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3.8 Wildlife

The Permit Area is located in the Wyoming Basin ecoregion (Chapman et al., 2004) at an elevation of approximately 7,000 feet above mean sea level. With approximately 260 feet of relief, sub-zero winter temperatures, and less than ten inches of annual precipitation, vegetation development and species diversity are limited. The topography is characterized by rolling plains with small, ephemeral drainages dissecting the area. There are no perennial water sources within the Permit Area (**Section 3.5**). Crooked Well Reservoir, a stock pond located in Section 16 of Township 25 North, Range 92 West, contains water only seasonally (**Figure 3.5-4**). The Permit Area covers approximately 4,254 acres, which includes the 4,194-acre main Permit Area and the East and West Access Roads, which extend to the east (26 acres) and west (34 acres). Land ownership of the Permit Area is under the jurisdiction of the BLM and the State of Wyoming.

Wildlife inventories of the Permit Area were conducted in 2006 through 2011. The inventories provided baseline data for permitting the ISR Project and ensured that wildlife species and habitats would be afforded adequate protection during Construction, Operation, and Reclamation. At the request of the BLM, additional baseline studies for the spadefoot toad and Wyoming pocket gopher were performed in 2010. Additionally, the Greater sage-grouse monitoring area was expanded in 2010 to more accurately address the SGIT stipulations (Mead, 2011 and Wyoming Interagency, 2011). Detailed results of the 2010 wildlife inventory are included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011). The report on the 2011 wildlife inventory is in preparation.

Data collection for the wildlife surveys included file searches of state and federal agency documents. Wildlife studies focused on threatened and endangered (T&E) species, Migratory Birds of High Federal Interest (MBHFI), raptors, Greater sage-grouse leks and nesting habitat, breeding birds, Pygmy rabbits, big game, Wyoming pocket gopher, and spadefoot toad as well as a general wildlife inventory of the Permit Area.

In order to identify the off-site habitat and individuals that could be affected by Project activities, a two-mile perimeter around the Permit Area was included for Greater sage-grouse, and a one-mile perimeter around the Permit Area was included for raptors. In 2010, the area surveyed for Greater sage-grouse was expanded even further.

3.8.1 Habitat Description and Wildlife Species

The vegetation in the Permit Area is described in detail in **Section 3.7**. The wildlife habitat in the Permit Area is predominantly Upland and Lowland Big

Sagebrush Shrublands (**Figure 3.7-1**). Other wildlife habitats include cushion plant communities, small isolated patches of grassland, and disturbed lands.
The Upland Big Sagebrush Shrubland wildlife habitat dominates the Permit Area and is generally found on flat and rolling hills. This habitat is important for pronghorn, mule deer, Greater sage-grouse, white-tailed prairie dogs, and reptiles. Raptors often hunt in Big Sagebrush Shrubland habitat, and Greater sage-grouse leks are typically located on ridge tops or other open areas.

The Lowland Big Sagebrush Shrubland wildlife habitat is found along drainages and swales. This habitat type has significantly more vegetation cover than the Upland Big Sagebrush Shrubland. The Lowland Big Sagebrush Shrubland wildlife habitat also provides important cover for resident and migratory birds, reptiles, and small mammals. The taller big sagebrush provides potential nesting sites for raptors and critical forage for ungulates and Greater sage-grouse during winters with extreme snowfall.

A list of wildlife species that potentially occur in the Permit Area is provided in **Table 3.8-1**. A total of 224 wildlife species potentially occur in the Permit Area. Of these, 164 species are birds, 51 species are mammals, four species are amphibians, and five species are reptiles. Species with known occurrence in or around the Permit Area are also indicated in the table.

3.8.2 Methods

3.8.2.1 File and Data Searches

Locations of raptor nest sites, Greater sage-grouse leks, prairie dog towns, big game ranges, and T&E species were obtained by request from GIS data from the BLM, WGFD, and the University of Wyoming. WGFD publications and the computerized WGFD Wildlife Observation System (WOS) of the Permit Area were reviewed (WGFD, 2008a) and are presented in Attachment D9-1 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

A copy of the Sweetwater Uranium Facility Environmental Report (Shepherd Miller, Inc., 1994) that covered a study area southwest of the Permit Area was also reviewed. The Shepherd Miller study was used as an initial survey reference for the area for T&E plant and animal species, big game ranges, Greater sage-grouse leks, and raptor nest sites.

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 1 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
BIRDS				
Pied-billed Grebe	*Podilymbus podiceps*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Eared Grebe	*Podiceps nigricollis*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American White Pelican	*Pelecanus erythrorhynchos*	Fairly Common	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Great Blue Heron	*Ardea herodias*	Uncommon	NSS4	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Snowy Egret	*Egretta thula*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Black-crowned Night-Heron	*Nycticorax nycticorax*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Canada Goose	*Branta canadensis*	Uncommon		x
Green-winged Teal	*Anas crecca*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Mallard	*Anas platyrhynchos*	Fairly Common		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 2 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Northern Pintail	*Anas acuta*	Uncommon	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Gadwall	*Ana strepera*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Blue-winged Teal	*Anas discors*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Cinnamon Teal	*Anas cyanoptera*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Northern Shoveler	*Anas clypeata*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American Wigeon	*Anas americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Canvasback	*Aythya valisineria*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Redhead	*Aythya americana*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Common Goldeneye	*Bucephala clangula*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 3 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Bufflehead	*Bucephala albeola*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Hooded Merganser	*Lophodytes cucullatus*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Common Merganser	*Mergus merganser*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Ruddy Duck	*Oxyura jamaicensis*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Turkey Vulture	*Cathartes aura*	Common		x
Osprey	*Pandion haliaetus*	Rare		No lake, pond or stream foraging habitat present
Bald Eagle	*Haliaeetus leucocephalus*	Unknown	MBHFI, FT, NSS2	
Northern Harrier	*Circus cyaneus*	Common		x
Sharp-shinned Hawk	*Accipiter striatus*	Uncommon		x
Cooper's Hawk	*Accipiter cooperii*	Uncommon		
Northern Goshawk	*Accipiter gentilis*	Uncommon	SSS, NSS4	No forested habitat present, nearest potential habitat on Green Mountain

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 4 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Swainson's Hawk	*Buteo swainsoni*	Common	BCC, MBHFI, NSS4	x
Red-tailed Hawk	*Buteo jamaicensis*	Common		x
Ferruginous Hawk	*Buteo regalis*	Common	BCC, MBHFI, SSS, NSS3	x
Rough-legged Hawk	*Buteo lagopus*	Common		x
Golden Eagle	*Aquila chrysaetos*	Common	BCC	x
American Kestrel	*Falco sparverius*	Common		x
Merlin	*Falco columbarius*	Unknown	MBHFI, NSS3	
Prairie Falcon	*Falco mexicanus*	Uncommon	BCC	x
Peregrine Falcon	*Falco peregrinus*	Unknown	BCC, MBHFI, SSS, NSS3	
Sage Grouse	*Centrocercus urophasianus*	Common	MBHFI, SSS, NSS2, FC	x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 5 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Sora	*Porzana carolina*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American Coot	*Fulica americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Sandhill Crane	*Grus canadensis*	Rare	NSS3	
Killdeer	*Charadrius vociferus*	Common		x
Mountain Plover	*Charadrius montanus*	Unknown	BCC, MBHFI, SSS, NSS4	Thick sagebrush cover provides poor nesting habitat on Permit Area
American Avocet	*Recurvirostra americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Greater Yellowlegs	*Tringa melanoleuca*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Lesser Yellowlegs	*Tringa flavipes*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Spotted Sandpiper	*Actitis macularia*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Upland Sandpiper	*Bartramia longicauda*	Rare	BCC, MBHFI, NSS4	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 6 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Long-billed Curlew	*Numenius americanus*	Uncommon	BCC, MBHFI, SSS, NSS3	
Marbled Godwit	*Limosa fedoa*	Rare	BCC	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Wilson's Snipe	*Gallinago delicata*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Wilson's Phalarope	*Phalaropus tricolor*	Uncommon	BCC	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Franklin's Gull	*Larus pipixcan*	Uncommon		
Ring-billed Gull	*Larus delawarensis*	Uncommon		
California Gull	*Larus californicus*	Uncommon		
Rock Dove	*Columba livia*	Common		
Band-tailed Pigeon	*Columba fasciata*	Unknown		
Mourning Dove	*Zenaida macroura*	Abundant		x
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Rare	MBHFI	
Great Horned Owl	*Bubo virginianus*	Fairly Common		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 7 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Snowy Owl	*Nyctea scandiaca*	Unknown		Could only occur as a rare winter migrant
Western Burrowing Owl	*Athene cunicularia*	Uncommon	MBHFI, SSS, NSS4	
Long-eared Owl	*Asio otus*	Uncommon		
Short-eared Owl	*Asio flammeus*	Uncommon	MBHFI, NSS4	
Common Nighthawk	*Chordeiles minor*	Common		x
Common Poorwill	*Phalaenoptilus nuttallii*	Uncommon		
White-throated Swift	*Aeronautes saxatalis*	Uncommon		
Broad-tailed Hummingbird	*Selasphorus platycercus*	Rare		
Rufous Hummingbird	*Selasphorus rufus*	Rare		
Downy Woodpecker	*Picoides pubescens*	Uncommon		
Hairy Woodpecker	*Picoides villosus*	Rare		
Northern Flicker	*Colaptes auratus*	Uncommon		
Western Wood-Pewee	*Contopus sordidulus*	Fairly Common		
Empidonax Species	*Empidonax spp.*	Common		
Willow Flycatcher	*Empidonax traillii*	Fairly Common	NSS3	

Table 3.7-6 Cover Parameters of the Lowland Big Sagebrush Shrubland (Page 3 of 3)

Species	Mean Cover (percent)	Relative Cover (percent)	Lowest Cover Value (percent)	Highest Cover Value (percent)	Frequency (percent)	Relative Frequency (percent)	Importance Value	Rank
CACTI								
Opuntia polyacantha	0.1	0.23	0	2	50	3.94	4.17	11
SHRUBS								
Artemisia tridentata	30.9	71.69	10	48	100	7.87	79.57	1
Chrysothamnus nauseosus	0.5	1.16	0	6	35	2.76	3.92	12
Chrysothamnus viscidiflorus	3.4	7.89	0	18	95	7.48	15.37	2
Sub-Total	34.8							
LICHENS								
Parmelia chlorochroa (lichen)	0.1							
Number of Species per 100 m^2	12.8							
		SD [1]						
Total Vegetation Cover	43.1	8.813						
Total Cover by Perenial Species	42.0	8.360						
Litter and Rock Combined	33.8	11.678						
Litter (and lichens)	33.8	11.678						
Rock								
Bare Soil	23.1	15.874						
Total Ground Cover	76.9	15.874						

† Based on data from twenty 25-meter point intercept transects sampled June 10 to 12, 2006

[1] SD = standard deviation

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 1 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
BIRDS				
Pied-billed Grebe	*Podilymbus podiceps*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Eared Grebe	*Podiceps nigricollis*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American White Pelican	*Pelecanus erythrorhynchos*	Fairly Common	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Great Blue Heron	*Ardea herodias*	Uncommon	NSS4	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Snowy Egret	*Egretta thula*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Black-crowned Night-Heron	*Nycticorax nycticorax*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Canada Goose	*Branta canadensis*	Uncommon		x
Green-winged Teal	*Anas crecca*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Mallard	*Anas platyrhynchos*	Fairly Common		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 2 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Northern Pintail	*Anas acuta*	Uncommon	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Gadwall	*Ana strepera*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Blue-winged Teal	*Anas discors*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Cinnamon Teal	*Anas cyanoptera*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Northern Shoveler	*Anas clypeata*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American Wigeon	*Anas americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Canvasback	*Aythya valisineria*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Redhead	*Aythya americana*	Rare	NSS3	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Common Goldeneye	*Bucephala clangula*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 3 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Bufflehead	*Bucephala albeola*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Hooded Merganser	*Lophodytes cucullatus*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Common Merganser	*Mergus merganser*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Ruddy Duck	*Oxyura jamaicensis*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Turkey Vulture	*Cathartes aura*	Common		x
Osprey	*Pandion haliaetus*	Rare		No lake, pond or stream foraging habitat present
Bald Eagle	*Haliaeetus leucocephalus*	Unknown	MBHFI, FT, NSS2	
Northern Harrier	*Circus cyaneus*	Common		x
Sharp-shinned Hawk	*Accipiter striatus*	Uncommon		x
Cooper's Hawk	*Accipiter cooperii*	Uncommon		
Northern Goshawk	*Accipiter gentilis*	Uncommon	SSS, NSS4	No forested habitat present, nearest potential habitat on Green Mountain

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 4 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Swainson's Hawk	*Buteo swainsoni*	Common	BCC, MBHFI, NSS4	x
Red-tailed Hawk	*Buteo jamaicensis*	Common		x
Ferruginous Hawk	*Buteo regalis*	Common	BCC, MBHFI, SSS, NSS3	x
Rough-legged Hawk	*Buteo lagopus*	Common		x
Golden Eagle	*Aquila chrysaetos*	Common	BCC	x
American Kestrel	*Falco sparverius*	Common		x
Merlin	*Falco columbarius*	Unknown	MBHFI, NSS3	
Prairie Falcon	*Falco mexicanus*	Uncommon	BCC	x
Peregrine Falcon	*Falco peregrinus*	Unknown	BCC, MBHFI, SSS, NSS3	
Sage Grouse	*Centrocercus urophasianus*	Common	MBHFI, SSS, NSS2, FC	x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 5 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Sora	*Porzana carolina*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
American Coot	*Fulica americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Sandhill Crane	*Grus canadensis*	Rare	NSS3	
Killdeer	*Charadrius vociferus*	Common		x
Mountain Plover	*Charadrius montanus*	Unknown	BCC, MBHFI, SSS, NSS4	Thick sagebrush cover provides poor nesting habitat on Permit Area
American Avocet	*Recurvirostra americana*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Greater Yellowlegs	*Tringa melanoleuca*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Lesser Yellowlegs	*Tringa flavipes*	Uncommon		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Spotted Sandpiper	*Actitis macularia*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Upland Sandpiper	*Bartramia longicauda*	Rare	BCC, MBHFI, NSS4	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 6 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Long-billed Curlew	*Numenius americanus*	Uncommon	BCC, MBHFI, SSS, NSS3	
Marbled Godwit	*Limosa fedoa*	Rare	BCC	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Wilson's Snipe	*Gallinago delicata*	Fairly Common		Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Wilson's Phalarope	*Phalaropus tricolor*	Uncommon	BCC	Nearest potential habitat at the Chain Lakes, approx. 7 miles south of Permit Area
Franklin's Gull	*Larus pipixcan*	Uncommon		
Ring-billed Gull	*Larus delawarensis*	Uncommon		
California Gull	*Larus californicus*	Uncommon		
Rock Dove	*Columba livia*	Common		
Band-tailed Pigeon	*Columba fasciata*	Unknown		
Mourning Dove	*Zenaida macroura*	Abundant		x
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Rare	MBHFI	
Great Horned Owl	*Bubo virginianus*	Fairly Common		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 7 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Snowy Owl	*Nyctea scandiaca*	Unknown		Could only occur as a rare winter migrant
Western Burrowing Owl	*Athene cunicularia*	Uncommon	MBHFI, SSS, NSS4	
Long-eared Owl	*Asio otus*	Uncommon		
Short-eared Owl	*Asio flammeus*	Uncommon	MBHFI, NSS4	
Common Nighthawk	*Chordeiles minor*	Common		x
Common Poorwill	*Phalaenoptilus nuttallii*	Uncommon		
White-throated Swift	*Aeronautes saxatalis*	Uncommon		
Broad-tailed Hummingbird	*Selasphorus platycercus*	Rare		
Rufous Hummingbird	*Selasphorus rufus*	Rare		
Downy Woodpecker	*Picoides pubescens*	Uncommon		
Hairy Woodpecker	*Picoides villosus*	Rare		
Northern Flicker	*Colaptes auratus*	Uncommon		
Western Wood-Pewee	*Contopus sordidulus*	Fairly Common		
Empidonax Species	*Empidonax spp.*	Common		
Willow Flycatcher	*Empidonax traillii*	Fairly Common	NSS3	

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 8 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Hammond's Flycatcher	*Empidonax hammondii*	Uncommon		
Gray Flycatcher	*Empidonax wrightii*	Common		
Dusky Flycatcher	*Empidonax oberholseri*	Common		
Say's Phoebe	*Sayornis saya*	Common		
Cassin's Kingbird	*Tyrannus vociferans*	Uncommon	MBHFI	
Western Kingbird	*Tyrannus verticalis*	Common		
Eastern Kingbird	*Tyrannus tyrannus*	Fairly Common		
Horned Lark	*Eremophila alpestris*	Abundant		x
Tree Swallow	*Tachycineta bicolor*	Fairly Common		
Violet-green Swallow	*Tachycineta thalassina*	Fairly Common		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Fairly Common		
Bank Swallow	*Riparia riparia*	Common		
Cliff Swallow	*Petrochelidon pyrrhonota*	Common		
Barn Swallow	*Hirundo rustica*	Fairly Common		
Steller's Jay	*Cyanocitta stelleri*	Uncommon		
Pinyon Jay	*Gymnorhinus cyanocephalus*	Rare		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 9 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Clark's Nutcracker	*Nucifraga columbiana*	Fairly Common		
Black-billed Magpie	*Pica pica*	Abundant		x
American Crow	*Corvus brachyrhynchos*	Fairly Common		x
Common Raven	*Corvus corax*	Abundant		x
Black-capped Chickadee	*Poecile atricapillus*	Uncommon		
Mountain Chickadee	*Poecile gambeli*	Uncommon		
Red-breasted Nuthatch	*Sitta canadensis*	Fairly Common		
White-breasted Nuthatch	*Sitta carolinensis*	Rare		
Brown Creeper	*Certhia americana*	Uncommon		
Rock Wren	*Salpinctes obsoletus*	Common		
House Wren	*Troglodytes aedon*	Uncommon		
Western Bluebird	*Sialia mexicana*	Rare		
Mountain Bluebird	*Sialia currucoides*	Common		x
Townsend's Solitaire	*Myadestes townsendi*	Uncommon		
Veery	*Catharus fuscescens*	Uncommon		
Swainson's Thrush	*Catharus ustulatus*	Uncommon		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 10 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Hermit Thrush	*Catharus guttatus*	Uncommon		
American Robin	*Turdus migratorius*	Common		x
Gray Catbird	*Dumetella carolinensis*	Uncommon		
Northern Mockingbird	*Mimus polyglottos*	Uncommon		
Sage Thrasher	*Oreoscoptes montanus*	Common	MBHFI, SSS, NSS4	x
European Starling	*Sturnus vulgaris*	Fairly Common		
Bohemian Waxwing	*Bombycilla garrulus*	Uncommon		
Cedar Waxwing	*Bombycilla cedrorum*	Uncommon		
Northern Shrike	*Lanius excubitor*	Uncommon		
Loggerhead Shrike	*Lanius ludovicianus*	Common	BCC, MBHFI, SSS	x
Warbling Vireo	*Vireo gilvus*	Uncommon		
Yellow Warbler	*Dendroica petechia*	Fairly Common		
Yellow-rumped Warbler	*Dendroica coronata*	Fairly Common		
American Redstart	*Setophaga ruticilla*	Uncommon		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 11 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Northern Waterthrush	*Seiurus noveboracensis*	Rare		
MacGillivray's Warbler	*Oporornis tolmiei*	Uncommon		
Common Yellowthroat	*Geothlypis trichas*	Uncommon		
Yellow-breasted Chat	*Icteria virens*	Uncommon		
Western Tanager	*Piranga ludoviciana*	Uncommon		
Black-headed Grosbeak	*Pheucticus melanocephalus*	Rare		
Blue Grosbeak	*Guiraca caerulea*	Rare		
Lazuli Bunting	*Passerina amoena*	Uncommon		
Indigo Bunting	*Passerina cyanea*	Unknown		
Green-tailed Towhee	*Pipilo chlorurus*	Common		
Spotted Towhee	*Pipilo maculatus*	Fairly Common		
American Tree Sparrow	*Spizella arborea*	Uncommon		x
Chipping Sparrow	*Spizella passerina*	Uncommon		x
Clay-colored Sparrow	*Spizella pallida*	Rare		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 12 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Brewer's Sparrow	*Spizella breweri*	Common	BCC, MBHFI, SSS, NSS4	x
Vesper Sparrow	*Pooecetes gramineus*	Common	MBHFI	x
Lark Sparrow	*Chondestes grammacus*	Common	MBHFI	x
Sage Sparrow	*Amphispiza belli*	Fairly Common	MBHFI, SSS, NSS4	x
Lark Bunting	*Calamospiza melanocorys*	Common	MBHFI, NSS4	
Savannah Sparrow	*Passerculus sandwichensis*	Uncommon		
Grasshopper Sparrow	*Ammodramus savannarum*	Uncommon	MBHFI, NSS4	
Song Sparrow	*Melospiza melodia*	Uncommon		
White-crowned Sparrow	*Zonotrichia leucophrys*	Uncommon		
Dark-eyed Junco	*Junco hyemalis*	Common		
McCown's Longspur	*Calcarius mccownii*	Uncommon	BCC, MBHFI, NSS4	
Chestnut-collared Longspur	*Calcarius ornatus*	Unknown	MBHFI, NSS4	x
Snow Bunting	*Plectrophenax nivalis*	Unknown		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 13 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Bobolink	*Dolichonyx oryzivorus*	Rare	MBHFI, NSS4	
Red-winged Blackbird	*Agelaius phoeniceus*	Abundant		
Western Meadowlark	*Sturnella neglecta*	Abundant		x
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Rare		
Brewer's Blackbird	*Euphagus cyanocephalus*	Abundant		
Common Grackle	*Quiscalus quiscula*	Fairly Common		
Brown-headed Cowbird	*Molothrus ater*	Fairly Common		
Bullock's Oriole	*Icterus bullockii*	Rare		
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	Fairly Common		
Cassin's Finch	*Carpodacus cassinii*	Uncommon		
House Finch	*Carpodacus mexicanus*	Uncommon		
Red Crossbill	*Loxia curvirostra*	Uncommon		
Pine Siskin	*Carduelis pinus*	Uncommon		
American Goldfinch	*Carduelis tristis*	Fairly Common		
House Sparrow	*Passer domesticus*	Uncommon		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 14 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
MAMMALS				
Masked Shrew	*Sorex cinereus*	Fairly Common		
Pygmy Shrew	*Sorex hoyi*	Rare		
Dusky Shrew	*Sorex monticolus*	Fairly Common		
Dwarf Shrew	*Sorex nanus*	Rare	NSS3	
Vagrant Shrew	*Sorex vagrans*	Rare	NSS3	
Western Small-footed Myotis	*Myotis ciliolabrum*	Uncommon	NSS3	
Long-eared Myotis	*Myotis evotis*	Uncommon	SSS	
Little Brown Myotis	*Myotis lucifugus*	Fairly Common	NSS3	
Long-legged Myotis	*Myotis volans*	Unknown	NSS2	
Hoary Bat	*Lasiurus cinereus*	Rare	NSS4	
Silver-haired Bat	*Lasionycteris noctivagans*	Uncommon	NSS4	
Big Brown Bat	*Eptesicus fuscus*	Fairly Common	NSS3	
Townsend's Big-eared Bat	*Plecotus townsendii*	Rare	SSS, NSS2	
Pallid Bat	*Antrozous pallidus*	Rare	NSS2	

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 15 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Pygmy Rabbit	*Brachylagus idahoensis*	Common	SSS, NSS3	x
Desert Cottontail	*Sylvilagus audubonii*	Common		x
Mountain Cottontail	*Sylvilagus nuttallii*	Fairly Common		
White-tailed Jackrabbit	*Lepus townsendii*	Common		x
Least Chipmunk	*Tamias minimus*	Common		x
Wyoming Ground Squirrel	*Spermophilus elegans*	Common		x
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*	Common		x
White-tailed Prairie Dog	*Cynomys leucurus*	Uncommon	SSS, NSS4	
Wyoming Pocket Gopher	*Thomomys clusius*	Uncommon	SSL, NSS4	x
Northern Pocket Gopher	*Thomomys talpoides*	Common		x
American Beaver	*Castor canadensis*	Common		
Olive-backed Pocket Mouse	*Perognathus fasciatus*	Common	NSS3	
Ord's Kangaroo Rat	*Dipodomys ordii*	Common		x
Western Harvest Mouse	*Reithrodontomys megalotis*	Uncommon		
Deer Mouse	*Peromyscus maniculatus*	Abundant		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 16 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Northern Grasshopper Mouse	*Onychomys leucogaster*	Fairly Common		x
Bushy-tailed Woodrat	*Neotoma cinerea*	Fairly Common		
House Mouse	*Mus musculus*	Uncommon		
Long-tailed Vole	*Microtus longicaudus*	Fairly Common		
Montane Vole	*Microtus montanus*	Common		
Prairie Vole	*Microtus ochrogaster*	Fairly Common	NSS3	
Sagebrush Vole	*Lemmiscus curtatus*	Fairly Common		
Western Jumping Mouse	*Zapus princeps*	Uncommon		
Common Porcupine	*Erethizon dorsatum*	Uncommon		
Coyote	*Canis latrans*	Abundant		x
Red Fox	*Vulpes vulpes*	Common		x
Raccoon	*Procyon lotor*	Rare		x
Long-tailed Weasel	*Mustela frenata*	Fairly Common		x
Black-footed Ferret	*Mustela nigripes*	Unknown	FE/NSS1	
American Badger	*Taxidea taxus*	Common		x
Western Spotted Skunk	*Spilogale gracilis*	Unknown		

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 17 of 18)

Common Name	Scientific Name	Abundance Code	Status	Confirmed on Site
Striped Skunk	*Mephitis mephitis*	Common		x
Mountain Lion	*Felis concolor*	Uncommon		
Bobcat	*Lynx rufus*	Fairly Common		x
American Elk	*Cervus elaphus*	Common		x
Mule Deer	*Odocoileus hemionus*	Abundant		x
Pronghorn	*Antilocapra americana*	Common		x
Feral Horse	*Equus caballus*	Common		x
AMPHIBIANS				
Tiger Salamander	*Ambystoma tigrinum*	Fairly Common		
Great Basin Spadefoot Toad	*Spea intermontana*	Unknown	SSS	
Western Chorus Frog	*Pseudacris triseriata*	Unknown		
Northern Leopard Frog	*Rana pipiens*	Rare	SSS	
REPTILES				
Northern Sagebrush Lizard	*Sceloporus graciosus*	Common		
Greater Short-horned Lizard	*Phrynosoma hernandesi*	Common		x
Great Basin Gopher Snake	*Pituophis catenifer*	Rare		
Western Terrestrial Garter Snake	*Thamnophis elegans*	Fairly Common		x
Prairie Rattlesnake	*Crotalus viridis*	Uncommon		x

Table 3.8-1 Wildlife Species Observed or Potentially Occurring in the Permit Area (Page 18 of 18)

Notes:

Abundance Code

Abundant - A species that inhabits much of the preferred habitat within its range. The species or its sign is typically encountered while using survey techniques that could be expected to indicate its presence.

Common - A species that inhabits much of the preferred habitat within its range. The species or its sign is usually encountered while using survey techniques that could be expected to indicate its presence.

Uncommon -A species that is common only in limited areas within its range or is found throughout its range in relatively low densities. Intensive surveying is usually required to locate the species or its sign.

Rare - A species that occupies only a small percentage of the preferred habitat within its range or is found throughout its range in extremely low densities. The species or its sign is seldom encountered while using survey techniques that could be expected to indicate its presence.

Unknown - Insufficient information is available to determine abundance. Species is difficult to observe without specialized survey techniques.

Status:

Federal – Endangered Species Act

FT - Federally listed threatened species

FC - Federal candidate species

Federal – Migratory Bird Treaty Act

BCC - Birds of Conservation Concern species identified by the USFWS as those migratory non-game birds that without additional conservation actions are likely to become candidates for listing under the Endangered Species Act.

Federal – Migratory Birds of High Federal Interest in Wyoming

MBHFI - List used by the USFWS, Wyoming Field Office for reviews concerning existing or proposed coal mine leased land.

BLM – Special Status Species

SSS - BLM Special Status Species are species protected under the Endangered Species Act and those designated by the State Director as Sensitive. Sensitive species are those under status review by the USFWS/National Marine and Fisheries Service (NMFS), or whose numbers are declining so rapidly that Federal listing may become necessary, or with typically small or widely dispersed populations, or those inhabiting ecological refugia or other specialized or unique habitats. The minimum level of policy protection for these designated sensitive species will be the same as the policy for candidate species.

State – Native Species Status

NSS1 - Native Species Status 1 - Populations are greatly restricted or declining, extirpation appears possible and on-going significant loss of habitat.

NSS2 - Native Species Status 2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.

NSS3 - Native Species Status 3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.

NSS4 - Native Species Status 4 - Populations are greatly restricted or declining, extirpation appears possible; habitat is stable and not restricted.

3.8.2.2 Field Surveys

Field surveys for breeding birds were completed in the Permit Area during spring 2006 and 2010; Greater sage-grouse lek and nesting raptor surveys were completed during spring 2006, 2007, 2008, 2009, and 2010. Pygmy rabbit surveys were completed during June and July 2007 and August 2010. Big game surveys were completed during 2006 and 2010. The presence of other wildlife species or their identifying signs was also recorded, and all observed species are included in **Table 3.8-1**. Breeding bird surveys were conducted within the Permit Area; surveys for raptor nests included the Permit Area and a surrounding one-mile buffer; surveys for Greater sage-grouse leks included a two-mile buffer from 2006 through 2009, and a much larger study area in 2010.

General field surveys were completed by traversing the Permit Area and the surrounding area in a high-wing aircraft, four-wheel drive vehicles, and on foot. Binoculars and spotting scopes were used for observations. Specific survey methods for individual species or groups of species are presented in Attachment D9-2 of the WDEQ-LQD Permit to Mine (LCI, 2011b). The field survey protocols were consistent with recommendations from both the BLM and WGFD as provided in Attachment D9-3 of the WDEQ-LQD Permit to Mine. As mentioned above, during the spring of 2010, LCI began a long-term program of wildlife monitoring. Details of this monitoring are described in Attachment OP-6 of the WDEQ-LQD Permit to Mine. Additional information is included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011). This annual wildlife monitoring program expands upon and continues the baseline wildlife inventories.

3.8.3 Results

3.8.3.1 Big Game

The relative abundance of big game observed during the course of field work was recorded and is presented in **Table 3.8-2**. Pronghorn, mule deer, and elk were the only big game animals recorded in the Permit Area during field observations in 2006 to 2009. The WGFD WOS indicates that pronghorn are the most abundant big game species in the Permit Area. WGFD and BLM GIS data show that the Permit Area and surrounding areas are classified as Winter/Yearlong Pronghorn Range. Winter/Yearlong Range includes range where a population of animals makes general use of the habitat on a year-round basis, and there is a significant influx of animals between December and April. The Permit Area comprises a portion of the Red Desert Antelope Herd Unit (WGFD Hunt Area 61). Based on the most current Annual Big Game Herd Unit Job Completion Reports (WGFD, 2006), the Red Desert Antelope Herd had an average population of 14,454 pronghorns from 2000 to 2005.

Table 3.8-2 Relative Abundance of Big Game Observations

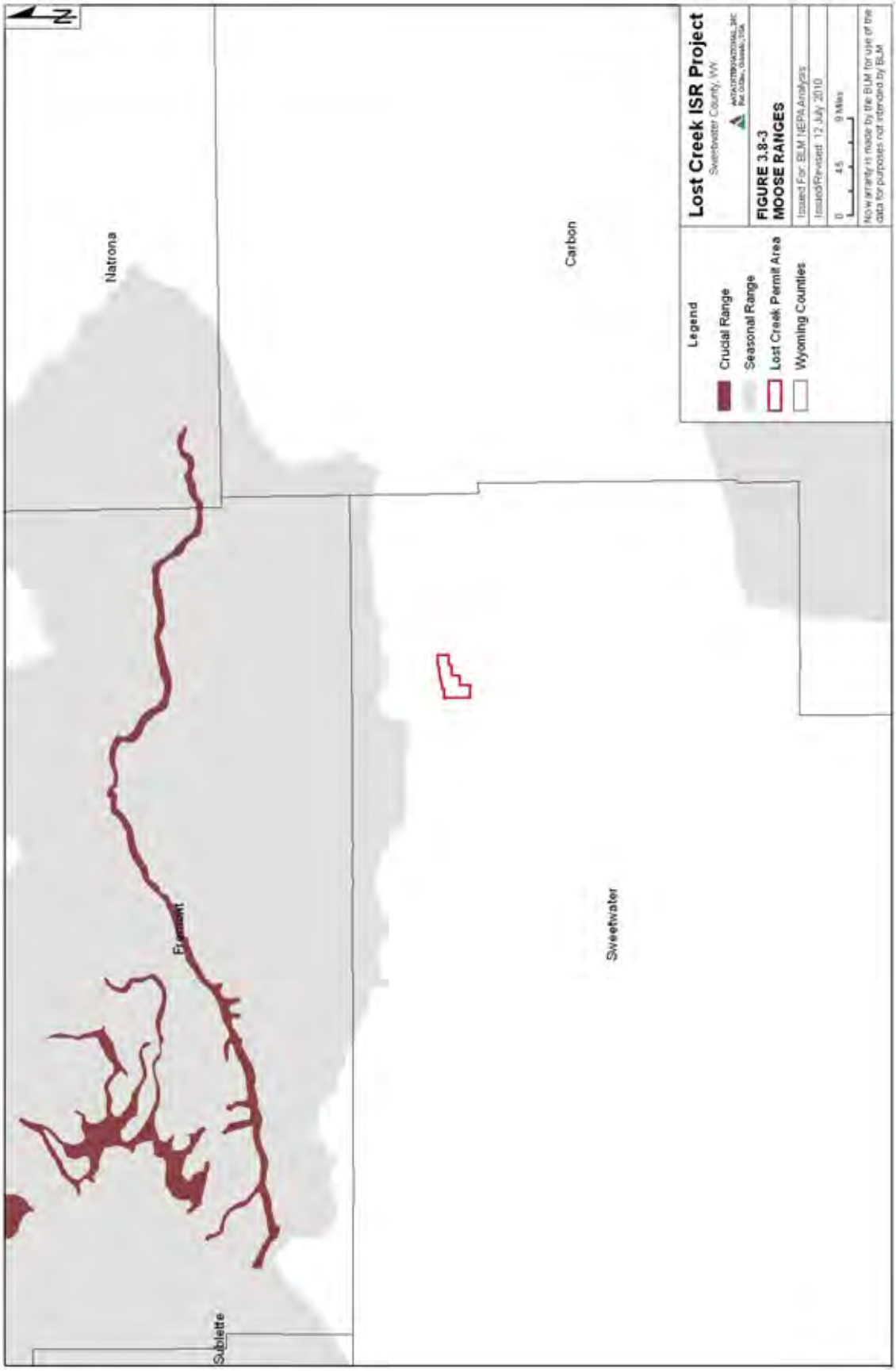
Month	Species	Habitat Type	
		Upland Sagebrush	Lowland Sagebrush
March	Pronghorn	High	High
March	Elk	Low	Low
April	Pronghorn	High	High
June	Pronghorn	Medium	Medium
July	Mule Deer	Low	--
July	Elk	Low	--
July	Pronghorn	Medium	Medium

The 2005 WGFD data define the Permit Area as seasonal range for elk and mule deer (**Figures 3.8-1** and **3.8-2**, respectively). The 2007 WGFD Herd Unit Data describe two elk herds, the Shamrock Herd Unit (#643) and the Steamboat Herd Unit (#426), as being situated on or near the Permit Area. Elk and mule deer have been infrequently spotted in low numbers in the Permit Area.

The Permit Area is outside of WGFD mapped moose range (**Figure 3.8-3**). Areas described as "out of range" contain few animals or the available habitat is of limited importance to the species. No moose or signs of moose have been observed.


N
Carbon
Fremont
Sweetwater
Legend
Lost Creek Permit Area
Wyoming Counties
Crucial Range
Seasonal Range
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-1
ELK RANGES
Issued For BLM NEPA Analysis
Issued/Revised: 12 July 2010
0
5
10 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM


N
Carbon
Fremont
Sweetwater
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-2
MULE DEER RANGE
Legend
Wyoming Counties
Lost Creek Permit Area
Crucial Range
Seasonal Range
0
5
10 Miles


N
Natrona
Carbon
Fremont
Sweetwater
Sublette
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-3
MOOSE RANGES
Issued For: BLM NEPA Analysis
Issued/Revised: 12 July 2010
0 4.5 9 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Crucial Range
Seasonal Range
Lost Creek Permit Area
Wyoming Counties

3.8.3.2 Greater sage-grouse

Greater sage-grouse and mourning doves were the only upland game birds noted in the study area. Greater sage-grouse inhabit the area all year, but mourning doves are migrants present during spring through early fall. The USFWS recently found that the Greater sage-grouse was warranted but precluded for listing as a T&E species (USFWS, 2010c). This designation means the USFWS has determined that, based on current status, the Greater sage-grouse warrants listing but listing is precluded because of the need to address other higher priority species.

The Wyoming Governor's SGIT was created in 2008 to develop and coordinate Greater sage-grouse conservation efforts in Wyoming. The original group included stakeholders from agriculture, conservation organizations, oil and gas, wildlife and land management agencies. SGIT then added representatives from county governments, WDEQ, Wyoming BLM, and the mining industry (including LCI). The SGIT has designated 'core population areas' throughout the state (**Figure 3.8-4**) and developed stipulations for the conservation of Greater sage-grouse in those areas (Mead, 2011 and Wyoming Interagency, 2011). As shown in **Figure 3.8-5**, the Permit Area is located within the Greater sage-grouse Core Area. The BLM designation of Key Habitat Areas corresponds directly with the State of Wyoming's Core Population Area (Core Area) (BLM, 2010). LCI would follow the stipulations and management principles provided by the Wyoming Governor's SGIT while conducting the Proposed Action. Additionally, LCI has consulted extensively with WGFD during the WDEQ permit process on various wildlife protection issues, including the protection of Greater sage-grouse in the Project area (Attachment D9-4 of the WDEQ-LQD Permit to Mine, 2011b and Hiatt, 2011).

Field surveys of upland game birds have focused on Greater sage-grouse leks (also known as strutting grounds). All known leks were inventoried, and the entire study area within two miles of the Permit Area was searched for additional leks during the period of 2006 to 2009. Three aerial surveys were completed for new leks from April of 2006 through 2009. In addition, ground surveys of new leks were completed by driving on roads within the study area and listening for booming Greater sage-grouse. Lek attendance surveys, which document the number of male Greater sage-grouse observed at each lek, were completed on the ground three times for each known lek during April and May of 2006 to 2009.

Starting in the spring of 2010, the study area for Greater sage-grouse surveys/monitoring was expanded to include a Small Sage Grouse Monitoring Area and a Large Sage Grouse Monitoring Area (**Figure 3.8-6**). The Small Sage Grouse Monitoring Area includes the area where nesting and early brood-rearing females may be influenced by Project activities. The Large Sage Grouse Monitoring Area includes a much larger area with leks that can be considered control leks (leks outside of the influence zone of the Project). During the spring of 2010, lek counts were completed in both the Large and Small Sage Grouse

Monitoring Areas. Concentrated ground surveys for searching for new leks were also completed in both areas. During April 2010, approximately 36 hen Greater sage-grouse were trapped and radio-tagged on leks within the Small Sage Grouse Monitoring Area. Ongoing radio-telemetry studies are being completed on these birds as part of a detailed Habitat Selection Study. The Habitat Selection Study is being completed to determine nest location, nest productivity, and seasonal habitat affinities. Detailed methods of these investigations are included in Attachment OP-6 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Detailed results of the 2010 investigations are included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011).

No active Greater sage-grouse leks have been located in the Permit Area. The Crooked Well Lek, located along the northeast boundary of the Permit Area (Township 25 North, Range 92 West, Section 16) is classified by WGFD as occupied but surveys completed from 2006 to 2009 have found it to be inactive. (**Figure 3.8-7**). Informal surveys before 2006 also indicated that birds had not been using the lek since 1994. A letter requesting a check of the official status of this lek was sent to WGFD in June 2009. Per the WGFD response, the lek is considered Occupied - Inactive. The request, which includes a summary of the formal and informal survey results, and response are included in Attachment D9-4 of the WDEQ-LQD Permit to Mine (LCI, 2011b).

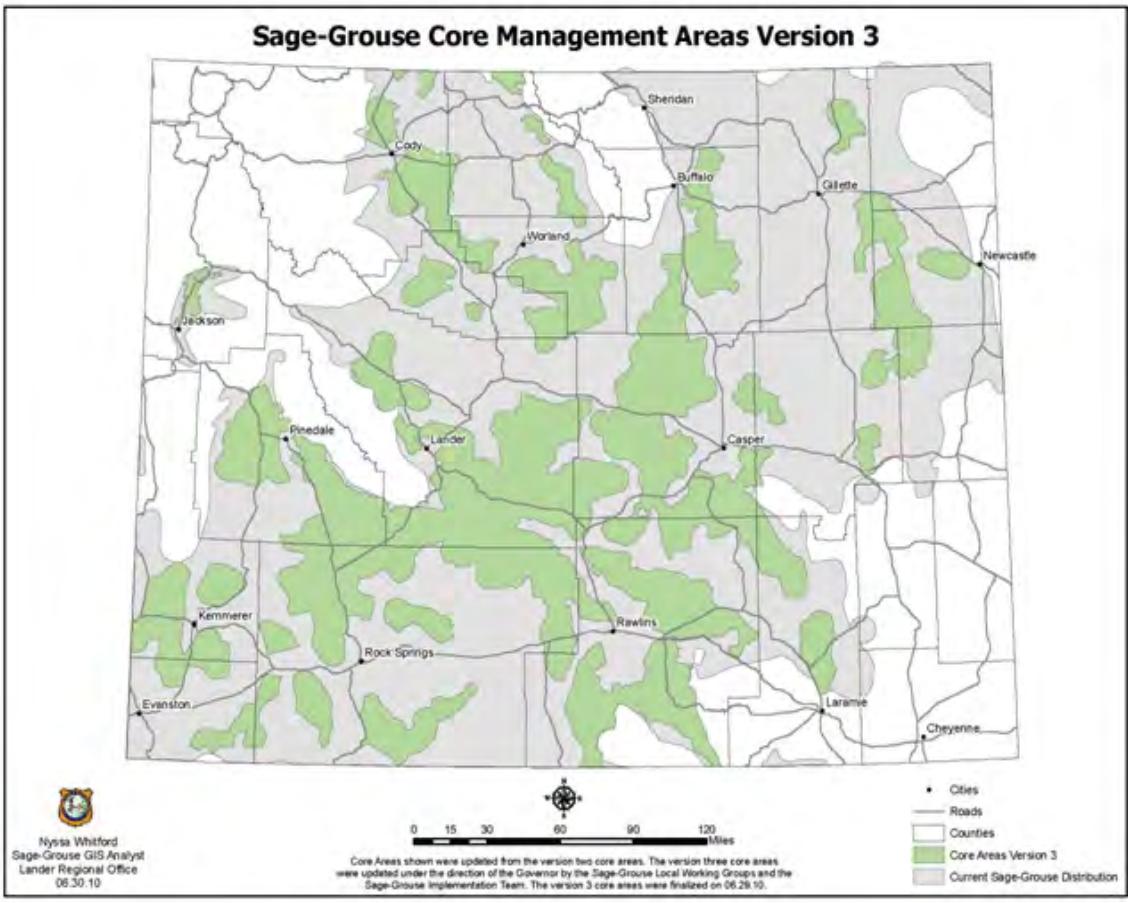
Four occupied and active leks were located within the two-mile buffer zone of the main Permit Area based on the 2006 through 2010 surveys. These include the Green Ridge Lek, Prospect South Lek, Discover Lek, and Discover South Lek. The active Discover South Lek was found during 2010 surveys. Recent surveys (2008 to 2010) have found the Discover 2 Lek (referred to as Discover East in **Table 3.8-3**) to be inactive. Three occupied and active leks were located not far north of the two-mile buffer zone of the Permit Area based on the 2006 through 2010 surveys: the Prospects Lek; the Eagles Nest Draw Lek; and the Sand Gully Lek. The locations of the aforementioned leks are presented in **Figure 3.8-7** and **Table 3.8-3. Table 3.8-3** also displays observed lek attendance. The Green Ridge Satellite Lek was observed on only two occasions in 2007, as shown in **Table 3.8-3**. The number of birds observed and the frequency of the observances did not meet the criteria to be classified as a lek (Hiatt, 2011). As a result, this lek is not included in the WGFD Greater sage-grouse database. Other nearby (between two and five miles of the Permit Area boundary) active leks include: Sooner, Minex West, Southland Well, which are within the area shown on **Figure 3.8-7**; and Harrier, Osborne Draw, Little Osborne, Eagles Nest Reservoir, and Upper Osborne, which are outside the area shown on the figure. (The locations are shown in the 2010 Annual Wildlife Monitoring Report [LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011].)

Lek attendance has generally declined since 2006 at all active leks (**Table 3.8-3**). This trend is consistent with a regional decline in lek attendance numbers

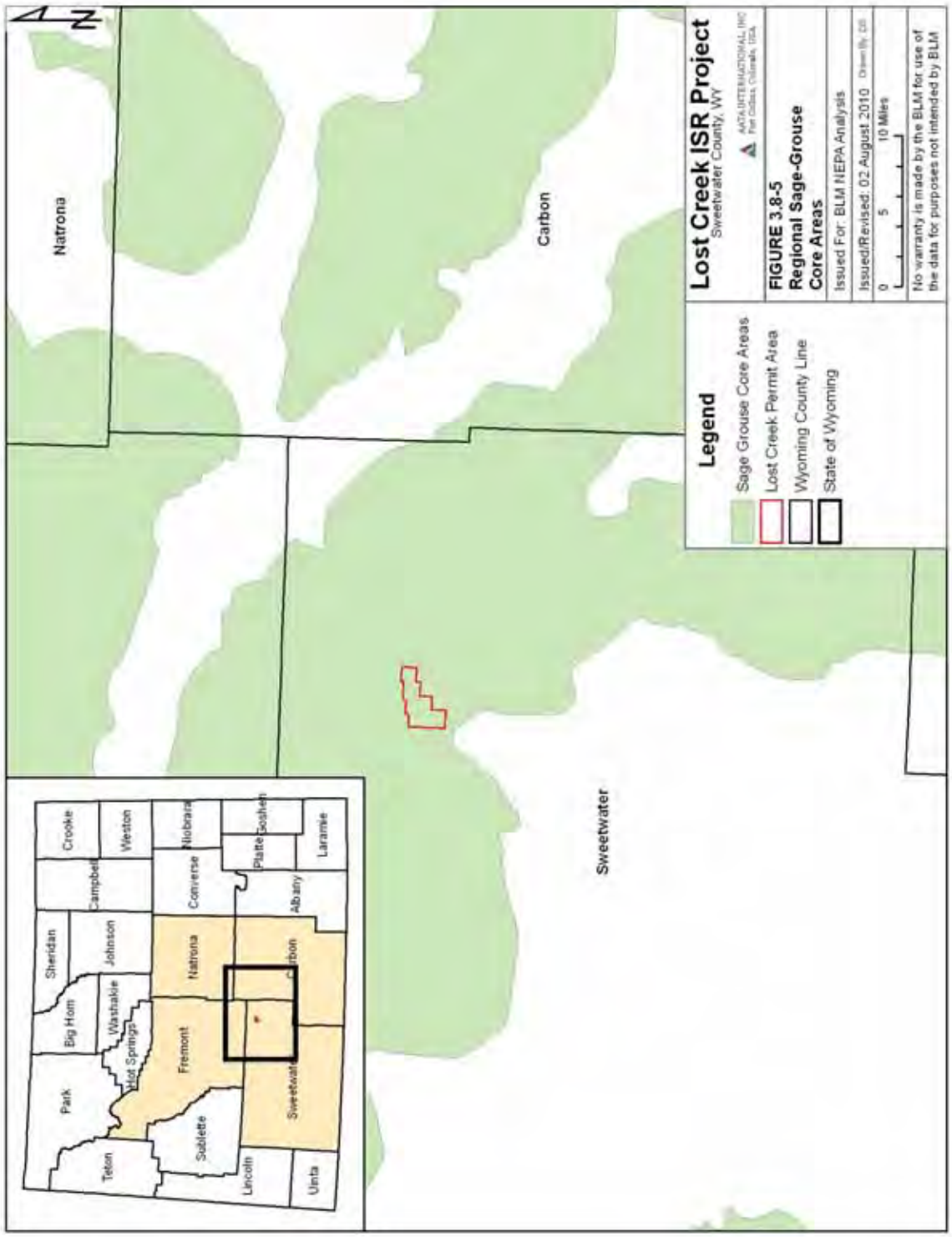
(WGFD, 2008c). The Greater sage-grouse leks occurred in the Upland Big Sagebrush Shrubland community in areas with cushion plants, blowouts and bare ground.

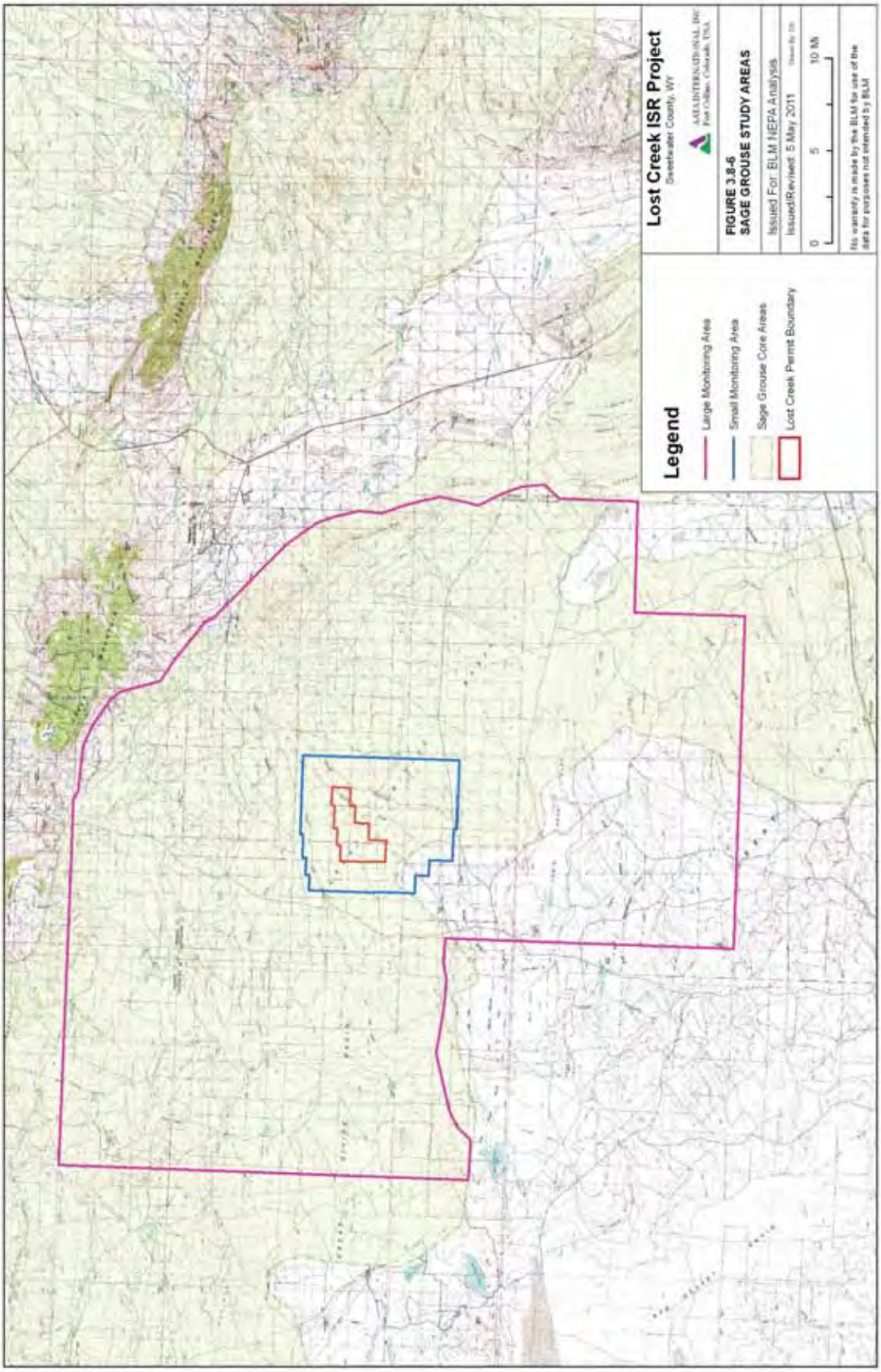
Data on seasonal habitat use and preferences of Greater sage-grouse in the area were collected as part of the ongoing annual Greater sage-grouse monitoring studies. Detailed methods of these investigations are included in Attachment OP-6 of the WDEQ-LQD Permit to Mine (LCI, 2011b). Detailed results of these investigations are included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011).

Figure 3.8-4 State-Wide Greater sage-grouse Core Management Areas



Source: Governor of Wyoming Executive Order 2010-4


Natrona
Carbon
Sweetwater
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-5
Regional Sage-Grouse
Core Areas
Issued For: BLM NEPA Analysis
Issued/Revised: 02 August 2010
0
5
10 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Sage Grouse Core Areas
Lost Creek Permit Area
Wyoming County Line
State of Wyoming
Crooke
Weston
Niobrara
Goshen
Laramie
Campbell
Converse
Platte
Albany
Sheridan
Johnson
Natrona
Carbon
Big Horn
Washakie
Hot Springs
Fremont
Park
Sweetwater
Sublette
Teton
Lincoln
Uinta


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-6
SAGE GROUSE STUDY AREAS
Issued For BLM NEPA Analysis
Issued/Revised: 5 May 2011
0
5
10 Mi
Legend
Large Monitoring Area
Small Monitoring Area
Sage Grouse Core Areas
Lost Creek Permit Boundary

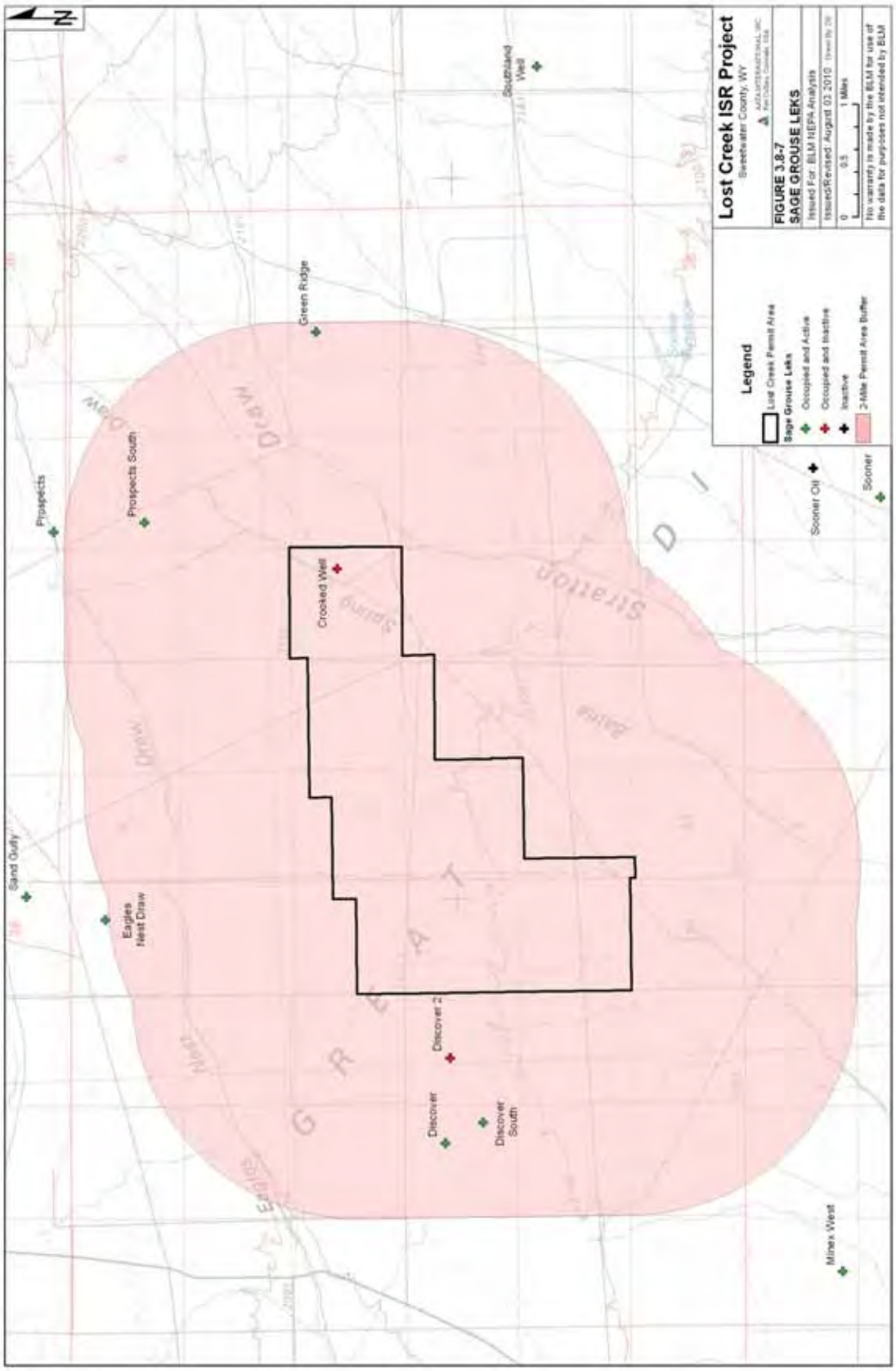

N
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-7
SAGE GROUSE LEKS
Issued For: BLM NEPA Analysis
Issued/Revised: August 03 2010
0
0.5
1 Miles
This warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Lost Creek Permit Area
Sage Grouse Leks
Occupied and Active
Occupied and Inactive
Inactive
2-Mile Permit Area Buffer
Green Ridge
Prospects
Prospects South
Crooked Well
Sooner Oil
Sooner
Sand Gully
Eagles Nest Draw
Discover 2
Discover
Discover South
Mines West
Stubtail Well

Table 3.8-3 Greater sage-grouse Lek Counts (Page 1 of 5)

Lek Name (alphabetical)	04-08-06	04-13-06	4-14-06	4-20-06	4-21-06	Comments
2006						
Crooked Well	0 m 2 f		0m 0f		0m 0f	Two females observed near the lek site, no displaying males.
Discover	59m 30f	19m 23f		69m 10f		
Discover East		17m 14f		22m 10f		
Eagles Nest Draw	57m 37f	8m 6f			6m 2f	Disturbance by drilling activity within 0.25 miles of lek pushed birds off lek. Not known who was responsible for drilling.
Green Ridge	40m 45f		61m 38f		39m 11f	
Prospects	41m 29f		41m 12f		64m 14f	
Sand Gully	99m 8f		126m 62f		97m 23f	

Table 3.8-3 Greater sage-grouse Lek Counts (Page 2 of 5)

Lek Name (alphabetical)	04-03-07	04-04-07	4-10-07	4-11-07	4-17-07	4-18-07	Comments
2007							
Crooked Well	4m 0f			0m 0f		0m 0f	Males observed in the vicinity of the Crooked Well lek, no displaying was observed.
Discover	15m 19f		23m 0f		19m 7f		
Discover East	2m 0f		3m 0f		12m 0f		
Eagles Nest Draw	13m 6f		22m 3f		6m 4f		
Green Ridge		62m 17f		73m 4f		82m 11f	
Green Ridge Satellite				8m 0f		5m 1f	
Prospects		66m 15f		59m 6f		64m 15f	
Prospects South				7m 0f		10m 0f	
Sand Gully	108m 18f		58m 30f		88m 13f		
Sooner		28m 6f		36m 0f		32m 0f	
Sooner Oil		0m 0f		0m 0f		0m 0f	

Table 3.8-3 Greater sage-grouse Lek Counts (Page 3 of 5)

Lek Name (alphabetical)	**04-17-08**	**4-25-08**	**5-07-08**	**5-09-08**	**5-11-08**	**Comments**
2008						
Crooked Well	0m 0f	0m 0f		0m 0f		
Discover	30m 10f			104m 34f	90m 28f	On the last two days, the birds were located in two groups, one on the traditional lek & one to the south.
Discover East	5m 0f			0m 0f	0m 0f	
Eagles Nest Draw	50m 24f			52m 18f	38m 6f	Lek moved to drilling pad & flat area to east of pad. Coordinates are for traditional lek site.
Green Ridge	58m 7f	58m 4f	44m 3f			
Green Ridge Satellite	0m 0f	0m 0f	0m 0f			
Prospects	58m 8f	66m 6f	62m 7f			
Prospects South	9m 0f	5m 0f	6m 0f			
Sand Gully	72m 23f			62m 16f	41m 3f	
Sooner	18m 6f	18m 2f	26m 2f			
Sooner Oil	0m 0f	0m 0f	0m 0f			

Table 3.8-3 Greater sage-grouse Lek Counts (Page 4 of 5)

Lek Name (alphabetical)	04-02-09	4-07-09	04-08-09	4-15-09	4-21-09	4-22-09	4-28-09	4-29-09	4-30-09	Comments
2009										
Crooked Well	No sign of birds (see Comments).	0m 0f		0m 0f		0m 0f		0m 0f		Completed morning ground survey after evening snow; no tracks or sign.
Discover		22m 1f			8m 0f			22m 0f		
Discover East			0m 0f		0m 0f			0m 0f		No birds observed.
Eagles Nest Draw			32m 2f		30m 3f		47m 2f			Lek still at drilling pad & flat area to east (see 2008). Coordinates are for traditional lek site.
Green Ridge	28m 7f			53m 6f		43m 4f		3m 0f		On April 29th, golden eagle flushed birds.
Green Ridge Satellite	0m 0f			0m 0f				0m 0f		
Harrier						77m 6f			47m 3f	

Table 3.8-3 Greater sage-grouse Lek Counts (Page 5 of 5)

Lek Name (alphabetical)	**04-02-09**	**4-07-09**	**04-08-09**	**4-15-09**	**4-21-09**	**4-22-09**	**4-28-09**	**4-29-09**	**4-30-09**	**Comments**
2009 (continued)										
Minex West			7m 1f		0m 0f			0m 0f		Lek active early in season.
Osborne Draw	0m 0f				0m 0f		0m 0f			Ground search could find no sign of lek.
Prospects		45m 31f		42m 6f		45m 7f		52m 2f		
Prospects South		1m 1f		2m 0f		2m 0f		1m 1f		
Sand Gully	36m 2f				29m 4f		24m 4f			
Southland Well	49m 59f			0m 2f				45m 0f		
Sooner	12m 16f			21m 2f				16m 1f		
Sooner Oil	0m 0f			0m 0f				0m 0f		
Upper Osborne					25m 4f	60m 7f			55m 2f	

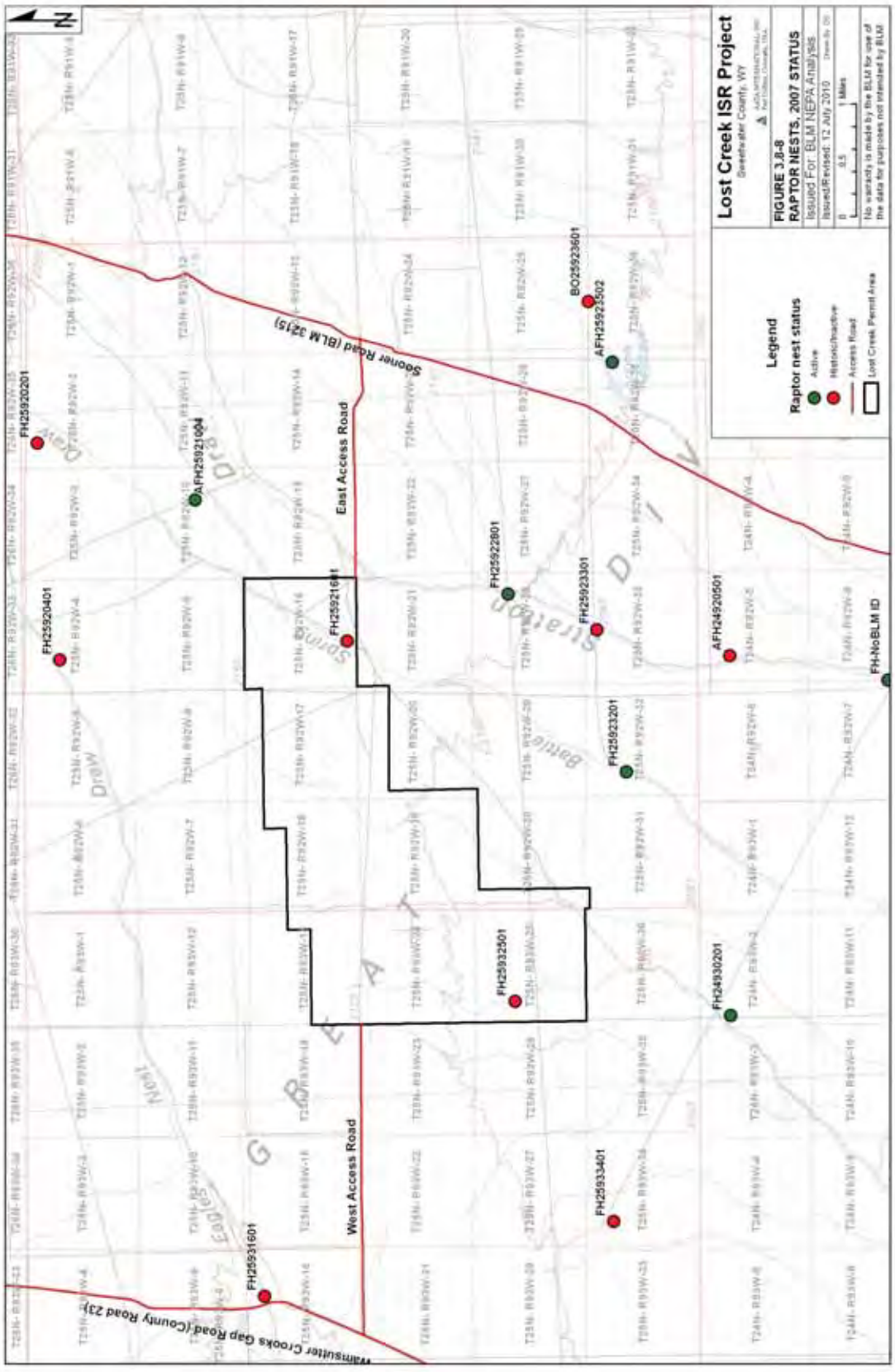
3.8.3.3 Raptors

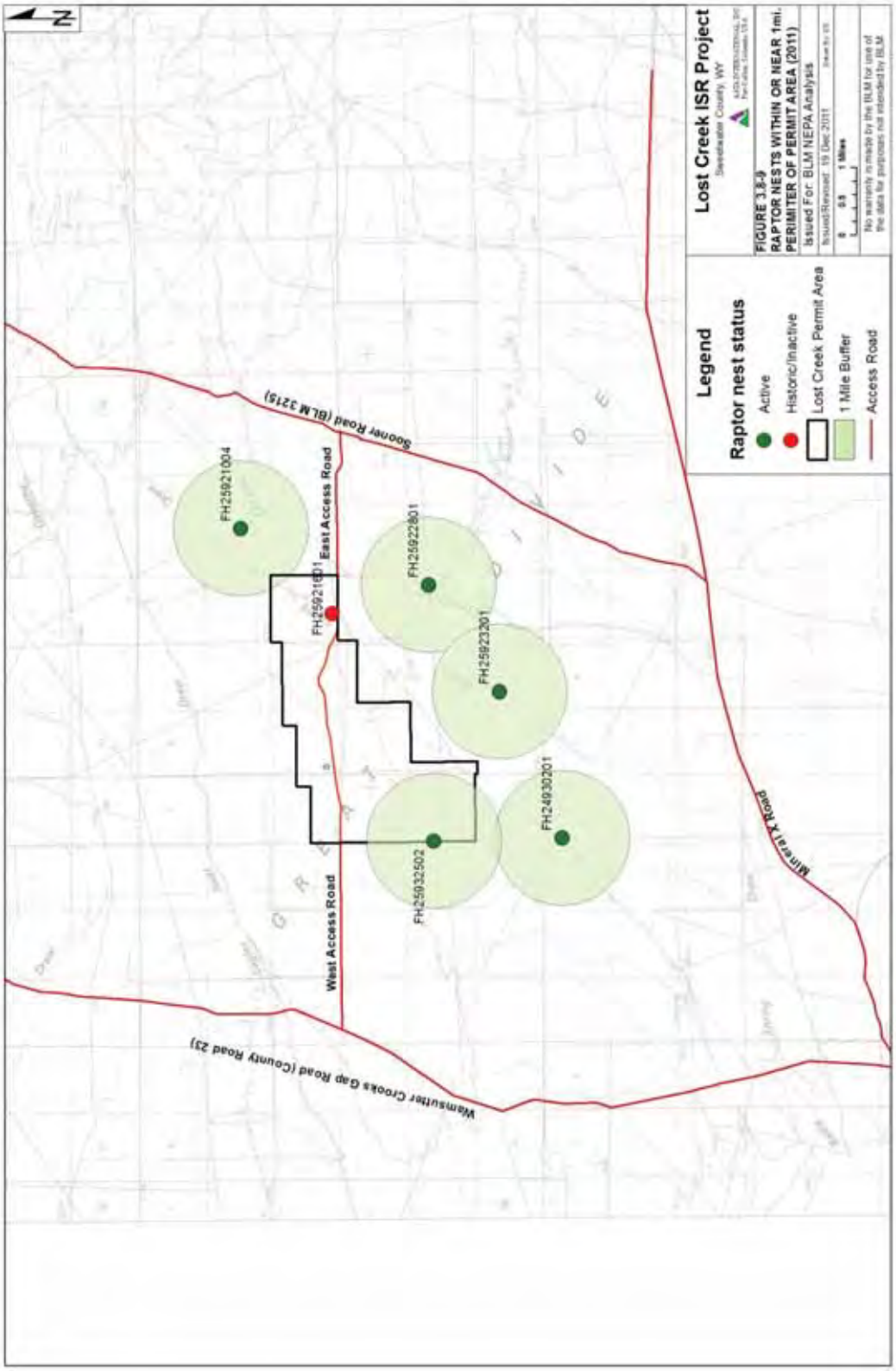
A raptor nest survey of the entire Permit Area and a one-mile buffer zone has been completed annually each spring since 2006. The survey provided status updates on nests previously identified by BLM and WGFD and identified new nests, if any. Surveys were conducted on foot or using four-wheel-drive vehicles; additional surveys were completed by air while looking for Greater sage-grouse leks. Raptor observations were made using binoculars and a high-powered spotting scope. Special attention was made to avoid disturbance of any active nests while completing the wildlife surveys.

Agency files were reviewed for data on raptor nests in the survey area. The file review identified 12 previously documented raptor nests within a one-mile buffer zone of the Permit Area. The status and locations of any of these nests that were still present in 2007 are shown on **Figure 3.8-8**. **Figure 3.8-9** shows the status and locations of these nests as of 2011.

No active raptor nests were observed within the Permit Area as of the 2010 monitoring; however, surveys during the summer of 2011 found an active ferruginous hawk nest (FH25932502) on the western boundary of the Permit Area (**Figure 3.8-9)**. Nest FH25921601 was inactive on multiple visits in 2006 through 2010 and is currently in poor condition. Nest FH25932501 was also inactive during the field surveys. One active raptor nest was found within the one-mile buffer zone. Nest FH25921004 was occupied by a pair of ferruginous hawks annually. This nest is located on an artificial nest platform. Seven other nests that had been previously documented by BLM in the one-mile buffer zone surrounding the Permit Area (**Figure 3.8-8**) were not located during the annual nest surveys. These nests are no longer present. Global Positioning System (GPS) units were used to visit the sites of these nests, but none were located. No new raptor nests were identified during the 2006 through 2010 field surveys.

Several other raptor species were recorded within the study area, but nests were not documented. These species include the Swainson's hawk, red-tailed hawk, northern harrier, golden eagle, kestrel, prairie falcon, and turkey vulture. Habitat conditions are present for the northern harrier and American kestrel to nest within the Permit Area; however, specific nest sites were not located. Northern goshawk, merlin, and peregrine falcons were not observed in the study area.


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-8
RAPTOR NESTS, 2007 STATUS
Issued For BLM NEPA Analysis
Issued/Revised: 12 July 2010
Legend
Raptor nest status
Active
Historic/Inactive
Access Road
Lost Creek Permit Area
Spoiler Road (BLM 3215)
East Access Road
West Access Road
Wamsutter Crooks Gap Road (County Road 23)
FH25920201
FH25920401
FH25921601
FH25921604
FH25922801
FH25923201
FH25923301
FH25923601
AFH25923502
AFH24920501
FH-NoBLM ID
FH25932501
FH25933401
FH25931601
FH24930201


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-9
RAPTOR NESTS WITHIN OR NEAR 1mi. PERIMITER OF PERMIT AREA (2011)
Issued For: BLM NEPA Analysis
Legend
Raptor nest status
Active
Historic/Inactive
Lost Creek Permit Area
1 Mile Buffer
Access Road
Sooner Road (BLM 3215)
East Access Road
West Access Road
Wamsutter Crooks Gap Road (County Road 23)
Mineral X Road
FH25921004
FH25921801
FH25922801
FH25923201
FH25932502
FH24930201

3.8.3.4 Waterfowl and Shorebirds

Two waterfowl species (mallard, Canada goose) have been observed during bird and wildlife surveys (**Table 3.8-1**). In the Permit Area, habitat for waterfowl and shorebirds is sparse. The man-made Crooked Well Reservoir fills in March or April, when there is sufficient snowmelt runoff in East Battle Springs Draw, and is dry for most of the year (**Figure 3.5-4**). Limited use by waterfowl and shorebird species would be expected in the Permit Area during migrations in the spring and fall, with additional use in the summer months if standing water is present. Late fall and winter use of the Permit Area by waterfowl and shorebirds is believed to be very limited.

If the stock ponds associated with the four BLM wells within one mile of the Permit Area (**Sections 3.6.3.1**) were kept full, they would provide additional water sources and potential areas for limited use by waterfowl and water birds near the Permit Area. (However, based on the elevated radionuclide concentrations in Battle Spring Draw Well No. 4451 [**Table 3.6-7**], sampling of these wells is recommended prior to use as a water source.) It is uncertain if two of the stock ponds have been filled in recent years. The other two stock ponds have been filled recently. The BLM Battle Spring Draw Well No. 4451 was observed filling its stock pond in April 2009 (**Figure 3.5-10**). Battle Spring Well No. 4777 and the Battle Spring Draw Well No. 4451 were pumped in 2011. However, as the wells would usually not be pumped over an entire growing season, surface water would not continually fill the stock ponds and a wetland should not develop.

The nearest high-use waterfowl and waterbird habitat is located within the Chain Lakes WHMA, about seven miles south of the Permit Area (**Figure 3.1-4**).

3.8.3.5 Passerine and Breeding Birds

A breeding bird survey of all representative habitats of the Permit Area was conducted during the peak of the nesting season in June 2006, using methods recommended in WDEQ-LQD Wildlife Guideline No. 5, Wildlife (1994b). Surveys were completed in both plant communities within the Permit Area (Upland and Lowland Big Sagebrush Shrublands). There were 12 breeding bird species observed within the Permit Area during breeding bird surveys. However, the Lowland Big Sagebrush Shrubland habitat provided higher densities and diversity of breeding birds.

All avian species observed when completing wildlife surveys are documented in the species list in **Table 3.8-1**. A total of 31 passerine species were recorded during the surveys. The most common species in the Permit Area were the horned lark, Brewer's sparrow, and sage sparrow.

3.8.3.6 Migratory Birds of High Federal Interest

MBHFI were inventoried during all site visits. This was accomplished by searching all suitable or potentially suitable habitats and recording all species encountered. The breeding bird surveys also included MBHFI species. Many of the MBHFI species are also BLM sensitive species or state SSS. Additional MBHFI surveys were completed during summer 2010. Detailed results of these investigations are included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011).

Several MBHFI species are known to occur in the region. Level I MBHFI species are described by USFWS as in need of conservation, while Level II MBHFI species are described as in need of monitoring. Level I MBFHI species in the region include the bald eagle, ferruginous hawk, Swainson's hawk, peregrine falcon, burrowing owl, Greater sage-grouse, mountain plover, Brewer's sparrow, and sage sparrow. Of these, the ferruginous hawk, Greater sage-grouse, Brewer's sparrow, and sage sparrow were documented in the Permit Area; the mountain plover and burrowing owl have been noted in adjacent areas. The bald eagle may occur as a sporadic migrant, and may forage on-site occasionally. The nearest known bald eagle nest to the Permit Area is greater than five miles from the Permit Area.

Level II species documented in the Permit Area include the sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow. Level II MBHFI species known to exist in the region, but not documented in the Permit Area, include the merlin, Cassin's kingbird, black-billed cuckoo, loggerhead shrike, and lark bunting.

The ferruginous hawk nests were previously discussed, as were Greater sage-grouse and their leks. The breeding Brewer's sparrow and sage sparrow were found throughout the big sagebrush habitats of the Permit Area. The breeding sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow were also located within the Permit Area. The Lowland Big Sagebrush Shrubland habitat provided the greatest species diversity for MBHFI species use.

Mountain Plover

The mountain plover (*Charadrius montanus*) is one of twelve endemic birds of the western Great Plains. They breed in grassland and shrubstep habitats and have a short to mid-distance migration (Smith and Keinath, 2004). It is thought that populations of mountain plovers have declined in the last century. Wyoming, Colorado, and Montana make up the vast majority of remaining populations. The population of breeding mountain plover in Wyoming is currently between 2,000 and 5,000 individuals and may account for a quarter of the global breeding population (Smith and Keinath, 2004). The USFWS has reinstated a proposal for the mountain plover to be listed as threatened under the Endangered Species Act

in 2010 (USFWS, 2010a). The mountain plover is also a BLM sensitive species and a state SSS.

No mountain plover have been observed on or near the Permit Area during spring and summer surveys completed between 2006 and 2010. However, mountain plover have been noted in nearby open grassland and shrubland habitats. The Permit Area was evaluated for mountain plover habitat. The extensive tall shrub cover and absence of grassland or open shrub habitats make the Permit Area poorly suited to the mountain plover. Small open areas (grassland and disturbed areas) do occur in the Permit Area, but are very small and isolated. Mountain plover prefer open low grasslands, bare ground, disturbed areas, prairie dog colonies and sparse shrubland habitats for nesting. Good potential mountain plover habitat occurs a few miles to the south and west of the Permit Area. Good potential mountain plover nesting habitat is not present in the Permit Area and no mountain plover have been observed on-site during extensive field studies. Based on this, it is unlikely that mountain plovers nest within the Permit Area.

3.8.3.7 Other Mammals

All mammal species observed (either by direct observation or sign) during the field studies were recorded and are documented on the species list in **Table 3.8-1**. A total of 19 mammal species were recorded in the Permit Area. The most common species seen were the white-tailed jackrabbit, desert cottontail, Wyoming ground squirrel, thirteen-lined ground squirrel, deer mouse, and meadow vole. The coyote was the most abundant predator.

Aerial and ground surveys of the entire Permit Area were conducted to locate prairie dog towns. There were no active colonies in the Permit Area.

3.8.3.8 Federal T&E Species, BLM Special Status Species, and State-Listed Species of Concern

T&E and candidate wildlife species surveys were completed during all site visits by searching suitable habitats for the target species. As part of baseline data collection, specific surveys were completed for many species (Greater sage-grouse, raptors, Pygmy rabbits, passerine birds).

Table 3.8-1 includes a list of federally listed species, candidate species, BLM sensitive species and state SSS observed or potentially occurring in the Permit Area.

Federally Listed or Candidate Species

The black-footed ferret (endangered) is the only federally listed species that may occur in the vicinity of the Permit Area according to WGFD WOS data (WGFD, 2008a). A black-footed ferret survey was not required, since black-footed ferrets

live exclusively in prairie dog colonies, which are not present within the Permit Area.

The bald eagle has recently been delisted, but bald eagle nesting habitat does not exist within the study area. It is possible they could occur in the Permit Area during migration, but it has not been recorded in the study area (**Table 3.8-1**). As discussed in **Section 3.8.3.2**, the Greater sage-grouse is a candidate for federal listing.

BLM Special Status Species

BLM SSS that have the potential to occur within the study area are shown in **Table 3.8-4** (BLM, 2002; WGFD, 2008a). These species include: Long-eared Myotis, Townsend's Big-eared Bat, Pygmy Rabbit, White-tailed Prairie Dog, Wyoming Pocket Gopher, White-faced Ibis, Trumpeter Swan, Bald Eagle, Northern Goshawk, Ferruginous Hawk, Peregrine Falcon, Burrowing, Owl, Greater sage-grouse, Long-Billed Curlew, Mountain Plover, Loggerhead Shrike, Sage Thrasher, Brewer's Sparrow, Sage Sparrow, Northern Leopard Frog, and Spadefoot Toad. BLM Sensitive Species that have been documented within the Permit Area include: Pygmy Rabbit, Ferruginous Hawk, Greater sage-grouse, Loggerhead Shrike, Sage Thrasher, Brewer's Sparrow, Wyoming Pocket Gopher, and Sage Sparrow.

Surveys were conducted for Pygmy rabbits (BLM Sensitive Species, NSS3 species). Pygmy rabbits were observed in the Permit Area during the summer of 2007 and 2010. Based on these surveys, Pygmy rabbits occur in most Lowland Big Sagebrush Shrubland habitat (**Figure 3.7-1**). Scat, burrows, and individual Pygmy rabbits were observed along each transect within the Lowland Big Sagebrush Shrubland habitat of the Permit Area. Locations of observed Pygmy rabbit burrows and pellets are presented in **Figure 3.8-10.**

Table 3.8-4 **Special Status Wildlife Species Potentially Occurring in the Permit Area (Page 1 of 3)**

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area
Mammals			
Long-eared Myotis	*Myotis evotis*	BLM Sensitive Species, NSS2	
Little Brown Myotis	*Myotis lucifugus*	NSS3	
Long-legged Myotis	*Myotis volans*	NSS2	
Hoary Bat	*Laiurus cinerus*	NSS4	
Silver-haired Bat	*Lasionycterius noctivagans*	NSS4	
Big Brown Bat	*Eptesicus fuscus*	NSS3	
Townsend's Big-eared Bat	*Plecotus townsendii*	BLM Sensitive Species, NSS2	
Pallid Bat	*Antrozous pallidus*	NSS2	
Pygmy Rabbit	*Brachylagus idahoensis*	BLM Sensitive Species, NSS3	Yes
White-tailed Prairie Dog	*Cynomys leucurus*	BLM Sensitive Species, NSS3	No prairie dog colonies present
Wyoming Pocket Gopher	*Thomomys idahoensis*	BLM Sensitive Species, NSS3	Yes
Black-footed Ferret	*Mustela nigripes*	Endangered, NSS1	No prairie dog colonies present
Olive-backed Pocket Mouse	*Perognathus fasciatus*	NSS3	
Prairie Vole	*Microtus ochrogaster*	NSS3	
Birds			
American White Pelican	*Pelecanus erythrorhynchos*	NSS3	Potential use Chain Lakes, 7 miles south
Great Blue Heron	*Ardea herodias*	NSS4	Potential use Chain Lakes, 7 miles south
Snowy Egret	*Egratta Thula*	NSS3	Potential use Chain Lakes, 7 miles south
White-faced Ibis	*Plegadis chihi*	BLM Sensitive Species, NSS3	Potential use Chain Lakes, 7 miles south
Sandhill Crane	*Grus canadensis*	NSS3	Potential use Chain Lakes, 7 miles south
Northern Pintail	*Anas acuta*	NSS3	Potential use Chain Lakes, 7 miles south
Redhead	*Aythya americana*	NSS3	Potential use Chain Lakes, 7 miles south
Canvasback	*Aythya valisineria*	NSS3	Potential use Chain Lakes, 7 miles south

Table 3.8-4 Special Status Wildlife Species Potentially Occurring in the Permit Area (Page 2 of 3)

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area
Trumpeter Swan	*Cygnus buccinator*	BLM Sensitive Species, NSS2	
Bald Eagle	*Haliaeetus leucocephalus*	BLM Sensitive Species, NSS2	Potential winter use, no known nests
Northern Goshawk	*Accipter gentilis*	BLM Sensitive Species, NSS4	No, forested areas not present
Swainson's Hawk	*Buteo swainsoni*	NSS4	
Ferruginous Hawk	*Buteo regalis*	BLM Sensitive Species, NSS3	Yes
Merlin	*Falco columbaris*	NSS3	
Peregrine Falcon	*Falco peregrinus*	BLM Sensitive Species, NSS3	No nesting habitat
Short-eared Owl	*Asio flammeus*	NSS4	
Burrowing Owl	*Athene cunicularia*	BLM Sensitive Species, NSS4	
Greater Sage Grouse	*Centrocercus urophasianus*	BLM Sensitive Species, Candidate	Yes
Upland Sandpiper	*Bartramia longicauda*	NSS4	
Long-billed Curlew	*Numenius americanus*	BLM Sensitive Species, NSS3	
Mountain Plover	*Charadrius montanus*	BLM Sensitive Species, NSS4	
Willow Flycatcher	*Empidonax traillii*	NSS3	
Loggerhead Shrike	*Lanius ludovicianus*	BLM Sensitive Species	Yes
Lark Bunting	*Calamospiza melanocorys*	NSS4	
Grasshopper Sparrow	*Ammodramum savannarum*	NSS4	Yes
Sage Thrasher	*Oreoscoptes montanus*	BLM Sensitive Species, NSS4	Yes
Brewer's Sparrow	*Spizella breweri*	BLM Sensitive Species, NSS4	Yes
Sage Sparrow	*Amphispiza belli*	BLM Sensitive Species, NSS4	Yes
Chestnut-collared Longspur	*Calcarius ornatus*	NSS4	Yes
McCown's Longspur	*Calcarius ornatus*	NSS4	
Bobolink	*Dolichonyx oryzivorus*	NSS4	

Table 3.8-4 Special Status Wildlife Species Potentially Occurring in the Permit Area (Page 3 of 3)

Common Name	Scientific Name	Status[1]	Confirmed in Permit Area
Amphibians			
Northern Leopard Frog	*Rana pipiens*	BLM Sensitive Species, NSS4	
Great Basin Spadefoot	*Spea intermontana*	BLM Sensitive Species, NSS4	

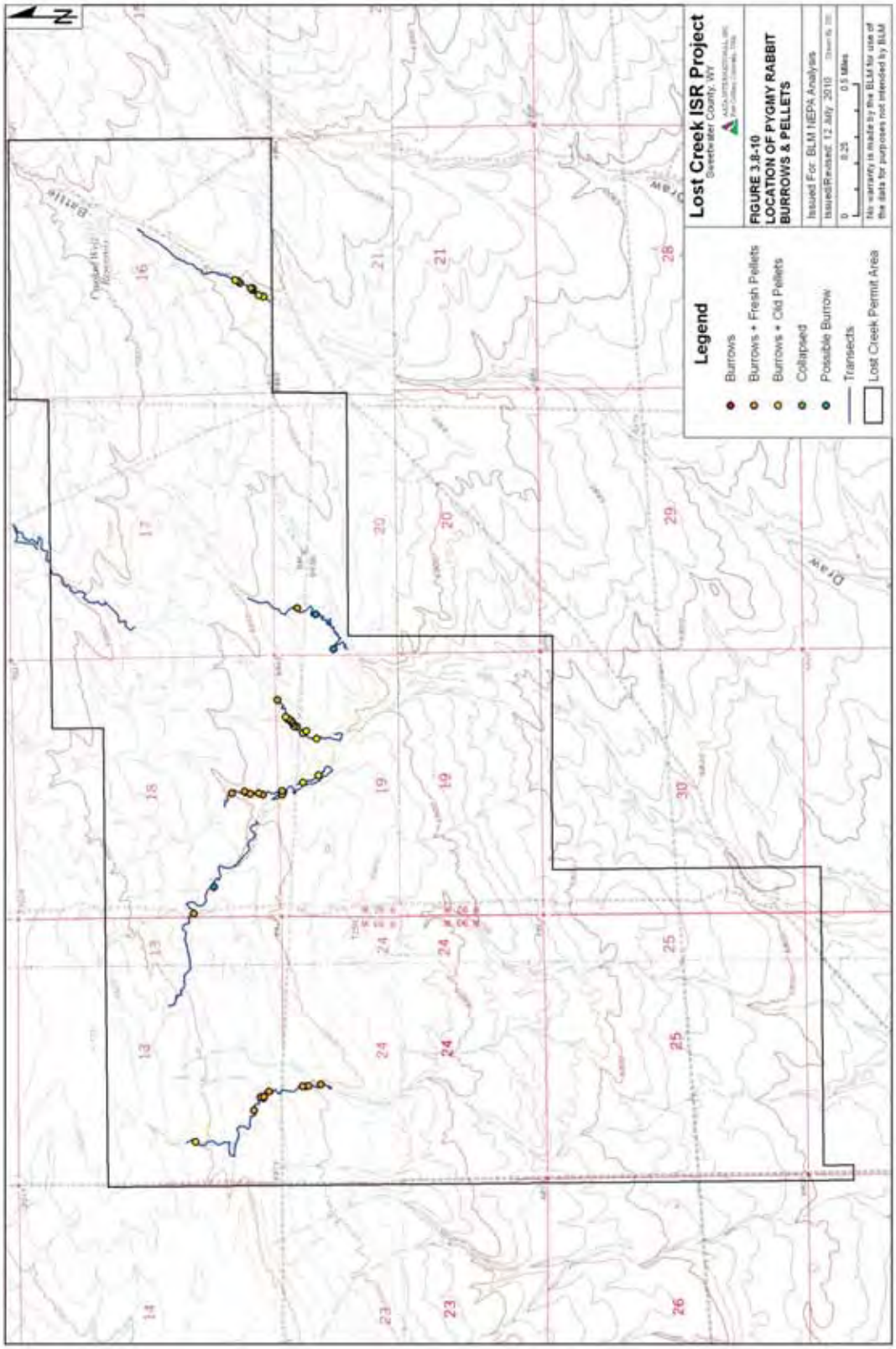
[1] Sensitive Species = BLM Sensitive Species List
Endangered, Threatened, Candidate = Status under the Endangered Species Act

NSS1 = State of Wyoming Native Species Status 1: Populations are greatly restricted or declining, extirpation appears possible ~*OR*~ on-going significant loss of habitat.

NSS2 = State of Wyoming Native Species Status 2: Populations are declining, extirpation appears possible; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. ~*OR*~ Populations are declining or restricted in numbers and/or distribution; extirpation is not imminent; ongoing significant loss of habitat.

NSS3 = State of Wyoming Native Species Status 3: Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable, but no loss; species is not sensitive to human disturbance. ~*OR*~ Populations are declining or restricted in numbers and/or distribution; extirpation is not imminent; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. ~*OR*~ Species is widely distributed; population status or trends are unknown, but are suspected to be stable; ongoing significant loss of habitat.

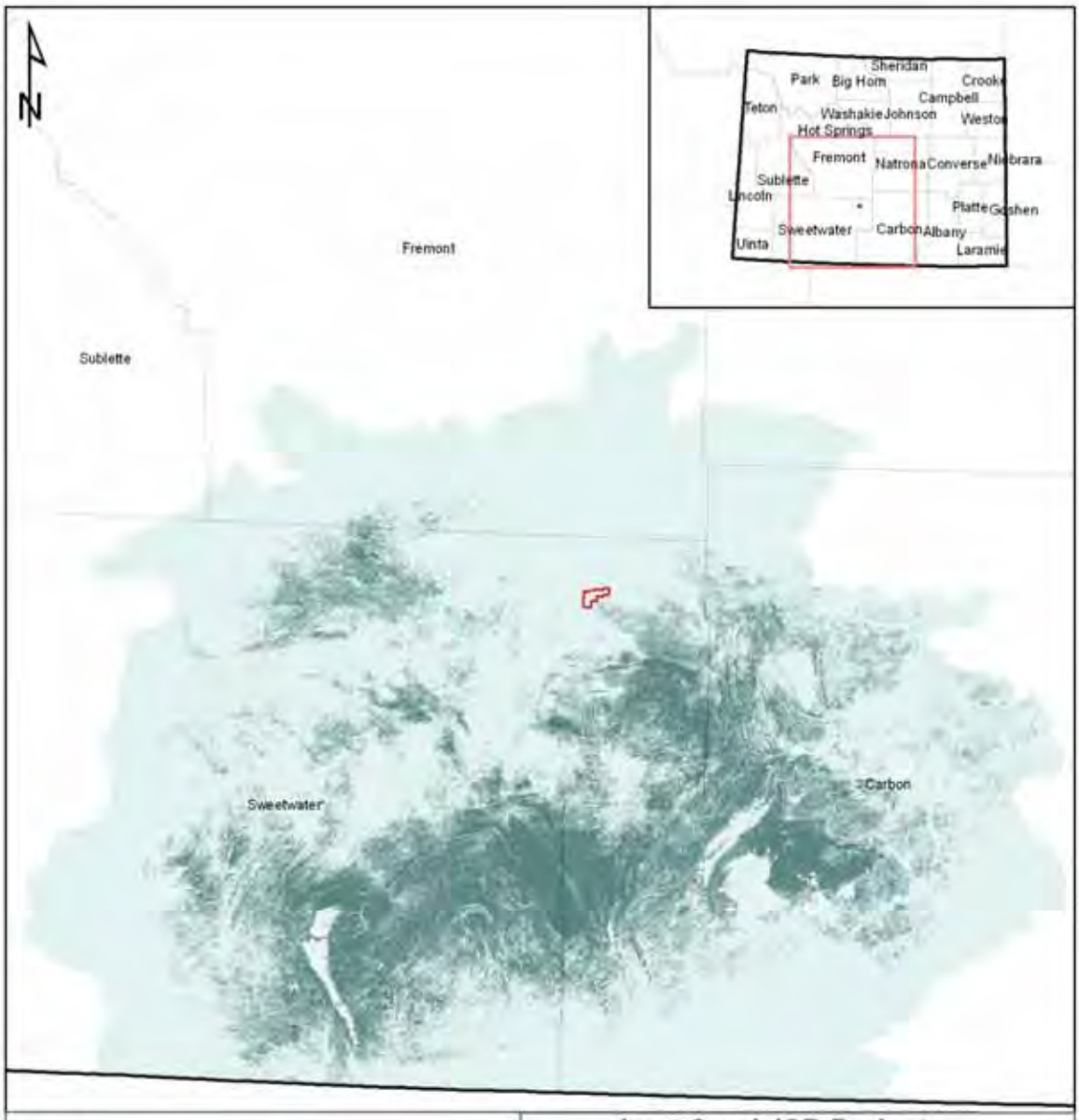
NSS4 = State of Wyoming Native Species Status 4: Restricted. ~*OR*~ Populations are declining or restricted in numbers and/or distribution; extirpation is not imminent; habitat is not restricted, vulnerable, but no loss; species is not sensitive to human disturbance. ~*OR*~ Species is widely distributed; population status or trends are unknown but are suspected to be stable; habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance. ~*OR*~ Populations are stable or increasing and not restricted in numbers and/or distribution; ongoing significant loss of habitat.

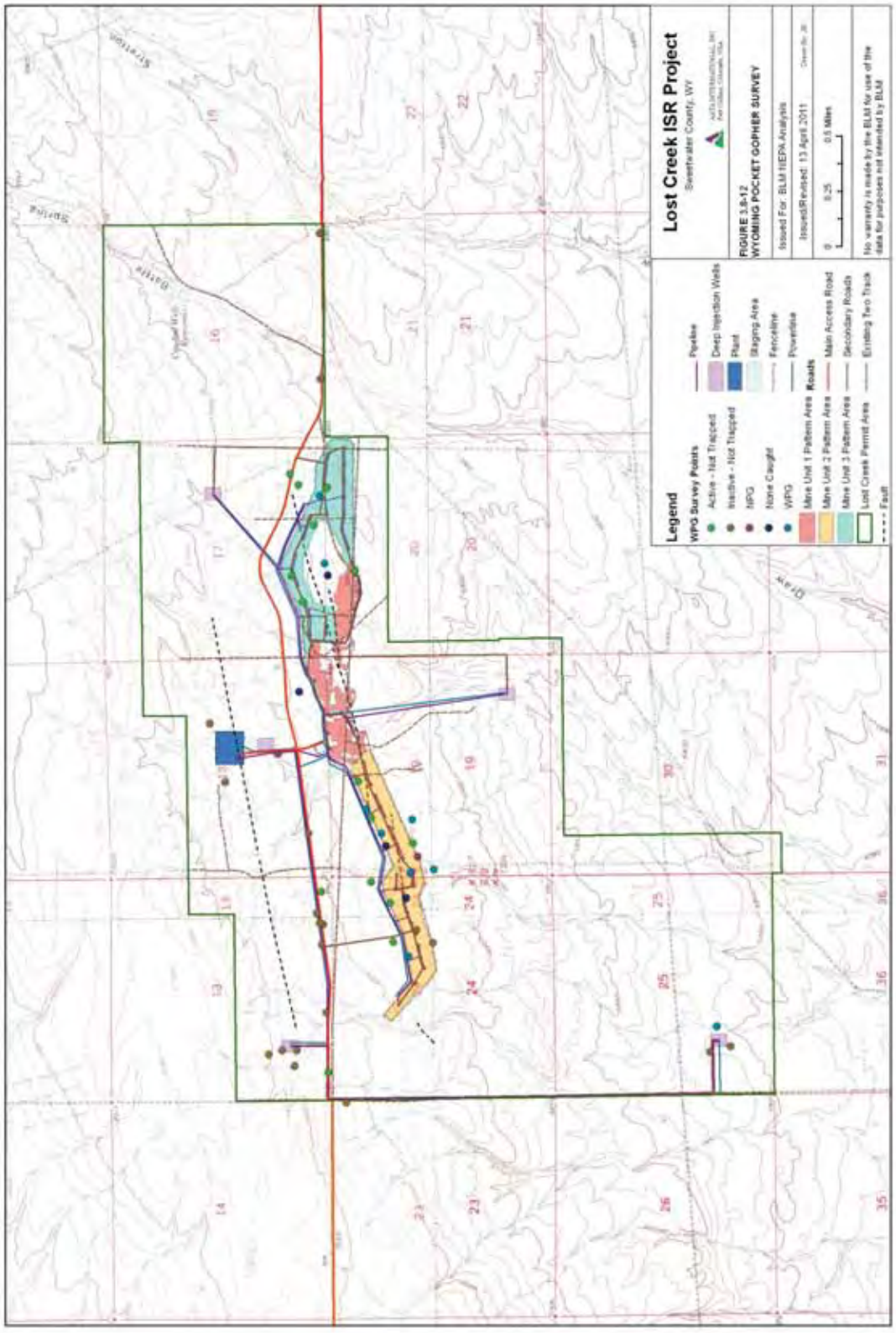

N
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-10
LOCATION OF PYGMY RABBIT
BURROWS & PELLETS
Issued For: BLM NEPA Analyses
Issued/Revised: 12 July 2010
0
0.25
0.5 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Burrows
Burrows + Fresh Pellets
Burrows + Old Pellets
Collapsed
Possible Burrow
Transects
Lost Creek Permit Area

Wyoming Pocket Gopher

The Wyoming pocket gopher (*Thomomys clusius*) is a BLM and USFS sensitive species, a State imperiled species (WNDD G2/S2 rank), and was petitioned to be listed as a T&E species. The USFWS has recently reviewed existing data to determine if the Wyoming pocket gopher should be federally protected as a T&E species (USFWS, 2010b). Based on this review, the USFWS made a determination that listing is not warranted. The Wyoming pocket gopher is restricted to a very small portion of south-central Wyoming and possibly into very northern Colorado (Clark and Stromberg, 1987). The Wyoming pocket gopher is a small, lighter-colored member of the Giomyidae family with a length of approximately six to seven inches and a weight of 1.5 to 2.5 ounces. The more common northern pocket gopher (*T. talpoides*) range overlaps the Wyoming pocket gopher range. Habitat analyses suggest that Wyoming pocket gophers occur predominantly on gentle slopes where Gardner's saltbush and winterfat are present and big sagebrush is absent or subdominant. Wyoming pocket gopher sites also tend to have less grass, rock, and litter cover when compared to control sites and those occupied by the more common northern pocket gopher (Griscom et al., 2010). As shown in **Figure 3.8-11**, predictive models show the Permit Area within potential habitat areas.

Trapping was completed during fall 2010 to determine if Wyoming pocket gophers are present within the Lost Creek Disturbance Area (approximately 330 acres anticipated to be disturbed by the Project). Based on the trapping effort, Wyoming pocket gophers are present throughout the Lost Creek Disturbance Area. Wyoming pocket gophers were captured in nine different locations within the Disturbance Area. Additional active burrow complexes were located throughout the Disturbance Area. Active burrow complexes were located within very small grassy openings within the sagebrush plant community (**Figure 3.8-12**). There is a high likelihood that Wyoming pocket gophers are present throughout the Permit Area.


N
Fremont
Sublette
Sweetwater
Carbon
Sheridan
Park
Big Horn
Crook
Campbell
Teton
Washakie
Johnson
Weston
Hot Springs
Fremont
Natrona
Converse
Niobrara
Sublette
Lincoln
Platte
Goshen
Sweetwater
Carbon
Albany
Uinta
Laramie
Legend
Lost Creek Permit Area
County Boundary
State of Wyoming
Predicted Probability of Occurrence
Low
Medium
High
Lost Creek ISR Project
Sweetwater County, WY
AATA INTERNATIONAL, INC
Fort Collins, Colorado, USA
FIGURE 3.8-11
WYOMING POCKET GOPHER DISTRIBUTION
Issued For: BLM NEPA Analysis
Issued/Revised: 13 July 2010
Drawn By: DS
0
25
50 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.8-12
WYOMING POCKET GOPHER SURVEY
Issued For: BLM NEPA Analysis
Issued/Revised: 13 April 2011
0 0.25 0.5 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
WPG Survey Points
Active - Not Trapped
Inactive - Not Trapped
WPG
None Caught
WPG
Roads
Mine Unit 1 Pattern Area
Mine Unit 2 Pattern Area
Mine Unit 3 Pattern Area
Lost Creek Permit Area
Fault
Pipeline
Deep Injection Wells
Plant
Staging Area
Fenceline
Powerline
Main Access Road
Secondary Roads
Existing Two Track

State-Listed Special Status Species

The state-listed wildlife species (WGFD, 2005a; WGFD, 2005c) not included under other wildlife categories, and their probability of occurrence in the Permit Area, are listed in **Table 3.8-5**. State-listed species that may occur in the Permit Area are classified as NSS 2, 3, or 4. Status 2 species have declining populations that are threatened with extirpation, and have restricted or vulnerable habitat. These species may also be sensitive to human disturbance or have significant habitat loss. Status 3 species have: 1) populations that are restricted or declining with the threat of extirpation, 2) habitat that is restricted or vulnerable, or 3) a wide distribution and unknown population, with significant habitat loss. Status 4 species have: 1) populations that are restricted or declining with stable habitat, 2) widely distributed stable populations with restricted habitat that are sensitive to human disturbance, or 3) stable or increasing populations with significant loss of habitat.

State-listed avian species that may occur in the Permit Area have been classified as NSS 3 or 4 (WGFD, 2005a). The listed waterfowl and shorebird species (e.g., American white pelican, upland sandpiper, and long-billed curlew) and passerines (e.g., McCown's longspur, and bobolink) are unlikely to be in the Permit Area because there is no suitable habitat for these species. However, they may pass through the Permit Area during migration. The sage thrasher, Brewer's sparrow, and sage sparrow (all NSS4 species) were observed in the Permit Area. An isolated observance of a chestnut collared longspur within the Permit Area was noted in 2010. Suitable habitat exists for the lark bunting, though this species was not observed.

State-listed mammal species that may occur in the Permit Area have been classified as NSS 2, 3, or 4 (WGFD, 2005c). Several listed shrew and bat species (e.g., dwarf shrew, vagrant shrew, hoary bat, and silver-haired bat) have ranges that include the Permit Area. There is no suitable habitat in the Permit Area, so they are unlikely to be present. Suitable roosting habitats for the western small-footed myotis, little brown myotis, long-legged myotis, big brown bat, Townsend's big-eared bat, and pallid bat might be found in rock crevices, rock outcrops, or trees near the Stratton Rim, approximately ten miles to the northeast of the Permit Area. These species could also potentially roost in the vertical walls of eroded streambeds in the Permit Area. However, none of these species were observed in the Permit Area. The state-listed olive-backed pocket mouse and prairie vole were not observed in the Permit Area either. Suitable habitat exists in the Permit Area, and these species are known to be in the region (WGFD, 2004a).

Table 3.8-5 Wildlife Species of Special Concern (Page 1 of 2)

Species	Status [1]	Preferred Habitat	Potential Occurrence	Identified in Permit Area
Birds				
American White Pelican	NSS3	Big rivers, lakes, reservoirs, estuaries, islands, peninsulas	Unlikely	
Great Blue Heron	NSS4	Wetlands, water banks, rivers, lakes, fields, meadows	Present	
Snowy Egret	NSS3	Marshes, water banks, and shallow rivers, lakes, ponds	Possible	
Northern Pintail	NSS3	Riparian/wetlands, rivers, lakes, ponds in grasslands, fields, boreal forest	Likely	
Canvasback	NSS3	Riparian/wetlands, big rivers, lakes, ponds	Present	
Redhead	NSS3	Wetlands, lakes, rivers	Likely	
Sandhill Crane	NSS3	Wetlands, grasslands, banks of rivers, lakes, ponds	Possible	
Upland Sandpiper	NSS4	Fen, cropland, grassland, fields	Unlikely	
Long-billed Curlew	NSS3	Wetland/riparian, grassland, meadows	Unlikely	
Western Burrowing Owl	NSS4	Grasslands, deserts, and savannas in burrows	Likely	
Short-eared Owl	NSS4	Wetland, fen, grassland, cropland, savanna	Possible	
Willow Flycatcher	NSS3	Riparian, shrubland, woodland	Possible	
Sage Thrasher	NSS4	Desert, shrubland, sagebrush plains	Present	x
Brewer's Sparrow	NSS4	Desert, shrubland, sagebrush plains	Present	x
Sage Sparrow	NSS4	Desert, shrubland, sagebrush	Present	x
Lark Bunting	NSS4	Cropland, desert, grassland, shrubland	Likely	
Grasshopper Sparrow	NSS4	Grasslands, fields, savanna	Present	x
McCown's Longspur	NSS4	Cropland, grassland	Unlikely	
Chestnut-collared Longspur	NSS4	Cropland, desert, grassland	Present	x
Bobolink	NSS4	Wetland, cropland, grassland	Unlikely	

Table 3.8-5 Wildlife Species of Special Concern (Page 2 of 2)

Species	Status [1]	Preferred Habitat	Potential Occurrence	Identified in Permit Area
Mammals				
Dwarf Shrew	NSS3	Wetlands in alpine, scree, conifer forest, grassland, shrubland, woodland	Possible	
Vagrant Shrew	NSS3	Wetland/riparian, fen, conifer forest, woodland, grassland, field, shrubland	Possible	
Western Small-footed Myotis	NSS3	Roost in rock crevices, caves, tunnels, under boulder, loose bark, buildings, mines in desert, badland, semiarid habitat	Possible	
Little Brown Myotis	NSS3	Roost in buildings, caves, hollow trees in fens, wetland/riparian, forests, shrublands, woodlands	Possible	
Long-legged Myotis	NSS2	Roosts in caves, mines, buildings, rock crevices, under bark, hollow trees in riparian, desert, forest, woodland	Possible	
Hoary Bat	NSS4	Roasts in tree foliage, rock crevices, tree trunks and cavities in riparian, conifer forest, woodland	Unlikely	
Silver-haired Bat	NSS4	Tree cavities of conifer forest adjacent to lakes, ponds, streams	Unlikely	
Big Brown Bat	NSS3	Roost in buildings, trees, rock crevices, tunnels, caves in woodlands and conifer forests	Possible	
Townsend's Big-eared Bat	NSS2	Roost in caves, mines, buildings, tree cavities in conifer forest, woodland sagebrush, riparian	Possible	
Pallid Bat	NSS2	Roost in rock crevices in desert and grasslands	Possible	
Pygmy Rabbit	NSS3	Burrows in dense big sagebrush and desert	Present	x
Olive-backed Pocket Mouse	NSS3	Burrows in cropland, grassland, shrubland	Likely	
Prairie Vole	NSS3	Burrows in grasslands, fields, shrubland	Likely	

[1] **State – Native Species Status**

NSS1: Native Species Status 1 - Populations are greatly restricted or declining, extirpation appears possible and on-going significant loss of habitat.

NSS2: Native Species Status 2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or ongoing significant loss; species may be sensitive to human disturbance.

NSS3: Native Species Status 3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.

NSS4: Native Species Status 4 - Populations are greatly restricted or declining, extirpation appears possible; habitat is stable and not restricted.

3.8.3.9 Reptiles and Amphibians

Several species of reptiles were observed during general surveys, as noted in **Table 3.8-1**. Reptiles included the greater short-horned lizard, prairie rattlesnake, and western terrestrial garter snake. No amphibians were observed within the Permit Area. Incidental herpetology observations are recorded as part of the annual monitoring and would continue beyond baseline for the purposes of monitoring and determining species composition.

Specific auditory surveys for the Great Basin spadefoot toad (*Spea intermontana*) were completed within the Permit Area during the spring and early summer of 2010 and 2011 as a part of the baseline data collected at the request of WGFD and BLM. No spadefoot toad vocalizations were heard during either survey. Detailed methods and results of the 2010 investigations are included in the Project's 2010 Annual Wildlife Monitoring Report (LWR Consultants, Inc. and Wyoming Wildlife Consultants, Inc., 2011).

3.8.3.10 Fish and Aquatic Life

The Permit Area is predominately dry shrubland. There is no aquatic habitat for most of the year. The Crooked Well Reservoir is an ephemeral stock pond that is dry except for a short period of time after spring snowmelt (**Figure 3.5-4**). The Permit Area is bisected by several intermittent drainages that provide running water only after large storm events. There is no habitat for fish within the Permit Area. Aquatic habitat is limited to ephemeral streams and stock ponds.

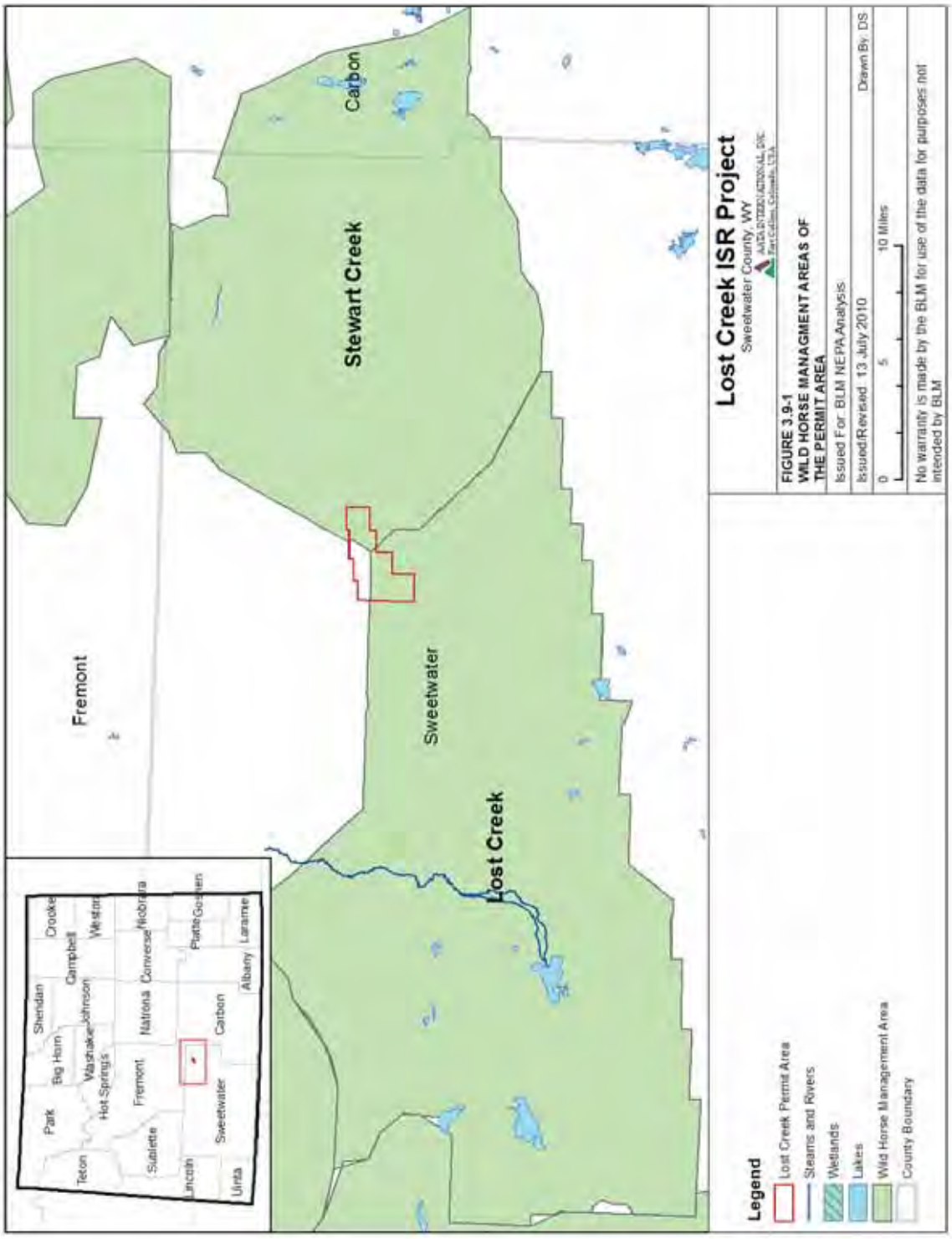
3.9 Wild Horses

In accordance with the Wild Free-Roaming Horse and Burro Act of 1971, the Wyoming BLM is required to protect, manage, and control wild free-roaming horses and burros on public lands. The Wyoming BLM manages 16 Herd Management Areas (HMAs) throughout the state for wild horses; there are no wild burros in the state (BLM, 2009c).

Even though they are considered part of the natural system, without constant management the wild horse population would experience periods of overpopulation, lack of food, and eventually starvation until a sustainable level was restored. In an effort to manage the horse population, the BLM has delineated HMAs, which are geographic regions where wild horses tend to congregate, graze and reproduce. For each HMA, the BLM has established an appropriate management level (AML), which is designed to ensure the ecological balance among all the users and resources of the HMA, such as wildlife, livestock, vegetation, water and soil and the wild horse population (BLM, 2009d). When wild horse numbers within an HMA exceed the AML, the BLM gathers the excess wild horses to prevent damage to the rangeland from wild horses and reduce the possibility of vegetation and water scarcity. Excess animals are offered to qualified people through the Adopt a Wild Horse or Burro Program

Of the 16 state-wide HMAs, two overlap the Permit Area: the Stewart Creek HMA and the Lost Creek HMA, but less than one percent of the two HMAs (1,969 acres of the Lost Creek HMA and 1,119 acres of the Stewart Creek HMA) are within the Permit Area (**Figure 3.9-1**). The AML for the Stewart Creek Herd is 125 to 175 horses. The present population has been influenced by the routine escape of domestic saddle stock from the surrounding populated areas. A noticeable number of tobiano paints are present in this herd. The horses range from 14 to 15 hands tall and 800 to 1,000 pounds mature weight (BLM, 2011k). The Lost Creek Herd has an AML of 60 to 82 horses. The Lost Creek Herd has also been influenced by the escape of domestic saddle stock from the surrounding populated areas, but is somewhat identified with the Spanish Mustang Breed. Recent genetic testing suggests that this herd has a mixed ancestry that primarily is North American with the possibility of some, although limited, Iberian ancestry. These horses measure 14 to 15 hands tall and have a mature weight of 800 to 1,000 pounds. (BLM, 2011k).

Though the Green Mountain HMA does not intersect the Permit Area, the Green Mountain Wild Horse Herd was also considered. The Green Mountain HMA is located approximately 13 miles northeast of the Permit Area. Although these horses interchange with the Stewart Creek Herd, those interchanges occur near Stewart Creek which is located, at the nearest proximity, more than 10 miles east of the Permit Area. It is rare that Green Mountain Wild Horses venture down to the project vicinity. Therefore, the Green Mountain Wild Horse Unit would not likely be affected by the Project. (Personal correspondence with Roy Packer, Range Specialist of the BLM Lander Field Office, November, 2011.)


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.9-1
WILD HORSE MANAGMENT AREAS OF THE PERMIT AREA
Issued For: BLM NEPA Analysis
Issued/Revised: 13 July 2010
Drawn By: DS
0
5
10 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Lost Creek Permit Area
Streams and Rivers
Wetlands
Lakes
Wild Horse Management Area
County Boundary
Stewart Creek
Lost Creek
Sweetwater
Fremont
Carbon
Sheridan
Crooke
Campbell
Weston
Niobrara
Platte
Goshen
Laramie
Big Horn
Washakie
Johnson
Natrona
Converse
Albany
Park
Hot Springs
Fremont
Carbon
Teton
Sublette
Sweetwater
Lincoln
Uinta

3.10 Meteorology, Climatology and Air Quality

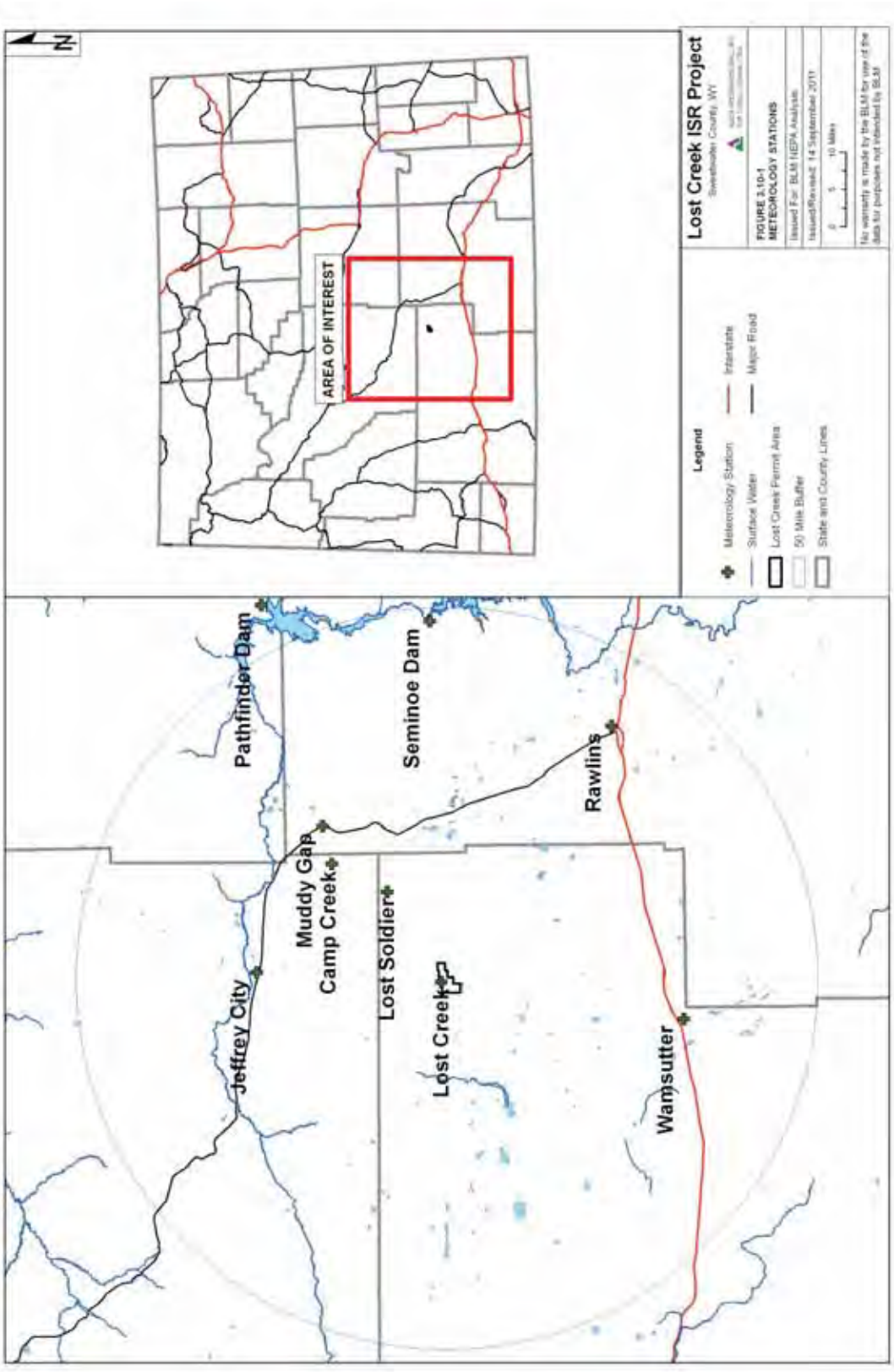
This section describes the meteorology, climatology, and air quality of the Project region. Both regional (long-term) and site-specific data (available periods of measurement [at least one year]) are discussed to describe climatological conditions at the Permit Area. Where site-specific data are not available, data from the closest representative location are presented.

The Project is located in the Basin, in south-central Wyoming. The Permit Area is located in the intermountain semi-desert ecoregion (Wyoming State Climate Office, 2005), which has cold winters and short, hot summers (Bailey, 1995). The average annual temperatures range from 40 to 52 °F in this ecoregion. The average annual precipitation ranges from five to 14 inches (Bailey, 1995). The nearest water bodies of any size are Pathfinder and Seminoe Reservoirs, shown on **Figure 3.10-1**, which are on the order of 50 miles downwind of the Permit Area and on the other side of the Continental Divide. It is unlikely these water bodies have any impact on meteorological measurements at the Permit Area. All other water bodies shown on **Figure 3.10-1** are seasonal, at best, and unlikely to have any impact on meteorological measurements.

3.10.1 Meteorology and Climatology

Meteorological stations within 50 miles of the Permit Area are shown in **Figure 3.10-1**. The National Weather Service (NWS) meteorological station closest to the Permit Area with a long period of record is Muddy Gap, Wyoming (High Plains Regional Climate Center [HPRCC], 2007). This station is 28 miles northeast of the Permit Area; and temperature, precipitation, snowfall and snow depth data have been collected since 1949. The Muddy Gap station is in the same Climate Division as the Permit Area, Climate Division 10 (CLIMAS, 2005), which means that these locations have similar climatic characteristics. Camp Creek is at a higher elevation in somewhat more rugged terrain (Western Regional Climate Center [WRCC] Remote Automated Weather Stations [RAWS], 2010), and is not representative of conditions at the Permit Area.

The Lost Soldier (LS) meteorological station was installed at a location near Bairoil in April 2006. The LS meteorological station is about 12 miles northeast from the Permit Area (**Figure 3.10-1**). After deciding to permit the Project, the Lost Creek (LC) meteorological station was installed within the Permit Area in May 2007 to collect on-site data (**Figure 3.10-1**).


N
AREA OF INTEREST
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.10-1
METEOROLOGY STATIONS
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0 5 10 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Meteorology Station
Surface Water
Lost Creek Permit Area
50 Mile Buffer
State and County Lines
Interstate
Major Road
Pathfinder Dam
Seminoe Dam
Rawlins
Muddy Gap
Camp Creek
Lost Soldier
Jeffrey City
Lost Creek
Wamsutter

Meteorological instrumentation at the LC station consists of the following sensors mounted on a ten-meter tower (**Figure 3.10-2**):

- Vaisala Temperature and Relative Humidity Probe: temperature range of -40 to 140 °F; accurate to ±2 percent at 10 to 90 percent relative humidity and to ±3 percent at greater than 90 percent humidity; shielded by RM Young 10-Plate Gill Solar Radiation Shield and mounted at 6.6 feet (two meters).
- Dual Met One Model 062 Temperature Probes: used for measurement of differential temperature (ΔT) for dispersion and inversion modeling; temperature range of -58 to 122°F; sensors accurate to ±0.09°F; sensors co-calibrated for a maximum error per degree of differential temperature of 0.05°F; shielded by Met One Model 077 Aspirated Shields and mounted at 6.6 feet (two meters) and 32.8 feet (ten meters).
- Met One 3-Cup Anemometer and Wind Vane: range of 0 to 110 miles per hour (mph); anemometer accurate to ±0.25 mph when less than 22.6 mph or ±1.1 percent of true when greater than 22.6 mph; vane accurate to ±4 degrees; mounted at 32.8 feet (ten meters).
- Texas Electronics Tipping Bucket Rain Gage with 8-inch Orifice: accurate to ±1 percent at rainfall rates up to one inch per hour; resolution of 0.01 inches; mounted on freestanding post approximately 3.3 feet (one meter) high, and 16.4 feet (five meters) from tower.
- LI-COR Silicon Pyranometer: measures incoming radiation with wavelengths in the daylight spectrum; measures wavelengths between 400 and 1,100 nanometers; accurate to within 3 to 5 percent; mounted at 32.8 feet (ten meters).

The sensors were connected to a CR1000 data logger. The data recovery rate is greater than 90 percent.

3.10.1.1 Temperature

Average monthly high and low temperatures from LC and four of the closest stations (LS, Muddy Gap, Jeffrey City, and Rawlins), including data available after October 2007, are shown in **Table 3.10-1**. The LC data are generally within the range of the other stations, with the exception that temperatures in the winter months appear to be somewhat lower. However, that is probably due to the short record for LC (in some cases, just one month), as compared to the other stations.

Based on the Muddy Gap data (which has the longest record), July is the warmest month, the average maximum daily temperatures are approximately 85°F, and the average minimum daily temperatures are approximately 55°F. January is the coldest month; the average daily maximum temperatures are 30 to 35°F; and the average minimum daily temperatures are approximately 10 to 15°F. The maximum temperature on record is 100°F in July, while the minimum temperature on record is -40°F in December.

Figure 3.10-2 Lost Creek Meteorological Station, May 2007

Picture shortly after installation; area around station is now fenced.

Table 3.10-1 Temperature Data, Degrees Fahrenheit

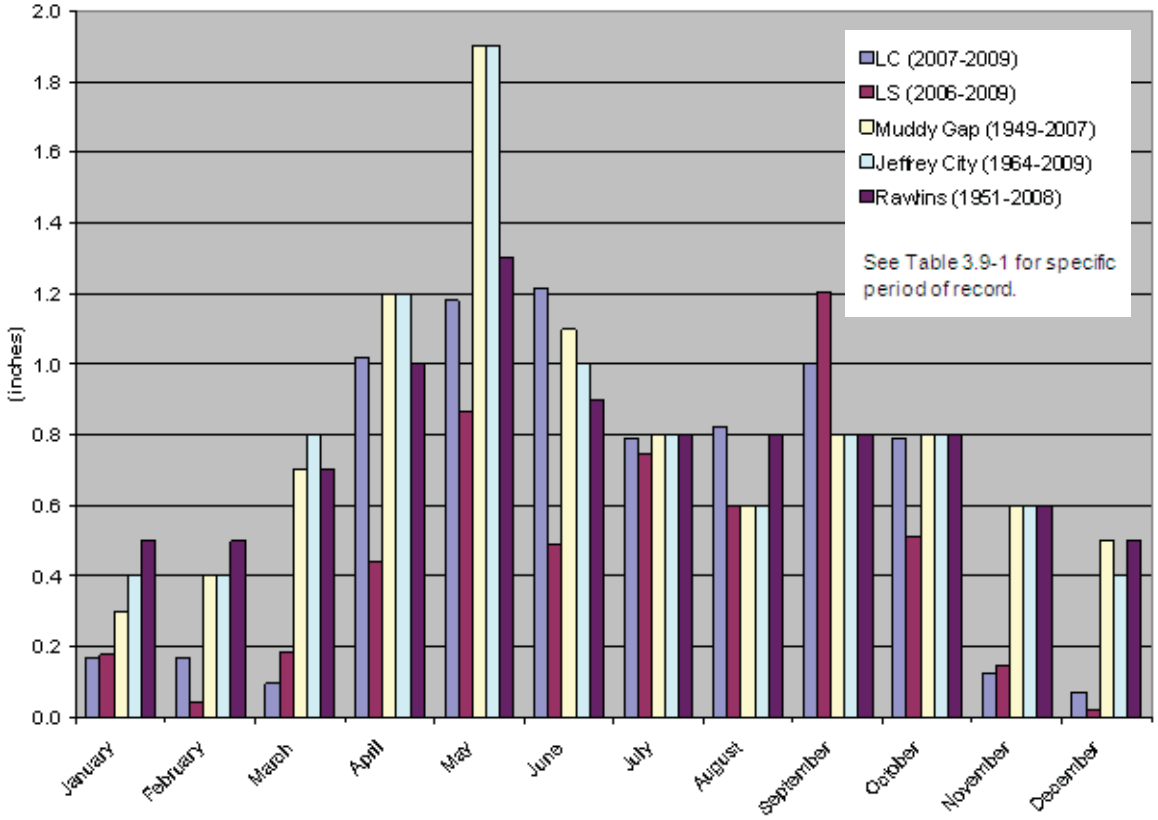
Station	Lost Creek		Lost Soldier		Muddy Gap		Jeffery City		Rawlins	
	Avg. High	Avg. Low	Avg. High	Avg. Low	Avg. High	Avg. Low	Avg. High	Avg. Low	Avg. High	Avg. Low
Period of Record included in Comparison	7/07 - 11/07; 3/08 - 11/09		5/06 - 11/08; 1/09 - 8/09		10/19/1949 - 12/31/2007		4/10/1964 - 6/30/2009		3/6/1951 - 5/31/2008	
January	31.8	5.6	22.4	7.0	31.3	13.8	30.6	8.5	30.8	12.6
February	34.1	9.8	29.5	14.1	34.9	15.9	34.1	10.6	33.8	14.7
March	35.9	11.9	38.0	20.1	43.4	21.4	43.5	18.5	41.3	20.4
April	47.3	22.7	47.0	26.0	55.2	29.2	54.5	26.3	52.6	27.6
May	61.1	34.4	61.0	37.9	66.0	37.9	64.6	34.8	63.9	36.3
June	70.4	41.1	72.4	46.7	76.2	46.4	75.2	42.6	75.4	44.6
July	84.3	50.6	81.6	55.5	85.1	53.5	85.2	49.6	83.8	51.5
August	80.7	48.3	78.4	52.6	83.1	52.2	82.9	48.3	81.1	50.0
September	69.7	38.7	64.7	41.7	72.8	42.5	71.7	38.2	70.5	40.8
October	52.4	26.4	52.6	31.7	59.9	32.9	59.2	28.8	57.0	31.2
November	44.8	18.1	42.5	23.6	42.1	22.1	41.0	17.2	40.7	20.4
December	27.9	4.0	26.0	10.2	32.7	15.2	30.9	9.3	32.0	14.0

3.10.1.2 Precipitation

The Permit Area is drier than many areas in the State of Wyoming. The mean annual precipitation at the Muddy Gap station from 1949 through 2005 was 10.0 inches. Precipitation is distributed throughout the year, but the mean monthly precipitation exceeds one inch only in April, May, and June. May is the wettest month, with 1.9 inches of mean precipitation. Actual annual moisture may be somewhat higher, since precipitation gauges capture only a small proportion of snowfall under windy conditions.

Average monthly precipitation data from LC and four of the closest stations (LS, Muddy Gap, Jeffrey City, and Rawlins) are shown in **Figure 3.10-3**. The LC data are within the range of the other stations, taking into account the variability in precipitation amounts due to local thunderstorms and the recent regionally low precipitation. Regional data showed the area recently received 50 to 70 percent less rainfall than average (HPRCC, 2007).

Figure 3.10-3 Total Monthly Precipitation



3.10.1.3 Humidity and Evaporation

The average relative humidity at the Permit Area is low in the summer, with the lowest average occurring in June (30.2 percent). The relative humidity is elevated during the winter, when the highest average occurred in February (75.6 percent). The monthly and daily maximum and minimum humidity measured at the LS meteorological station is provided in **Table 3.10-2**. Information on total evaporation by month from Seminoe Dam (the nearest available measurement location) is included in **Table 3.10-3** (WRCC, 2010).

Table 3.10-2 Humidity (Percent) at the LC Meteorological Station

Record		Average Monthly Maximum and Minimum		Average Daily Maximum and Minimum	
Month	**Year**	**Maximum**	**Minimum**	**Maximum**	**Minimum**
January	2009	99.7	17.5	91.9	52.8
February	2009	99.0	20.6	93.8	50.4
March	2008, 2009	97.8	20.7	89.4	42.3
April	2008, 2009	99.1	10.3	88.6	34.4
May	2008, 2009	97.8	20.7	89.6	42.7
June	2008, 2009	97.5	6.5	80.1	23.0
July	2007, 2008, 2009	97.3	5.9	69.2	15.1
August	2007, 2008, 2009	96.8	7.3	72.3	16.7
September	2007, 2008	99.4	8.8	80.6	23.7
October	2007, 2008	97.8	20.7	89.1	41.9
November	2007, 2008	97.9	20.7	89.6	43.1
December	2008	98.4	30.8	94.8	55.3

Table 3.10-3 Monthly Estimated Pan Evaporation (Inches) at Seminoe Dam, 1948 to 2005

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
0.00	0.00	0.00	0.00	5.24	8.27	8.99	8.12	5.59	0.00	0.00	0.00	36.21

3.10.1.4 Wind, Mixing, and Stability

The mean wind speed measured at the LC station during 2007 through 2009 was about 11 mph (9.47 knots), and the predominant wind direction was from the west-southwest. The data are summarized in a wind rose on **Figure 3.10-4**.

Atmospheric stability was categorized into six classes according to Pasquill, ranging from A (very unstable) to F (stable) (Pasquill, 1961). Calculations were made using wind speed and solar radiation data collected at the Permit Area. The stability class distribution at the LC station is shown in **Figure 3.10-5**. The data show that the Stability Class is usually Class D (neutral), with Class F (stable) occurring only about one percent of the time, making atmospheric inversion conditions unlikely. Data collected for Lander/Riverton, Wyoming indicated that the average annual mixing height is 1,142 feet in the morning and 7,546 feet in the afternoon. These can also be considered the inversion heights (Holzworth, 1972).

3.10.1.5 Comparison of Local and Regional Data

All available temperature, precipitation, and data from the Lost Creek meteorological station, since the beginning of its operation in 2007 through 2009, were compared to paired data from the Rawlins meteorological station in order to examine the similarities and differences of the data from the two stations. In addition, to examine the representativeness of the meteorological data obtained from 2007 to 2009 (short-term), the historical (long-term) data obtained from the Rawlins station were also examined for comparison. The data and statistical comparisons are described in detail in Attachment 2.5-1 of the NRC Technical Report (NRC, 2011a) and summarized below.

Temperature

Average daily temperatures for LC and Rawlins (short-term and long-term) are presented in **Figure 3.10-6**. In comparing the average daily temperatures for each month from 2007 to 2009 at LC and Rawlins, Rawlins was slightly warmer than LC on average during this time period. However, average daily temperatures at LC and Rawlins are in the same range, i.e., within the 95 percent confidence intervals for the two data sets to overlap. Variations in daily temperatures during all months are very similar.

Figure 3.10-4 Wind Speed and Direction at the LC Meteorological Station

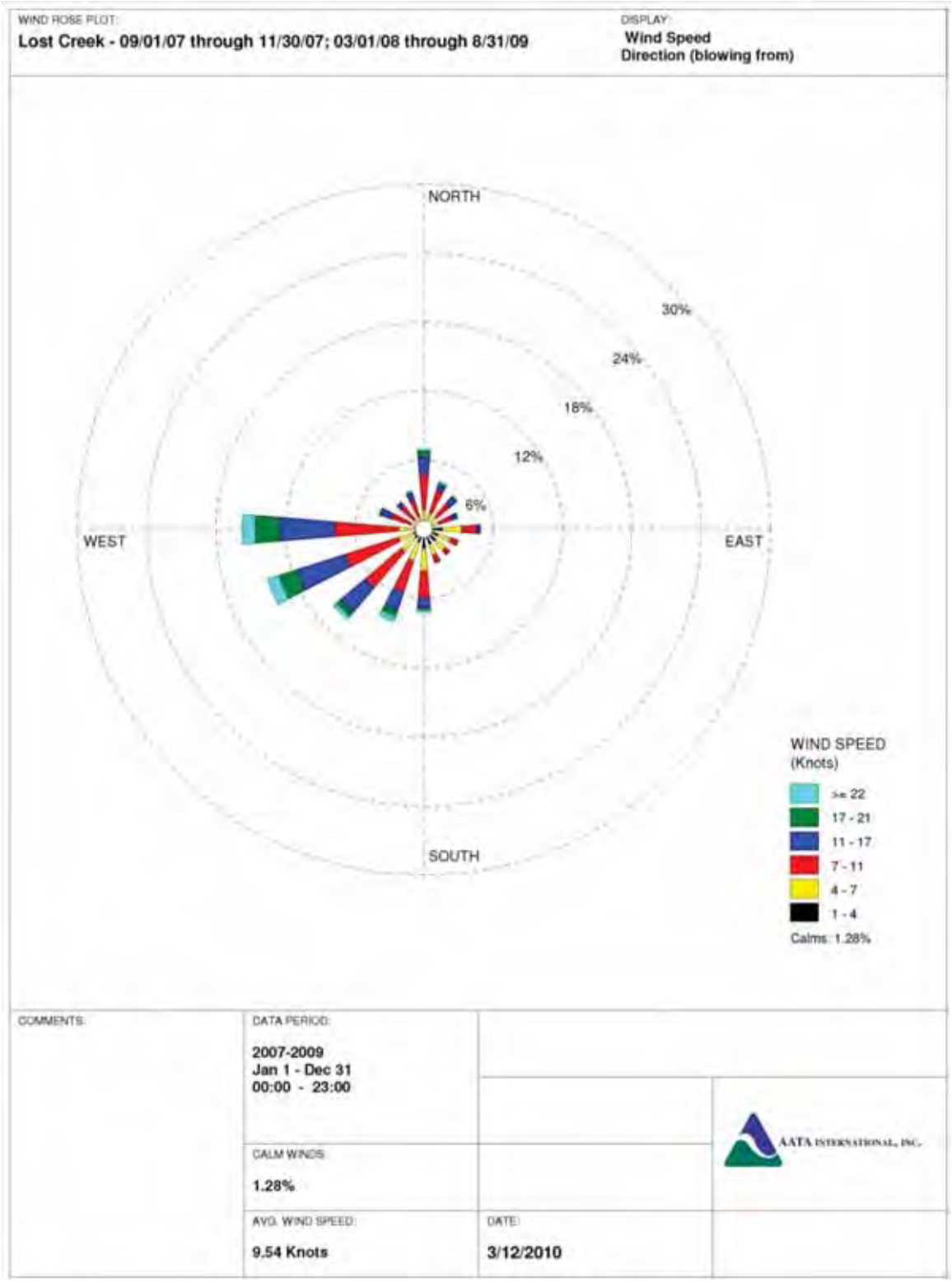


Figure 3.10-5 Stability Class Distribution at the LC Meteorological Station

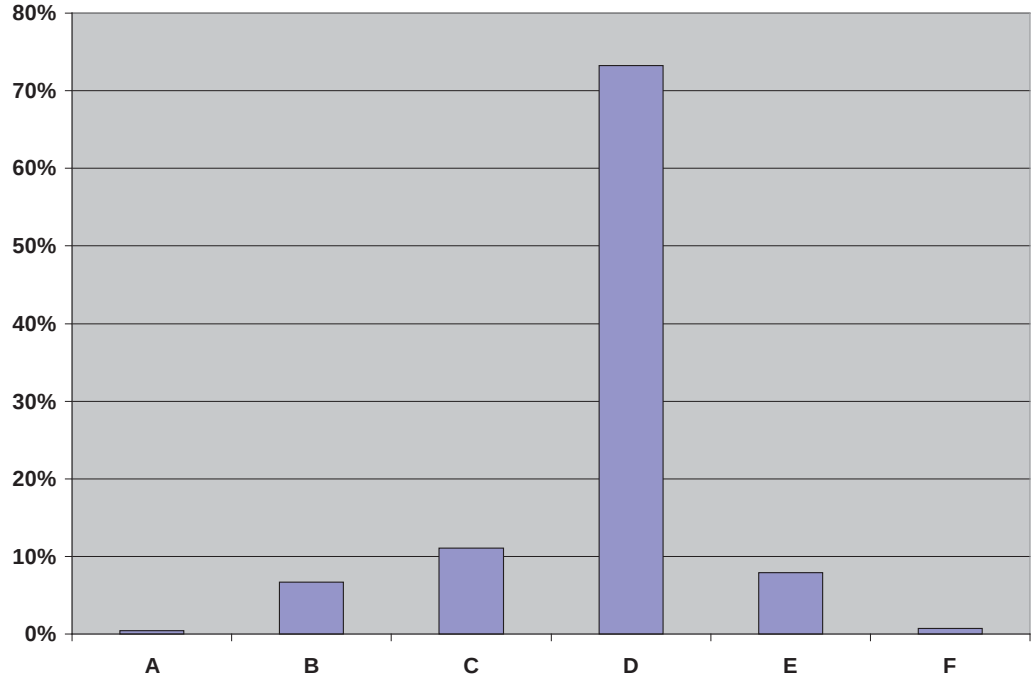
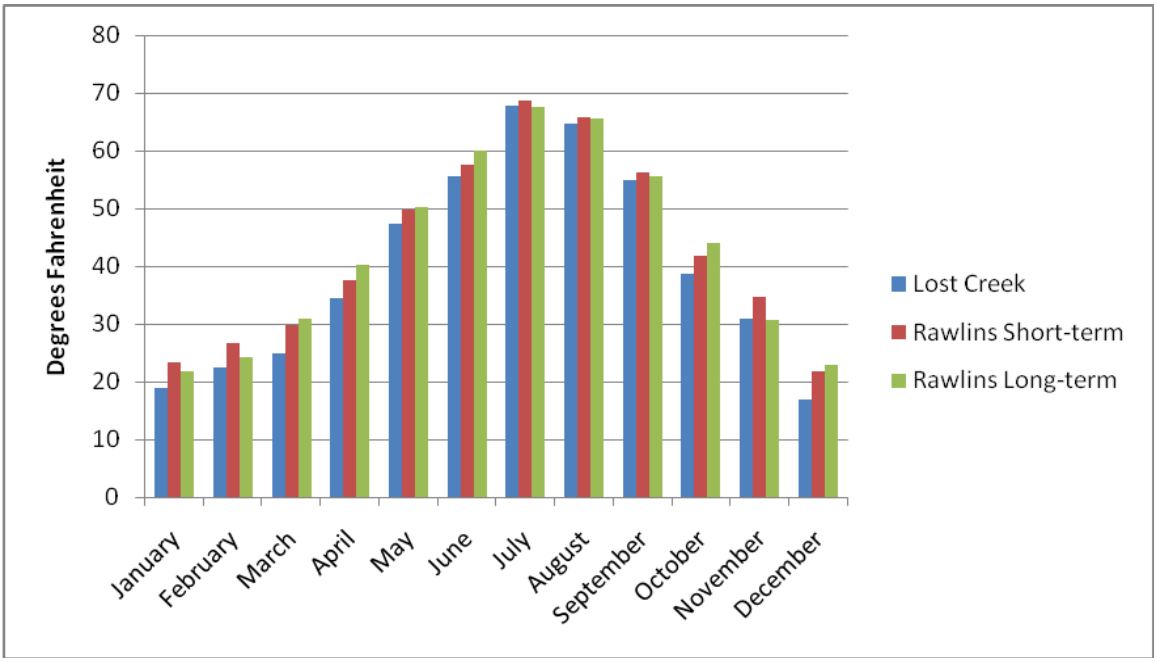


Figure 3.10-6 Comparison of Average Daily Temperatures



Precipitation

Average total monthly precipitation was compared for available complete monthly data for LC (07/07 to 11/07 and 3/08 to 11/09), matched data from Rawlins, and long-term data (1951 to 2008) from Rawlins. The average monthly precipitation totals are presented in **Table 3.10-4**. Total monthly precipitation amounts over the short-term and long-term are relatively variable. Taking into account this inherent variation, which is likely due in part to local thunderstorm occurrences, the LC precipitation averages are generally within the same range, as indicated by the overlap of the 95 percent confidence intervals, as the paired Rawlins data.

Table 3.10-4 Comparison of Average Total Monthly Precipitation (Inches)

Station:	Lost Creek		Rawlins Short-Term		Rawlins Long-Term	
Period of record:	07/2007-11/2007; 3/2008-11/2009		07/2007-11/2007; 3/2008-11/2009		1951-2008	
Statistic:	Avg. Monthly Precip.	95% CI	Avg. Monthly Precip.	95% CI	Avg. Monthly Precip.	95% CI
January	0.16	NA	0.73	NA	0.45	0.36-0.55
February	0.18	NA	0.10	NA	0.50	0.40-0.60
March	0.09	0.07-0.11	0.12	0.04-0.19	0.69	0.59-0.80
April	1.00	0-2.79	1.26	0-2.67	1.01	0.85-1.17
May	1.10	0.83-1.37	1.53	1.31-1.75	1.30	1.07-1.52
June	1.30	0-3.66	1.23	0-2.72	0.90	0.72-1.07
July	0.79	0.07-1.51	1.00	0.64-1.35	0.77	0.62-0.92
August	0.82	0.43-1.21	0.57	0.43-0.71	0.76	0.62-0.90
September	0.92	0.24-1.60	1.05	0.30-1.80	0.84	0.67-1.01
October	0.87	0.16-1.58	0.91	0.54-1.28	0.81	0.64-0.98
November	0.12	0-0.25	0.28	0.12-0.44	0.55	0.44-0.66
December	0.08	NA	0.00	NA	0.46	0.38-0.55

NA= Not Applicable, only one year of data available

Wind

Means and standard deviations of scalar wind speed and directions from LC (short-term) and Rawlins (both short-term and long-term) are summarized in **Table 3.10-5**. As is apparent from the results shown in **Table 3.10-5**, the mean wind speed at the LC station (9.47 knots) was found to be well-matched to the mean wind speed from the paired data at the Rawlins station (9.79 knots). Data

from both stations indicate that the mean wind direction is from the west-southwest.

Table 3.10-5 Comparison of Wind Speed and Direction

Meteorological Station	Period of Record	Mean Scalar Wind Speed (knots)	STDV Scalar Wind Speed	Mean Scalar Wind Direction (degrees)	STDV Scalar Wind Direction
Lost Creek	6/14/2007-11/30/2007; 2/23/2008-8/31/2009	9.47	5.90	245	83.9
Rawlins (short-term)	6/14/2007-11/30/2007; 2/23/2008-8/31/2009	9.79	7.30	267	66.4
Rawlins (long-term)	1/01/1973-6/13/2007	11.1	6.81	244	61.0

3.10.1.6 Violent Weather

Tornadoes are more prevalent in eastern Wyoming than in western Wyoming, because mountain ranges in western Wyoming are barriers to the flow of warm, moist air that causes tornadoes. In Sweetwater County, 19 tornados were reported in a 55-year period, none of which caused an injury or death. An individual tornado would affect only a portion of the County; therefore, chances are small that the Permit Area would experience a tornado. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused to man-made structures (The Tornado Project, 2003). The most destructive tornado recorded in Sweetwater County from 1950 to 2004 was an F-1 "moderate" tornado, which would be unlikely to cause extensive damage to the Project.

The Permit Area is located in an area that has statistically shown a lower density of lightning strikes. The probability of hail is also low, with six occurrences recorded in a 24-year period (Curtis and Grimes, 2007).

Although severe winter storms are generally less violent than summer storms, the relative duration of the winter storms (a day or more) compared to summer storms (generally a few hours) and the combination of heavy snow, strong winds, and low temperatures require that all Wyoming residents be aware of and prepared for the possibility. A history of blizzards in Wyoming is provided in Chapter 19 of the State of Wyoming Multi-Hazard Mitigation Plan (Wyoming Office of Homeland Security, 2008).

3.10.1.7 Climate Change

The Permit Area is considered part of the Great Plains in the study of climate change by the US Global Change Research Program (GCRP), a Federal Advisory Committee (GCRP, 2009). In the period from 1993 to 2008, the average temperature in the Great Plains increased by approximately 1.5°F from the 1961 to 1979 baseline. The projected change in temperature from 2000 to 2020, including the Project's timeframe, ranges from a decrease of approximately 0.5°F to an increase of approximately 2°F. GCRP also projected a change in spring precipitation from the baseline period (1961 to 1979) to the next century (2080 to 2099). For the region of Wyoming where the Project is proposed, GCRP forecasted a 10 to 15 percent increase in spring precipitation over the next century.

3.10.2 Air Quality - Non-Radiological Parameters

The overall air quality in the Project region is good. The area is sparsely populated and is not heavily developed with industrial sources of air pollution. Air quality for radiological parameters is discussed in **Section 3.15**.

3.10.2.1 Air Quality Standards

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), lead, and particulate matter small enough to move easily into the lower respiratory tract (particles less than ten micrometers in aerodynamic diameter, designated Particulate Matter [PM_{10}]). The NAAQS are expressed as pollutant concentrations that are not to be exceeded in the ambient air, that is, in the outdoor air to which the general public has access (40 CFR Part 50.1(e)). Primary NAAQS are designated to protect human health; secondary NAAQS are designated to protect human welfare by safeguarding environmental resources (such as soil, water, vegetation, and wildlife) and manufactured materials. Primary and secondary NAAQS are presented in **Table 3.10-6**. The closest monitoring station to the Permit Area is in Rawlins, and shows that regional air quality is in compliance with the NAAQS and Wyoming Ambient Air Quality Standards (WAAQS) (BLM, 2008a).

Table 3.10-6 Primary and Secondary Limits for NAAQS and the State of Wyoming

Pollutant	National			State of Wyoming		
	Primary Standards	Averaging Times	Secondary Standards	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour [1]	None	9 ppm (10 mg/m^3)	8-hour [1]	None
	35 ppm (40 mg/m^3)	1-hour [1]	None	35 ppm (40 mg/m^3)	1-hour [1]	None
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary	1.5 µg/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary	0.05 ppm (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	Revoked [2]	Annual [2] (Arithmetic Mean)	--	50 µg/m^3	Annual [2] (Arithmetic Mean)	--
	150 µg/m^3	24-hour [3]	--	150 µg/m^3	24-hour [3]	--
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual [4] (Arithmetic Mean)	Same as Primary	15.0 µg/m^3	Annual [4] (Arithmetic Mean)	Same as Primary
	35 µg/m^3	24-hour [5]	--	65 µg/m^3	24-hour [5]	--
Ozone	0.08 ppm	8-hour [6]	Same as Primary	0.08 ppm	8-hour [6]	Same as Primary
	0.12 ppm	1-hour [7] (Applies only in limited areas)	Same as Primary			
Sulfur Oxides	0.03 ppm	Annual (Arithmetic Mean)	--	0.02 ppm (60 µg/m^3)	Annual (Arithmetic Mean)	--
	0.14 ppm	24-hour [1]	--	0.10 ppm (260µg/m^3)	24-hour [1]	--
	--	3-hour [1]	0.50 ppm (1300µg/m^3)	0.50 ppm (1300µg/m^3)	3-hour [1]	--

* EPA, 2007

µg/m^3 = micrograms per cubic meter; mg/m^3 = milligrams per cubic meter; ppm = parts per million

[1] Not to be exceeded more than once per year.

[2] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).

[3] Not to be exceeded more than once per year on average over three years.

[4] In this standard, the three-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.

[5] To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).

[6] To attain this standard, the three-year average of the fourth-highest daily maximum eight-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[7] a. The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is < 1, as determined by Appendix H.

b. As of June 15, 2005, EPA revoked the one-hour ozone standard in all areas except the fourteen eight-hour ozone nonattainment Early Action Compact (EAC) Areas.

In addition to ambient air quality standards, which represent an upper bound on allowable pollutant concentrations, there are national standards for the Prevention of Significant Deterioration (PSD) of air quality (40 CFR Part 51.166). The PSD standards differ from the NAAQS in that the NAAQS provide maximum allowable concentrations of pollutants, while PSD requirements provide maximum allowable increases in concentrations of pollutants for areas already in compliance with the NAAQS. PSD standards are, therefore, expressed as allowable increments in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for three pollutants: NO_2, SO_2, and PM_{10}. Increments are particularly relevant when a major proposed action (involving either a new source or a major modification to an existing source) may degrade air quality without exceeding the NAAQS, as would be the case, for example, in an area where the ambient air is very clean. One set of allowable increments exists for Class II areas, which cover most of the US. A much more stringent set of allowable increments exists for Class I areas, which are specifically designated areas where the degradation of ambient air quality is severely restricted. Class I areas include certain national parks and monuments, wilderness areas, and other areas as described in 40 CFR Part 51.166(e) and 40 CFR Part 81:400-437. Maximum allowable PSD increments for Class I and Class II areas are given in **Table 3.10-7**. The nearest PSD Class I areas, Bridger Wilderness, Fitzpatrick Wilderness, and Mt Zirkel (WDEQ, 2011b), are located about 60, 100, and 90 miles, respectively, to the northwest and south (Mt. Zirkel) of the Lost Creek site. The Popo Agie Wilderness area is the closest Sensitive Class II area and is located about 58 miles to the northwest of the Lost Creek site (NRC, 2011a).

Table 3.10-7 Allowable Increments for Prevention of Significant Deterioration of Air Quality

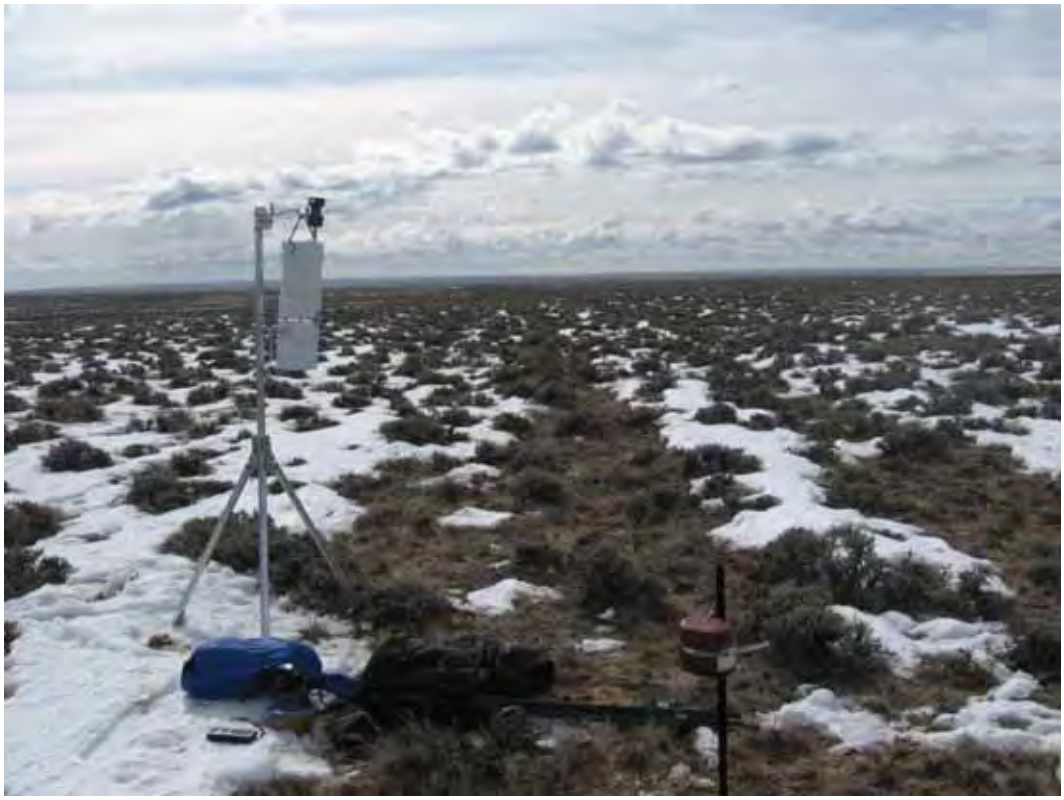
Pollutant	Averaging Time	PSD Increment					
		Class I			Class II		
		µg/m^3	ppm	ppb	µg/m^3	ppm	ppb
NO_2	Annual	2.5	0.0013	1.3	25	0.013	13
PM_{10}	24-hour	8			30		
	Annual	4			17		
SO_2	3-hour	25	0.0096	9.6	512	0.1956	196
	24-hour	5	0.0019	1.9	91	0.0348	35
	Annual	2	0.0008	0.8	20	0.0076	8

ppb= parts per billion

3.10.2.2 Air Particulate Sampling

Air particulate matter in the Permit Area was sampled using two Mini Volumetric (MiniVol) samplers with ten micron (PM_{10}) filters (**Figure 3.10-7**). Dust trapped by these filters is the size considered most detrimental to human health. Two samplers were used as a pair, with samples collected concurrently, upwind and downwind of the Permit Area, at three locations: northern (LCAIR9&10); central (LCAIR13&14); and southern (LCAIR11&12). The sampling duration was approximately 24 hours; the results were time-adjusted for a 24-hour period. **Figure 3.10-8** shows the sampling locations, and the results are presented in **Table 3.10-8**.

Figure 3.10-7 MiniVol Air Particulate Sampler, February 2007



White instrument on left, red instrument on right is passive gamma sampler (**Section 3.15**).

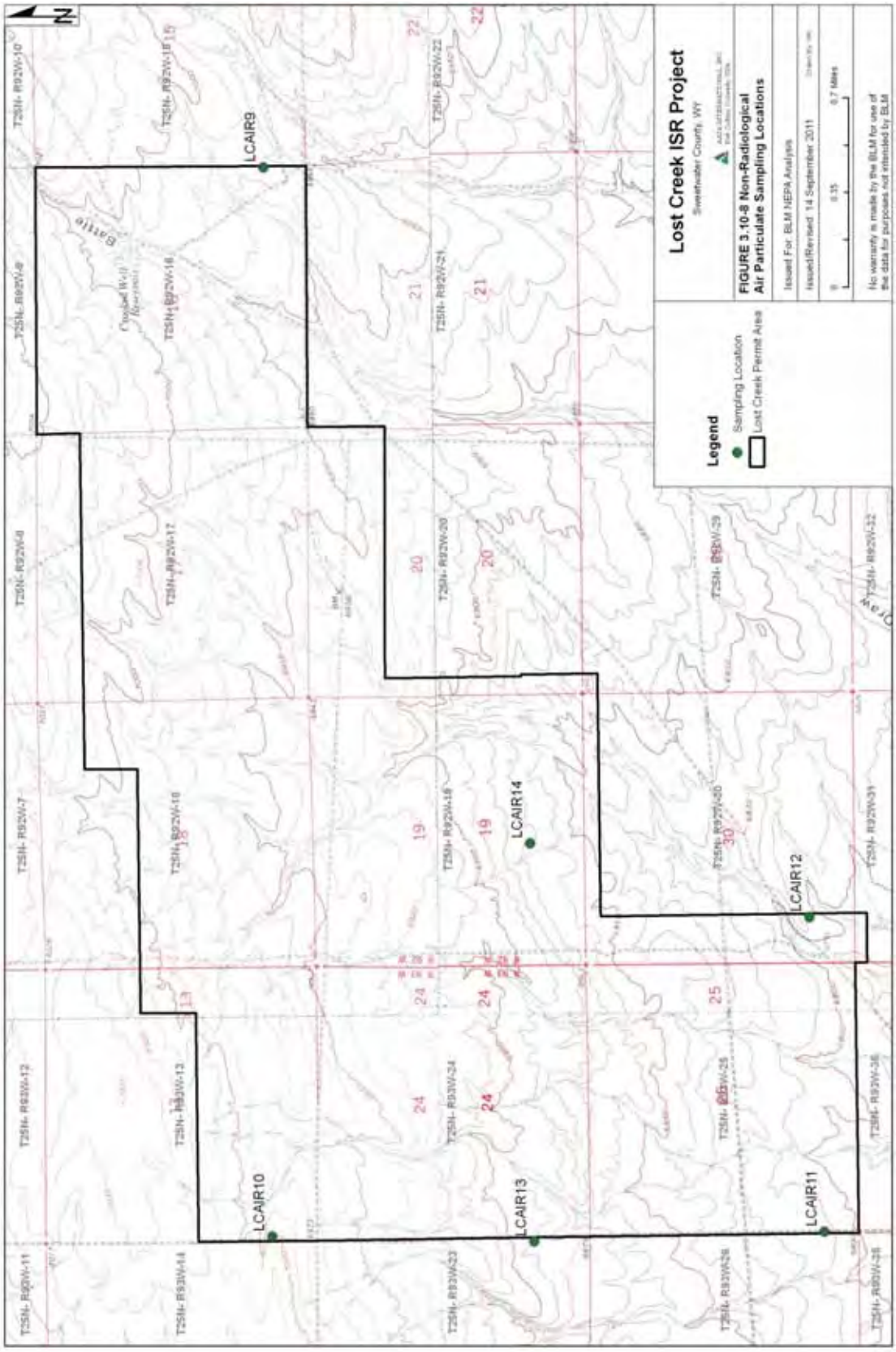

N
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.10-8 Non-Radiological
Air Particulate Sampling Locations
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0
0.35
0.7 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Sampling Location
Lost Creek Permit Area
LCAIR9
LCAIR14
LCAIR12
LCAIR10
LCAIR13
LCAIR11

Table 3.10-8 PM_{10} Concentrations

Location (Figure 3.10-4)	Date	Wind Speed (mph)	Concentration (µg/m^3)			
			Upwind Sample		Downwind Sample	
Northern	6/24/2006	10.1	LCAIR10	9.3	LCAIR9	5.4
Central	6/26/2006	10.3	LCAIR13	10.5	LCAIR14	9.1
Southern	6/25/2006	n/a	LCAIR11	8.0	LCAIR12	8.9
Central	2/7/2007	7.2	LCAIR16	4.7	LCAIR15	3.7

The average PM_{10} concentration in June 2006, including both upwind and downwind sampling locations, was 8.5 µg/m^3. The maximum value was 10.5 µg/m^3 and the minimum value was 5.4 µg/m^3. For comparison, the average PM_{10} in Casper Wyoming was 18.8 µg/m^3 from 1990 through 1994 (Natural Resources Defense Council, 2007). At the northern sampling location, the PM_{10} concentration in the upwind sample was more than 70 percent higher than the downwind sample. At the central and southern sampling locations, the upwind and downwind samples differed by 15 percent or less. The sample collection runs lasted between 21.5 to 28 hours. In February 2007, the PM_{10} concentration at the central sampling location was about one-half of the concentration in June 2006, possibly due to slightly damper soil conditions.

The NAAQS criteria for PM_{10} set a limit of 150 µg/m^3 for a 24-hour period, not to be exceeded more than once per year on an average over three years. The data show that for both upwind and downwind locations, this standard was not exceeded.

3.10.2.3 Greenhouse Gases

Existing greenhouse gas (GHG) emissions in the vicinity of the Permit Area for the last five to ten years are primarily from gas and diesel vehicle and equipment engines, including: vehicles along the Wamsutter Crooks Gap, Sooner, and Mineral Exploration Roads; water well drilling rigs for exploration bore holes and test wells; and equipment for the Sweetwater Uranium Project. **Table 3.10-9** provides the estimated annual emissions from current activities. Specific figures on the number of vehicles, rigs, and equipment operating within and in the vicinity are not available. However, for the purposes of estimating the current level of traffic, it was assumed that five light-duty trucks operate in the vicinity, including one at the Sweetwater Uranium Project. For drilling activity, it was assumed to be one-tenth of that during installation of an operational mine unit, i.e., drilling of 40 borings and/or wells per year. Specific emissions were not included for the Sweetwater Uranium Project because of the limited operations and intermittent equipment use.

Table 3.10-9 Estimated Annual Emissions from Current Activities (tons/year)

Drilling Activity	Vehicular Traffic [1]	Well Drilling and Support Equipment [3]
Nitrogen Oxides (NO_x)	0.1	3.6
Carbon Monoxide (CO)	1.3	0.77
SO_2	2	0.24
PM_{10}	<0.01	0.25
Carbon Dioxide (CO_2)	42	134
Formaldehyde	-- [2]	0.001
Volatile Organic Compounds (VOCs)	--	0.29

[1] Using emission factors from EPA (2005) for a single vehicle multiplied by the expected number of vehicles, it was assumed that five light-duty trucks operate in the vicinity, including one at the Sweetwater Uranium Project.

[2] Dashes (--) indicate information not provided in reference

[3] Operational mine unit (water well) drilling emissions from Table D.3-1, Appendix D of NRC SEIS (NRC, 2011a)

3.11 Noise

3.11.1 Definition

Noise can be defined as unwanted sound of greater than usual volume. Noise, like other sound, can be quantified by its sound pressured level (SPL). SPL, measured in decibels (dB), is a logarithmic measure of the effective sound pressure of a sound to a reference value:

$$dB = 20\log_{10}\left(\frac{sound\ pressure}{reference\ sound\ pressure}\right)$$

The common reference pressure used to calculate decibels is the threshold of human hearing. When using this reference value, 0 dB represents the threshold of hearing and 120 dB is the approximate level at which humans suffer immediate hearing impairment. In relative terms, a sound pressure level increase of 10 dB is perceived as doubling the volume of a sound.

In 1974, the EPA determined sound levels required to protect the health and welfare of the public (including an adequate margin of safety). For outdoor areas where people may spend limited amounts of time, such as the Permit Area, the sound energy level averaged over a 24-hour period should not exceed more than a 49 dBA (A-weighted decibels). (The EPA's Office of Noise Abatement and Control suggests 55 dBA for 24 hours with a 10 dBA penalty added for the hour between 22:00 and 07:00 [nighttime]. This is equivalent to a steady-state sound level for 24 hours of 49 dBA [1978].) Although the EPA assigned regulation of environmental noise to the States in 1981, the 49 dBA level provides a useful reference value for the Project.

3.11.2 Ambient Noise in the Permit Area

The Permit Area is rural and remote as described in **Section 3.1**. The closest non-Project structure is three miles to the south; the closest town, Bairoil, is 15 miles to the northeast; and the closest major road is 18 miles to the northeast. The closest residence is in Bairoil. There are no sensitive receptors near the Permit Area. Baseline noise levels for typical undeveloped desert or arid environments range from 22 dB on calm days to 38 dB on windy days (Brattstrom and Bondello, 1983; DOE, 2007).

At present, ambient sounds in the Permit Area may be produced by high winds, aircraft flyovers (of unknown frequency), thunderstorms, and wildlife. Of these sources, wind produces the most common, intense, and persistent sounds within the Permit Area. Field measurements were made in June 2007 and April 2009 using a Sper Scientific Sound Meter 840005, which accurately measures noise

between 40 and 80 dBA to within ±3.0 dBA. At eight cardinal directions, noise levels were measured for three 30-second intervals facing a cardinal direction. The peak noise level of each interval was recorded. The mean of these peak noise levels for each of the eight cardinal directions is presented in **Table 3.11-1**.

Initial noise measurements were made on the afternoon of June 13, 2007, presumably at the Plant site. Meteorological conditions at the time of measurement were relatively calm, with an east wind averaging 10.7 mph. As shown in **Table 3.11-1**, the measured noise levels were below the instrument detection limit of 40 dBA.

Noise measurements at the Plant site were repeated on the morning of April 28, 2009, when no workers were on site and no heavy equipment was operational. Meteorological conditions at the time of the measurements were windy, with a south-southwest wind averaging 25 mph and gusts up to 34 mph. **Table 3.11-1** shows the measured noise levels ranged from 68 to 89 dBA, with the greatest noise levels measured while facing west and southwest. The maximum peak noise level of a 30-second interval was 94 dBA, facing east and west. The minimum peak noise level was 66 dBA, facing north and south. The noise levels measured on April 28, 2009 were greater than on June 13, 2007 due to the high winds present.

Table 3.11-1 Ambient Noise Field Measurements at the Plant Site

Cardinal Direction	Date	
	June 13, 2007	April 28, 2009
	dBA	dBA
N	<40	69
NE	<40	73
E	<40	87
SE	<40	85
S	<40	68
SW	<40	89
W	<40	89
NW	<40	73

An ambient noise measurement was also made at the northwest high-volume air particulate sampler (Location HV-5 on **Figure 3.15-4**) prior to measurement of the noise produced by various equipment (the equipment noise measurements are included in **Section 4.12**). Meteorological conditions at the time of the measurements were breezy, with the wind averaging 8.5 mph with gusts up to 21 mph. The noise level ranged from 60 to 70 dBA with an average of 65 dBA.

3.12 Historic and Cultural Resources

Discussion of the results of the Project archaeological studies is confidential; disclosure of site locations is prohibited under 43 CFR 7.18. Therefore, the information in this section is presented in general terms.

3.12.1 Overview of Historic and Cultural Setting

The Great Divide Basin (Basin) is one of the geographic subregions in the Northwestern Plains cultural area (BLM, 2008a). The archaeological cultural sequence for the area is divided into the prehistoric periods (Paleoindian, Archaic, and Late Prehistoric) followed by the protohistoric and historic periods. The prehistoric period encompasses about 11,000 years between 12,000 BP (before present; *anno domini* [AD] 1950) and 250 BP (about AD 1700). The protohistoric period extends from about AD 1700 to AD 1840, and the historic period extends to 1957, which was the 50-year cutoff date for possible inclusion on to the National Register of Historic Places (NRHP) when the Project studies were conducted.

The Paleoindian period, between 12,000 to 8,500 BP, is the earliest known period of human occupation in Wyoming (Thompson and Pastor, 1995). Paleoindian groups apparently colonized North America at the close of the last glaciation. These groups are typically associated with subsistence strategies that placed emphasis on big game hunting. The late Pleistocene period exhibited both cooler and wetter climatic conditions than those of the present day, and supported a more diverse environment of savanna and grasslands in the Wyoming area. Animal resources available at this time included camel, horse, mammoth, and a now-extinct bison species.

The Archaic period, between 8,500 to 1,800 BP, is marked by an apparent change in material culture and subsistence practices from the preceding Paleoindian period. During this period, the climate became progressively warmer and drier as glacial conditions completely dissipated. Most megafauna species became extinct at the beginning of this period and bison diminished in size. In response to changing climatic and ecological conditions, native groups switched to an emphasis on smaller game animals and plant resources. This shift is most obvious archaeologically due to the vast increase in the number of ground stone artifacts compared to earlier periods (Thompson and Pastor, 1995).

The transition from the Archaic to the Late Prehistoric period is marked by the development of pottery and the introduction of the bow and arrow. The Late Prehistoric period, between 1,800 to 250 BP, demonstrates a continuation of the increased exploitation of plant foods and the use of structures. This period appears to mark the highest population of southwestern Wyoming seen at any

time in prehistory (Thompson and Pastor, 1995), and ends with the introduction of European traders and trade goods into the region.

The Protohistoric period dates from approximately 250 BP (1700 AD) until the full development of the fur trade in the 1840s. The easiest way to differentiate the Protohistoric period from the preceding period is through the presence or absence of European trade goods. One of the most important changes in this period was the acquisition of the horse in the early 18th century. The horse greatly increased the mobility and range of the inhabitants. Artifact assemblages from this period are often quite diverse with a mix of stone and metal projectile points, knives, copper trade goods and glass beads.

The State of Wyoming recognizes seven historical divisions in the 19th and 20th centuries. These are the Early Historic, Pre-territorial, Territorial, Expansion, Depression, World War (WW) II era, and Post-WWII periods. The Early Historic period dates from 1801 to 1842 and represents the period when Anglo presence in Wyoming was largely limited to trappers and mountain men. The following Pre-territorial period (1843 to 1867) covers the era from the start of the Oregon Trail to the organization of the territory. The Territorial period (1868 to 1889) marks a gradual increase in the population of the state and ends with President Benjamin Harrison signing the statehood bill in 1890 (Larson, 1965). The Expansion period (1890 to 1919) marks the early development of the state and ends after WWI. The Depression period (1920 to 1939) covers the depressed conditions of the 1920s and 1930s and ends with the start of WWII. The WWII era (1940 to 1946) covers the period of the war and its immediate aftermath. The Post-WWII period covers the end of WWII until 1957, the 50-year cut-off for historic artifacts. Sites and artifacts more recent than 1957 are classified as modern.

3.12.2 Archaeological Surveys

In 2006, a Class I site file search was conducted prior to fieldwork in the main Permit Area. According to the file search, three Class III surveys had been conducted in the locality, including: Wyoming State Historic Preservation Office (SHPO) Cultural Resources Office (WYCRO) Projects 80-278, 88-875, and 93-1306. Western Wyoming College completed Project 80-278 for a proposed uranium drill site. The BLM conducted Project 88-875 for a proposed fence line; and a consulting firm had conducted an intensive survey for an expansion of Wamsutter Road (not related to the Project). (Kinneer et al., 2007).

In 2006 and 2007, a Class III archaeological inventory of the main Permit Area was conducted under BLM Cultural Resource Use Permit (CRUP) No. 033-WY-SR06. The survey was conducted by qualified personnel in two four-person crews, walking systematically, conducting back-and-forth sweeps over the entire area, with spacing between individual transects not exceeding 100 feet (Kinneer et al., 2007). In November 2007, Class I and Class III archaeological surveys were conducted for the East and West Access Roads (Kinneer, 2008). Details of the

inventory methods are included in the respective reports for the studies, which were submitted to WDEQ-LQD (Appendices D3 and D-E&W-3 of the WDEQ-LQD Permit to Mine [LCI, 2011b]) and to NRC (Section 2.4 of the Technical Report [LCI, 2010]).

3.12.2.1 Archaeological Survey Results

The Class III survey of the main Permit Area resulted in the map relocation of a site found during one of the earlier surveys and the identification of 17 new sites and 75 isolated resources (IRs). Under the State Protocol between the BLM and the Wyoming SHPO, the IRs are ineligible to the NRHP and no further archaeological consideration of them is recommended. Of the new sites, ten were subjected to subsurface test excavation and evaluated for listing. Three prehistoric sites were recommended as eligible to the NRHP based on the testing results (NRC, 2011a). During the survey of the East and West Access Roads' corridors in November 2007, two additional IRs, one historic and one prehistoric, were recorded. These IRs were, by definition, not eligible for the NRHP (Kinneer, 2008).

3.12.3 Agency and Public Consultation

LCI's archaeological consultants began communications with BLM personnel early in the Project, prior to the 2006 and 2007 surveys; and the BLM received the reports of the study results when they became available. The reports were submitted to NRC in October 2007 as Section 2.4 of the Technical Report to NRC (LCI, 2010), with a Request for Confidentiality and associated Affidavit. The results for the main Permit Area and the East and West Access Roads were also submitted to WDEQ-LQD in December 2007 and October 2009 as Appendices D3 and D-E&W-3, respectively, of the WDEQ-LQD Permit to Mine (LCI, 2011b). These appendices are automatically considered confidential per WDEQ-LQD procedures. A subsequent mitigation plan for one site, discussed in more detail in **Section 4.12**, was also submitted to the BLM for review and approval and to WDEQ-LQD for inclusion in the Permit to Mine.

The communication among the BLM, Wyoming SHPO, NRC, Bureau of Indian Affairs, and tribal governments is outlined in the following paragraphs.

3.12.3.1 State Historic Preservation Office

The BLM has a programmatic agreement with the Wyoming SHPO. NRC contacted the Wyoming SHPO in a letter dated October 3, 2008, requesting information from the SHPO to facilitate the identification of historic and cultural resources that could be affected by the Project. NRC staff also met with a member of the SHPO's office on January 12, 2009 to discuss site-specific issues, including Wyoming SHPO's review process, cumulative impacts to historic sites, and best management practices (BMPs). The staff also met with the SHPO on

June 25, 2009 to discuss protocol for archaeological sites found eligible for inclusion in the NRHP (NRC, 2011a).

3.12.3.2 Nuclear Regulatory Commission

During the permitting for the Lost Creek Project, the NRC and the BLM were developing a Memorandum of Understanding (MOU), such that the BLM and NRC would offer each other cooperating agency status for environmental reviews of ISR licensing projects involving BLM-managed lands. The BLM provided information and guidance on energy-related activities in the region to the NRC during preparation of the Draft SEIS for the Project (NRC, 2011a).

Staff from several BLM offices, including the State Office in Cheyenne, Rawlins Field Office, and the Casper Field Office, met with the NRC in January 2009. Among other topics of discussion, the BLM provided guidance on typical mitigation measures to protect cultural resources. In addition to this meeting, the NRC consulted with the Wyoming BLM offices on a regular basis regarding the progress of the staff's environmental review for the Project (NRC, 2011a).

3.12.3.3 Bureau of Indian Affairs

The NRC staff met with staff from the Bureau of Indian Affairs in Fort Washakie, Wyoming on January 15, 2009 to brief the Bureau of Indian Affairs on the proposed facilities in Wyoming and discuss how the Bureau of Indian Affairs and Native American tribes would be involved in the environmental review process. The Bureau of Indian Affairs stated that tribal governments should be consulted for any projects in the state, and also recommended that tribal elders be involved in cultural and historic surveys (NRC, 2011a).

3.12.3.4 Tribal Governments

Consultations with tribal governments were initiated by NRC in the form of letters dated December 24, 2008 to the following nine tribes: Eastern Shoshone, Northern Arapaho, Northern Cheyenne, Blackfeet, Three Affiliated Tribes, Ft. Peck Assinboine/Sioux, Oglala Sioux, Crow, and Cheyenne River Sioux. No responses from these tribes of this general inquiry were received by NRC. However, several communications have taken place with the Eastern Shoshone and Northern Arapaho with regard to the Project. Tribal Historic Preservation Officers (THPOs) from each of these two tribes have had several communications concerning an eligible pre-historic site discovered in the Permit Area. The THPO from the Eastern Shoshone visited the Permit Area and determined that it held no interest to the tribe (NRC, 2011a).

3.12.4 Paleontological Resources

As noted in Table D5-3 of the WDEQ-LQD Permit to Mine, up to 20 feet of the shallow materials underlying the Permit Area are Quaternary materials derived from Tertiary age formations. Under the BLM's Potential Fossil Yield Classification (PFYC) system, Quaternary age deposits are assigned a Class 2 ranking, indicating the deposits are unlikely to have vertebrate fossils or significant nonvertebrate fossils. No significant paleontological resources are known to occur within the Permit Area. Any Quaternary materials are underlain by the Battle Spring Formation sandstone and shale. The Battle Spring Formation in the Permit Area is part of a major alluvial system consisting of thick beds of very fine- to coarse-grained arkosic sandstones separated by various layers of mudstones and siltstones (LCI, 2010). Under the PFYC system, the Battle Spring Formation is assigned a ranking of Class 3A to 3B. These rankings range from moderate (3A) to unknown (3B) sensitivity for the occurrence of significant vertebrate or invertebrate fossils (BLM, 2007b). To date, no significant paleontological resources are known to occur within the Permit Area.

3.13 Visual and Scenic Resources

3.13.1 Visual and Scenic Classifications

The BLM classifies and manages scenic values and visual quality of public lands through visual resource inventories (detailed in BLM Land Use Planning Handbook H-1601-1, Appendix C [2005]). The visual resource inventory process provides BLM managers with a means for determining visual values. The inventory consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. The scenic quality evaluation is a measure of the visual appeal of the land; the sensitivity level analysis is a measure of the public concern for the scenic quality; and, distance zones indicate how often and how easily seen the area is from highways, rivers, or other common or important viewing locations.

Based on these three factors, BLM-administered lands are placed into one of four visual resource inventory classes. These inventory classes represent the relative value of the visual resources. Class I is assigned to those areas where a management decision has been made previously to maintain a natural landscape. This includes areas such as national wilderness areas, the wild section of national wild and scenic rivers, and other congressionally and administratively designated areas where decisions have been made to preserve a natural landscape. Classes II, III, and IV are assigned based on a combination of scenic quality, sensitivity level, and distance zones. This is accomplished by combining the 3 overlays for scenic quality, sensitivity levels, and distance zones and using guidelines to assign the proper class.

Inventory classes are informational in nature and provide the basis for considering visual values in the Resource Management Plan (RMP) process. They do not establish management direction and should not be used as a basis for constraining or limiting surface disturbing activities. Visual resource inventories are combined with BLM management goals established in BLM's RMP for the area (**Figure 3.13-1**). Within the RMP, BLM assigns one of the four management classes to the area based on the level of necessity to preserve the landscape and the acceptable level of change. The objectives of the four classes are:

- Class I Objective. The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

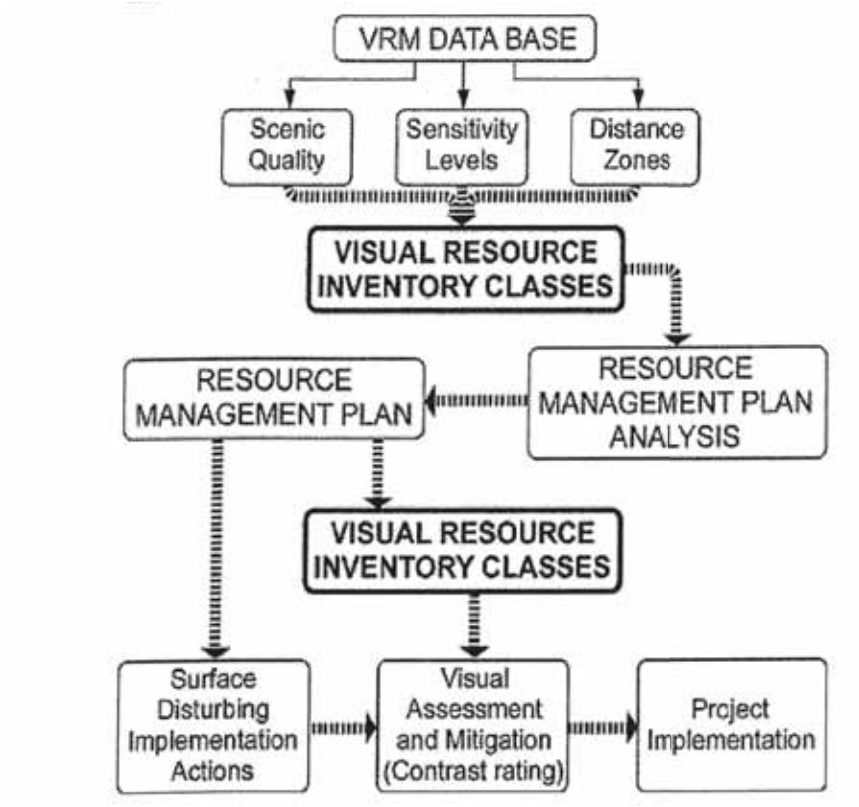
- Class II Objective. The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should

not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

- Class III Objective. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

- Class IV Objective. The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Figure 3.13-1 Flow chart of the BLM Visual Resource Management process (From BLM Manual 8400)



3.13.2 Visual and Scenic Quality of the Permit Area

The Permit Area and surrounding land is relatively homogenous. There is little topographic relief and the most visible vegetation is sagebrush of varying height (**Section 3.7**). There are shallow drainages and channels throughout and surrounding the Permit area, but flow is ephemeral in nature (**Section 3.5**).

There are no wilderness areas within approximately 60 miles of the Permit Area; and the nearest town is located 15 miles northeast of the Permit Area (**Figure 3.13-2**). The closest section of the Continental Divide Trail is eight miles to the northeast of the Permit Area. The closest portion of the Rawlins-Fort Washakie Stage Road, is approximately ten miles northeast of the eastern Project boundary. Although this stage road is mostly located on BLM-managed public lands, it is not marked or well mapped.

A visual resource inventory is available for most of the area affected by the Project. Most of the surrounding area is VRI Class IV, which represents the least valued visual resource inventory class. The Rawlins Field Office has jurisdiction over the majority of the Permit Area, and the Lander Field office has jurisdiction over a small area in the northwestern section of the Permit Area. The Rawlins potion of the Permit Area is assigned as VRM Class III; while the Lander portion, is assigned as VRM Class IV. The Rawlins RMP (BLM, 2008c) also shows a Class IV area just south of the Permit Area surrounding the Sweetwater Mill.

The only potential sensitive visual receptors near the Permit Area are recreationists, such as hikers, sight-seers, antler collectors, OHV users, hunters, and wild horse viewers, as these activities can be dispersed throughout the Basin. Previous modifications to the natural environment of the Permit Area include fencing, power lines, and roads. Drilling rigs can currently be seen in the Permit Area; although these impacts are temporary. **Figure 3.13-3** includes photographs taken from the center of the Permit Area, facing eight compass directions. The scenic quality field inventory score according to BLM methodology was seven out of a possible 32. The associated scenic quality classification was “C”, the lowest possible.

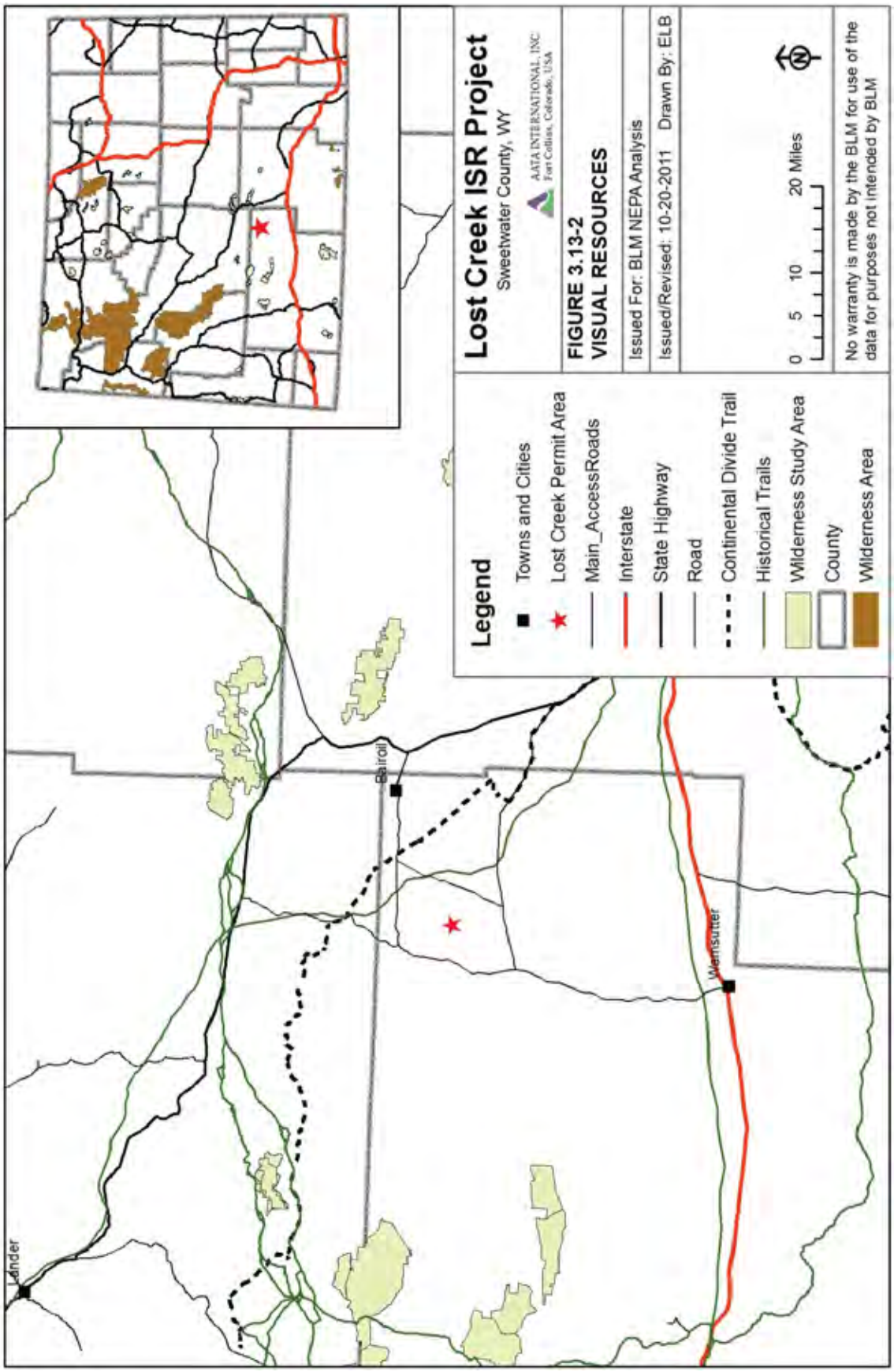

Lost Creek ISR Project
Sweetwater County, WY
AATA INTERNATIONAL, INC
Fort Collins, Colorado, USA
FIGURE 3.13-2
VISUAL RESOURCES
Issued For: BLM NEPA Analysis
Issued/Revised: 10-20-2011 Drawn By: ELB
0 5 10 20 Miles
N
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Towns and Cities
Lost Creek Permit Area
Main_AccessRoads
Interstate
State Highway
Road
Continental Divide Trail
Historical Trails
Wilderness Study Area
County
Wilderness Area
Lander
Bairoil
Wamsutter

Figure 3.13-3 View from Center of Permit Area, October 2011 (Page 1 of 2)

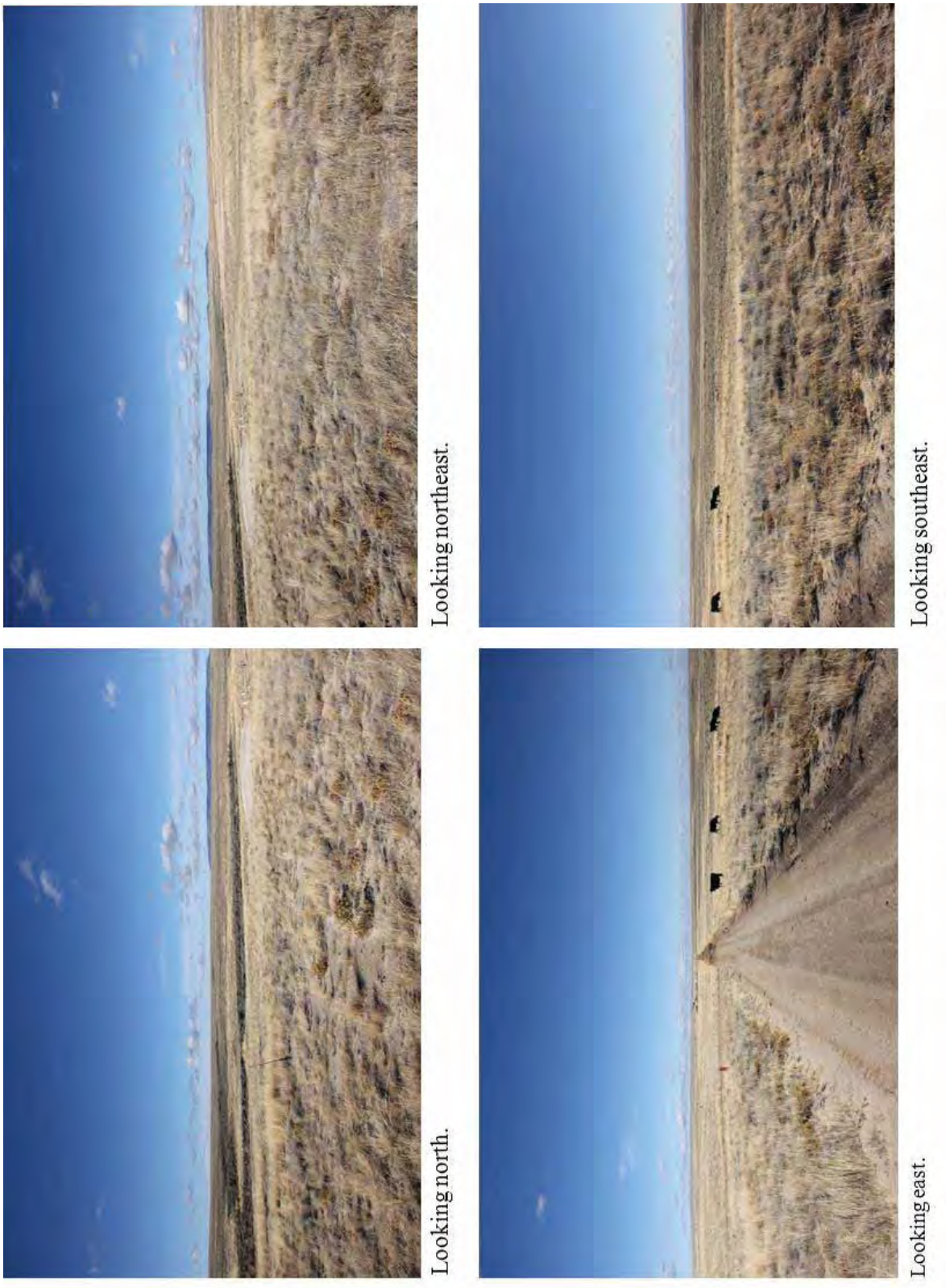
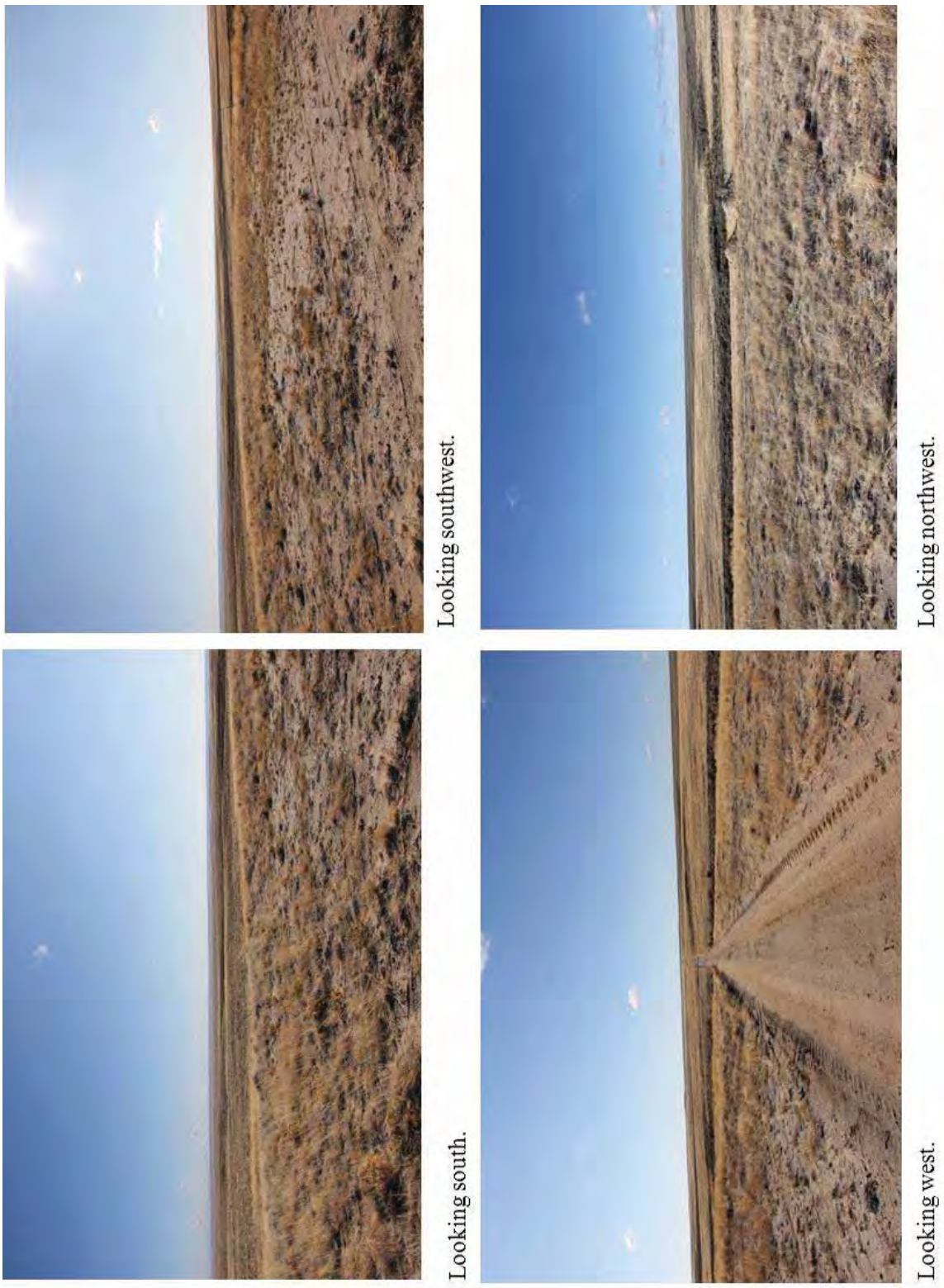


Figure 3.13-3 View from Center of Permit Area, October 2011 (Page 2 of 2)



3.14 Socioeconomic Conditions

3.14.1 Introduction

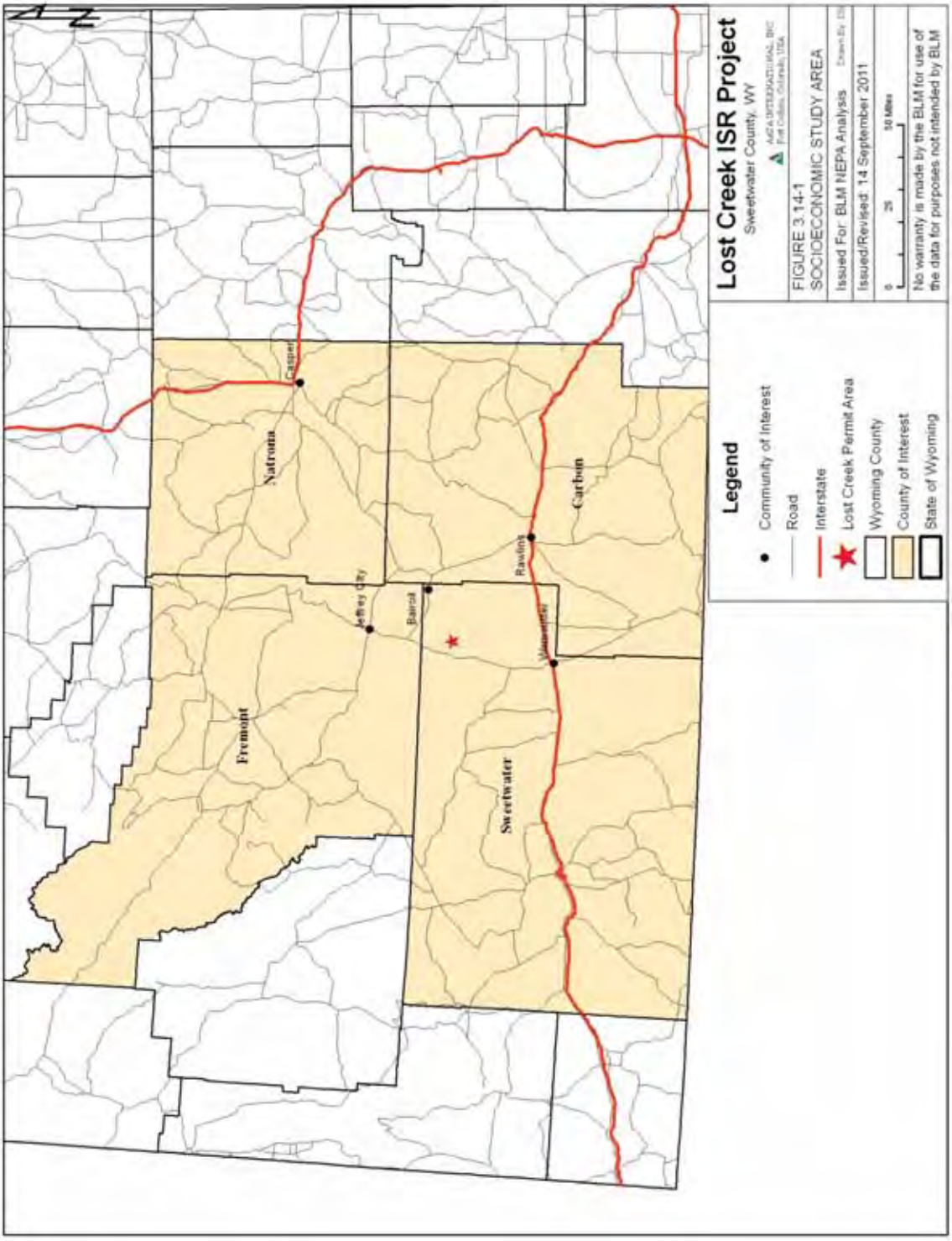
Several Native American tribes originally inhabited the region now known as Wyoming. The Crow, Arapaho, Lakota, and Shoshone tribes were present when European explorers came to the region. Although French fur traders were in the area in the late 1700s, the first recorded American explorer of Wyoming was John Colter, a member of the Lewis and Clark Expedition, in 1807. The initial development and settling of Wyoming throughout the 1800s can be attributed to the fur trade and the prospect of gold, which in turn, brought people westward via the Oregon, Mormon and Overland Trails. Most prospectors passed through Wyoming into neighboring states with an abundance of gold; however, Wyoming is rich in non-precious material, such as coal, oil, natural gas, bentonite, and uranium. Commercial coal mining expanded with the arrival of the railroad in the 1860s, as the demand for coal increased across the nation. With the establishment of the railroad came the establishment of permanent towns and cattle ranching. Ranching was the State's economic base until the world energy crisis enhanced the value of the State's vast reserves of coal, oil, gas, and uranium. Then the State became an important national center of energy development, as it remains to this day.

3.14.2 Study Area

The socioeconomic study area comprises the State of Wyoming as well as counties and communities near the Permit Area. As shown in **Figure 3.14-1**, the Permit Area is situated in a remote area near the corners of four counties: Sweetwater County, Carbon County, Fremont County, and Natrona County. The communities of interest include Rawlins, Casper, Bairoil, Jeffrey City, and Wamsutter. Rawlins and Casper are the two larger population centers near the Permit Area. Rawlins and Casper are situated about 40 miles southeast and 90 miles northeast of the Permit Area, respectively. The nearest and smallest population center is Bairoil, located about 15 miles northeast of the Permit Area. Jeffrey City is about 24 miles due north of the Permit Area. Both Bairoil and Jeffrey City are examples of boom-and-bust towns. Wamsutter is located about 30 miles south-southwest of the Permit Area.

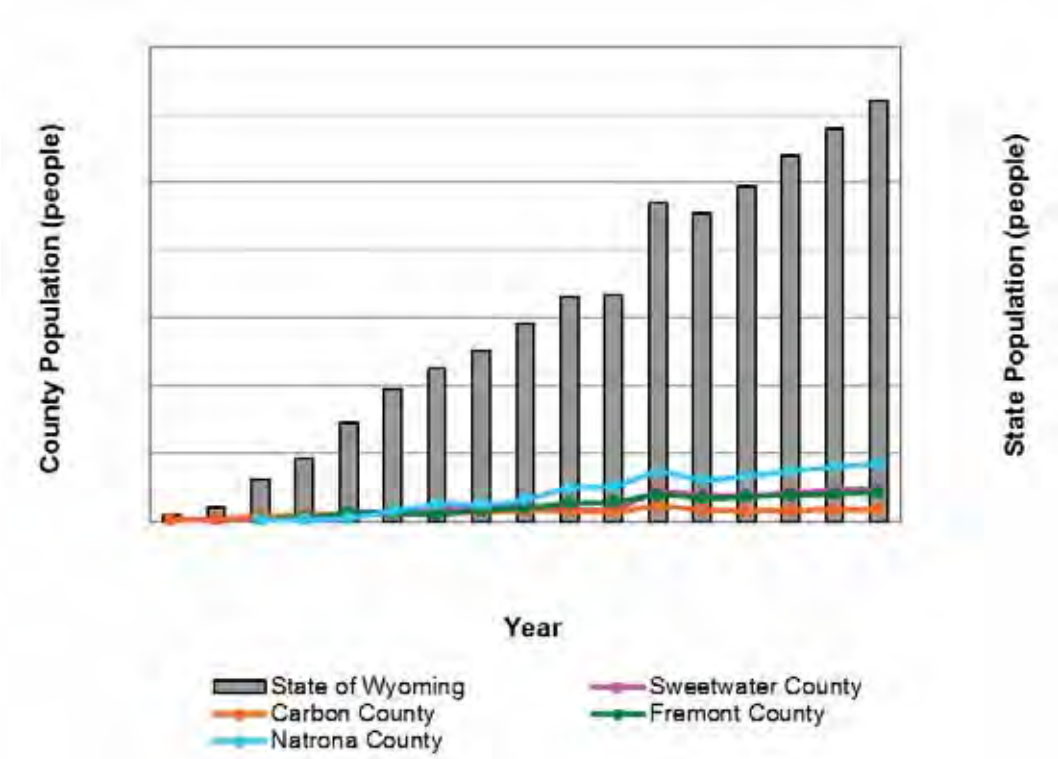
3.14.3 Demographics

According to the 2000 Census and population estimates of the 50 states, Wyoming is the least populous state even though it is the tenth largest in area (Population Division of the US Census Bureau, 2006). Behind Alaska, Wyoming has the second lowest state population density, 5.1 people per square mile.


Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.14-1
SOCIOECONOMIC STUDY AREA
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Community of Interest
Road
Interstate
Lost Creek Permit Area
Wyoming County
County of Interest
State of Wyoming
Natrona
Carbon
Fremont
Sweetwater
Casper
Rawlins
Riverton
Jeffrey City
Baroil

As shown in **Figure 3.14-2**, population changes in the four counties of interest have paralleled those of the State. In general, Wyoming's population has steadily risen throughout its history. Of note is the population change around 1980, during the time of the oil boom and bust. The population increased by about 50 percent between 1970 and 1980, and then decreased between 1980 and 1990.

Figure 3.14-2 Historic and Projected Decennial Population, 1870-2030



* State of Wyoming Department of Administration and Information's Economic Analysis Division (EAD), 2001; EAD, 2008

In the 2000 Census, 493,782 people were reported living in Wyoming (EAD, 2010m). By July 2009, an estimated 544,270 people resided in the State, which was an increase of 2.1 percent (11,300 people) from July 2008 – the highest percentage increase in the nation (EAD, 2009a). The 2.1-percent population growth was the State's highest percentage growth since 1982, the last year of the oil boom.

Table 3.14-1 lists the recorded and forecasted decennial populations of the State, counties, and communities of interest from 1990 to 2030. As of the most recent census, the populations of the counties ranged from 15,639 people (Carbon) to 66,533 people (Natrona) (EAD, 2008). From 2000 to 2030, Carbon and Fremont counties were forecasted to increase their populations by 9 and 18 percent, respectively; Sweetwater and Natrona counties were forecasted to increase by nearly 30 percent.

Table 3.14-1 Population, 1990 to 2030

Area	Population (people)				
	1990 Census	2000 Census	2010 Forecast	2020 Forecast	2030 Forecast
Sweetwater County	38,823	37,613	41,700	46,530	48,130
Bairoil	228	97	103	115	119
Wamsutter	240	261	282	315	326
Carbon County	16,659	15,639	16,160	17,230	17,120
Rawlins	9,380	8,538	9,063	9,663	9,601
Fremont County	33,662	35,804	38,390	40,110	42,370
Jeffrey City	--	106	--	--	--
Natrona County	61,226	66,533	74,050	79,650	85,540
Casper	46,765	49,644	54,702	58,839	63,190
State of Wyoming	**453,588**	**493,782**	**539,740**	**578,730**	**621,160**

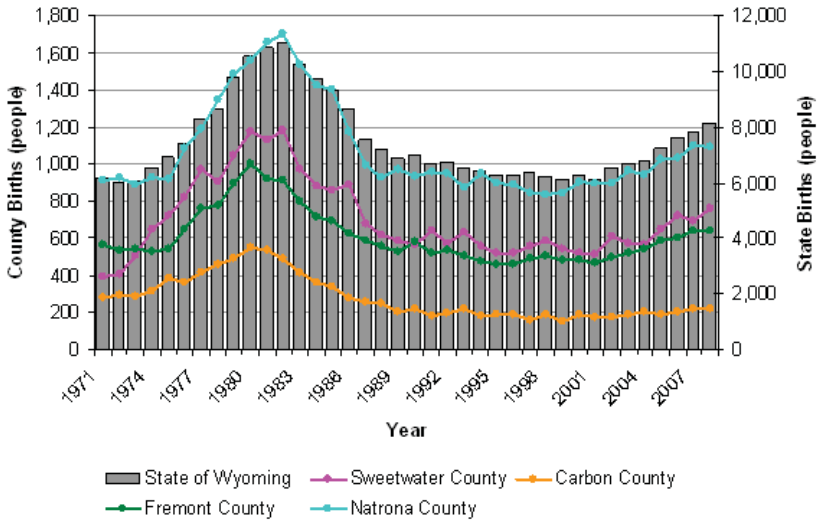
* EAD, 2001; EAD, 2008

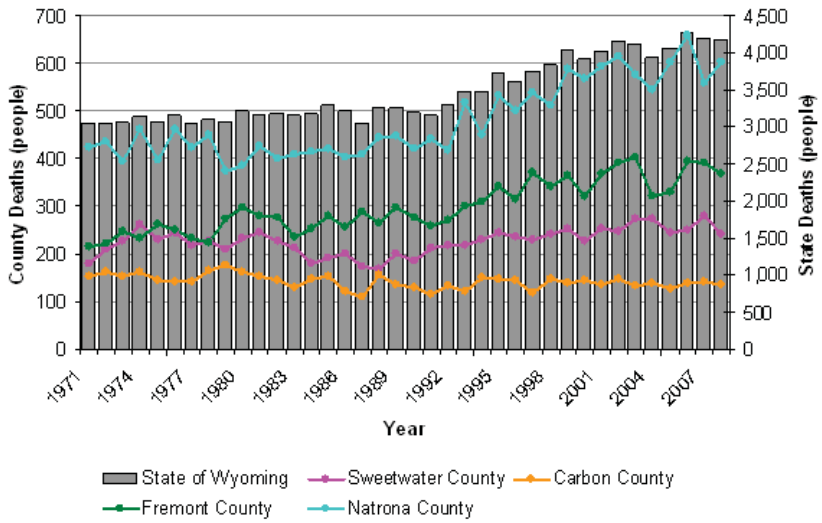
In 2000, the cities of Casper and Rawlins had populations of 49,644 and 8,538 people, respectively. Each of the other communities of interest (Bairoil, Jeffrey City, Wamsutter) had less than 300 residents in 2000. As previously mentioned, both Bairoil and Jeffrey City are examples of boom-and-bust towns. The population of Bairoil was estimated around 240 people in the 1980s and early 1990s, and then fell with the fall of oil and gas prices and the sale of oil properties. Jeffrey City was a former uranium mining town. Consequent to layoffs at the Big Eagle mine, the Lucky Mc mine, and the Split Rock processing mill, more than 95 percent of Jeffrey City's residents left between 1980 and 1983. In 2000, Bairoil had a population of 97 people; Jeffrey City had a population of 106 people.

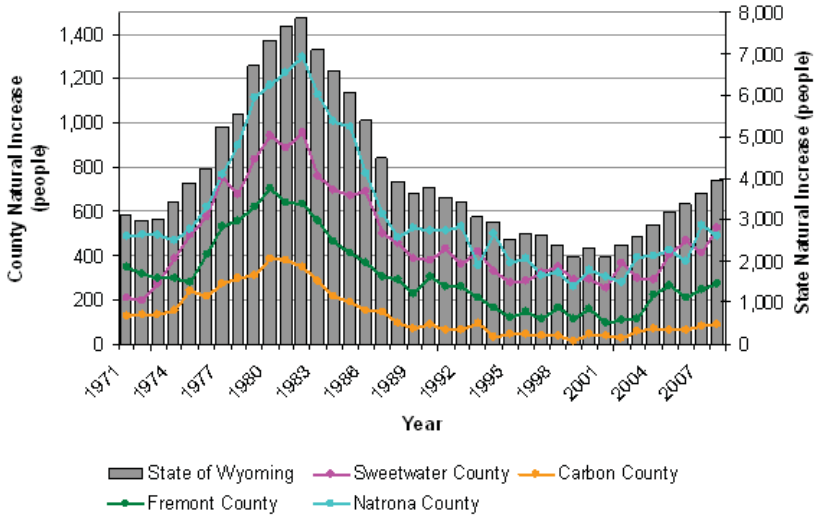
Population change is a result of births, deaths, and migration. As observed in **Figure 3.14-3 and Figure 3.14-4**, the State and counties are currently experiencing a new wave of births – the baby boomers' grandchildren. Since deaths from 1971 to 2008 have remained fairly stable; the natural increase (sum of births minus deaths) reflects annual births.

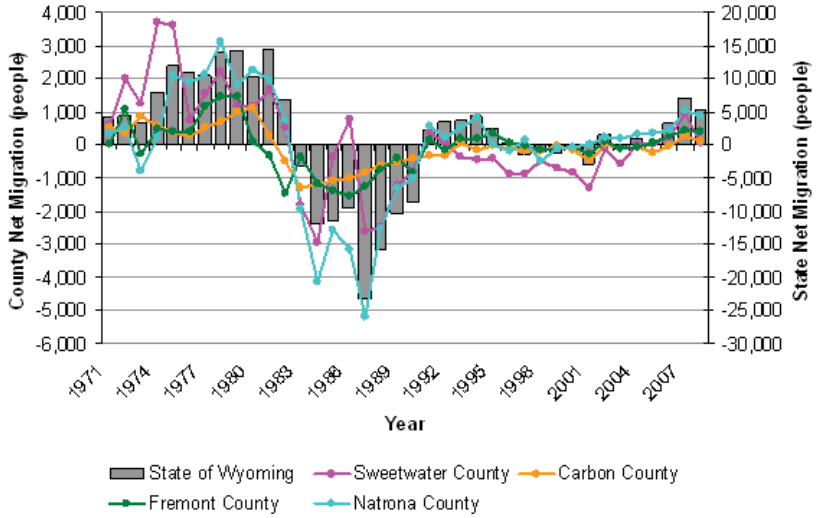
The net migration of the State and counties from 1971 to 2008 is presented in **Figure 3.14-3**. Generally indicative of employment opportunities, in-migration occurred from 1971 to about 1982 (the last year of the oil boom), from about 1991 to 1996, and from about 2006 to present. Lagging behind the national recession by one year, Wyoming had a prospective job market in 2008. As such, the State attracted employment seekers from other areas of the country, such as Michigan, California, Nevada, and Florida (EAD, 2010c). From 2008 to 2009, the total net migration was 7,553 people. Overall, population change (natural increase plus the net migration) has been driven by migration.

Figure 3.14-3 Population Change Factors, 1971 to 2008



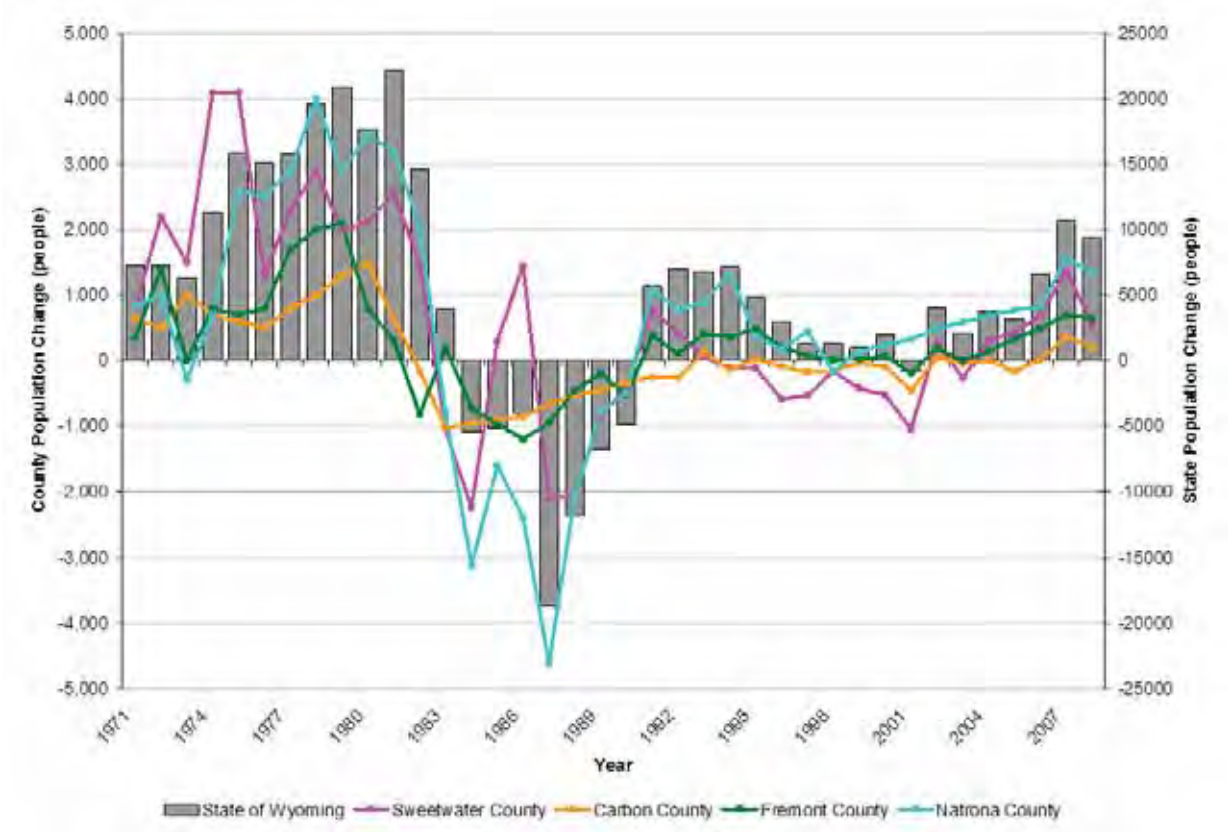






* EAD, 2010b

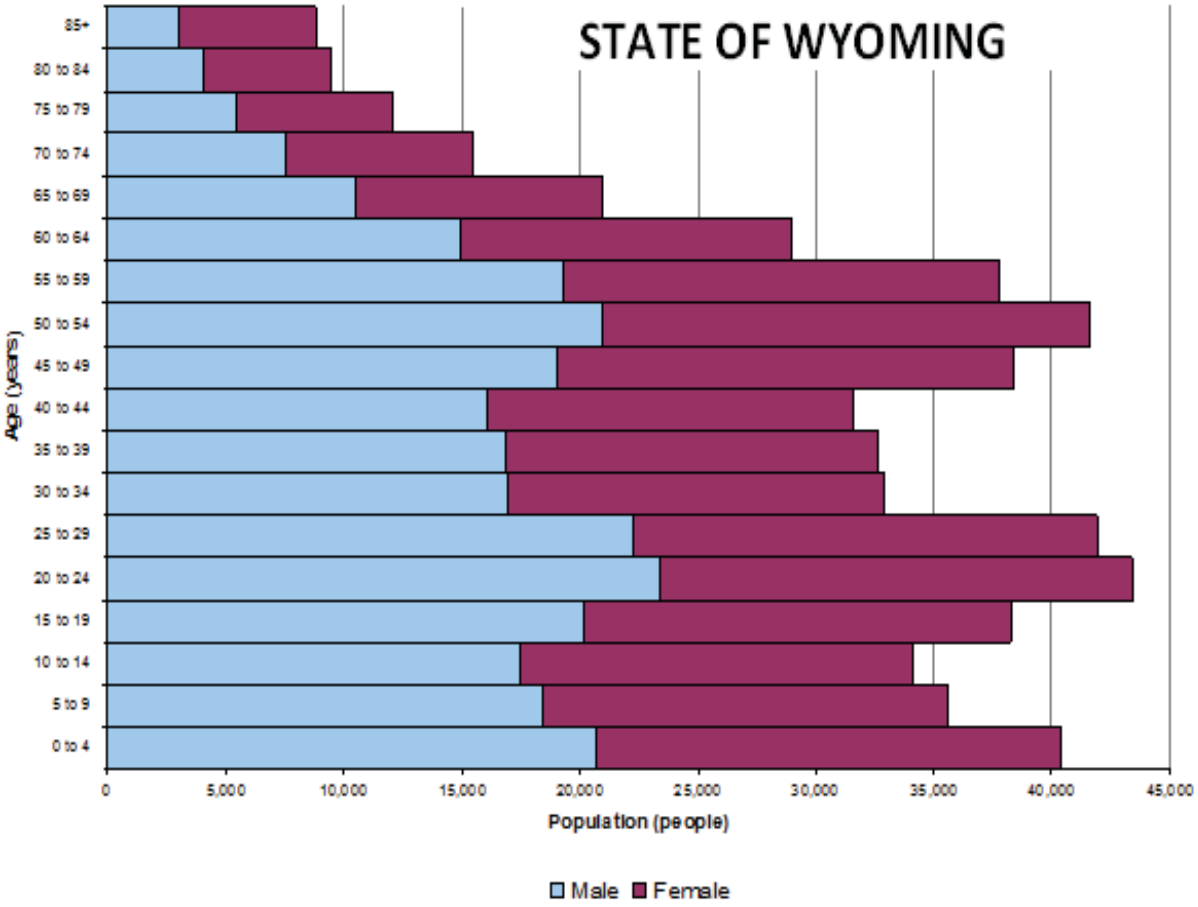
Figure 3.14-4 Population Change, 1971 to 2008

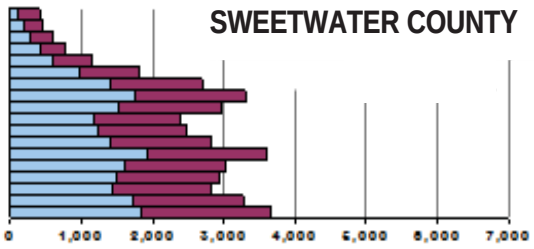


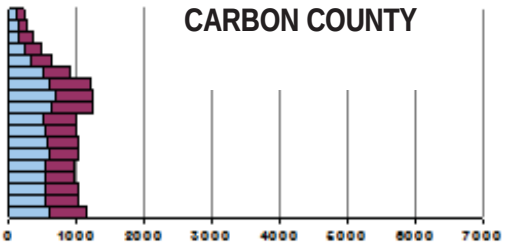
* EAD, 2010m

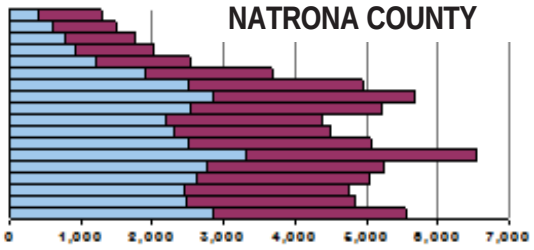
The median population age is dependent on four factors: fertility rates, mortality rates, baby booms, and in-migration. Fertility rates have declined, which affects the ratio of old to young (less than five years vs. greater than 65 years) (Liu and Bittner, 2010). Mortality rates have declined over the past century due to improved public health, advanced medical technology, and improved standards of living, thereby increasing the median age. As for baby booms, the baby boom of the grandchildren of the post-WW II baby boomers is currently ongoing, as observed in **Figure 3.14-5**. In-migrants also affect the median population age. Since in-migrants tend to be younger, the mean population age tends to decrease as in-migration increases. In 2000, the median age of Wyoming was 36.2 years (US Census Bureau, 2000). The median age of Sweetwater, Carbon, Fremont, and Natrona counties was 34.2 years, 38.9 years, 37.7 years, and 36.4 years, respectively.

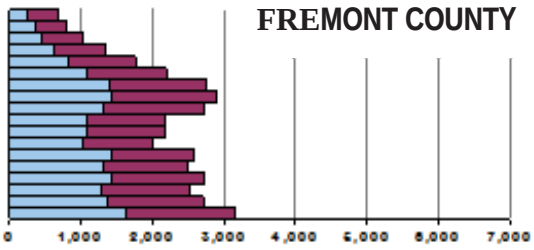
Figure 3.14-5 Population by Age and Gender, 2009











* EAD, 2010a

Table 3.14-2 shows the population distribution by race. According to the 2000 Census, 92 percent of Wyomingites identified themselves as white (US Census Bureau). The other reported races of the population are shown in **Table 3.14-2**. Sweetwater, Carbon, and Natrona counties had comparable distributions of race. Fremont County's population was 77 percent white and 20 percent American Indian or Alaska Native. A portion of the Wind River Indian Reservation, the only tribal land of Wyoming, is located in Fremont County. In 2000, six percent of the State's population was of Hispanic or Latino ethnicity. About four to five percent of Fremont and Natrona counties' populations were of Hispanic or Latino ethnicity, whereas Sweetwater and Carbon counties' Hispanic or Latino ethnic populations were nine and 14 percent, respectively.

Table 3.14-2 Population by Race, 2000

Race	Wyoming		Sweetwater County		Carbon County		Fremont County		Natrona County	
	#	%	#	%	#	%	#	%	#	%
White	454,670	92	34,461	92	14,092	90	27,388	77	62,644	94
Black or African American	3,722	1	275	1	105	1	44	0	505	1
American Indian and Alaska Native	11,133	2	380	1	199	1	7,047	20	686	1
Asian	2,771	1	240	1	105	1	106	0	277	0
Native Hawaiian and Other Pacific Islander	302	0	16	--	9	0	9	--	25	--
Some other race	12,301	3	1,349	4	808	5	417	1	1,275	2
Two or more races	8,883	2	892	2	321	2	793	2	1,121	2
Total	**493,782**	**100**	**37,613**	**100**	**15,639**	**100**	**35,804**	**100**	**66,533**	**100**

* US Census Bureau, 2000

As defined by the US Census Bureau and the Federal Office of Management and Budget, a minority population is any group other than single-race, non-Hispanic white. According to estimates by the US Census Bureau, Wyoming's total minority population was 75,119 people or 13.8 percent of the State's population in July 2009 (EAD, 2010f). Between April 2000 and July 2009, the minority population increased by an estimated 21,489 people or 40 percent of the 2000

population, which contrasts to the 10.2 percent increase of the State's population. Those of Hispanic or Latino ethnicity were the largest minority group, increasing from 31,669 to 43,977 people during the nine-year time frame. Non-white races (black or African American, American Indian and Alaska Native, and Asian) increased at least 24 percent from the 2000 population. The majority (single-race, non-Hispanic, white) population increased by an estimated 8.4 percent from the 2000 population. Predominantly Native American, Fremont County had the highest estimated minority population (10,846 people or 28 percent) in 2009. In 2009, minorities in Sweetwater, Carbon, and Natrona counties represented an estimated 17.7, 19.4, and 11.1 percent of the total county populations, respectively.

In 2000, 98 percent of the State's population was US native (US Census Bureau). Of the foreign-born population, about 40 percent was from Latin America, 26 percent was from Europe, 19 percent was from Asia, 10 percent was from North America, 2 percent was from Africa, and 2 percent was from Oceania.

The majority of the State's population is located in urban areas. In 2000, one of every five Wyomingites lived in either Cheyenne or Casper (US Census Bureau, 2000). About two-thirds of the population lived in urban areas in 2000. Rawlins accounted for 57 percent of Carbon County's population in 2000. Three in four of Natrona County's population resided in Casper in 2000.

At the time of the 2000 Census, there were 193,608 households in Wyoming (US Census Bureau). The composition of households was comparable between the State and the counties of interest. About two-thirds of these households were family households, of which 55 percent were married couples, about 33 percent had children under the age of 18 years, and about 10 percent were female householders with no husband present. The average household size for the State and the counties of interest was about 2.5 people, which is comparable to that of the average family size of about 3.0 people of the State and counties of interest.

School enrollment in the State and the counties of interest in 2000 is presented in **Table 3.14-3**. About one in every four people was enrolled in school at the State and county level (US Census Bureau, 2000). In the State and the counties of interest, about 85 percent of the population older than 25 years had completed high school and about 20 percent had received at least a bachelor's degree.

About 12 percent of Wyomingites identified themselves as civilian veterans in 2000 (US Census Bureau). Ten to thirteen percent of people residing in counties of interest were civilian veterans in 2000.

In 2000, 15.6 percent of the Wyoming population was disabled (US Census Bureau). Of this percentage, 12 percent was 5 to 20 years old, 60 percent was 21 to 64 years old, and 28 percent was at least 65 years old.

Table 3.14-3 School Enrollment, 2002

School	Wyoming		Sweetwater County		Carbon County		Fremont County		Natrona County	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total population	493,782	100	37,613	100	15,639	100	35,804	100	66,533	100
Population enrolled in school	136,139	27.6	11,129	29.6	3,674	23.5	9,531	26.6	18,067	27.2
Nursery school, preschool	7,880	5.8	654	5.9	316	8.6	585	6.1	1,299	7.2
Kindergarten	6,612	4.9	497	4.5	217	5.9	531	5.6	976	5.4
Elementary school (grades 1-8)	59,518	43.7	5,039	45.3	1,672	45.5	4,495	47.2	7,853	43.5
High school (grades 9-12)	32,432	23.8	2,935	26.4	1,080	29.4	2,458	25.8	4,035	22.3
College or graduate school	29,697	21.8	2,004	18.0	389	10.6	1,462	15.3	3,904	21.6
Population not enrolled in school	357,643	72.4	26,484	70.4	11,965	76.5	26,273	73.4	48,466	72.8

* US Census Bureau, 2000

3.14.4 Economic Trends and Characteristics

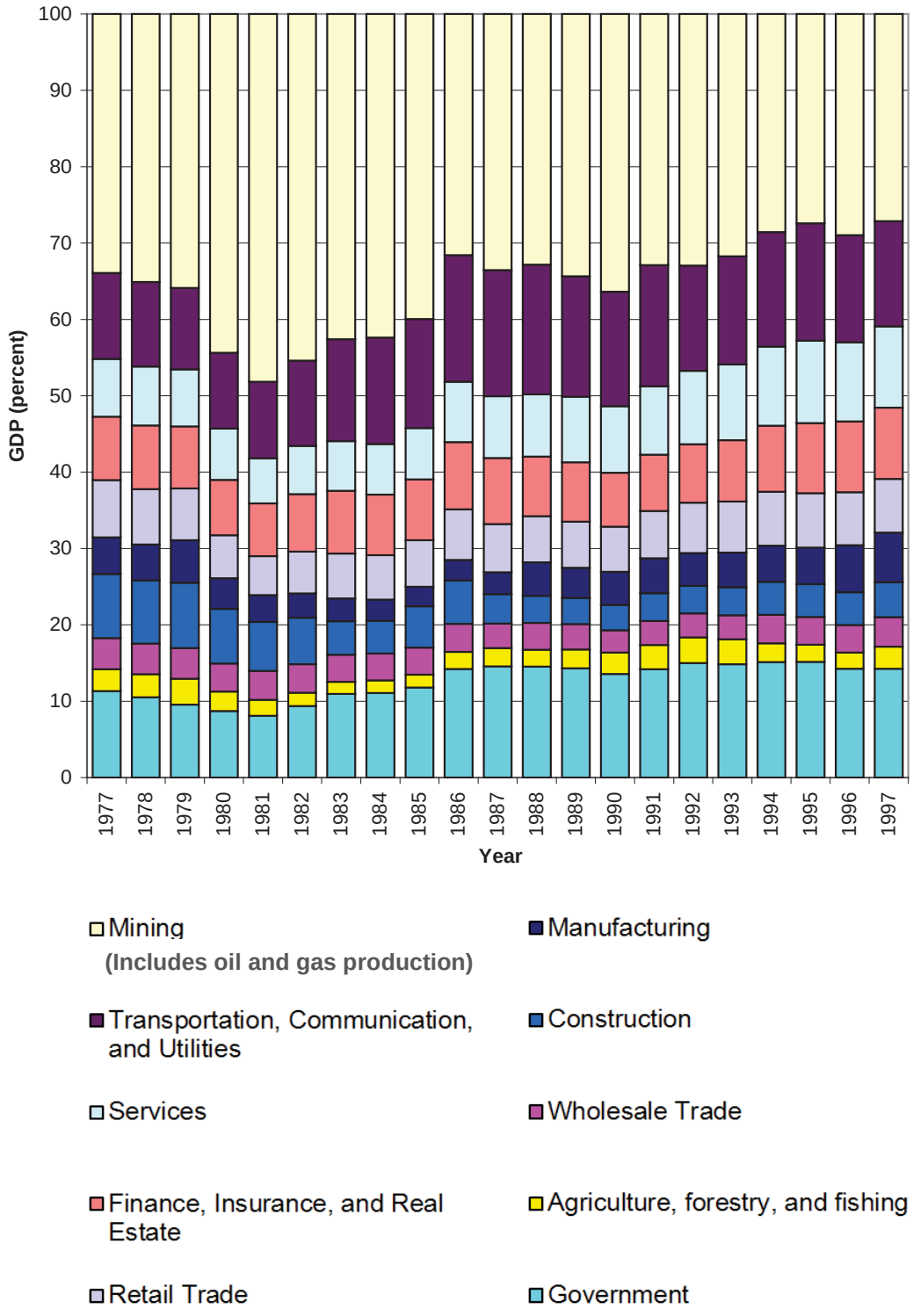
The Wyoming economy is largely focused on the State's primary industry: mining, which includes oil and gas development. Even though it is the foundation of Wyoming's economy, the extent to which mining occurs depends heavily on state and national demand for domestic resources. For example, during WWII, Wyoming oil production spiked and refineries in the State produced aircraft fuel and other petroleum products that supported planes, ships and tanks of the war. Another example is between 1978 and 1986, when oil prices experienced their largest historical fluctuation; national prices increased from $9 per barrel in 1978 to $31.77 per barrel in 1981. As a result, employment in Wyoming's oil and gas sector increased by 374 percent from 1971 to 1981. By 1986, prices had decreased to $12.51 per barrel, causing Wyoming's oil production to decline steadily and approximately 14,000 industry jobs and more industry-related jobs were lost in six years. While the State has not since experienced a comparable period of boom and bust, economic trends and characteristics continue to be associated with mining. Mid-year 2008, crude oil and natural gas prices peaked. By the end of 2008, the downturn in energy exploration dragged Wyoming's economy into a recession, about one year after the US recession began (EAD, 2010e). Crude oil prices began recovering at the start of 2009; natural gas prices began recovering later in 2009. The improved energy prices have been slowly stabilizing the mining sector, thereby stabilizing Wyoming's economy.

3.14.4.1 Gross Domestic Product

Gross domestic product (GDP) is the total market value of goods and services produced by the labor and property within a specified area during a certain time period. In 2008, Wyoming's GDP ($35.3 billion) was the third lowest in the nation (EAD, 2009b). Unlike the fairly even distribution of GDP across various industries in the US, Wyoming's GDP has been dominated by mining. As shown in **Figure 3.14-6 and Figure 3.14-7**, mining has accounted for as little as 16 percent (in 1998) to as much as 48 percent (in 1981) of the State GDP from 1977 to 2008 (EAD, 2010l and 2010k). In 2008, the GDP primarily comprised of: mining (33 percent); real estate, rental and leasing (7 percent); construction (6 percent); transportation and warehousing (6 percent); retail trade (5 percent); utilities (4 percent); health care and social assistance (4 percent); wholesale trade (3 percent); accommodation and food services (3 percent); manufacturing (3 percent); and government (13 percent).

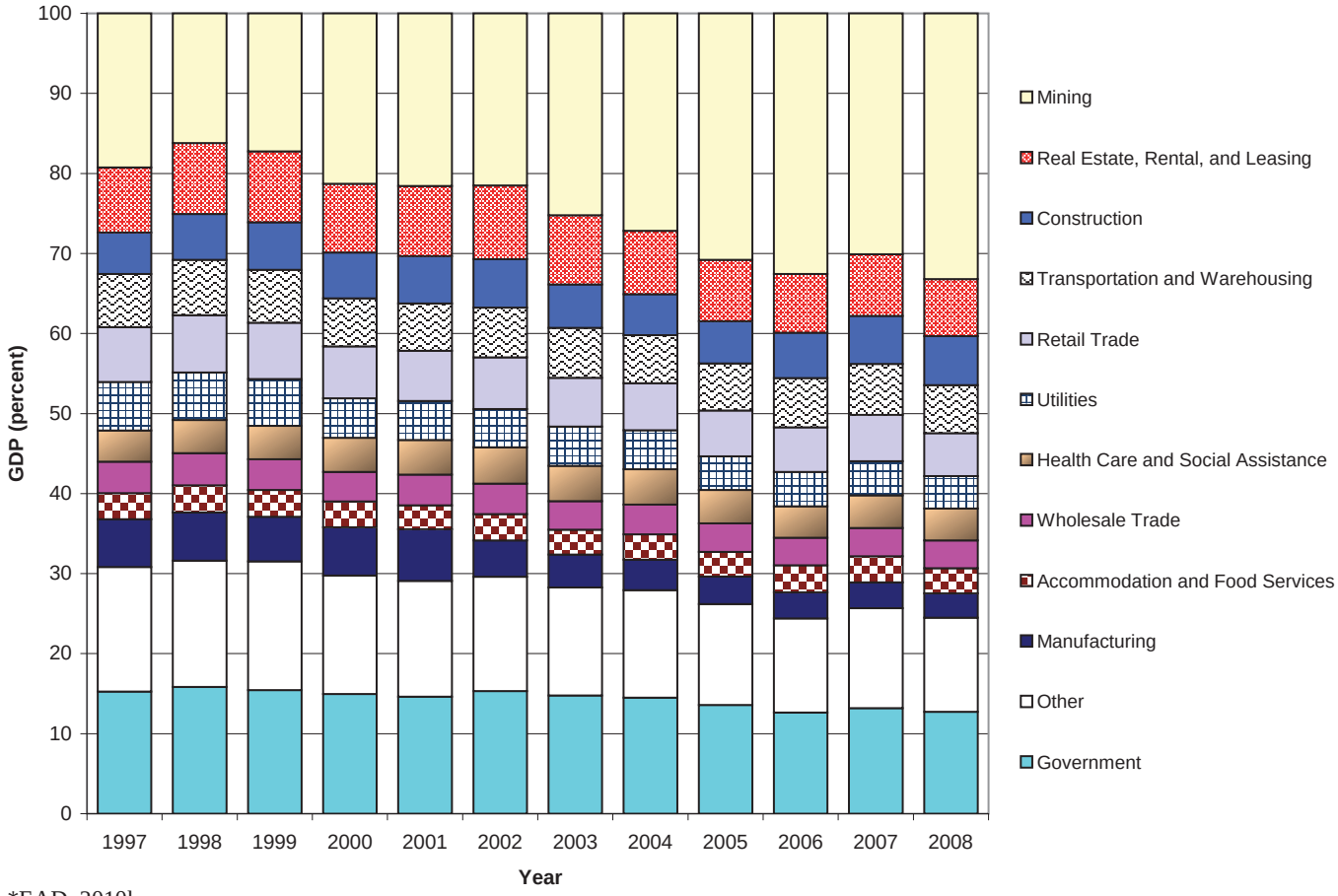
Although agriculture was only one percent of Wyoming's GDP in 2008, it is culturally significant to Wyoming residents. As noted by the EAD, "Wyoming has a rich agricultural history and many rural residents rely on agriculture for their livelihood. The influence and significance of agriculture may not be evident in a basic analysis of Wyoming's economy, but by visiting the State or talking with one of the many ranching or farming families reveals the importance of agriculture in Wyoming's identity" (2009b).

Figure 3.14-6 GDP by Industry, 1977 to 1997



* EAD, 2010

Figure 3.14-7 GDP by Industry, 1997 to 2008



*EAD, 2010k

Other = Professional and Technical Services; Finance and Insurance, Information; Administrative and Waste Services; Agriculture, Forestry, Fishing, and Hunting; Arts, Entertainment, and Recreation; Management of Companies and Enterprises; and Education Services

3.14.4.2 Revenue and Taxation

As of April 2010, the three major sources of income to Wyoming's general fund were: the sales and use tax; investment income; and the severance tax (Consensus Revenue Estimating Group, 2010). **Table 3.14-4** lists the sources of the State's general fund revenue.

Sales and Use Tax

The sales and use tax varies in the counties of interest:

- Sweetwater County has a six-percent sales and use tax (statewide base of four percent, one-percent optional general purpose county tax, and one-percent optional specific purpose county tax);
- Carbon County has a five-percent sales and use tax (statewide base of four percent and one-percent optional general purpose county tax);
- Fremont County has a five-percent sales and use tax (statewide base of four percent and one-percent optional specific purpose county tax); and
- Natrona County has a five-percent sales and use tax (statewide base of four percent and one-percent optional general purpose county tax) (Wyoming Department of Revenue, 2008).

Table 3.14-5 presents the sales and use tax distribution of the counties of interest. The State sales tax contributes the largest sales and use tax revenue to each county, representing 53 percent (Carbon County) to 73 percent (Natrona County). The State use tax generates seven percent (Natrona County) to 13 percent (Sweetwater and Carbon counties) of the total sales and use tax revenue.

The general purpose tax of the counties provides 16 percent (Sweetwater County) to 20 percent (Carbon County) of the sales and use tax revenue. Fremont County does not have a general purpose tax.

A specific purpose tax exists in Sweetwater, Carbon and Fremont counties. A specific purpose tax is an additional percent of sales tax paid by visitors and residents on most goods and services within a given county. Funds generated from the specific purpose tax of a county are used for specific county projects approved by county voters. Sweetwater County's specific purpose tax accounts for 16 percent of the sales and use tax revenue; Fremont County's specific purpose tax accounts for 20 percent of the sales and use tax revenue. Carbon County's specific purpose tax is negligible. Natrona County does not have a specific purpose tax. Each of the counties also has a lodging tax that may range from two to five percent, which contributes no more than one percent of the sales and use tax revenue.

Investment Income

As of June 2009, the State's investment portfolio totaled $11.6 billion (Wyoming Treasurer's Office), and the State had seven investments: the Permanent Wyoming Mineral Trust Fund (PWMTF), the Permanent Land Funds; the Hathaway Scholarship Endowment Fund; the Excellence in Higher Education Endowment Fund; the Workers Compensation Fund; the Tobacco Settlement Fund; and the State Agency Pool. As shown in **Table 3.14-7**, the PWMTF accounted for more than one-third of the State's investment in both 2005 and 2009 (Wyoming Treasurer's Office, 2005 and 2009). The State Agency Pool accounted for about another third of the State's investment in 2005 and 2009. In 2009, the total State investment was about 180 percent, nearly double, of the total State investment in 2005. Investment income is a primary source of income to the State's general fund, which is distributed to towns, cities, counties, the University, community colleges, rural hospitals, county libraries, and state agencies. The investment income supports public primary and secondary schools, scholarship programs for Wyoming students, the hiring of and resources for faculty at the University of Wyoming, recruitment and faculty retention at community colleges, workers compensation costs, and health improvement programs.

Severance Tax

A severance tax is an excise tax on the present and continued privilege of removing, extracting, severing, or producing any mineral in Wyoming. Functioning like a savings account, the PWMTF holds 25 percent of all severance taxes received by the State. In accordance with WS §39-14-801, severance taxes are distributed to communities, counties, road construction and maintenance funds, the highway fund, water development accounts, the capital construction account, and the general fund. As seen in **Table 3.14-7**, the PWMTF balance was $4.262 billion on June 30, 2009 (Wyoming Treasurer's Office, 2009).

Mining

The minerals industry accounts for a substantial share of revenues to the State and to local governments in Wyoming. Even though produced minerals are exempt from property taxes, mineral producers pay two other types of taxes: the county property (ad valorem-gross products) tax on production; and the state severance tax. Producers pay county property (ad valorem) taxes on plants, refineries, mining and well head equipment, pipelines, and other facilities used in the mineral production and transportation operations.

The State's total taxable valuation of mineral production is comprised of the following: 59 percent natural gas, 20 percent oil, 18 percent coal, and one percent other minerals, including trona, bentonite, sand and gravel, uranium, etc. (Wyoming Department of Revenue, 2009). In 2008, the counties of interest contributed 21 percent of the State's total mineral taxable value from the

production of natural gas, oil, coal, trona, bentonite, and sand and gravel (**Table 3.14-6**), but uranium was not noted as a taxable mineral.

As shown in **Table 3.14-6**, Sweetwater County's mineral production is related to natural gas, oil, coal, trona, and sand and gravel. Carbon County produces natural gas, oil, coal, and sand and gravel. Mineral production in Fremont County is based on gas, oil, and sand and gravel. Natrona County produces natural gas, oil, bentonite, and sand and gravel. Sweetwater County is the only county in the State with trona and underground coal production.

Other

Other sources of State revenue include sales and services charges, the franchise tax, the cigarette tax, penalties and interest, federal aid and grants, etc. Unlike most other states, Wyoming does not levy personal or corporate income tax. The State does not assess tax on retirement income earned and received from another state, nor does it collect inheritance taxes.

Table 3.14-4 State General Fund Revenue, 2004 to 2009

Source	2004	2005	2006	2007	2008	2009
Sales and Use Tax	$326,625,269	$363,846,232	$421,438,545	$479,072,573	$504,711,048	$492,443,467
Investments	$126,827,238	$127,130,007	$189,001,600	$241,077,194	$426,924,926	$225,234,182
PWMTF Interest	$98,110,315	$87,789,396	$123,952,616	$150,487,083	$321,357,789	$135,264,226
Pooled Interest	$28,716,923	$39,340,611	$65,048,984	$90,590,111	$105,567,137	$89,969,956
Severance Tax	$184,408,599	$225,275,895	$240,254,869	$213,964,458	$257,859,262	$217,580,768
Sales and Services Charges	$24,260,907	$26,460,644	$24,733,817	$29,478,126	$30,458,234	$33,780,336
Franchise Tax	$21,745,077	$23,962,541	$24,889,058	$28,164,990	$26,251,292	$23,978,875
Cigarette Tax	$10,148,964	$19,625,402	$19,502,270	$20,031,303	$20,361,377	$19,802,475
Penalties and Interest	$9,031,984	$11,571,551	$17,153,208	$15,248,945	$6,443,234	$11,878,190
Federal Aid and Grants	$11,651,917	$8,313,378	$10,264,260	$10,830,645	$9,819,073	$9,159,713
Other	$29,853,497	$27,751,482	$28,833,559	$32,426,055	$37,086,361	$30,959,626
Total	**$744,553,452**	**$833,937,132**	**$976,071,186**	**$1,070,294,289**	**$1,319,914,807**	**$1,064,817,632**

* EAD, 2009c

Table 3.14-5 County Sales and Use Tax Distribution, 2008

County	County	Lodging Option Tax	General Purpose Tax		Specific Purpose Option		State Sales Tax	State Use Tax	Total
			Sales Tax	Use Tax	Sales Tax	Use Tax			
Sweetwater County	Amount	$742,202	$17,756,577	$4,385,678	$17,688,132	$4,431,881	$71,058,753	$17,543,373	$133,606,600
	Percent	0.6	13	3	13	3	53	13	100
Carbon County	Amount	$472,174	$5,625,449	$1,077,816	$50,200	$-21,490	$22,502,257	$4,311,431	$34,017,838
	Percent	1	17	3	0.1	-0.1	66	13	100
Fremont County	Amount	$304,449	0	0	$7,418,438	$1,368,335	$29,669,025	$5,474,943	$44,235,192
	Percent	0.7	0	0	17	3	67	12	100
Natrona County	Amount	$1,008,959	$20,609,554	$1,911,384	0	0	$82,446,333	$7,645,839	$113,622,070
	Percent	0.9	18	2	0	0	73	7	100

* Wyoming Department of Revenue, 2008

Table 3.14-6 Percentage of State Mineral Taxable Value by County, 2008

Investment	2005 [1]		2009 [2]		Cost Basis Difference of 2005 and 2009	Percent of Total Cost Basis Difference of 2005 and 2009
	Cost Basis	Percent of Total Cost Basis	Cost Basis	Percent of Total Cost Basis		
Permanent Wyoming Mineral Trust Fund	$2,465,356,863	38	$4,262,215,811	37	$1,796,858,948	36
Permanent Land Funds	$1,118,632,377	17	$1,906,030,164	16	$787,397,787	16
Hathaway Scholarship Endowment Fund	--	--	$455,621,941	4	$455,621,941	9
Excellence in Higher Education Endowment Fund	--	--	$102,451,644	1	$102,451,644	2
Workers Compensation Fund	$567,446,792	9	$1,135,301,050	10	$567,854,258	11
Tobacco Settlement Fund	$51,808,440	1	$58,960,172	1	$7,151,732	0
State Agency Pool	$2,304,521,868	35	$3,635,882,919	31	$1,331,361,051	26
Total	**$6,507,766,340**	**100**	**$11,556,463,701**	**100**	**$5,048,697,361**	**100**

[1] Wyoming Treasurer's Office, 2005

[2] Wyoming Treasurer's Office, 2009

Table 3.14-7 Wyoming State Investment, 2005 to 2009

County	Natural Gas	Crude Oil	Stripper Oil	Surface Coal	Underground Coal	Trona	Bentonite	Sand and Gravel	Percentage of Statewide Total Mineral Taxable Value
Sweetwater County	10.4	11.1	0.1	2.2	100	100	0	6.9	10.8
Carbon County	6.2	3.1	1.3	0.2	0	0	0	6.4	4.3
Fremont County	3.9	6.6	8.8	0	0	0	0	3.5	3.7
Natrona County	1.5	9.4	4.9	0	0	0	1.7	6.7	2.6
Counties of Interest	21.9	30.2	15.1	2.4	100	100	1.7	23.5	21.4

* Wyoming Department of Revenue, 2009

3.14.4.3 Labor and Employment

The latest actual labor and employment information for the State of Wyoming and counties of interest is from the 2000 census report (US Census Bureau, 2000). In 2000, two-thirds of the Wyoming population of ages 16 years and older was in the labor force. Only five percent of the labor force was unemployed at that time. **Table 3.14-8** shows the percentage of employment by industry in 2000 for the State and the counties of interest.

In 2000, the common top of employment industries for the counties of interest included: educational, health and social services; retail trade; arts, entertainment, recreation, accommodation, and food services; and, agriculture, forestry, fishing, hunting, and mining (except for Natrona County). Sweetwater County's employment in the transportation, warehousing, and utilities industry and the manufacturing industry is higher than the other counties. Carbon County has a higher percentage of employment in public administration compared to other counties of interest. Fremont County's employment distribution by industry is similar to the State. Natrona County has a noticeably higher percentage of employment in the professional, scientific, management, administrative and waste management services. In the counties of interest in 2000, the private sector represented 64 to 77 percent of the work force; the government sector represented 16 to 25 percent of the work force; and the self-employed represented 6 to 9 percent of the work force.

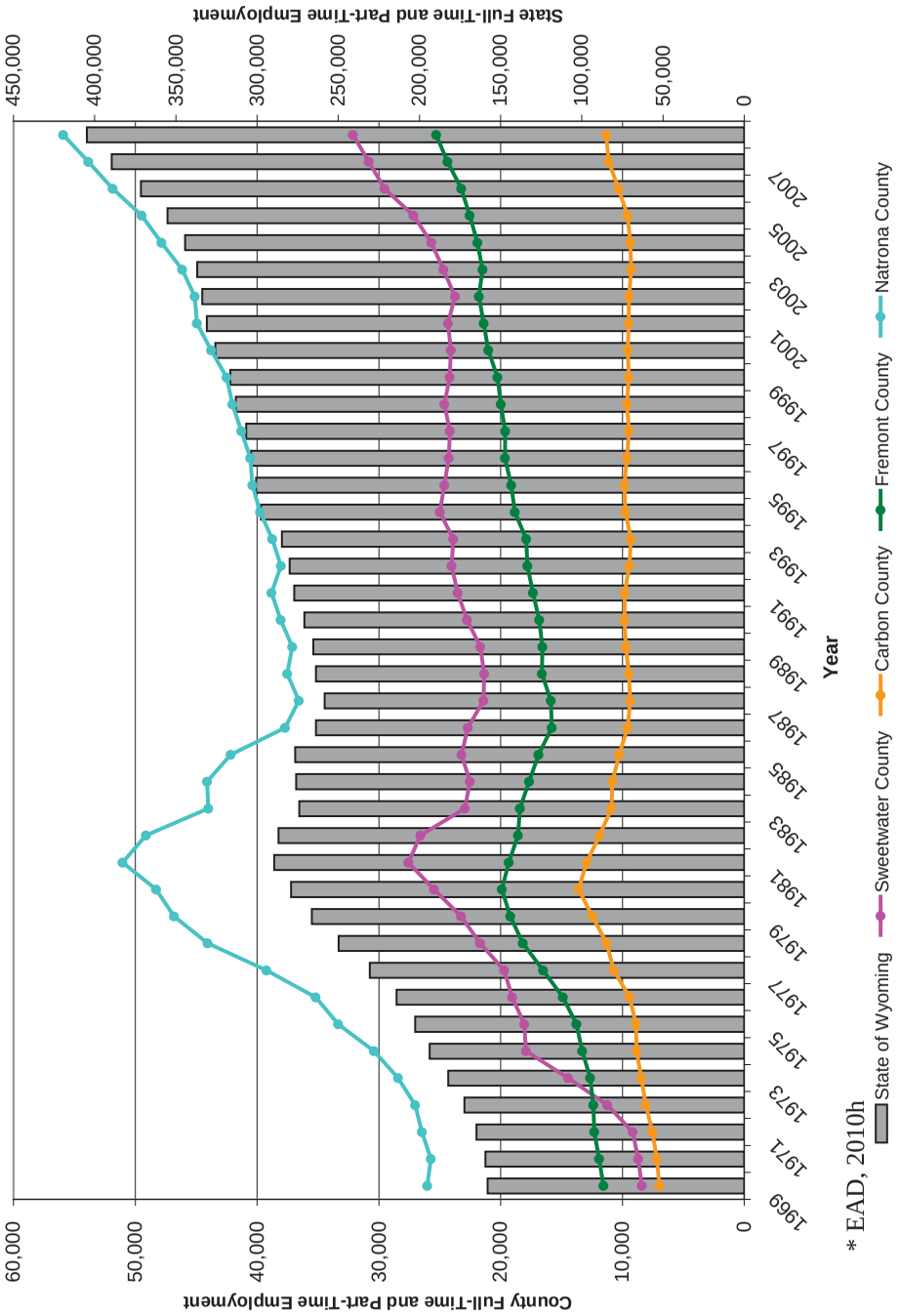
From 1969 to 2008, the State full-time and part-time employment (156 percent growth) increased more than the national employment (100 percent growth) (EAD, 2010h). In fact, driven by the mining sector, Wyoming had the highest annual employment growth rates of the nation from 2006 to 2008 (Liu and Bittner, 2010). Employment in the counties of interest has generally paralleled State employment, as shown in **Figure 3.14-8**.

By the end of 2008, the economic recession was taking effect in Wyoming. Between the fourth quarters of 2008 and 2009, employment in the State decreased by 18,530 jobs (EAD, 2010e). In the fourth quarter of 2009, Wyoming's unemployment rate climbed to 7.5 percent, while the US unemployment rate rose to 10.0 percent. As observed across the nation, Wyoming's job growth occurred only in a few industries between the fourth quarters of 2008 and 2009. Educational and health services had the highest employment increase (2.4 percent or 600 jobs) among the private industries. The government industry added 1,170 jobs or 1.6 percent. Consequent to low commodity prices, the mining industry lost 6,100 jobs or 20.0 percent over the year, which in turn affected other services and industries. The construction industry lost 4,730 jobs or 17.0 percent within the one-year period. As a result of these layoffs, the available labor force increased. Fortunately, the unemployment rate appears to be peaking (EAD, 2010e). As of January 2010, the State's unemployment rate was 7.5 percent (EAD, 2010d).

Table 3.14-8 Employment by Industry, 2000

Industry	Employment (percent)				
	State of Wyoming	Counties			
		Sweetwater	Carbon	Fremont	Natrona
Educational, health and social services	21.5	18.2	17.1	28.5	21.2
Retail trade	11.8	11.9	10.3	12	14.5
Agriculture, forestry, fishing and hunting, and mining	10.7	14.8	12.1	9.5	6.7
Arts, entertainment, recreation, accommodation, and food services	9.6	8.8	10.4	8.4	8.5
Construction	8.7	8.6	10	8.4	8.1
Transportation and warehousing, and utilities	6.6	9.6	8.5	4.6	4.9
Public administration	6.3	3.9	10.7	7.3	5.2
Professional, scientific, management, administrative, and waste management services	5.9	4.3	4.8	5.2	8.1
Other services (except public administration)	4.9	4	3.3	5.3	5.7
Manufacturing	4.9	8.2	6.6	3	6.1
Finance, insurance, real estate, and rental and leasing	4.7	3.8	3.2	3.6	4.7
Wholesale trade	2.3	2.2	1.3	2.1	4.3
Information	2.2	1.5	1.6	2.2	2

* US Census Bureau, 2000



* EAD, 2010h

Figure 3.14-8 Full-Time and Part-Time Employment, 1969 to 2008

3.14.4.4 Income

As with labor and employment, income data were collected and evaluated from the 2000 census report (US Census Bureau, 2000). **Table 3.14-9** presents the distribution of household incomes in 1999 for the State of Wyoming and the counties of interest. Two-thirds of household incomes in the State as well as each county of interest ranged between $15,000 and $74,999.

Table 3.14-9 Household Income, 1999

Income	Households (percent)				
	State of Wyoming	Counties			
		Sweetwater	Carbon	Fremont	Natrona
Less than $10,000	9.2	6.5	11.9	12	8.7
$10,000 to $14,999	7.5	5.4	7.5	8.4	8
$15,000 to $24,999	14.9	12	14.9	17.2	15.3
$25,000 to $34,999	14.3	11.9	14.6	15.8	15.6
$35,000 to $49,999	18.3	17.7	18.2	19.5	18.1
$50,000 to $74,999	20.2	25.8	20	16.1	19.5
$75,000 to $99,999	9	12.5	7	6	8.5
$100,000 to $149,999	4.5	6.7	3.7	3.2	4.3
$150,000 to $199,999	1	1	1.2	0.8	0.9
$200,000 or more	1.3	0.6	1	1	1.1
Median household income (dollars)	$37,892	$46,537	$36,060	$32,503	$36,619

* US Census Bureau, 2000

In 1999, the median family income of the State was 21 percent higher than the median household income. Natrona County's median family income was 24 percent higher than the median household income in 1999. The median family incomes of the other counties of interest were 16 to 17 percent higher. The State's per capita 1999 income was $19,134. The 1999 per capita income of the counties of interest ranged from $16,519 in Fremont County to $19,575 in Sweetwater County.

The income of full-time workers contrasted between genders. For the State in 1999, males had an income of $34,442, and females had an income of $21,735. In other words, the income of females was about two-thirds of that of males, which was true for the counties of interest except Sweetwater County. In Sweetwater County, the female income was half of the male income.

In 1999, eight percent of families and 11 percent of individuals in Wyoming lived in poverty. The percent of families below the poverty level in the counties of interest ranged from five percent in Sweetwater County to 13 percent in Fremont

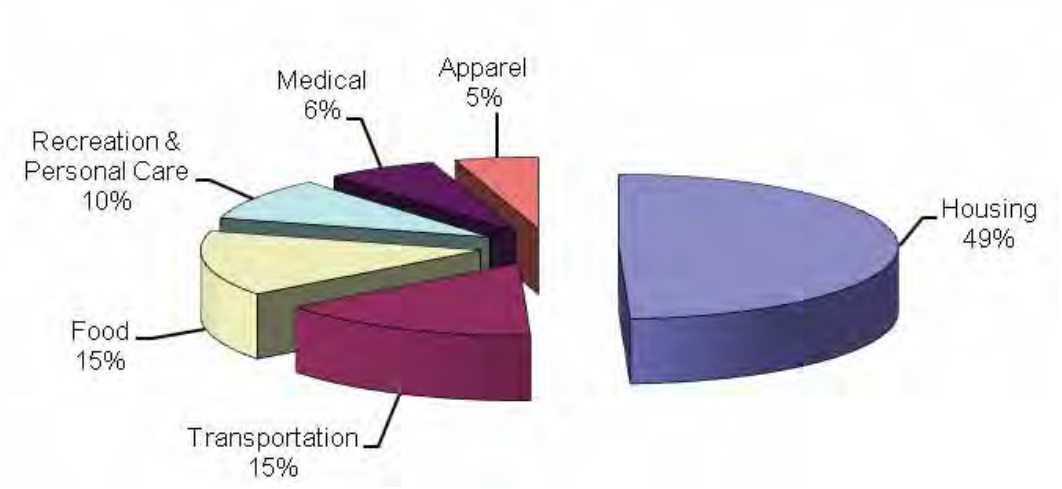
County. The percent of individuals below the poverty level in the counties of interest ranged from eight percent in Sweetwater County to 18 percent in Fremont County.

3.14.4.5 Cost of Living

The Wyoming Cost of Living Index was assessed by EAD for the fourth quarter of 2009. The Wyoming Cost of Living Index is a summary of price data collected in 28 cities and towns throughout Wyoming. The price data collected were used to build a comparative index and to estimate inflation rates for Wyoming. The 140 items surveyed were aggregated into six categories, which were then weighted according to their overall importance in the average consumer's budget.

Figure 3.14-9 displays the Wyoming cost of living categories with their weights in the fourth quarter of 2009. The housing category carries the largest weight (49 percent) and is the most influential category in both the comparative index and the inflation rates (EAD, 2010j). The other cost of living categories in decreasing order of weight were transportation (15 percent), food (15 percent), recreation and personal care (10 percent), medical (6 percent), and apparel (5 percent).

Figure 3.14-9 Wyoming Cost of Living Categories and their Weights, 4Q09



* EAD, 2010j

Table 3.14-10 presents the comparative index, which compares the price level of each county to the statewide average of 100 for the fourth quarter of 2009. Fremont County has an observably lower cost of housing and apparel, and higher recreation/personal care and medical costs compared to the State and the other counties of interest. Carbon County has higher food and apparel costs. Sweetwater County has the highest housing costs.

Table 3.14-10 Wyoming Comparative Cost of Living Index, 4Q09 Prices

Category	State of Wyoming	Counties			
		Sweetwater	Carbon	Fremont	Natrona
Housing	100	106	101	94	103
Transportation	100	101	102	101	101
Food	100	97	106	93	95
Recreation and Personal Care	100	96	103	107	98
Medical	100	99	96	111	97
Apparel	100	97	112	84	95
All Items	100	102	102	97	100

* EAD, 2010j

The annual inflation rates by cost of living categories from 2003 to 2009 are presented in **Table 3.14-11**. The inflation rate represents the percent change in the price level of selected consumer items for the given category from the price level of the same goods one year prior. Of note are changes to the inflation rates of transportation, housing, and food. The transportation inflation rate flipped from positive 15 to negative 15 between the second and fourth quarters of 2008. Annual housing and food inflation rates remained fairly stable until the second quarter of 2009, when they decreased substantially. Statewide inflation for the fourth quarter of 2009 was the same rate (2.7 percent) as the nation, with increased transportation costs again contributing to the inflation rate.

Table 3.14-11 Percent Annual Inflation Rates by Category, 2003 to 2009

Quarter	Inflation Rate by Category						
	Housing	Transportation	Food	Recreation & Personal Care	Medical	Apparel	All Categories
4Q03	5.7	-1.2	5.1	1.4	3.0	2.2	3.6
2Q04	6.3	4.8	5.2	-0.4	5.0	1.8	4.9
4Q04	4.8	5.9	4.2	0.4	5.5	0.4	4.3
2Q05	5.1	6.2	3.1	1.5	5.0	1.0	4.5
4Q05	5.3	6.6	5.3	0.4	5.8	4.4	5.0
2Q06	6.9	7.9	2.0	2.0	4.3	3.7	5.6
4Q06	7.2	1.2	0.4	2.3	3.8	3.6	4.4
2Q07	6.1	1.2	6.5	2.2	5.0	3.5	4.7
4Q07	5.2	9.9	6.8	4.6	5.9	2.9	6.1
2Q08	7.2	15.0	7.4	3.4	5.5	2.3	7.9
4Q08	6.5	-15.1	7.0	7.5	5.6	2.3	2.6
2Q09	1.1	-11.2	1.7	5.2	5.3	2.4	0.0
4Q09	-0.6	16.9	-0.8	2.6	2.8	1.7	2.7

* EAD, 2010j

3.14.4.6 Housing

In 2000, Wyoming had 223,854 housing units, of which 86.5 percent were occupied (EAD, 2010g). Of the occupied units, 70 percent were owner-occupied and the other 30 percent were renter-occupied. The counties of interest shared similar housing occupancy percentages to the State except Carbon County (**Table 3.14-12**). Carbon County reported a housing occupancy of 73.8 percent, which equates to a higher vacancy (26.2 percent). In the State, Fremont County and Natrona County, the homeowner vacancy was 2 percent, and the rental vacancy was 10 percent in 2000. In 2000, Sweetwater County had a vacancy of 3 percent and 16 percent for homeowners and rentals, respectively. Carbon County had a homeowner vacancy of 5 percent and a rental vacancy of 17 percent in 2000.

In 2000, the median value of owner-occupied housing units in Wyoming was $96,600 (US Census Bureau, 2000). The median value of owner-occupied housing units for the counties of interest ranged from $76,500 (Carbon County) to $104,200 (Sweetwater County). Carbon County had the highest percentage (75) of owner-occupied housing units valued less than $100,000 (**Figure 3.14-10)**. In Wyoming, two-thirds of the houses were mortgaged, with a median monthly mortgage of $825. Approximately half to two-thirds of houses in the counties of interest were mortgaged, with a median monthly mortgage range of $685 (Carbon County) to $953 (Sweetwater County). In the State and the counties of interest in 1999, about half of the homeowners paid less than 15 percent of their monthly income on home ownership costs, and about 85 percent paid less than 30 percent.

In 1999, the median gross monthly rent across the State was $428. At least 82 percent of the rentals in each county of interest cost less than $750 per month. The percentage of monthly rental cost to monthly income differed from that of homeownership cost to monthly income. Only one-quarter to one-third of renters allocated less than 15 percent of their income to housing costs. About 20 percent of renters in the counties of interest paid at least 35 percent of their income for housing, compared to 10 percent of homeowners.

In 2007, when energy prices were continuing to rise, the housing situation was difficult to characterize with any degree of certainty because the status of the housing market and availability was changing constantly. The high demand on housing from the oil and gas industry was impacting the availability and price of both owner-occupied and rental units. The housing situation was a major issue for the region. Lack of affordable housing contributed to social problems and created a transitory workforce with little invested in the local communities.

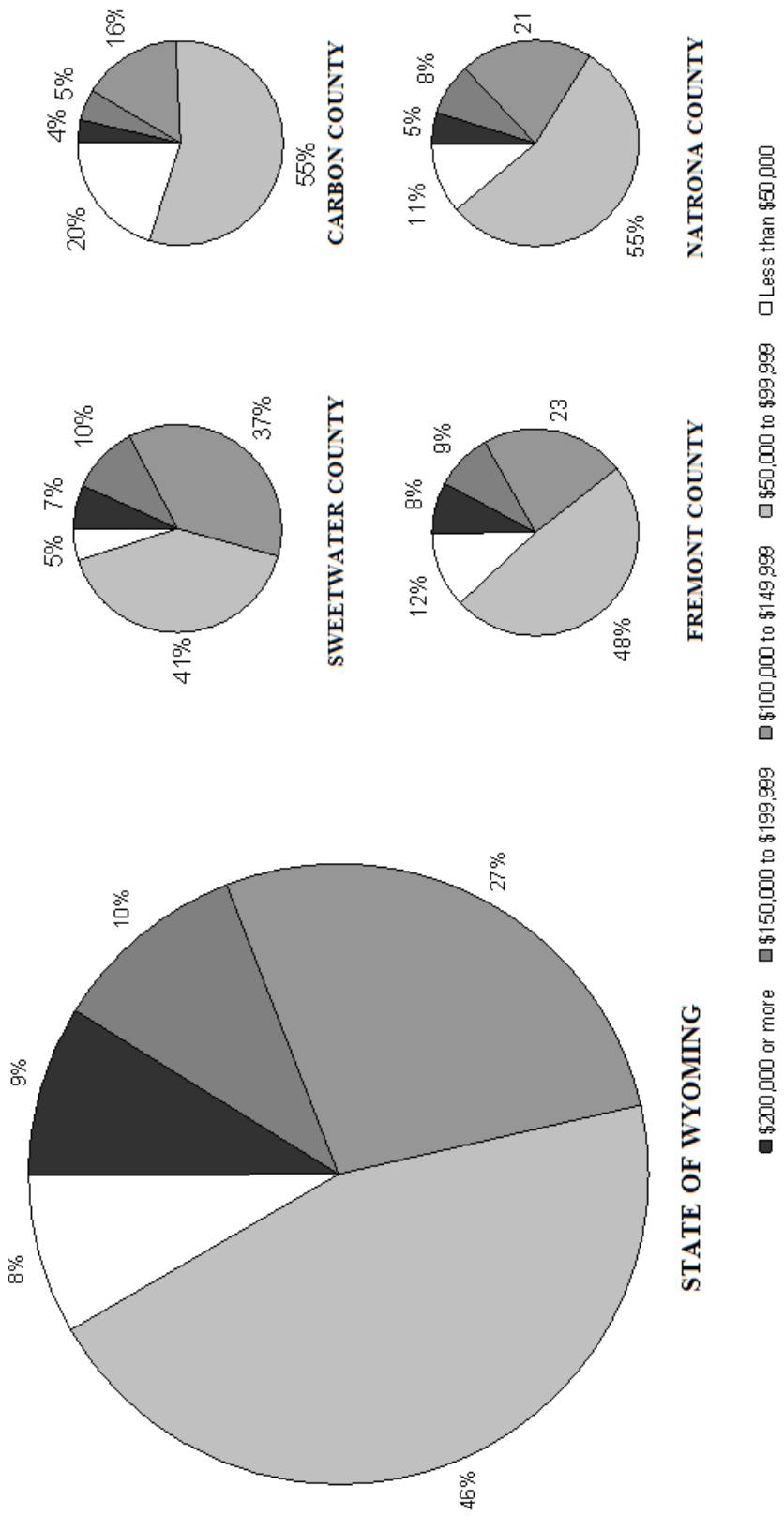
Since 2007, Wyoming's active residential real estate markets have eased somewhat with increased inventories and lower transactions in many communities (EAD, 2010e). Homebuilders have been cautious due to layoffs and tight credit. Even though housing inventory build-up and decreased demand have led home sellers to accept lower prices, Wyoming was still one of only a few states in the nation where home prices appreciated in 2008.

Table 3.14-12 General Housing Characteristics, 2000

Place	Population	Housing Units	Occupied	Vacant		Homeowner Vacancy Rate (percent)	Rental Vacancy Rate (percent)	Occupied Housing Units				
				Total	Vacant for Seasonal Use			Total	Owner Occupied	Renter Occupied	Household size for Owner Occupied	Household size for Renter Occupied
Wyoming	493,782	223,854	193,608	30,246	12,389	2.1	9.7	193,608	135,514	58,094	2.58	2.25
Sweetwater County	37,613	15,921	14,105	1,816	243	2.6	16.2	14,105	10,586	3,519	2.74	2.28
Bairoil	97	78	42	36	10	15	20	42	34	8	2.47	1.63
Wamsutter	261	148	100	48	1	13	41.1	100	67	33	2.61	2.39
Carbon County	15,639	8,307	6,129	2,178	1,050	4.7	16.9	6,129	4,354	1,775	2.46	2.24
Rawlins	8,538	3,860	3,320	540	50	4.1	17.3	3,320	2,247	1,073	2.58	2.16
Fremont County	35,804	15,541	13,545	1,996	657	2	11.3	13,545	9,870	3,675	2.61	2.5
Jeffrey City	106	112	45	67	0	5.6	84.3	45	34	11	2.12	3.09
Natrona County	66,533	29,882	26,819	3,063	923	1.5	8.4	26,819	18,740	8,079	2.52	2.19
Casper	49,644	21,872	20,343	1,529	115	1.5	8.1	20,343	13,616	6,727	2.5	2.13

* EAD, 2010

Figure 3.14-10 House Values, 2000

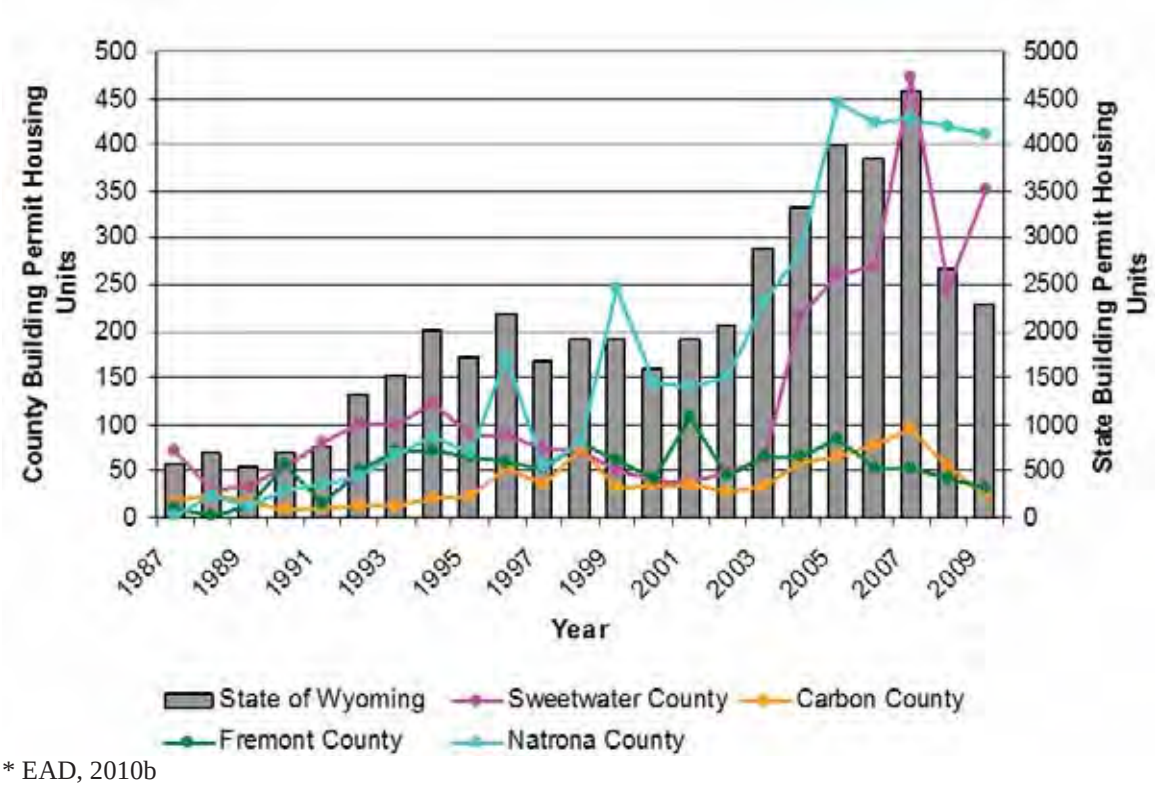


* US Census Bureau, 2000

In 2009, home construction and existing home prices continued to decrease. Consequently, residential construction permits decreased. **Figure 3.14-11** shows the annual housing units authorized by building permits from 1987 to 2009. The permitted housing units of Wyoming peaked in 2007 at 4,584, fell to 2,669 in 2008, and fell even further to 2,294 in 2009. The permitted housing units in Sweetwater and Carbon counties also peaked in 2007 and then dramatically fell in 2008; however, Sweetwater County's permitted housing units increased from 245 in 2008 to 351 in 2009. Both Fremont and Natrona counties had declines in permitted housing units from 2005 to 2008.

The State's price contraction in 2009 was the deepest decline since the late 1980s (EAD, 2010e). However, Wyoming homes retain most of their value despite the weak pace of sales and prices. Growth in affordability and relatively few foreclosures help protect residential real estate from significant declines. Strong population and income gain, and the lack of reliance upon non-prime lending to sustain home sales in recent years have left Wyoming's housing market fairly stable. Wyoming was still in first place throughout the country in terms of cumulative five-year home price appreciation in the fourth quarter of 2009.

Figure 3.14-11 Annual Housing Units Authorized by Building Permits, 1987 to 2009



* EAD, 2010b

3.14.5 Infrastructure and Services

The infrastructure and services include education, health care, law enforcement and fire protection, communication, utilities, and recreation (transportation is discussed in **Section 3.2**.) The discussion is focused on communities and counties, including Bairoil and Wamsutter in Sweetwater County, Rawlins in Carbon County, and Casper in Natrona County. Common municipal services include administration (e.g., council, manager, clerk), police, fire, public works, and parks and recreation. The counties provide typical government services, such as assessor, attorney, clerk, commissioners, treasurer, planning, roads and bridges, sheriff, and emergency management.

3.14.5.1 Education

Two school districts serve the immediate Project region: Sweetwater County School District One and Carbon County School District One. In 2009, the total enrollment of Sweetwater County School District One was 5,033 students (Wyoming Department of Education, 2010). From 1991 to 2009, Sweetwater School District One's enrollment ranged from 4,193 students (in 2003) to 6,127 students (in 1991) with an average of 5,063 students. The total enrollment of Carbon County School District One in 2009 was 1,727 students. Between 1991 and 2009, Carbon County School District One's enrollment ranged from 1,664 students (in 2004) to 2,420 students (in 1991) with an average of 1,989 students.

Although Bairoil and Wamsutter are within Sweetwater County, their public education is overseen by both Sweetwater County School District One and Carbon County School District One. Bairoil Elementary School is part of Carbon County School District One and had five students enrolled in 2008 (Wyoming Department of Education, 2010). Wamsutter has an elementary and middle school (Desert Elementary and Middle School) for grades kindergarten through 8th; this school is served by Sweetwater County School District One. Desert Elementary and Middle School enrolled 71 students and 12 students in 2008, respectively. Middle school students in the Bairoil area attend Rawlins Middle School. High school students in the Bairoil and Wamsutter area attend Rawlins High School. Both Rawlins Middle School and High School are in Carbon County School District One.

Rawlins is served by Carbon County School District One, and has three elementary schools, one middle school, and two high schools. The enrollment of the three elementary schools in 2008 was 322 students at Highland Hills Elementary, 208 students at Mountain View Elementary, and 250 students at Pershing Elementary. A new Rawlins Elementary School was completed in 2011 for all Rawlins second through fifth grades, with expansion plans to include kindergarten and first grade. Rawlins Middle School enrolled 341 students in 2008. Rawlins High School and Rawlins Cooperative High School (an alternative school) enrolled 425 students and 23 students, respectively, in 2008.

Natrona School District One serves the Casper area. Within Casper, Natrona School District One serves 19 elementary schools, five junior high/middle schools, and three high schools. An additional elementary school, Summit Elementary, was opened on the east side of Casper in August 2010. As of 2008, the Casper elementary schools enrolled 5,101 students. The five Casper junior high/middle schools enrolled 2,718 students in 2008. The three Casper High Schools enrolled 2,967 students in 2008.

Also located in Casper are Casper College and the Wyoming Contractors Association McMurry Training Center, which offer higher education and technical training opportunities and facilities. Casper College has approximately 4,000 full- and part-time students. The McMurry Training Center provides industry-driven, short-term, high intensity training programs for job placement and career development in the construction, energy, and transportation industries. The McMurry Training Center offers three tiers of service:

- Full-service solution: McMurry Training Center recruits, screens, trains, and places technical labor;
- Trainers solution: an industry or business provides a specific curriculum and McMurry Training Center provides expert trainers and facilities; and
- Facilities solution: a specific industry or business leases the training facility, and provides their own curriculum, trainers, and employees.

3.14.5.2 Health Care

The nearest hospital to the Permit Area is the Memorial Hospital of Carbon County in Rawlins. The Memorial Hospital of Carbon County is a 35-bed acute care facility that offers a 24-hour fully staffed emergency room (Memorial Hospital of Carbon County, 2008). This hospital also provides the only full-time ambulance service in Carbon County. The hospital has five physicians and 105 full-time equivalent employees. Rawlins also has a Public Health Department, Senior Citizens Center, South Central Wyoming Health Care and Rehabilitation, Senior Citizens apartment complex, and various private health care providers. No medical care is available in either Bairoil or Wamsutter.

The only full-service regional hospital is also the largest acute care hospital in the State. Located in Casper, the Wyoming Medical Center is a 205-bed licensed regional medical center with 150 physicians and nearly 1,300 skilled staff (Wyoming Medical Center, 2010b). Its Level II Trauma Center operates Wyoming Life Flight, the only air ambulance program in the State. The Medical Center has undergone a five-stage $17 million construction project to renovate and expand the Emergency Room (Wyoming Medical Center, 2010a).

Casper also has the Wyoming Behavioral Institute, Mountain View Regional Hospital (neurosurgical and spine hospital), Elkhorn Valley Rehabilitation Hospital, several specialty clinics, and two long-term care facilities.

3.14.5.3 Law Enforcement and Fire Protection

Law enforcement for the Permit Area is primarily provided by the Bairoil Police Department, which consists of a police chief, one sergeant, and one part-time police officer. The department provides law enforcement for Bairoil and the surrounding unincorporated area under the jurisdiction of the Sweetwater County Sheriff's Department. This area is 165 square miles and extends 20 miles west and 15 miles south of Bairoil. Fire protection is provided by the Bairoil Volunteer Fire Department, with a station in Bairoil.

Law enforcement in the Wamsutter area is currently provided by the Sweetwater County Sheriff's Department; a deputy patrols the town daily. Two Wyoming Highway Patrol officers also live in Wamsutter. Emergency response services are provided by 15 volunteer emergency medical technicians operating one ambulance and ten volunteer firefighters operating two fire trucks.

The Carbon County Sheriff has an office and 74 jail beds in Rawlins, a substation in Medicine Bow, a deputy in Baggs, and a part-time deputy in Saratoga. The sheriff's office has 17 patrol officers, 23 detention deputies, seven full-time and three part-time dispatchers, and 11 other support staff. The sheriff covers a service area of 8,000 square miles. Rawlins has a police department with one chief, two detectives, 12 patrol officers, and 19 additional staff employees. All law enforcement offices have 911 emergency telephone services. Fire protection is provided by the Rawlins Fire Department, which has eight paid staff and 15 volunteers in the area. The fire department has two fire stations, a training center, five engines, a wildland engine, and a rescue truck.

Casper's Police Department has one chief with several administrative and support staff. It has two main operations divisions: the Patrol Division with 65 personnel and the Investigation Division with 18 personnel (City of Casper Police Department, 2009). The Patrol Division officers have specialized units, including, but not limited to, the Problem Oriented Response Team, Crime Prevention Team, school resource officers, K9 unit, Accident Investigation Team, bomb technicians, and Special Response Team. The Investigation Division is responsible for the following programs: Youth Diversion, Drug Court, Child Advocacy Program, Property Evidence, Victim Services, Crime Analysis, Internal Affairs, and the Central Wyoming Drug Task Force Officers. The Casper Fire-EMS Department has a total of five fire stations that employ more than 70 people trained as firefighters and as emergency medical technicians.

3.14.5.4 Communications

The local providers of telephone services are Century Link (formerly Qwest) in Bairoil, Wamsutter, Rawlins, and Casper, and Optimum (formerly Bresnan Communications) in Rawlins and Casper. Long-distance carriers include AT&T,

MCI, Sprint, and others. Digital switching and fiber-optic systems are available. Local internet access is provided Century Link, Optimum, and others.

3.14.5.5 Utilities

Wamsutter, Rawlins and Casper share the same electricity provider, Rocky Mountain Power. High Plains Power provides electricity service to Bairoil. Three natural gas companies provide services to the communities of interest: Source Gas (Bairoil, Rawlins, and Casper), Questar (Wamsutter), and Wyoming Community Gas (Casper).

Bairoil and Wamsutter provide water and sewage services for residents and businesses. Wells supply the public drinking water at Bairoil and Wamsutter. Wamsutter has a landfill, with a transfer station in Bairoil. Rawlins and Casper provide water, sewer, landfill, and recycling services for residents and businesses.

3.14.5.6 Recreation

As discussed in **Section 3.1**, the Project region has abundant and diverse recreational opportunities, including historic and cultural sight-seeing, hiking, OHV use, winter recreation, and hunting. In addition to the recreational activities detailed in **Section 3.1**, the communities of interest provide other recreational activities. Bairoil, Wamsutter, Rawlins, and Casper all have libraries. Rawlins has a recreation center (including a shooting range, fitness room, gymnasiums, and racquetball courts), a golf course, and three museums, and hosts Music in the Park.

Casper offers a wide variety of recreation, including: hiking, skiing, and snowmobiling at Casper Mountain; fishing, swimming, and boating at Alcova Lake and Pathfinder Lake; music festivals, and theater performances. The city has an events center, 45 developed park areas, two public and two private golf courses, a community trail system, the Stuckenhoff Shooting Range, a planetarium, four museums, the National Historic Trails Interpretive Center, and the Wyoming Symphony Orchestra. Casper is also home to the Casper Ghosts (a Minor League Baseball team), the Wyoming Cavalry (a professional indoor football team), and the Casper College Thunderbirds.

3.15 Background Radiology

Information on background radiological conditions in the Permit Area and surrounding region were obtained from Section 2.9 of the NRC Technical Report (LCI, 2010). General radiological conditions in the Western Wyoming region can be found in Section 3.2.11.1 of the NRC GEIS (NRC and WDEQ, 2009), and conditions in the Permit Area are also described in Section 3.12 of the NRC SEIS (NRC, 2011a).

Baseline radiological information was collected within the Permit Area to document the pre-operation radiological environment. The baseline radiological measurements were performed to identify areas with anomalously high radiological activity; establish preliminary surface background radiological levels in soil, water, air, sediment, vegetation, and food resources; and provide source data for radiation dispersion and dose calculation modeling (**Section 4.11**). The results for all of these resources are included in this section, with the exception of the results for surface water and groundwater, which are included in **Sections 3.5** and **3.6**, respectively.

Sampling began with a permit-wide gamma radiation survey and associated shallow soil sampling to determine overall conditions. Monitoring equipment for collecting radon and gamma readings and air particulates over time was then installed based on NRC requirements, site knowledge, preliminary Project plans, and available meteorological data. Vegetation and additional shallow soil sampling was conducted to determine conditions in the vicinity of the Plant, along with sediment sampling in drainages and deeper soil sampling. Based on additional NRC requirements, more definitive Project plans, and updated modeling of potential exposures, some of the monitoring locations for radon and gamma were modified.

3.15.1 Permit-Wide Gamma Radiation Survey and Initial Soil Sampling

Radiological baseline studies in the Permit Area began in January 2006. As part of the studies, a radiological baseline survey of naturally occurring gamma exposure rates and soil radionuclide concentrations was performed. The survey and sampling methods and results are outlined below, and additional detail can be found in Section 2.9 of the NRC Technical Report (LCI, 2010).

3.15.1.1 Methods

To detect areas of anomalously high radiological activity on the surface, such as from a geologic outcrop or previous site activities, a gamma survey was conducted throughout the Permit Area. These measurements were correlated with gamma levels measured by High-Pressure Ionization Chambers (HPICs) levels and with radiation in soil samples.

Gamma Survey

The survey was conducted using sodium iodide (NaI) detectors (linked to data loggers and a GPS) to take hundreds of thousands of gamma measurements throughout the Permit Area. Given the rugged terrain, sagebrush vegetation and the large Permit Area, two-seater all-terrain vehicles (ATVs) (with roll-bar cages, conventional driver control systems, and extra-wide tires) were used to safely negotiate the Permit Area while minimizing environmental impacts (**Figure 3.15-1**).

Figure 3.15-1 Equipment Used for the Gamma Survey

Three Ludlum 44-10 NaI gamma detectors and paired GPS receivers were mounted on the outriggers of each ATV. The detectors were coupled to Ludlum 2350 rate meters housed in a cooler carried in the ATV cargo bed. Simultaneous GPS and gamma exposure rate data were recorded using an onboard personal computer (PC) with data acquisition software developed by Tetra Tech Inc. The vehicle speed while scanning ranged between 2 and 8 mph, depending on the roughness of the terrain, with an average speed of 4 to 5 mph.

Data were downloaded daily into a Project database and mapped using Gamma Viewer software (Tetra Tech Inc., 2006). In addition to daily quality control (QC) measurements, daily scan results were evaluated in terms of general agreement between onboard detectors to help identify any problems that may have occurred during data acquisition throughout the day. Evaluation of updated gamma maps each day also helped in planning the next day's scanning activities.

After assessment of initial scanning results, a distance of 15 to 30 feet between the adjacent detectors in both vehicles was deemed practical and sufficient to resolve smaller-scale variability in the areas targeted for higher-density scanning coverage. This vehicle spacing provided an estimated effective ground scan coverage of 75 to 90 percent. The area of higher-density scanning covered the approximate location of primary subsurface ore deposits and probable area of operational facilities. However, for most areas of the Permit Area, a target distance of 300 feet between vehicles was a conservative goal employed during scanning, as this provides an estimated scan coverage of about 15 percent.

Cross-Calibration between NaI Detectors and the HPIC

Gamma exposure rates measured by NaI detectors are only relative measurements, as response characteristics of NaI detectors are energy dependent. True gamma exposure rates are best measured with an energy independent system such as an HPIC. Depending on the radiological characteristics of a given site, NaI detectors can have measurement values significantly higher than corresponding HPIC measurement values. NaI systems are useful for ISR sites because they can quickly and effectively demonstrate relative differences between pre- and post-ISR gamma exposure rate conditions. Unless the exact same equipment is used for both surveys; however, it is necessary to normalize the data to a common basis of comparison. This is the purpose of performing NaI/HPIC cross-calibration measurements. Cross-calibration insures that the results of future gamma scans, which are likely to use different detectors (and perhaps different detector models or technologies), can be meaningfully compared against the results of the pre-ISR baseline gamma surveys.

To perform NaI/HPIC cross-calibrations, static measurements were taken at various discrete locations covering a range of exposure rates representative of the Permit Area. Many locations were selectively chosen to be at or near earlier soil sampling grids for verification purposes. At each cross-calibration measurement location, ten to 20 individual HPIC readings were recorded and averaged.

Initial ATV scanning in the Permit Area was conducted with the detectors set three feet above the ground surface until problems with the detector clearance necessitated a change to 4.5 feet. Cross-calibration between the HPIC and NaI detectors positioned at both three-foot and 4.5-foot detector heights was conducted, and regression coefficients for the calibration curves are similar to those measured at other uranium recovery sites and to other reported values (Ludlum, 2006; Schiager, 1972). For measured gamma values less than 25 microRoentgens per hour (μR/hr), there was no evidence that readings from the two detector heights were different. For areas with measured values greater than 25 μR/hr, the difference is proportional to the magnitude of exposure rate being measured.

Soil Sampling and Gamma Correlation Grids

Because of the high density of the gamma survey information (as compared to traditional methods for selecting soil sampling locations), the focus of the initial soil sampling was on developing a correlation between soil Ra-226 concentrations and gamma exposure rates. Depending on the statistical strength of any such relationship, the resulting correlation could be used to infer approximate Ra-226 concentrations across the Permit Area based on the gamma survey results. Therefore, ten sampling locations were selected across the site at locations with relatively high and low gamma exposure rates.

Soil sampling was conducted as composite sampling over 33-by-33 foot (ten-by-ten meter) grids. Within each grid, ten soil sub-samples were collected to a depth of six inches then composited into a single sample. GPS coordinates were taken at the center of each sampling grid and recorded. Samples were sent to Energy Laboratories Incorporated (ELI) in Casper, Wyoming, for analysis of radium-226 (Ra-226), natural uranium (U-nat), thorium-230 (Th-230), and lead-210 (Pb-210). Each soil sampling grid was also scanned to determine the average gamma exposure rate over the same area, following methods described in Johnson et al. (2006).

Data Quality Assurance and Quality Control

Sources of gamma measurement uncertainty include instrument variability, spatial variability in gamma exposure rates (differences in readings due to small differences in the measurement location or geometry), and temporal variability in gamma exposure rates (differences over time due to changes in soil moisture,

barometric pressure, etc. that can affect ambient radon levels and/or photon attenuation characteristics of the soil profile).

Data quality assurance (QA) and QC issues for the radiological surveys in the Permit Area were addressed in various ways. In general, QA includes qualitative factors that provide confidence in the results, while QC includes quantitative evidence that supports the accuracy and precision of results. Data QA factors included: extensive personnel experience and method peer review; proper equipment calibration; detailed sampling and analysis protocols; and proper documentation. Quantification of data QC for the Project included the following: instrument control charts; consistency reviews; re-scans; and sample duplicates and laboratory protocols. The QA and QC information for the gamma survey and initial soils sampling is described in detail in the Section 2.9 of the NRC Technical Report (LCI, 2010).

3.15.1.2 Results

Gamma Survey

The gamma survey results in the Permit Area are shown in **Figure 3.15-2**. Localized trends or 'pockets' of higher gamma activity are evident across the Permit Area. These areas may coincide with naturally occurring materials or with historic exploration activities. All final gamma survey data presented have been normalized to a three-foot HPIC equivalent to create a uniform final gamma baseline survey dataset of the Permit Area. A kriging program in ArcGIS was used to develop the continuous estimates of three-foot-HPIC-equivalent gamma exposure rates throughout the Permit Area shown on **Figure 3.15-2**.

Soil Sampling

Overlays of soil sampling locations and baseline gamma survey results are shown on **Figure 3.15-2**. The soil sampling results for each of the ten sampling grids are included **Table 3.15-1**. A general relationship between gamma exposure rates and Ra-226 concentrations at the soil surface is visually apparent in **Figure 3.15-3**, and statistical analysis demonstrated a significant linear relationship. Also shown in **Figure 3.15-3** is another correlation developed for the nearby Lost Soldier study area that shares similar geophysical and geochemical soil characteristics. One data point for the Lost Creek correlation appears to be a mild outlier that increases the slope of the regression relative to that of the Lost Soldier study area. Without this data point, the two regressions are nearly identical, suggesting that the basic relationship between the gamma reading and the Ra-226 concentration is reasonably consistent in this region of Wyoming.

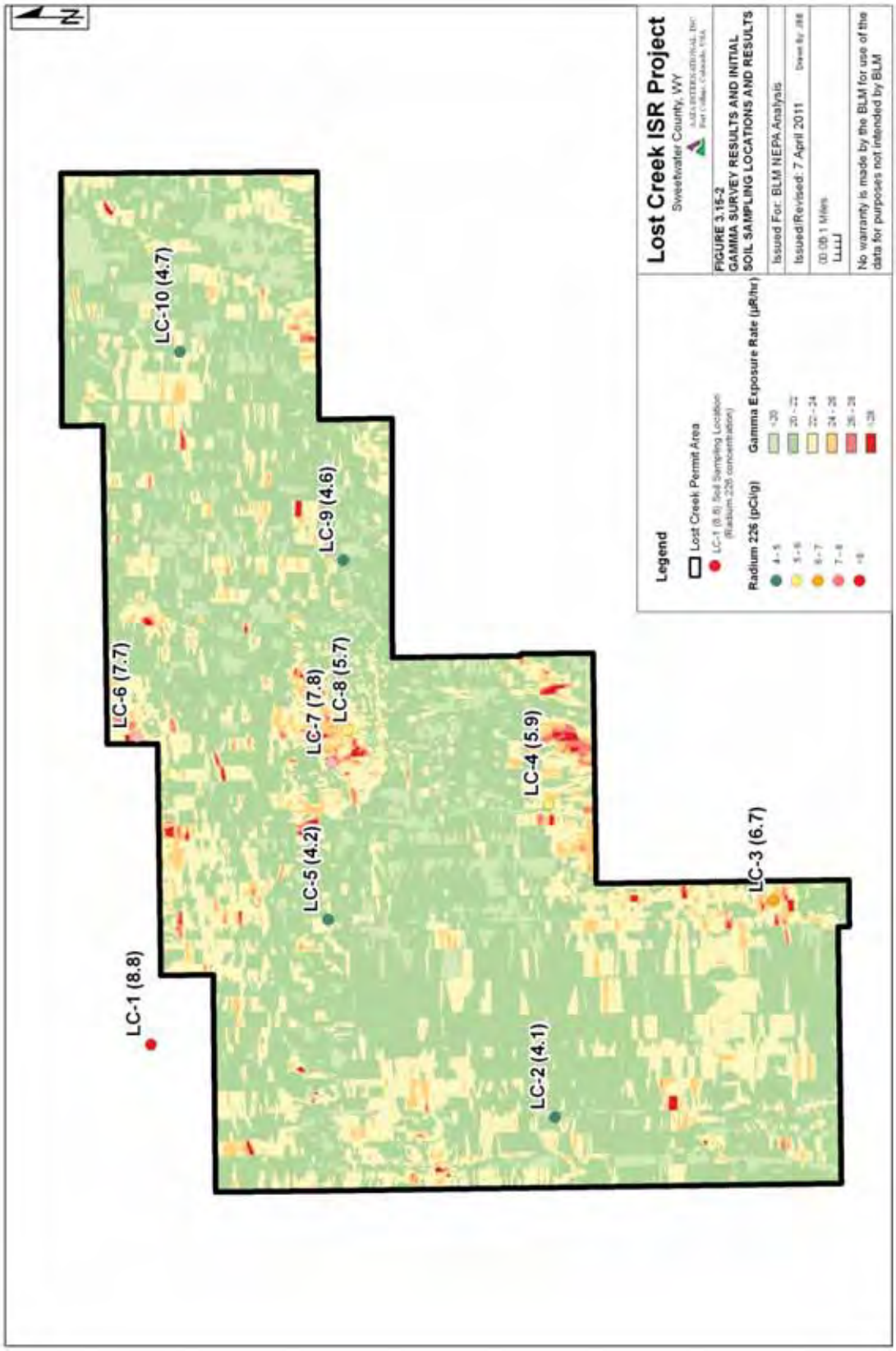

N
Lost Creek ISR Project
Sweetwater County, WY
Legend
Lost Creek Permit Area
LC-1 (8.8) Soil Sampling Location (Radium 226 concentration)
Radium 226 (pCi/g)
4 - 5
5 - 6
6 - 7
7 - 8
>8
Gamma Exposure Rate (µR/hr)
<20
20 - 22
22 - 24
24 - 26
26 - 28
>28
FIGURE 3.15-2
GAMMA SURVEY RESULTS AND INITIAL SOIL SAMPLING LOCATIONS AND RESULTS
Issued For: BLM NEPA Analysis
Issued/Revised: 7 April 2011
0 0.05 1 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
LC-10 (4.7)
LC-9 (4.6)
LC-6 (7.7)
LC-7 (7.8)
LC-8 (5.7)
LC-4 (5.9)
LC-5 (4.2)
LC-3 (6.7)
LC-1 (8.8)
LC-2 (4.1)

Table 3.15-1 Soil and Sediment Sampling Results (Page 1 of 2)

Sample ID and Depth Interval (inches) if not at Surface		Ra-226 (pCi/g)	U-nat (mg/kg)	Th-230 (pCi/g)	Pb-210 (pCi/g)	Mean Gamma Exposure Rate (µR/hr)
Soil Sampling associated with Initial Gamma Survey (October 2006)						
LC-1		8.8	12.9	2.1	4.9	31.6
LC-2		4.1	2.9	1.0	0.6	23.4
LC-3		6.7	3.9	1.9	1.1	29.4
LC-4		5.9	4.4	0.8	0.4	28.6
LC-5		4.2	1.7	0.3	ND 0.1	23.2
LC-6		7.7	5.0	0.7	0.4	34.6
LC-7		7.8	6.5	1.5	0.4	33.4
LC-8		5.7	2.9	0.6	1.0	26.9
LC-9		4.6	1.6	0.4	ND 0.1	24.4
LC-10 [1]		4.7	1.7	ND 0.1	ND 0.1	24.4
		4.8	NA	NA	NA	24.4
Soil Sampling associated with Vegetation Sampling (June 2009)						
LCSSURF-D [1]		3.8	7.2	2.0	ND 1.9	34.6
		4.2	7.1	3.1	2.3	
LCSSURF-E		1.6	2.5	1.1	ND 1.7	28.9
LCSSURF-F		6.3	17.5	4.0	ND 1.8	45.2
LCSSURF-G		6.5	23.6	5.2	ND 1.4	48.2
LCSSURF-H		1.7	2.6	0.9	ND 1.3	27.6
LCSSURF-I		3.8	4.1	2.1	2.9	38.9
LCSSURF-J		1.3	2.1	0.8	ND 1.6	26.3
Soil Profile Sampling (September & December 2008)						
LCDS-C (MU1PR33) [2]	0-12	1.7	1.08	0.5	ND 0.7	--
	12-33	2.3	2.14	1.3	ND 1.8	--
	33-60	2.8	0.52	2.7	4.2	--
LCDS-CE MU1PR35 [2]	0-8	2.1	3.37	1.3	ND 0.8	--
	8-18	2.1	2.17	1.3	ND 0.4	--
	18-34	1.7	1.49	1.6	ND 1.5	--
	34-48	1.2	3.72	1.9	ND 0.9	--
LCDS-N [2]	0-24	1.5	2.19	1.0	ND 0.7	--
	24-33	1.0	1.77	0.8	ND 0.9	--
	33-40	1.1	4.84	1.4	ND 1.4	--
LCDS-E [2]	0-8 [2]	1.2	2.9	0.1	ND 2.1	--
		0.7	1.3	0.4	ND 2.0	--
	8-40	0.8	2.71	0.9	ND 1.9	--
LSDS-S MU1PR23 [2]	0-10	1.9	0.57	0.8	ND 3.2	--
	10-60	1.2	1.55	0.6	ND 1.8	--
LCDS-W [2]	0-21	1.5	2.53	1.1	ND 1.1	--
	21-31	1.2	1.79	1.1	ND 1.0	--
	31-40	1.4	3.01	0.6	ND 1.0	--

Table 3.15-1 Soil and Sediment Sampling Results (Page 2 of 2)

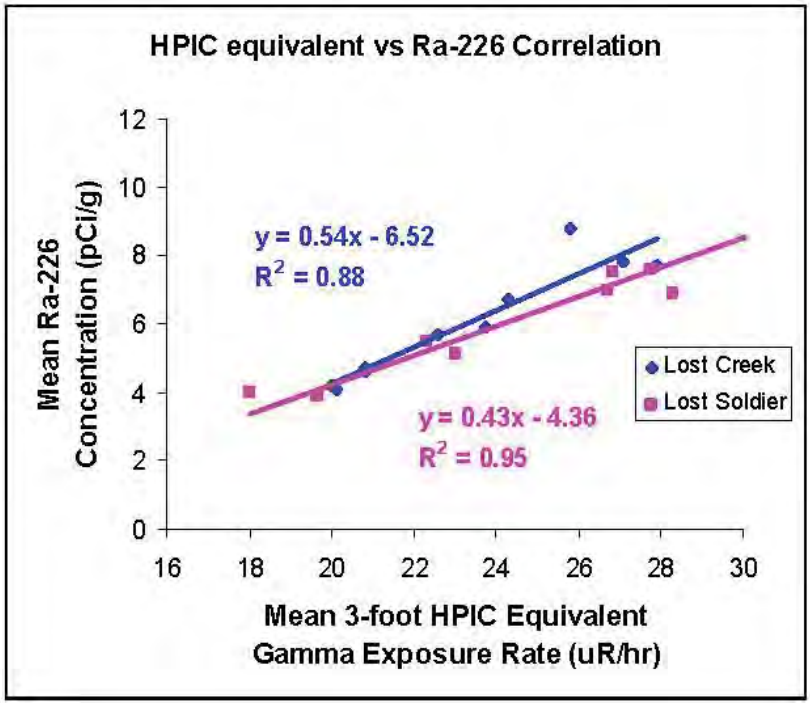
Sample ID & Depth Interval (inches) if not at Surface	Ra-226 (pCi/g)	U-nat (mg/kg)	Th-230 (pCi/g)	Pb-210 (pCi/g)	Mean Gamma Exposure Rate (µR/hr)
Stream Sediment Sampling (December 2008)					
LCSS-1	1.3	2.7	1.2	ND 1.6	--
LCSS-2	0.3	1.1	ND 0.1	ND 1.2	--
LCSS-3	1.0	2.0	ND 0.1	ND 3.2	--
LCSS-4	1.2	2.2	1.5	ND 0.2	--
LCSS-5	0.6	1.2	0.2	ND 1.0	--
LCSS-6	1.2	5.0	2.5	ND 2.4	--
LCSS-7	ND 0.05	1.0	1.3	ND 2.0	--
Pond at BLM Well No. 4551 (July 2010)					
Sediment	--	11.8	--	--	--

"--" indicates not analyzed; mg/kg = milligrams per kilogram; ND = Not Detected at indicated limit; pCi/g = picoCuries per gram

[1] Duplicate analysis

[2] Locations LCDS-C, N, E, and W are in Pepal Sandy Loam; Location LCDS-CE is in Poposhia Loam; and Location LCDS-S is in Teagulf Sandy Loam. Locations LCDS-C, LCDS-CE, and LCDS-S coincide with topsoil suitability soil sampling locations MU1PR33, MU1PR35, and MU1PR23, respectively, which are shown in **Figures 3.4-3 and 3.4.4**.

Figure 3.15-3 Correlation of Gamma Scan and Soil Sampling Results



3.15.2 Radon, Passive Gamma, and Radiological Air Particulate Monitoring

3.15.2.1 Radon and Passive Gamma Monitoring

Radon gas measurements have been made using Landauer Radtrak® long-term radon monitors equipped with a thoron-proof filter in order to measure radon-222, only, and X9 Environmental/Low Level Dosimetry badges manufactured by Landauer, Inc. were used to measure gamma levels in the air (**Figure 3.15-4**).

Monitoring began in 2006. Sampling locations were based on NRC requirements, site knowledge, preliminary Project plans, and available meteorological data (**Figure 3.15-5**). Results of the monitoring are shown in **Table 3.15-2**. The locations were at: the closest full-time residence, in Bairoil, (URPA1 [Ur-Energy Passive Air 1]); the western, upwind site boundary (URPA7); the southeastern site boundary (URPA8); the northeastern, downwind site boundary (URPA10); and the center of the site, coinciding with the ore trend (URPA9). Another site (URPA13) was added after the first quarter to reflect changes to the proposed Permit Area. Two locations (URPA1 and UPRPA10) coincided with high-volume radiological particulate sampling locations (HV-1 and HV-4, respectively). Based on further NRC review, more definitive Project plans, and updated modeling of potential radiation dispersion, additional radon and gamma monitoring stations were installed and the equipment replaced at previous stations. A station was established next to each of the five air particulate samplers, and four new stations were established on the Permit Area boundary. Three stations were also placed near the Plant, at locations where potential radiological impacts are predicted to be highest (**Section 4.17**).

Figure 3.15-4 Equipment for Radon and Gamma Monitoring (Location PR-2) and HiVol Particulate Sampling (Location HV-3)

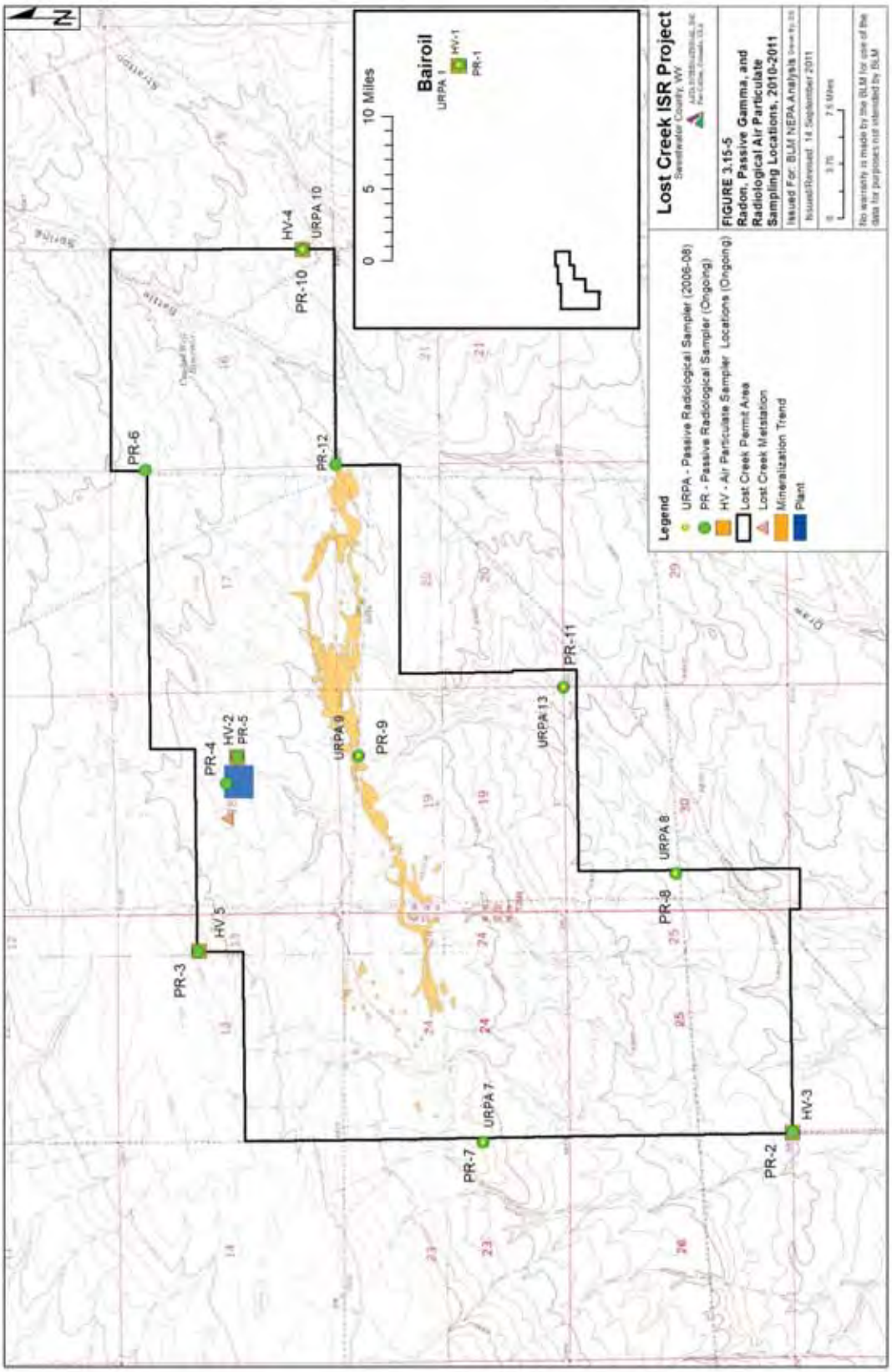

N
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.15-5
Radon, Passive Gamma, and Radiological Air Particulate Sampling Locations, 2010-2011
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0 5 10 Miles
Bairoil
URPA 1
HV-1
PR-1
Legend
URPA - Passive Radiological Sampler (2006-08)
PR - Passive Radiological Sampler (Ongoing)
HV - Air Particulate Sampler Locations (Ongoing)
Lost Creek Permit Area
Lost Creek Metstation
Mineralization Trend
Plant
HV-4
URPA 10
PR-10
PR-6
PR-12
PR-11
URPA 13
HV-2
PR-5
PR-4
URPA 9
PR-9
URPA 8
PR-8
HV-5
PR-3
URPA 7
PR-7
HV-3
PR-2

Table 3.15-2 Radon and Gamma Results (Page 1 of 2)

Radon and Gamma Monitoring Location [1]	Associated HiVol Location	Period [2]	Radon-222 (pCi/L)	Radon-222 Exposure (pCi/L-days)	Gamma Exposure (millirems)	Gamma Exposure Rate (millirems/day)
URPA1 (Bairoil)	**HV-1**	Q1	0.5	50.3	11.3	0.12
		Q2	0.3	22.5	16.9	0.20
		Q3	0.9	90.5	18.6	0.19
		Q4	0.6	58.9	44.2	0.43
		Q5	0.8	89.1	23.0	0.20
PR-1		2ndQ1	1.3	96.3	9.9	0.13
		2ndQ2	3.4	339.0	20.8	0.21
		2ndQ3	0.4	36.3	17	0.20
PR-2	**HV-3**	2ndQ2 [3]	5.7	564.1	18.5	0.19
		2ndQ3	0.9	75.6	41.6	0.50
PR-3	**HV-5**	2ndQ1	1.5	116.9	18.4	0.24
		2ndQ2	4.1	404.8	28.5	0.29
		2ndQ3	0.5	44.9	40.3	0.39
PR-4		2ndQ1	1.5	114.9	16.5	0.21
		2ndQ2	4.5	446.6	39.3	0.4
		2ndQ3	0.9	94.7	22.4	0.22
PR-5	**HV-2**	2ndQ1	1.6	126.2	16.7	0.22
		2ndQ2	4.4	439.4	57.9	0.58
		2ndQ3	0.8	64.0	NA	NA
PR-6		2ndQ1	1.3	96.3	14.5	0.19
		2ndQ2	3.1	302.6	28.0	0.28
		2ndQ3	0.5	54.4	22.2	0.22
URPA7 (W of LC)		Q1	1.5	147.6	33.0	0.34
		Q2	0.7	56.3	23.2	0.28
		Q3	1.6	153.7	41.7	0.43
		Q4 [4]	2.8	297.6	53.6	0.51
PR-7		2ndQ1	1.7	130.4	25.0	0.32
		2ndQ2	3.2	319.7	30.6	0.31
		2ndQ3	0.9	95.8	21.8	0.21
URPA8 (SE of LC)		Q1	2.7	258.4	13.6	0.14
		Q2	1.3	108.1	23.4	0.28
		Q3	2.1	203.1	38.2	0.39
		Q4 [4]	3.2	331.3	69.6	0.66
PR-8		2ndQ1	2.1	160.4	15.1	0.20
		2ndQ2	3.7	362.2	34.3	0.35
		2ndQ3	1.6	167.1	30.3	0.29

Table 3.15-2 Radon and Gamma Results (Page 2 of 2)

Radon and Gamma Monitoring Location [1]	Associated HiVol Location	Period [2]	Radon-222 (pCi/L)	Radon-222 Exposure (pCi/L-days)	Gamma Exposure (millirems)	Gamma Exposure Rate (millirems/day)
URPA9 (Central LC)		Q1	3.8 [5]	370.6	23.7	0.24
		Q2	0.8	67.5	18.0	0.21
		Q3	1.5	148.8	42.1	0.43
		Q4	2.8	295.2	67.4	0.64
		Q5	1.7	184.8	20.7	0.18
PR-9		2ndQ1	1.5	113.8	20.4	0.26
		2ndQ2	3.2	312.7	30.9	0.31
		2ndQ3 [4]	10.2	1048.4	32.3	0.38
URPA10 (NE of LC)	HV-4 PR13	Q1	2.1	201.7	24.4	0.25
		Q2	1.2	100.7	NA [6]	NA [6]
		Q3	1.8	173.2	50.4	0.52
		Q4	1.0	100.4	55.3	0.53
		Q5	2.0	206.9	32.6	0.29
PR-10		2ndQ1	1.7	128.3	29.6	0.38
		2ndQ2	3.0	294.5	28.5	0.29
		2ndQ3	1.2	97.9	16.9	0.16
URPA13 (SE of new LC)	HV4	Q2 [7]	2.0	167.2	25.6	0.30
		Q3	1.5	146.8	24.8	0.26
		Q4	2.5	259.2	42.6	0.41
		Q5	2.7	290.9	37.7	0.37
PR-11 & PR-13 (duplicates)		2ndQ1	1.8	136.6	17.6	0.23
			1.4	110.7	25.8	0.34
		2ndQ2	3.6	359.2	49.0	0.49
			3.7	366.3	33.3	0.34
		2ndQ3	1.1	111.7	19.2	0.17
			1.0	86.2	26.1	0.31
PR-12		2ndQ1	NA [8]	NA [8]	11.2	0.15
		2ndQ2	3.1	303.6	29.1	0.29
		2ndQ3	NA	91.5	25.2	0.30

NA = not analyzed

[1] UPRA refers to radon and passive gamma monitoring locations established in 2006; PR refers to radon and passive gamma monitoring locations established in 2010; HV refers to high-volume radiological particulate samplers. The radon and gamma monitoring quarters do not cover exactly the same time spans as the HiVol particulate samplers, but there is some overlap.

[2] Beginning dates: Q1 on 11/10/06; Q2 on 2/15/07; Q3 on 5/10/07; Q4 on 8/16/07; Q5 on 11/28/07. Sampling concluded: 3/14/08. Sampling restarted with 2nd Q1 on 4/21/2010; 2nd Q2 on 7/7/2010; 2nd Q3 on 10/24/2010. Ending date corresponds to beginning date of next quarter; 2nd Q3 for PR-1, 2, 5, 9, and 12 ended on 1/6/2011 and for all others ended on 1/25/2011 (bad weather).

[3] Dosimeter not deployed until 2nd Q2 because only 12 dosimeters available in 1st Q2, rather than the 13 needed, and duplicate considered more important.

[4] Elevated reading may be due to the fact that the sensor was buried in a snow drift when recovered.

[5] No 5th quarter data collected at this site.

[6] Sensor missing; new sensor installed for the next quarter.

[7] No data available for first quarter due to later installation of monitoring equipment.

[8] Cows knocked over sensor sometime during the quarter.

3.15.2.2 Radiological Air Particulate Monitoring

LCI began collection of air particulate samples for radiological parameters in November 2007. Five sites were selected in November 2007 based on NRC requirements, site knowledge, and available meteorological data. Sampling locations and equipment are shown in **Figures 3.15-4** and **3.15-5**, respectively.

Per Section C.1.1.1 of Regulatory Guide 4.14 (NRC Office of Standards Development, 1980), the air particulate sampling should include "a minimum of three locations at or near the site boundary". LCI installed five air particulate samplers, including three samplers (HV-3, HV-4, and HV-5) at the site boundaries. The guidance also indicates that one sampling location should be representative of background conditions. Site HV-3 is representative of background conditions, because it is the location furthest from the Plant (over two miles) and the mine units (over one mile) in a westerly, generally upwind, direction. The guideline also indicates a sampling location should be positioned as closely as possible to the area where airborne radionuclide concentrations related to the ISR operation are predicted to be the highest; therefore, Site HV-2 was located immediately downwind of the ten-acre Plant site. Site HV-4 was placed at the eastern Permit Area boundary, generally downwind of the Plant and all the mine units. Site HV-5 was located at a Permit Area boundary, less than one mile northwest (generally upwind) of the Plant and mine units. Based on further NRC review, more definitive Project plans, and updated modeling of potential exposures, these sampling locations were confirmed as representative of background and the potential range of Project impacts.

Composite quarterly samples were analyzed for U-nat, Th-230, Ra-226, and Pb-210. The analytical results are included as **Table 3.15-3**. All of the analytical results were either non-detect or less than four percent of the respective effluent concentration limit from Appendix B of 10 CFR 20.

Table 3.15-3 Air Particulate Results
(Page 1 of 2)

Location	Associated Radon and Gamma Monitor Location [1]	Period [2]	U-nat (µCi/L)	Th-230 (µCi/L)	Ra-226 (µCi/L)	Pb-210 (µCi/L)
HV1 (Bairoil)	URPA1	Q1	5.00E-17	5.00E-17	2.86E-16	1.78E-14
		Q2	5.00E-17	5.00E-17	5.00E-17	6.81E-15
		Q3	5.61E-16	1.95E-16	5.00E-17	2.22E-14
		Q4	5.00E-17	5.00E-17	5.00E-17	1.69E-14
		Q5	5.00E-17	2.28E-16	5.00E-17	1.11E-14
		Q6	5.00E-17	1.15E-16	5.00E-17	1.05E-14
		Q7	1.98E-16	5.00E-17	5.00E-17	8.20E-15
		Q8	2.78E-16	5.00E-17	5.00E-17	1.02E-14
		Q9	5.00E-17	5.00E-17	1.23E-16	1.82E-14
	PR-1	Q10	5.00E-17	5.00E-17	5.00E-17	6.62E-15
		Q11	5.00E-17	5.00E-17	5.00E-17	5.00E-15
		Q12	5.00E-17	1.34E-16	1.07E-16	1.00E-14
HV2		Q1	5.00E-17	5.00E-17	2.34E-16	1.53E-14
		Q2	5.00E-17	5.00E-17	5.00E-17	3.02E-15
		Q3	1.48E-16	5.00E-17	5.00E-17	1.62E-14
		Q4	5.00E-17	5.00E-17	5.00E-17	1.62E-14
		Q5	1.55E-16	5.00E-17	5.00E-17	1.15E-14
		Q6	5.00E-17	5.00E-17	5.00E-17	1.15E-14
		Q7	1.21E-16	5.00E-17	5.00E-17	9.43E-15
		Q8	1.90E-16	5.00E-17	5.00E-17	1.86E-14
		Q9	5.00E-17	5.00E-17	2.00E-16	1.97E-14
		Q10	5.00E-17	5.00E-17	5.00E-17	8.13E-15
		Q11	5.00E-17	5.00E-17	5.00E-17	9.70E-15
		Q12	5.00E-17	1.24E-16	5.00E-17	1.21E-14
HV3		Q1	5.00E-17	5.00E-17	2.23E-15	1.31E-14
		Q2	5.00E-17	5.00E-17	5.00E-17	5.01E-15
		Q3	1.18E-16	2.59E-16	5.00E-17	1.41E-14
		Q4	5.00E-17	5.00E-17	5.00E-17	1.91E-14
		Q5	1.48E-16	5.00E-17	5.00E-17	1.67E-14
		Q6	5.00E-17	5.00E-17	5.00E-17	1.12E-14
		Q7	1.44E-16	5.00E-17	5.00E-17	1.38E-14
		Q8	1.53E-16	5.00E-17	5.00E-17	1.41E-14
		Q9	5.00E-17	5.00E-17	1.89E-16	1.98E-14
		Q10	5.00E-17	5.00E-17	5.00E-17	7.82E-15
		Q11	5.00E-17	1.03E-16	5.00E-17	8.80E-15
		Q12	5.00E-17	5.00E-17	1.65E-16	1.30E-14

Table 3.15-3 Air Particulate Results (Page 2 of 2)

Location	Associated Radon and Gamma Monitor Location [1]	Period [2]	U-nat (µCi/L)	Th-230 (µCi/L)	Ra-226 (µCi/L)	Pb-210 (µCi/L)
HV4		Q1	5.00E-17	1.62E-16	3.51E-16	2.38E-14
		Q2	5.00E-17	5.00E-17	5.00E-17	9.24E-15
		Q3	5.00E-17	5.00E-17	5.00E-17	1.95E-14
		Q4	5.00E-17	5.00E-17	5.00E-17	1.72E-14
		Q5	5.00E-17	5.00E-17	5.00E-17	1.57E-14
		Q6	5.00E-17	5.00E-17	5.00E-17	1.11E-14
		Q7	1.29E-16	5.00E-17	5.00E-17	1.30E-14
		Q8	3.45E-16	1.94E-16	5.00E-17	1.42E-14
		Q9	5.00E-17	5.00E-17	5.00E-17	1.66E-14
		Q10	5.00E-17	5.00E-17	5.00E-17	7.57E-15
		Q11	5.00E-17	1.09E-16	5.00E-17	1.15E-14
		Q12	5.00E-17	5.00E-17	5.00E-17	1.22E-14
HV5		Q1	5.00E-17	2.38E-16	2.91E-16	1.81E-14
		Q2	5.00E-17	5.00E-17	5.00E-17	5.28E-15
		Q3	2.21E-16	5.00E-17	5.00E-17	1.51E-14
		Q4	5.00E-17	5.00E-17	5.00E-17	2.31E-14
		Q5	1.36E-16	2.01E-16	5.00E-17	1.05E-14
		Q6	5.00E-17	5.00E-17	5.00E-17	9.53E-15
		Q7	1.56E-16	5.00E-17	5.00E-17	7.16E-15
		Q8	4.89E-16	1.58E-16	5.00E-17	1.05E-14
		Q9	5.00E-17	5.00E-17	5.00E-17	1.89E-14
		Q10	5.00E-17	5.00E-17	5.00E-17	6.88E-15
		Q11	5.00E-17	5.00E-17	5.00E-17	1.11E-14
		Q12	5.00E-17	5.00E-17	5.00E-17	1.15E-14

[1] UPRA refers to radon and passive gamma monitoring locations established in 2006; PR refers to radon and passive gamma monitoring locations established in 2010. The radon and gamma monitoring quarters do not cover exactly the same time spans as the HiVol particulate samplers, but there is some overlap.

[2] Beginning dates: Q1 on 11/30/07; Q2 on 3/1/2008 or 3/8/2008 (bad weather); Q3 on 6/5/2008; Q4 on 8/29/08; Q5 on 12/2/2008; Q6 on 3/19/2009; Q7 on 6/15/2009; Q8 on 9/18/2009; Q9 on 12/16/2009; Q10 on 3/30/2010; Q11 on 6/18/2010; and Q12 on 9/29/2010. End date corresponds to beginning date of next quarter; Q12 ended on 12/21/2010.

3.15.3 Additional Radiological Studies

Additional soils samples, as well as samples of water, vegetation, sediment, and food resources were collected for evaluation of baseline conditions. The surface water and groundwater sampling results are included in **Sections 3.5** and **3.6**, respectively. The sampling results of the other media are presented below.

3.15.3.1 Vegetation and Associated Surface Soil Sampling

In July and August 2008, vegetation was sampled at three locations downwind (to the east and southeast) of the Plant, where radiation dispersion might occur (**Figure 3.15-6**). Samples were analyzed for U-nat, Ra-226, Th-230, Pb-210, and polonium-210 (Po-210). The sampling results for Sites A, B, and C are included in **Table 3.15-4**. Subsequent to this sampling, LCI conducted additional radiation dispersion and dose calculation modeling, and in the summer of 2009, collected additional vegetation samples from sites that would be subject to maximum radon daughter deposition according to the results of that modeling. Vegetation samples were also collected from sites within the Permit Area with high and low gamma activity, according to the baseline gamma scan. These sampling results are also included in **Table 3.15-4**, and the site designations are:

- Sites D and E: where total ground concentrations were predicted to be the greatest during operations, based on the 2009 'near-Plant' MILDOS analysis;
- Sites F, G, H, and I: each had a different gamma activity; and
- Site J: where the baseline direct gamma scan survey indicated comparatively low gamma activity that is upwind of the Plant and where Project-related radon deposition is expected to be low or non-existent.

Soil samples were also collected at the 2009 vegetation sampling sites and analyzed for U-nat, Ra-226, Th-230, and Pb-210. The results are included in **Table 3.15-1**.

3.15.3.2 Soil Profile Sampling

Six sites were selected for soil profile sampling, i.e., sampling at depth as well as at the surface, at the locations shown in **Figure 3.15-7**. In accordance with Regulatory Guide 4.14 (NRC Office of Standards Development, 1980), one sampling site was placed near the center of the Plant, with four additional sites approximately 2,500 feet away, in each of the cardinal directions. A detailed soil survey had identified three soil types in the Permit Area (**Section 3.4**); therefore, an additional sampling site was selected approximately 500 feet east of the Plant, so all three soil types were represented. Depending on the soil profile, two to four samples were collected at each site, to a minimum depth of 40 inches. Samples were analyzed for U-nat, Ra-226, Th-230, and Pb-210. Analytical results from soil profile sampling are included in **Table 3.15-1**.

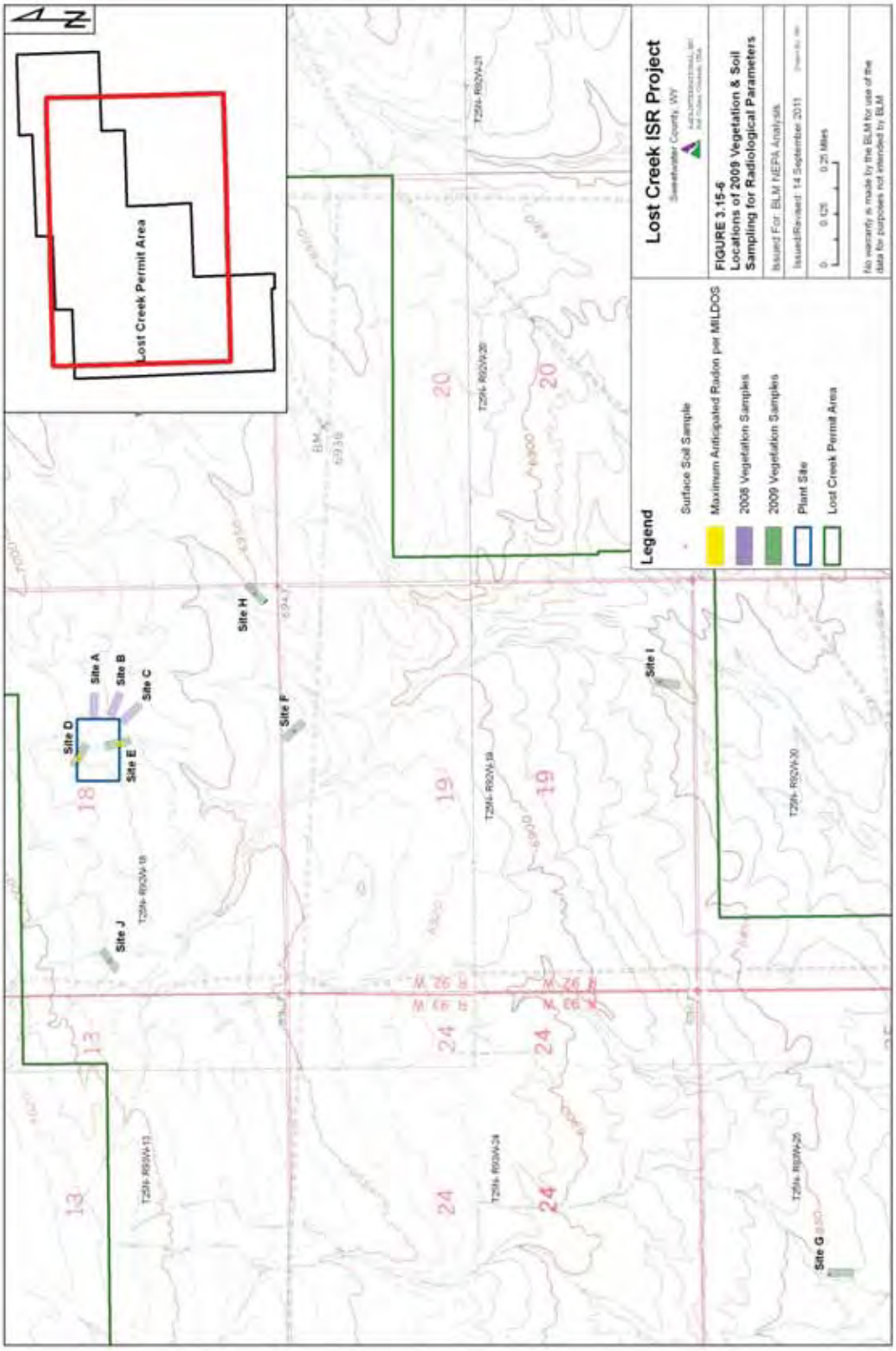
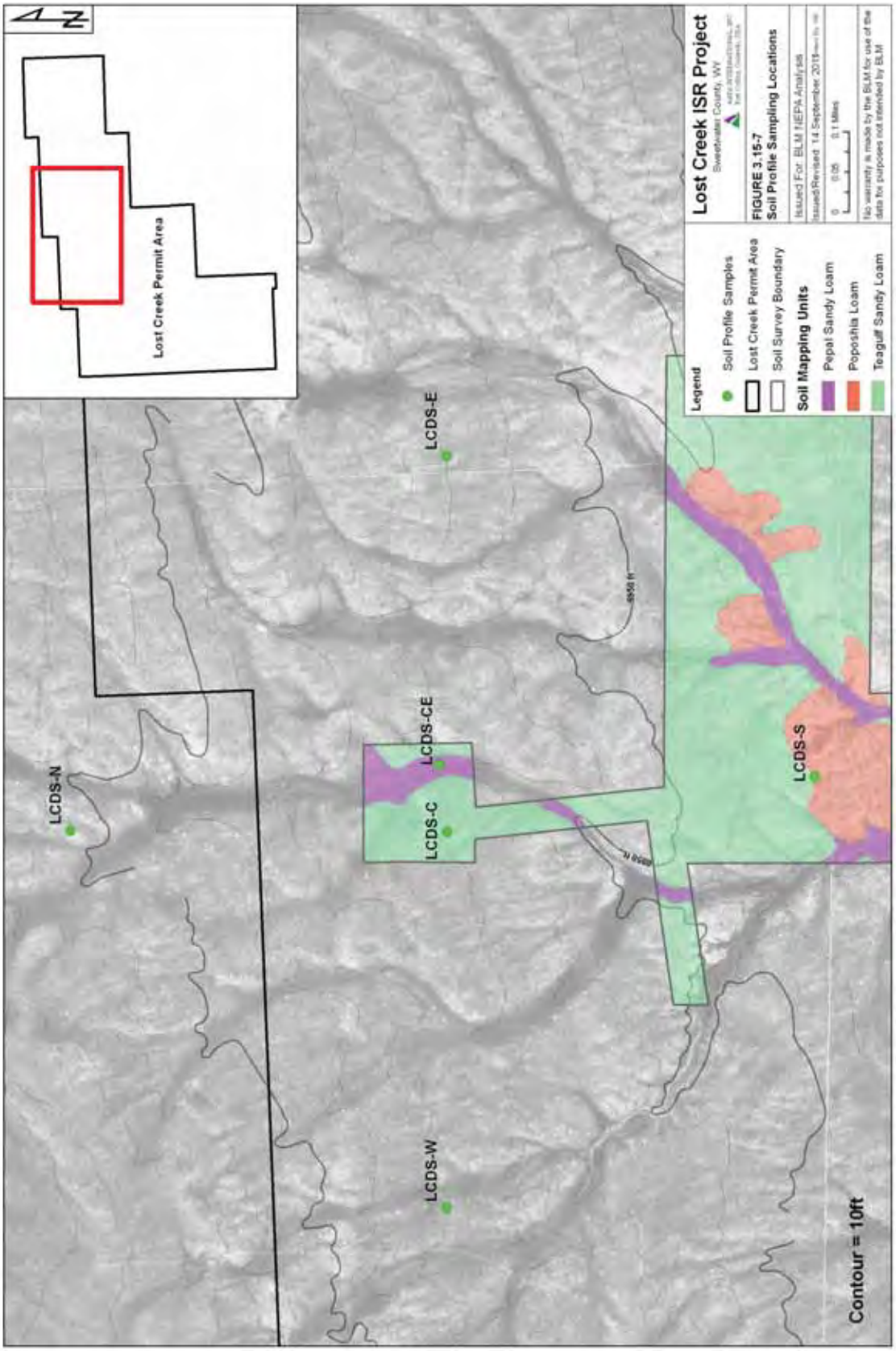

N
Lost Creek Permit Area
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.15-6
Locations of 2009 Vegetation & Soil Sampling for Radiological Parameters
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0 0.125 0.25 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Surface Soil Sample
Maximum Anticipated Radon per MILDOS
2008 Vegetation Samples
2009 Vegetation Samples
Plant Site
Lost Creek Permit Area
Site A
Site B
Site C
Site D
Site E
Site F
Site G
Site H
Site I
Site J
T25N-R92W-18
T25N-R92W-19
T25N-R92W-20
T25N-R92W-21
T25N-R92W-30
T25N-R92W-13
T25N-R92W-24
T25N-R92W-25
BLM
18
19
20
13
24
25

Table 3.15-4 Vegetation Sampling Results

Location	Date	Ra-226 (µCi/kg)	U-nat (mg/kg)	Th-230 (µCi/kg)	Pb-210 (µCi/kg)	Po-210 (µCi/kg)
LCVEGRAD-A	7/17/2008	8.3E-05	0.760	1.6E-05	1.5E-03	7.2E-05
	8/4/2008	7.5E-05	0.080	1.4E-05	<6.5E-04	3.5E-05
	8/20/2008	1.5E-04	0.110	2.8E-05	6.9E-04	1.0E-04
LCVEGRAD-B	7/17/2008	7.1E-05	0.170	2.2E-05	1.9E-03	3.5E-05
	8/4/2008	1.5E-04	0.060	2.4E-05	9.0E-04	6.8E-05
	8/20/2008	1.6E-04	0.060	3.4E-05	1.0E-03	8.0E-05
LCVEGRAD-C	7/17/2008	1.5E-04	0.200	3.2E-05	8.9E-04	3.2E-05
	8/4/2008	1.5E-04	0.090	3.9E-05	<6.2E-04	3.5E-05
	8/20/2008	1.3E-04	0.080	1.9E-05	7.9E-04	9.7E-05
LCVEGRAD-D	6/24/2009	5.4E-05	0.029	1.5E-05	3.1E-04	1.4E-05
	7/10/2009	8.8E-05	0.029	7.0E-06	3.7E-04	7.0E-06
	7/29/2009	1.4E-04	0.053	2.7E-05	5.2E-04	2.3E-05
LCVEGRAD-E	6/24/2009	5.4E-05	0.019	6.4E-06	2.8E-04	1.4E-05
	7/10/2009	7.1E-05	0.023	8.8E-06	3.3E-04	1.5E-05
	7/29/2009	9.9E-05	0.033	1.7E-05	2.8E-04	1.6E-05
LCVEGRAD-F	6/25/2009	9.3E-05	0.051	2.1E-05	2.0E-04	1.1E-05
	7/9/2009	8.9E-05	0.029	1.1E-05	2.2E-04	6.0E-06
	7/28/2009	2.4E-04	0.078	2.3E-05	3.1E-04	7.3E-06
LCVEGRAD-G	6/25/2009	1.1E-04	0.028	1.7E-05	6.3E-04	5.3E-06
	7/9/2009	2.1E-04	0.066	2.6E-05	7.8E-04	1.2E-05
	7/28/2009	5.5E-04	0.150	7.1E-05	1.5E-03	2.7E-05
LCVEGRAD-H	6/25/2009	7.1E-05	0.025	9.2E-06	1.2E-04	2.8E-06
	7/9/2009	1.6E-04	0.059	1.6E-05	2.9E-04	5.2E-06
	7/28/2009	1.1E-04	0.040	2.0E-05	2.4E-04	1.1E-05
LCVEGRAD-I	6/25/2009	9.0E-05	0.029	2.5E-05	3.6E-04	1.1E-05
	7/9/2009	1.6E-04	0.027	2.2E-05	4.8E-04	1.1E-05
	7/28/2009	1.5E-04	0.029	2.0E-05	7.2E-04	3.3E-05
LCVEGRAD-J	6/24/2009	6.9E-05	0.038	1.6E-05	3.7E-04	2.9E-05
	7/10/2009	1.6E-04	0.140	3.5E-05	7.6E-04	9.1E-06
	7/29/2009	6.7E-05	0.033	1.6E-05	6.5E-04	2.0E-05

µCi/kg = microCuries per kilogram


N
Lost Creek Permit Area
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.15-7
Soil Profile Sampling Locations
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
0 0.05 0.1 Miles
No warranty is made by the BLM for use of the data for purposes not intended by BLM
Legend
Soil Profile Samples
Lost Creek Permit Area
Soil Survey Boundary
Soil Mapping Units
Pepal Sandy Loam
Poposhia Loam
Teaguff Sandy Loam
LCDS-E
LCDS-CE
LCDS-C
LCDS-N
LCDS-S
LCDS-W
Contour = 10ft

3.15.3.3 Sediment Sampling

In accordance with Regulatory Guide 4.14 (NRC Office of Standards Development, 1980), sediment samples were collected from sites at the upstream and downstream Permit Area boundaries (**Figure 3.15-8**) in December 2008. Sediment samples were analyzed for U-nat, Ra-226, Th-230, and Pb-210. Analytical results from sediment sampling are presented in **Table 3.15-1**.

Regulatory Guide 4.14 (NRC Office of Standards Development, 1980) also recommends sampling sediment from any impoundments that could receive contaminated surface waters. The only on-site impoundment, Crooked Well Reservoir, is located upstream of any Project activities (**Figure 3.5-1**). There are four additional 'stock ponds' in the vicinity of the Permit Area, each associated with a groundwater right, as shown in **Figure 3.6-16**. None of these is subject to drainage from potentially contaminated areas.

As discussed in **Section 3.5.2**, BLM Battle Springs Draw Well No. 4451 was improved by the BLM for stock use between November 2007 and April 2009. To determine baseline conditions in the new pond adjacent to the well, the pond sediment was sampled in July 2010. The uranium concentration was 11.8 mg/kg U-nat (**Table 3.15-1**).

3.15.3.4 Food and Fish Sampling

There is no crop production near the Permit Area, no perennial surface water to sustain fish, and very limited use of the Permit Area for cattle grazing. However, in accordance with Regulatory Guide 4.14 (NRC Office of Standards Development, 1980), tissue samples were collected at the time of slaughter in fall 2008 and fall 2009 from cattle with access to grazing fodder within 1.9 miles (three kilometers) of the Plant site. Samples of meat (muscle tissue), kidney, and bone were analyzed for U-nat, Ra-226, Th-230, Pb-210, and Po-210. A liver sample was also analyzed in 2009. Analytical results are included in **Table 3.15-5**.

As noted above, BLM Battle Springs Draw Well No. 4451 was improved between 2007 and 2009, and a new pond was created adjacent to the well. Along with the well water and the pond sediment, the algae in the pond were sampled in July 2010. The uranium concentration was 112 mg/kg U-nat (Table 3.6-7).

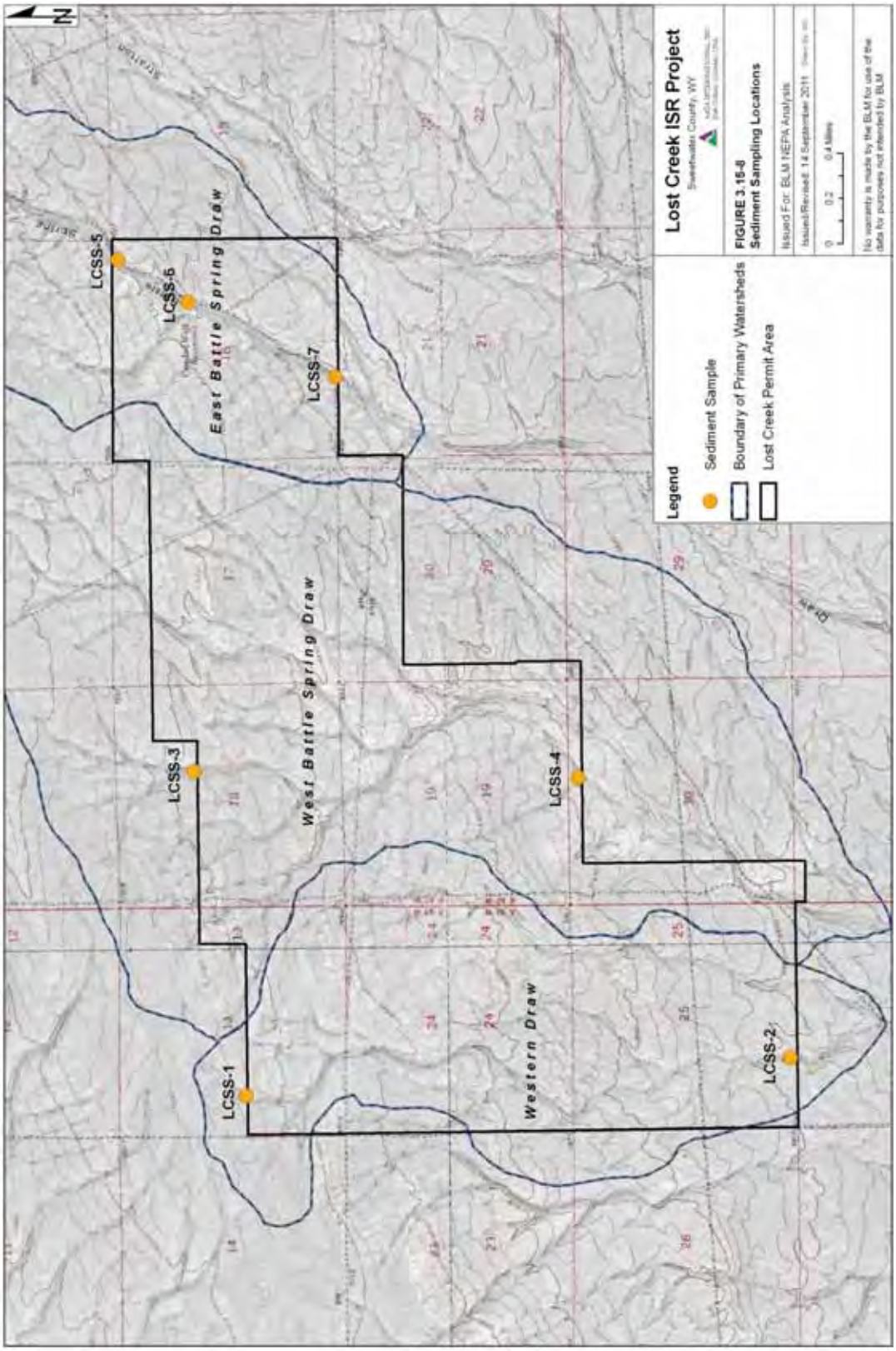

N
LCSS-5
LCSS-6
LCSS-7
LCSS-3
LCSS-4
LCSS-1
LCSS-2
East Battle Spring Draw
West Battle Spring Draw
Western Draw
Lost Creek ISR Project
Sweetwater County, WY
FIGURE 3.15-8
Sediment Sampling Locations
Issued For: BLM NEPA Analysis
Issued/Revised: 14 September 2011
Legend
Sediment Sample
Boundary of Primary Watersheds
Lost Creek Permit Area
No warranty is made by the BLM for use of the data for purposes not intended by BLM

Table 3.15-5 Tissue Sampling Results

Type of Tissue and Year Sampled	Ra-226		U-nat	Th-230		Pb-210		Po-210	
	Sample (pCi/g)	Precision (±pCi/g)	Sample (mg/kg)	Sample (pCi/g)	Precision (±pCi/g)	Sample (pCi/g)	Precision (±pCi/g)	Sample (pCi/g)	Precision (±pCi/g)
Meat									
2008	0.01	0.002	ND 0.5 [1]	ND 0.1	0.004	ND 0.003	0.04	ND 0.1	0.009
2009	ND	0.0005	ND	ND	0.001	ND	0.03	0.02	0.009
Bone									
2008	0.3	0.01	ND 0.5	ND 0.1	0.2	0.2	0.06	0.6	0.2
2009	0.04	0.003	0.0042	ND	0.01	0.5	0.06	0.4	0.08
Kidney									
2008	0.02	0.004	ND 0.5	ND 0.1	0.01	0.2	0.06	1.0	0.2
2009	0.009	0.003	ND 0.5	ND	0.003	0.2	0.05	1.0	0.2
Liver									
2009	ND	0.0002	0.0097	ND	0.006	0.1	0.04	0.8	0.2

[1] Not Detected at indicated limit