012	9.4	25.4	34.8	24.6
Apr. 2012	17.4	10.2	27.6	11.4
May 2012	0.0	7.6	7.6	5.6
June 2012	0.0	10.2	10.2	9.6
Growing Season Totals	**42.1**	**96.6**	**138.7**	**181.4**
Dec. 2012	13.6	12.7	26.3	-
Total	**55.7**	**109.3**	**165.0**	**-**

Figure 7-5. Operational irrigation system composed of a central 10 cm supply line with multiple 2.5 cm lateral lines. Sprinkler heads were Nelson R2000WF Rotator® installed on a 90 cm super stand.

(Photo by D. Anderson, February 9, 2012)

Figure 7-6. A young *L. tridentata* seedling established on the 92-Acre Site
(Photo by D. Anderson, June 3, 2012)

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8.0 MONITORING THE NPTEC

8.1 Task Description

Biological monitoring at the NPTEC on the playa of Frenchman Lake in Area 5 is performed, if necessary, for certain types of chemical releases according to NPTEC's programmatic Environmental Assessment. In addition, the Environment, Safety, Health, and Quality Division has requested that NSTec monitor any test that may influence plants or animals downwind off the playa. A Biological Monitoring Plan for the NPTEC was prepared in fiscal year (FY) 1996 and updated in FY 2002 (Bechtel Nevada 2002). It describes how field surveys will be conducted to determine test impacts on plants and animals and to verify that NPTEC's program complies with pertinent state and federal environmental protection requirements.

NSTec biologists are asked by NPTEC personnel to review chemical release test plans to determine if field monitoring along the treatment transects is required for each test in accordance with the monitoring plan criteria. All test specific field monitoring is funded through the NPTEC. Since 1996, the majority of chemical releases being studied at NPTEC have used such small quantities that downwind test specific monitoring has not been necessary.

8.2 Task Progress Summary

NSTec biologists reviewed one test plan during 2012. Baseline monitoring was not conducted at established control-treatment transects near the NPTEC in 2012 because no test-specific monitoring was required because of small quantities and low concentration levels.

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