Final

UPDATED LAND MANAGEMENT PLAN FOR CALIFORNIA DEPARTMENT OF FISH AND GAME'S HEENAN LAKE WILDLIFE AREA

ALPINE COUNTY, CALIFORNIA

September 2007

California Department of Fish and Game
Region II Headquarters
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
Attention: Terri Weist
530/644-5980

Final

UPDATED LAND MANAGEMENT PLAN FOR CALIFORNIA DEPARTMENT OF FISH AND GAME'S HEENAN LAKE WILDLIFE AREA

ALPINE COUNTY, CALIFORNIA

September 2007

Prepared for:

California Department of Fish and Game
Region II Headquarters
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
Attention: Terri Weist
530/644-5980

Prepared by:

GALLAWAY
CONSULTING, INC.
115 Meyers Street, Suite 120, Chico, CA 95928
Phone(530)343-8327 Fax(530)342-1882

TABLE OF CONTENTS

I. INTRODUCTION 1

PURPOSE OF ACQUISITION 1
ACQUISITION HISTORY 1
PURPOSE OF THIS MANAGEMENT PLAN 1

II. PROPERTY DESCRIPTION 2

DESCRIPTION 2
FISH AND WILDLIFE 5
LAND USE HISTORY 5
CULTURAL FEATURES 6
RELATIONSHIP TO ADJACENT LANDS 10
ACCESS 10
SOILS 10
CLIMATE 11
GEOLOGY 11
HYDROLOGY 14

III. HABITAT AND SPECIES DESCRIPTIONS 14

VEGETATION COMMUNITIES, HABITATS AND PLANT SPECIES 14
JUNIPER WOODLAND 20
JEFFERY PINE 21
BITTER BRUSH 21
WET MEADOW 22
LACUSTRINE 23
ANNUAL GRASSLAND 24
MONTANE CHAPARRAL 25
MONTANE RIPARIAN 25
SAGEBRUSH 26
URBAN 26
ASPEN 27
ANIMAL SPECIES 28
MAMMALS 28
BIRDS 30
FISH 32
REPTILES 35
AMPHIBIANS 36
PHOTO 9. PACIFIC TREE FROG IN HAND AT HLWA. 37
THREATENED, RARE OR ENDANGERED SPECIES AND SPECIES OF CONCERN 38
BIRDS 38
FISH 40
PLANTS 40

IV. MANAGEMENT GOALS AND ENVIRONMENTAL IMPACTS 41

DEFINITION OF TERMS USED IN THIS SECTION 41
BIOLOGICAL ELEMENTS: GOALS AND IMPACTS 41
PUBLIC USE ELEMENTS: GOALS & ENVIRONMENTAL IMPACTS 51
FACILITY MAINTENANCE ELEMENT: GOALS & ENVIRONMENTAL IMPACT 55
REGULATORY FRAMEWORK FOR BIOLOGICAL ELEMENTS 57

REFERENCES 61

LIST OF FIGURES

Figure 1 3
Figure 2 4
Figure 3 12
Figure 4 15
Figure 5 17

ATTACHMENTS

Attachment A	Initial Study/Negative Declaration
Attachment B	Public Comments and Department Responses
Attachment C	Class I Archaeological Survey
Attachment D	Soil Series Descriptions
Attachment E	Complete List of Species
Attachment F	Hatchery Operation and Water Rights Acquisition Documents
Attachment G	Center for Disease Control West Nile Virus Guidelines
Attachment H	Electronic Copy of Report

I. INTRODUCTION

Purpose of Acquisition

The ownership of Heenan Lake, in combination with fishery management, ensures the continued survival of Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), a federal threatened species. The Department of Fish and Game (CDFG) operates and maintains an egg taking station near the lake on Heenan Creek, which provides Lahontan cutthroat trout stock to areas in California and Nevada.

The acquisition also affords protection to important summer deer range and migration corridors for the Carson River deer herd. In addition, the area just south of Heenan Lake has been identified as a holding area for the West Walker Deer Herd.

Acquisition History

The CDFG purchased in fee the Heenan Lake Wildlife Area (HLWA) on November 30, 1982 from the Trust for Public Land. Purchase price totaled $902,500; of which $526,850 was allocated from the 1982/83 Energy and Resources Fund, and $375,650 from the Wildlife Restoration Fund. However, the original purchase of the HLWA did not include the water rights to Heenan Lake.

Recent (1996-2003) CDFG Departmental management accomplishments include, with the assistance of the Wildlife Conservation Board and Proposition 70 funding, the acquisition of 78.8% of the water rights associated with Heenan Lake. This represents 2,324 acre-feet of water storage in Heenan Lake and is deemed sufficient water to protect the Lahontan cutthroat trout broodstock population from potentially stressful summer and wintering lake conditions. The CDFG attempted to buy the remaining 22% of the lake's water right from the Parks Land and Livestock Company in 2005, but the owner was not interested in selling the right. In the future the CDFG would like to acquire the entire water right associated with Heenan Lake to ensure the future success of this fishery, provide downstream riparian restoration and additional flexibility in water management.

It was mandated in the Heenan Lake Operations, Maintenance, and Cost-Sharing Agreement dated May 25, 1999, by and among Danberg Holdings Nevada, LLC, Park Cattle Co., the Bently Family Limited Partnership, and the State of California, CDFG, that a minimum pool of 500 acre feet be maintained within the lake at all times.

Purpose of This Management Plan

The Heenan Lake Wildlife Area Land Management Plan (the Plan) will provide the framework necessary for implementing management goals (Section IV of this Plan). These goals were summarized following the recognition of the Heenan Lake Wildlife Area (HLWA) as an important operational base for the rearing of Lahontan cutthroat trout and acquisition of the property by the CDFG. In addition, the Plan addresses the CDFG staff's intent to protect the Carson River deer herd migration corridor and bald eagle (*Haliaeetus leucocephalus*) foraging habitat, while implementing overall habitat

enhancement practices. The CDFG is also investigating the feasibility of maintaining aspen stands by suppressing aspen rust and encroachment of conifers. The following management goals were identified during the initial acquisition process and were summarized in the Heenan Lake Wildlife Area Management Plan of 1990. These goals are still the basis for establishing current management practices at Heenan Lake:

1) Maintain Heenan Lake and adjacent riparian habitat in a healthy manner to insure growth of Lahontan cutthroat trout into healthy brood stock.
2) Retain and enhance the wide diversity of existing vegetative communities with emphasis on riparian, meadow habitats, and preventing juniper encroachment in aspen stands.
3) Monitor representative species to indicate health of habitat types on the wildlife area, and enhance habitats for sage grouse, and maintain populations of bald eagles.
4) To provide public use recreational activities that do not conflict with the primary objectives of the acquisition.
5) To monitor the area for building, dam, and fence maintenance; management activities and their effectiveness.
6) Maintain the public fishing and hunting programs.

II. PROPERTY DESCRIPTION

Description

The HLWA consists of Heenan Lake, Heenan Creek, and surrounding lands totaling 1,652 acres (**Figure 1**) (**Photo 1**). Heenan Lake covers 130 surface acres and has a capacity of 3,000 acre feet. The spillway elevation is 7,076 feet while the elevation of the wildlife area rises to slightly over 8,000 feet. Historically, the property was used primarily for grazing. Historic cattle use has been moderate to heavy. Minor erosion (head-cutting) is evident in the meadow at the head of Heenan Creek and in the meadow on the southern end of the HLWA.

The HLWA is located about seven miles southeast of Markleeville, California in eastern Alpine County. It is in a mountainous setting on the west side of Monitor Pass and may be reached via State Highway 89 (**Figure 1** and **Figure 2**). The property includes all, or portions of, Sections 1, 2, 3, 10 and 11 in Township 9 north, Range 21 east of the Heenan Lake U.S. Geological Survey quadrangle.

The ridges are covered with shrubs such as sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), gooseberry (*Ribes* sp.), western blueberry (*Vaccinium occidentale*), western juniper (*Juniperus occidentalis*), and mountain mahogany (*Cercocarpus ledifolius*). East slopes contain the conifers, Jeffery pine (*Pinus jeffreyi*) and white fir (*Abies concolor*). Aspens (*Populus tremuloides*) occur on the damp slopes in areas across the HLWA. Willows (*Salix* sp.), aspen, grasses, and forbs are found along the drainages of Heenan Creek. Lower elevations, south of Heenan Lake, are dominated by sagebrush, grasses, and forbs.

Figure 1

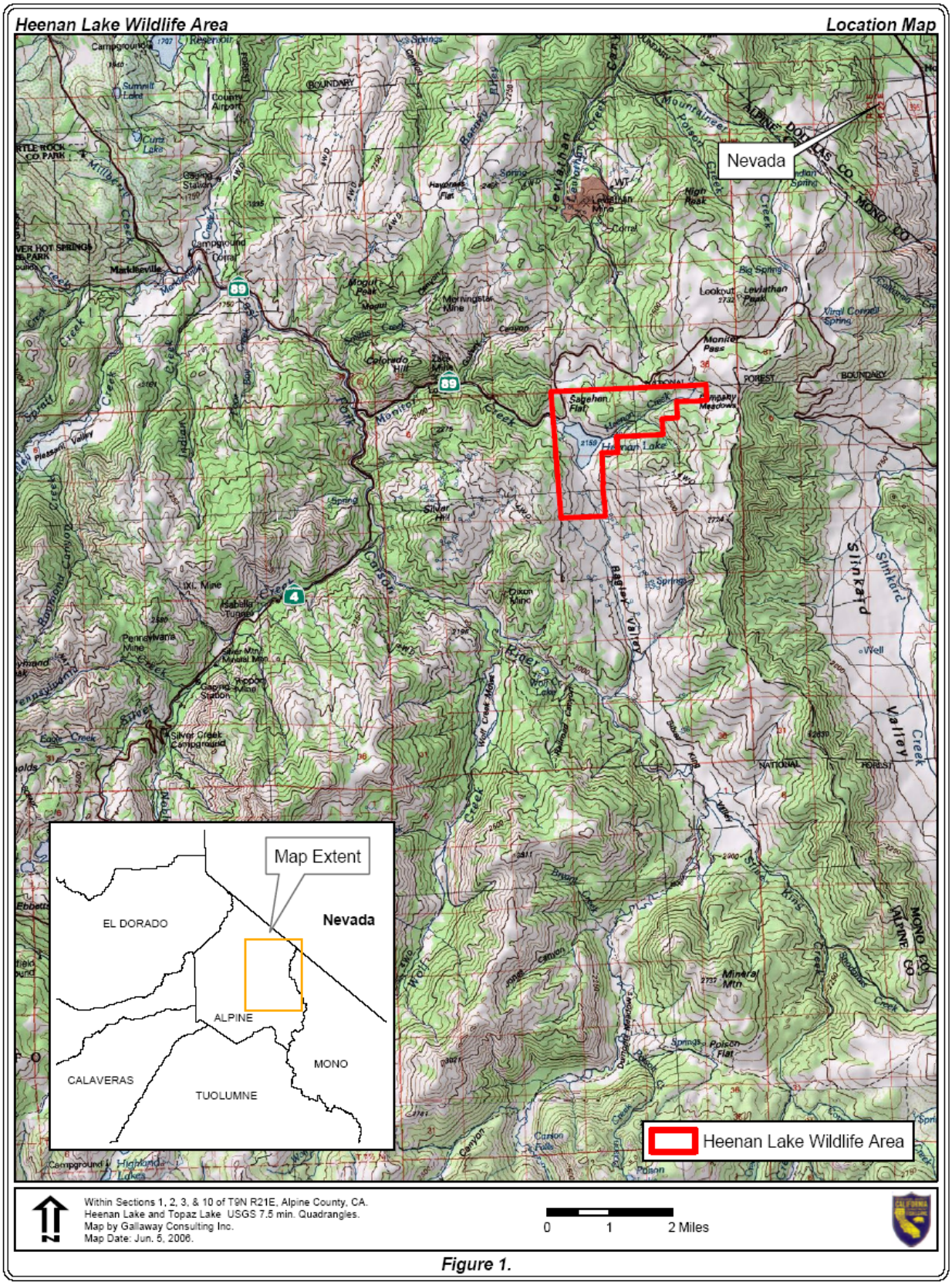


Figure 1.

Figure 2

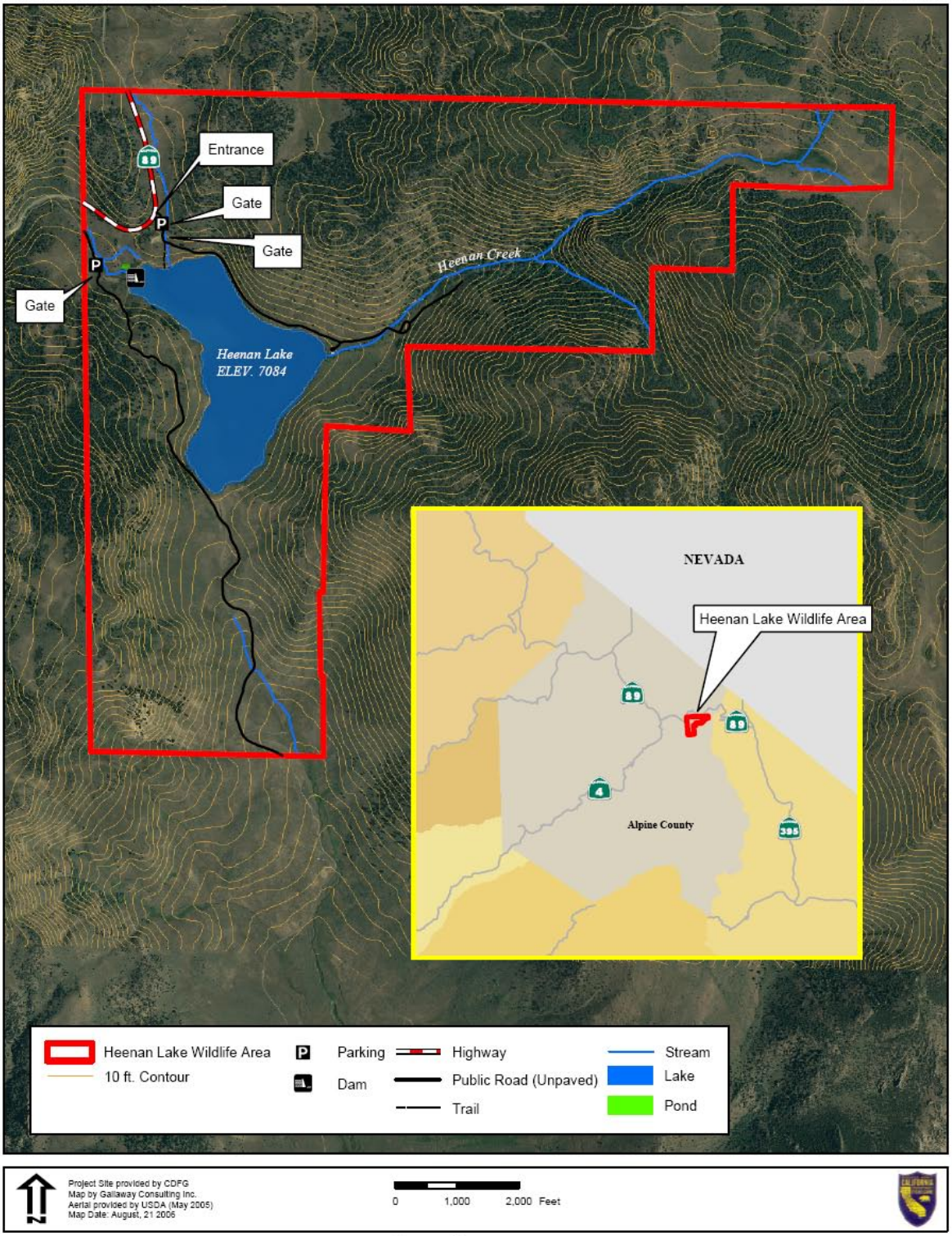


Figure 2.

Photo 1 Heenan Lake and surrounding landscape.

Fish and Wildlife

Heenan Lake contains Lahontan cutthroat trout brood fish used for egg production. Eggs provide fingerling and yearling trout for maintenance stocking in California and Nevada. Heenan Lake supports a popular catch and release fishery for trophy-sized Lahontan cutthroat trout. Wildlife that occur in the meadows and adjacent ridges include mule deer (*Odocoileus hemionus*), belding ground squirrel (*Citellus beldingi*), red-tailed hawk (*Buteo jamaicensis*), ravens (*Corvus corax*), Clarks nutcrackers (*Nucifraga columbiana*), robins (*turdus migratorius*), coyotes (*Canis latrans*), black bear (*Ursus americanus*), and marmots (*Marmota flaviventris*). Blue grouse (*Dendragapus obscurus*) can be heard booming in the spring and golden eagles (*Aquila chrysaetos*) have been observed during the summer and fall. Bald eagles have also been observed during the spring, summer, and fall.

Land Use History

Under private ownership, the area was primarily grazed for livestock. The water in Heenan Lake has been used to irrigate downstream lands in Nevada. An old siphon system allowed for irrigation of pasture and meadows on private lands to the south. The system is not currently operational.

Public access was limited but some recreation use was allowed, with landowner permission for activities such as hunting, camping, and access to fishing areas in Bagley Valley to the south.

Under CDFG ownership, walk-in use is allowed for hiking, hunting during open seasons, and a catch-and-release fishing program, in the Lake, during September and October. All unauthorized motorized vehicle use is prohibited.

When the property was purchased by CDFG, the previous owners retained several provisions in the deed. These provisions applied to livestock management, use of water and timber rights. An easement allowed full use of existing corrals, related structures, and the movement of livestock through the property over existing roads, but did not include grazing rights. The seller disclaimed all responsibility for trespass livestock. Water rights to the lake were retained by the previous owner; however, a minimum pool of water (500-acre feet) must be maintained in the Lake. Since that time, CDFG has acquired more water rights to Heenan Lake to assure wintertime survival of the Lahontan cutthroat trout. A total of 2,324 acre feet, 78.8% of existing water rights, now belong to CDFG. Timber harvest rights were held by American Forest Products Co. (currently Georgia-Pacific), but were purchased by CDFG several years after purchase of the property.

Cultural Features

There are 19 cultural resource locations for which records have been submitted and site numbers assigned. These 19 cultural resources include 7 prehistoric sites, one dual component site, containing both prehistoric and historic cultural materials, 8 historic sites, and 3 Isolates (non-sites) (**Photo 3** and **4**). Sixteen additional sites have been reported by Summit Envirosolutions, Inc. to the Information Center, but no site records have yet been submitted and precise site locations are unknown.

<u>Brief Synopsis, Cultural Context</u>

Prehistory: Native American occupation of the project area and region likely dates from 10,000 or more years ago (Elston et al. 1994), culminating in use of the area by the Washoe. Other north-central Sierran groups, including the Nisenan and Northern Sierra Miwok, may have visited the project area. A series of archaeological phases have been defined that characterize patterns of technological and cultural change that occurred during this long interval.

Initial occupation of the north-central Sierra region is defined by the appearance of the Tahoe Reach Phase and the following Spooner Phase (Early Archaic). However, sites of this age (circa. 7500 BP to 4000 BP) containing relevant archaeological “diagnostics” are rare in the north-central Sierra, perhaps because of limited use of higher elevation regions during this period.

Photo 3. Cultural site at the HLWA.

Photo 4. Cultural site at the HLWA.

The Middle Archaic (circa. 4000 BP to 2500 BP) in the north-central Sierra is often equated with the Martis, and involved utilization of higher elevation zones more intensively than previous occupants. As such, Basalt was intensively utilized, while obsidian use waned. The Late Archaic through Protohistoric and Historic Contact period (circa. 2500 BP to historic contact) is defined archaeologically as Kings Beach and Washoe-Late Kings Beach, and is marked by increasing populations, smaller and lighter projectile points, and possible increased reliance on smaller game and floral resources (Elston 1986:147-149).

Archaeological studies relevant to this long prehistoric sequence are detailed on pp. 15 - 21 of the Summit Envirosolutions report included in **Attachment C** *Class I Archaeological Survey, Heenan lake Wildlife Management Plan Study Area*. Maps or descriptions of the locations of archaeological sites, included in **Attachment C,** are for in-house use only, and are not for public viewing.

Ethnography: The project area is located within territory, which, at the time of initial contact with European-American culture (*circa* AD 1830's), was occupied and claimed by the Washoe (Downs 1966). There was possible limited use by neighboring groups including the Nisenan, the Northern Sierra Miwok, and the Northern Paiute. However, strong Washoe ethnographic ties to the project area, and numerous Washoe place names for the specific area, suggest that use by these neighboring groups may have been quite limited.

Heenan Lake was known to the Washoe as *Who-sa lee-watak* (or "Squirrel Lake"), due to an abundance of small squirrels known to inhabit the marshy area prior to construction of the lake. Surrounding areas and lands throughout Bagley Valley, referred to by the Washoe as *su gil* (for the plant mule's ears) further establishes Washoe ties to this land. Practicing a seasonally transhumant subsistence and settlement pattern, the Washoe moved from one area or elevation zone to another to harvest plants, fish, and hunt game. Their geographical range was extensive, with the largest aggregations of people occurring at winter camps and at good fishing locations, particularly within the lower valleys along the east margin of the Sierra Nevada. Some high elevation settlements were occupied year round, such as at Donner Lake. These appear to be linked with high-quality fisheries, especially the Truckee River.

A detailed summary of Washoe social organization, settlement and subsistence patterns, technology and material culture, and inter-group relations relevant to the Heenan Lake and Bagley Valley areas is presented on pp. 21 - 26 of the attached Summit Envirosolutions report (**Attachment C**).

Resource Considerations, Native American Sites: Based on the test excavation report by Summit Envirosolutions and previous studies and site records, a wide range of Native American site and feature types are present within the project area and surrounding vicinities. The site and feature types already documented, or considered likely to be present, within the study area include:

- Relatively large village sites located along the margins of streams or at other natural surface water sources, particularly at confluences of streams.
- Surface scatters of lithic artifacts and debitage without evidence of buried cultural deposits, resulting from short-term occupation and/or specialized/seasonal economic activities.
- Bedrock milling features.
- Quarries utilized to extract tool stone, undertake initial reduction of the quarried raw material, and manufacture finished lithic tools.
- Possible surface features such as short rock wall segments, rock ("sleeping") circles, and other feature types.
- Isolated finds of aboriginal artifacts and waste flakes.

Historic Context: Recorded history in the project area may have begun with European American exploration parties of the 1820s through 1840s. Jedediah Smith, with a party of trappers, crossed the Sierra Nevada at Ebbetts Pass and traveled along the East Fork of the Carson River in May of 1826 (Farquhar 1965). The Walker-Leonard trapping party of 1833 and the Bartleson-Bidwell emigrant party of 1841 may also have traversed Alpine County. Several communicable diseases were introduced to the region during these early visits, with devastating consequences for the Native inhabitants (see, for example, Work 1945; Cook 1976).

Additional major incursion by European American populations followed, with relevant historic themes including early transportation (which is particularly relevant to the present project area at Heenan Lake), land grant settlements, mining, logging, and ranching.

Resource Considerations, Historic Sites and Features: A detailed summary of the area's major historic themes is presented on pp. 26 - 33 of the attached Summit Envirosolutions report (**Attachment C**). The discussion of early transportation is of particular relevance to the Heenan Lake and Bagley Valley areas. Based on Summit Envirosolutions' discussion of historic context, combined with previous studies and site records, a wide range of historic site and feature types are present within the project area and the general vicinity, including:

- Historic roads and associated features, including SR 89.
- Water distribution systems, including small and large ditch systems, improved and tapped springs, check dams and other features along natural drainages.
- Historic homesteads and ranch features, including possible refuse disposal areas, privy pits, etc. Remnants of "Bagley's Ranch" are also present within the vicinity, with the core features of the original ranch built near the headwaters of Monitor Creek and thus near the project area. Also potentially present are salt licks and other small structures associated with the Dangberg Land and Livestock Company who purchase the land at and around "Grass Lake", now known as Heenan Lake. Dangberg constructed the lake and dam in 1926, and erected the structure in the mid- to late-1940's in order to deliver water south to Bagley Valley. The dam and

Heenan Lake itself, directly associated structures features, and features linked with delivery of Heenan Lake water to Bagley Valley are all historic.
- Blazed trees with Basque inscriptions, names and dates.
- Quarries.
- Historic telegraph line features.
- Mining-related features.
- Historic logging features, including high-cut stumps, landings, skid trails.

Relationship to Adjacent Lands
Adjacent property owners include Toiyabe National Forest (TNF) to the north and west, Bureau of Land Management (BLM) to the east and federal lands to the south.

Grazing allotments exist on the adjacent federal lands. While the former owner did not retain grazing rights, the CDFG is responsible for controlling trespass cattle. The CDFG constructed a two-strand 12-volt electric perimeter fence operated by several solar units. Trespass still occurs, as adequate staffing is not available for proper fence maintenance. The electric fence has not been as effective as originally anticipated. Livestock, bears, and broken tree limbs have, at different times, hit the wire, pulled the insulators from the posts and shorted the electric fence. The northern portion of the property has an old, common-boundary barbed wire fence with TNF lands. The fence, which is the responsibility of CDFG to maintain, is in poor shape and in need of repair. A new let down fence has been proposed as a replacement. The USFWS and CDFG are cooperating on fencing current cattle trespass locations to prevent future trespass problems.

A new egg taking station was constructed at the mouth of Heenan Creek. However, while surveying property lines in preparation of fence building, the building was discovered to be outside the HLWA boundary, on BLM lands. Two fragmented pieces were exchanged with BLM in November 2000, for two equal pieces of property contiguous with the rest of the HLWA. This land exchange provided the area containing the new egg take station.

Access
Two roads lead into the HLWA from Highway 89. The west side road parallels Heenan Lake and continues south onto USFS lands in Bagley Valley and Vaquero Cow Camp, a distance of approximately seven miles. A second road enters the property off Highway 89 near the north shoreline of the lake. This road provides access to the egg taking station and corrals.

Public access is limited to foot or horseback. During the winter season an occasional cross country skier or snowshoer crosses the property to gain access to adjacent Federal Lands.

Soils
The soil series and soil complexes on-site were derived from colluvium, alluvium, and residuum from volcanic parent materials andesite, tuff, and tuff-brecca that occur on

mountains (**Figure 3**). The soils in the area are well-drained except for Wetbag and Vermdig series, and are deep except for the shallow Gerdog, and Loope series. Official soil series descriptions can be found in **Attachment D**.

Climate

The climate of the HLWA consists of Lower Boreal (Dsb), and Upper Boreal (Dsc). These climates, based on the Köppen classification system, are described as having pleasant dry summers with cold snowy winters and cool dry summers, with occasional thunderstorms, and very cold snowy winters respectively. See **Charts 1, 2,** and **3** for monthly temperature, monthly precipitation, and seasonal precipitation data.

Geology

During the Mesozoic Era a chain of volcanoes formed along the present location of the Sierra Nevada Mountain Range (USGS 2004). These volcanoes formed as the Pacific Plate was subducted under the North American Plate (USGS 2004). Molten rock pushed through the older Paleozoic rock. Some of it erupted at the surface, but most stayed below the Earth's surface as large plutons of granite (USGS 2004). The volcanoes were eventually weathered away to low rolling mountains of just a few thousand feet. The granite plutons, once buried, were exposed at the Earth's surface by the late Cretaceous (USGS 2004).

The fault block features to the east of the Sierra Nevada range began to form due to increased tension of the continental crust in that area less than 20 million years ago during the Miocene Epoch (USGS 2004). This tension stretched and broke the Earth's crust, forming the north-south oriented fault block mountains of the Great Basin and Range region (USGS 2004).

The Sierra Nevada began to rise and tilt, which created the sharp contrast in elevation on the eastern side of the Sierra Nevada Range around 5 million years ago (USGS 2004). During this time, the Earth began to cool and Pleistocene glaciers carved the dramatic hanging valleys, sheer walls and waterfalls characteristic of the Sierra Nevada region we know today (USGS 2004).

Figure 3

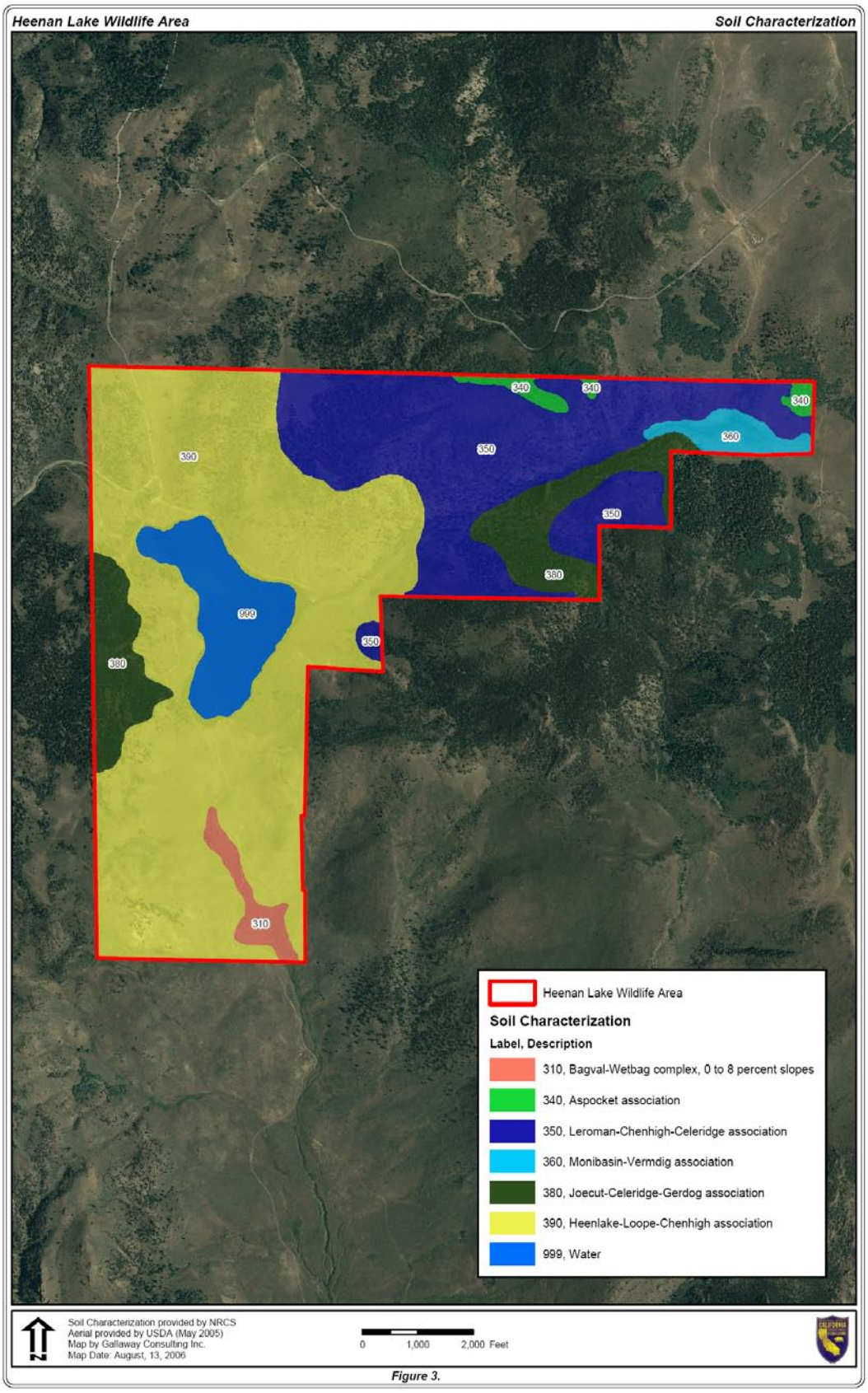


Figure 3.

Chart 1 Monthly Temperature data for the HLWA*

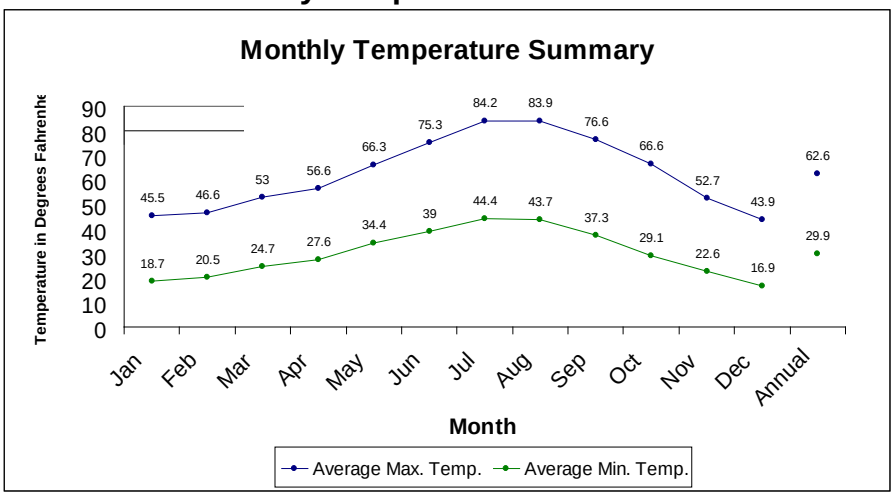


Chart 2 Monthly Precipitation Data for the HLWA*

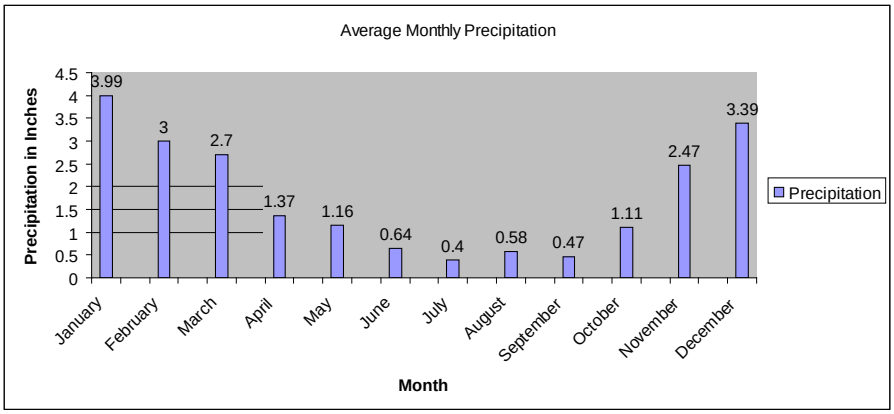
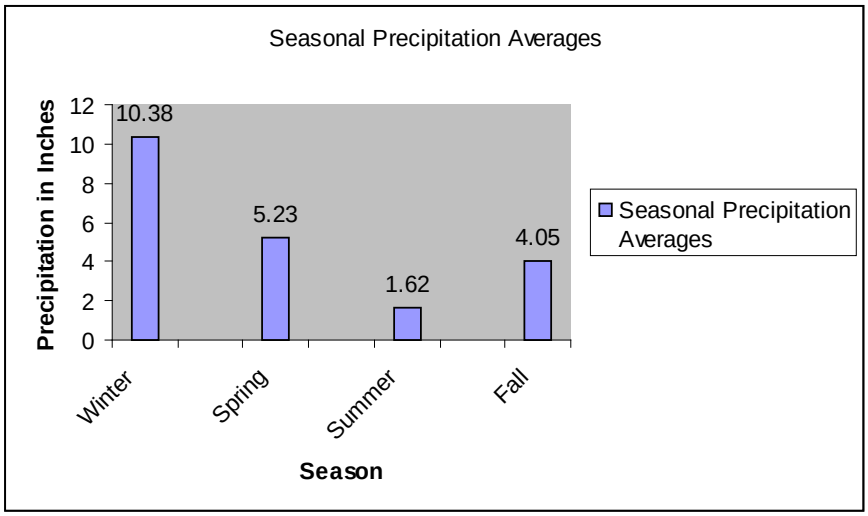


Chart 3 Seasonal Precipitation Averages for the HLWA*



* Data retrieved from the Western Regional Climate Center for Markleeville CA.

The formations found within the HLWA are the Relief Peak Formation, Quartz Latite Porphyry flows, and Leviathan Peak Andesite (John et al. 1981). The Relief Peak Formation is an andesite and basaltic flow formation containing flow breccias, lahars, intrusive rocks, and volcanic sediments (John et al. 1981). The Quartz Latite Porhpyry flows, found to the south of the eastern portion, are ”intrusive onto Relief Peak Formation and overlain by the Leviathan Peak Andesite” (John et al. 1981). Levithan Peak Andesite, a flow formation containing “platy-jointed, flow-banded porphyritic hornblende andesite flows and shallow intrusions,” is found on the northern border of the project area (John et al. 1981).

Hydrology

Heenan Lake dam was constructed in 1924 by the Dangberg Family (Bryson 2000). Heenan Lake collects snowmelt and spring water from uplands to the north and east (Bryson 2000). Heenan Creek makes up the major drainage of the eastern portion of the HLWA property, and an un-named drainage flows into Heenan Lake from the north (**Figure 4**). A derelict diversion ditch conveys runoff to Heenan Lake from an unnamed tributary to Monitor Creek, north of Sagehen Flat. During high water years, Heenan Lake also spills water into Monitor Creek, which flows down-slope along State Route 89. Heenan Lake covers 130 surface acres and has a capacity of 3,000 acre-feet. Heenan Creek water temperature can fluctuate greatly during the course of a day because of the small, shallow nature of the creek (Bryson 2000). Summer temperatures typically range from 35° F in the morning to 60° F in the afternoon (Bryson 2000).

III. HABITAT AND SPECIES DESCRIPTIONS

The unique climate and topography of the area supports a number of plant communities, which, consequently, satisfy the habitat needs of a vast range of plant and animal species.

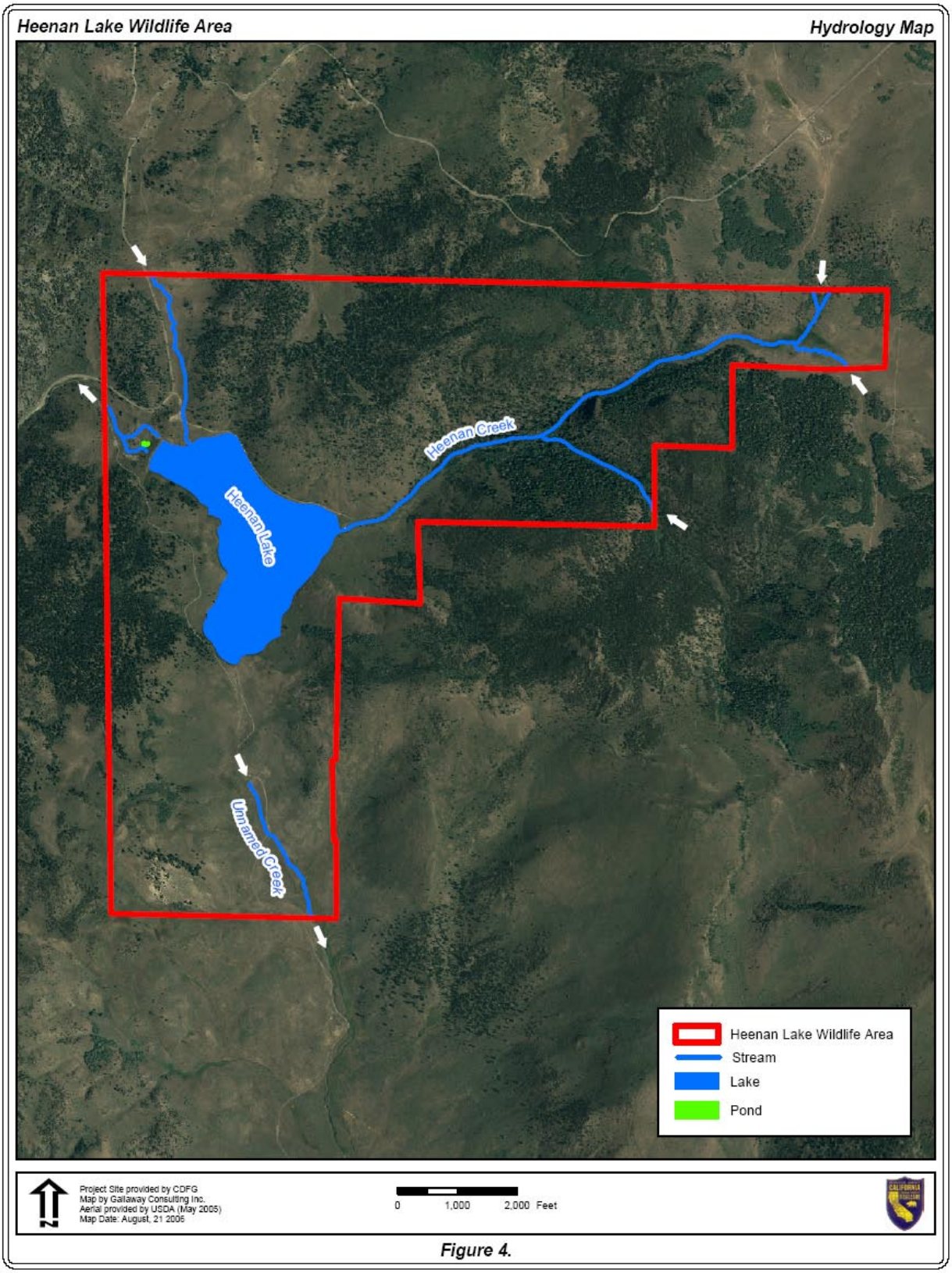
The HLWA provides habitat for several species including the Lahontan cutthroat trout, several species of ducks, raptors including bald eagles and golden eagles, passerines, and mammals including coyotes, mule deer, black bears, and pika (*Ochonta princeps*).

Vegetation Communities, Habitats and Plant Species

Vegetation surveys and habitat typing and mapping were conducted by CDFG staff using the CWHR habitat classification system. Eleven habitat types were mapped within the HLWA. They include: Annual Grassland, Aspen, Bitter Brush, Jeffery Pine, Juniper, Lacustrine, Montane Chaparral, Montane Riparian, Sage Brush, Wet Meadow, and Urban.

Heenan Lake provides the open-water lacustrine habitat that occurs on-site. The Lake is 130 surface acres, made up of open-water and littoral habitat. The 51 acres of montane riparian habitat within the HLWA occur as a long strip along Heenan creek, which flows from the northeast into Heenan Lake (**Figure 4**). Wet Meadow habitat can be found along the spillway of Heenan Lake, as well as a small patch to the northeast,

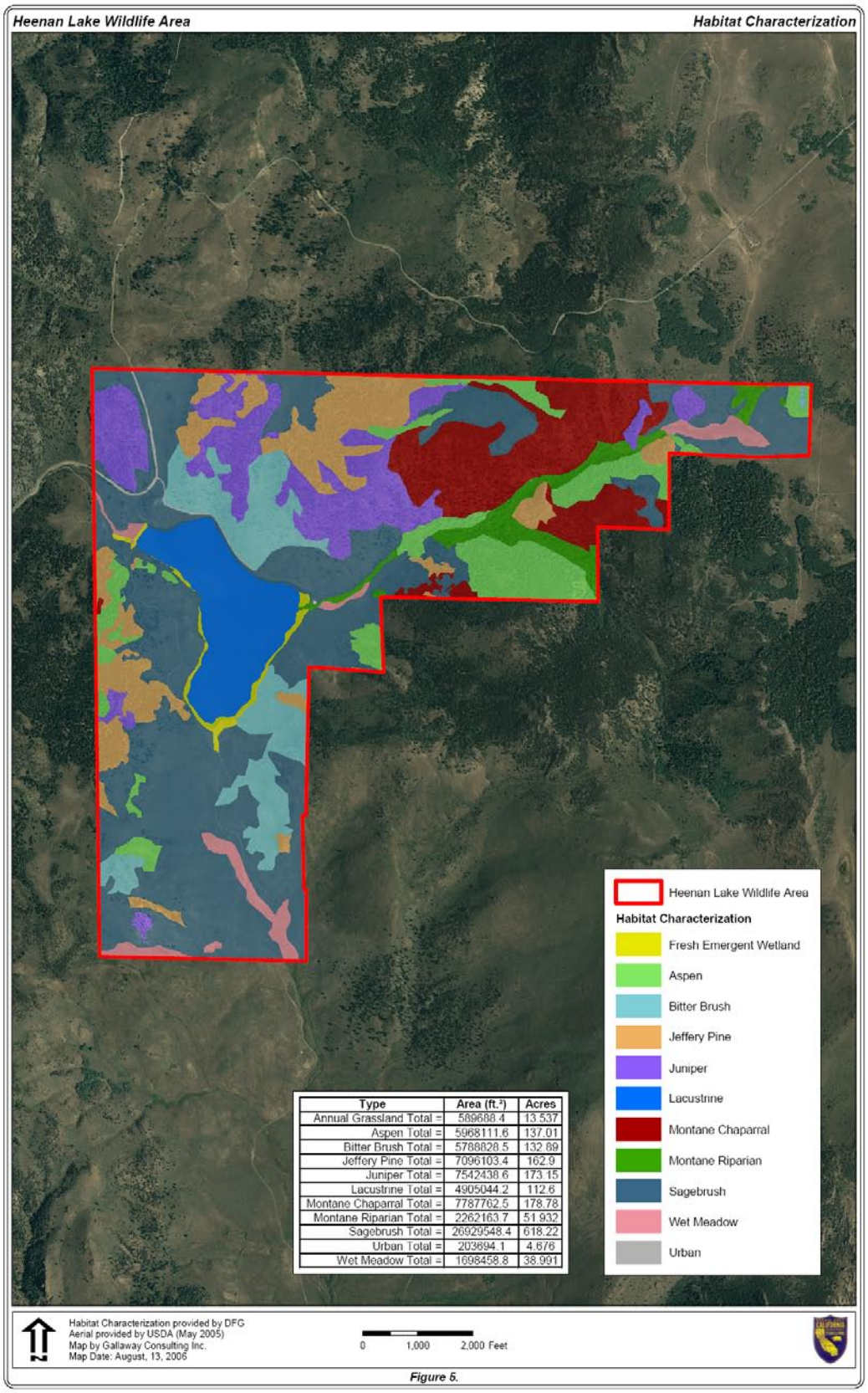
Figure 4


Heenan Lake Wildlife Area
Hydrology Map
Heenan Creek
Heenan Lake
Unnamed Creek
Heenan Lake Wildlife Area
Stream
Lake
Pond
Project Site provided by CDFG
Map by Gallaway Consulting Inc.
Aerial provided by USDA (May 2005)
Map Date: August, 21 2006
0
1,000
2,000 Feet
Figure 4.

and 3 small patches to the southwest within the HLWA boundaries, totaling 38 acres (**Figure 5**). Annual grassland occurs as a thin strip around the east, south and west side of Heenan Lake, and a small patch occurs adjacent to the Heenan Lake spillway (**Figure 5**). Annual grassland totals 13 acres. Sagebrush is the largest habitat found on-site totaling 618 acres (**Figure 5**) and is found throughout the HLWA. Bitterbrush habitat totals 132 acres, and is found north of Heenan Lake as well as in two patches in the south of the HLWA (**Figure 5**). Jeffery pine habitat, totaling 162 acres, is found intermixed with juniper habitats totaling 173 acres, and aspen habitats totaling 137 acres. Jeffery pine and juniper habitats are encroaching upon aspen stands, especially on the western boundary (**Figure 5**) of the HLWA. Montane chaparral habitat is found in the northeastern portion of the HLWA and totals 178 acres (**Figure 5**). Urban habitat, totaling 4 acres, consists of two buildings that house the egg taking station and the parking area (**Figure 5**).

Plant communities correspond with the Guide to Wildlife Habitats of California (CWHR) (Mayer and Laudenslayer 1988). Habitat types are cross walked into corresponding classifications from An Annotated List of California Habitat Types (Cheatham 1975), the CDFG California Natural Diversity Database (CNDDB) (CDFG 1986), and A Manual of California Vegetation (Sawyer, Keeler-Wolf 1995) in **Table 1.**

Figure 5



Type	Area (ft.²)	Acres
Annual Grassland Total =	589688.4	13.537
Aspen Total =	5968111.6	137.01
Bitter Brush Total =	5788828.5	132.89
Jeffery Pine Total =	7096103.4	162.9
Juniper Total =	7542438.6	173.15
Lacustrine Total =	4905044.2	112.6
Montane Chaparral Total =	7787762.5	178.78
Montane Riparian Total =	2262163.7	51.932
Sagebrush Total =	26929548.4	618.22
Urban Total =	203694.1	4.676
Wet Meadow Total =	1698458.8	38.991

Figure 5.

Table 1: Habitat Crosswalk for the Heenan Lake Wildlife Area

CWHR Habitat Type	CNDDB 1986	Sawyer, Keeler-Wolf, 1995	Cheatham and Haller (1975)	Total Acres
Juniper Woodland	Juniper-Oak Cismontane Woodland (72310)	California Juniper Woodland and Shrubland	Northern Juniper Woodland (7.211)	173.15
	Northern Juniper Woodland (72110)	Mountain Juniper Woodland		
	Great Basin Juniper Woodland and Scrub (72123)	Utah Juniper Woodland		
	Cismontane Juniper Woodland and Scrub (72400)	Western Juniper Woodland		
Jeffery Pine	Northern Ultramafic Jeffery Pine Forest (84171)	Jeffery Pine Forest and Woodland	Jeffery Pine (8.51)	162.9
	Southern Ultramafic Jeffery Pine Forest (84172)	Jeffery Pine- Ponderosa Pine Forest and Woodland	Upper Montane Mixed Conifer Forest (8.52)	
	Jeffery Pine Forest (85100)			
	Jeffery Pine-Fir Forest (85210)			
Bitter Brush	Great Basin Mixed Scrub (35100)	Antelope Bitterbrush Shrubland	Sagebrush Scrub (3.31)	132.89
	Big Sagebrush Scrub (35210)	Blackstem Rabbitbrush		
	Rabbitbrush Scrub (35400)	Bluebunch Wheatgrass Bunchgrass Grassland		
	Shadscale Scrub (36140)	Cliff Rose Scrub		
		Parry Rabbitbrush Dwarf Scrub		
		Rubber Rabbitbrush Scrub		
		Curlleaf Mountain Mahogany Woodland and Scrub		

CWHR Habitat Type	CNDDB 1986	Sawyer, Keeler-Wolf, 1995	Cheatham and Haller (1975)	Total Acres
Wet Meadow	Meadow and Seep (45000)	Alpine Habitat	Montane Meadow (4.51)	38.99
		Montane Meadow	High Elevation Meadows (4.52)	
		Beaked Sedge	Alkali Meadows (4.55)	
		Nebraska Sedge	Alkali Seep (4.55)	
		Rocky Mountain Sedge	Freshwater Seep (4.56)	
		Sedge Series		
		Shorthair Sedge Series		
		Spikerush Series		
Lacustrine	-----	-----	Lakes and Ponds (10.4)	112.60
Annual Grassland	Bald Hills Prairie (41200)	California Annual Grassland	Costal Prairie (4.1)	13.54
	Valley and Foothills Grassland (42000)	California Annual Herbland	Valley and Foothill Grassland (4.2)	
Montane Chaparral	Montane Chaparral (37500)	Birchleaf Mountain-Mahogany	Montane Chaparral (3.75)	178.78
	Montane Dwarf Scrub (38000)			
Montane Riparian	Montane Riparian Forest (61500)	Mixed Willow Series	Mixed Riparian Woodlands (6.21)	51.93
	Montane Riparian Scrub (63500)	Lemmon's Willow Riparian Scrub	Red Alder Groves (6.22)	
			Willow Thickets (6.24)	
Sagebrush	Blackbrush Scrub (34300)	Big Sagebrush Shrubland	Great Basin Sagebrush (3.311)	618.22
	Great Basin Mixed Scrub (35100)	Curlleaf Mountain Mahogany and Scrub	Wyethia Meadow – Scrub (3.34 – 4.53)	
	Big Sagebrush Scrub (35210)	Parry Rabbitbrush Dwarf Scrub		

CWHR Habitat Type	CNDDB 1986	Sawyer, Keeler-Wolf, 1995	Cheatham and Haller (1975)	Total Acres
	Sagebrush Steppe (35300)	Rubber Rabbitbrush Scrub		
	Rabbitbrush Scrub (35400)	Ashy Ryegrass		
	Great Basin Juniper Woodland and Scrub (72123)	Blackstem Rabbitbrush		
		Blue Sage Dwarf Scrubland		
		Bluebunch Wheatgrass Bunchgrass Grassland		
		Green Ephedra – Basin Sagebrush		
		Mountain Big Sagebrush Scrub		
		Silver Sagebrush		
Urban	-----	-----	-----	4.68
Aspen	Aspen Riparian Forest (61520)	Quaking Aspen Forest	Aspen Groves (6.23)	137.01
	Aspen Forest (81B00)			

JUNIPER WOODLAND

Juniper Woodland is also known as:

- Cismontane Juniper Woodland and Scrub, etc. (CNDDB 1986)
- California Juniper Series, etc, (Sawyer and Keeler-Wolf 1995)
- Northern Juniper Woodland (Cheatham and Haller 1975)

Juniper woodlands are common on level, to gently rolling, topography though they may occur on virtually all exposures and slopes (Dealy et al. 1978). They will utilize soils ranging from rocky and well drained to drier or poorly drained (Cheatham and Haller 1975). Dispersion of western juniper ranges from small clumps to widely scattered individuals (Dealy et al. 1978). Associates may include common yarrow (*Achillea millefolium*), serviceberry (*Amelanchier alnifolia*), rubber rabbitbrush (*Ericameria nauseosa*), largeflower hawksbeard (*Crepis occidentalis*), wild rye (*Elymus glaucus*), big squirrel-tail grass (*Elymus elymoides*), pestle parsnip (*Lomatium nudicaule*), gay penstemon (*Penstemon laetus*), showy phlox (*phlox speciosa*), desert gooseberry (*Ribes velutinum*), and nose skullcap (*Scutellaria antirrhinoides*) (**Photo 5**). Juniper berries are an important food source for wintering birds (Mayer and Laudenslayer 1988).

Photo 5. Showy Phlox at the HLWA.

JEFFERY PINE

Jeffery Pine Woodlands are also known as:

- Jeffery Pine Forest, etc. (CNDDB 1986)
- Jeffery Pine Forest and Woodland, etc. (Sawyer, Keeler-Wolf, 1995)
- Jeffery Pine, etc. (Cheatham and Haller 1975)

Jeffery pine woodlands are tolerant of areas influenced by frost, and commonly occur on soils whose parent materials are granite and lava flow (Mayer and Laudenslayer 1988). Jeffery pine woodlands can be comprised of a number of other plant species including black oak (*Quercus kelloggii*), canyon live oak *Quercus chrysolepis*), foxtail pine (*Pinus balforiana*), incense-cedar (*Calocedrus decurrens*), interior live oak (*Quercus wislizeni*), knobcone pine (*Pinus attenuata*), lodgepole pine (*Pinus contorta* var. *murrayana*), ponderosa pine (*Pinus ponderosa*), Port Orford-cedar (*Chamaecyparis lawsoniana*), red fir (*Abies magnifica* var. *magnifica*), Shasta fir (*Abies magnifica* var. *shastensis*), western juniper, and western white pine (*Pinus monticola*) (Sawyer and Keeler-Wolf 1995). The seeds and bark of Jeffery pine trees are important food sources to many wildlife species, including squirrels (family Sciuridae), mule deer, nuthatches (family Sittidae), brown creepers (family Certhiidae), and woodpeckers (family Picidae) (Mayer and Laudenslayer 1988).

BITTER BRUSH

Bitter Brush (*Purshia tridentata*) is also known as:

- Great Basin Mixed Scrub, etc. (CNDDB 1986)
- Sagebrush Scrub (Cheatham and Haller 1975)
- Antelope Bitterbrush Shrubland, etc. (Sawyer, Keeler-Wolf 1995)

Bitter brush tends to occupy well-drained, rapidly permeable soils; and live where climates are warm in summer and very cold in winter. Bitter brush provide moisture, calcium, phosphorus, and fat to the mule deer, and pronghorn antelope (*Antilocapra americana*) that feed on it (Hickman 1975). Bitter brush is also very browse tolerant, and provides an excellent source of protein during the winter months. It is often found with rabbitbrush (*Chrysothamnus nauseosus*), big sagebrush, mahogany, and gray horsebrush (*Tetradymia* sp.) (Mayer and Laudenslayer 1988).

WET MEADOW

Wet Meadow is also known as:

- Meadow and Seep (CNDDB 1986)
- Montane Meadow, etc. (Cheatham and Haller 1975)
- Sedge Series, etc. (Sawyer and Keeler-Wolf 1995)

Wet meadows occur where water is at, or near, the surface for most of the growing season (Mayer and Laudenslayer 1988) (**Photo 6**). Seasonality and reliability of annual hydrologic regimes largely determine the consistency of vegetation within wet meadows, which will persist indefinitely unless the regimes are altered (Mayer and Laudenslayer 1988). Plants commonly found in wet meadow habitats are generally from the genera *Carex*, *Danthonia*, *Juncus*, *Salix*, and *Scirpus*. Dehydrated, late summer wet meadows may provide foraging habitat and cover for small mammals. Blacktail deer (*Odocoileus hemionus* ssp. *columbianus*), mule deer, and elk (*Cervus canadensis*) may feed in wet meadows (Mayer and Laudenslayer 1988). Wet meadows also provide fawning grounds for these species. Waterfowl, yellow-headed blackbird (*Xanthocephalus xanthocephalus*) and red-winged blackbird (*Agelaius phoeniceus*) may visit and/or occasionally nest within wet meadow vegetation (Mayer and Laudenslayer 1988). Various frogs and reptiles also frequent this habitat type.

Photo 6. Wet Meadow Habitat at the HLWA.

LACUSTRINE

Lacustrine habitat is also known as:

- Ponds and Lakes (Cheatham and Haller 1975)

Ponds and lakes, usually permanently flooded, can vary greatly in size and depth. Ponds and lakes can contain emergent vegetation (**Photo 7**), submerged vegetation, and free-floating vegetation, such as duckweed (*Lemna* sp.) and phytoplankton. Lakes and ponds consist of open water and the "littoral" areas. In open water habitats photosynthesis of the phytoplankton is the basis of the food chain; zooplankton eat the phytoplankton, small fish and invertebrates eat the zooplankton, which are in turn eaten by larger fish and insects (Mayer and Laudenslayer 1988). This food chain, combined with submerged and emergent plants in the littoral areas, provide food for numerous animals (Mayer and Laudenslayer 1988).

Photo 7. Littoral zone around Heenan Lake.

ANNUAL GRASSLAND

Annual Grassland is also known as:

- Valley and Foothill Grassland, etc. (CNDDB 1986)
- Valley and Foothill Grassland, etc. (Cheatham and Haller 1975)
- California Annual Grassland, etc (Sawyer and Keeler-Wolf 1995)

Annual Grassland

The physiognomy of annual grassland can vary annually and/or seasonally depending on grazing regimes and climate. Non-native grasses and forbs tend to dominate annual grasslands in California (Mayer and Laudenslayer 1988). They occur on level plains to gently undulating foothills and often occur beneath oak trees in oak woodlands. Common annual grassland species include: wild oats (*Avena fatua*), soft chess (*Bromus mollis*), red brome (*Bromus rubens*), ripgut brome (*Bromus diandrus*), foxtail fescue (*Festuca megalura*), broadleaf filagree (*Erodium* sp.), redstem filagree (*Erodium* sp.), turkey mullein (*Eremocarpus setigerus*), true clovers (*Trifolium* sp.), bur clover (*Trifolium* sp.), and popcorn flower (*Plagiobothrys nothofulvus*) (Mayer and Laudenslayer 1988). Annual grassland provides foraging habitat for many wildlife species (Mayer and Laudenslayer 1988). Reptiles, such as the western fence lizard (*Scleoporus*

occidentalis), common garter snake (*Thamnophis sirtalis*), and western rattlesnake (*Crotalus viridis*), use annual grassland for breeding (Basey and Sinclear 1980). Mammals commonly associated with this habitat include the black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), badger (*Taxidea taxus*), and coyote (White et al. 1980). The burrowing owl (*Athene cunicularia*), mourning dove (*Zenaida macroura*), and western meadowlark (*Sturnella neglecta*) are commonly seen nesting in annual grassland (Mayer and Laudenslayer 1988). Annual grassland is an important foraging habitat for raptors (Mayer and Laudenslayer 1988).

MONTANE CHAPARRAL

Montane Chaparral is also known as:

- Montane Chaparral, etc. (CNDDB 1986)
- Montane Chaparral (Cheatham and Haller 1975)
- Birchleaf Mountain Mahogany (Sawyer, Keeler-Wolf 1995)

Montane chaparral habitat varies in density, height, and crown cover depending on the influences of fire and soils in the area (Mayer and Laudenslayer 1988). At maturity, the montane chaparral habitat can be impenetrable to large animals (Mayer and Laudenslayer 1988). Species found in montane chaparral habitats are generally evergreen, however, deciduous shrubs can also intermix (Mayer and Laudenslayer 1988).

Infrequent fires are an important component of the continued success of montane chaparral. After fire within montane chaparral habitat the first stage of recovery is the emergence of herbaceous plants and the re-sprouting of shrubs from the root and seeds. The herbaceous species rely on long-lived seeds to survive and sprout after the next burn sequence (Mayer and Laudenslayer 1988). Eventually, the shrub canopy will increase, blocking sun exposure and out-competing the herbaceous species. If montane chaparral has not burned in some-time it can be overrun by conifer development, which will reduce chaparral shrubs with shading (Mayer and Laudenslayer 1988). Montane chaparral is very important to deer which utilize the habitat as foraging area, cover, and areas to fawn (Mayer and Laudenslayer 1988). Herbivorous rodents eat the twigs and leaves, and insects and seed-eating birds forage and nest in montane chaparral (Mayer and Laudenslayer 1988). On-site habitat originally mapped as mixed chaparral, was verified as montane chaparral by Gallaway Consulting, Inc.

MONTANE RIPARIAN

Montane Riparian is also known as:

- Montane Riparian Forest, etc. (CNDDB 1986)

- Mixed Riparian Woodland, etc. (Cheatham and Haller 1975)
- Mixed Willow Series, etc. (Sawyer, Keeler-Wolf 1995)

Generally no more than 50 feet wide, montane riparian habitats are linear in nature as they run along rivers and streams (Mayer and Laudenslayer 1988). Plant species found in montane riparian habitats include thin leafed (sitka) alder (*Alnus viridis* ssp. *sinuate*), aspen, black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), dogwood (*Cornus* sp.), wild azalea (*Rhododendron occidentale*), water birch (*Betula occidentalis*), and white alder (*Alnus rhomifolia*) (Mayer and Laudenslayer 1988). Riparian habitats provide water, migration corridors, food, nesting sites, and thermal cover to many wildlife species (Mayer and Laudenslayer 1988).

SAGEBRUSH

Sagebrush (*Artemisia* sp.) habitat is also known as:

- Blackbrush Scrub, etc. (CNDDB 1986)
- Great Basin Sagebrush, etc. (Cheatham and Haller 1975)
- Big Sagebrush, etc. (Sawyer, Keeler-Wolf 1995)

Sagebrush stands are generally very large, and their density can vary from very open to touching crowns (Mayer and Laudenslayer 1988). Sagebrush roots are deep and spread laterally near the soil surface utilizing almost all the edaphic soil resources in the area to the exclusion of other plants (Mayer and Laudenslayer 1988). Therefore, sagebrush plants tend to be in pure stands or with other species of sagebrush, and of uniform size and spacing (Mayer and Laudenslayer 1988). Other plant species that may occur with sagebrush are rabbitbrush, horsebrush, gooseberry, western chokecherry (*Prunus virginiana* L. var. *demissa*), curlleaf mountain mahogany (*cercocarpus ledifolius*), and bitterbrush. Wildlife found in association with sagebrush stands include mule deer, jackrabbits, ground squirrels (family Sciuridae), least chipmunk (*Neotamias minimus*), kangaroo rats (*Dipodomys* sp.), wood rats (*Neotoma* sp.), pocket mice (family Heteromyidae), deer mice (*Peromyscus maniculatus*), grasshopper mice (*Onychomys leucogaster*), sagebrush vole (*Lemmiscus curtatus*), sage grouse (*Centrocercus urophasianus*, gray flycatcher (*Empidonax wrightii*), black-billed magpie (*Pica hudsonia*), chuckar (*alectoris chukar*), pinyon jay (*Gymnorhynus cyanocephalus),* sage thrasher (*Oreoscoptes montanus*), several sparrows (family Emberizidae), and hawks (family Accipitridae).

URBAN

Urban vegetation tends to be of low diversity but high biomass production due to fertilization and irrigation (Mayer and Laudenslayer 1988). The mix of native and non-native species provides a diversity of food available to wildlife species in the form of berries and seeds (Mayer and Laudenslayer 1988). Tree density is dependent on landscape planning, and the understory shrub layer tends to be minor (Mayer and Laudenslayer 1988). Animal species that tend to do well in urban areas are scrub jay

(*Aphelocoma californica*), mockingbird (*Mimus polyglottos*), house finch (*Carpodacus mexicanus*), raccoon (*Procyon lotor*), opossum (Didelphis virginiana), and striped skunk (*Mephitis mephitis*).

The areas characterized as urban within the HLWA include the egg taking station, road, and parking lot. The Urban habitat is located adjacent to montane riparian and sagebrush habitat and is not typical of urban habitat described above with landscaping, irrigation, and a low diversity of vegetation.

ASPEN

Aspen habitat is also known as:

- Aspen Riparian Forest, etc. (CNDDB 1986)
- Aspen Groves (Cheatham and Haller 1975)
- Quaking Aspen Forest (Sawyer, Keeler-Wolf 1995)

Aspen stands tend to be mixed with other deciduous and conifer trees in open canopies allowing a healthy understory or shrubs and herbaceous plants (Mayer and Laudenslayer 1988).

Aspen stands are considered a stage of the successional reclamation of land by forest after fire disturbance; long-term fire suppression in an area may result the disappearance of aspen stands in that area (Mayer and Laudenslayer 1988). Aspen stands are commonly found near streams and can be the only tree species near sagebrush habitats (Mayer and Laudenslayer 1988). Other trees and shrubs commonly found in aspen stands include willows, alders (*Alnus* sp.), black cottonwood, lodgepole pine, Jeffery pine, ponderosa pine, red fir, white fir, Douglas fir (*Pseudotsuga menziesii*), Engelmann spruce (*Piceae engelmannii*), sagebrush, roses (*Rosa* sp.), snowberry (*Symphoricarpos rotundifolius*), western chokecherry, and western serviceberry (Mayer and Laudenslayer 1988).

Aspen stands tend to have many snags and the trees are easily drilled out by wildlife. Many cavity-nesting birds such as bluebirds (*Sialia* sp.), sapsuckers (*Sphyrapicus* sp.), downy woodpeckers (*Picodes pubescens*), and chickadees (*Poecile* sp.) utilize these features (Mayer and Laudenslayer 1988) (**Photo 8**).

Photo 8. Aspen Habitat at the HLWA.

Animal Species

The diverse habitats of the HLWA result in an abundance of species, including birds, mammals, reptiles and amphibians, (see **Attachment E** for complete species lists). All dry land within the HLWA is considered upland habitat and is actively managed for dependent species. In addition, the Lake supports Lahontan cutthroat trout as well as aquatic invertebrates.

MAMMALS

Twenty-two known mammals, representative of fourteen families, inhabit the HLWA during all, or some portion, of the year.

Deer

The family Cervidae is represented by mule deer, of the Carson River herd. Mammals in the family Cervidae are long-legged, short-tailed ungulates. Mule deer occur in early to intermediate successional stages of most forest, woodland, and brush habitats. Deer prefer a mosaic of various-aged vegetation that provides woody cover, meadow and shrubby openings, and free water (CWHRS 2003). Known natural predators within the HLWA include coyotes and mountain lions (*Puma concolor*).

Squirrels

The family Sciuridae is made up of small to medium sized rodents that usually have long, bushy tails and tufted erect ears (Jameson and Hans 2004). This family fills an important niche in the food chain as prey for larger mammals such as badgers and coyotes. Within the HLWA the family Sciuridae is represented by the California ground squirrel, western gray squirrel (*Sciurus griseus*), northern flying squirrel (*Glaucomys sabrinus*), golden mantled ground squirrel (*Spermophilus lateralis*), and Douglas squirrel (*Tamiasciurus douglasii*). California ground squirrels commonly use openings and disturbed areas, particularly along roadsides, in croplands, and in grazed meadows (CWHRS 2003). Douglas squirrels are yearlong residents of conifer, hardwood-conifer, and riparian habitats. Western gray squirrels are fairly common locally in mature stands of most conifer, hardwood, and mixed hardwood-conifer habitats. Northern flying squirrels use the cavities of mature trees and snags for cover, and are preyed upon by spotted owls, and other mammals such as martens and bobcats (CWHRS 2003).

Hares and Rabbits

The family Leporidae is represented by black-tailed jackrabbits and mountain cottontails. The mountain cottontail is primarily an animal of rocky, sage-covered hills and canyons. It is common in sagebrush, fairly common in sparse, montane riparian habitats, and uncommon in subalpine conifer, pinyon-juniper, juniper, and alpine dwarf-shrub habitats (CWHRS 2003). Predators include mountain lions, coyotes, eagles, northern harriers, barn owls, red-tailed hawks, great horned owls, rattlesnakes, and gopher snakes (CWHRS 2003).

Pika

The family Ochotonidae contains the American pika. American pika were sighted during a visit to the area. The American pika is a common resident of rock and talus slopes of the Cascades and Sierra Nevada. Populations are highly restricted to rock and talus slopes. They eat a wide variety of plants, including grasses, sedges, forbs, and shrubs (CWHRS 2003). Predators include weasels, martens, coyotes, and hawks (CWHRS 2003).

Canines

The primary, carnivorous mammals are coyotes, of the family Canidae. Coyotes frequent open brush, scrub, shrub, and herbaceous habitats, and may be associated opportunistically with croplands (CWHRS 2003). They are also found in younger stands of deciduous and coniferous forests and woodlands with a low to intermediate canopy, and a shrub and grass understory (CWHRS 2003). Golden eagles, great horned owls, and mountain lions may occasionally kill coyotes (CWHRS 2003). An omnivorous opportunist, coyotes eat primarily mice, rats, ground squirrels, gophers, rabbits, and carrion (Ferrel et al. 1953, Bekoff 1977). Some take insects, reptiles, amphibians, fruits, and occasionally birds, their eggs, and deer fawns (CWHRS 2003).

Bears

Members of the family Ursidae, bears are omnivorous, eating mostly grasses, forbs, insects, and carrion (CWHRS 2003). Bears change their eating habits as the seasons

change, eating grasses and forbs in the spring, fruits and insects in the summer and fruits and nuts in the fall (CWHRS 2003). Black bears will fish, dig holes and climb trees for food (CWHRS 2003). They need dense vegetation and trees, logs and stumps creating various cavities and holes for dormancy in their winter dens (CWHRS 2003).

BIRDS

Many avian species utilize the HLWA each year. Some of them are resident and seen regularly, while others are seasonal visitors over-wintering or spending just the fall, spring, and/or summer in the area. The following groups of birds are represented within the HLWA (families shown in parentheses). A list of bird species that have been seen within the HLWA is provided in **Attachment E.**

Vultures, Eagles, Hawks and Falcons (Cathartidae, Accipitridae, Falconidae)
Raptor species found on-site, or expected to occur within the HLWA, include turkey vultures, falcons, hawks, eagles, and kestrels. Turkey vultures feed primarily on carrion and infrequently on rotting fruit, small mammals, and birds (CWHRS 2003). A vulture's foraging territory is very large 24-32 km, and they do not appear to be territorial (CWHRS 2003). Peregrine falcons (Falco peregrinus anatum) nest on cliffs and ledges near water sources. They forage on the wing, swooping down at high speeds onto flying prey, knocking them to the ground (CWHRS 2003). Cooper's hawks (Accipiter cooperii) and red-tailed hawks are also found on-site. Cooper's hawks use dense cover to hide from small bird prey and will suddenly dash from cover and chase them down (CWHRS 2003). They will also take small reptiles and amphibians (CWHRS 2003). Red-tailed hawks forage on grassland areas and sometimes in dense coniferous stands, feeding mostly on small birds and mammals (CWHRS 2003). Bald eagles have been observed within the HLWA on several occasions. A nesting pair has been observed for several years near the road along the western edge of Heenan Lake. Bald eagles feed on fish taken on the wing from large bodies of water. They also feed on carrion, injured water birds, and they have been known to steal prey from osprey (Pandion haliaetus) (CWHRS 2003). American kestrels (Falco sparverius) nest on rock crevices, tree cavities, and snags (CWHRS 2003). They will pounce on insect, small mammal, bird, reptile, or earthworm prey from a low perch or hover (CWHRS 2003).

Owls (Strigidae)
Several owl species can be found in the HLWA, including great-horned (Bubo virginianus), long-eared (Asio otus), northern pygmy (Glaucidium gnoma), flammulated (Otus flammeolus), and northern saw-whet (Aegolius acadicus). All of these species can be found year-round within the HLWA except for the flammulated owl, which is only found during the summer months. Owls mainly forage by perching on a high point in a forest or overlooking a meadow and waiting for prey such as small mammals, birds, and insects.

Grebes (Podicipedidae)
Three species of grebes can be found within the HLWA including the eared grebe (Podiceps nigricollis), Clark's grebe (Aechmophorus clarkii), and the horned grebe (Podiceps auritus). Grebes live most of their lives on water, including feeding, sleeping,

and nesting. Grebes will build nests upwards from underwater and sometimes create floating nests (CWHRS 2003). Grebes eat fish and insects, chasing their prey by diving and pursuing them underwater (CWHRS 2003). Grebes have difficulty walking on land. Some, including Clark's and western grebes, are entirely incapable of walking (Sibley 2001).

Pelicans (Pelecanidae)
The American white pelican (Pelecanus erythrorhynchos) can be found in the Lake Tahoe area, including the HLWA in the late spring and summer. They are monogamous, colony nesters in groups of several to several hundred (CWHRS 2003). White pelicans will roost on the ground or on logs, but never in trees. American white pelicans actively hunt for fish, their primary source of nourishment (CWHRS 2003).

Herons (Ardeidae)
This family is represented by seven species including two species of bittern, two species of egrets, and three species of herons. Great blue heron (Ardea herodias) can be found within the HLWA during summer, but depart the eastern Sierra Nevada region in the winter (CWHRS 2003). Birds in the family Ardeidae are graceful waders who use their long legs, neck, and bill to forage for food in shallow waters.

Ducks (Anatidae)
There are numerous species of waterfowl that occur within the HLWA. Of these, the mallard (Anas platyrhynchos), bufflehead (Bucephala albeola), ringed-neck duck (Aythya collaris), ruddy duck (Oxyura jamaicensis), and hooded mergansers (Lophodytes cucullatus) have been sighted. There are likely many more. Ducks float on water surface eating vegetation, or invertebrates. Bufflehead ducks will also eat fish (CWHRS 2003).

Quail and Grouse (Odontophoridae, Phasianidae)
Mountain quail (Oreortyx pictus) are HLWA residents, occurring in all seasons. These birds are ground-dwellers found in open country, farmlands, brushy areas, woodland edges, brushy foothills, and stream valleys. They forage quietly and secretively on vegetation and insects in a small group called a covey. When flushed they fly with noisy beating wings (Sibley 2001). Part of the Plan is to enhance habitat for sage grouse (see section IV, B Biological Management Goals: Enhance and Restore Sage Grouse Habitat).

Coots, Gallinules, and Rails (Rallidae)
American coots (Fulica Americana) were observed at Heenan Lake during on-site surveys. Rails (Rallus sp.), the sora (Porzana carolina), and American coots represent the family Rallidae. Birds in this family are marsh dwellers that prefer either freshwater or brackish wetlands, including rice fields, grainfields, ponds, and/or near lakes or ponds (National Geographic Society 1987).

Shorebirds (Scolopacidae)

Two shorebirds, killdeer (*Charadrius vociferus*) and spotted sandpiper (*Actitis macularia*), have been sighted within the HLWA. Killdeer can be seen year round where as spotted sandpiper occur in the warmer months. These two shore birds eat invertebrates by walking or wading and chasing prey (CWHR 2003).

Doves (Columbidae)
Mourning doves have been noted within the HLWA. They can be found there year-round, though they are less common in the winter. Doves feed primarily on grasses, forbs, seeds, and occasionally snails in the spring (CWHR 2003).

Goatsuckers (Caprimulgidae)
Goatsuckers are wide-mouthed night-hunters that spend their days roosting on the ground or along low branches (National Geographic Society 1987). Two species of nightjar, the common nighthawk (*Chordeiles minor*) and the common poorwill (Phalenoptilus nuttallii), visit the HLWA uncommonly to rarely during the spring, summer, and fall. Common poorwills feed on flying insects by making short vertical flights from the ground (CWHR 2003). Common nighthawks feed opportunistically, often in urban areas, flying above streetlights capturing insects attracted to the light.

Kingfishers (Alcedinidae)
The belted kingfisher (*Ceryle alcyon*) is conspicuous when present along rivers, brooks, ponds, lakes, and estuaries. Kingfishers perch above bodies of water and dive underwater in pursuit of fish prey.

Woodpeckers (Picidae)
Woodpeckers forage along tree trunks using their sharp bill to carve out insects and nest cavities. Members of the family Picidae seen at the HLWA include northern flicker (*Colaptes auratus*), hairy woodpecker (*Picodes villosus*), white-headed woodpecker (*Picoides albolarvatus*), and red-brested sapsucker (*Sphyrapicus ruber*).

Passerines
Passerines, or songbirds, are the most abundant avian group at the HLWA. Many families have been sighted within the HLWA throughout the year including, but not limited to: Tyrannidae (flycatchers), Corvidae (jays, ravens, and crows), Sylviidae (gnatcatchers and old world warblers), Emberizidae (new world sparrows, towhees, and juncos), Turdidae (thrushes), troglodytidae (wrens), Parulidae (warblers), Hirundinidae (swallows), Fringillidae (finches), and Icteridae (orioles).

FISH

Lahontan Cutthroat Trout
Federally listed Threatened

The Lahontan cutthroat trout is a member of the *Salmonidae* (trout and salmon) family. Dark olive backs and reddish to yellowish sides frequently characterize the Lahontans found in stream. The sides of lake-dwelling Lahontan cutthroat trout are often silvery. A

broad, pinkish stripe may be present. The yellow to red slashes of pigment under each side of the lower jaw of adults predicate the species common name.
Body spots distinguish the Lahontan cutthroat trout subspecies from the Paiute cutthroat (*Oncorhynchus clarki seleniris*). Paiute cutthroat trout rarely have more than five body spots. Lahontans typically have 50 to 100 or more large, roundish-black spots that cover their bodies evenly. The spots extend onto the head and often to the ventral surface (underside). A secondary distinguishing character is body color. The Lahontan cutthroat trout typically have a coppery to purplish-pink body color

Lahontan cutthroat trout bodies are typically elongated, but not greatly flattened. Like other cutthroat trout, they have basibranchial teeth (on the base of the tongue), red slashes under the jaw and smaller scales than rainbow trout. Lahontan cutthroat trout have 21 to 28 gill rakers (small bony projections on the gills), higher than any other trout of the genus Oncorhynchus.

Spawning typically occurs late May through July at Heenan Lake, depending on annual environmental fluctuations in precipitation and temperature. Females mature at 3 to 4 years of age, males at 2 to 3 years of age. Consecutive-year spawning by individuals is uncommon. Natural spawning behavior is similar to other stream-spawning trout. They pair, display courtship, lay eggs in redds (nests) dug by females and chase intruders away from the nest. Lahontan cutthroat trout generally spawn in riffle areas over gravel substrate, which occur in Heenan Creek above the Lake. Lahontan spawning migrations have been observed in water temperatures ranging from 41 to 61°F. Eggs generally hatch in 4 to 6 weeks, depending on water temperature, and fry emerge 13 to 23 days later.

Nearly all fish in Heenan Lake are the result of hatchery spawning at the lake's spawning station located on Heenan Creek just as it flows into the water body. Some natural spawning does occur above the lake in Heenan Creek, although these fish are believed to be remnants of the West Carson River Lahontan cutthroat trout strain, which is slightly introgressed with rainbow trout. Fish reaching the egg take station not adipose fin marked are considered West Carson River strain fish and are not spawned. It is the CDFG's desire to maintain a pure Independence Lake strain of Lahontan cutthroat trout in the lake. These fish provide an important backup of pure Lahontan cutthroat trout for Independence Lake. There is a small population of Lahontan cutthroat trout in Heenan Creek between the egg take station and a barrier falls ¾-miles upstream. These cutthroat trout are of West Carson River origin and are also hybridized with rainbow trout.

Lahontan cutthroat trout living in stream are opportunistic feeders, with diets consisting of drift organisms, typically terrestrial and aquatic insects. In lakes, small Lahontans feed largely on insects and zooplankton. Larger Lahontans typically feed on other fish, though in Heenan Lake no other fish species occur. Food resources associated with the lake are a large amphipod (scud) in the *Gammarus* genus, which occurs in abundance along shorelines in vegetation, insects, and plankton.

Lahontan cutthroat trout are particularly noted for their ability to thrive in highly alkaline waters, most notably in Pyramid and Walker Lakes where alkalinity reaches 3,000-13,000 mg/liter total dissolved solids and pH ranges from 9.5 to 10.5. A reading taken during field surveys in 2006 found water leaving the lake to have a pH of 8.2.

History

Lahontan cutthroat trout were stocked in Heenan Lake from 1938 through 1942 from the Alpine Hatchery located at Markleeville on Pleasant Valley Creek. Later plants to Heenan Lake were from Hot Creek hatchery, presumably from eggs collected from Heenan Lake. Heenan Lake has served as a broodstock source for an annual yield meeting or exceeding 2,000,000 eggs since the early 1940s. The CDFG operates and maintains an egg station at the mouth of Heenan Creek and currently takes closer to 500,000 eggs per year.

Lahontan cutthroat trout planted in Heenan Lake, originally taken from Blue Lakes, Alpine County, were of stock derived from the West Carson River. In 1975 a plant of 5,000 adipose marked yearlings from Independence Lake, Sierra Nevada counties, began a phase-out of the original earlier strain of West Carson River fish, which have been determined to be “slightly introgressed with rainbow trout”. There are still small numbers of non-adipose clipped fish observed during annual hatchery operations, presumably these fish come from Heenan Creek and are derived from West Carson River fish. These fish are also known to be hybridized with rainbow trout. Occasionally, anglers catch fish in the Lake that resemble rainbow trout and are not adipose clipped. It is also thought these fish have recruited to the Lake population from Heenan Creek.

Current (2006), restocking includes the addition of 3,000 fingerlings per year that are adipose fin clipped and are raised from Heenan Lake eggs at the Hot Creek Hatchery. This stocking regimen had been closer to 10,000 fingerlings per year. The numbers were reduced in the mid-90s to 3,000 yearlings to improve survivorship of the plants, to reduce intra-specific competition in the lake, and potentially avoid fish die-offs during elevated summer water temperatures.

Fishing

A special season catch-and-release fishery at Heenan Lake was implemented in 1984 and continues to the present. Title 14, §553 of the California Code of Regulations identifies regulations that are specific to the special fishing season in the HLWA. The CDFG may require acquisition of permits, and payment of related fees, prior to angling in the HLWA. The season is open to angling Friday through Sunday weekly, from the Friday before Labor Day through the last Sunday in October. Angling regulations include a zero bag limit and a gear restriction allowing only barbless artificial lures. Boats that are propelled by oars or electric motors are allowed. The CDFG maintains the right to close any portion of the HLWA to trespass or fishing. The lake is designated as Wild Trout, Catch and Release and Heritage Trout water by the California Fish and Game Commission.

Department Management

Internal coordination has been accomplished by CDFG experts addressing management concerns for the species and to effectively protect the Lahontan cutthroat trout population in Heenan Lake. Currently, there is an actively-managed hatchery operation for stocking programs within the state, which contribute to "back-up broodstock" within several state waters. In recent years, water rights have been purchased to greater ensure suitable yearlong habitat within the lake. Documents pertaining to hatchery operation and water right acquisition can be found in **Attachment F** of this Plan.

REPTILES

The following reptiles highly likely to occur within the HLWA include, but are not limited to, the western rattle snake (*Crotalus viridis)*, striped whipsnake (*Masticophis taeniatus*), rubber boa (*Charina bottae*), western terrestrial garter snake (*Thamnophis elegans*), sage brush lizard (*Sceloporus graciosus*), common kingsnake (*Lampropeltis getulus*), western fence lizard *(Sceloporus occidentalis),* and northern alligator lizard (Elgaria coerulea). Reptiles within the HLWA are not actively managed individually, yet will be monitored on a habitat basis.

Common King Snake

The California mountain king snake is widely distributed, and occurs in nearly all habitats (exclusive of high mountains). The common kingsnake is most abundant in valley-foothill riparian situations and in other habitats occurring in the vicinity of irrigated agriculture (CWHRS 2003). Adults and young are probably taken by predatory birds, such as hawks, owls, and mammals, such as skunks and raccoons (CWHRS 2003).

Western Rattlesnake

The western rattlesnake is quite common, absent only from true desert regions and from large tracts in the Central Valley, where irrigated agriculture has eliminated habitat (CWHRS 2003). They forage in, or near, brushy areas, rock outcrops, mammal burrows, around and under surface objects, and in the open, taking primarily rodents, especially ground squirrels (CWHRS 2003). Western rattlesnakes are preyed upon by mammals, predatory birds, and other snakes.

Striped Whip Snake

Striped whip snakes in California inhabit eastside pine, pine-juniper, sagebrush, bitterbrush, and desert scrub (CWHRS 2003). They seek cover in dense vegetation, rocky crevices, or around surface objects (CWHRS 2003). Whipsnakes are taken by a variety of predators, including mammals, diurnal birds of prey, and other snakes (CWHRS 2003).

Rubber Boa

The rubber boa is a very secretive snake taking cover in rotten logs, under rocks, boards, bark and other debris, usually found close to a water resource (CWHRS 2003).

They eat mainly small mammals and small lizards (CWHRS 2003). Though not subjected to intense predation because of their secretive nature, rubber boas are probably taken by hawks, skunks, and raccoons (CWHRS 2003).

Western Terrestrial Garter Snake

Western terrestrial garter snakes seek cover and will hibernate in burrows made by mammals (CWHRS 2003). They eat small mammals, birds, fish, frogs, salamanders, and invertebrates, including gastropods (CWHRS 2003). When captured by a predator, the western terrestrial garter snake will release a foul scent from its postanal glands (CWHRS 2003). Predators include mammals, birds and other snakes (CWHRS 2003).

Western Fence Lizard

Western fence lizards are extremely common, perhaps the most common reptile in California due to its adaptability in many different habitats (CWHRS 2003). They are found in every habitat except extreme desert and dense forest (CWHRS 2003). Western fence lizards eat insects almost exclusively but they will also eat spiders, scorpions, centipedes, ticks, and isopods (CWHRS 2003). Western fence lizards provide an important food source for some snakes and birds, and shrews will also eat them during times of inactivity (CWHRS 2003).

Northern Alligator Lizard

The northern alligator lizard is wide spread in the northern California Sierra Nevada region and can occur up to 11,000 feet (CWHRS 2003). Populations living at high elevations will hibernate for a large portion of the year, only emerging for brief periods of activity in the late summer to early fall (CWHRS 2003). Their diet consists of invertebrates including millipedes, spiders, and insects. Northern alligator lizards are taken by snakes, birds and cats (CWHRS 2003).

Sage Brush Lizard

When disturbed, sagebrush lizards will take cover in brush and shrubs. They also utilize small mammal burrows (CWHRS 2003). They eat invertebrates almost exclusively, and are eaten by snakes and predatory birds (CWHRS 2003).

AMPHIBIANS

There are two amphibians known to occur within the HLWA – the western toad (*Bufo boreas*) and the Pacific tree frog (*Hyla regilla*). Adult toads eat invertebrates. Tadpoles filter plant material from the water and eat detritus from the bottom (CWHRS 2003). The tadpoles are taken by water snakes and birds. Adults are protected by noxious secretions from their skin (CWHRS 2003).

Western Toad

The western toad is found almost everywhere in California except for the highest mountains. They feed on invertebrates such as terrestrial insects and arthropods and, at times, earthworms, snails, and slugs (CWHRS 2003). Western toads are primarily nocturnal and seek cover under logs, large rocks, and tree bark (CWHRS 2003).

Tadpoles can be found in stagnant bodies of water, and are predated by birds, garter snakes, and aquatic invertebrates. Adults are somewhat protected from predation by noxious skin excretions (CWHRS 2003).

Pacific Tree Frog

The native Pacific tree frog is found in a wide range of habitats from sea level to the tops of mountains, including grasslands, chaparral, woodland, desert oases, agricultural regions, and residential areas (SDNHM 2005) (**Photo 9**). The Pacific tree frog eats a wide variety of arthropods. A number of predators, including garter snakes, rely on the Pacific tree frog as a food source (SDNHM 2005).

Photo 9. *Pacific tree frog in hand at HLWA.*

Threatened, Rare or Endangered Species and Species of Concern

The HLWA is home to state and/or federal listed species, state species of concern, state "fully protected" species, and California Native Plant Society (CNPS) listed plants (**Table 2**). The CDFG manages for these species on a habitat basis through restoration, protection, and enhancement. Currently, Heenan Lake is being managed for Lahonton cutthroat trout populations. Sage brush habitats will be managed to provide territory for nesting and foraging sage grouse and the host of animals associated with sage brush habitats. Aspen stands will be managed for aspen fungus infestation and conifer encroachment. Habitat for the Carson River mule deer populations will be enhanced or allowed to naturally recover, in support of healthy populations of these animals. Mule deer use wet meadow and the edges of aspen habitat for fawning. The wet meadow habitat is naturally recovering from heavy grazing and will continue to recover and support fawning of mule deer. A management plan for the recovery/sustainability of aspen stands within the HLWA is outlined in Section IV below. These guidelines will promote healthy aspen stands that will continue to provide high quality habitat for mule deer, and other habitat-associated species, into the future. The U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) will be consulted prior to any modifications to the habitats of federal listed plant, animal, and fish species. Internal consultations have been conducted to address any management concerns for state-listed species.

Table 2: Definitions of Special-status Listings

Federal Endangered = Federally listed as Endangered; in danger of extinction.
Federal Threatened = Federally listed as Threatened; likely to become endangered in the foreseeable future.
State Endangered = State-listed as Endangered; in danger of extinction
State Threatened = State-listed as Threatened; likely to become endangered in the foreseeable future.
State Fully Protected (Fish and Game Code §3511, §4700, §5050 and §5515) = The State's initial effort to identify and provide additional protection to those animals that were rare or faced possible extinction. The code states that these species "....may not be taken or possessed at any time and no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any "fully protected" species, although take may be authorized for necessary scientific research". Take for recovery activities are also permitted.
California Species of Concern = May be declining or may be in need of concentrated conservation efforts to prevent decline.
CNPS 1B = Rare or Endangered in California and Elsewhere.
CNPS List 2 = Rare, threatened, or endangered in California, but more common elsewhere.

BIRDS

<u>Bald Eagle</u>
State Endangered, State Fully Protected

Bald eagles are occur in the HLWA, and can be seen year-round. A nesting pair has been observed and the nest site has been used five of the past six years. They require large bodies of water, or free flowing rivers with abundant fish, and adjacent snags or other perches from which they swoop down and pluck prey from water (CWHRS 2003). They forage primarily on waterfowl, yet also hunt for fish and small to medium sized

mammals. Wintering bald eagle abundance tends to correlate with waterfowl numbers, particularly coot populations. Bald eagles require large, old-growth trees or snags in remote, mixed stands near water (CWHRS 2003). Bald eagle eggs and young may be preyed upon by raccoons, squirrels, ring-billed gulls, and great horned owls. Adults lack major predators, though they often compete with osprey for food and are harassed by other birds such as crows, ravens, and smaller raptors.

Willow Flycatcher (Empidonax traillii)
State Endangered

A willow flycatcher was sighted within the HLWA boundary. Willow flycatchers most often occur in broad, open river valleys or large mountain meadows with lush growth of shrubby willows (Serena 1982). Willow flycatchers require dense willow riparian areas for nesting. Their main predator is the brown-headed cowbird that often parasitizes willow flycatcher nests.

American White Pelican
California Species of Concern

White pelicans are relatively common in the spring, summer and fall at Heenan Lake. They feed in water of various depths, dipping for prey from the surface and scooping them up in their substantial throat pouches. American white pelicans rest in the day and roost at night along the edge of water bodies, on beaches, sandbars, or on old driftwood (CWHRS 2003). They often nest on small islands or remote dikes in large freshwater and salt water lakes (CWHRS 2003). Mortality results mostly from human disturbance, "colony interactions" and bad weather (Sloan 1982). Their major natural enemies are gulls, which steal eggs, but only in small numbers, and coyotes, which can eliminate colonies if nesting islands become connected to the shore (CWHRS 2003). American white pelicans are susceptible to pollution of watershed by persistent pesticides. The degradation of breeding habitat has eliminated several major colonies in California (CWHRS 2003).

Cooper’s Hawk
California Species of Concern

Cooper’s hawks have been seen within the HLWA. They prefer dense stands of live oak, riparian deciduous or other forest habitats near water nesting in the crook of deciduous trees (CWHRS 2003). Cooper’s hawks prey on small birds, mammals, reptiles and amphibians. Nestlings and immatures not yet skilled at catching prey may be killed by ravens, northern goshawks, and great horned owls.

Osprey
California Species of Concern

Osprey nest on large platform nests in trees, manmade structures, and snags (CWHRS 2003). They forage near bodies of water, taking most of their prey directly from the

water (CWHRS 2003). Prey consists mainly of fish but they will also eat amphibians, small mammals, birds, lizards and snakes. Eagles compete with osprey, often taking their catch (CWHRS 2003).

FISH

Lahontan Cutthroat Trout
Federal Threatened

Lahontan cutthroat trout were planted in Heenan Lake in 1975. Lahontan cutthroat trout like other cutthroat trout, have red slashes under their jaw. They are opportunistic feeders whose diet consists of insects and zooplankton. Lahontan cutthroat trout are known for their ability to thrive in alkaline water and are known to live in waters with a pH of 9.5-10.5. The egg taking station on Heenan Lake provides Lahontan cutthroat trout to several areas around California and Nevada, and is considered an essential operation to assure the continued existence of the species.

PLANTS

The CDFG has concluded, based on existing data from CNPS, USFWS, and CNDDB, that the following plants, which occur within the HLWA, are species regulated under California Environmental Quality Act (CEQA) guidelines because they meet the criteria for listing as rare, threatened, or endangered species in Section 15380, Title 14, CCR. A complete list of plant species can be found in **Attachment E**.

Great Basin claytonia (Claytonia umbellata)
CNPS 2. 3

Great Basin claytonia is in the family Portulacaceae, and is found on dry, north and east facing, talus slopes in sub-coniferous forests. It flowers in May through August, and has white to pink petals. Great Basin claytonia occurs between 5,600 feet and 11,500 feet in elevation, and was seen within the boundaries of the HLWA during on-site surveys in late August of 2006.

Valley Sedge (Carex vallicola)
CNPS 2.3

Valley sedge is a monocot in the family Cyperaceae, which can be found on moist to dry slopes. It occurs between 5,000 feet and 9,000 feet in elevation and blooms between July and August. It is associated with Great Basin scrub and meadows and seep habitats. Valley sedge was seen within the HLWA boundaries during on-site surveys in late August of 2006.

IV. MANAGEMENT GOALS AND ENVIRONMENTAL IMPACTS

Definition of Terms Used in This Section

1. ***Element*:** An element refers to any biological, public use, or facility maintenance program as defined below for which goals and tasks have been prepared and presented within this plan.
2. ***Biological Element*:** These elements consist of species, habitats, or communities for which specific management goals and tasks have been developed within the plan.
3. ***Biological Element Goal*:** A biological goal is the statement or statements of intended long-range results of management based upon the feasibility of maintaining, enhancing or restoring species populations and/or habitat.
4. ***Hydrophyte:*** Any plant that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; plants typically found in wet habitats (Federal Interagency Committee for Wetland Delineation 1989).
5. ***Other Waters of the United States*:** Other waters of the United States (Other Waters) are seasonal or perennial water bodies, including lakes, stream channels, drainages, ponds, and other surface water features, that exhibit an ordinary high-water mark but lack positive indicators for one or more of the three wetland parameters (hydrophytic vegetation, hydric soil, and wetland hydrology) (33 CFR 328.4).
6. ***Recruitment*:** The number of a species added to the population per reproductive unit within a specified time-frame.
7. ***Tasks*:** Tasks are the individual projects or work elements which implement the goal(s) and are useful in planning operation and maintenance budgets.
8. ***Waters of the United States:*** This is the encompassing term for areas under federal jurisdiction pursuant to Section 404 of the CWA. Waters of the United States are divided into “wetlands” and “Other Waters”.

Biological Elements: Goals and Impacts

The overall biological management goals for the HLWA, including the original acquisition goals, are:

- Maintain Lahontan cutthroat trout brood stock within Heenan Lake;
- Enhance and restore sage grouse habitat on-site;
- Manage encroaching conifer populations, including juniper and Jeffery pine;
- Actively manage aspen groves;
- Conduct bird surveys and small mammal trapping surveys;
- Prevent disturbance to bald eagle nests.

All management goals are designed to minimize impacts to individual species through maintenance, enhancement, and protection of habitat. Consultations with the appropriate regulatory agencies, and internal coordination with CDFG, will occur for

listed species prior to the commencement of any activities that may potentially impact these species. No impacts to listed species are expected to occur.

Imposed conditions of permit approvals are not described in this document. They will be included in all permit applications on a per application basis and at the time in which permits are sought for activities subject to federal and state regulations.

Biological Element: Biological Management

Goal: Maintain Lahontan cutthroat trout brood stock population within Heenan Lake.

Management Constraints

1. Hatchery funding availability.
2. Hatchery personnel availability.
3. The potential for hybridization of the West Carson River strain with the Independence Lake strain of Lahontan cutthroat trout.
4. Natural events such as drought or fire could impair operations at the facility.

Tasks

a. Purchase the last water rights not owned by CDFG from willing sellers.
b. Secure funding for continued operations at the HLWA egg taking station.

Discussion:
Lahontan cutthroat trout planted in Heenan Lake were originally taken from Blue Lakes, Alpine County, which were of stock derived from the West Carson River. In 1975 a plant of 5,000 adipose marked yearlings from Independence Lake, Sierra Nevada counties, began a phase-out of the original earlier strain of West Carson River fish, which have been determined to be “slightly introgressed with rainbow trout.” The West Carson River strain cutthroat trout are not managed for in Heenan Lake, although there are still small numbers of non-adipose clipped fish observed during annual hatchery operations. Presumably, these fish come from Heenan Creek and are derived from West Carson River fish. Genetic analysis has confirmed the purity of the Independence strain and that the West Carson River strain are hybridized with rainbow trout.

The Heenan Lake egg taking station annually takes approximately 500,000 eggs, providing Lahontan cutthroat trout to hatcheries in California and Nevada.

Purchase Water rights
As a provision of the original purchase of the HLWA on November 30, 1982, the water rights were retained by the original landowner. Since that time, 78.8% of the water rights have been purchased by the CDFG to maintain proper lake levels in order to promote the continued success of the egg taking station. In 2005, the CDFG attempted to purchase the remaining 21.2%, but the owner was not interested in selling. If these

water rights become available, they will be purchased by the CDFG to assure the future of operations at the egg taking station.

Maintain Funding
The importance of the Heenan Lake egg taking station assures its continued financial support into the future. The operations at Heenan Lake should continue to remain a top priority as new managers take over as stewards of the HLWA.

Potential Environmental Impacts and Mitigation

No negative environmental impacts are expected from these actions.

Biological Element: Biological Management

Goal: Enhance and restore sage grouse habitat.

Management Constraints

1. Management practices may not seem immediately effective due to sage grouse's low fecundity, nesting success, low juvenile survivability rates, and complex year round habitat requirements.
2. Predators on-site such as coyotes, may pose a threat to sage grouse recovery.
3. Natural events such as flood or drought may impact the success of management practices.
4. Management implementation is dependent on long-term funding.

Tasks

a. Survey the HLWA to assess existing suitable sagebrush habitats.
b. Identify if need exists for additional sites that could be improved for sage grouse habitat.
c. Implement management techniques to improve sagebrush habitat for sage grouse.
d. Conservation strategies should be adaptive and responsive to new information regarding sage grouse management.

Discussion:
Population Management
Assessment of populations will occur first with the identification of lek locations if they exist. The breeding population should be assessed with a lek survey each year, followed by a recruitment survey later in the season. The utmost care should be taken to avoid disturbance of birds during the leking season. A routine population survey schedule will be established to monitor the population and document any trends. Past efforts to translocate grouse from other areas has been minimally successful (Musil et al. 1993, Reese and Connelly 1997).

Prescribed burning should be avoided in areas where sage provides habitat for grouse. Fire tends to burn the plants that provide good habitat and leave the lesser quality habitat plants intact.

General Habitat Management

General habitat management priorities include, monitoring of habitat conditions currently found on-site. This will provide a baseline of data as to what quality of habitat is available, if it is being utilized by sage grouse, and what can be done to make it more attractive to sagebrush species. Schedule vegetation removal if junipers or other conifers have invaded the habitat. Utilize vegetation removal techniques that cause the least damage to sage brush plants. Sage grouse cannot see barbed wire fencing and will collide with fence wires. Flagging will be placed on barbed wire fencing within 1 km of all sage grouse habitat, or alternative fencing materials will be used such as hog wire or wood. The placement of tall structures, such as power line poles, adjacent to sage grouse habitat that will provide predatory raptors perches from which to hunt sage grouse habitat will be avoided (Connelly et al. 2000).

Sage grouse require specific types of habitat structure for breeding, rearing, and wintering habitats. Management strategies for these habitat structures are outlined below.

Breeding Habitat

Sage grouse breeding habitat vegetation control is described as follows: "Manage breeding habitats to support 15–25% canopy cover of sagebrush, perennial herbaceous cover averaging >18 cm in height with >15% canopy cover for grasses and >10% for forbs and a diversity of forbs (Barnett and Crawford 1994, Drut et al. 1994*a*, Apa 1998) during spring. Habitats meeting these conditions should have a high priority for wildfire suppression and controlled burns should not be considered for sagebrush control programs. Sagebrush and herbaceous cover should provide overhead and lateral concealment from predators. If average sagebrush height is >75 cm, herbaceous cover may need to be substantially greater than 18 cm to provide this protection. There is much variability among sagebrush-dominated habitats (Tisdale and Hironaka 1981, Hironaka et al. 1983), and some Wyoming sagebrush and low sagebrush breeding habitats may not support 25% herbaceous cover. In these areas, total herbaceous cover should be >15 %. Further, the herbaceous height requirement may not be possible in habitats dominated by grasses that are relatively short when mature. In all of these cases, local biologists and range ecologists should develop height and cover requirements that are reasonable and ecologically defensible. Leks tend to be relatively open, thus cover on leks should not meet these requirements" (Connelly et al. 2000). All grouse habitat meeting these requirements should be protected not manipulated. All wildfires should be suppressed in breeding habitat.

Brooding Rearing Habitat

Sage grouse rearing can happen anytime between June and November. Sage grouse will potentially use a variety of moist habitats, which support succulent forbs near sage brush cover, such as farmlands, riparian zones, wet meadows, dry lakes and streambeds. All disturbances in these areas will be avoided during these times (Connelly et al. 2000).

Wintering Habitat
Sagebrush provides the main winter habitat for sage grouse. Sagebrush should be tall enough to rise 25-35cm above snow levels allowing sage grouse to utilize this habitat. Wintering habitat should receive the highest priority for fire suppression. If areas are burned avoid removing live brush, live brush will provide an important seed source in areas that burned (Connelly et al. 2000).

Conservation Strategies
Sage brush habitat within the HLWA will be assessed and compared to other sage brush habitat in the surrounding areas where sage grouse occur. This comparison will provide an idea as to why sage grouse may not occur at the HLWA. Management of the sagebrush on the HLWA will be adaptive and responsive to new information about sage grouse in the local area. It is important to the CDFG to preserve species on an ecological/community level, and improvements to sagebrush habitat will promote healthy sage community overall.

Potential Environmental Impacts and Mitigation

The primary goal of the CDFG is to provide suitable habitat in both quantity and quality that can sustain sage grouse populations.

Juniper trees can encroach on sagebrush and diminish the quality of sage grouse habitat. Controlling these trees will benefit sagebrush habitat and all the species that rely on it. However, juniper trees provide an excellent winter food source for wintering mammals and birds, and the removal of juniper trees could negatively impact those species. If juniper trees are controlled only as they encroach upon other habitats there should be no net loss of food for wintering species and, therefore, no negative impact.

Biological Element: Biological Management

Goal: Manage encroachment of conifers, especially juniper and Jeffery pine, into aspen tree stands.

<u>Management Constraints</u>

1. Successful eradication of juniper and Jeffery pine can be difficult and costly. Funding should be secured to implement efforts to the point of continued success.
2. The grazing activities of stray cattle can severely disrupt native plant community structures and habitat restoration efforts.

3. There is currently a high recruitment of invasive juniper saplings in aspen stands.

Tasks

a. Conduct on-going surveys to assess the presence and population sizes of known juniper and Jeffery pine trees where they are encroaching upon aspen stands within the HLWA.
b. Boundary fencing should be repaired to prevent trespass cattle from grazing within the HLWA.
c. In aspen stands negatively affected by conifer encroachment, conifers (up to pole size trees) will be removed whenever feasible.
d. Possible use of fire in aspen stands to control invasive conifers and to stimulate vegetation regeneration (Kay 1997).

Discussion:
Aspen forest is considered an unsettled successional stage of forest recovery after a disturbance such as fire or heavy grazing. Herbaceous plants and deciduous trees, such as aspen, will quickly re-colonize an area after a disturbance (Mayer and Laudenslayer 1988). Aspen has adapted to fire and will re-sprout vigorously and profusely for several years after a stand has burned (Brown 2000). Conifers eventually grow and out-compete the aspen trees to complete the mature forest stand (Mayer and Laudenslayer 1988). Conifers, especially western juniper, will utilize most of the soil moisture, out-competing other species in the area (Bates 1998). If fires, or other disturbances, are suppressed on a long-term basis the natural influx of aspen into disturbed areas will be suppressed. However, re-sprouting aspen after a fire may not reach tree size if ungulate browsing is high (Kay 1997). This may ensue lose of that aspen clone. As the natural forest succession processes continue, conifer encroachment will also threaten aspen stands. Fire can be used successfully to control conifer encroachment onto aspen stands. However, these factors make it difficult to manage and preserve aspen stands on a long-term basis.

Population Surveys
Periodic surveys of aspen stands, where juniper and Jeffery pine trees are encroaching, such as the western edge of the HLWA (**Figure 5**) will provide a data set that will document encroachment trends over time. By understanding the areas where encroachment is the greatest it will be easier to prioritize efforts and utilize resources more efficiently. Annual studies will also document the effectiveness of current efforts and could provide excellent management practice information to other managers in the Sierra Nevada Mountain area.

Fencing Repair
Finding and closing holes in the current fence that runs the perimeter of the HLWA will prevent stray cattle from entering the HLWA.

Removal of Conifer Trees

If HLWA biologists determine that conifers are encroaching upon aspen stands, the conifers shall be removed to prevent further damage to aspen habitat.

Controlled Burning of Aspen Stands
Controlled burning of aspen stands would allow for regeneration of juniper as the burned area goes through the successional stages of reforestation. Mature aspen trees can survive a low-severity fire. Aspen stands are often referred to as having an "asbestos" or "fire break effect" as a fire travels through a forest. After fire disturbance, aspen are quick to re-sprout (Brown 2000). Increased sun exposure of the soil due to canopy death, "blackening" of the soil due to the charring effect of fire, and the absence of moisture trapping due to reduced leaf litter and organic matter on the top layer of soil after a burn cause increased soil temperatures. Growth hormone inhibitors present in aspen roots are destroyed by soil heating, and aspen re-sprout profusely from their root systems.

If a controlled burn is being considered, a fuels manager will assess the area and consult the CDFG as to the best approach and desired results of a controlled burn.

Potential Environmental Impacts and Mitigation

All juniper and Jeffery pine eradication and monitoring efforts will be conducted according to established protocols and extreme care will be taken to minimize human disturbance. All juniper and Jeffery pine eradication will be conducted by qualified staff to assure minimized disturbance to species and habitats.

Future decisions regarding fire suppression on the HLWA need to consider aspen tree management. If fires are to be suppressed other conifer encroachment measures will need to be implemented. However, if fire is to be used within the HLWA, effects to other areas, such as sage grouse habitat, need to be considered carefully.

Biological Element: Biological Protection and Enhancement

Goal: Active management of aspen stands and damaging agents on these stands.

<u>Management Constraints</u>

1. Aspen fungus can be difficult to control and remove.
2. Aspen fungus can be costly in time as well as money to control in a forest stand setting.
3. Funding and personnel for fall season disposal of infected leaves.
4. Funding and personnel for removal of seriously infested trees.

<u>Tasks</u>

a. Survey for fungus during the late summer and mark affected trees

b. Dispose of leaves of effected trees after leaf drop in the fall if fungus threatens the survivability of a clone.

Discussion:
Aspen fungus diseases can effect the health of the host severely only if infection is repeated for several years. After a severe infection, the tree could prematurely drop its leaves. If this happens late in the growing season, the tree may not be able to harden off in time for winter, causing it to loose much of its stored starch and incur severe frost damage during the winter. However, this is a rare occurrence and takes many years of infection to reach that point (Jacobi 2006). If severe infection occurs within a single clone stand for several years in a row, the site may experience loss of that clone.

One type of fungus that effects aspen trees is aspen rust (*Melamspora* sp.), a fungus whose life cycle involves two species of tree, a conifer and the aspen. Pines, firs, or spruces may act as the conifer host for aspen rust. The dead, dry leaves of infected aspen that fell in the previous fall will release spores in the wet, early spring. These spores will infect the needles of a conifer host, and within 2-3 weeks, spores will be produced again and can be blown onto aspen trees (Jacobi 2006).

Fungus Management
Infected trees should be identified and flagged in the late summer by the orange pustules on the underside of the leaves. After leaf drop, leaves of flagged trees can be collected and disposed to diminish infection the following spring (Jacobi 2006).

Management of aspen fungus diseases can include spot burning in areas of severe infection. However, the fungus species should be identified before any management actions are taken.

Potential Environmental Impacts and Mitigation

All aspen rust control and monitoring activities will be conducted with extreme care to minimize human disturbance to the ecosystem. Aspen rust control may involve the removal or controlled burning of aspen trees, which could disrupt the habitats of a number of species found within aspen stands. However, cutting or burning of the trees will only take place in cases of extreme infestation.

Aspen rust control can also involve removal of fallen leaves, which exposes soil to the erosive effects of rain, wind, and runoff. If large portions of ground are exposed and there is not an herbaceous layer for protection from erosive forces, a ground cover, such as straw or biodegradable cloth will be placed over the area.

Biological Element: Biological Inventory

Goal: Conduct bird surveys and small mammal trapping to provide a data inventory of wildlife community structure found on-site.

Management Constraints

1. Funding for field personnel and equipment to conduct surveys, and follow up analysis of data collected.

Tasks

a. Conduct bird surveys and small mammal trapping surveys.
b. Conduct follow-up data analyses of populations and trends.

Discussion:
It is necessary to know the wildlife community structure found on-site to ensure management actions at the HLWA can be well guided and appropriate to the species and communities that occur there. The introduction or encroachment of non-native species can be monitored and addressed in a timely manner.

Ongoing, protocol-level surveys are needed to track and identify known and potential special-status species present within the HLWA, including habitat associations and densities. These ongoing surveys will serve to monitor known populations of special-status species within the HLWA and will provide baseline data for any newly identified species.

Protocol level surveys have not been conducted and there is limited data regarding the presence of non-game species on-site. Additional funding for the HLWA could provide for additional employees to lead small mammal trapping and bird surveys. If lack of funds prevent in-house studies of the area, graduate students from nearby universities, or other interested research entities, could be encouraged to conduct research on the HLWA.

Many of the habitats found on-site, especially the wet meadow habitats are naturally recovering from past grazing activities. As the stray cattle are prevented from grazing within the HLWA by the repair of the fence, this habitat recovery may attract additional animals and allow for plants to return to the HLWA that have not been documented on-site in recent years. This recovery process could also be an additional “selling point” to graduate students, or other research entities, who may be interested in studying the area.

Potential Environmental Impacts and Mitigation

Wildlife assessments can negatively impact the populations under study. Small mammal trapping and mist netting/banding of bird species can cause stress and at times, harm to the subject individuals. However, the resulting benefit of a thoroughly understood community in regards to management of the area, is thought to out-weigh the negative impacts to individuals of that community. All wildlife assessment and monitoring will be conducted according to established protocols and extreme care will be taken to minimize and prevent injury to wildlife. All wildlife assessments will be

conducted by qualified staff, or university personnel, and students under direction of the CDFG to assure minimal disturbance to species and habitats.

Biological Element: Wildlife Protection

Goal: Actively prevent the introduction of human attractants to the black bear population and the disturbance of bald eagle nests and other sensitive resources.

Management Constraints

1. Availability of funding

Tasks

a. Erect electric fencing around the egg taking facility structures that hold trout and could allow bears to easily access the fish.
b. Properly dispose of bear attractants.
c. Provide information to HLWA visitors about bear life history, aggressive behavioral cues, and appropriate human response to these cues.

Discussion

Electric Fencing

The man-made trout run into the egg taking facility at Heenan Lake provides an easy meal for black bears. This poses a problem by negatively effecting operations at the station and could culture problem bears. Electric fencing can be erected around the station structures to prevent predation on LCT.

Public Information

The kiosk at the HLWA can be used to provide information about black bears to the public. Information could include proper disposal of bear attractants, black bear biology and life history, aggressive behavioral cues, and appropriate responses to these behavioral cues.

Road Closure

The road along the western edge of Heenan Lake leading to Bagley Valley runs very near a tree that has had a nesting pair of bald eagles for five of the past six years. Other sensitive bird species, such as pelicans, osprey and the willow flycatcher, could be impacted by motorized vehicle use within the HLWA. Additionally, motorized vehicles, particularly off highway vehicles (OHV), within the HLWA would be operating adjacent to a USFS wildlife area. The HLWA is remote, and patrol of the area would not be feasible if motorized vehicles were granted access. Thus, unauthorized motor vehicle traffic, including ATV use, is prohibited within the HLWA. Due to the remote nature of the site, the absence of adequate patrols and the presence of sensitive resources within, and adjacent to, the HLWA, unrestricted motorized vehicle access could result in significant impacts to the area's resources.

Potential Environmental Impacts and Mitigation

No negative impacts are foreseen as a result of these actions. These actions can decrease the chance of negative human-bear interactions. The road closure will prevent negative impacts resulting from disturbances to nesting bald eagles, special-status bird species, the adjacent USFS wildlife area and other sensitive resources.

Public Use Elements: Goals & Environmental Impacts

The overall public use goals for the HLWA are:

- to develop existing fishing and hunting as public use of the area;
- to inventory cultural sites.

.

Public Use Element: Fish and Wildlife

Goal: Continue to provide recreational catch-and-release fishing and seasonal hunting public use of the area.

Management Constraints

1. Management success of wildlife harvest populations is dependent on healthy population numbers.
2. The continued spread of invasive plant species may impact the health of wildlife that depend on native plant species.
3. The presence of threatened and endangered species will limit and/or guide the process of management practice implementation.
4. Management implementation is dependent on long-term funding.

Tasks

a. Conduct periodic surveys of the HLWA to determine fish and wildlife species present.
b. Enhance habitat for wildlife, repair fencing.
c. Conduct wildlife surveys, including deer population and recruitment studies to maintain healthy populations.
d. Protect the wildlife sanctuary during breeding and nesting of sensitive species.
e. Monitor predation on deer populations.
f. Monitor disease outbreaks.
g. Evaluate fish health and population trends in Heenan Lake; provide special angling and boating regulations as needed.
h. Actively assess and manage migratory deer herds using established CDFG protocol.
i. Evaluate reimplementation of public use permits during fishing season.

Discussion of Tasks:

Species Surveys

Casual observations have identified birds, mammals, reptiles, amphibians and plants. Ongoing surveys are needed to identify other species present, including habitat associations and densities. These ongoing surveys will also serve to monitor known populations of fish and wildlife. Introduction of invasive fish or plant species will need to be monitored to quickly assess problems and prevent further spread, or possible attempts at eradication, of the invasive species.

Enhance Wildlife Habitat and Cover

The HLWA has been used for summer grazing by cattle and sheep beginning in 1924-1925. Grazing is not currently allowed within the HLWA. However, the fencing around the site is in need of repair and cattle stray into the area. Without active restoration efforts, the native meadow plants are recovering on their own. Fencing will be repaired to prevent stray cattle from grazing within the HLWA boundary. This will allow habitats to continue to recover without further disturbance.

Conduct Recruitment and Population Studies for Deer

Short-term fluctuations in deer populations are usually attributed to weather events that affect forage production (CDFG 2005). As part of CDFG's Deer Management Program, biologists develop hunting regulations, provide expertise on habitat and population assessments, compile harvest information, conduct and direct research needs, monitor and estimate populations and respond to various public inquiries related to deer in California (CDFG 2005). The CDFG biologists are currently developing a more realistic approach through a *Strategic Plan for California Deer* in order to more effectively manage deer herds given the existing and anticipated changes to California's environment (CDFG 2005).

Wildlife Sanctuary

Periodic assessments are needed to ensure that management of the area satisfies the function of suitable habitat for wildlife. Surveys will be conducted to collect trend and management data. Sight specific surveys are not used to set hunting seasons.

Predation Monitoring

Ground-nesting birds are especially vulnerable to predation by skunks, raccoons, and coyotes. One of the primary causes of poor recruitment for sage grouse is predation. Future management within the HLWA would be consistent with the Statewide Recovery Plan for Sage grouse.

Control of Disease Outbreak

As a preventative measure, and in the case of an outbreak of the West Nile Virus, the staff at the HLWA will implement the *Center for Disease Control Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control (***Attachment G)**.

The Chronic Wasting Disease (CWD) Surveillance Program has yet to find any cases of CWD in California and CDFG tests 500 deer annually for the disease. Because of limits on the importation of deer, elk, and their body parts from other states, California is considered a low risk state for a CWD outbreak. The CDFG CWD Surveillance Program staff will be consulted if an outbreak is reported in California. Appropriate preventatives and controls will be implemented for all other relevant diseases as well.

Fish Species
Electrofishing surveys should be conducted in Heenan Lake. Ongoing surveys will be conducted to account for Lahonton cutthroat trout occurring within the HLWA and to evaluate age and growth structure of the population. The assessment of the actual, and potential, introduction of nonnative species into the lake, particularly in regard to public use, will be annually assessed.

Fishing is allowed on a catch-and-release basis during the months of September and October. Only the use of single, barbless hooks on artificial lures are allowed in the HLWA. No motorized boats are allowed on Heenan Lake. Canoes and float tubes, powered by small electric motors, are permitted.

Monitor Deer Herd Populations
The Carson River deer herd population will be monitored and assessed in keeping with CDFG's Deer Management Program through the *Strategic Plan for California Deer.* Wet Meadow and the edges of aspen habitats provide excellent fawning grounds for deer. Therefore, management and recovery of these habitats within the HLWA will support a healthy deer population.

Public Use Permits
Pursuant to the California Code of Regulations, Title 14 (§553), the CDFG may require anglers to obtain public use permits during the fishing season at Heenan Lake. If the CDFG elects to reinstate a mandatory permit, all anglers aged 16-years or older shall be required to pay a set fee per 3-day weekend period. If the CDFG chooses to reinstate the use permit requirements, the Department will adhere to appropriate guidelines, including the public notification process.

Potential Environmental Impacts and Mitigation

All wildlife assessment and monitoring, as well as fence repair activities, will be conducted according to established protocols. Extreme care will be taken to minimize human disturbance.

Fencing will prevent stray cattle from entering the HLWA and disturbing the habitats found on-site. Disturbance by heavy cattle grazing can provide benefits for aspen habitat. Areas formerly disturbed by grazing can provide excellent opportunities for aspen trees to re-colonize the area. Preventing cattle grazing is in keeping with CDFG's community level management philosophy. Therefore, no negative impacts are assumed to occur due to the erection of a fence around the perimeter.

Fencing can prove hazardous to sage grouse and goshawks. These birds do not see the thin fence wires and can collide with them mid-air. To increase visibility, flagging will be installed and maintained on all fencing within 1 km of sage grouse and goshawk habitat and foraging areas.

The following public use activities are allowed in the HLWA: hunting, fishing, sightseeing, bird watching/nature study, hiking, skiing and snowshoeing. Cycling is permitted on the roads within the HLWA and horseback riding is allowed for passage only. Pack stock and the grazing of horses are not permitted within the HLWA. Care must be taken to ensure public use activities do not disrupt the activities of wildlife. Species are particularly sensitive to disturbance during the nesting and brood rearing season. Information will be displayed informing the public on proper conduct in regards to sensitive species within the HLWA. The following uses are not permitted within the HLWA: unauthorized motor vehicle use (including all terrain vehicles and snowmobiles), camping/trailers or fires. As described above, boats are permitted, with limitations, during the fishing season. Commercial activities are generally prohibited, though filming may be permissible through acquisition of the appropriate permits.

Catch-and-release fishing may negatively impact individual fish. Negative impacts stemming from catch-and-release fishing include: fishing gear breaking and remaining lodged in fishes' mouths, damage to mouth parts from the hooks or removal of hooks, and damage to the slimecoat of fish by handling. Informing the public on the proper way to handle and release fish is the best way to prevent these potential impacts. Negative impacts due to catch-and-release fishing tend to be significant only when water temperatures approach 70º F (Titus 1988). If anglers follow proper fish handling techniques, negative impacts to fish in Heenan Lake can be minimized.

Hunting activities can have an obvious negative impact to wildlife resources if populations of wildlife are not managed correctly. Wildlife game surveys shall be conducted to provide population trend data overtime. These data can help the HLWA managers promote sustainable, healthy communities of wildlife and their habitats on-site.

Public Use Element: Cultural Resources

Goal: Acquire additional information about the cultural sites within the HLWA, especially mapped locations of the sites.

Management Constraints

1. Funding availability.
2. Personnel availability.

Tasks

a. Review existing literature for the data points.
b. If data cannot be found conduct site visits and obtain GPS coordinates of cultural sites.

Discussion:
Information exists regarding the cultural sites within the HLWA (see **Attachment C**). However, the CDFG does not currently have a location map for the sites. A location map would be used when planning any activities that would include road or facility repair, storage of equipment, or even public access issues. The location map will not be published or available for public viewing to protect these areas from any impacts such as vandalism.

Literature Review
Summit Envirosolutions, Inc. may posses data points currently unknown to the CDFG. Summit Envirosolutions should be contacted regarding CDFG acquisition of these data.

Site Visits
If Summit Envirosolutions, Inc. does not posses the cultural site locations, site visits by qualified personnel will be necessary to map these locations. Site locations will be recorded using a GPS unit to keep these data easily accessible to CDFG staff.

Environmental Impact

No negative environmental impacts are expected from these actions. It is important to keep the site locations from being made available to the public to prevent vandalism. Cultural resources will be protected as activities occurring at the HLWA can be planned to avoid impacts to the sites.

Facility Maintenance Element: Goals & Environmental Impact

The overall facility maintenance goal for the HLWA is:

- to develop and maintain the necessary facilities for the Lahonton cut throat trout hatchery and administrative activities to operate the wildlife area.

Biological Element: Preservation through facility maintenance and proper wildlife area management.

Goal: Develop and maintain the necessary facilities for the Lahonton cutthroat trout hatchery and administrative activities to operate the wildlife area.

<u>Management Constraints</u>

1. Continued funding of facilities maintenance and trout fishery management.
2. Competition between the Lahontan and the Lahonton hybrid cutthroat trout in Heenan Lake.

Tasks

a. Conduct annual inspection of hatchery and identify any potential problems or maintenance issues.
b. Conduct annual inspection of fencing and public use signage, repair any locations where fencing integrity is compromised or signage needs repair or has been vandalized.
c. Conduct annual inspection of the dam, valve, and spillway at Heenan Lake and identify any potential problems or maintenance issues.
d. The Department will conduct an annual review of the HLWA, identify any management problems or changes and will make the proper adjustments or changes to the management of the wildlife area.
e. Maintain proper functioning of all open roads on-site.
f. Maintain Department's existing water rights and conduct periodic inspections of water conveyance facilities within the HLWA to identify any potential problems or maintenance issues.

Discussion:

Annual Hatchery Inspection

A yearly inspection of hatchery facility conditions can identify potential problems and maintenance issues. Inspections will be conducted by qualified personnel who will identify problems and recommend solutions. Proper maintenance of the facility is the cost-effective approach to facility management. Problems, and plans for repairing the problems will be addressed by the Department in a timely manner. Problems, and potential problems, identified and addressed early can prevent larger more costly repairs in the future.

Annual Fencing and Signage Inspection

Fencing will be inspected once a year to insure proper functioning and maintenance in areas where the illegal trespass of cattle is likely. Proper maintenance includes repairing problems such as holes in the fence and fence post failure. Proper fence maintenance also includes maintenance of flagging within 1 km of sage grouse habitat and goshawk foraging and nesting habitat to prevent these birds from colliding with the fence mid-air.

The kiosk sign located near the lake will be inspected and properly maintained. Signage is subject to many uses and abuses in public use areas. All serious wear and vandalism will be repaired in a timely manner.

Annual Inspection of the Dam

Qualified personnel shall conduct an annual inspection of the dam, valve, and spillway to identify problems and possible future problems. If potential problems to the dam are found and repaired early, costly structural and environmental damage can be avoided.

Annual Administrative Review

Department personnel shall hold an annual meeting where they will discuss current direction and needs of the HLWA. Management of the HLWA should be considered adaptable to changing conditions on-site and changing knowledge about the proper management of wildlife areas. New studies continually increase the base knowledge of wildlife, and habitat management. New information about the best ways to maintain viable populations of the animals and habitats on-site should be actively incorporated into the management of the HLWA.

Road Repair and Maintenance
Maintain proper functioning of roads within the HLWA. Roads will be inspected for erosion and failure annually. Erosion is not only hazardous to vehicles using the road, it can also damage adjacent habitats. Poorly maintained roads can cause the dewatering of adjacent wet meadow, wetland or pond habitats, converting it to dry land. Poorly placed or maintained drainage ditches and culverts in association with roads can cause large erosion problems, and becoming very costly over time.

Water Rights and Facilities Inspections
Qualified personnel will conduct inspections of the water conveyance facilities within the HLWA to ensure proper functioning. The timely identification of maintenance issues will ensure cost effective remedies and the avoidance of environmental damage due to the failure of existing facilities.

Environmental Impacts

Facilities maintenance activities, including the use of heavy machinery, may temporarily impact lands immediately surrounding the work site. However, timely maintenance and repairs to the facilities within the HLWA will ensure cost-effective remedies and the avoidance of environmental degradation caused by failing infrastructures. For example, repairs to the access road will restore the adjacent wet meadow habitats to properly functioning conditions by allowing for habitat appropriate drainage of the wet meadows.

Other than the temporary impacts due to repair activities, no environmental impacts are foreseen from the implementation of these tasks. Negative impacts will be prevented by the scheduled inspection and timely maintenance of structures and facilities within the HLWA.

Regulatory Framework for Biological Elements

The following laws apply to the Biological Elements previously discussed. The CDFG will comply with any requirements mandated by these laws in the case of temporary or permanent impacts to respective resources.

Federal Endangered Species Act

The USFWS and National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) (formerly the National Marine Fisheries Service or NMFS) have jurisdiction

over species listed as threatened or endangered under Section 9 of the federal ESA. The ESA protects listed species from harm, or take, which is broadly defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct”. Under section 7 of the ESA, a federal agency must consult with the USFWS and NOAA Fisheries if the agency’s action may affect a threatened or endangered species and/or its critical habitat under the authority of each agency. The goal of this consultation is to ensure that the action is not likely to jeopardize the continued existence of any threatened or endangered species, or to result in the destruction or adverse modification of habitat critical to such species. If USFWS or NOAA Fisheries determines that an agency action is likely to adversely affect a listed species or critical habitat, the agency taking the action (Lead Agency) must initiate formal consultation.

California Endangered Species Act

The CDFG has jurisdiction over species listed as threatened or endangered under Section 2080 of the California Fish and Game Code. Section 2080 prohibits the take of a species listed by CDFG as threatened or endangered. The state definition of take is similar to the federal definition, except that Section 2080 does not prohibit indirect harm to listed species by way of habitat modification. To qualify as take under CESA, an action must have direct, demonstrable detrimental effect on individuals of the species. Impacts on habitat that may ultimately result in effects on individuals are not considered take under the CESA but can be considered take under the ESA.

Proponents of a project taking a state-listed species must consult with CDFG and enter into a management agreement and take permit under Section 2081. The CESA consultation process is similar to the federal process. The CESA does not require preparation of a state biological assessment; the federal biological assessment and the CEQA analysis or any other relevant information can provide the basis for consultation. CESA requires that CDFG coordinate consultation for joint federally listed and state-listed species to the extent possible; generally, the state opinion for the listed species is brief and references provisions under the federal opinion.

Clean Water Act, Section 404

The US Army Corps of Engineers (COE) and Environmental Protection Agency regulate the placement of dredged or fill material into “Waters of the United States” under Section 404 of the Clean Water Act. Waters of the United States include lakes, rivers, streams, and their tributaries, and wetlands. Wetlands are defined for regulatory purposes as “areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 Code of Federal Regulations [CFR] 328.3, 40 CFR 230.3).

The COE may issue either individual permits on a case-by-case basis or general permits on a program level. General permits are pre-authorized and are issued to cover

similar activities that are expected to cause only minimal adverse environmental effects. Nationwide permits (NWPs) are general permits issued to cover particular fill activities. All NWPs have general conditions that must be met for the permits to apply to a particular project, as well as specific conditions that apply to each NWP.

Clean Water Act, Section 401

Section 401 of the Clean Water Act requires water quality certification and authorization of placement of dredged or fill material in wetlands and Other Waters. In accordance with Section 401 of the Clean Water Act, criteria for allowable discharges into surface waters have been developed by the State Water Resources Control Board, Division of Water Quality. The resulting requirements are used as criteria in granting National Pollution Discharge Elimination System (NPDES) permits or waivers, which are obtained through the Central Valley Regional Water Quality Control Board (CVRWQCB). Any activity or facility that will discharge waste (such as soils from construction) into surface waters, or from which waste may be discharged, must obtain an NPDES permit or waiver from the CVRWQCB. The CVRWQCB evaluates an NPDES permit application to determine whether the proposed discharge is consistent with the adopted water quality objectives of the basin plan.

California Fish and Game Code, Sections 1601-1616

Under the California Fish and Game Code, Sections1601-1616, CDFG regulates projects that divert, obstruct, or change the natural flow or bed, channel, or bank of any river, stream, or lake. Proponents of such projects must notify CDFG and enter into streambed alteration agreement with them. Section 1601 of the California Fish and Game Code requires a state or local governmental agency or public utility to notify CDFG before it begins a construction project that will: (1) divert, obstruct, or change the natural flow or the bed, bank, channel, or bank of any river, stream, or lake; (2) use materials from a streambed; or (3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake. Once the notification is filed and determined to be complete, CDFG issues a streambed alteration agreement that contains conditions for construction and operations of the proposed project.

California Fish and Game Code, Section 3503.5

Under the California Fish and Game Code, Section 3503.5, it is unlawful to take, possess, or destroy any birds in the orders Falconiformes (hawks, eagles, and flacons) or Strigiformes (owls). Take would include the disturbance of an active nest resulting in the abandonment or loss of young.

Migratory Bird Treaty Act

The MBTA (16 United States Code [USC] 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and

authorized the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. The MBTA sets seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703, 50 CFR 21, 50 CFR 10).

Magnuson-Stevens Fishery Conservation and Management Act

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth new mandates for NOAA Fisheries, regional fishery management councils, and federal action agencies to identify and protect important marine and anadromous fish habitat. The Councils, with assistance from NOAA Fisheries, are required to delineate “essential fish habitat” (EFH) in fishery management plans (FMPs) or FMP amendments for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NOAA Fisheries’ conservation recommendations. In addition, NOAA Fisheries is required to comment on any state agency activities that would impact EFH. Although the concept of EFH is similar to that of critical habitat under the ESA, measures recommended to protect EFH are advisory, not prescriptive.

REFERENCES

APA, A. D. 1998. Habitat use and movements of sympatric sage and Columbian sharp-tailed grouse in southeastern Idaho. Dissertation, University of Idaho, Moscow, USA.

Barnett, J. F., and J. A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. Journal of Range Management 47: 114–118.

Bates, J., R.F. Miller, and T.J. Svejcar. 1998 (In press). *Understory patterns in cut western juniper (Juniperus occidentalis spp. occidentalis Hook.)* Woodlands. Great Basin Nat.

Brown, James K.; Smith, Jane Kapler, eds. 2000. *Wildland Fire in Ecosystems: Effects of Fire on Flora*. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

Bryson Sandy, *Burping the Cutts: Spawning Cutthroat Trout at Heenan Lake* Outdoor California. November/December 2000. http://www.dfg.ca.gov/lands/articles/heenanlake.pdf

CDFG. Black Bear Management Plan July 1998. http://www.dfg.ca.gov/ hunting/bear/

Cheatham, N.H. and J.R. Haller. 1975. An annotated list of California habitat types. University of California Natural Land and Reserve System, California, USA.

Connelly, John W., Schroeder, Michael A., Sands, Alan R. S., and Braun, Clait E. 2000 *Habitat and Management Guidelines to Manage Sage Grouse Populations and Their Habitats*, Wildlife Society Bulletin. http://sagemap.wr.usgs.gov/Docs/Sage_Grouse_Guidelines.pdf#search=%22sage%20grouse%20habitat%20enhancement%22

Cook, S. F. 1976 *The Conflict Between the California Indian and White Civilization*. Berkeley: University of California Press.

Dealy, J. E., J.M. Geist, and R.S. Driscoll. 1978. Communities of western juniper in the intermountain northwest. U.S. Department of Agriculture, Portland, Oregon, USA.

Downs, M. P.1966 *The Two Worlds of the* Washoe. Holt, Rinehart and Winston. New York.

Drut, M. S., J. A. Crawford, and M. A. Gregg. 1994*a*. Brood habitat use by sage grouse in Oregon. Great Basin Naturalist 54:170–176.

Hickman, O. E. 1975. *Seasonal trends in the nutritive content of important range forage species near Silver Lake, Oregon*. U.S. Dep. Agric., For. Serv. (Portland, Ore.), Res. Pap. PNW-187.

Hironaka, M., M. A. Fosberg, and A. H. Winward. 1983. *Sagebrushgrass habitat types of southern Idaho*. Idaho Forest, Wildlife and Range Experiment Station, Bulletin 35, Moscow, Idaho, USA.

Elston, Robert G. 1986 Prehistory of the Western Area. In Great Basin, edited by W.L d'Azevedo, pp. 135-148. *Handbook of the North American Indians, Volume 11*, William C. Sturtevant, General Editor. Smithsonian Institution, Washington, D.C.

Elston, Robert G., S. Stornetta, D.P. Dugas, and P. Mires. 1994 *Beyond the Blue Roof: Archaeological Survey of the Mt. Rose Fan and Northern Steamboat Hills*. Report on File, USDA-Forest Service, Toiyabe National Forest, Sparks, Nevada.

Jacobi, W.R. 2006 Colorado State University Cooperative Extension. *Aspen and Poplar Leaf Spots*. http://www.ext.colostate.edu/PUBS/garden/02920.html

John, D.A., J. Giusso, W.J. Moore, R.A. Armin, and J.C. Dohrenhend, 1981. *Reconnaissance Geologic Map of the Topaz Lake 15 Minute Quadrangle, California and Nevada*. U.S. Geological Survey Open File Report 81-273. http://ngmdb.usgs.gov/ngm-bin/ILView.pl?sid=q62_11997_us_1.sid&vtype=b&sfact=1.5.

Kay, Charles E. 1997 The Condition and Trend of Aspen *Populus tremuloides,* in Kootenay and Yolo National Parks: Implications for Quality and Integrity. Canadian Field Naturalist. 111(4):607-616.

Musil, D. D., J. W. Connelly, and K. P. Reese. 1993. *Movements, survival, and reproduction of sage grouse translocated into central Idaho*. Journal of Wildlife Management 57:85–91.

National Geographic Society. 1987. Field guide to the birds of North America. Second edition. National Geographic Society, Washington, D.C., USA.

Reese, K. P., and J. W. Connelly. 1997. *Translocations of sage grouse Centrocercus urophasianus in North America*. Wildlife Biology 3/4:235–241.

Sawyer, J. O. and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society, Sacramento, California, USA.

Sibley, D. A., *The Sibley Guide to Bird Life & Behavior*. New York: Alfred A. Knopf, 2001.

Sloan, N. F. 1982. Status of breeding colonies of white pelicans in the United States through 1979. Am. Birds 36:250-257.

Tisdale, E. W., and M. Hironaka. 1981. *The sagebrush-grass region: a review of the ecological literature*. Idaho Forest, Wildlife, and Range Experiment Station, Bulletin 33, Moscow, USA.

Titus, Robert G. and C. David Vanicek. 1988. *Comparative Hooking Mortality of Lure-Caught Lahontan Cutthroat Trout at Heenan Lake*, California. Department of Biological Sciences, California State University. Sacramento CA.

United States Geological Survey (USGS), Department of Interior. 2004. http://geology.wr.usgs.gov/parks/province/pacifmt.html

Work, John *"Fur Brigade to the Bonaventura: John Work's California Expedition, 1832-1833, for the Hudson's Bay Company*", IN, The Journal of John Work, Alice B. Maloney, Editor. California Historical Society, San Francisco.

Western Regional Climate Center, WRCC. http://www.wrcc.dri.edu/index.html contacted August.

ATTACHMENT A

Initial Study/Negative Declaration

Update to the Heenan Lake Wildlife Area Land Management Plan

This study covers the update to the Heenan Lake Wildlife Area Land Management Plan

Initial Study/Negative Declaration

Lead Agency:

California Department of Fish and Game
North-Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670

Prepared by:

GALLAWAY
CONSULTING, INC.
115 Meyers Street, Suite 120, Chico, CA 95928
Phone(530)343-8327 Fax(530)342-1882

Table of Contents

INTRODUCTION **1**

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED **2**
- **Aesthetics** 3
- **Agricultural Resources** 3
- **Air Quality** 4
- **Biological Resources** 5
- **Cultural Resources** 7
- **Geology, Soils and Seismicity** 8
- **Hazards and Hazardous Materials** 10
- **Hydrology and Water Quality** 11
- **Land Use and Land Use Planning** 12
- **Mineral Resources** 13
- **Noise** 13
- **Population and Housing** 15
- **Public Services** 15
- **Recreation** 16
- **Transportation and Traffic** 16
- **Utilities and Service Systems** 17
- **Mandatory Findings of Significance** 18

Environmental Checklist Initial Study
Heenan Lake Wildlife Area Land Management Plan

INTRODUCTION

1.	**Project Title:**	Heenan Lake Wildlife Area Land Management Plan* (LMP)
2.	**Lead Agency Name and Address:**	California Department of Fish and Game North-Central Region 1701 Nimbus Road, Suite A Rancho Cordova, CA 95670
3.	**Contact Person and Phone Number:**	Terri Weist: (530) 644-5980
4.	**Project Location:**	Heenan Lake, Alpine County
5.	**Project Sponsor's Name and Address:**	California Department of Fish and Game North Central Region 1701 Nimbus Road, Suite A Rancho Cordova, CA 95670
6.	**General Plan Designation(s):**	Open Space
7.	**Zoning Designation(s):**	AG: Agriculture
8.	**Description of Project:**	The LMP is a program intended to provide the framework for implementing the Department's management goals for the wildlife area.
9.	**Surrounding Land Uses and Setting:**	North, West, South: Toiyabe National Forest. Northeast, East: Bureau of Land Management.
10.	**Other public agencies whose approval is required:**	None

* The potential environmental impacts evaluated in this document address the long-term implementation of the proposed project (Land Management Plan for the Heenan Lake Wildlife Area). Future activities or development that may be proposed in the project area (that are separate from activities described in the LMP - and not considered exempt per statute or CEQA guidelines §§15301-15332) would be subject to a separate environmental review.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

The proposed project could potentially affect the environmental factor(s) checked below. The following pages present a more detailed checklist and discussion of each environmental factor.

☐ Aesthetics	☐ Agricultural Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology and Soils
☐ Hazards/Hazardous Materials	☐ Hydrology/Water Quality	☐ Land Use/Planning
☐ Mineral Resources	☐ Noise	☐ Population and Housing
☐ Public Services	☐ Recreation	☐ Transportation/Circulation
☐ Utilities/Service Systems	☐ Mandatory Findings of Significance	

DETERMINATION: (To be completed by Lead Agency)

On the basis of this initial study:

☒ I find that the Proposed Project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the Proposed Project could have a significant effect on the environment, there will not be a significant effect in this case because the project-specific mitigation measures described in Section III have been added to the project. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the Proposed Project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a significant effect(s) on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets, if the effect is a “potentially significant impact” or “potentially significant unless mitigated.” An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, there WILL NOT be a significant effect in this case because all potentially significant effects a) have been analyzed adequately in an earlier EIR pursuant to applicable standards and b) have been avoided or mitigated pursuant to that earlier EIR, including revisions or mitigation measures that are imposed upon the proposed project. No further action is required.

_____ _____

Signature Date

_____

Printed Name

Environmental Checklist

Aesthetics

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
1. AESTHETICS. Would the project:				
a) Have a substantial adverse effect on a scenic vista?				☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a scenic highway?				☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?				☒
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?				☒

DISCUSSION
1.a – 1.d:
The existing facilities within the Heenan Lake Wildlife Area (HLWA) would require maintenance, and occasional repair, to achieve the established goals for the Heenan Lake Wildlife Area Land Management Plan (LMP). Activities related to facility maintenance and repair would likely include:

- Maintenance/repairs to the hatchery
- Maintenance /repairs to fencing and signage
- Maintenance/repairs to dam and spillway
- Repair/prevent erosion on existing access road to egg-taking station.

The proposed project does not propose large-scale changes that would alter the aesthetic characteristics of the site. The maintenance and repair of existing facilities could reduce potentially negative aesthetic impacts resulting from the degradation of these facilities. The project would have **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Agricultural Resources

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
2. Agricultural Resources. In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997), prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture.				

a)	Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				☒
b)	Conflict with existing zoning for agricultural use, or a Williamson Act contract?			☒	
c)	Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use?				☒

DISCUSSION

2.a, 2.c:

The proposed project would not result in changes to existing agreements that address land use and water rights in the project area. The project would not conflict with guidelines intended to protect farmland or prevent its conversion to non-agricultural use. As of June 8, 2006, the Farmland Mapping and Monitoring Program classified all of Alpine County as "Local, State and Federal Owned Land" or "Out of Survey Area." Grazing is not allowed under current agreements in the HLWA. Currently, cattle are prone to enter the project area due to poorly maintained and inadequate fencing. Fence maintenance and improvements described in the LMP are intended to prevent grazing in areas currently not allowed. The project would not result in potentially significant impacts to agricultural resources. There would be **no impact.**

2.b:

The HLWA is zoned AG (agriculture) with an open space land use designation. While the property has been grazed in the past, implementation of the LMP would not reduce the amount of agricultural lands currently available in the area. Implementation of the proposed LMP would result in impacts that are considered **less than significant.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Air Quality

Issues (and Supporting Information Sources)		Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
3.	**AIR QUALITY.** Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a)	Conflict with or obstruct implementation of the applicable air quality plan?				☒
b)	Violate any air quality standard or contribute substantially to an existing or projected air quality violation?			☒	
c)	Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions that			☒	

	exceed quantitative thresholds for ozone precursors)?				
d)	Expose sensitive receptors to substantial pollutant concentrations?				☒
e)	Create objectionable odors affecting a substantial number of people?				☒

DISCUSSION

3.a, 3.d, 3.e:

The proposed LMP would not result in the construction of new facilities or the generation of increased vehicular trips. Undeveloped lands, absent of sensitive receptors, surround the project site. The LMP does not propose activities that would generate objectionable odors. Neither specific maintenance activities identified in the LMP nor long-term implementation of the LMP would result in significant impacts. There would be **no impact.**

3.b, 3.c:

Some of the management tasks identified in the proposed LMP could result in emissions of criteria pollutants. These emissions would be subject to local, County and State regulations as well as Best Management Practices (BMP), identified by the Great Basin Unified Air Pollution Control District (GBUAPCD). As Alpine County is a member of the GBUAPCD, activities related to management tasks in the proposed LMP would be subject to pertinent guidelines and BMPs required by the District. Emissions generated by management tasks would be temporary and would not contribute to the cumulative net increase of pollutants. Through adherence to local, regional, state and federal guidelines, and by implementing appropriate BMP as standard conditions of approval of any required permits, temporary emissions would result in **less than significant** impacts.

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Biological Resources

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
4. BIOLOGICAL RESOURCES. Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			☒	
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?			☒	
c) Have a substantial adverse effect on Federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited			☒	

	to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?			
d)	Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?		☒	
e)	Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?			☒
f)	Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan?			☒

DISCUSSION

4.a – 4.d:

The purpose of the project is to implement a framework that will facilitate the implementation of the management goals identified for the HLWA. The management goals include the following elements:

- Biological
  - Enhance/Restore sage grouse habitat
  - Management practices associated with aspen stand improvement projects
  - Conduct biological inventories
- Public Use
  - Continue to provide recreational catch and release/seasonal hunting public use
- Facility Maintenance
  - Develop and maintain necessary facilities for the Lahonton cut throat trout hatchery and administrative activities to manage the wildlife area.

The project is not expected to result in significant impacts to biological resources. The project would result in the increased ability to implement the proponent's management goals, which are intended to improve conditions for significant biological resources in the project area. Active management strategies will be implemented pursuant to relevant guidelines (including the Alpine County General Plan, the California and Federal Endangered Species Acts, the Migratory Bird Treaty Act, the Clean Water Act, Fish and Game Code, et cetera) and recommendations in order to prevent potential impacts to significant resources. The LMP identifies the potential impacts of active management strategies described in the management goals of the HLWA:

- Wildlife assessments, trapping, netting and banding can cause stress, and occasionally harm, in individual specimens.
- Active management in aspen stands could include human intrusion, burning and cutting.
- Fences could present hazards to flying birds.
- Public use could cause disruptions to wildlife activities and harm/stress to individual cutthroat trout specimens during catch-and-release activities.
- Road maintenance could impact the lands adjacent to the areas being maintained.
- Maintenance of water conveyance facilities could impact the lands adjacent to the areas being maintained.

This document provides an evaluation of actions that are consistent with the LMP. The amount of review required for future projects and actions not identified in this LMP would be determined pursuant to article 11 and articles 18 and 19 of the CEQA Guidelines (addendums and statutory and categorical exemptions respectively). These potential impacts of the proposed LMP, which would be implemented pursuant to appropriate local, state and federal regulations, are

considered insignificant when compared to the benefits of the implementation of the project's management goals. Furthermore, the proposed LMP identifies appropriate measures that would ensure the implementation of the management goals do not generate potentially significant impacts. Through adherence to the recommended measures set forth in the proposed LMP, and relevant regulations, the proposed project would not result in the generation of potentially significant impacts. The project would have a **less than significant impact.**

4.e, 4.f:
The LMP is intended to protect and enhance the special-status species and habitats located within the project site. All management goals would be implemented pursuant to state and federal Endangered Species Acts as well as all other applicable regulations. The proposed LMP incorporates an ecosystem approach in its management goals. Thus, the actions proposed in one part of the plan are not evaluated independent of potential repercussions to other portions of the functioning ecosystem within the project area. Management tasks that promote a part, but hinder the health of the whole, are subsequently avoided. The LMP, which was developed using an ecosystem approach, and would be implemented pursuant to relevant guidelines, would not conflict with policies, plans or ordinances that are intended to protect biological resources. There would be **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Cultural Resources

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
5. CULTURAL RESOURCES. Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in 15064.5?			☒	
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to 15064.5?			☒	
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?			☒	
d) Disturb any human remains, including those interred outside of formal cemeteries?			☒	

DISCUSSION
5.a – 5.d:
The project is not expected to result in construction or development of new facilities. Implementation of the LMP is not expected to result in large-scale ground disturbances. Maintenance and improvement of existing facilities would be implemented when necessary. Genesis Society conducted an Archaeological Survey for the proposed LMP in 2006. The survey identified the following potential impacts to cultural resources that may occur through implementation of the LMP:

- Direct impacts to previously identified and, as yet, unidentified historic resources
- Direct impacts to previously identified and, as yet, unidentified prehistoric resources
- Inadvertent impacts to previously undocumented cultural resources (historic, prehistoric or dual component)

- Inadvertent impacts to human remains or burials

The Archaeological Survey recommends the following tasks, as part of a cultural resource management approach, to eliminate any potentially significant impacts to cultural resources within the project site:

1. Inventory Survey: Synthesize data in from past surveys, compile new data, and prepare an archaeological inventory survey per CEQA guidelines.
2. Site Location Map: Any activities that could result in ground disturbances should be preceded by map consultation. This would preclude disturbances to known resources identified by the inventory survey and mapped by the site location map.
3. Properties or Human Remains Discovered
   A. If previously unidentified cultural resources are discovered through the implementation of the LMP all work shall cease in the area. A professional archaeologist shall be consulted to evaluate the cultural resource(s) and, if necessary, describe appropriate mitigation to be implemented.
   B. If human remains are discovered on the project site, work will cease in the project area and the coroner will be contacted immediately. Activities relative to newly discovered human remains will be regulated pursuant to applicable sections of the Public Resources and Health and Safety Codes.

The proposed LMP, as described in the Public Use Element, contains goals and objectives pertaining to the management and preservation of cultural resources. The Department's goal identified in this section is to "acquire additional information about the cultural sites within the HLWA…" The proposed LMP sets forth two primary tasks that would achieve this goal: 1) Review existing literature and 2) If data cannot be found, conduct site visits and obtain GPS coordinates of cultural sites. Thus, adherence to the proposed LMP would result in adherence to tasks 1 and 2 recommended in the archaeological survey. Consistency with task 3, as recommended in the archaeological survey, would be accomplished through adherence to relevant Public Resources and Health and Safety Codes. Management activities would not be allowed to cause detriment to cultural resources. The LMP requires the following cultural resource management tasks that closely mirror the recommendations of the Archaeological Survey:

- Site alteration would not occur without an appropriate resource survey.
- Sites would be monitored to assure public impacts are not occurring.
- Locations of known sites within the project area would not be made public, though the locations would be used to avoid impacts to known resources.

Through implementation of appropriate cultural resource management tasks, and by adhering to local, state and federal regulations, the proposed project would result in potential impacts to cultural resources that are considered **less than significant.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the management goals relating to cultural resources and the avoidance of potential impacts.

Geology, Soils and Seismicity

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
6. GEOLOGY AND SOILS. Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other				☒

	substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.		
	ii) Strong seismic ground shaking?		☒
	iii) Seismic-related ground failure, including liquefaction?		☒
	iv) Landslides?		☒
b)	Result in substantial soil erosion or the loss of topsoil?	☒	
c)	Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?		☒
d)	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?		☒
e)	Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?		☒

DISCUSSION

6.a, 6.c – 6.e:

Existing infrastructure would be maintained to ensure continued functionality, or improved to promote greater functionality, efficiency and lessen negative effects to wildlife resources. The implementation of the LMP would not result in the development of new facilities, or the creation of conditions, that would expose people or facilities to geologic hazards or unstable conditions at levels that are not currently experienced within the project site. The project does not propose new wastewater disposal systems. The project would result in **no impact.**

6.b:

Management activities, such as vegetation thinning in aspen stands, could result in the exposure of topsoil. Road maintenance activities could result in ground disturbances. These tasks would be implemented pursuant to the framework of the LMP, which is intended to improve environmental conditions within the HLWA. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). Activities would also be regulated by pertinent local, state and federal regulations. Projects that could result in soil erosion or ground disturbances may be subject to regulation by the Regional Water Quality Control Board, Department of Fish and Game and Alpine County. Through adherence to appropriate regulations and securing the required permits, management tasks that could result in soil erosion or loss of topsoil would generate impacts considered **less than significant.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Hazards and Hazardous Materials

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
7. HAZARDS AND HAZARDOUS MATERIALS. Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?			☒	
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?			☒	
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?			☒	

DISCUSSION

7.a, 7.b and 7.h:

The project would not result in placing people or structures at risk that are not currently at risk to hazards within the project area. There are no residences within, and no urbanized areas adjacent to, the HLWA. The project would not result in an increased hazard risk to people, structures or the environment. Prescribed burning has been used as a management tool to prevent the encroachment of conifers into aspen stands. The proposed LMP identifies prescribed burning as an option for the management of aspen stands within the HLWA. However, it is not specifically identified as tool that will be used in this manner. Besides the obvious safety hazards, improperly prescribed burns can negatively impact sage grouse habitat. Prior to implementation

of controlled burning, a fuels manager would consult with the DFG to ensure adherence to state regulations. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). Consistency with the management goals identified in the proposed LMP and adherence to appropriate regulations would ensure hazardous materials and wildfire hazards generate impacts that are considered **less than significant.**

7.c – 7.g:
The project site is not located within one-quarter mile of a school, is not a recognized hazardous materials site, would not generate safety risks due to proximity to airports/airstrips or impair the implementation of response or evacuation plans. Risks currently experienced within the project site would not be increased through implementation of the LMP. There would be **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of specific management goals relative to their anticipated benefits.

Hydrology and Water Quality

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
8. HYDROLOGY AND WATER QUALITY. Would the project:				
a) Violate any water quality standards or waste discharge requirements?			☒	
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?			☒	
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?			☒	
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?			☒	
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?			☒	
f) Otherwise substantially degrade water quality?			☒	

g)	Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				☒
h)	Place within a 100-year flood hazard area structures which would impede or redirect flood flows?				☒
i)	Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?			☒	
j)	Inundation by seiche, tsunami, or mudflow?				☒

DISCUSSION

8.a – 8.f, 8.i:

The erosion of an existing access road is identified in the LMP as a current contributor to degradation of adjacent habitat through sedimentation. Road maintenance is a management goal identified in the LMP. This maintenance would ensure continued safe access to the hatchery and minimize erosion from impacting adjacent habitats. Rather than resulting in potential impacts, road maintenance identified in the LMP would effectively minimize impacts that would occur if no action were taken. Maintenance activities and implementation of the LMP would place people and equipment within the vicinity of several water features within the project site. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to §§15162-15164, article 11 and articles 18 and 19 of the CEQA Guidelines (Types of EIRs and Statutory and Regulatory Exemptions respectively). The implementation of an ecosystem-level management plan, with a primary goal of protecting the continued existence of Lahontan cutthroat trout, would require special consideration for hydrology and water quality. Any activities that may impact water quality would be subject to relevant local, state and federal regulations, including the Alpine County Code, the state and federal Endangered Species Acts and the Clean Water Act. Through adherence to appropriate regulations and securing of necessary permits, the project would result in impacts that are considered **less than significant.**

8.g, 8.h, 8.j:

The proposed project would not result in the construction of housing or structures. Existing hazards generated by the area's hydrology would not be heightened or exacerbated through implementation of the LMP. There would be **no impact.**

REFERENCES

See the attached Heenan Lake Wildlife Area Land Management Plan for further discussion of habitat degradation associated with road erosion, and the effective avoidance of potential impacts associated with maintenance goals in the LMP.

Land Use and Land Use Planning

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
9. LAND USE AND PLANNING. Would the project:				
a) Physically divide an established community?				☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with				☒

	jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				
c)	Conflict with any applicable habitat conservation plan or natural community conservation plan?				☒

DISCUSSION
9.a – 9.c:
The project would not result in land use conflicts, which could impact communities or habitats. It is a management plan that would not result in the construction of facilities, but rather focuses on the maintenance and enhancement of facilities and habitats. Land use would not change as a result of the project. Currently there are no habitat or natural community conservation plans that are applicable to the HLWA. In the future, any proposed tasks would be required to adhere to habitat or conservation plans that may be applicable at that time. Currently, the protection and preservation characteristics of the LMP would not divide a community or conflict with plans policies or regulations. The proposed project would have **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of current land uses in the project area. The LMP would not result in changes to these uses.

Mineral Resources

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
10. MINERAL RESOURCES. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?				☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				☒

DISCUSSION
10.a, 10.b:
The proposed project would not result in lost availability of resources that would be available in pre-project conditions. The LMP would not result in resource extraction. The project would have **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for a description of land use history within the project site, which does not include mineral extraction.

Noise

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact

11. NOISE. Would the project:		
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☒	
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☒	
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?		☒
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☒	
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?		☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?		☒

DISCUSSION

11.a, 11.b, 11.d

Some activities identified in the proposed LMP could generate temporary increases in noise and ground-borne vibration levels. The HLWA is isolated and these temporary increases in levels are not expected to impact areas outside the project site. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). Implementation of the management activities contained within the LMP would be required to remain consistent with relevant state and federal laws intended to protect special-status species and communities. Any potentially significant noise related impacts on wildlife resulting from management activities would be avoided through proper timing of management activities during biologically non-critical timeframes. Temporary increases in noise or vibration levels would result in potential impacts to humans, and wildlife, at levels considered **less than significant.**

11.c, 11.e, 11.f:

The proposed project would not result in permanent increases in ambient noise levels. The project would not result in the construction of residences or structures. Airport/airstrip-generated noise levels would not impact people within the project site at levels that are greater than currently experienced. The project would have **no impact.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of the potential impacts of the proposed Management Plan relative to the anticipated benefits.

Population and Housing

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
12. POPULATION AND HOUSING. Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				☒

DISCUSSION
12.a - 12.c:
The proposed project consists of the implementation of a land management plan. The LMP would not induce growth directly or indirectly. The proposed project would not result in the construction or displacement of people or residences. No infrastructure that could induce population growth is proposed as part of the plan. The project would not construct residences, nor would it displace people or housing. There would be **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan, which describes surrounding land uses and land use history within the project site.

Public Services

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
13. PUBLIC SERVICES. Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the following public services:				
a) Fire protection?				☒
b) Police protection?				☒
c) Schools?				☒
d) Parks				☒
e) Other public facilities?				☒

DISCUSSION
The proposed project would not result in impacts to service ratios, response times or performance objectives. The LMP would not create residences or infrastructures that would create new demands on public services. Future proposed activities, that are consistent with, but not

identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively).The proposed LMP is not expected to generate the need for additional or altered facilities that would be required to provide these public services. There would be **no impact.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan

Recreation

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
14. RECREATION.				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?			☒	
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?			☒	

DISCUSSION
The project would not create increased demand on recreational facilities above existing levels. It would not include construction of new recreational facilities. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). Existing public use activities, such as hunting, fishing and sightseeing, could result in impacts to the HLWA. As a component of the LMP, public use would be monitored to ensure impacts are not being generated within the HLWA. Information would be posted at points of public access that would inform the public on proper conduct within the HLWA. The project does not propose the expansion or construction of recreational facilities. The proposed LMP would not impact area parks or recreational facilities, as it would not result in the construction of residences or structures. The project would result in potential impacts that are considered **less than significant.**

REFERENCES
See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of public use within the project site.

Transportation and Traffic

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
15. TRANSPORTATION/TRAFFIC. Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and				☒

	capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?				
b)	Exceed, either individually or cumulatively, a level of service (LOS) standard established by the county congestion management agency for designated roads or highways?				☒
c)	Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				☒
d)	Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				☒
e)	Result in inadequate emergency access?				☒
f)	Result in inadequate parking capacity?				☒
g)	Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?				☒

DISCUSSION

15.a – 15.g:

The HLWA is accessed via Highway 89 by way of two unpaved roads. One of these roads continues along the eastern shore of the Lake and then along Heenan Creek. This road provides access to the egg taking station. The other unpaved road travels the western shore of the Lake and then turns southward towards Bagley Valley. These roads are gated and public access is limited to foot or horseback. The gates are a sufficient distance from the Highway and there is off street parking to alleviate the potential for traffic hazards generated by public use. The proposed project is an LMP and would not result in potential traffic impacts in the project area. Increased traffic, increased traffic hazards, degradation of LOS, impacts to air traffic patterns and other similar impacts are the results of projects that propose construction, population growth, increased daily trips, et cetera. The management activities included in the LMP would result in the maintenance of unpaved roads within the project site to avoid continued degradation. The proposed LMP is not expected to change the levels of use, and subsequently traffic volumes, in the area. The proposed project would result in **no impact.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan for further discussion of vehicular access to, and within, the project site.

Utilities and Service Systems

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
16. UTILITIES AND SERVICE SYSTEMS. Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				☒

b)	Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				☒
c)	Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				☒
d)	Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				☒
e)	Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?				☒
f)	Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				☒
g)	Comply with Federal, State, and local statutes and regulations related to solid waste?				☒

DISCUSSION

The proposed project is an LMP and would not result in increased demand on utilities or service systems. There are no residences in the HLWA and none would be constructed as a result of the proposed LMP. The proposed LMP would not result in the construction of new infrastructures, population growth or other similar effects. The proposed LMP would provide a framework for the maintenance and improvement of existing facilities. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). The proposed LMP is not expected to result in potential impacts to utilities and service systems that are experienced currently within the project site. The project would have **no impact.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan

Mandatory Findings of Significance

Issues (and Supporting Information Sources)	Potentially Significant Impact	Less Than Significant With Mitigation	Less than significant Impact	No Impact
17. MANDATORY FINDING OF SIGNIFICANCE. Would the project:				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered			☒	

	plant or animal or eliminate important examples of the major periods of California history or prehistory?	
b)	Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒
c)	Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? Disturb paleontological resources?	☒

DISCUSSION

17.a:

The proposed LMP would establish of a framework for the implementation of management goals identified for the project site. Implementation of these goals would not result in potentially significant environmental impacts. Rather, the project would result in a more effective management of special status species and related habitats. Relative to the above-mentioned environmental resources, the project is expected to result in benefits rather than potentially significant impacts. However, active management practices identified in the proposed LMP could result in impacts if not implemented after careful consideration of the area's environmental characteristics and pursuant to pertinent regulations. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). All tasks that would be implemented as a result of the adoption of the proposed LMP would be conducted pursuant to relevant regulations. While there is the potential for specific tasks to generate impacts, the goal of the proposed LMP is to generate a net benefit for the site's biological and cultural resources. Adherence to all regulatory requirements, including acquisition of all necessary permits, would ensure the proposed project generates impacts at levels considered **less than significant.**

17.b:

The proposed LMP would not result in the construction of new infrastructures, population growth or other similar effects. The proposed LMP is expected to result in a net benefit for the area's environmental conditions. Potential impacts that might be generated by the implementation of the proposed LMP would be temporary in nature and less than significant. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively). As such cumulative potential impacts would occur at levels considered **less than significant.**

17.c:

Implementation of the proposed LMP would be carried out in accordance with all applicable regulations. Land use within the HLWA would not be significantly changed through implementation of the proposed LMP. As a result, direct and indirect impacts on human beings or paleontological resources are not anticipated. Future proposed activities, that are consistent with, but not identified as tasks within, the LMP would be subjected to review as required by CEQA. The amount of review required for future projects not identified in this LMP would be determined

pursuant to articles 11, 18 and 19 of the CEQA Guidelines (Addendums and Statutory and Regulatory Exemptions respectively).. Therefore, the proposed project is expected to generate impacts at levels that are considered **less than significant.**

REFERENCES

See attached Heenan Lake Wildlife Area Land Management Plan.

ATTACHMENT B

Public Comments and Department Responses

Comment 1

Comments

Why not reinitiate the fee imposed on Heenan Lake anglers for their fishing use as it has been done in the past? It would help to provide the much needed moneys to assist in the Cutthroat Trout Management goals (egg taking/hatching) as well as Trophy Trout/Heritage fishing operations.

Response to Comment 1:

The Director of the Department of Fish and Game made a determination to stop charging the access fee for Heenan Lake. The reasoning was that the Department would fund the program from existing resources and the fee was an unnecessary burden on anglers.

Comment 2

How will the annual Heenan Lake water rights allocations be implemented? DFG wants the water to stay in the lake with no water flowing off the lake by way of the overflow spillway. If each year DFG gets its allotment without releasing any water into the East Fork Carson River, the lake will fill and spill. Even in drought years, as expected in 2007, each water rights owner reduces his share if the expected water flowing into Heenan Lake by the April 1 Water Resources evaluation of the water available in the Heenan Lake watershed. How is that number of acre feet determined for each and when it is diverted from Heenan Lake? How is that amount determined when the DFG's water from previous years has been stored in the lake and should not be considered part of the Heenan Lake water to be allocated to the other water rights owner? Is there a formula is used to insure DFG continues to receive and store its fair share from year to year?

Response to Comment 2

The Department of Fish and Game entered into an operation, maintenance and cost-sharing agreement in 1999 with the water rights holders at that time. The reservoir shall be operated in accordance with the Alpine Decree and other jurisdictional agencies to obtain a full reservoir on or before 1 July of each year. The total of all water accumulated at any time during each year shall be allocated to each owner in accordance with each owner's ownership interest in the water rights. Each owner may use or release its share of water rights or storage in the reservoir according to the Alpine Decree to meet its water supply and operation objectives. In the event of any conflict between or among owners regarding the use or release of water in storage in the reservoir, the available water and release capacity shall be allocated in proportion to the amount of water then remaining in storage of each owner proposing a release. An owner may carry over water stored during one water year but not released during that year into another water year, provided that any such carryover shall not interfere with any other owner's allocated reservoir capacity in subsequent years.

The Department of Fish and Game has managed its share of the water right to maintain storage in Heenan Lake for Lahontan cutthroat trout, a federally listed threatened species. Should additional water rights be acquired, these could be used for maintenance of downstream riparian habitat.

Comment 3

There is s documented **rumor** that DFG has promised to open the road on the west side of Heenan Lake to public access. Why could/would this future action even be considered when so many of the biological event goals and public use event goals as mentioned numerous times in this document would be jeopardized? What, if any, beneficial effect will it have for the management of the DFG property?

Response to Comment 3:
The California Department of Fish and Game has reviewed the possibility of opening the gate to allow public access into Bagley Valley. The gate has remained closed due to potential impacts to natural resources, including nesting bald eagles.

Opening the gate to the public for access would also require the United States Forest Service, which manages lands south of the Heenen Lake Wildlife Area boundary, to determine that vehicular access by the public is warranted through their National Environmental Policy Act process.

The Department will continue to evaluate the potential for providing additional wildlife related recreational opportunities that are consistent with the proposed management of the area. Currently, staff limitations and the lack of operating funds to pay added costs and expenses from opening the gate together preclude this option. Also, the USFS must conduct appropriate environmental reviews, before the gate will be opened to public vehicular access.

Comment 4

Why utilize Sage grouse as the main indicator Species to manage its habitat requirements on the Heenan Lake property? There has been a very limited, rumored, occurrence of this species on the DFG property. Why not try to restore and save the deer habitat which used to produce abundant deer populations?

Response to Comment 4:
Sage grouse has not been observed within the Heenan Lake Wildlife Area (HLWA). Sign of sage grouse presence has been observed in Bagley Valley, south of the boundary line of the HLWA. Sage grouse are an important game species and there is currently an interstate working group to manage this species. A Greater Sage-grouse Comprehensive Conservation Strategy developed by the National Framework Team had been completed and is currently being published.

Furthermore, there have been petitions to list the species in Mono County and elsewhere. We believe habitat that benefits sage grouse will also benefit deer. However, due to juniper encroachment into sagebrush communities, habitat capability has been compromised.

Management activities may include removal of some junipers to enhance and promote early seral stage communities that benefit many early-seral stage species, including deer.

Comment 5

I thought I'd take a few minutes and respond to the proposed plan regarding the Heenan Lake area.

I am a long-time resident of Gardnerville, Nv and have enjoyed this area for almost twenty years. I understand that the road from the west side of the lake down Bagley valley is proposed to be opened for general usage. I think this is not in the best interest of the Management area for a number of reasons.

In a time of dwindling manpower and financial resources, this would put further strains on both the financial and enforcement requirements for the area. As it is now, if you want to go down to the East Carson, you have to walk. Nothing wrong with that. I am 64, and realize that I will not be able to do that for too many more years, but to open the road would leave the area vulnerable to poaching the broodstock fish out of the lake, which are already an threatned species, as well as turning it into another illegal dumping ground for trash.

There would also be the potential for the introduction of unwanted species of fish into Heenan Lake. This has already happened in several lakes in the area, so I believe that this is a legitimate concern. As you have experienced first hand, this can be a real nightmare to reverse.

I believe that the detrimental effects of this road opening will be far out-weighed by the beneficial effects to the few people who are unwilling to walk the road down to fish the lower end of Bagley Valley. Addidtional vehicular traffic on this road would also disturb the bald eagle nesting area, and bring in more "souvenir hunters" to scour the region for Indian artifacts.

Response to Comment 5:

The California Department of Fish and Game has reviewed the possibility of opening the gate to allow public access into Bagley Valley. The gate has remained closed due to potential impacts to natural resources, including nesting bald eagles.

Opening the gate to the public for access would also require the United States Forest Service, which manages lands south of the Heenan Lake Wildlife Area boundary, to determine that vehicular access by the public is warranted through their National Environmental Policy Act process.

The Department will continue to evaluate the potential for providing additional wildlife related recreational opportunities that are consistent with the proposed management of the area. Currently, staff limitations and the lack of operating funds to pay added costs and expenses from opening the gate together preclude this option. Also, the USFS must conduct appropriate environmental reviews, before the gate will be opened to public vehicular access.

Comment 6

Comments

The new management plan seems satisfactory considering there are almost no changes.

Friends of Hope would like to see the road down Bagley Valley remain closed to motorize use, we hope you continue with that policy.

Our group also supports the possible acquisition of more water rights

Thank you,

Debbi Waldear

Friends of Hope Valley

Response to Comment 6

The California Department of Fish and Game has reviewed the possibility of opening the gate to allow public access into Bagley Valley. The gate has remained closed due to potential impacts to natural resources, including nesting bald eagles.

Opening the gate to the public for access would also require the United States Forest Service, which manages lands south of the Heenan Lake Wildlife Area boundary, to determine that vehicular access by the public is warranted through their National Environmental Policy Act process.

The Department will continue to evaluate the potential for providing additional wildlife related recreational opportunities that are consistent with the proposed management of the area. Currently, staff limitations and the lack of operating funds to pay added costs and expenses from opening the gate together preclude this option. Also, the USFS must conduct appropriate environmental reviews, before the gate will be opened to public vehicular access.

Alpine County Board of Supervisor's Comments
6/14/07

Comment 7

5.a: Cultural Resources
The unpaved road traveling along the Western shore of the Heenan Lake is a historical county road under the provisions of RS 2477. This road is gated at the entry with access limited to foot or horseback. The road, however, is the only access to Vaquero Cow Camp, a historic resource, located in Bagley Valley. Restrictions to access could potentially limit the ability of the County or other interested parties to engage in future preservation or maintenance activities related to this resource. The LMP should identify this as a potential activity in the future and evaluate the impact.
Appendix A, referenced in the Plan (pg 9), indicates "not for public distribution."

Response to Comment 7:

The lands accessed by the road are managed by the State of California and U.S. Forest Service. Maintenance or preservation work is conducted by the appropriate land-owning agency and therefore access is not warranted to other parties without permit or permission.

Additional access to these lands will be evaluated by the appropriate land management agency to make sure that access is congruent with the purpose of the acquisition and does not conflict with management goals and objectives for the area.

Comment 7a

Appendix A, referenced in the Plan (pg 9), indicates "not for public distribution."

Response to Comment 7a:

Appendix A refers to sensitive cultural resource information. Due to the sensitivity and risk of vandalism, this information is kept from public view and is used only for management purposes.

Comment 8

8.a - 8.f, 8i: Hydrology and Water Quality
The County supports road maintenance as an important management goal in reducing erosion and other water quality issues.

Response to Comment 8:

The Department of Fish and Game maintains the roads within the Heenen Lake Wildlife Area boundaries as needed. We agree that this is important for reducing erosion and water quality issues.

Comment 9

14b: Recreation
"The County supports expansion of public recreation in the area. Lack of permitted motorized access along the existing road that travels the western portion of the lake to Bagley Valley significantly limits the ability of special needs populations. Such as the elderly or disabled, from enjoying the area. The County supports implementation of a fee-based permit system that would allow limited public access to the U.S. Forest Service boundary line.
Contrary to the statement made in the Draft IS ("The proposed LMP is not expected to change levels of use, and subsequently traffic volumes, in the area."), the County supports some limited form of access that we believe will increase public benefit.
Additionally, as part of the *Alpine Winter Recreation Strategy,* these lands may prove desirable in the future for other forms of recreation, including expansion of winter sports activities such as snowmobiling and cross country skiing. This is critical to the economic viability of the county. The final LMP should recognize the need of the County to utilize these lands for local economic and broad public benefit. The LMP should include this as a potential activity in the future and evaluate the impact.

Response to Comment 9:

The Department will continue to evaluate the potential for providing additional wildlife related recreational opportunities that are consistent with the proposed management of the area. Currently, staff limitations and the lack of operating funds to pay added costs and expenses from opening the gate together preclude this option. Also, the USFS must conduct appropriate environmental reviews, before the gate will be opened to public vehicular access.

Motorized vehicles can negatively impact wildlife species from harassment, noise, interruption of denning, foraging or other critical activities.

Limiting vehicular access to the Heenen Lake Wildlife Area, protects the Lahontan cutthroat trout broodstock by reducing the potential for poaching fish or fishing out of season and the potential for illegal introduction of live bait. Should these roads be opened, or use increased in the winter, additional patrol by law enforcement would be warranted. At this time, the Department does not have the resources to add personnel that would be necessary to adequately enforce this area.

There are federal lands outside of the Heenen Lake Wildlife Area that allows for the kind of recreational opportunities described. Currently, low-impact activities such as: hunting, fishing, horseback riding, mountain biking, hiking and crosscountry skiing are allowed on the Heenen Lake Wildlife Area.

Comment 10

J 5.a: **Transportation**
The County supports the expansion of controlled motorized access to adjacent U.S. Forest Service lands. To that end, the County has previously discussed with DFG the possibility of strategically placing large boulders along the western side of Heenan Lake to prevent motorized intrusion, should such access by permitted. The LMP should identify this as a potential activity in the future and evaluate the impact

Response to Comment 10:

The Department recognizes that boulders are needed to prevent people from driving around the gate and illegally accessing the wildlife area. In accordance with the goals of the LMP to manage recreational resources, the Department will conduct the appropriate activities to prevent illegal actions in the wildlife area.

Comment 11

Heenan Lake and its surrounding lands are a valued public resource in Alpine County. Protecting the integrity of the Lahontan cutthroat trout broodstock while providing meaningful public recreational experiences is critical to the Board of Supervisors. Our future economic viability relies heavily on our ability to balance these competing needs for the greatest public good. The Department of Fish and Game's active participation and cooperation is essential in achieving this goal.

Response to Comment 11:

The Department agrees that balancing the needs for sensitive biological resources and public desires can be a challenge. The purpose of acquisition for the Heenen Lake Wildlife Area was not to provide a recreation area for the public, but to provide habitat for endangered Lahontan Cutthroat trout and to provide habitat for terrestrial species such as deer, bear, upland game birds, waterfowl and sensitive species such as bald eagle, white pelicans, osprey and many other species.

However, recreational activities that do not conflict with this primary objective are allowed. As stated previously, hunting, fishing, horseback riding, mountain biking, hiking and cross-country skiing are allowed on the Heenen Lake Wildlife Area.

RE: SCH# 2007032055 – Heenen Lake Wildlife Management Plan Update, Alpine County

Dear Ms. Weist:

The Native American Heritage Commission has reviewed the Notice of Preparation (NOP) regarding the above referenced project. The California Environmental Quality Act (CEQA) states that any project that causes a substantial adverse change in the significance of an historical resource, which includes archeological resources, is a significant effect requiring the preparation of an EIR (CEQA guidelines 15064(b)). To adequately comply with this provision and mitigate project-related impacts on archaeological resources, the Commission recommends the following actions be required:

Comment 12

- ✓ Contact the appropriate Information Center for a record search to determine:
  - If a part or all of the area of project effect (APE) has been previously surveyed for cultural resources.
  - If any known cultural resources have already been recorded on or adjacent to the APE.
  - If the probability is low, moderate, or high that cultural resources are located in the APE.
  - If a survey is required to determine whether previously unrecorded cultural resources are present.

Comment 13

- ✓ If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
  - The final report containing site forms, site significance, and mitigation measurers should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for public disclosure.
  - The final written report should be submitted within 3 months after work has been completed to the appropriate regional archaeological Information Center.

Comment 14

- ✓ Contact the Native American Heritage Commission for:
  - A Sacred Lands File Check. **Sacred Lands File check completed, no sites indicated**
  - A list of appropriate Native American Contacts for consultation concerning the project site and to assist in the mitigation measures. **Native American Contacts List attached**

Comment 15

- ✓ Lack of surface evidence of archeological resources does not preclude their subsurface existence.
  - Lead agencies should include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources, per California Environmental Quality Act (CEQA) §15064.5(f). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American, with knowledge in cultural resources, should monitor all ground-disturbing activities.
  - Lead agencies should include in their mitigation plan provisions for the disposition of recovered artifacts, in consultation with culturally affiliated Native Americans.
  - Lead agencies should include provisions for discovery of Native American human remains in their mitigation plan. Health and Safety Code §7050.5, CEQA §15064.5(e), and Public Resources Code §5097.98 mandates the process to be followed in the event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

Sincerely,

Katy Sanchez

Katy Sanchez
Associate Governmental Program Analyst
(916) 653-4040

CC: State Clearinghouse

General Response:

The proposed LMP is a programmatic document, as such; it does not describe "typical" project activities, such as grading or construction. Furthermore, large-scale earth moving and construction activities are not likely activities identified in the proposed LMP. The proposed LMP sets forth a series of goals specifically intended to identify, map and avoid generating impacts to cultural resources.

Comment 12

✓ Contact the appropriate Information Center for a record search to determine:
- If a part or all of the area of project effect (APE) has been previously surveyed for cultural resources.
- If any known cultural resources have already been recorded on or adjacent to the APE.
- If the probability is low, moderate, or high that cultural resources are located in the APE.
- If a survey is required to determine whether previously unrecorded cultural resources are present.

Response to Comment 12:

Pursuant to CEQA (PRC §21000, et seq.) and the Guidelines (CCR §15000, et seq.), the Genesis Society conducted an Archaeological Survey for the proposed LMP. This included a records search at the Central California Information Center at CSU, Stanislaus. The Survey also involved consultations with relevant agencies, individuals and documents and a field inspection of the project site.

Comment 13

- ✓ If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
  - The final report containing site forms, site significance, and mitigation measurers should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for pubic disclosure.
  - The final written report should be submitted within 3 months after work has been completed to the appropriate regional archaeological Information Center.

Response to Comment 13:

The archaeological Survey was used to inform the environmental review, which is set forth in the proposed Initial Study/Negative Declaration. The Archaeological Survey will be used to implement the proposed LMP in a manner that will ensure the cultural resources within the Wildlife Area are not subjected to impacts. The information will be used by the Department, and will not be available for public review.

Comment 14

- ✓ Contact the Native American Heritage Commission for:
  - A Sacred Lands File Check. **Sacred Lands File check completed, no sites indicated**
  - A list of appropriate Native American Contacts for consultation concerning the project site and to assist in the mitigation measures. **Native American Contacts List attached**

Response to Comment 14:

As part of the Archaeological Survey, the Genesis Society consulted:

- US Department of the Interior, National Register (1986, Supplements to 12/05).
- The California Register of Historical Resources.
- The California Inventory of Historic Resources (State of California 1976).
- The California Historical Landmarks (State of California 1996).
- The California Points of Historical Interest (May 1992 and updates).
- The Historic Property Data File (OHP 10/02).
- The CALTRANS State and Local Bridge Survey (1989 and updates).
- The Survey of Surveys (1989).
- The Native American Heritage Commission.
- Washoe Tribe of Nevada and California, William Dancingfeather, Carson City, Nevada.
- Washoe Tribe of Nevada and California, Brian Wallace, Gardnerville, Nevada.
- GLO Plat Maps (1874-1875 and 1865-1876), and historic USGS quad (1941 Heenan Lake).
- Existing published and unpublished documents relevant to prehistory, ethnography, and early historic developments in the vicinity.

Comment 15

✓ Lack of surface evidence of archeological resources does not preclude their subsurface existence.

- Lead agencies should include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources, per California Environmental Quality Act (CEQA) §15064.5(f). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American, with knowledge in cultural resources, should monitor all ground-disturbing activities.
- Lead agencies should include in their mitigation plan provisions for the disposition of recovered artifacts, in consultation with culturally affiliated Native Americans.
- Lead agencies should include provisions for discovery of Native American human remains in their mitigation plan. Health and Safety Code §7050.5, CEQA §15064.5(e), and Public Resources Code §5097.98 mandates the process to be followed in the event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

Response to Comment 15:

For the sake of clarity, the DFG would like to reiterate that cultural resources within the project site, whether currently identified or yet-to-be discovered, are to be protected to the maximum extent practicable. The National Historic Preservation Act, Native American Graves Protection and Repatriation Act and the Archaeological Resources Protection Act are potentially applicable federal regulations. At the state level, Public Resources Code, §5097.94, §5097.98, and §5097.99 are potentially applicable regulations. In addition to these sections of the PRC, Health and Safety Code §7050.5 pertains to the discovery of previously undiscovered human remains. As identified in the proposed Initial Study/Negative Declaration:

- If previously unidentified cultural resources are discovered through the implementation of the LMP all work shall cease in the area. A professional archaeologist shall be consulted to evaluate the cultural resource(s) and, if necessary, describe appropriate mitigation to be implemented.
- If human remains are discovered on the project site, work will cease in the project area and the coroner will be contacted immediately. Activities relative to newly discovered human remains will be regulated pursuant to applicable sections of the Public Resources and Health and Safety Codes.

ATTACHMENT C

Heenan Lake Wildlife Management Plan Study Area
Class I Archaeological Survey
(**Not for Public Distribution**)

ATTACHMENT D

Soil Series Descriptions

LOCATION ASPOCKET CA

Established Series
Rev. EWB-JVC
05/2006

ASPOCKET SERIES

The Aspocket series consists of deep, well drained soils that formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Aspocket soils are on mountains. Slopes are 4 to 30 percent. The mean annual precipitation is about 30 inches and the mean annual temperature is about 40 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic Pachic Argicryolls

TYPICAL PEDON: Aspocket gravelly sandy loam--forest land. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 15 percent gravel and 3 percent stones.

A1--0 to 5 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist, moderate fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; common very fine and fine tubular and interstitial pores; 15 percent gravel and 5 percent stones; neutral; clear wavy boundary. (3 to 7 inches thick)

A2--5 to 13 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine through coarse roots; common very fine tubular and interstitial pores; 25 percent gravel and 10 percent stones; neutral; clear wavy boundary. (5 to 12 inches thick)

Bt1--13 to 22 inches; brown (7.5YR 5/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and common fine through coarse roots; common very fine tubular and interstitial pores; common faint clay bridges between sand grains; 25 percent gravel and 20 percent stones; slightly acid; clear wavy boundary. (7 to 12 inches thick)

Bt2--22 to 38 inches; brown (7.5YR 5/3) very stony clay loam, dark brown (7.5YR 3/3) moist; strong medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; common very fine through coarse roots; common very fine tubular and interstitial pores; common distinct clay films on faces of peds and lining pores; 30 percent gravel and 25 percent stones; slightly acid; clear wavy boundary. (8 to 20 inches thick)

2Bt3--38 to 54 inches; brown (7.5YR 5/4) gravelly clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; few very fine and common fine through coarse roots; common very fine tubular and interstitial pores; common distinct clay films on faces of peds and lining pores; 15 percent gravel and 5 percent cobbles; 30 percent paragravel; slightly acid. (10 to 18 inches thick)

2Cr--54 to 64 inches; weathered andesitic tuff.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.75 mile north of the Fire Lookout on Leviathan Peak; approximately 1,100 feet north and 700 feet east of the southwest corner of section 19, T. 10 N., R. 21 E.; USGS Topaz Lake 7.5 minute topographic quadrangle; 38 degrees 41 minutes 44.7 seconds north latitude and 119 degrees 36 minutes 36.7 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October; Xeric moisture regime.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 47 to 52 degrees F.

Mollic epipedon thickness - 30 to 50 inches, includes the Bt1 and Bt2 horizons.

Depth to base of argillic horizon - 40 to 60 inches.

Depth to bedrock - 40 to 60 inches to a paralithic contact. The paralithic materials below the contact are weathered volcanic rock such as andesitic tuff.

Sodium fluoride pH - 8.5 to 9.5.

Particle-size control section - Clay content: Averages 18 to 27 percent; Rock fragments: Averages 35 to 60 percent. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizons - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 1 or 2, dry or moist.
Organic matter content: 5 to 8 percent.
Reaction: Slightly acid or neutral.

Bt1 and Bt2 horizons - Hue: 10YR or 7.5YR.

Chroma: 2 or 3, dry or moist.
Texture: Very stony loam or very stony clay loam.
Clay content: 18 to 27 percent.
Rock fragments: 35 to 60 percent.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

2Bt3 horizon - Hue: 10YR or 7.5YR.
Value: 5 or 6 dry, 4 or 5 moist.
Chroma: 4 or 6 dry or moist.
Texture: Gravelly clay loam, very gravelly clay loam, or very gravelly loam.
Clay content: 25 to 35 percent.
Rock fragments: 15 to 50 percent.
Pararock fragments: 15 to 30 percent paragravel.
Reaction: Slightly acid or neutral.

COMPETING SERIES: There are currently no other series in this family.

GEOGRAPHIC SETTING: Aspocket soils are on mountains. They typically occur on footslope positions. They formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Slopes are 4 to 30 percent. Elevations range from 7,000 to 10,000 feet. The climate is subhumid-continental with cold, moist winters and cool, dry summers. The mean annual precipitation is 20 to 45 inches, mean annual temperature is 36 to 43 degrees F., and the frost-free period is 30 to 60 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Celeridge, Monibasin, and Vermdig soils. Celeridge soils are shallow to lithic contacts and have mixed mineralogy. Monibasin soils are very deep and have mixed mineralogy. Vermdig soils have mollic epipedons less than 16 inches thick, have aquic conditions within 40 inches of the soil surface during the spring and early summer, and have mixed mineralogy.

DRAINAGE AND PERMEABILITY: Well drained; medium surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity).

USE AND VEGETATION: Aspocket soils are used for forest land, recreation, watershed, and wildlife habitat. The native vegetation is mainly a forest canopy of quaking aspen with an understory of snowberry, mountain brome, and bluegrass.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 4,200 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 38 inches (A1, A2, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 13 to 54 inches (Bt1, Bt2, and 2Bt3 horizons).

Paralithic contact - The boundary at 54 inches to underlying soft, weathered bedrock (2Cr layer).

Particle-size control section - The zone from 13 to 33 inches (Bt1 horizon and part of the Bt2 horizon).

The isotic mineralogy class is based on the field determined values for sodium fluoride pH.

National Cooperative Soil Survey
U.S.A.

LOCATION BAGVAL CA

Established Series
Rev. EWB-JVC
05/2006

BAGVAL SERIES

The Bagval series consists of very deep, well drained and moderately well drained soils that formed in alluvium derived from altered tuff, tuff-breccia, and andesite. Bagval soils are on fan remnants and low stream terraces. Slopes are 0 to 8 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Fine, smectitic, frigid Typic Haploxererts

TYPICAL PEDON: Bagval clay loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 25 percent gravel.

A--0 to 2 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable, moderately sticky and moderately plastic; few very fine roots; common very fine interstitial pores; 10 percent gravel; neutral; abrupt wavy boundary. (1 to 3 inches thick)

Bt--2 to 9 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to strong fine angular blocky; many very fine and fine roots; common very fine tubular and interstitial pores; prominent pressure cutans on faces of peds; 1 to 2 cm wide vertical cracks; 5 percent gravel; slightly acid; clear wavy boundary. (5 to 10 inches thick)

Btss--9 to 30 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) moist; strong coarse prismatic parting to strong medium and coarse angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine through medium roots; common very fine tubular and interstitial pores; 40 percent intersecting slickensides bounding wedge-shaped peds; 1 to 2 cm wide vertical cracks; 10 percent gravel; neutral; clear wavy boundary. (14 to 30 inches thick)

Btkss1--30 to 45 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common very fine through medium roots; few very fine tubular and interstitial pores; many (40 percent) intersecting slickensides bounding wedge-shaped peds; 1 to 2 cm wide vertical cracks; 10 percent gravel; secondary carbonates segregated as common fine and medium masses; noneffervescent matrix and strongly effervescent carbonate masses; neutral; clear wavy boundary. (12 to

20 inches thick)

Btkss2--45 to 60 inches; brown (7.5YR 5/3) clay, dark brown (7.5YR 3/3) moist; strong medium prismatic structure parting to strong medium and coarse angular blocky; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular and interstitial pores; common intersecting slickensides bounding wedge-shaped peds; 10 percent gravel; secondary carbonates segregated as many fine and medium masses; noneffervescent matrix and strongly effervescent carbonate masses; moderately alkaline.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 2.2 miles south of Heenan Lake; approximately 1,900 feet north and 500 feet west of the southeast corner of section 22, T. 9 N., R. 21 E.; USGS Wolf Creek 7.5 minute topographic quadrangle; 38 degrees 36 minutes 39.1 seconds north latitude and 119 degrees 38 minutes 59.9 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during fall, winter, and spring; usually dry from July through early October; adjacent soils have Xeric moisture regime.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 62 to 65 degrees F.

Mollic epipedon thickness - 30 to 60 inches.

Depth to horizons with secondary carbonates - 30 to 40 inches.

Cracks- 1 to 2 cm wide vertical cracks are present in the upper 30 to 45 inches and are open from July to October in most years.

Particle-size control section - Clay content: 45 to 60 percent; Rock fragments: Averages less than 15 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizon - Hue: 7.5YR or 10YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt horizon - Hue: 7.5YR or 10YR.
Value: 4 or 5 dry, 2 or 3 moist.

Chroma: 1 or 2, dry or moist.
Clay content: 45 to 60 percent.
Rock fragments: 0 to 15 percent.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Btss horizon - Hue: 7.5YR or 10YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 1 or 2, dry or moist.
Clay content: 45 to 60 percent.
Rock fragments: 0 to 15 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Btkss horizons - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 1 or 2, dry or moist.
Clay content: 45 to 60 percent.
Rock fragments: 0 to 15 percent.
Organic matter content: 1 or 2 percent.
Reaction: Neutral through moderately alkaline.
Identifiable secondary carbonates: Occurs as few to many masses or filaments.
Calcium carbonate equivalent: 1 to 5 percent.

COMPETING SERIES: These are the Frenchollow (T), Hawkins, Obnot, and Obray series.

Frenchollow soils have mollic epipedons less than 30 inches thick, have cambic horizons, and have secondary carbonates at depths greater than 40 inches. Hawkins soils do not have argillic horizons and have lower subhorizons with hue of 10YR or 2.5Y. Obnot soils do not have argillic horizons and have mollic epipedons 12 to 23 inches thick. Obray soils do not have argillic horizons and have mean summer soil temperature of 65 to 68 degrees F.

GEOGRAPHIC SETTING: Bagval soils are on fan remnants and low stream terraces. They formed in alluvium derived from altered tuff, tuff-breccia, and andesite. Slopes are 0 to 8 percent. Elevations range from 6,000 to 7,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 40 to 44 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Heenlake, Loope, and Wetbag soils. Heenlake and Loope soils are loamy-skeletal. Wetbag soils have aquic conditions within the upper part of the profile during part of the growing season.

DRAINAGE AND PERMEABILITY: Well drained and moderately well drained; medium surface runoff; very slow permeability (low or moderately low saturated hydraulic conductivity). Endosaturation is present in the moderately well drained phase with an apparent seasonal high water table between 3.3 and 5 feet (deep free water occurrence class) between November and July. Cumulative annual duration class is Persistent. These soils are susceptible to rare flooding for extremely brief periods year-round.

USE AND VEGETATION: Bagval soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly low sagebrush, bottlebrush squirreltail, and bluegrass. The vegetative phase on low stream terraces is dominated by silver sagebrush.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 180 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 60 inches (A, Bt, Btss, Btkss1, and Btkss2 horizons).

Argillic horizon - The zone from 2 to 60 inches (Bt, Btss, Btkss1, and Btkss2 horizons).

Slickensides - The zone from 9 to 60 inches (Btss, Btkss1, and Btkss2 horizons).

Identifiable secondary carbonates - The zone from 30 to 60 inches (Btkss1 and Btkss2 horizons).

Particle-size control section - The zone from 10 to 40 inches (parts of the Btss and Btkss1 horizons).

National Cooperative Soil Survey
U.S.A.

LOCATION CHENHIGH CA

Established Series
Rev. EWB-JVC
05/2006

CHENHIGH SERIES

The Chenhigh series consists of shallow, well drained soils that formed in residuum derived from tuff, tuff-breccia, and andesite. Chenhigh soils are on mountains. Slopes are 4 to 30 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Clayey-skeletal, mixed, superactive, frigid Lithic Argixerolls

TYPICAL PEDON: Chenhigh very gravelly sandy loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 30 percent gravel, 5 percent cobbles, and 5 percent stones.

A--0 to 3 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular and interstitial pores; 45 percent gravel, 5 percent cobbles and 5 percent stones; slightly acid; abrupt wavy boundary. (2 to 5 inches thick)

Bt1--3 to 6 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; strong fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; common very fine and fine roots; common very fine and fine tubular and interstitial pores; many distinct clay films on faces of peds and lining pores; 45 percent gravel and 5 percent cobbles; slightly acid; clear wavy boundary. (2 to 3 inches thick)

Bt2--6 to 10 inches; brown (10YR 4/3) very gravelly clay, dark brown (10YR 3/3) moist; strong fine and medium angular blocky structure; very hard, firm, very sticky and very plastic; common very fine through medium roots; common very fine tubular and interstitial pores; many distinct clay films on faces of peds and lining pores; 45 percent gravel and 5 percent cobbles; neutral; clear wavy boundary. (3 to 6 inches thick)

Bt3--10 to 18 inches; brown (7.5YR 5/3) extremely gravelly clay, brown (7.5YR 4/3) moist; strong fine and medium angular blocky structure; common very fine through medium roots; common very fine tubular and interstitial pores; many prominent clay films on faces of peds and lining pores; 70 percent

gravel and 5 percent cobbles; neutral; clear irregular boundary. (3 to 8 inches thick)

R--18 inches; hard, fractured andesitic tuff.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.6 mile north of Heenan Lake; approximately 300 feet north and 900 feet east of the southwest corner of section 34, T. 10 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 39 minutes 49.0 seconds north latitude and 119 degrees 39 minutes 53.8 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 75 to 90 consecutive days in the four months following the summer solstice; Xeric moisture regime that borders on aridic.

Mean annual soil temperature - 44 to 47 degrees F.

Mollic epipedon thickness - 7 to 14 inches; includes the Bt1 and Bt2 horizons.

Depth to bedrock - 14 to 20 inches to a lithic contact.

Particle-size control section - Clay content: Averages 35 to 50 percent; Rock fragments: Averages 50 to 80 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizon - Value: 4 or 5 dry.
Chroma: 2 or 3, dry or moist.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt1 horizon - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry.
Chroma: 2 or 3, dry or moist.
Texture: Very gravelly clay loam or very gravelly clay.
Clay content: 30 to 45 percent.
Rock fragments: 35 to 60 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Bt2 horizon - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry.
Chroma: 2 or 3, dry or moist.

Texture: Very gravelly clay loam, very gravelly clay, or extremely gravelly clay.
Clay content: 35 to 50 percent.
Rock fragments: 50 to 80 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Bt3 horizon - Hue: 10YR or 7.5YR.
Value: 4 through 6 dry, 4 or 5 moist.
Chroma: 3 or 4, dry or moist.
Texture: Very gravelly clay loam, very gravelly clay, or extremely gravelly clay.
Clay content: 35 to 50 percent.
Rock fragments: 50 to 80 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: There are currently no other series in this family.

GEOGRAPHIC SETTING: Chenhigh soils are on mountains. They typically occur on summit or shoulder positions. They formed in residuum derived from tuff, tuff-breccia, and andesite. Slopes are 4 to 30 percent. Elevations range from 6,500 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Celeridge, Heenlake, Leroman, and Loope soils. These soils are loamy-skeletal. In addition, Heenlake and Leroman soils are moderately deep to paralithic contacts.

DRAINAGE AND PERMEABILITY: Well drained; very high surface runoff; slow permeability (moderately low or moderately high saturated hydraulic conductivity).

USE AND VEGETATION: Chenhigh soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly low sagebrush, antelope bitterbrush, currant, bluegrass, western needlegrass, and mountain brome.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 4,500 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 10 inches (A, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 3 to 18 inches (Bt1, Bt2, and Bt3 horizons).

Lithic contact - The boundary at 18 inches to underlying hard bedrock (R layer).

Particle-size control section - The zone from 3 to 18 inches (Bt1, Bt2, and Bt3 horizons).

National Cooperative Soil Survey
U.S.A.

LOCATION GERDOG CA

Established Series
Rev. EWB-JVC
05/2006

GERDOG SERIES

The Gerdog series consists of very shallow and shallow, well drained soils that formed in colluvium and residuum derived from andesite, tuff, and tuff-breccia. Gerdog soils are on mountains. Slopes are 4 to 30 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Lithic Argixerolls

TYPICAL PEDON: Gerdog very gravelly sandy loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 30 percent gravel, 5 percent cobbles, and 4 percent stones.

A--0 to 3 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine and common fine roots; common very fine interstitial and tubular pores; 40 percent gravel, 5 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary. (1 to 5 inches thick)

Bt1--3 to 7 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine interstitial and tubular pores; few faint clay films bridging sand grains; 40 percent gravel; slightly acid; clear wavy boundary. (3 to 5 inches thick)

Bt2--7 to 9 inches; brown (7.5YR 5/3) very gravelly loam, dark brown (7.5YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; common very fine and fine roots; common very fine interstitial and tubular pores; common faint clay films bridging sand grains; 40 percent gravel; slightly acid; clear wavy boundary. (2 to 4 inches thick)

Bt3--9 to 11 inches; brown (7.5YR 5/3) very gravelly sandy clay loam, dark brown (7.5YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; common very fine and fine roots; common very fine interstitial and tubular pores;

common distinct clay films on faces of peds and lining pores; 40 percent gravel; 30 percent paragravel; slightly acid; clear irregular boundary. (0 to 3 inches thick)

R--11 to 16 inches; hard andesite; slightly weathered in the upper part.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 1.5 miles south-southeast of the Leviathan Mine; approximately 1,600 feet south and 2,200 feet east of the northwest corner of section 26, T. 10 N, R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 41 minutes 14.3 seconds north latitude and 119 degrees 38 minutes 29.7 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 75 to 90 consecutive days in the four months following the summer solstice; Xeric moisture regime that borders on aridic.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 62 to 66 degrees F.

Mollic epipedon thickness - 7 to 14 inches, includes the Bt horizons.

Depth to bedrock - 7 to 14 inches to a lithic contact.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 18 to 25 percent; Rock fragments: Averages 35 to 60 percent, mainly gravel. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizon - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Rock fragments: 35 to 60 percent.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt horizons - Hue: 10YR or 7.5YR.
Chroma: 2 or 3, dry or moist.
Texture: Very gravelly sandy clay loam or very gravelly sandy loam.
Clay content: 18 to 27 percent.
Rock fragments: 35 to 50 percent.

Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: These are the Bellenmine, Celeridge, Cleavage, Cleavmor, Cropper, Gabica, Gaciba, Genoa, Gidwin, Grosschat, Hawkridge, Hutchley, Loope, Mascamp, Melling, Pernog, Pernty, Rozara, Shalcleav, Shalper, Slatter (T), Tractuff, and Tweener series.

Bellenmine, Cleavage, Cleavmor, Cropper, Gaciba, Grosschat, Mascamp, Pernty, Shalper, Slatter, Tractuff, and Tweener soils have an aridic moisture regime. Celeridge, Gabica, Gidwin, and Loope soils have lithic contacts at depths of 14 to 20 inches. Genoa soils are dominated by cobbles in the particle-size control section and have rock fragments that are granitic rocks. Hawkridge soils have mean summer soil temperature of 59 to 62 degrees F. Hutchley soils have subhorizons of the argillic horizon with 28 to 35 percent clay. Melling soils are dry for 45 to 60 consecutive days in the four months following the summer solstice. Pernog soils are dominated by stones and have more than 27 percent clay in some part of the particle-size control section. Rozara soils are dominated by fine gravel, have rock fragments that are granitic rocks, and have 14 to 18 percent clay in the particle-size control section. Shalcleav soils are dominated by channers and flagstones.

GEOGRAPHIC SETTING: Gerdog soils are on mountains. They typically occur on summit and shoulder positions. These soils formed in colluvium and residuum derived from andesite, tuff, and tuff-breccia. Slopes are 4 to 30 percent. Elevations range from 6,500 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Celeridge and Loope soils and the Joecut soil. Joecut soils are very deep and have umbric epipedons.

DRAINAGE AND PERMEABILITY: Well drained; very high surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity).

USE AND VEGETATION: Gerdog soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly low sagebrush, bluegrass, bottlebrush squirreltail, and antelope bitterbrush.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 2,400 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 11 inches (A, Bt1, Bt2, and Bt3 horizons).

Argillic horizon - The zone from 3 to 11 inches (Bt1, Bt2, and Bt3 horizons).

Lithic contact - The boundary at 11 inches to underlying hard bedrock (R layer).

Particle-size control section - The zone from the soil surface to 11 inches (A, Bt1, Bt2, and Bt3 horizons).

The revision of October 2003 updated the taxonomic class from Loamy-skeletal, isotic, frigid Lithic Argixerolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION HEENLAKE CA

Established Series
Rev. EWB-JVC
05/2006

HEENLAKE SERIES

The Heenlake series consists of moderately deep, well drained soils that formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Heenlake soils are on mountains. Slopes are 8 to 50 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Typic Argixerolls

TYPICAL PEDON: Heenlake very stony loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 20 percent gravel, 10 percent cobbles, and 8 percent stones.

A--0 to 6 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular and interstitial pores; 25 percent gravel, 10 percent cobbles, and 10 percent stones; slightly acid; clear wavy boundary. (3 to 7 inches thick)

Bt1--6 to 13 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; common very fine through medium roots; common very fine tubular and interstitial pores; many distinct clay films on faces of peds and lining pores; 40 percent gravel, 10 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary. (3 to 8 inches thick)

Bt2--13 to 18 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; common very fine through coarse roots; common very fine tubular and interstitial pores; many distinct clay films on faces of peds and lining pores; 40 percent gravel and 5 percent cobbles; 5 percent paragravel and 5 percent paracobbles; neutral; clear wavy boundary. (4 to 8 inches thick)

Bt3--18 to 22 inches; 70 percent brown (7.5YR 5/4) and 30 percent grayish brown (10YR 5/2) very gravelly clay loam, 70 percent dark brown (7.5YR 3/4) and 30 percent very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; common very fine through coarse roots; common very fine tubular and interstitial pores; many distinct clay films on faces of peds and

lining pores; 40 percent gravel; 10 percent paragravel; neutral; clear irregular boundary. (4 to 20 inches thick)

Cr--22 to 32 inches; weathered andesitic tuff.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.4 mile south of Heenan Lake; approximately 1,650 feet north and 1,500 feet west of the southeast corner of section 10, T. 9 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 38 minutes 16.2 seconds north latitude and 119 degrees 39 minutes 16.6 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 75 to 90 consecutive days in the four months following the summer solstice; Xeric moisture regime that borders on aridic.

Mean annual soil temperature - 44 to 47 degrees F.

Mollic epipedon thickness - 10 to 20 inches; includes the Bt1 and Bt2 horizons.

Depth to base of argillic horizon - 20 to 40 inches.

Depth to bedrock - 20 to 40 inches to a paralithic contact. The paralithic materials below the contact are weathered volcanic rocks such as andesitic tuff.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 25 to 35 percent; Rock fragments: Averages 35 to 60 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizon - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt1 and Bt2 horizons - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Texture: Very gravelly clay loam, very gravelly loam, or very gravelly sandy clay loam.
Clay content: 25 to 30 percent.
Rock fragments: 35 to 60 percent.

Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Bt3 horizon - Hue: 10YR or 7.5YR.
Value: 3 through 5 moist.
Texture: Very gravelly clay loam or very gravelly sandy clay loam.
Clay content: 27 to 35 percent.
Rock fragments: 35 to 60 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: These are the Clanalpine, Devaul (T), Elaero, Heechee, Holmes, Horrocks, Hoskin, Howcan, Longday, Pequop, Squawtip, Suak, Valmar, Vitale, and Wambolt series.

Clanalpine soils typically have mollic epipedons that do not include the Bt horizons and are dominated by cobbles in the particle-size control section. Devaul soils are deep to paralithic contacts. Elaero soils average 12 to 18 percent clay in the particle-size control section, have rock fragments that are granitic rocks, and have paralithic material of weathered granitic rock in the series control section. Heechee, Holmes, Howcan, Longday, Pequop, and Wambolt soils are very deep. Horrocks soils are deep to lithic contacts. Hoskin, Suak, Valmar, and Vitale soils are moderately deep to lithic contacts. Squawtip soils average 18 to 25 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Heenlake soils are on mountains. They typically occur on footslope and backslope positions. They formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Slopes are 8 to 50 percent. Elevations range from 6,200 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Celeridge, Chenhigh, and Joecut soils. Celeridge and Chenhigh soils have lithic contacts within 20 inches. Joecut soils are very deep and have umbric epipedons.

DRAINAGE AND PERMEABILITY: Well drained; high or very high surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity).

USE AND VEGETATION: Heenlake soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly mountain big sagebrush, antelope bitterbrush, and western needlegrass.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are moderately extensive. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 18 inches (A, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 6 to 22 inches (Bt1, Bt2, and Bt3 horizons).

Paralithic contact - The boundary at 22 inches to underlying soft bedrock (Cr layer).

Particle-size control section - The zone from 6 to 22 inches (Bt1, Bt2, and Bt3 horizons).

The revision of October 2003 updated the taxonomic class from Loamy-skeletal, isotic, frigid Typic Argixerolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION JOECUT CA

Established Series
Rev. EWB-JVC
05/2006

JOECUT SERIES

The Joecut series consists of very deep, moderately well drained or well drained soils that formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Joecut soils are on mountains. Slopes are 15 to 50 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, isotic, frigid Ultic Palexeralfs

TYPICAL PEDON: Joecut very gravelly peaty loam--forest land. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 15 percent gravel, 15 percent cobbles, 5 percent stones, and 5 percent boulders.

Oi--0 to 1 inch; slightly decomposed plant material composed of fibrous needle litter. (0 to 2 inches thick)

A1--1 to 2 inches; very dark gray (10YR 3/1) very gravelly peaty loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine interstitial pores; 30 percent gravel, 5 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary. (0 to 1 inches thick)

A2--2 to 5 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine interstitial and tubular pores; 30 percent gravel, 5 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary. (2 to 7 inches thick)

A3--5 to 14 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine interstitial and tubular pores; 45 percent gravel, 5 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary. (8 to 14 inches thick)

Bt1--14 to 22 inches; light brownish gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR

4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; common very fine to medium and many coarse roots; common very fine interstitial and tubular pores; few distinct clay films on faces of peds and lining pores; 40 percent gravel and 5 percent cobbles; slightly acid; clear wavy boundary. (7 to 10 inches thick)

Bt2--22 to 40 inches; 70 percent light olive brown (2.5Y 5/4) and 30 percent brownish yellow (10YR 6/6) very gravelly clay loam, 70 percent olive brown (2.5Y 4/3) and 30 percent yellowish brown (10YR 5/6) moist; moderate fine and medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; few very fine and fine roots; common very fine interstitial and tubular pores; common distinct clay films on faces of peds and lining pores; 40 percent gravel and 5 percent cobbles; slightly acid; clear wavy boundary. (12 to 20 inches thick)

Bt3--40 to 60 inches; 70 percent brownish yellow (10YR 6/6) and 30 percent light olive brown (2.5Y 5/4) very cobbly clay loam, 70 percent yellowish brown (10YR 5/6) and 30 percent olive brown (2.5Y 4/3) moist; massive; hard, very friable, moderately sticky and moderately plastic; few very fine and fine roots; common very fine interstitial and tubular pores; common distinct clay films on rock fragments and lining pores; 25 percent gravel, 20 percent cobbles, and 5 percent stones; slightly acid.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 1.5 miles south-southeast of the Leviathan Mine; approximately 1,800 feet north and 900 feet east of the southwest corner of section 26, T. 10 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 40 minutes 55.6 seconds north latitude and 119 degrees 38 minutes 52.5 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from mid-July through September for 60 to 80 consecutive days in the four months following the summer solstice; Typic xeric moisture regime.

Mean annual soil temperature - 44 to 47 degrees F.

Umbric epipedon thickness - 10 to 20 inches.

Depth to base of argillic horizon - more than 60 inches.

Depth to bedrock - 60 to 80 inches to a paralithic contact. The paralithic materials below the contact are weathered volcanic rocks such as andesitic tuff.

Sodium fluoride pH - 8.5 to 9.5.

Particle-size control section - Clay content: Averages 25 to 35 percent; Rock fragments: Averages 35 to

50 percent. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizons - Value: 3 through 5 dry, 2 or 3 moist; dry value of 3 present only in the A1 horizon.
Chroma: 1 through 3, dry or moist; chroma of 1 present only in the A1 horizon.
Organic matter content: 10 to 15 percent in the A1 horizon (when present) and 2 to 8 percent in the A2 and A3 horizons, decreasing with depth.
Reaction: Moderately acid or slightly acid.

Bt horizons - Hue: 7.5YR through 2.5Y.
Value: 5 or 6 dry, 4 or 5 moist.
Chroma: 2 through 6, dry or moist.
Texture: Very gravelly loam, very gravelly clay loam, very gravelly sandy clay loam, or very cobbly clay loam.
Clay content: 25 to 35 percent.
Rock fragments: 35 to 50 percent.
Reaction: Moderately acid or slightly acid.
Other features: Some pedons have dual or variegated horizon matrix colors in lower subhorizons that may be redox concentrations of iron.

COMPETING SERIES: This is the Southcamp (T) series. Southcamp soils have albic horizons and are dominated by cobbles and stones in the particle-size control section.

GEOGRAPHIC SETTING: Joecut soils are on mountains. They typically occur on footslope and backslope positions. They formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Slopes are 15 to 50 percent. Elevations range from 6,000 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and cool, dry summers. The mean annual precipitation is 20 to 30 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Aspocket, Celeridge, Gerdog, and Leroman soils. All of these soils have mollic epipedons. In addition Aspocket soils are deep to paralithic contacts. Celeridge and Gerdog soils have lithic contacts within 20 inches. Leroman soils are moderately deep to paralithic contacts.

DRAINAGE AND PERMEABILITY: Moderately well drained or well drained; high surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity). Endosaturation is present in a moderately well drained phase with an apparent seasonal high water table between 2.5 and 5 feet (moderately deep and deep free water occurrence classes) between March and June. Cumulative annual duration class is Transitory.

USE AND VEGETATION: Joecut soils are used for forest land, recreation, watershed, and wildlife habitat. The native vegetation are forest canopies of white fir and Sierra juniper on north-facing aspects

or Jeffrey pine on south-facing aspects with an understory of snowberry, bluegrass, and sedge.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are moderately extensive. MLRA 22A.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Organic soil material - The zone from the soil surface to 1 inch (Oi horizon).

Umbric epipedon - The zone from 1 to 14 inches (A1, A2, and A3 horizons).

Argillic horizon - The zone from 14 to 60 inches (Bt1, Bt2, and Bt3 horizons).

Particle-size control section - The zone from 14 to 34 inches (Bt1 horizon and part of the Bt2 horizon).

The isotic mineralogy class is based on the field determined values for sodium fluoride pH.

National Cooperative Soil Survey
U.S.A.

LOCATION LEROMAN CA

Established Series
Rev. EWB-JVC
05/2006

LEROMAN SERIES

The Leroman series consists of moderately deep, well drained soils that formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Leroman soils are on mountains. Slopes are 8 to 30 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Pachic Argixerolls

TYPICAL PEDON: Leroman very gravelly sandy loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 30 percent gravel, 5 percent cobbles, and 5 percent stones.

A--0 to 5 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine and fine roots; common very fine tubular and interstitial pores; 45 percent gravel, 5 percent cobbles, and 5 percent stones; neutral; clear wavy boundary. (4 to 8 inches thick)

Bt1--5 to 16 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; many very fine through medium roots; common very fine tubular and interstitial pores; common faint clay films on ped faces and lining pores; 35 percent gravel and 10 percent cobbles; neutral; clear wavy boundary. (6 to 12 inches thick)

Bt2--16 to 23 inches; brown (10YR 5/3) very gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, friable, moderately sticky and moderately plastic; common very fine through medium roots; common very fine tubular and interstitial pores; many distinct clay films on faces of peds and lining pores; 40 percent gravel and 10 percent cobbles; neutral; clear wavy boundary. (5 to 12 inches thick)

Bt3--23 to 34 inches; pale brown (10YR 6/3) very gravelly sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, friable, moderately sticky and moderately plastic; few very fine and fine roots; few very fine tubular and interstitial pores; many distinct clay films

on faces of peds and lining pores; 40 percent gravel and 15 percent cobbles; neutral; clear wavy boundary. (5 to 12 inches thick)

Cr--34 to 43 inches; weathered ash-flow tuff.

R--43 inches; hard, unweathered ash-flow tuff.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 1.5 miles south of the Leviathan Mine; approximately 1,100 feet north and 1,600 feet east of the southwest corner of section 27, T. 10 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 40 minutes 50.1 seconds north latitude and 119 degrees 39 minutes 43.9 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 75 to 90 consecutive days in the four months following the summer solstice; Xeric moisture regime that borders on aridic.

Mean annual soil temperature - 44 to 47 degrees F.

Mollic epipedon thickness - 20 to 30 inches; includes the Bt1 and Bt2 horizons.

Depth to base of argillic horizon - 20 to 40 inches.

Depth to bedrock - 20 to 40 inches to a paralithic contact. The paralithic materials below the contact are weathered volcanic rocks such as andesitic tuff.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 18 to 27 percent; Rock fragments: Averages 35 to 60 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A horizon - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 3 to 5 percent.
Reaction: Slightly acid or neutral.

Bt1 and Bt2 horizons - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.

Texture: Very gravelly sandy clay loam, very gravelly loam, or very gravelly sandy loam.
Clay content: 18 to 27 percent.
Rock fragments: 35 to 60 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Bt3 horizon - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Texture: Very gravelly sandy clay loam, very gravelly loam, or very gravelly sandy loam.
Clay content: 18 to 27 percent.
Rock fragments: 35 to 60 percent.
Organic matter content: 0.5 to 1 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: These are the Bullump, Bullvaro, Burchflat, Camelback, Chrisflat, Demner (T), Dogbed, Dooh (T), Erig, Krenka, Lockgate, Murain, Nutval (T), Snyderville, Softback, Softscrabble, Staberg, Vetagrande, and Vipont series.

Bullump and Camelback soils have lithic contacts between 40 and 80 inches from the soil surface. Bullvaro, Demner, Dooh, Nutval, and Vetagrande soils have an aridic moisture regime. Burchflat and Vipont soils are moderately deep to lithic contacts. Chrisflat, Dogbed, Krenka, Murain, Snyderville, Softback, and Softscrabble soils are very deep. Erig soils are deep to lithic contacts. Lockgate soils are deep to paralithic contacts. Staberg soils have argillic horizons that are 6 to 15 inches thick, have the upper boundary of the argillic horizon at depths of 14 to 25 inches from the soil surface, and have C horizons overlying the paralithic contact.

GEOGRAPHIC SETTING: Leroman soils are on mountains. They typically occur on footslope and backslope positions. They formed in residuum and colluvium derived from tuff, tuff-breccia, and andesite. Slopes are 8 to 30 percent. Elevations range from 6,500 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Chenhigh, Celeridge, and Heenlake soils. Chenhigh and Celeridge soils are shallow to lithic contacts. Heenlake soils have mollic epipedons that are less than 20 inches thick.

DRAINAGE AND PERMEABILITY: Well drained; high surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity).

USE AND VEGETATION: Leroman soils are used for rangeland, recreation, watershed, and wildlife

habitat. The native vegetation is mainly mountain big sagebrush, antelope bitterbrush, snowberry, mountain brome, and western needlegrass.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 5,000 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 23 inches (A, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 5 to 34 inches (Bt1, Bt2, and Bt3 horizons).

Paralithic contact - The boundary at 34 inches to underlying soft bedrock (Cr layer).

Particle-size control section - The zone from 5 to 25 inches (Bt1 and Bt2 horizons and part of the Bt3 horizon).

The revision of October 2003 updated the taxonomic class from Loamy-skeletal, isotic, frigid Pachic Argixerolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION LOOPE CA

Established Series
Rev. EWB-JVC
05/2006

LOOPE SERIES

The Loope series consists of shallow, well drained soils that formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Loope soils are on mountains. Slopes are 4 to 75 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Lithic Argixerolls

TYPICAL PEDON: Loope very gravelly sandy loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 30 percent gravel, 5 percent cobbles, and less than 1 percent stones.

A--0 to 1 inch; brown (7.5YR 5/2) very gravelly sandy loam, dark brown (7.5YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular and interstitial pores; 50 percent gravel; neutral; clear smooth boundary. (1 to 3 inches thick)

Bt1--1 to 7 inches; brown (7.5YR 5/3) extremely gravelly sandy loam, dark brown (7.5YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular and interstitial pores; few faint clay films bridging sand grains; 70 percent gravel and 5 percent cobbles; neutral; clear wavy boundary. (3 to 7 inches thick)

Bt2--7 to 14 inches; brown (7.5YR 5/3) extremely gravelly sandy clay loam, dark brown (7.5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine through very coarse roots; common very fine tubular and interstitial pores; common faint clay films bridging sand grains; 70 percent gravel and 5 percent cobbles; neutral; clear irregular boundary. (6 to 10 inches thick)

R--14 inches; hard fractured tuff.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.4 mile northeast of Colorado Hill; approximately 600 feet south and 1,350 feet east of the northwest corner of section 32, T. 10 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 40

minutes 24.4 seconds north latitude and 119 degrees 41 minutes 53.6 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 75 to 90 consecutive days in the four months following the summer solstice; Xeric moisture regime that borders on aridic.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 62 to 66 degrees F.

Mollic epipedon thickness - 14 to 20 inches; includes the Bt horizons.

Depth to bedrock - 14 to 20 inches to lithic contact.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 18 to 27 percent; Rock fragments: Averages 60 to 80 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, or andesite.

A horizon - Hue: 10YR or 7.5YR.
Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt horizons - Hue: 10YR or 7.5YR.
Chroma: 2 or 3, dry or moist.
Texture: Extremely gravelly sandy loam, extremely gravelly sandy clay loam, or extremely gravelly loam.
Clay content: 18 to 27 percent.
Rock fragments: 60 to 80 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: These are the Bellenmine, Celeridge, Cleavage, Cleavmor, Cropper, Gabica, Gaciba, Genoa, Gerdog, Gidwin, Grosschat, Hawkridge, Hutchley, Mascamp, Melling, Pernog, Pernty, Rozara, Shalcleav, Shalper, Slatter (T), Tractuff, and Tweener series.

Bellenmine, Cleavage, Cleavmor, Cropper, Gaciba, Grosschat, Mascamp, Pernty, Shalper, Slatter, Tractuff, and Tweener soils have an aridic moisture regime. Celeridge soils have 5 to 8 percent organic matter in the A horizons and have mean summer soil temperatures of 59 to 62 degrees F. Gabica soils average 35 to 60 percent rock fragments in the particle-size control section and have 1 or 2 percent organic matter in the mollic epipedon. Genoa soils are dominated by cobbles in the particle-size control section and have rock fragments that are granitic rocks. Gerdog and Hawkridge soils have lithic contacts at depths of 7 to 14 inches. Gidwin soils are influenced by loess, have rock fragments that are basalt, and have frost-free periods of 70 to 110 days. Hutchley soils have subhorizons of the argillic horizon with 28 to 35 percent clay. Melling soils average 35 to 60 percent rock fragments in the particle-size control section and are dry for 45 to 60 consecutive days in the four months following the summer solstice. Pernog soils are dominated by stones and have more than 27 percent clay in some part of the particle-size control section. Rozara soils are dominated by fine gravel, have rock fragments that are granitic rocks, have 14 to 18 percent clay, and average 45 to 60 percent rock fragments in the particle-size control section. Shalcleav soils are dominated by channers and flagstones and have lithic contacts at depths of 4 to 12 inches.

GEOGRAPHIC SETTING: Loope soils are on mountains. They typically occur on backslope positions. They formed in colluvium and residuum derived from tuff, tuff-breccia, and andesite. Slopes are 4 to 75 percent. Elevations range from 6,000 to 8,000 feet. The climate is subhumid-continental with cold, moist winters and warm, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Carshal, Chenhigh, and Heenlake soils. Carshal soils have ochric epipedons and do not have argillic horizons. Chenhigh soils are clayey-skeletal. Heenlake soils are moderately deep to paralithic contacts.

DRAINAGE AND PERMEABILITY: Well drained; very high surface runoff; moderate permeability (moderately high or high saturated hydraulic conductivity).

USE AND VEGETATION: Loope soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly mountain big sagebrush, antelope bitterbrush, and western needlegrass with scattered singleleaf pinyon, Jeffrey pine, and Sierra juniper.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are moderately extensive. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 14 inches (A, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 1 to 14 inches (Bt1 and Bt2 horizons).

Lithic contact - The boundary at 14 inches to underlying hard bedrock (R layer).

Particle-size control section - The zone from 1 to 14 inches (Bt1 and Bt2 horizons).

The revision of October 2003 updated the taxonomic class from Loamy-skeletal, isotic, frigid Lithic Argixerolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION MONIBASIN CA

Established Series
Rev. EWB-JVC
05/2006

MONIBASIN SERIES

The Monibasin series consists of very deep, well drained soils that formed in slope alluvium derived from andesite, tuff, and tuff-breccia. Monibasin soils are on mountains. Slopes are 4 to 15 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 40 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Pachic Argicryolls

TYPICAL PEDON: Monibasin gravelly sandy loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 20 percent gravel and 2 percent boulders.

A1--0 to 2 inches; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine interstitial pores; 20 percent gravel and 1 percent boulders; slightly acid; clear wavy boundary. (1 to 4 inches thick)

A2--2 to 7 inches; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; common very fine interstitial and tubular pores; 20 percent gravel; slightly acid; clear wavy boundary. (2 to 6 inches thick)

A3--7 to 15 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine interstitial and tubular pores; 20 percent gravel; slightly acid; clear wavy boundary. (5 to 8 inches thick)

Bt1--15 to 34 inches; brown (7.5YR 5/3) extremely stony sandy loam, dark brown (7.5YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine interstitial and tubular pores; few faint clay bridges between sand grains; 20 percent gravel, 5 percent cobbles, and 50 percent stones; neutral; clear wavy boundary. (12 to 20 inches thick)

Bt2--34 to 60 inches; 90 percent pale brown (10YR 6/3) and 10 percent brown (7.5YR 5/3) very stony

sandy loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine interstitial and tubular pores; few faint clay bridges between sand grains; 20 percent gravel, 10 percent cobbles, and 10 percent stones; neutral.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.5 mile west of Monitor Pass; approximately 1,000 feet south and about 900 feet east of the northwest corner of section 36, T. 10 N., R. 21 E.; USGS Heenan Lake 7.5 minute topographic quadrangle; 38 degrees 40 minutes 26.4 seconds north latitude and 119 degrees 37 minutes 43.2 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, and spring; dry from July through early October for 60 to 80 consecutive days in the four months following the summer solstice; Typic xeric moisture regime.

Mean annual soil temperature - 42 to 46 degrees F.

Mean summer soil temperature - 52 to 59 degrees F.

Mollic epipedon thickness - 26 to 36 inches, includes the Bt1 horizon.

Depth to base of argillic horizon - more than 60 inches.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 18 to 25 percent; Rock fragments: Averages 60 to 80 percent, mainly stones. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, or andesite.

A horizons - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Bt1 horizon - Hue: 10YR or 7.5YR.
Texture: Extremely stony sandy loam or extremely stony sandy clay loam.
Clay content: 18 to 25 percent.
Rock fragments: 60 to 80 percent.
Organic matter content: 1 to 3 percent.
Reaction: Slightly acid or neutral.

Bt2 horizon - Hue: 10YR or 7.5YR.
Texture: Extremely stony sandy loam or very stony sandy clay loam.
Clay content: 18 to 25 percent.
Rock fragments: 35 to 80 percent.
Reaction: Slightly acid or neutral.

COMPETING SERIES: These are the Angelwhine, Aspetill, Badwater, Bickmore, Bluebell, Booneville, Buena Vista, Dab, Dailybasin (T), Delhew, Hawkinspeak, Keman, Littlemud (T), Lostcannon, Parkalley (T), Parkay, Redbird, Rutherford, Sweetmount, and Woodhurst series.

Angelwhine soils have mollic epipedons that are less than 24 inches thick and are dominated by gravel in the particle-size control section. Aspetill soils have mean summer soil temperature of 47 to 52 degrees F. and are dominated by cobbles in the particle-size control section. Badwater soils have 25 to 35 percent clay and are dominated by boulders in the particle-size control section. Bickmore, Bluebell, Buena Vista, Hawkinspeak, Littlemud, Rutherford, and Woodhurst soils are moderately deep to lithic contacts. Booneville soils have mean annual soil temperature of 36 to 40 degrees F. Dab soils are dominated by gravel in the particle-size control section. Dailybasin soils have an ustic moisture regime. Delhew soils have less than 18 percent clay, are dominated by fine gravel (2 to 5 mm diameter) in the particle-size control section, and have rock fragments that are granitic rocks. Keman soils are dominated by gravel in the particle-size control section and have mean annual soil temperature of 39 to 42 degrees F. Lostcannon soils have less than 18 percent clay in the particle-size control section and have rock fragments that are granitic rocks. Parkalley soils have the base of the argillic horizon between 28 and 35 inches from the soil surface and are dominated by flagstones. Parkay soils average 27 to 35 percent clay in the particle-size control section. Redbird soils average 27 to 35 percent clay in the particle-size control section and have horizons with identifiable secondary carbonates within 40 inches of the soil surface. Sweetmount soils are deep to paralithic contacts and have subhorizons of the argillic horizon with 27 to 50 percent clay.

GEOGRAPHIC SETTING: Monibasin soils are on mountains. They typically occur on footslope positions. They formed in slope alluvium derived from tuff, tuff-breccia, and andesite. Slopes are 4 to 15 percent. Elevations range from 7,500 to 8,500 feet. The climate is subhumid-continental with cold, moist winters and cool, dry summers. The mean annual precipitation is 16 to 24 inches, the mean annual temperature is 37 to 43 degrees F., and the frost-free period is 30 to 60 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Aspocket and Vermdig soils. Aspocket soils are deep to paralithic contacts and have mean summer soil temperature of 47 to 52 degrees F. Vermdig soils are fine-loamy and have a seasonal high water table within 30 to 40 inches of the soil surface.

DRAINAGE AND PERMEABILITY: Well drained; medium surface runoff; moderate permeability

(moderately high or high saturated hydraulic conductivity).

USE AND VEGETATION: Monibasin soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly mountain big sagebrush, Letterman's needlegrass, and sedge.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 580 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 34 inches (A1, A2, A3, and Bt1 horizons).

Argillic horizon - The zone from 15 to 60 inches (Bt1 and Bt2 horizons).

Particle-size control section - The zone from 15 to 35 inches (Bt1 horizon and part of the Bt2 horizon).

The revision of October 2003 updated the taxonomic class from Loamy-skeletal, isotic Pachic Argicryolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION VERMDIG CA

Established Series
Rev. EWB-JVC
05/2006

VERMDIG SERIES

The Vermdig series consists of very deep, somewhat poorly drained soils that formed in slope alluvium derived from andesite, tuff-breccia, and tuff. Vermdig soils are on mountains. Slopes are 2 to 8 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 40 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive Aquic Argicryolls

TYPICAL PEDON: Vermdig loam--rangeland. (Colors are for dry soil unless otherwise noted.) The soil surface is covered with 10 percent gravel.

A--0 to 2 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine interstitial pores; moderately acid; clear smooth boundary. (1 to 3 inches thick)

Bt1--2 to 8 inches; brown (7.5YR 5/3) gravelly sandy clay loam, dark brown (7.5YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine interstitial and tubular pores; few faint clay films bridging sand grains; many medium distinct brown (7.5YR 4/2) moist irregular zones of iron depletion; 20 percent gravel; moderately acid; clear smooth boundary. (3 to 8 inches thick)

Bt2--8 to 13 inches; brown (7.5YR 5/3) gravelly loam, dark brown (7.5YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; common very fine and fine roots; common very fine interstitial and tubular pores; few distinct clay films on faces of peds and lining pores; many medium distinct brown (7.5YR 4/2) moist irregular zones of iron depletion and few fine distinct brown (7.5YR 4/4) moist irregular masses of iron accumulation in the matrix; 20 percent gravel; slightly acid; clear smooth boundary. (4 to 9 inches thick)

Bt3--13 to 32 inches; light brown (7.5YR 6/3) gravelly loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; common very fine and fine roots; common very fine interstitial and tubular pores; few distinct clay films

on faces of peds and lining pores; common medium distinct brown (7.5YR 4/2) moist irregular zones of iron depletion; 20 percent gravel; slightly acid; clear smooth boundary. (11 to 19 inches thick)

Bt4--32 to 39 inches; light brown (7.5YR 6/3) gravelly clay loam, brown (7.5YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, very friable, moderately sticky and moderately plastic; few very fine and fine roots; common very fine interstitial and tubular pores; few distinct clay films on faces of peds and lining pores; common fine prominent strong brown (7.5YR 4/6) moist irregular masses of iron accumulation lining pores; 30 percent gravel; slightly acid; clear smooth boundary. (0 to 12 inches thick)

Bt5--39 to 60 inches; light brown (7.5YR 6/4) gravelly clay loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; very hard, friable, very sticky and moderately plastic; few very fine and fine roots; common very fine interstitial and tubular pores; common distinct clay films on faces of peds and lining pores; common fine prominent strong brown (7.5YR 4/6) moist irregular masses of iron accumulation lining pores; 15 percent gravel; slightly acid.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest about 0.5 mile west of Monitor Pass; approximately 2,000 feet south and 1,000 feet east of the northwest corner of section 36, T. 10 N., R. 21 E.; Heenan Lake USGS 7.5 minute topographic quadrangle; 38 degrees 40 minutes 19.2 seconds north latitude and 119 degrees 37 minutes 38.6 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually moist in the moisture control section during late fall, winter, spring, and early summer; usually dry from mid-July through September for 60 to 80 consecutive days in the four months following the summer solstice; occasionally saturated in the upper 6 to 15 inches during March to May, commonly saturated within 40 inches and occasionally saturated within 30 inches of the surface March to July; Typic xeric moisture regime.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 52 to 59 degrees F.

Mollic epipedon thickness - 10 to 16 inches.

Depth to base of argillic horizon - more than 60 inches.

Sodium fluoride pH - 8.5 to 9.0.

Particle-size control section - Clay content: Averages 18 to 27 percent; Rock fragments: Averages 15 to 35 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as andesite, tuff-breccia, and tuff.

A horizon - Value: 4 or 5 dry, 2 or 3 moist.
Chroma: 2 or 3, dry or moist.
Organic matter content: 1 to 3 percent.
Reaction: Moderately acid or slightly acid.

Bt1 and Bt2 horizons - Hue: 10YR or 7.5YR.
Chroma: 2 or 3, dry or moist.
Texture: Gravelly sandy clay loam, gravelly sandy loam, or gravelly loam.
Clay content: 18 to 25 percent.
Rock fragments: 15 to 35 percent.
Organic matter content: 1 or 2 percent.
Reaction: Moderately acid or slightly acid.
Redoximorphic features: Redox concentrations occur as masses of iron or manganese accumulation in the matrix, and redox depletions occur as irregular zones of iron and manganese loss in the matrix.

Bt3, Bt4, and Bt5 horizons (when present) - Hue: 10YR or 7.5YR.
Chroma: 3 or 4, dry or moist.
Texture: Gravelly sandy clay loam, gravelly clay loam, or gravelly loam.
Clay content: 25 to 35 percent.
Rock fragments: 15 to 35 percent.
Reaction: Moderately acid or slightly acid.
Redoximorphic features: Redox concentrations occur as masses of iron or manganese accumulation in the matrix, and redox depletions occur as irregular zones of iron and manganese loss in the matrix.

COMPETING SERIES: This is the Animas series. Animas soils are moderately deep to paralithic contacts.

GEOGRAPHIC SETTING: Vermdig soils are on mountains. They typically occur on toeslope positions. They formed in slope alluvium derived from andesite, tuff, and tuff-breccia. Slopes are 2 to 8 percent. Elevations range from 7,500 to 8,500 feet. The climate is subhumid-continental with cold, moist winters and cool, dry summers. The mean annual precipitation is 16 to 24 inches, the mean annual temperature is 37 to 42 degrees F., and the frost-free period is 30 to 60 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Aspocket and Monibasin soils. Aspocket and Monibasin soils have mollic epipedons more than 16 inches thick and have bedrock within 40 to 60 inches of the soil surface.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained; very high surface runoff; moderately slow permeability (moderately high saturated hydraulic conductivity). Endosaturation is present with an apparent seasonal high water table between 30 and 40 inches (moderately deep free water occurrence class) from March to July. Cumulative annual duration class is Common. Episaturation

is occasionally present within the upper 6 to 15 inches from March to May.

USE AND VEGETATION: Vermdig soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly silver sagebrush, bluegrass, and mat muhly.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 125 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 13 inches (A, Bt1, and Bt2 horizons).

Argillic horizon - The zone from 2 to 60 inches (Bt1, Bt2, Bt3, Bt4, and Bt5 horizons).

Aquic conditions - The conditions of endosaturation and reduction in horizons between 39 and 60 inches in normal years (Bt4 and Bt5 horizons).

Particle-size control section - The zone from 2 to 22 inches (Bt1 and Bt2 horizons and part of the Bt3 horizon).

The revision of October 2003 updated the taxonomic class from Fine-loamy, isotic Aquic Argicryolls. The isotic mineralogy class was based solely on the field determined values for sodium fluoride pH. Laboratory data on 15 bar water to clay ratio does not exist to verify the isotic mineralogy class.

National Cooperative Soil Survey
U.S.A.

LOCATION WETBAG CA

Established Series
Rev. EWB-JVC
05/2006

WETBAG SERIES

The Wetbag series consists of very deep, poorly drained and very poorly drained soils that formed in alluvium derived from tuff, tuff-breccia, and andesite. Wetbag soils are on fan remnants and low stream terraces. Slopes are 0 to 8 percent. The mean annual precipitation is about 20 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Fine, smectitic Vertic Cryaquolls

TYPICAL PEDON: Wetbag peaty silt loam--rangeland. (Colors are for moist soil unless otherwise noted.)

A1--0 to 2 inches; very dark brown (10YR 2/2) peaty silt loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; hard, friable, moderately sticky and moderately plastic; many very fine and common fine and medium roots; many very fine interstitial pores; neutral; clear wavy boundary. (1 to 4 inches thick)

A2--2 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; many very fine and common fine and medium roots; many very fine and common fine tubular pores; common fine faint very dark gray (2.5Y 3/1) irregular zones of iron depletion and common fine prominent brown (7.5YR 4/4) irregular masses of iron accumulation in the matrix; 5 percent gravel; neutral; clear wavy boundary. (3 to 6 inches thick)

Btg--6 to 15 inches; very dark gray (2.5Y 3/1) clay, gray (2.5Y 5/1) dry; moderate fine subangular blocky structure; slightly hard, firm, very sticky and very plastic; common very fine and many fine and medium roots; common very fine and fine tubular pores; few faint clay films lining pores; few fine prominent brown (7.5YR 4/4) irregular masses of iron accumulation in the matrix; 5 percent gravel; neutral; clear wavy boundary. (7 to 12 inches thick)

Btssg1--15 to 26 inches; 60 percent black (N 2.5/0) and 40 percent dark gray (2.5Y 4/1) clay, 60 percent dark gray (N 4/0) and 40 percent gray (2.5Y 6/1) dry; moderate fine subangular blocky structure; hard, friable, very sticky and very plastic; common very fine through medium roots; many very fine and

common fine tubular pores; few slickensides; few faint clay films lining pores; few fine prominent dark yellowish brown (10YR 4/6) irregular masses of iron accumulation in the matrix; 5 percent gravel; neutral; clear wavy boundary. (8 to 17 inches thick)

Btssg2--26 to 46 inches; 75 percent dark gray (2.5Y 4/1) and 25 percent gray (2.5Y 5/1) clay, 75 percent gray (2.5Y 5/1) and 25 percent gray (2.5Y 6/1) dry; moderate fine and medium angular blocky structure; hard, friable, very sticky and very plastic; common very fine and few fine and medium roots; few slickensides; common pressure cutans on faces of peds and few faint clay films lining pores; common fine and medium prominent dark yellowish brown (10YR 4/6) irregular masses of iron accumulation in the matrix and few fine prominent pale green (5G 6/2) irregular zones of iron depletion in the matrix; 2 percent gravel; neutral; clear wavy boundary. (12 to 26 inches thick)

B'tg--46 to 60 inches; 60 percent dark gray (2.5Y 4/1) and 40 percent dark yellowish brown (10YR 4/4) clay, 60 percent gray (2.5Y 5/1) and 40 percent light yellowish brown (10YR 6/4) dry; weak fine and medium angular blocky structure; hard, friable, very sticky and very plastic; few very fine and fine roots; common very fine tubular and interstitial pores; common pressure cutans on faces of peds; common fine prominent greenish gray (5G 6/1) and few fine black (N 2.5/0) irregular zones of iron depletion within the matrix; areas with dark yellowish brown color are very coarse irregular masses of iron accumulation in the matrix; 10 percent gravel; neutral.

TYPE LOCATION: Alpine County, California; on the Toiyabe National Forest in Bagley Valley about 1.5 miles south of Heenan Lake; approximately 350 feet north and 1,500 feet west of the southeast corner of section 15, T. 9 N., R. 21 E.; USGS Wolf Creek 7.5 minute topographic quadrangle; 38 degrees 37 minutes 14.8 seconds north latitude and 119 degrees 39 minutes 11.4 seconds west longitude, NAD27.

RANGE IN CHARACTERISTICS:

Soil moisture - Usually saturated in some part of the moisture control section during winter, spring, and early summer, usually dry in some part summer and fall; seasonal periods of aquic moisture regime from November through June during saturation with ground water and anaerobic conditions; Aquic moisture regime.

Mean annual soil temperature - 44 to 47 degrees F.

Mean summer soil temperature - 55 to 59 degrees F.

Mollic epipedon thickness - 20 to 40 inches.

Depth to seasonal aquic conditions - 0 to 20 inches.

Particle-size control section - Clay content: Averages 35 to 50 percent; Rock fragments: Averages 0 to

15 percent, mainly pebbles. Lithology of fragments are volcanic rocks such as tuff, tuff-breccia, and andesite.

A1 horizon - Hue: 10YR or neutral (N).
Value: 3 or 4 dry, 2 or 3 moist.
Chroma: 0 (if hue is Neutral) through 2, dry or moist.
Organic matter content: 10 to 15 percent.
Reaction: Slightly acid or neutral.
Redoximorphic features: Redox concentrations occur as masses of iron or manganese accumulation in the matrix; redox depletions may occur as zones of iron or manganese removal in the matrix.

A2 horizon - Hue: 10YR or neutral (N).
Value: 2 or 3 moist, 3 or 4 dry.
Chroma: 0 (if hue is Neutral) through 2, moist or dry.
Organic matter content: 5 to 8 percent.
Reaction: Slightly acid or neutral.

Btg horizon - Hue: 10YR, 2.5Y, or neutral (N).
Value: 2 or 3 moist, 4 or 5 dry.
Chroma: 0 (if hue is Neutral) through 2, moist or dry.
Texture: Clay or clay loam.
Rock fragments: 0 to 15 percent, dominantly pebbles.
Organic matter content: 2 to 4 percent.
Reaction: Slightly acid or neutral.

Btssg1 horizon - Hue: 10YR, 2.5Y, or neutral (N).
Value: 2 through 4 moist, 4 through 6 dry.
Chroma: 0 (if hue is Neutral) through 2, moist or dry.
Texture: Clay or clay loam.
Rock fragments: 0 to 15 percent, dominantly pebbles.
Organic matter content: 1 or 2 percent.
Reaction: Slightly acid or neutral.
Redoximorphic features: Redox concentrations occur as masses of iron or manganese accumulation in the matrix; redox depletions may occur as zones of iron or manganese removal in the matrix.

Btssg2 and B'tg horizons - Hue: 10YR, 2.5Y, or neutral (N).
Value: 2 through 4 moist, 4 through 6 dry.
Chroma: 0 (if hue is Neutral) through 2, moist or dry.
Texture: Clay or clay loam.
Rock fragments: 0 to 15 percent, dominantly pebbles.
Reaction: Slightly acid or neutral.
Redoximorphic features: Redox concentrations occur as masses of iron or manganese accumulation in

the matrix; redox depletions may occur as zones of iron or manganese removal in the matrix.

COMPETING SERIES: These are the Egeria (T), Railway (T), and Silvies series.

Egeria soils do not have argillic horizons, do not have horizons with slickensides, and have mean annual soil temperature of 36 to 40 degrees F. Railway soils do not have argillic horizons, have mean summer soil temperatures that are less than 55 degrees F., and have a perched water table in the upper part of the profile. Silvies soils do not have argillic horizons, do not have horizons with slickensides, and are influenced by volcanic ash.

GEOGRAPHIC SETTING: Wetbag soils are on fan remnants and low stream terraces. They formed in alluvium derived from altered tuff, tuff-breccia, and andesite. Slopes are 0 to 8 percent. Elevations range from 6,000 to 7,000 feet. The climate is subhumid-continental with cold, moist winters and cool, dry summers. The mean annual precipitation is 16 to 24 inches, mean annual temperature is 39 to 45 degrees F., and the frost-free period is 40 to 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bagval, Heenlake, and Loope soils. These soils have a xeric moisture regime. In addition, Heenlake soils are moderately deep to paralithic contacts and Loope soils are shallow to lithic contacts.

DRAINAGE AND PERMEABILITY: Poorly drained and very poorly drained; very high surface runoff; very slow permeability (low or moderately low saturated hydraulic conductivity). Endosaturation is present with an apparent seasonal high water table between the soil surface and 20 inches (very shallow or shallow free water occurrence classes) from November through June. Cumulative annual duration classes are Common or Persistent. Some areas of these soils are susceptible to occasional flooding for brief periods between December and June.

USE AND VEGETATION: Wetbag soils are used for rangeland, recreation, watershed, and wildlife habitat. The native vegetation is mainly rushes and sedges.

DISTRIBUTION AND EXTENT: Eastern California, on the east side of the Sierra Nevada Range. These soils are not extensive with about 70 acres of the series mapped to date. MLRAs 22A and 26.

MLRA OFFICE RESPONSIBLE: Reno, Nevada.

SERIES ESTABLISHED: Alpine County (Toiyabe National Forest Area), California, 2006.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon - The zone from the soil surface to 26 inches (A1, A2, Btg, and Btssg1 horizons).

Argillic horizon - The zone from 6 to 60 inches (Btg, Btssg1, Btssg2, and B'tg horizons).

Slickensides - The zone from 15 to 46 inches (Btssg1 and Btssg2 horizons).

Aquic conditions - The conditions of endosaturation and reduction in horizons between the soil surface and 60 inches at certain times in normal years (A1, A2, Btg, Btssg1, Btssg2, and B'tg horizons).

Particle-size control section - The zone from 6 to 26 inches (Btg and Btssg1 horizons).

National Cooperative Soil Survey
U.S.A.

ATTACHMENT E

Complete List of Species

These data include Garrison's crews data and incidental survey information

HEENEN LAKE PLANT AND WILDLIFE DOCUMENTED SPECIES LIST

AVIAN Species	WHR Habitat Type
Horned grebe	LAC
Bufflehead	LAC
Am. White pelican	LAC
Mallard	LAC
Ring-necked duck	LAC
Hooded mergansers	LAC
Ruddy duck	LAC
Turkey vulture	JUN
Turkey vulture	SGB
Turkey vulture	JPN
Common poorwill	
Bald Eagle	JPN
Bald Eagle	LAC
Cooper's hawk	JUN
Red-tailed hawk	MCP
Am. Kestrel	SGB
American coot	LAC
Killdeer	LAC/shore
spotted sandpiper	LAC/shore
Hairy woodpecker	WFR
Northern flicker	JPN
Northern flicker	SGB
Northern flicker	JPN
Northern flicker	WFR
Steller's jay	ASP
Steller's jay	WFR
Clark's nutcracker	SGB

MAMMAL Species	WHR Habitat Type
Chipmunk spp	JPN
Douglas ground squirrel	ASP
Belding's ground squirrel	SGB
Black bear	AGS
Black bear	ASP
Douglas ground squirrel	WFR
Black bear	JPN
Mule deer	ASP
Mule deer	SGB
Mule deer	JUN
Mule deer	MCP
Deer mice	ASP
Deer mice	SGB
Pika	JPN/Talus slope
Coyote	SGB
Coyote	AGS
Great basin pocket mouse	SGB
Golden mantled ground squirrel	SGB
Golden mantled ground squirrel	JUN

MISC. Species	WHR Habitat Type
chorus frog	
tiger swallowtail butterfly	

PLANT Species
White fir
Yarrow
Horse mint
Sierra onion
Pacific Service-berry
tower rock cress
Broad-seeded rock cress
Mountain sagebrush
Mountain dogbane
Crimson columbine
Balsamroot
Mariposa-lily
Sedge
Indian-paintbrush
Birchleaf mountain mahogany
Mountain mahogany
Rabbitbrush
Rose-thistle
Bull-thistle
Collinsia
Bindweed
Delphinium
Spike-rush
Squirrel-tail grass
Blue wild-rye
Willowherb
California buckwheat

Clark's nutcracker	MCP			Nude buckwheat
Clark's nutcracker	WFR			Sulfur-flower
Common raven	JPN			Horsetail
Mountain chickadee	JPN			Groundsmoke
Mountain chickadee	WFR			St. John's wort
Mountain chickadee	MCP			Iris
Red-breasted nuthatch	WFR			Toadrush
Red-breasted nuthatch	MCP			Slender rush
Pygmy nuthatch	MCP			Iris-leaved juncus
American robin	JUN			Western juniper
American robin	WFR			Mule's ears
American robin	LAC/shore			Duckweed
American robin	MCP			Peppergrass
yellow-rumped warbler	JPN			Linanthus
Orange-crowned warbler	MCP			Small-flowered woodlandstar
spotted towhee	MCP			Lotus
rock wren	SGB			Lupine
Western wood pewee	WFR			Common madia
blue gray gnatcatcher	SGB			California melic
Sage sparrow	SGB			Monkeyflower
white-crowned sparrow	SGB			primrose monkeyflower
Vesper sparrow	LAC/shore			Mountain monardella
Vesper sparrow	MCP			Navarretia
Black-throated sparrow	MCP			Brown's peony
Dark-eyed junco	MCP			Yampa
Dark-eyed junco	WFR			Timothy grass
Western meadowlark	SGB			Spreading phlox
Western tanager	ASP			Lodgepole pine
Mountain bluebird	SGB			Jeffrey's pine
American goldfinch	MRI			Sierra bluegrass
Mountain quail	SGB			Polemonium
Mountain quail	ASP			Quaking aspen
mourning dove	SGB/JUN			Cinquefoil
Brewer's blackbird	LAC/shore			Choke-cherry

Red-winged blackbird	LAC/shore			Bitterbrush
Willow flycatcher	MRI			Sticky currant
Brown creeper	WFR			Rose
House wren	MRI/ASP			Dock
Green-tailed towhee	SGB			Lemmon's willow
Tree swallow	MCP			Jepson's willow
Cliff swallow				Red Elderberry
Townsend's solitaire				Tule
				Glaucous checkerbloom
				Checkerbloom
				Ranger's buttons
				Common snowberry
				Fendler's meadow-rue
				Clover
				Salsify
				Cow parsnip
				Mullin

ATTACHMENT F

Hatchery Operation & Water Rights Acquisition Documents
(Available in Hardcopy Only)

ATTACHMENT G

Center for Disease Control West Nile Virus Guidelines

Centers for Disease Control and Prevention

Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Center for Infectious Diseases
Division of Vector-Borne Infectious Diseases
Fort Collins, Colorado
3rd Revision

2003

Table of Contents

Introduction 5

I. SURVEILLANCE 7

A. Ecologic Surveillance 7
1. Avian 7
2. Equine 13
3. Mosquito 15
B. Surveillance for Human Cases 18
1. Recent Experience 18
2. Types of Surveillance 20
3. Specimens 21
4. Surveillance Case Definition 22
5. Minimal Components of a Human Surveillance System 22
C. Geography and Timing 22
1. Northeastern and Midwestern U.S. 22
2. Southern U.S. 22
3. Western U.S. 22
4. Other Areas of the Western Hemisphere 22

II. LABORATORY DIAGNOSIS 24

A. Biocontainment 24
1. Laboratory Safety Issues 24
2. Shipping of Agents 25
B. Serologic Laboratory Diagnosis 25
1. Human 25
2. Animal 26
C. Virologic Laboratory Diagnosis 26
1. Virus Isolation 26
2. Virus Detection in Tissues 27
D. Training and Infrastructure 27
1. State and Local Arbovirus Laboratories 27
2. Training Programs 27

III. PREVENTION AND CONTROL 28

A. Surveillance 28
1. Larval Mosquito Surveillance 28
2. Adult Mosquito Surveillance 28
3. Virus Surveillance 29
B. Source Reduction 29
1. Sanitation 30
2. Water Management 30
C. Chemical Control 31
1. Larviciding 31
2. Adulticiding 32

D. Resistance Management 33
E. Biological Control 34
F. Continuing Education of Mosquito Control Workers 34
G. Vector Management in Public Health Emergencies 34
H. Adult Mosquito Control Recommendations 35
I. Determining the Scope of Mosquito Adulticiding Operations 36
J. Evaluation of Adult Mosquito Control 37
K. Health Education, Public Information, and Human Behavior Change 37
1. Key WNV Prevention Messages 37
2. Selected Best Practices 38
3. Research and Program Development Priorities 39
4. Resources 40
L. Legislation 41
M. Guidelines for a Phased Response to WN Virus Surveillance Data 41

IV. HEALTH DEPARTMENT INFRASTRUCTURE 45

A. Staffing and Personnel 45
B. Training and Consultation 45
C. Laboratory Capacity 45
1. Testing for West Nile Virus Infections 45
D. Developing Local Public Health Agency Infrastructure 46

V. INTERJURISDICTIONAL DATA SHARING AND NATIONAL REPORTING OF HUMAN CASES 48

A. Human Epidemiological, Clinical, and Laboratory Data Collection 48
B. National Reporting of Human WNV Disease Cases 48
1. WNME 48
2. WNF 48
C. Ecologic Data 48
1. Accurate Taxonomic Identification of Specimens 49
2. Unique Identifier (UID) Numbering System for Specimens 49
3. Durable Tagging System for Field-Collected Specimens 49

VI. RESEARCH PRIORITIES 50

A. Current and Future Geographic Distribution of WNV 50
B. Bird Migration as a Mechanism of WNV Dispersal 50
C. Vector and Vertebrate Host Relationships and Range 50
D. Virus Persistence Mechanisms 50
E. Mosquito Biology, Behavior, Vector Competence, Surveillance, and Control 50
F. Development and Evaluation of Prevention Strategies 50
G. Laboratory Diagnosis 51
H. Clinical Spectrum of Disease and Long-Term Prognosis in Humans 51
I. Risk Factor Studies 51
J. Detailed Clinical Descriptions and Outcome in Human Cases 51
K. Viral Pathogenesis 51
L. Genetic Relationships and Molecular Basis of Virulence 51
M. Vaccine Development for Animals and Humans 52

N. Antiviral Therapy for West Nile Virus and Other Flaviviruses 52
O. The Economic Cost of WNV Epidemic/Epizootic.....52
P. WNV Impact on Wildlife 52
Q. Investigate Alternate Modes of WNV Transmission to Humans 52

Appendix A B National West Nile Virus Surveillance System.....53

Appendix B B Surveillance Case Definition for West Nile Virus Infection in Equines 66

Appendix C B National Surveillance Case Definition for Arboviral Encephalitis/Meningitis.....68

Appendix D B CDC-Recommended Surveillance Case Definition for WN Fever 70

Appendix E B Recommended Framework for Standardized "Extended" Clinical Variables in Studies of Human WNV Disease 72

References 73

Department of Health and Human Services
Centers for Disease Control and Prevention
Julie Louise Gerberding, M.D., M.P.H., Director

National Center for Infectious Diseases (NCID)
James M. Hughes, M.D., Director
Stephen M. Ostroff, M.D., Deputy Director

The following CDC, Division of Vector-Borne Infectious Diseases staff members prepared this report:

Duane J. Gubler, Sc.D., Director
Lyle R. Petersen, M.D., M.P.H., Deputy Director
John T. Roehrig, Ph.D.
Grant L. Campbell, M.D., Ph.D.
Nicholas Komar, Sc.D.
Roger S. Nasci, Ph.D.
Emily Zielinski-Gutierrez, Ph.D.
Anthony A. Marfin, M.D., M.P.H.
Robert S. Lanciotti, Ph.D.
Michel L. Bunning, DVM
Daniel R. O'Leary, DVM
Mel Fernandez, Deputy Director
Lauren Dieterich
Barbara B. Tuttle
Rebecca L. Deavours

Prepared in consultation with:

Association of Public Health Laboratories
Council of State and Territorial Epidemiologists
Environmental Protection Agency
Department of Army
National Association of County and City Health Officials

National Institutes of Health
National Parks Service
State Public Health Veterinarians
State Public Health Vector Control Conference
United States Department of Agriculture, Veterinary Services

INTRODUCTION

In late summer 1999, the first domestically acquired human cases of West Nile (WN) encephalitis were documented in the U.S.[1-6] The discovery of virus-infected, overwintering mosquitoes during the winter of 1999-2000 presaged renewed virus activity for the following spring and precipitated early season vector control and disease surveillance in New York City (NYC) and the surrounding areas.[7, 8] These surveillance efforts were focused on identifying and documenting WN virus (WNV) infections in birds, mosquitoes and equines as sentinel animals that could alert health officials to the occurrence of human disease. Surveillance tracked the spread of WNV throughout much of the U.S. between 2000 and 2002. By the end of 2002, WNV activity had been identified in 44 states and the District of Columbia. The 2002 WNV epidemic and epizootic resulted in reports of 4,156 reported human cases of WN disease (including 2,942 meningoencephalitis cases and 284 deaths), 16,741 dead birds, 6,604 infected mosquito pools, and 14,571 equine cases. The 2002 WNV epidemic was the largest recognized arboviral meningoencephalitis epidemic in the Western Hemisphere and the largest WN meningoencephalitis epidemic ever recorded. Significant human disease activity was recorded in Canada for the first time, and WNV activity was also documented in the Caribbean basin and Mexico. In 2002, 4 novel routes of WNV transmission to humans were documented for the first time: 1) blood transfusion, 2) organ transplantation, 3) transplacental transfer**,** and 4) breast-feeding.

WNV is a member of the family Flaviviridae (genus Flavivirus). Serologically, it is a member of the Japanese encephalitis virus antigenic complex, which includes St. Louis, Japanese, Kunjin, and Murray Valley encephalitis viruses.[9,10] WNV was first isolated in the WN province of Uganda in 1937.[11,12] Human and equine outbreaks have been recorded in portions of Africa, southern Europe, North America, and Asia.[13,14]

Although it is still not known when or how WNV was introduced into North America, international travel of infected persons to New York, importation of infected birds or mosquitoes, or migration of infected birds are all possibilities. In humans, WNV infection usually produces either asymptomatic infection or mild febrile disease, sometimes accompanied by rash, but it can cause severe and even fatal diseases in a small percentage of patients. The human case-fatality rate in the U.S. has been 7% overall, and among patients with neuroinvasive WNV disease, 10%.

Unlike WNV within its historical geographic range, or St. Louis encephalitis (SLE) virus in the Western Hemisphere, mortality in a wide variety of bird species has been a hallmark of WNV activity in the U.S. The reasons for this are not known; however, public health officials have been able to use bird mortality (particularly birds from the family Corvidae) to effectively track the movement of WNV. WNV has now been shown to affect 162 species of birds. Previous early-season field studies have determined that areas with bird mortality due to WNV infection were experiencing ongoing enzootic transmission. However, most birds survive WNV infection as indicated by the high seroprevalence in numerous species of resident birds within the regions of most intensive virus transmission. The contribution of migrating birds to natural transmission cycles and dispersal of both WN and SLE viruses is poorly understood.

WNV has been transmitted principally by *Culex* species mosquitoes, the usual vectors of SLE virus. Thirty-six species of mosquitoes have been shown to be infected with WNV. This wide variety of WNV-infected mosquito species has widened this virus' host-range in the U.S.: 27 mammalian species have been shown to be susceptible to WNV infection and disease has been reported in 20 of these (including humans and horses). It must be remembered, however, that the detection of WNV in a mosquito species is necessary but not sufficient to implicate that species as a competent vector of WNV.

Since 1999, the Centers for Disease Control and Prevention (CDC) and a variety of other U.S. governmental agencies and partners have sponsored yearly national meetings of arbovirologists, epidemiologists, laboratorians, ecologists, vector-control specialists, wildlife biologists, communication experts, and state and local health and agriculture officials to assess the implications of the WNV introduction into the U.S. and to refine the comprehensive national response plan. Recommendations from these meetings have been used to develop and to update these guidelines.[15,16] This document is available electronically from the CDC Web site at: http://www.cdc.gov/ncidod/dvbid/westnile/publications.htm.

To assist guideline implementation in 2000, CDC developed an electronic-based surveillance and reporting system (ArboNet) to track WNV activity in humans, horses, other mammals, birds and mosquitoes. In 2003, the ArboNet surveillance system has been updated to streamline reporting to CDC of WNV activity by the state public health departments.

Today=s rapid transport of people, animals, and commodities increase the likelihood that other introductions of exotic pathogens will occur. CDC continues to implement its plan titled APreventing Emerging Infectious Diseases, a Plan for the 21st Century".[17]

I. SURVEILLANCE

A universally applicable arbovirus surveillance system does not exist. In any given jurisdiction, surveillance systems should be tailored according to the probability of arbovirus activity and available resources. In jurisdictions without pre-existing vector-borne disease surveillance and control programs, newly developed avian-based and/or mosquito-based arbovirus surveillance systems will be required. In some, resurrection of previously abandoned systems will be necessary. In others, modification and/or strengthening of existing arbovirus surveillance systems (i.e., those intended to monitor eastern equine encephalitis [EEE], western equine encephalitis [WEE], and/or St. Louis encephalitis [SLE] virus activity) will be the most appropriate response. In yet other jurisdictions in which the probability of arbovirus activity is very low and/or resources to support avian-based and/or mosquito-based surveillance are unavailable, laboratory-based surveillance for neurologic disease in humans and equines should be employed at minimum.

Seasonality of surveillance activities may vary depending upon geographic region. With the anticipated spread of West Nile virus (WNV) to all of the 48 contiguous United States in 2003, all states should initiate surveillance after mosquitoes become active in the spring.

Appropriate and timely response to surveillance data is the key to preventing human and animal disease associated with WNV and other arboviruses. That response must include effective mosquito control and public education without delay, if an increasing intensity of virus activity is detected by bird- or mosquito-based surveillance systems (see Section III.M). For basic information on arbovirus surveillance, see CDC Guidelines for Arbovirus Surveillance Programs in the United States,[18] this document can be obtained from CDC's Division of Vector-Borne Infectious Diseases, Fort Collins, Colorado, and is also available from the CDC Web site at: www.cdc.gov/ncidod/dvbid/arbor/arboguid.htm.

A. Ecologic Surveillance

Detection of WNV in bird and mosquito populations helps health officials predict and prevent human and domestic animal infections. Surveillance to detect WNV should focus on the avian and mosquito components of the enzootic transmission cycle. Non-human mammals, particularly equines, may also serve as effective sentinels because a high intensity of mosquito exposure makes them more likely to be infected than people. Descriptions of the avian-, mosquito-, and non human mammal-based surveillance strategies follow.

1. Avian

a) Avian morbidity/mortality surveillance

Avian morbidity/mortality surveillance appears to be the most sensitive early detection system for WNV activity, and should be a component of every state's arbovirus surveillance program. Its utility for monitoring ongoing transmission in a standardized fashion is currently being investigated, but should include at least two basic elements: the timely reporting and analysis of dead bird sightings and the submission of selected individual birds for WNV testing.

GOAL OF AVIAN MORBIDITY/MORTALITY SURVEILLANCE: Utilize bird mortality associated with WNV infection as a means of detecting WNV activity in a location.

1) Protocols and specimens

The level of effort involved in this surveillance activity will depend on a risk assessment in each jurisdiction. Generally, avian surveillance should be initiated when local adult mosquito activity begins in the spring. A database should be established to record and analyze dead bird sightings with the following suggested data: caller identification and call-back number, date observed, location geocoded to the highest feasible resolution, species, and condition. Samples from birds in good condition (unscavenged and without obvious decomposition or maggot infestation) may be submitted for laboratory testing. As with all dead animals, carcasses should be handled carefully, avoiding direct contact with skin. For greatest sensitivity, a variety of bird species should be tested, but corvids should be emphasized.[19] The number of bird specimens tested will be dependent upon resources and whether WNV-infected birds have been found in the area; triage of specimens may be necessary on the basis of sensitive species (such as corvids) and geographic location. Many jurisdictions may limit (or even stop) avian mortality surveillance once WNV is confirmed in their region. It is suggested that avian mortality surveillance be continued in each region as long as it remains necessary to know whether local transmission persists, because dead-bird-based surveillance is the most sensitive method for detection of WNV activity in most regions.

A single organ specimen from each bird is sufficient to detect WNV or viral RNA. Kidneys, brains, or hearts are preferable.[20-22] Oral swabs from corvids have been validated as a sensitive alternative to organ samples, and because fewer resources are necessary to acquire them, oral swabs are the preferred specimen from corvid carcasses.[23] Testing involves isolation of infectious virus, specific RNA detection by reverse transcription-polymerase chain reaction (RT-PCR), [24] or antigen detection,[25,26] and will generally be positive within 1-2 weeks after specimen submission.

2) Recent experience

Analysis of recent avian morbidity and mortality data indicated that

(a) The American crow was the most sensitive species for avian morbidity/ mortality surveillance in northern regions. However, some areas did not have WNV-positive American crows, but only WNV-positive birds of other species. In southern regions, blue jays have been more sensitive than crows.
(b) Almost all of the positive birds were found singly and not as part of a mass die-off at a single time and place.
(c) Approximately one-third of the WNV-positive birds had signs of trauma on necropsy.
(d) Many WNV-positive birds did not have pathology indicative of WNV infection on necropsy. No lesions are pathognomonic for WNV infection.
(e) WNV-positive dead birds usually provided the earliest indication of viral activity in an area. In 2002, the detection of WNV-infected dead birds was

the first positive surveillance event in 1,534 (61%) of 2,531 counties reporting WNV activity.

(f) The detection of WNV-positive dead birds preceded reports of human cases (although knowledge of the test result did not necessarily predate the onset of human cases). In 2002, 527 (89%) of 589 counties reporting human WN meningoencephalitis cases first detected WNV transmission in animals. In 327 (72%) of these 527 counties, detection of WNV-infected dead birds was the first positive surveillance event, preceding human illness onset by a median of 38.5 days (range, 2-252 days).

(g) Many counties with human cases of WNV infection tended to have high dead bird surveillance indices, both WNV-positive and sightings. Notable exceptions included sparsely populated counties, particularly those in the midwestern states.[27,28]

(h) Experimental evidence of direct transmission among corvids and gulls exists, but whether this occurs in nature is unknown.[29] If it does, then in some settings, virus-infected mosquitoes might not be necessary to maintain enzootic transmission cycles.

3) *Advantages of avian morbidity/mortality surveillance include the following:*

(a) Certain species of birds, in particular corvids (e.g., crows and jays) experience high clinical attack rates.

(b) The size and coloration of certain dead birds makes them conspicuous (e.g., crows).

(c) RT-PCR and antigen-detection assays can be used to rapidly detect WN viral RNA and protein, respectively, in tissues, even if the tissue is partly decomposed. Both assays have now been adapted for field applications.

(d) Due to public involvement in reporting dead bird sightings, dead wild birds are readily available over a much wider region than can be sampled by other surveillance methods.

(e) Detection of WNV in dead birds likely signifies local transmission.[30]

(f) This type of surveillance provides a temporally and spatially sensitive method for the detection of WNV activity.

(g) It can be used for early detection and possibly also for ongoing monitoring of WNV transmission.

(h) It may be used to estimate risk of human infection with WNV.[27,31,32]

4) *Disadvantages of avian morbidity/mortality surveillance include the following:*

(a) Dead bird surveillance data from different jurisdictions are difficult to compare.

(b) Birds are highly mobile and often have extensive home ranges, so that the site of death may be distant from the site of infection (especially after the breeding season, when birds are generally less territorial).

(c) Collection, handling, shipping, and processing of birds or their clinical specimens is cumbersome.

(d) Systems for handling, processing, and testing have at times been overwhelmed by high public response and public expectations.

(e) The long-term usefulness of this system is uncertain because natural selection for disease-resistant birds may occur, populations of susceptible species may become very low, or the virus may evolve, resulting in low or no

avian mortality. In areas where WNV annually recurs, intense environmental sampling might not be as useful.

(f) Success is influenced by public participation, which is highly variable, and depends on the number of public outreach programs, level of public concern, etc.

(g) The system may be less sensitive in rural areas, where there are fewer persons to observe dead birds over a wider geographic area. In the western U.S., low observer density is coupled with the presence of a vector (*Culex tarsalis*) that is less ornithophilic, resulting in fewer reports of dead birds relative to other non-avian surveillance indicators.

b) Live bird surveillance

Live-bird surveillance has been used traditionally both to detect and monitor arbovirus transmission (e.g., for SLE, EEE and WEE viruses). Two approaches are captive sentinel surveillance (typically using chickens, but other species have been used as well), and free-ranging bird surveillance.[33] Both depend on serological testing, which generally requires at least 3 weeks to detect and confirm an infection. Successful application of these approaches requires extensive knowledge of local transmission dynamics. It is recommended that further research be done before relying on sentinel birds as a primary means of WNV surveillance. Use of sentinel birds may require institutional animal use and care protocols, and other authorization permits.

GOAL OF LIVE-BIRD SURVEILLANCE: Utilize seroconversions in captive or free-ranging bird species as indicators of local WNV activity.

1) Captive sentinel surveillance

Although an ideal captive avian sentinel for WNV -- or any other arbovirus – may not exist, such a species would meet the following criteria: 1) is universally susceptible to infection, 2) has a 100% survival rate from infection and universally develops easily detectable antibodies, 3) poses no risk of infection to handlers, and 4) never develops viremia sufficient to infect vector mosquitoes.[18] Captive sentinels have been effectively used to monitor transmission of arboviruses in a standardized fashion, including SLE virus in California and Florida, especially in historical enzootic transmission foci. Captive sentinel flocks should be placed in likely transmission foci (e.g., near vector breeding sites or adult mosquito congregation sites), and presented appropriately to allow feeding by enzootic WNV vectors. Alternatively, pre-existing captive birds (e.g., domestic poultry or pigeons, or zoo birds) may be used as sentinels.

(a) Protocols and specimens
Whole blood can be collected and centrifuged for serum. Serum is screened by either hemagglutination inhibition (HI), enzyme-linked immunosorbent assay (ELISA) or plaque-reduction neutralization test (PRNT).[34] It is important to note that the extraction of avian serum samples to remove non specific inhibitors of hemagglutination for use in the HI test follows procedures different from those used in tests of

human serum samples.[35] Positive tests must be confirmed by neutralization to rule out false positives and cross-reactions due to infection with related flaviviruses (e.g., SLE virus).

(b) Recent experience
   (i) In 2000, sentinel chickens were used in selected counties in New York State, New York City (NYC), New Jersey, Pennsylvania, Maryland, and Delaware. Small numbers of seroconversions were detected late in the season in New Jersey and New York. As used in 2000, chickens were ineffective sentinels. In NYC in 2001, sentinel chickens were placed in known transmission foci and seroconverted earlier in the season, but not earlier than the first human cases. In 2002, hundreds of sentinel chickens in the Southeast seroconverted, but these were rarely the earliest indicators of WNV activity at the county level.
   (ii) IgM capture enzyme-linked immunosorbent assay (MAC-ELISA) testing of experimentally infected chickens points to the need for biweekly sampling of sentinels.[36]
   (iii) Experimental studies have shown that chickens, pigeons, and pheasants (CDC, unpublished data) are candidate sentinels due to their susceptibility to infection, low mortality, and relative incompetence as amplifying hosts. However, small amounts of WNV were detected in cloacal swabs from infected chickens and pigeons.[29,37]
   (iv) Field studies of avian seroprevalence in Queens in 1999 indicated that captive chickens frequently were infected.[38] In Staten Island in 2000, captive pigeons frequently were infected.[39]
   (v) Some mortality in chickens was attributed to WNV at various locations in New York State.[40]

(c) Advantages of sentinel captive bird surveillance include the following:
   (i) Chickens have been successfully used in flavivirus surveillance for over 6 decades.
   (ii) Birds are readily fed upon by *Culex* mosquitoes.
   (iii) Captive birds can be serially bled, making the geographic location of infection definite.
   (iv) The system is flexible and therefore can be expanded and contracted as appropriate.
   (v) Mosquito-abatement districts can maintain and bleed flocks and submit specimens for testing.
   (vi) Collection of specimens is inexpensive compared with the costs of free-ranging bird surveillance.

(d) Disadvantages of captive sentinel surveillance include the following:
   (i) Sentinel flocks detect only focal transmission, requiring multiple flocks be positioned in representative geographic areas. This is particularly true when vector mosquitoes have short flight ranges (e.g., *Culex pipiens*).
   (ii) Flocks are subject to vandalism and theft.
   (iii) Flocks must be protected from predators.

(iv) Flock set-up and maintenance (i.e., birds, cages, feed, transportation) are expensive. Training is required for proper maintenance and sampling.
(v) Pre-existing flocks may already have been exposed due to previous local WNV transmission.

2) *Free-ranging bird surveillance*

Free-ranging birds provide the opportunity for sampling important reservoir host species and may be used both for early detection and for monitoring virus activity. This type of surveillance has been used effectively for SLE, EEE and WEE virus surveillance in several states. In each geographic area, the optimal free-ranging bird species to be monitored should be determined by serosurveys. The best species for serologic surveillance are those in which infection is rarely, if ever, fatal, and population replacement rates are high, ensuring a high proportion of uninfected individuals.

(a) Protocols and specimens
The use of free-ranging birds requires differentiation of recent infection from infections acquired in previous years. For most species, assays for detection of IgM antibody will not be available and other tests such as IgG (IgY)-detection ELISAs[41,42] and the PRNT[34] must be used to detect WNV-specific antibody. Antibody-positive birds less than 1 year old may be presumed to have been infected recently (during current transmission season). Weak seropositivity in very young birds (less than 1 month old) may be due to maternal transfer of antibody. Seroconversion in older birds is also evidence of recent transmission, but requires frequent recapture for acquisition of multiple specimens from uniquely banded individuals during the course of the transmission season. WNV seropositivity among after-hatch-year birds, when determined from a single serum specimen, should not be interpreted or reported as evidence of recent infection. State and federal permits are required for capture and banding of federally-protected migratory birds.

(b) Recent experience
(i) In urban epizootic transmission foci in NYC, several common species (i.e., house sparrows, cardinals, catbirds, mourning doves, rock doves) developed high seroprevalence, making them strong candidate sentinels, although other species may be important in other locations.[38,39]
(ii) A comparison of free-ranging bird surveillance in NYC in 2001 found that much greater effort was required for this surveillance system compared with other surveillance systems (Green Street Scientific, LLC, unpublished data). Similar observations have been made in Indiana, Louisiana, New Jersey, Ohio, and Texas.

(c) Advantages of free-ranging bird surveillance include the following:
(i) It has a long history of successful use in flavivirus surveillance.
(ii) Local movement of resident wild birds may increase contact with enzootic transmission foci, thus increasing sensitivity (relative to captive sentinels).
(iii) Set-up or maintenance costs may be minimal.

(iv) Its sampling capability is highly flexible.
(v) It permits evaluation of herd immunity among important amplifying hosts.
(vi) Owner confidentiality may be less of an issue.

(d) Disadvantages of free-ranging bird surveillance include the following:
(i) Interpretation of serologic results is complex.
(ii) Handling and venipuncture of birds increases the risk of exposure to pathogens in blood and feces.
(iii) Movement of free-ranging wild birds makes it impossible to know where an infection was acquired.
(iv) Most birds are protected by federal law, and their collection and sampling requires state and federal permits. Banding permits require complex data reporting.
(v) Training is required for live-trapping, blood-sampling, handling, and accurate determination of the species and age of wild birds.
(vi) It is generally not feasible to serially bleed individual free-ranging birds because of low recapture rates (although banding can be useful).

2. Equine

Equines appear to be important sentinels of WNV epizootic activity and human risk, at least in some geographic regions. In addition, equine health is an important economic issue. Therefore, surveillance for equine WNV disease should be conducted in jurisdictions where equines are present. Veterinarians, veterinary service societies/agencies, and state agriculture departments are essential partners in any surveillance activities involving equine WNV disease. A working surveillance case definition of clinical WNV infection in equines is presented in Appendix B.

GOALS OF EQUINE DISEASE SURVEILLANCE: To use data on equine WNV disease cases to assess the threat of human disease, identify geographic areas of high risk, and assess the need for and timing of interventions.

a) Protocols and Specimens

1) Serum and cerebrospinal fluid (CSF) for antibody testing. Because an equine WNV vaccine is now in widespread use, a complete vaccination history should accompany all specimens submitted for antibody testing.

2) Necropsy tissues (especially brain and spinal cord) for gross pathology, histopathology, RT-PCR, virus isolation, and immunohistochemistry. The differential diagnosis of equine encephalitis includes, but is not limited to, the other arboviral encephalitides and rabies.

b) Recent experience

1) In 2002, equine WNV disease cases were the first indication of WNV activity in 95 (16%) of the 589 counties where human disease was reported. The majority of these 95 counties were located in the central and western U.S.

2) In general, equine WNV disease cases have been scattered. Few case clusters have been documented.

3) In fatal equine WNV disease cases, pathological findings have been non-specific. Pathognomonic lesions have not been described.

4) A licensed equine WNV vaccine has been available in the U.S. since 2001. No studies of efficacy have been published.

c) Advantages of equine disease surveillance include the following:

1) Equines are highly conspicuous, numerous, and widely distributed in some areas. They may be particularly useful sentinels in rural areas, where dead birds may be less likely to be detected.

2) Some equines are routinely bled and tested for other pathogens.

3) Ill equines have been one of the earliest, if not the earliest, sentinels of WNV activity in some geographic areas.

d) Disadvantages of equine disease surveillance include the following:

1) In some geographic areas, equines may not be an early sentinel (i.e., human WNV disease cases may occur simultaneously with or soon after equine cases).

2) Necropsies are expensive and logistically difficult.

3) Equines are not present or abundant in many areas of the U.S. (e.g., densely populated metropolitan areas), and proximity of equines to human populations varies.

4) Widespread use of equine WNV vaccines may decrease the incidence of equine WNV disease and therefore the usefulness of equines as sentinels.

5) Because the costs of clinical equine specimen collection and testing are usually borne directly by the owner, economic factors work against the submission and testing of equine specimens for arboviral infections.

e) Minimal components of an equine surveillance program

1) All equine neurologic disease cases should be promptly reported; the equines should be tested for infection with WNV and other arboviruses as geographically appropriate, and for rabies.

2) Clusters of equine neurologic disease cases should be promptly investigated.

3. Mosquito

While dead-bird-based surveillance has proven to be the most sensitive method of detecting WNV presence in an area, mosquito-based surveillance remains the primary tool for quantifying the intensity of virus transmission in an area, and should be a mainstay in most surveillance programs for WNV and other arboviruses.

GOALS OF MOSQUITO-BASED SURVEILLANCE: To 1) use data on mosquito populations and virus infection rates to assess the threat of human disease; 2) identify geographic areas of high risk; 3) assess the need for and timing of interventions; 4) identify larval habitats for targeted control; 5) monitor the effectiveness of this type of surveillance and improve prevention and control measures; and 6) develop a better understanding of transmission cycles and potential vector species.

a) Protocols and specimens

1) Adult mosquitoes are collected using a variety of trapping techniques and are used to identify the mosquito species and primary vector species present in an area and the relative density of those species. When coupled with virus detection protocols, mosquito collections can be screened for the presence of virus and provide a quantifiable index of WNV activity. Adequate sampling requires trapping regularly at representative sites throughout a community, and rapid testing of collections of sufficient size to detect low infection rates in the vector population. Minimally, adult mosquito density (number collected per trap night) and infection rate (number of individual mosquitoes estimated containing WNV per 1,000 specimens tested) should be recorded for each area to provide a basis for tracking mosquito density and virus incidence.

2) Larval mosquitoes are collected by taking dip samples from a variety of habitats to identify species present in the area and to identify mosquito sources. Thorough mapping of larval habitats will facilitate larval control or source reduction activities. In addition, where larval management is not feasible, quantitative estimates of larval densities will permit anticipation of new adult emergences. Minimally, the number of larvae collected per dip and location where collected should be recorded to provide a basis for tracking larval production and association of larval density with resulting adult mosquito population density.

b) Recent experience

1) If mosquito trapping effort is intensive, detection of WNV in mosquitoes might precede detection of virus activity by other surveillance tools. If mosquito trapping effort is inadequate, WNV-positive mosquitoes may not be detected prior to the identification of a virus in dead bird, sentinel animal, or human WNV disease cases.

2) Moderate to high infection rates sustained for several weeks in *Cx. pipiens* or *Cx. quinquefasciatus* have been associated with subsequent human outbreaks. Sustained high infection rates early in the year are associated with a higher risk for subsequent outbreaks.

3) Several intense, focal outbreaks during 2002 were associated with relatively low vector densities, but with high infection rates in key vector species (i.e., infection rates in *Cx. pipiens* or *Cx. quinquefasciatus* of approximately 10 per 1,000 or greater).

4) Large numbers of WNV-positive *Cx. tarsalis* pools have been found in association with WNV activity in areas where this species is common. Meaningful infection rates have not yet been determined.

5) Avian epizootics may occur without demonstrable human WNV infection. The epizootics are demonstrated, in part, by detection of WNV-positive mosquito pools containing only species that feed predominantly on birds (e.g., *Cx. restuans*).

6) During 1999-2002, WNV was detected in 36 mosquito species in the U.S. (see www.cdc.gov/ncidod/dvbid/westnile/mosquitoSpecies.htm). The vast majority of isolates came from *Cx. pipiens*, *Cx. quinquefasciatus* and *Cx. restuans*. Numerous isolates have also come from several potential accessory vectors (i.e., *Cx. tarsalis, Cx. salinarius, Oc. Ae. albopictus, Oc. triseriatus, Ae. vexans, Cx. nigripalpus*). While detection of WNV in these species demonstrates intensified virus transmission (i.e., virus in primarily mammal-feeding or opportunistic mosquitoes), the contribution of these species to human risk is poorly understood.

c) Advantages of mosquito-based surveillance include the following:

1) It may provide the earliest evidence of transmission in an area.

2) It helps establish information on potential mosquito vector species.

3) It provides an estimate of vector species abundance.

4) It gives quantifiable information on virus infection rates in different mosquito species.

5) It provides quantifiable information on potential risk to humans and animals.

6) It provides baseline data that can be used to guide emergency control operations.

7) It allows evaluation of control methods.

d) Disadvantages of mosquito-based surveillance include the following:

1) It is labor-intensive and expensive.

2) Substantial expertise is required for collecting, handling, sorting, species identification, processing, and testing.

3) Collectors may be at risk from mosquito bites, especially if day biting species are important bridge vectors, and should wear topical repellents and/or repellent-treated clothing when working in areas where a risk of WNV transmission exists.

e) Minimal components of an entomological surveillance program

A comprehensive mosquito surveillance program must include larval and adult sampling components, a mapping/record keeping component, a virus-testing component, and a data analysis component. To provide useful data, the surveillance program must be sustained and maintain a consistent effort over several seasons. The exact design of mosquito-based surveillance programs will vary by geography and availability of financial and personnel resources. Not every community will be able to support a comprehensive mosquito-based surveillance program. Minimally, a mosquito-based WNV surveillance program must include the following:

1) Collection of adult mosquitoes using gravid traps and/or light traps, providing representative geographic coverage and with sufficient trap sites and trapping frequency to obtain sample sizes required to detect WNV at relatively low infection rates. Use both fixed and flexible trap positions if possible.

(a) Fixed positions allow for the development of a database that would let public health officials compare population data to previous years and spatially map changes in mosquito abundance.
(b) Flexible sites allow for response to epidemiological and natural events (e.g., a suspected human case, dead crow, or a flood).
(c) A variety of trapping methods should be used, including the following:
  (i) CDC light traps baited with CO_2 for sampling potential accessory vectors.
  (ii) Gravid traps for *Cx. pipiens* and *Cx. quinquefasciatus* to sample primary WNV vectors.

(d) Trap distribution will be influenced by the following species factors:
  (i) Habitat diversity, size, and abundance;
  (ii) Resource availability;
  (iii) Proximity to human population centers and/or recreational areas; and
  (iv) Flight range of vector species in the area.

2) Laboratory support to identify the mosquitoes' species, and to test the specimens for the presence of WNV. Determine infection rates by species.

(a) Make arrangements with a lab for testing. Rapid turnaround is essential.
(b) Focus initially on *Culex* mosquitoes to provide first indication of WNV presence.
(c) Once virus is detected in *Culex* mosquitoes, pool and test all potential vector species with emphasis on incriminated or suspected species.

(3) Data management and analysis capabilities to allow tracking of adult mosquito densities and infection rates over time and space. Patterns of virus activity are more likely to be useful than predetermined threshold levels.

(4) Development of a plan with descriptions of actions that will be taken in response to indicators of WNV activity.

B. Surveillance for Human Cases

Because the primary public health objective of surveillance systems for neurotropic arboviruses is prevention of human infections and disease, human case surveillance alone should not be used for the detection of arbovirus activity, except in jurisdictions where arbovirus activity is rare, or resources to support avian-based and/or mosquito-based arbovirus surveillance are unavailable.

GOALS OF SURVEILLANCE FOR HUMAN CASES: To 1) assess the local, state and national public health impact of WNV disease and monitor national trends; 2) demonstrate the need for public health intervention programs; 3) allocate resources; 4) identify risk factors for infection and determine high-risk populations; 5) identify geographic areas in need of targeted interventions; and 6) identify geographic areas in which it may be appropriate to conduct analytic studies of important public health issues.

1. Recent Experience

a) In the U.S. during 1999-2002, the peak human risk for WN viral infection occurred in August and September, although in 2002 human illness onset was reported as early as mid-May and as late as mid-December. In many regions, the peak minimum infection rates in mosquitoes and a rapid increase in the number of reported avian and equine WN viral infections occurred just prior to the period of maximal human risk.

b) In 1999-2002, the majority of reported, confirmed, or probable cases of human WN viral disease were among persons with meningoencephalitis. Testing of patients with aseptic meningitis or unexplained febrile illnesses for evidence of WN viral infection may be beneficial, but can also overwhelm laboratory testing capacity and appears to be of relatively low yield for surveillance purposes since the majority of these cases will not be due to WNV infection.

c) Most patients with WN encephalitis or meningitis (WNME) are older adults, generally over 50 years old. In the U.S. in 1999-2001, the median age among the 142 reported WNME cases was 68 years. In 2002, among 2,942 reported cases of WN meningoencephalitis, the median age was 59 years. Although 21% of reported cases were in persons younger than 40, only 4% of reported cases were in persons younger than 18.

d) When WN viral infections were first identified in the U.S., WN encephalitis was associated with a Guillain-Barrè-like syndrome with generalized muscle weakness. In 1999-2000, generalized muscle weakness was reported in 29% of WN encephalitis cases. In 2002, at least 2 new neurologic syndromes associated with WN viral infection were identified: acute flaccid paralysis (“WN poliomyelitis-like syndrome”) and brachial plexopathy.

e) Using CDC-recommended test methods in public health laboratories, WNV-specific IgM antibody was detected in acute-phase (i.e., those collected 8 or less days after illness onset) serum or CSF specimens, or both, in the large majority of confirmed cases. In contrast, only a small minority of suspected cases were subsequently confirmed in which specific IgM antibody reactivity in acute-phase serum or CSF was in the equivocal or low-positive range.

f) Longitudinal studies of WNME cases have shown that WNV-specific IgM antibody can persist in serum for 12 months or longer.[43] Thus, the presence of WNV-specific IgM antibody in a single serum sample is not necessarily diagnostic of *acute* WN viral infection. For this reason, especially in areas where WNV is known to have circulated previously, suspected, acute WN viral disease cases should be confirmed by observing a fourfold or more change in titer of WNV-specific antibody in serum and the presence of WNV-specific IgM antibody in CSF, when available.

g) In 1999 in the U.S., the sensitivity of polymerase chain reaction (PCR) tests of CSF for the diagnosis of human WN encephalitis cases was only 57%; more recent statistics are currently unavailable. Thus, PCR for the diagnosis of WN viral infections of the human central nervous system (CNS) continues to be experimental and should not replace tests for the detection of WNV-specific antibody in CSF and serum, tests that are far more sensitive.

h) During 1999-2001, 7 cases of uncomplicated WN fever (WNF) were reported in the U.S., which represents 5% of the total number of WNV disease cases reported. In 2002, over 1,100 WNF cases were reported (30% of total). Contributing factors likely include the intensive media attention paid to the 2002 epidemic that may have led to increased consumer demand for WNV diagnostic testing by patients and physicians, and the greater availability of commercial testing. Nevertheless, during 1999-2002, WNF was probably significantly underdiagnosed in the U.S. It has been estimated that approximately 20 WNF cases occur for every WNME case.[44]

i) For suspected WNV disease cases in immunocompromised patients, WNV-specific antibody may not be present. Since longer viremias may be observed in these patients, testing serum and CSF samples for the presence of virus or viral RNA may be useful.

2. Types of Surveillance

a) Clinical syndromes to monitor

Monitoring of encephalitis cases is the highest priority. Monitoring milder illnesses (e.g., aseptic meningitis, Guillain-Barré syndrome, acute flaccid paralysis, and brachial plexopathy, and fever or rash illnesses) is resource-dependent and should be of lower priority.

b) Types of human surveillance

1) Enhanced passive surveillance

In the absence of known WNV activity in an area, enhanced passive surveillance* for hospitalized cases of encephalitis (and milder clinical syndromes as resources allow**), and for patients who have IgM antibodies to

---

*Passive surveillance enhanced by general alerts to key health care personnel such as primary care providers, infectious disease physicians, neurologists, hospital infection control personnel, and diagnostic laboratories.

** While human infections with neurotropic arboviruses are usually clinically inapparent, most clinically apparent infections are associated with fever, with or without neurologic manifestations, which can range from

either WN or SLE virus in tests conducted in diagnostic or reference laboratories, should be employed. A high clinical suspicion for arboviral encephalitis should be encouraged among health care providers. When the diagnosis is in doubt, appropriate clinical specimens should be submitted to CDC or another laboratory capable of performing reliable serologic testing for antibodies to domestic arboviruses. Testing of CSF and paired acute- and convalescent-phase serum samples should be strongly encouraged to maximize the accuracy of serologic results.

2) *Active surveillance*

Active surveillance should be strongly considered in areas with known WNV activity. In general, one or both of the following approaches should be taken:
(a) Contact physicians in appropriate specialties (i.e., infectious diseases, neurology, and critical care) and hospital infection control personnel on a regular basis to inquire about patients with potential arboviral infections;
(b) Implement laboratory-based surveillance to identify CSF specimens meeting sensitive but nonspecific criteria for arboviral infections (e.g., mild to moderate pleocytosis and negative tests for the presence of nonarboviral agents such as bacteria, fungi, herpesviruses, and enteroviruses) and test them for evidence of WNV infection.

3) *Special surveillance projects*

Special projects may be used to enhance arboviral disease surveillance. Such projects include the Emerging Infections Network of the Infectious Diseases Society of America (IDSA EIN), Emergency Department Sentinel Network for Emerging Infections (EMERGEncy ID NET), Unexplained Deaths and Critical Illnesses Surveillance of the Emerging Infections Programs (EIP), and the Global Emerging Infections Sentinel Network of the International Society of Travel Medicine (GeoSentinel). In some areas, syndromic surveillance systems may be considered. "Piggy-backing" surveillance for WNME and milder clinical forms of WN viral infection, such as fever with rash or lymphadenopathy, onto existing syndromic surveillance systems, especially those involving large health maintenance organizations, may be considered. Real-time computerized syndromic surveillance in emergency departments, and special surveillance projects to identify WNV disease in pediatric populations, may be useful.

3. Specimens

a) <u>Cerebrospinal fluid (CSF)</u>

In WNME cases, WNV-specific IgM antibody commonly can be found in CSF on the day of illness onset using antibody-capture ELISA. Virus also may be isolated (rarely) or detected by RT-PCR (in up to 60% of cases) in acute-phase CSF samples.

b) <u>Serum</u>

---

mild aseptic meningitis to fulminant and fatal encephalitis. Signs and symptoms may include fever, headache, stiff neck, confusion or other mental status changes, nausea, vomiting, meningismus, cranial nerve abnormalities, paresis or paralysis, sensory deficits, altered reflexes, abnormal movements, convulsions, and coma of varying severity. Arboviral meningitis or encephalitis cannot reliably be clinically distinguished from other central nervous system infections.

Paired acute-phase (collected 0-8 days after onset of illness) and convalescent-phase (collected 14-21 days after the acute specimen) serum specimens are useful for demonstration of seroconversion to WNV and other arboviruses by ELISA or neutralization tests. Although tests of a single acute-phase serum specimen may provide evidence of a recent WNV infection, a negative acute-phase specimen is inadequate for ruling out such an infection, underscoring the importance of collecting paired samples. As mentioned previously, antibody synthesis in immunocompromised individuals might be delayed or absent altogether.

c) Tissues

When arboviral encephalitis is suspected in a patient who undergoes a brain biopsy or who dies, tissues (especially brain samples, including samples of cortex, midbrain, and brainstem), heart/venous blood, and buffy coat samples should be submitted to CDC or other specialized laboratories for arbovirus and other testing. Tissue specimens should be divided; half should be frozen at -70°C and the other half fixed in formalin. Available studies include gross pathology, histopathology, RT-PCR tests, virus isolation, and immunohistochemistry.

4. Surveillance Case Definition

The national case definition for arboviral encephalitis (available at www.cdc.gov/epo/dphsi/casedef/encephalitiscurrent.htm) should be used to classify cases as confirmed or probable, once appropriate laboratory results are available (also see Section II). In CDC publications of national arbovirus surveillance data, no distinction is usually made between confirmed and probable human cases for the purposes of case counting.

5. Minimal Components of a Human Surveillance System

Enhanced passive surveillance for hospitalized encephalitis cases of unknown etiology, and for patients who have IgM antibodies to either WN or SLE virus in tests conducted in diagnostic or reference laboratories.

C. Geography and Timing

In general, the WNV transmission season in the U.S. is longer than that for other domestic arboviruses and requires longer periods of ecologic and human surveillance.

1. Northeastern and Midwestern U.S.

In the northeastern states in 2001-2002, human illness onset occurred as early as early July and as late as mid-November. During these same years, avian cases occurred as early as the first week of April and as late as the second week of December. Active ecological surveillance and enhanced passive surveillance for human cases should begin in early spring and continue through the fall until mosquito activity ceases because of cold weather. Surveillance in urban and suburban areas should be emphasized.

2. Southern U.S.

In 2001-2002, WNV circulated throughout the year, especially in the Gulf states. Although, in 2001-2002, human illness onset was reported as early as mid-May and June and as late as mid-December, equine and avian infections were reported in all

months of the year. Active ecologic surveillance and enhanced passive surveillance for human cases should be conducted year round in these areas.

3. Western U.S.

In 2002, WNV activity was first reported among humans and animals in Rocky Mountain states and among animals in Pacific coast states. These events occurred relatively late in the year (mid-August). Predicting the temporal characteristics of future WNV transmission seasons based on these limited reports is not possible. Despite this limitation, active ecological surveillance and enhanced passive surveillance for human cases beginning in early spring and continuing through the fall until mosquito activity ceases because of cold weather should be encouraged.

4. Other Areas of the Western Hemisphere

In 2002, Canada experienced a WNV epidemic in Ontario and Quebec provinces and an equine/avian epizootic that extended from the maritime provinces to Saskatchewan.

Recent serologic evidence supports the conclusion that WNV has now reached Central America. Further spread to South America by migratory birds seems inevitable, if this has not already occurred. Development of surveillance systems capable of detecting WNV activity should be encouraged in the Caribbean and Central and South America. WNV surveillance should be integrated with dengue surveillance in these areas, and with yellow fever surveillance in areas where urban or peri-urban transmission of this virus occurs.

II. LABORATORY DIAGNOSIS

The clinical presentation of most patients with viral encephalitis is similar regardless of the cause. Also, infection by many of the arboviruses that cause encephalitis, including West Nile and St. Louis encephalitis viruses, usually is clinically inapparent, or causes a nonspecific viral syndrome in most patients. Definitive diagnosis, therefore, can only be made by laboratory testing using specific reagents. To be successful, active surveillance must have adequate laboratory support.

The basic laboratory diagnostic tests—and how they should be used at the national, state, and local level—are outlined below. The initial designation of reference and regional laboratories that can do all testing will be based on the availability of biosafety level 3 (BSL3) containment facilities. Details of the surveillance case definition for human West Nile virus (WNV) disease and of how the laboratory diagnostic tests are used to support surveillance are presented in Appendix B.

A. Biocontainment

1. Laboratory Safety Issues

Laboratory-associated infections with WNV have been reported in the literature. The Subcommittee on Arbovirus Laboratory Safety (SALS) in 1980, reported 15 human infections from laboratory accidents. One of these infections was attributed to aerosol exposure. Recently, two parenteral inoculations have been reported during work with animals.

a) WNV may be present in blood, serum, tissues and CSF of infected humans, birds, mammals and reptiles. The virus has been found in the oral fluids and feces of birds. Parenteral inoculation with contaminated materials poses the greatest hazard; contact exposure of broken skin is a possible risk. Sharps precautions should be strictly adhered to when handling potentially infectious materials. Workers performing necropsies on infected animals may be at high risk of infection.

b) Biosafety Level 2 practices and facilities are recommended for activities for human diagnostic specimens. In some cases it may be advisable to perform initial processing of clinical samples in a biosafety cabinet, particularly if high levels of virus is suspected (such as tissues from fatal human cases). Biosafety Level 2 is recommended for processing field collected mosquito pools. Biosafety Level 3 and Animal Biosafety Level 3 practices, containment equipment, and facilities are recommended, respectively, for all manipulations of West Nile cultures and for experimental animal and vector studies. Containment specifications are available in the Centers for Disease Control and Prevention/National Institutes of Health publication Biosafety in Microbiological and Biomedical Laboratories (BMBL).[45] This document can be found online at both http://bmbl.od.nih.gov/ and http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm.

c) All bird necropsies should be done in a Class 2 biological safety cabinet.

2. Shipping of Agents

Shipping and transport of WNV and clinical specimens should follow current International Air Transport Association (IATA) and Department of Commerce recommendations. Because of the threat to the domestic animal population, a U.S. Department of Agriculture (USDA) shipping permit is required for transport of known WNV isolates. For more information, visit the IATA dangerous goods Web site at http://www.iata.org/cargo/dg/, and the USDA Animal and Plant Health Inspection Service (APHIS), National Center for Import /Export's Web site at http://www.aphis.usda.gov/ncie/.

B. Serologic Laboratory Diagnosis

Accurate interpretation of serologic findings requires knowledge of the specimen. For human specimens the following data must accompany specimens submitted for serology before testing can proceed or results can be properly interpreted and reported: 1) symptom onset date (when known); 2) date of sample collection; 3) unusual immunological status of patient (e.g., immunosuppression); 4) state and county of residence; 5) travel history in flavivirus-endemic areas; 6) history of prior vaccination against flavivirus disease (e.g., yellow fever, Japanese encephalitis, or Central European encephalitis); and 7) brief clinical summary including clinical diagnosis (e.g., encephalitis, aseptic meningitis).

1. Human

a) Commercial kits for human serologic diagnosis of WNV infection are currently in development. Until these kits are available, the CDC-defined IgM and IgG ELISA should be the front-line tests for serum and CSF.[46-48] These ELISA tests are the most sensitive screening assays available. The HI and indirect immunofluorescent antibody (IFA) test may also be used to screen samples for flavivirus antibodies. Laboratories performing HI assays need be aware that the recombinant WNV antigens produced to date are not useful in the HI test; mouse brain source antigen (available from CDC) must be used in HI tests. The recombinant WNV antigen is available from commercial sources.

b) To date, the prototype WNV strains Eg101 or NY99 strains have performed equally well as antigens in diagnostic tests for WNV in North America.

c) To maintain Clinical Laboratory Improvements Amendments (CLIA) certification, CLIA recommendations for positive and negative ranges should be followed, and laboratories doing WNV testing should participate in a proficiency testing program through experienced reference laboratories; CDC's Division of Vector-Borne Infectious Diseases in Fort Collins, Colorado and the National Veterinary Services Laboratories in Ames, Iowa both offer this type of program.

d) Because the ELISA can cross-react between flaviviruses (e.g., SLE, dengue, yellow fever, WN), it should be viewed as a screening test only. Initial serologically positive samples should be confirmed by neutralization test. Specimens submitted for arboviral serology should also be tested against other arboviruses known to be active or be present in the given area (e.g., test against SLE, WN and EEE viruses in Florida).

2. Animal

a) In general, the procedures for animal serology should follow those used with humans cited above.

b) Plaque-reduction neutralization test (PRNT) and HI assays, although technically more demanding, may be useful because they are species independent.

C. Virologic Laboratory Diagnosis

Experience gained in WNV diagnostic testing over the past 4 years has led to the following recommendations:

1. Virus Isolation

a) Virus isolation attempts should be performed in known susceptible mammalian or mosquito cell lines. Mosquito origin cells may not show cytopathic effect and should be screened by immunofluorescence.

b) Appropriate samples for virus isolation are prioritized as follows:

1) Clinically ill humans - CSF (serum samples may be useful early in infection)

2) Human (biopsy or postmortem) - brain tissue

3) Horses (postmortem) - brain tissue (including brainstem), spinal cord tissue

4) Birds - kidney, brain, heart

5) Other mammals - multiple tissues, especially kidney and brain

c) Confirmation of virus isolate identity can by accomplished by indirect immunofluorescence assay (IFA) using virus-specific monoclonal antibodies, nucleic acid detection, or virus neutralization.

d) The IFA using well-defined murine monoclonal antibodies (MAbs) is the most efficient, economical, and rapid method to identify flaviviruses. MAbs are available that can differentiate WNV and SLE virus from each other and from other flaviviruses. Flavivirus-grouping MAbs are available for use as positive controls, and MAbs specific for other arboviruses can be used as negative controls. In addition, incorporating MAbs specific for other arboviruses known to circulate in various regions will increase the rapid diagnostic capacities of state and local laboratories. These reagents are available and should be used.

e) Nucleic acid detection methods including RT-PCR, TaqMan and nucleic acid sequence based amplification (NASBA) methods may be used to confirm virus isolates as WNV.

f) Virus neutralization assays also may be used to differentiate viruses, by using fourfold or greater titer differences as the diagnostic criterion in paired specimens (acute- and convalescent-phase).

2. Virus Detection in Tissues

a) <u>Antigenic analysis</u>

1) Immunohistochemistry (IHC) using virus-specific MAbs on brain tissue has been very useful in identifying both human and avian cases of WNV infection. In suspected fatal cases, IHC should be performed on formalin-fixed autopsy, biopsy, and necropsy material, ideally collected from multiple anatomic regions of the brain, including the brainstem, midbrain, and cortex.[24, 49]

2) Well-characterized antigen-capture ELISAs are now available for detection of SLE[50,51] and WNV antigen in mosquito pools and avian tissues.[25]

b) Nucleic acid analysis

A number of nucleic acid detection methods have recently been employed for WNV diagnostic and surveillance purposes. An independent antigen or nucleic acid test is required to confirm detection of WNV nucleic acid with any of these methods.

1) RT-PCR of tissues, mosquito pools, and CSF has proven to be a useful surveillance tool. RT-nested PCR has detected WNV nucleic acid in equine brain and spinal cord tissues. Standardized protocols developed by reference laboratories should be disseminated, and primer design information should be included so that other laboratories can prepare primers. A proficiency testing program should be developed by the reference laboratories so that these tests can be CLIA-certified in local laboratories.

2) Fluorogenic 5' nuclease techniques (real-time PCR) and nucleic acid sequence-based amplification (NASBA) methods have been developed and have undergone initial validation in specific diagnostic applications.[24,52-54]

D. *Training and Infrastructure*

1. State and Local Arbovirus Laboratories

Greater numbers of capable state and local laboratories performing screening assays (such as ELISA) should be developed to reduce time demands on reference laboratories. Reference laboratories should be utilized to confirm results of state and local laboratories, particularly for the initial identification of WNV in new locations and in new hosts.

2. Training Programs

Laboratory training programs have been developed and implemented at the federal level. Additional regional training programs may be beneficial.

III. PREVENTION AND CONTROL

Prevention and control of arboviral diseases is accomplished most effectively through a comprehensive, integrated mosquito management program using sound integrated pest management (IPM) principles.[55] IPM is based on an understanding of the underlying biology of the transmission system, and utilizes regular monitoring to determine if and when interventions are needed to keep pest numbers below levels at which intolerable levels of damage, annoyance, or disease occur. IPM-based systems employ a variety of physical, mechanical, cultural, biological and educational measures, singly or in appropriate combination, to attain the desired pest population control.

Programs consistent with best practices and community needs should be established at the local level and, at a minimum, should be capable of performing surveillance sensitive enough to detect West Nile Virus (WNV) enzootic/epizootic transmission that has been associated with increased risk of disease in humans or domestic animals. Integrated mosquito management programs designed to minimize risk of WNV transmission and prevent infections of humans and domestic animals should optimally include the following components (modified from information provided by the American Mosquito Control Association, the New Jersey Mosquito Control Association, and the Florida Coordinating Council on Mosquito Control)[56-58]

A. *Surveillance*

Effective mosquito control begins with a sustained, consistent surveillance program that targets pest and vector species, identifies and maps their immature habitats by season, and documents the need for control. Records should be kept on the species composition of mosquito populations prior to enacting control of any kind and to allow programs to determine the effectiveness of control operations. All components of the integrated management program must be monitored for efficacy using best practices and standard indices of effectiveness. The following is a list of surveillance methodologies used by mosquito control agencies.

1. Larval Mosquito Surveillance

Larval surveillance involves sampling a wide range of aquatic habitats for the presence of pest and vector species during their developmental stages. Most established programs have a team of trained inspectors to collect larval specimens on a regular basis from known larval habitats, and to perform systematic surveillance for new sources. A mosquito identification specialist normally identifies the larvae's species. Properly trained mosquito identification specialists can separate nuisance and vector mosquito species. Responsible control programs target vector and nuisance populations for control and avoid managing habitats that support benign species.

2. Adult Mosquito Surveillance

Adult mosquito surveillance is used to monitor species presence and relative abundance of adult mosquitoes in an area. Information derived from adult mosquito surveillance programs using standardized and consistent surveillance efforts provide information essential to monitoring potential vector activity, setting action thresholds, and evaluating control efforts. Various methods are available for this purpose and have been demonstrated to be effective in collecting a variety of mosquito species.[59] The New Jersey light trap, CDC's miniature light trap, and other modifications of this design, with or without carbon dioxide bait, have been used extensively for collecting host-seeking adult mosquitoes.[60] Gravid traps frequently are used to monitor the

ovipositing segment of *Cx. pipiens* and *Cx. restuans* populations. These species have been incriminated as the primary enzootic vectors of WNV in the northeastern states.[61,62] Host-seeking *Cx. tarsalis*, a species that has been strongly associated with WNV transmission in areas where this species is common, are readily collected in CO_2-baited CDC miniature light traps. Resting boxes frequently are used to measure populations of *Culiseta melanura*, a bird-feeding mosquito that is important in the amplification of eastern equine encephalitis (EEE) virus. Pigeon-baited traps may be employed to measure host-seeking *Culex* mosquitoes that amplify St. Louis encephalitis (SLE) and West Nile viruses. Day-active mosquitoes like *Ae. albopictus* are difficult to collect, and obtaining a sample representative of the local populations requires extra effort. Where these species are important, sample sizes may be enhanced by using CO_2-baited CDC miniature light traps during daylight hours or by using alternative trap configurations that may be more effective in collecting these species (e.g., Fay trap or traps using a counterflow geometry). Trap deployment should carefully address species habitat requirements on several spatial scales.

3. Virus Surveillance

The purpose of this component of the vector management program is to determine the prevalence of WNV in the mosquito population. This is often expressed simply as the number of WNV-positive mosquito pools of a given species collected at a defined location and time period. While the number of positive pools provides valuable information, it does not provide an index of virus prevalence in the vector population. Preferably, the proportion of the mosquito population carrying the virus should be expressed as the infection rate (IR, expressed as the estimated number of infected individual mosquitoes per 1,000 specimens tested). This is a more useful index of virus prevalence. The IR can be calculated by dividing the number of positive pools by the total number of specimens tested for that species and collection period, and multiplying the proportion by 1,000. This assumes that a positive pool contains only one infected mosquito, which is a valid assumption in most circumstances. When infection rates are high or sample sizes are low, a more accurate estimate of IR may be obtained by using a maximum likelihood estimate of the infection rate – see www.cdc.gov/ncidod/dvbid/westnile/software.htm. Elevated infection rates, particularly if sustained over several weeks or in populations of opportunistic blood-feeders that may act as bridge vectors, are indicators of increased WNV transmission risk. Specimens collected in the routine adult mosquito surveillance program plus special collections from key areas identified by other surveillance indicators (e.g., dead birds, sentinel flocks) can be used for this purpose. Mosquito collections made at permanent study sites in a sustained program provide important baseline data to which new surveillance data are compared and decisions about human risk and need for emergency interventions are made.

B. Source Reduction

Source reduction is the alteration or elimination of mosquito larval habitat breeding. This remains the most effective and economical method of providing long-term mosquito control in many habitats. Source reduction can include activities as simple as the proper disposal of used tires and the cleaning of rain gutters, bird baths and unused swimming pools by individual property owners, to extensive regional water management projects conducted by mosquito control agencies on state and/or federal lands. All of these activities eliminate or substantially reduce mosquito breeding habitats and the need for repeated applications of insecticides in the affected habitat. Source reduction activities can be separated into the following two general categories:

1. Sanitation

The by-products of human's activities have been a major contributor to the creation of mosquito breeding habitats. An item as small as a bottle cap or as large as the foundation of a demolished building can serve as a mosquito breeding area. Sanitation, such as tire removal, stream restoration, catch-basin cleaning and container removal, is a major part of all integrated vector management programs. Mosquito control agencies in many jurisdictions have statutory powers that allow for due process and summary abatement of mosquito-related public health nuisances created on both public and private property. The sanitation problems most often resolved by agency inspectors are problems of neglect, oversight, or lack of information on the part of property owners. Educational information about the importance of sanitation in the form of videos, slide shows**,** and fact sheets distributed at press briefings, fairs, schools and other public areas are effective.

2. Water Management

Water management for mosquito control is a form of source reduction that is conducted in fresh and saltwater breeding habitats. Water management programs for vector control generally take two forms, described below. Water management through impoundment and open water management have been very effective in the past. Recently, restrictions on modification of aquatic habitats have limited the implementation of these practices, and in many areas, water management for vector control is no longer routinely employed and may be impractical in many settings. In these situations, alternative methods of mosquito management must be employed.

a) <u>Impoundment Management</u>
Impoundments are mosquito-producing marshes around which dikes are constructed, thereby allowing water to stand or to be pumped onto the marsh surface from the adjacent estuary. This eliminates mosquito oviposition sites on the impounded marsh and effectively reduces their populations. Rotational Impoundment Management (RIM) is the technique developed to minimally flood the marsh during the summer months and then use flapgated culverts to reintegrate impoundments to the estuary for the remainder of the year, thereby allowing the marsh to provide many of its natural functions. Although impoundments usually achieve adequate control of salt-marsh mosquitoes, there are situations in which impoundments can collect stormwater or rainwater and create freshwater mosquito problems that must be addressed using other techniques.

b) <u>Open Marsh Water Management (OMWM)</u>
Ditching as a source-reduction mosquito control technique has been used for many years. Open marsh water management is a technique whereby mosquito-producing locations on the marsh surface are connected to deep-water habitat (e.g., tidal creeks, deep ditches) with shallow ditches. Mosquito broods are controlled without pesticide use by allowing larvivorous fish access to mosquito-producing depressions. Conversely, the draining of these locations occurs before adult mosquitoes can emerge. OMWM can also include establishing or improving a hydrological connection between the marsh and estuary, providing natural resource enhancement as well as mosquito control benefits. The use of shallow ditching (ditches approximately 3 feet or less in depth rather than the deep ditching used in

years past) is considered more environmentally acceptable because than deep ditching because fewer unnatural hydrological impacts occur to the marsh.

c) Management in Stormwater Retention Structures

Source reduction and water management practices may also be applied to stormwater retention structures designed to hold runoff before it is discharged into groundwater or surface water. Mosquito control should be considered in the design, construction, and maintenance of these structures, as appropriate. Stormwater retention structures should be designed in consultation with experts in mosquito biology and control to prevent as much mosquito production as possible, and to facilitate proper functioning and maintenance in the future. Regulations associated with stormwater retention and flood control structures should incorporate appropriate operations and maintenance provisions including considerations for routine monitoring and control of mosquito populations.

C. Chemical Control

Insecticides can be directed against either the immature or adult stage of the mosquito life cycle when source reduction and water management are not feasible or have failed because of unavoidable or unanticipated problems, or when surveillance indicates the presence of infected adult mosquitoes that pose a health risk. [63] Chemicals used by mosquito control agencies must comply with state and federal requirements. Public health pesticide applicators and operators in most states are required to be licensed or certified by the appropriate state agencies.

1. Larviciding

Larviciding, the application of chemicals to kill mosquito larvae or pupae by ground or aerial treatments, is typically more effective and target-specific than adulticiding, but less permanent than source reduction. An effective larviciding program is an important part of an integrated mosquito control operation. The objective of larviciding is to control the immature stages at the breeding habitat before adult populations have had a chance to disperse and to maintain populations at levels at which the risk of arbovirus transmission is minimal. Larvicides can be applied from the ground or by aerial application if large or inaccessible areas must be treated. Several materials in various formulations are labeled for mosquito larviciding including the organophosphate temephos (Abate); several biological larvicides such as *Bacillus thuringiensis israelensis* (*Bti*, a bacterial larvicide), *Bacillus sphaericus*; methoprene, an insect growth regulator (e.g., Altosid,); several larvicidal oils (e.g., petroleum-based Golden Bear and mineral-based Bonide) and monomolecular surface films (e.g., Agnique, Arosurf); and in some limited habitats diflubenzuron (e.g., Dimilin, a chitin synthesis inhibitor). Applications of larvicides often encompass fewer acres than adulticides because treatments are made to relatively small areas where larvae are concentrated, as opposed to larger regions where adults have dispersed. When applying larvicides, it is important that the material be specific for mosquitoes, minimize impacts on non-target organisms, and**,** where appropriate, be capable of penetrating dense vegetation canopies. Larvicide formulations (i.e., liquid, granular, solid) must be appropriate to the habitat being treated, accurately applied, and based on surveillance data. Accuracy of application is important because missing even a relatively small area can cause the emergence of a large mosquito brood resulting in the need for broad-scale adulticiding.

2. Adulticiding

Adulticiding is the application of pesticides to kill adult mosquitoes. The ability to control adult mosquitoes is an important component of any integrated mosquito management program, and like the other components of the program, its use should be based on surveillance data. Mosquito adulticiding may be the only practical control technique available in situations where surveillance data indicate that is necessary to reduce the density of adult mosquito populations quickly to lower the risk of WNV transmission to humans. In some situations, source reduction and larvicide applications are not practical, and adulticide application is the only available control strategy. Mosquito adulticides typically are applied as an Ultra-Low-Volume (ULV) spray where small amounts of insecticide are dispersed either by truck-mounted equipment or from fixed-wing or rotary aircraft.[64-68] Thermal fog applications of adulticides by ground or air are also used in some areas, but to a much lesser degree. Barrier treatments, typically applied as high volume liquids with hand-held spray equipment using compounds with residual characteristics, are common in some U.S. locations. This technique is especially attractive to individual homeowners living near mosquito-producing habitats where residual chemicals applied along property boundaries can provide some control benefits. Mosquito adulticiding differs fundamentally from techniques used to control many other adult insects. For adult mosquito control, insecticide must drift through the habitat in which mosquitoes are flying in order to provide optimal control benefits. The EPA has determined that the insecticides labeled nationally for this type of application do not pose unreasonable health risks to humans, wildlife, or the environment when used according to the label.[56] Adulticides labeled for mosquito control include several organophosphates such as malathion and naled. Some natural pyrethrins and synthetic pyrethroids (permethrin, resmethrin and sumithrin) also hold adulticide labels. Insecticide selection and timing of application should be based on the distribution and behavior of the target mosquito species. Application of adulticides should be timed to coincide with the activity period of the target mosquito species. Many *Culex* species are nocturnal and are active in the tree canopy level. This should be taken into consideration when planning adulticide applications. Operational experience indicates that *Cx. pipiens* and *Cx. quinquefasciatus* may require more frequent adulticide application to achieve desired levels of population reduction during an outbreak. Control of adult day-active species poses additional problems because ULV adulticide effectiveness is greatly reduced during daylight hours. Early-morning use of adulticides, applied before temperatures rise, may provide a measure of control for these species.

D. Resistance Management

In order to delay or prevent the development of insecticide resistance in vector populations, integrated vector management programs should include a resistance management component (modified from Florida Coordinating Council on Mosquito Control, 1998).[57] Ideally, this should include annual monitoring of the status of resistance in the target populations to:

1. Provide baseline data for program planning and pesticide selection before the start of control operations.

2. Detect resistance at an early stage so that timely management can be implemented (even detection of resistance at a late stage can be important in elucidating why disease control may fail); however, in such cases, management options other than replacement of the pesticide may not be possible).

3. Continuously monitor the effect of control strategies on resistance. In addition to monitoring resistance in the vector population, the integrated program should include

options for managing resistance that are appropriate for the local conditions.[69-70] The techniques regularly used include the following:

a) Management by Moderation - preventing onset of resistance by

1) Using dosages no lower than the lowest label rate to avoid genetic selection.

2) Using less frequent applications.

3) Using chemicals of short environmental persistence.

4) Avoiding slow-release formulations.

5) Avoiding the use of the same class of insecticide to control both adults and immature stages.

6) Applying locally**.** Currently, most districts treat only hot spots. Area-wide treatments are used only during public health alerts or outbreaks.

7) Leaving certain generations, population segments**,** or areas untreated.

8) Establishing high pest mosquito densities or action thresholds prior to insecticide application.

9) Alternation of biorational larvicides and insect growth regulators annually or at longer intervals.

b) Management by continued suppression - a strategy used in areas of high-value (e.g., heavily touristed areas) or where arthropod vectors of disease must be kept at very low densities.

This does not mean saturation of the environment by pesticides, but rather the saturation of the defense mechanisms of the insect by insecticide dosages that can overcome resistance. This is achieved by the application of dosages within label rates but sufficiently high to be lethal to susceptible as well as to heterozygous-resistant individuals. If the heterozygous individuals are killed, resistance (which is a homozygous trait) will be slow to emerge. This method should not be used if any significant portion of the population in question is resistant. Another approach more commonly used is the addition of synergists that inhibit existing detoxification enzymes and thus eliminate the competitive advantage of these individuals. Commonly, the synergist of choice in mosquito control is piperonyl butoxide (PBO).

c) Management by multiple attack - achieving control through the action of several different and independent pressures such that selection for any one of them would be below that required for the development of resistance.

This strategy involves the use of insecticides with different modes of action in mixtures or in rotations. There are economic problems (e.g., costs of switching chemicals or having storage space for them) associated with this approach, and critical variables in addition to mode of action must be taken into consideration (i.e., mode of resistance inheritance, frequency of mutations, population dynamics of the target species, availability of refuges, and migration). General recommendations are to evaluate resistance patterns at least annually and the need for rotating insecticides at annual or longer intervals.

E. Biological Control

Biological control is the use of biological organisms, or their by-products, to control pests. Biocontrol is popular in theory, because of its potential to be host-specific and virtually without non-target effects. Overall, larvivorous fish are the most extensively used biocontrol agent for mosquitoes. Predaceous fish, typically *Gambusia* or other species which occur naturally in many aquatic habitats, can be placed in permanent or semipermanent water bodies where mosquito larvae occur, providing some measure of control. Other biocontrol agents that have been tested for mosquito control, but that to date generally are not widely used, include the predaceous mosquito *Toxorhynchites*, predacious copepods, the parasitic nematode *Romanomermis,* and the fungus *Lagenidium giganteum*. Biocontrol certainly holds the possibility of becoming a more important tool and playing a larger role in mosquito control in the future, but will likely be effective only as part of an integrated approach.

F. Continuing Education of Mosquito Control Workers

Continuing education is directed toward operational workers to instill or refresh knowledge related to practical mosquito control. Training is primarily in safety, applied technology, and requirements for the regulated certification program mandated by most states.

G. Vector Management in Public Health Emergencies

A surveillance program adequate to monitor WNV activity levels associated with human risk must be in place. Detection of epizootic transmission of enzootic arboviruses typically precedes detection of human cases by several days to 2 weeks or longer (e.g., as found in SLE epidemics).[71,72] If adequate surveillance is in place, the lead time between detecting significant levels of epizootic transmission and occurrence of human cases can be increased, which will allow for more effective intervention practices.[19,27,31] Early-season detection of enzootic or epizootic WNV activity appears to be correlated with increased risk of human cases later in the season. Control activity should be intensified in response to evidence of virus transmission, as deemed necessary by the local health departments. Such programs should consist of public education emphasizing personal protection and residential source reduction; municipal larval control to prevent repopulation of the area with competent vectors; adult mosquito control to decrease the density of infected, adult mosquitoes in the area; and continued surveillance to monitor virus activity and efficacy of control measures.

As evidence of sustained or intensified virus transmission in an area increases, emergency response should be implemented. This is particularly important in areas where vector surveillance indicates that infection rates in *Culex* mosquitoes are increasing, or that potential accessory vectors (e.g., mammalophilic species) are infected with WNV. Delaying adulticide applications in such areas until human cases occur is illogical and negates the value and purpose of the surveillance system.

H. Adult Mosquito Control Recommendations

Ground-based (truck-mounted) application of adult mosquito control agents has several positive attributes. Where road access is adequate, such as in urban and suburban residential areas, good coverage may be achieved. In addition, ground-based application can be done throughout the night, thereby targeting night-active mosquito species. Such applications are prone to skips and patchy coverage in areas where road coverage is not adequate or in which the habitat contains significant barriers to spray dispersal and penetration.

Aerial application is capable of covering larger areas in shorter time periods than a ground-based application. This is a critical positive attribute when large residential areas must be treated quickly. In addition, aerial application is less prone to patchy coverage than ground-based application in areas where road coverage is not adequate. One limitation of aerial application is that many applicators will not fly at night, potentially reducing the effectiveness of the applications in *Culex* species control efforts. Cost benefits of aerial application over ground application may not be realized unless relatively large areas are treated.

Several formulations of a variety of active ingredients are available for adulticide applications. Material choice for ground-based or aerially applied mosquito control in public health emergency situations is limited by EPA restrictions on the pesticide label and applicable state and local regulations.

Multiple applications will likely be required to appreciably reduce *Culex* populations and interrupt arbovirus transmission. An emergency SLE virus response plan developed for New Orleans, Louisiana[63] indicates the need for repeated applications to control *Cx. quinquefasciatus*, and the need to repeatedly apply adulticides in high-risk areas (areas with human cases or positive surveillance events). Two to three adulticide applications spaced 3-4 days apart may be required to significantly reduce *Cx. pipiens* populations. Effective surveillance must be maintained to determine if and when re-treatment is required to maintain suppression of the vector populations.

Urban/suburban population centers with multiple positive surveillance events as described above should be treated first to most efficiently protect the largest number of people from exposure to WNV. Applications should be timed to coincide with the peak activity periods of the target species. For example, applications should be made at night to maximize control of night-active *Culex* species. Other species such as *Oc. sollicitans* or *Ae. vexans* are active shortly after sunset and are effectively controlled with appropriately timed applications. Day-active potential accessory vectors (e.g., *Oc. japonicus*, *Oc. triseriatus*, *Ae. albopictus*) must be addressed separately and are most effectively controlled by residential source reduction efforts, though there is preliminary evidence that early morning ULV applications may be used to control these species.

I. Determining the Scope of Mosquito Adulticiding Operations

Once arbovirus activity is detected in a jurisdiction and a decision is made to implement or intensify mosquito control by using adulticides, the size of the area to be treated must be determined. In the broadest context, the underlying program objective (i.e., interruption of the enzootic transmission cycle vs. prevention of transmission to humans and domestic animals) should determine the amount of adulticide coverage that is required. For most jurisdictions the objective is the prevention of transmission to humans and domestic animals. There is no simple formula for determining how large an area to treat around a positive surveillance indicator or a suspected or confirmed human case of WNV. Nor is there adequate information to guide decisions about the degree of vector population suppression that must be attained, or for how long this suppression must be maintained to reduce human disease risk. At a minimum, the following factors must be considered when deciding the scope of the adulticiding effort:

1. The general ecology of the area, e.g., key habitat types and the presence of natural barriers such as large rivers;

2. The population density, distribution, flight range, and age structure (proportion of parous females) of the target mosquito species;
3. The flight range of the avian amplifying host(s);
4. The length of time since birds started dying or became infected in the affected area (typically, there may be a lag of several weeks between recovery of dead birds and confirmation of WNV infection) or since virus-positive mosquito pools were collected;
5. The human population characteristics – spatial distribution and density relative to the positive locality (e.g., urban vs. rural), age demographics;
6. Evidence of persistent WNV activity detected by the surveillance program; and
7. Season of the year and how long WNV activity can be expected to persist until the epizootic/epidemic vector(s) enter diapause.

Several of these factors will be unknown or poorly understood. Technical assistance from a mosquito control professional, particularly one experienced in mosquito control in the region, is crucial in this process. Practical experience in conducting mosquito control is required to refine control recommendations. For example, the size of an area selected for control applications may be reduced in response to structures like open areas, bodies of water, major highways, or other barriers that may restrict the distribution of targeted species. Alternatively, adulticide coverage may be expanded to cover large urban or suburban residential neighborhoods with dense human populations.

Hypothetically, in some settings where focal early season enzootic WNV activity has been detected, early season adulticiding may be useful in interrupting virus transmission and lead to lower transmission rates later in the season. However, effective larval control of the principal enzootic mosquito vector is probably a more cost-effective way to interrupt early-season virus amplification.

J. Evaluation of Adult Mosquito Control

The following parameters should be periodically monitored during control operations:

1. Minimum requirements:

   a) Pre- and post spray vector mosquito densities inside and outside control area using CO_2-baited traps and gravid traps;
   b) Vector mosquito infection rates pre- and post-spray inside and outside the control area; and
   c) Weather conditions during application (temperature, wind speed, direction).

2. Desirable additions if capacity exists: population age structure of key mosquito species (*Cx. pipiens*)

3. In addition, both droplet size and flow rate should be documented for each piece of ULV application equipment:

4. During aerial application, GPS monitoring of spray track should be conducted if equipment is available on aircraft.

K. Health Education, Public Information, and Human Behavior Change

The goals of health education, public information, and behavior change programs are to

inform the public about WNV, promote the adoption of preventive behaviors that reduce disease risk, and gain public support for control measures. Health education/public information includes use of print materials (posters, brochures, fact sheets), electronic information (Web sites), presentations (health experts or peers speaking to community groups), and the media.

Information alone is seldom sufficient to encourage people to adopt new behaviors or to change old practices. Programs should include strategies to facilitate protective actions and to address barriers that hinder preventive actions. Examples of programs that go beyond information include developing a community task force, interventions to improve access to window screening materials or repellents, and social marketing to reinforce preventive behaviors.

The following section covers key prevention messages, selected best practices, and research/program development priorities for promotion of personal and community measures to decrease risk of WNV infection. Public education and risk communication activities must be ramped up to respond to the degree of WNV risk in a community, as noted in Table 1.

1. Key WNV Prevention Messages

a) Address the multiple levels at which prevention can occur: personal protection (use of repellent on skin and clothing, use of protective clothing, awareness of prime mosquito-biting hours); household protection (eliminating mosquito breeding sites, repairing/installing screens); and community protection (reporting dead birds, advocating for organized mosquito abatement, participating in community mobilization).

b) Use of DEET-based repellents on skin and clothing is the backbone of personal protection. (For current recommendations, see www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm.) Permethrin-based repellents should be promoted for use on clothing.

c) Emphasize the feasibility of actions that can lower an individual's WNV risk through personal protection measures. Messages should acknowledge the seriousness of the disease but should not be fear-driven. Fear-driven messages may heighten the powerlessness many people express in dealing with emerging diseases.

d) Recommendations to avoid being outdoors from dusk to dawn may conflict with neighborhood social patterns or practices of persons without air-conditioning or without other health programs seeking to increase physical activity. An alternative is to emphasize that the hours from dusk until dawn are prime mosquito-biting hours, and that protecting oneself through repellent use during these hours is important, with the option of remaining indoors.

e) Communication about adulticiding: Public acceptance of emergency adult mosquito control is critical to its success, especially where mosquito control is unfamiliar or unpopular. Questions about the products being used, their safety, and their effects on the environment are common. Improved communication about surveillance and how decisions to adulticide are made may help residents weigh the risks and benefits of control. When possible, provide detailed information regarding the schedule for adulticiding through newspapers, radio, the Internet, or a recorded phone message

f) Keep messages clear and consistent with the recommendations of coordinating agencies. Use plain language whenever possible, and adapt materials for lower-literacy and non-English speaking audiences.

2. Selected Best Practices

a) Targeted prevention

Audience members have different disease-related concerns and motivations for action. Proper message targeting permits better use of limited communication and prevention resources. The following are some audience groups that require specific targeting:

1) *Persons over age 50*: While persons of any age can be infected with WNV, US surveillance data indicate that persons over age 50 are at higher risk for severe disease and death due to WNV infection.

   Collaborate with organizations that have an established relationship with mature adults, such as the AARP, senior centers, or programs for adult learners. Include images of older adults in your promotional material. Identify activities in your area where older adults may be exposed to mosquito bites (e.g. jogging, golf, gardening).

2) *Persons with outdoor exposure:* While conclusive data are lacking, it is reasonable to infer that persons engaged in extensive outdoor work or recreational activities are at greater risk of being bitten by WNV-infected mosquitoes. Develop opportunities to inform people engaged in outdoor activities about WNV. Encourage use of repellent and protective clothing, particularly if outdoors during evening, night, or early morning hours. Local spokespersons (e.g., union officials, job-site supervisors, golf pros, gardening experts) may be useful collaborators.

3) *Homeless persons:* Extensive outdoor exposure and limited financial resources in this group present special challenges. Application of repellents with DEET or permethrin to clothing may be most appropriate for this population. Work with social service groups in your area to reach this population segment.

4) *Persons who live in residences lacking window screens:* The absence of intact window/door screens is a likely risk factor for exposure to mosquito bites. Focus attention on the need to repair screens and resources to do so. Partner with community organizations that can assist elderly persons or others with financial or physical barriers to screen installation or repair.

b) Partnerships with media and the community

Cultivate relationships with the media. Obtain media training for at least one member of your staff, and designate that individual as the organization's spokesperson. Develop clear press releases and an efficient system to answer press inquiries.

Develop partnerships with agencies/organizations that have relationships with populations at higher risk (such as persons over 50) or are otherwise recognized as community leaders (e.g., churches, service groups). Working through sources trusted by the target audience can heighten the credibility of and attention to messages. Partnerships with businesses that sell materials to fix or install window screens or that sell insect repellent may be useful in some settings.

c) Community mobilization and community outreach

Community mobilization can further education and behavior change goals. To

counter any idea that health departments/mosquito control programs are able to control WNV alone, develop community ownership for prevention activities. A community task force that includes civic, business, health, and environmental concerns can be valuable in achieving buy-in from various segments of society and in developing a common message. Community mobilization activities can include clean-up days to get rid of mosquito breeding sites.

Community outreach involves presenting messages in person, in addition to media and educational materials, and incorporating citizens in prevention activities. Hearing the message of personal prevention from community leaders can validate the importance of the disease. Health promotion events reinforce the importance of prevention in a community setting.

3. Research and Program Development Priorities

a) Audience research

Attitudes toward arboviral disease prevention vary considerably by region. Previous experience with nuisance mosquitoes and mosquito control will affect the acceptability of prevention efforts. Audience research can identify local attitudes, motivations, barriers to prevention, and opportunities to promote desired behaviors.

Audience research should ideally combine qualitative and quantitative efforts. Surveys assessing knowledge, attitude, and practice levels in the target population can be very helpful, especially in evaluation, though they are a substantial undertaking. Qualitative research techniques, such as interviews and focus groups, can yield valuable data, and are more adaptable to resource levels. Expertise to undertake such efforts may be available from other divisions within a health department (e.g., chronic disease programs, maternal and child health).

Pretesting of educational materials is an important step to ensure the usability of materials by the intended audience. Pretesting does not always have to involve considerable time or expense; simply having representatives of the intended audience review materials before printing will be useful.

b) Evaluation

Outcome evaluation should be conducted whenever possible to measure the efficacy of the intervention in achieving protective behaviors (e.g., frequency of repellent use, presence of household mosquito breeding sites). Outcome measurement requires extensive effort and must be planned from the outset of a program.

c) Social marketing and risk communication

The goal of social marketing is to achieve specific behaviors, using the concepts of product, price, place, and promotion. Use of social marketing approaches can help programs plan to achieve specific behavior change goals.

Risk communication is already used by many health departments, and can be useful in refining communication messages for WNV, especially as the disease becomes endemic in new areas, and in discussing community control. Risk communication can help people analyze the choices that are available to them and to their community.

4. Resources

The CDC Web site (www.cdc.gov/westnile) is updated frequently to reflect new findings and recommendations. Materials on the CDC Web site are generally in the public domain, and serve as a resource for state and local health departments and other organizations.

CDC staff can provide technical assistance in the development of audience research and strategies for public education and community outreach. Contact CDC/Division of Vector-Borne Infectious Diseases' health communication staff at 970-221-6400. CDC can provide other communication planning resources, including CDCynergy (www.cdc.gov/cdcynergy/), an interactive CD-ROM designed to help systematically plan health communication programs.

Other organizations that can provide useful information are the American Mosquito Control Association (www.mosquito.org/) and the National Pesticide Information Center (NPIC) (npic.orst.edu), a program of EPA and Oregon State University concerning pesticides and repellents. They can be contacted at 1-800-858-7378.

L. Legislation

In addition to statutes permitting legal action to abate mosquito-related public health nuisances, legislation must be in place to allow creation of and provide funding for municipally-based integrated mosquito management programs. Local jurisdictions can contact state mosquito control associations to provide examples of enabling legislation.

M. Guidelines for a Phased Response to WNV Surveillance Data

The principal goal is to minimize the health impact of the WNV in humans, as well as in domestic and zoo animals. Given the limited understanding of the ecology and epidemiology of WNV in the U.S., the low incidence of arboviral encephalitis, and the limitations of prevention methods, prevention and control measures, regardless of intensity, may not prevent all WNV infections in humans.

The recommended response levels for the prevention and control of WNV should augment, but not replace, long-standing mosquito control efforts by established programs. These programs often have two objectives: 1) to control nuisance mosquitoes, and 2) to control vector mosquitoes that can transmit pathogenics. Nuisance mosquito control often has different objectives than vector control, and the target mosquito species may also differ. Established mosquito control programs often have long-standing experience with the surveillance and control of indigenous neurotropic arboviruses such as SLE virus. These programs have established thresholds for response based on historical data. Long-standing experience with WNV does not exist in the U.S.

These guidelines for the prevention and control of WNV should be interpreted according to the following considerations:

1. All states should prepare for WNV activity. Given the extensive geographic spread of WNV since 1999, its occurrence in many different habitats and ecosystems in the Old World, its expansion into numerous habitat types in the Western Hemisphere, and the fact that SLE virus, a related flavivirus, is widespread in the U.S., there appear to be no barriers to the spread of WNV throughout the U. S. At a minimum, a plan for the

surveillance, prevention, and control of WNV should be developed at the state and local levels.

2. Measures of the intensity of WNV epizootic in an area should be considered when determining the level of the public health response. Accumulating data analyses indicate that intensity of epizootic WNV activity as measured by avian mortality and mosquito infection rates are good indicators of subsequently increased human infection risk. Data from NYC indicate that human WNV disease cases were more likely to occur in counties that had experienced more than 0.1 dead crow reports per square mile per week. In the Staten Island outbreak of 2000, the density exceeded 1.5 dead crow reports per square mile per week. Also, analysis of 2001 and 2002 surveillance data indicate that counties reporting WNV-infected dead birds early in the transmission season are more likely to report subsequent WNV disease cases in humans than are counties that do not report early WNV-infected dead birds. These observations should be interpreted as a guide rather than an absolute. Levels of epizootic activity that correlate with increased human risk will vary by region.

3. Flexibility is required when implementing the guidelines. Knowledge gained from ongoing surveillance and research could change the phased response recommendations. Specific and detailed recommendations that will fit all possible scenarios are not possible, particularly at a local level. Therefore, public health action should depend on interpreting the best available surveillance data in an area, in light of these general guidelines. In addition, the following factors should be considered when translating these guidelines into a plan of action:

a) Current weather and predicted climate anomalies;

b) Quality, availability, and timeliness of surveillance data;

c) Feasibility of the planned prevention and control activities, given existing budgets and infrastructure;

d) Public acceptance of the planned prevention and control strategies;

e) Expected future duration of WNV transmission (surveillance events earlier in the transmission season will generally have greater significance); and

f) Other ongoing mosquito control activities, such as nuisance mosquito control or vector mosquito control for the established arboviral encephalitis viruses.

The recommended phased response to WNV surveillance data is shown in Table 1. Local and regional characteristics may alter the risk level at which specific actions must be taken.

Table 1. Suggested Guidelines for Phased Response to WNV Surveillance Data

Risk category	Probability of human outbreak	Definition	Recommended response*
0	None	Off-season; adult vectors inactive; climate unsuitable.	Develop WNV response plan. Secure surveillance and control resources necessary to enable emergency response. Initiate community outreach and public education programs. Conduct audience research to develop/ target education & community involvement. Contact community partners.
1	Remote	Spring, summer, or fall; areas anticipating WNV epizootic based on previous WNV activity in the region; no current surveillance findings indicating WNV epizootic activity in the area.	Response as in category 0, plus: conduct entomologic survey (inventory and map mosquito populations, monitor larval and adult mosquito density), Initiate source reduction; use larvicides at specific sources identified by entomologic survey and targeted at likely amplifying and bridge vector species; Maintain avian mortality, vector and virus surveillance; Expand community outreach and public education programs focused on risk potential and personal protection, and emphasizing residential source reduction; Maintain surveillance (avian mortality, mosquito density /IR, human encephalitis/meningitis and equine illness).
2	Low	Summer, or fall; areas with limited or sporadic WNV epizootic activity in birds and/or mosquitoes. No positives prior to August.	Response as in category 1, plus: increase larval control, source reduction, and public education emphasizing personal protection measures, particularly among the elderly. Enhance human surveillance and activities to further quantify epizootic activity (e.g., mosquito trapping and testing). Implement adulticide applications if vector populations exceed locally established threshold levels, emphasizing areas where surveillance indicates potential for human risk to increase.
3	Moderate	Spring, summer, or fall; areas with initial confirmation of epizootic WNV in birds before August; a horse and/or a human case, or sustained WNV activity in birds and/or mosquitoes.	Response as in category 2, plus: intensify adult mosquito control in areas where surveillance indicates human risk, Initiate adult mosquito control if not already in progress, Initiate visible activities in community to increase attention to WNV transmission risk (speaker, social marketing efforts, community mobilization for source reduction, etc.), Work with collaborators to reduce risks to elderly (e.g., screen repair).
4	High	Spring, summer, or fall; quantitative measures indicating WNV epizootic activity at a level suggesting high risk of human infection (*e.g.*, high dead bird densities In early summer, sustained high mosquito infection rates, multiple positive mosquito species, horse or mammal cases indicating escalating epizootic transmission, or a human case and high levels of epizootic activity). Areas with early season positive	Response as in category 3, plus: Expand public information program to include TV, radio, and newspapers (use of repellents, personal protection, continued source reduction, risk communication about adult mosquito control), Increase visibility of public messages, engage key local partners (e.g., government officials, religious leaders) to speak about WNV ; intensify and expand active surveillance for human cases; intensify adult mosquito control program, repeating applications in areas of high risk or human cases.

		surveillance indicators where WN epidemic activity has occurred in the past.	
5	Outbreak in progress	Multiple confirmed cases in humans; Conditions favoring continued transmission to humans (*e.g.*, persistent high infection rate in mosquitoes, continued avian mortality due to WNV)	Response as in category 4, plus: Intensify emergency adult mosquito control program repeating applications as necessary to achieve adequate control. Enhance risk communication about adult mosquito control. Monitor efficacy of spraying on target mosquito populations. If outbreak is widespread and covers multiple jurisdictions, consider a coordinated widespread aerial adulticide application; emphasize urgency of personal protection through community leaders and media, and emphasize use of repellent at visible public events.

- Local and regional characteristics may alter the risk level at which specific actions must be taken.

IV. HEALTH DEPARTMENT INFRASTRUCTURE

State and Local Health Departments

In the 48 contiguous United States, state and local health departments should have a functional arbovirus surveillance and response unit, staffed by well-trained personnel who have adequate data-processing resources, appropriate laboratory facilities, and an adequate operating budget. The size and complexity of these units will vary by jurisdiction, depending on both the risk of arboviral transmission in the area and available resources. A functional arbovirus surveillance unit at the state level should be considered an essential component of any emerging infectious diseases program. Local health department expertise and capabilities should be supported in a manner that complements statewide programmatic goals.

A. Staffing and Personnel

Ideally, arboviral surveillance involves epidemiologists, virologists, medical entomologists, vertebrate biologists, veterinarians, laboratory staff, environmental toxicologists, public affairs personnel, and data managers. In a particular jurisdiction, the combination of personnel needed to conduct arboviral surveillance will depend on the importance of arboviral diseases in the area and on resources. Many health departments experience a chronic shortage or complete absence of medical entomologists and expertise in wildlife pathobiology. Addressing these deficiencies should be a high priority. In the event of an arboviral disease outbreak, local health departments will likely require significant surge capacity to ensure an adequate public health response. Contingency planning to identify resources to assist with the enhanced surveillance, laboratory, environmental, and public health needs should be identified ahead of time.

B. Training and Consultation

Opportunities exist at federal and state agencies for appropriate training of and consultation with laboratorians, medical entomologists, epidemiologists, vertebrate biologists, and others involved in arbovirus surveillance.

C. Laboratory Capacity

The infrastructure of arbovirus laboratories in the U.S. has deteriorated significantly in recent decades, not only in terms of the total number of functional laboratories and overall capacity, but also in terms of the staffing, physical plant, and financial support of many remaining laboratories. This is a problem of national scope and significance, the solution for which will require leadership at all levels of government.

1. Testing for West Nile Virus (WNV) Infections

In the wake of the introduction of WNV into the Western Hemisphere, it is important to distinguish between increasing short-term and long-term laboratory capacity. The latter is preferred and should be emphasized over the former. Laboratories with an existing capability for arbovirus serology should consider adding serologic screening tests for WNV to their repertoire. For serologic screening of patients and mosquito pools, arrangements can be made with CDC to transfer existing technology and reagents, and to obtain appropriate training. Samples giving positive or equivocal screening results should be confirmed by CDC or another laboratory capable of definitive testing. For selected laboratories, similar technology transfer arrangements can be made with regard to RT-PCR primers for use in the testing of tissues and mosquito pools. In the wake of the recent epidemic of WN encephalitis in the Northeast, it is important that

programs continue to routinely test for other arboviruses historically active in their area, such as St. Louis encephalitis, eastern equine encephalitis, western encephalitis, and La Crosse viruses, as well as for other causes of acute encephalitis.

D. Developing Local Public Health Agency Infrastructure

The function of local public health agencies is assessment, assurance, and policy development to promote and protect the health of the public. As part of this function, local public health agencies are responsible for preventive activities to reduce the risk of WNV infection to individuals in their jurisdictions. This responsibility includes educating communities about reducing mosquito breeding sites and taking personal protective measures. Local public health agencies also must have the capacity to assess human risk by gathering surveillance data or having access to surveillance data gathered on a district, regional, or statewide basis. These local public health agencies are important to formulating local recommendations on the indications and decisions concerning mosquito adulticiding. Education of and communication with the public, and maintenance of local media contacts are generally primary functions of the local public health agency. Included in this responsibility is communicating risk regarding the use of pesticides.

The following infrastructure and functional capacities fall within the province of local public health agencies. Where these are not directly provided, access to these capacities is to be ensured).

1. Risk assessment based on surveillance data (including mosquito, bird, and human data). Surveillance data may also include reports from individuals or healthcare providers indicating possible adverse health effects from pesticide use.

2. Health education regarding personal protection, reduction of mosquito breeding sites and minimum health risks posed by approved pesticides applied according to the label.[73,74]

3. Communication with the media.

4. Development of a preventive plan including education, mosquito source reduction, and larviciding.

5. Public response capability, particularly when surges of public inquiries arise. This may include the use of telephone hotlines and Internet Web sites.

6. Training of staff.

7. Coordination with state and federal agencies.

8. Local coordination by formulation of a task force with organizations such as departments of public works, offices of public affairs, city/county building management, departments of parks and recreation, departments of planning and zoning, property or building inspection services, police, public schools, colleges and universities, nonprofit and grassroots organizations, businesses, zoos, animal/vector control, local mosquito control districts, emergency medical services, hospitals, poison control centers, departments of game and inland fisheries, departments of environmental quality, emergency, management agencies, etc.

V. INTERJURISDICTIONAL DATA SHARING AND NATIONAL REPORTING OF HUMAN CASES

The public and animal health response to West Nile virus (WNV) epidemics/epizootics involves all levels of government, including the federal governments of the U.S. and neighboring countries, and the Pan American Health Organization. In addition, multiple government agencies at each level are often involved. Rapid, efficient, secure, and coordinated systems are needed to allow the sharing of human and ecologic data between these multiple agencies to support long-term surveillance activities, and to support activities that are part of the rapid outbreak response.

During an epidemic involving multiple jurisdictions, CDC staff and other authorized persons will use Epi-X, a CDC-sponsored, Web-based system for secured electronic communication, or similar integrated communication systems, for rapid dissemination of information on public health events of public health significance.

A. Human Epidemiological, Clinical, and Laboratory Data Collection

Patient confidentiality statutes vary among jurisdictions. Data can be shared between jurisdictions if recipients agree to adhere to the confidentiality statutes of the jurisdiction providing the data. Electronic databases should be appropriately secured by passwords to limit access and minimize opportunities for breaches in confidentiality or security.

B. National Reporting of Human WNV Disease Cases

1. National Reporting of Human Cases of West Nile Meningoencephalitis (WNME)

WNME is included in the list of nationally notifiable diseases maintained by the Council of State and Territorial Epidemiologists (CSTE) in consultation with CDC. CDC has designated 10056 as a specific disease code ("EVENT" code) for use in reporting WNME cases via the National Electronic Telecommunications System for Surveillance (NETSS). For national reporting purposes, states should use the national surveillance case definition of arboviral encephalitis/meningitis for classifying cases as either confirmed or probable (see Appendix C). Until such time as ArboNET and NETSS are consolidated under the National Electronic Disease Surveillance System (NEDSS) standards, duplicate reporting of human cases of WNME to both ArboNET and NETSS will be encouraged.

2. West Nile Fever (WNF)

Although WNF is not included in the list of nationally notifiable diseases, states are encouraged to report WNF cases to CDC via ArboNET, using a CDC recommended case definition (see Appendix D). States may also choose to report WNF cases to NETSS using EVENT code 10049.

C. Ecologic Data

Many of the issues that apply to the interjurisdictional sharing of human data apply to the sharing of ecologic data as well, although key differences exist. For example, confidentiality is generally not an issue with nonhuman cases, particularly wild animals identified as part of a surveillance program. Maintaining confidentiality may be important for certain owned animals. Data standardization is a far more challenging issue because of the relatively large number of species being studied. Specific needs include the following:

1. **Accurate Taxonomic Identification of Specimens**

   Fully understanding the epidemiology and developing effective prevention and control strategies for WNV requires accurate identification of all animal species involved in the virus transmission and maintenance cycles. This is especially true for birds and mosquitoes.

2. **Unique Identifier (UID) Numbering System for Specimens**

   A UID numbering system should be used in each jurisdiction (e.g., state, county, city, surveillance area). Such a system should distinguish readily between each major animal group reported (i.e., humans, birds, and mosquitoes), and encode the location of collection (county or town), date of collection (day/month/year), and a specimen-specific number.

3. **Durable Tagging System for Field-Collected Specimens**

   Use appropriate labels containing complete specimen information on all samples (blood, tissues, or whole animals) so field specimen identification will not be lost during shipment to testing facilities.

VI. RESEARCH PRIORITIES

The human and animal health implications of the introduction of West Nile virus (WNV) to the U.S. and to the Western Hemisphere continue to emerge. Many questions remain, the answers to which will require considerable research. A research agenda should be supported, with priority given to research questions whose answers can be directly applied to prevention and control.

A. Current and Future Geographic Distribution of WNV

To determine the geographic distribution of WNV in the Western Hemisphere, existing laboratory-based surveillance systems for WNV in human, birds, other selected animals, and mosquitoes should be enhanced, or new, active systems should be developed and implemented (see Section I).

B. Bird Migration as a Mechanism of WNV Dispersal

Experience in Europe and the Middle East suggests that WNV regularly is introduced to new geographic areas along bird migration routes. A better understanding of this potential is required for the Western Hemisphere. Studies should include the frequency and duration of chronic infections that will allow the long-range transport and recrudescence of viremias necessary to infect mosquitoes.

C. Vector and Vertebrate Host Relationships and Range

Relatively little is known about the vertebrate host and mosquito vector relationships of WNV in the U.S. and the Western Hemisphere. Effective prevention and control strategies will require targeting selected species involved in maintenance, epidemic/ epizootic transmission cycles, or both. It is critical that the principal species and the range of these species be determined.

D. Virus Persistence Mechanisms

It is not known whether or how WNV will be maintained in the U.S. over the long term. Overwintering mechanisms in *Culex* and *Aedes* species should be investigated, as well as persistence and maintenance of the virus in ticks. Other possibilities that should be investigated include the duration of chronic infection and reactivation in birds or other animals, and the introduction of the virus by migratory birds.

E. Mosquito Biology, Behavior, Vector Competence, Surveillance, and Control

It is critical that a better understanding is gained of the principal mosquito vectors involved in maintenance, bridge (from enzootic to peridomestic), and epidemic/epizootic transmission. Different vector species may be important in different geographic or ecologic regions. Understanding their biology and behavior will allow for more effective surveillance and development of targeted control methods.

F. Development and Evaluation of Prevention Strategies

Effective prevention and control of WNV transmission will require evaluation of the efficacy of current control methods and research on new and innovative control strategies for the principal mosquito vectors. Ultimately, prevention strategies must be integrated and use a variety of approaches to control mosquitoes and reduce the risk of transmission. Research should also be conducted to better define target areas for mosquito control in response to documented WNV activity in an area.

A very long-term goal is the identification and implementation of new, natural compounds to repel and control mosquito vectors of disease. With efforts to decertify current pesticides, new compounds will be needed in the fight against vector-borne diseases.

Much effort has been expended to increase public awareness of the WNV threat and of the actions needed to reduce exposure to infected mosquitoes. These actions include using mosquito repellents, reducing periresidential mosquito breeding sites, and wearing protective clothing when entering mosquito-infested areas. The success of these public information campaigns has not been formally evaluated using scientific instruments such as knowledge and behavior surveys. The cost of such campaigns is high, so formal attempts to assess their success are needed.

G. Laboratory Diagnosis

Surveillance for WNV will continue to require accurate laboratory diagnostic tests. Ideally, these tests will be simple and inexpensive, and will distinguish between WNV and other flaviviruses such as the SLE, dengue, and yellow fever viruses. Virus-specific tests for IgM or IgG antibody will be required for humans, various species of birds, horses, and other mammals. Sensitive viral detection methods will be required for both human and animal tissues as well as for mosquito pools.

H. Clinical Spectrum of Disease and Long-Term Prognosis in Humans

A better understanding of the spectrum of illness caused by WNV infection in humans is needed, including the long-term consequences of acute infection of the central nervous system. In addition to the severe end of the clinical spectrum (viral encephalitis), it is important to know the degree to which mild viral syndromes occur and whether these patients have any unique clinical presentations that may be characteristic or even pathognomonic. It is also important to know whether they have viremia and, if so, its magnitude and duration. Effective clinical management of severe disease will require detailed clinical studies of confirmed human cases of WNV infection.

I. Risk Factor Studies

Data on the risk factors associated with human and animal infection with WNV are required to develop more effective prevention strategies, particularly when educating the public to take specific prevention measures to reduce exposure to infection.

J. Detailed Clinical Descriptions and Outcome in Human Cases

Larger and more detailed case series, as well as studies of short- and long-term outcomes, are needed to better understand the clinical features, clinical course, and public health impact of WNV disease in humans. A suggested framework for collecting standardized “extended” clinical variables is included in Appendix E.

K. Viral Pathogenesis

Little is known of the pathogenesis of WNV in humans or other animals. Research is needed to better understand the organ systems affected, the mechanism of central nervous system (CNS) infection, and the role of virus strain in pathogenesis.

L. Genetic Relationships and Molecular Basis of Virulence

Only since 1996 has WNV been associated with significant numbers of severe disease cases and fatalities in humans. It is important to better understand whether genetic changes in WN viruses influence their phenotypic expression (i.e., host and vector range, clinical expression in various hosts, and epidemic potential). This will require detailed studies of the genome of WN virus strains isolated from different epidemics in various geographic areas.

M. Vaccine Development for Animals and Humans

Ultimately, the most effective prevention strategy may be vaccination. It is important to support research on the development of both human and equine vaccines.

N. Antiviral Therapy for West Nile Virus and Other Flaviviruses

To date, none of the available antiviral agents are effective against flaviviruses, including WNV. Research in this area is critical to effective management of severe disease in humans.

O. The Economic Cost of the WNV Epidemic/Epizootic

It is important to estimate the total economic cost of the epidemic/epizootic. These data will help set priorities for capacity building and prevention programs.

P. WNV Impact on Wildlife

WNV has the potential to greatly impact the wildlife populations in the Western Hemisphere. This is especially true for birds, in many of which the infection appears to have high mortality rates (i.e., Corvidae). Research is needed to analyze and define this impact to determine if the development of new epizootic intervention strategies is needed. Research is also needed to determine what long-term effects WNV infection may have on its animal hosts.

Q. Investigate Alternate Modes of WNV Transmission to Humans

Four new modes of WNV transmission to humans were identified in 2002: blood transfusion, tissue transplantation, transplacental transfer, and breast-feeding. New modes of transmission should be investigated to determine the impact they have on human infection and to develop effective approaches for prevention and control of WNV infection by these routes.

Appendix A - National WNV Surveillance System

Objectives:

The objectives of the national West Nile virus (WNV) surveillance system are to:

- Monitor the geographic and temporal spread of WNV in the U.S.
- Develop national public health strategies for WNV surveillance, prevention, and control.
- Develop a more complete regional picture of the geographic distribution and incidence of the other clinically important arboviruses in the U.S.
- Provide national and regional information to public health officials, elected government officials, and the public.
- Evaluate the use of cooperative agreement funds and the need for additional resources.

Scope:

Coordinated, multi-state surveillance of WNV infections in humans and animals has been repeatedly identified as a high priority by states affected by WNV in 1999-2002. All states conducting surveillance for WNV and other arboviruses are encouraged to participate in ArboNET, a CDC-coordinated program to collect these surveillance data. While the components of WNV surveillance systems employed in individual jurisdictions will vary, national WNV surveillance should, at a minimum, focus on collection of data from:

- Mosquito surveillance
- Avian (dead bird) surveillance
- Equine surveillance
- Human surveillance

In addition to data from states, data from commercial laboratories will be sought. CDC will 1) formally notify all such laboratories of the need to report any positive laboratory results to the appropriate state or local health department who, in turn, will notify CDC; 2) provide them with a list of state health department contact persons; 3) periodically contact them to encourage reporting; and 4) remind them of the need to have all positive screening tests for arboviral infections confirmed by state public health laboratories. In addition, CDC will provide a list of these commercial laboratories to its cooperative agreement partners, to facilitate their efforts to conduct active laboratory-based surveillance for arboviral infections.

Categories of Data to be Collected:

National surveillance will focus on the collection of two general categories of data:

- *"Denominator"* data

  Definition: Weekly totals of dead birds (classified as either corvids or 'others') and mosquito pools (classified by species) collected and/or tested by a jurisdiction's WNV surveillance system, stratified by county within a state. Because recent experience has demonstrated that the following categories of denominator data are of limited use in meeting national surveillance goals, as of 2003, CDC will discontinue the collection of totals of sentinel and free-ranging wild birds, horses, or other non-human mammals tested.

- *"Numerator"* data

  Definition: Detailed information on individual mosquito pools, sentinel species, dead birds, and ill humans, horses, or other species with confirmed or suspected WNV infections, as determined by laboratory-confirmed or -probable test results.

General Procedures:

Reporting "denominator" data:

CDC will collect aggregate denominator data via a secure file upload system using a state-based database provided by CDC, continuous data entry into a database stored on a secured CDC web site, or importation of delimited records in a specified format. Denominator data variables are specified in Table 1. An appropriate submission schedule will be arranged by CDC with the jurisdictions submitting surveillance data via file uploading. In addition,

- CDC will distribute the necessary software and provide the adequate licenses that will allow regular secured file upload or continuous web-based data entry.

- CDC will accommodate state health departments with existing integrated data collection systems, *e.g.*, by arranging for uploads of XML-formatted data.

- The data entry screens will be designed as a series of simple forms or tables.

- The system will accommodate updates and corrections of previously transmitted data by jurisdictions.

- Following the entry of a week's data into the database at the state level, transmission of the data file to CDC will involve a minimal number of keystrokes. Security will be insured by use of the sender's digital certificate. CDC will arrange for those who will be transmitting surveillance data to CDC to obtain digital certificates.

- Upon arrival at CDC, records from the specific reporting week of interest will automatically be captured and imported into a master database on the CDC fileserver and also transmitted to USGS in Reston, Virginia.

- Using these data, reports will be generated automatically each week. Maps will be generated by CDC and USGS and made available on the USGS web site. A basic set of dynamic maps and corresponding graphs and tables will be made available weekly. The CDC web site and Epi-X (or a similar secured communication network) will contain links to the relevant USGS web pages.

Reporting "numerator" data:

CDC strongly encourages prompt ("real-time") reporting of numerator data. CDC will collect such reports in a standardized manner to allow monitoring of regional and national trends, and facilitate prompt confirmatory testing when necessary. As the arbovirus transmission season progresses, the need for immediate reporting of certain data to CDC may diminish. For example, once numerous WNV-positive mosquito pools have been previously documented in a given geographic area, there may not be a compelling need to *immediately* report further findings. In addition, if at any time the volume of reporting becomes overwhelming, adoption of an alternative system may be necessary.

Numerator data variables that will be collected are specified in Table 2. WNV laboratory and surveillance case criteria are specified in Table 3.

Specified, line-listed numerator data may be submitted using one of three methods:

- Web-based data entry to a CDC server;
- Use of state-based, CDC-distributed, Microsoft Access-based data entry/management software (ArboNET) with continuous file upload to a CDC server; or
- Data messaging from a unique data collection system to a CDC server (*e.g.,* in XML format).

All data entry will be done by the reporting jurisdiction and data is transmitted to a CDC server. After data entry and submission, numerator data will be available on the CDC Secure Data Network (SDN) so that authorized personnel from the reporting jurisdiction may "verify" (proofread, correct, and clear for publication) individual numerator data records in selected surveillance categories.

It is essential that each numerator data record include a unique identifier (UID) assigned by the reporting state agency. UIDs will be used by CDC staff to track and update individual numerator data records, and by states to verify records via the CDC SDN. The UID will not appear in output products for public release. Most jurisdictions already have systems in place for generating UIDs, and they should continue to use them. CDC's databases will accommodate numeric or alphanumeric UIDs up to 25 characters long. Jurisdictions are encouraged to begin their UIDs with their state's 2-letter postal code (or "NYC" for New York City).

The issue of numerator data records associated with laboratory-probable results deserves special mention. Although CDC encourages confirmation of all laboratory-probable results, it is realized that under some circumstances some states may choose not to do so, depending on the epidemiologic situation, laboratory capacity, and volume. For example, during a known WN viral epizootic, a state may decide that a crow brain associated with a single positive result for WN viral RNA by RT-PCR will undergo no further testing. Although this bird is a laboratory-probable case (see table below), the jurisdiction may decide to upload that bird's numerator data record to CDC and subsequently authorize CDC to release it publicly. In contrast, a jurisdiction may opt to delay the release of such results to the public until they have been laboratory-confirmed. CDC will rely on individual jurisdictions to decide when to authorize the public release of numerator data records based on *laboratory-probable* results.

CDC will not publicize numerator data records associated with laboratory-equivocal results.

In terms of human surveillance, the national surveillance case definition of arboviral encephalitis/meningitis includes two official case-status categories: confirmed and probable (Table 3). For national arboviral encephalitis surveillance, CDC has traditionally combined records in

these two categories for its annual summary reports, and will continue this practice within the WNV surveillance system. States are encouraged to promptly report both laboratory-confirmed and laboratory-probable human WN encephalitis cases as numerator data records.

CDC encourages the reporting of human WN viral illnesses other than WNME (*e.g.*, WNF, acute flaccid paralysis, other clinical syndrome, or unspecified). To determine case status (confirmed or probable) for reporting purposes, refer to the national surveillance case definition of arboviral encephalitis/meningitis (Appendix C) and the CDC-recommended surveillance case definition for WNF (Appendix D). A working case definition for WNME in equines is shown in Appendix B.

Arboviruses other than WNV:

It is anticipated that enhanced WNV surveillance will result in increased recognition of other domestic arboviral activity, including eastern equine encephalitis (EEE), western equine encephalitis (WEE), SLE, La Crosse (LAC), and Powassan (POW) virus activity. Surveillance numerator (laboratory-positive) data regarding these viruses may be reported to CDC/DVBID via ArboNET, telephone, FAX, or e-mail.

Data Security Issues:

General principles:

- State and local health authorities will retain control of the timing of data release.

- As of 2003, reporting agencies will electronically report to ArboNET all categories of surveillance data, including human numerator data. For non-human data, agencies will verify accuracy and readiness for public release prior to submission. Upon the electronic submission of non-human data to CDC, these reports will be considered verified and publishable. With the 2003 version of ArboNET, human data will be automatically verified upon entry, and the reporting agency has the option to unverify the data via electronic checkbox. CDC will not publicly release unverified human case reports.

- Personal identifying or localizing (more specific than county) information will not be released.

Specific issues:

- To report data via secure file upload to the CDC fileserver or to enter data directly onto a secured web site, states will utilize the CDC SDN, which provides data encryption for transmission via the Internet. To use the SDN, users must obtain and install a digital certificate from the CDC certificate server. This allows for unique identification of the computer/browser that is accessing a secure web site.

- To obtain a digital certificate and be approved to use the SDN, the digital certificate authority at CDC/DVBID must approve the request and forward it to CDC/Atlanta. CDC requests that <u>a maximum of 3</u> persons from each state be designated to receive digital certification. These should include those who will transmit data to CDC, as well as those who will verify data on the SDN.

Summary Reports to be Produced by CDC and USGS:

A working list of basic summary reports is shown in Table 4. The exact list and formats of these

reports remain to be determined, and this should be viewed as a dynamic process. Modifications, additions, and deletions may take place over time, as dictated by feedback, experience, technical issues, and events.

Using state-approved numerator and denominator data, reports will be generated weekly. Maps and tables will be generated by DVBID and by USGS. Maps and corresponding graphs and tables will be updated at least weekly on the USGS web site (www.USGS.gov).

Communication Issues:

- A dedicated telephone line (970-266-3592), electronic mailbox (dvbid2@cdc.gov), and fax machine (970-266-3599) will be available at CDC/DVBID (in Fort Collins, Colorado) 24 hours/day for reporting numerator data or other urgent WNV-related business. During nights and weekends, calls to the dedicated phone line will be forwarded to the cellular phone of an on-call CDC/DVBID staff scientist. *Because of potential delays in the receipt and reading of email and fax messages, in general please use the telephone for time-sensitive business.*

- In addition to periodic conference calls between CDC, cooperating states, and other federal agencies, Epi-X and the WNV Information Exchange (WNVIX, part of the Epi-X Forum) will be available to participating jurisdictions and agencies using the CDC SDN. For further information, contact the CDC/DVBID ArboNET staff at 970.221.6400 or send electronic mail to dvbid2@cdc.gov.

Submission of Laboratory Specimens to CDC for WNV Testing:

See Table 5.

Table 1. *Denominator* Data Variable List

(Note: As of 2003, *denominator* data will no longer be collected in the following categories: sentinel animals, seroprevalence in free-ranging birds, and ill equines or humans.)

I. *Avian mortality:* (Includes ill or dead birds, except for sentinels.)

? Year

? MMWR week that bird collected ("MMWR week collected")
(Note: "MMWR week collected" corresponds to the earliest date associated with a specimen. Preferably, this should be MMWR week that corresponds *to the date that the bird was reported by the public*. But, if a date of report is not available, use the MMWR week that corresponds to the *date that the specimen was collected in the field*. This "MMWR week collected" should remain associated with this specimen **throughout testing.**)

? County

? State

? Number of reported corvids by "MMWR week collected" and by county (Data source: State, county or township WNV surveillance coordinators through the state to CDC)

? Number of corvids **tested** by "MMWR week collected" and by county (Data source: Testing laboratories through state)

? Number of other reported birds by "MMWR week collected" and by county (Data source: Jurisdictional WNV surveillance coordinators to CDC via state or municipal health departments)

? Number of other birds **tested** by "MMWR week collected" and by county (Data source: Testing laboratories through state)

Note: Laboratory-positive" results are reported through the *numerator* system by the testing facility/agency. In this report, the date of reporting/sighting or field collection is routinely obtained. By definition, each *numerator* data record of a WNV-positive dead bird should also be included within an aggregated *denominator* data record.)

II. *Mosquito collections:*

? Year

? MMWR week of collection
(Note: This is the MMWR week that corresponds to the date of field collection. This date should remain associated with this specimen **throughout testing.**)

? County

? State

? Species of mosquito

? Number of mosquitoes collected by MMWR week of collection, by county, and by species (Data source: Jurisdictional WNV surveillance coordinators to CDC via state or municipal health departments)

? Number of mosquitoes **tested** by MMWR week of collection, by county, and by species (Data source: Testing laboratories through state).

(Note**:** Laboratory-positive results are reported through the *numerator* system by the testing facility/agency. In this report, the date of field collection is routinely obtained. By definition, each *numerator* data record of a WNV-positive mosquito pool should also be included within an aggregated *denominator* data record.)

Table 2. *Numerator* data variables

Mosquito surveillance – state, county, pool UID, date of mosquito collection, week of collection, species, arbovirus, case status

Sentinel species surveillance - State, county, group UID, date of serum collection, week of serum collection, species, arbovirus, case status

Avian mortality surveillance – state, county, bird UID, week bird found collected, date bird collected, species (including "captive species"), arbovirus, case status

Avian seroprevalence surveillance – state, county, bird UID, week bird trapped & bled, date bird trapped & bled, species, arbovirus, case status

Veterinary (non-avian) surveillance – state, county, animal UID, week of illness onset, date of illness onset, species (canine, equine, feline, bat, squirrel, rabbit, raccoon, or other species), arbovirus, case status.

Human surveillance – state, county, patient UID, week of illness onset, date of illness onset, imported from, arbovirus, case status, age, age unit, birthdate, sex, race, ethnicity, clinical syndrome, fatality, date of death, lab acquired, non-lab acquired, blood donor, blood recipient. organ donor, organ transplant recipient, breast fed infant at time of illness, potential in-utero infection, pregnant at time of illness

Table 3. WNV Laboratory and Surveillance Case Criteria

Laboratory case definitions:

Surveillance Type	Laboratory-confirmed WNV infection	Laboratory-probable WNV infection*
Mosquito	• WNV isolation (identity of virus established by at least two of the following techniques: • Positive RT-PCR test for WN viral RNA with validation by 1) repeated positive test using different primers, 2) positive PCR result using another system (*e.g.*, TaqMan), or 3) virus isolation. • Detection of WN viral antigen (*e.g.,* IFA, EIA, VecTest™) validated by inhibition test (for ELISA), RT-PCR, or virus isolation	• Positive RT-PCR test for WN viral RNA in a single test • Antigen detection not validated by another procedure
Sentinel species	• WNV isolation, RNA detection, or antigen detection as described for mosquitoes, • Seroconversion to WNV in serially collected serum specimens, by plaque-reduction neutralization** • Detection of IgM antibody to WNV, validated by demonstration of neutralizing antibody to WNV**	• Detection of IgM antibody to WNV • Seroconversion to WNV in serially collected serum specimens, strongly reactive by EIA or IFA
Avian mortality	• WNV isolation, RNA detection, or antigen detection as described for mosquitoes, ,	• Positive RT-PCR test for WN viral RNA in a single test • Antigen detection not validated by another procedure

Surveillance Type	Laboratory-confirmed WNV infection	Laboratory-probable WNV infection*
Veterinary (non-avian)	• As for humans (see below)	• As for humans (see below)
Human	• See national surveillance case definitions (Appendices C and D)	• See national surveillance case definitions (Appendices C and D)

* CDC strongly encourages attempts to confirm all laboratory-probable and -equivocal results. Further testing of laboratory-probable human specimens will depend on availability of confirmatory testing.

** SLE virus infection should be ruled-out by cross-neutralization; criterion for PRNT positive is a 90% neutralization titer of at least 1:10, and 4-fold greater titer compared to other flaviviruses such as SLE.

Table 4. Working List of Basic Weekly Summary Reports to be Produced by CDC

NOTE: The exact list and formats of these reports remain to be determined, and this should be viewed as a dynamic process. Modifications, additions, and deletions may occur over time, as dictated by feedback, experience, technical issues, and events.

A. National map: U.S. map with state boundaries reflecting cumulative data.
   1. Mosquito surveillance:
      a. Map showing each state's counties as WNV-positive, WNV-negative, or blank (no data)
   2. Sentinel chicken surveillance:
      a. Map showing each state's counties as WNV-positive or blank (no data)
   3. Avian morbidity/mortality surveillance:
      a. Map showing each state's counties as WNV-positive, WNV-negative, or blank (no data)
   4. Veterinary (non-avian) surveillance:
      a. Map showing each state's counties as WNV-positive (# cases) or blank (no data)

   5. Human surveillance:
      a. Map showing each state's counties as WNV-positive (# cases) or blank (no data)

B. State Maps: Selecting an individual state from the national map will produce a map of that state with its county boundaries indicating the positive specimens reported for that county and an accompanying table of cumulative positive specimens reported by county.
   1. Mosquito surveillance:
      a. Map showing each county as WNV-positive with a count of positive specimens reported, WNV-negative, or blank (no data)
   2. Sentinel species surveillance:
      a. Map showing each county as WNV-positive with a count of positive specimens reported or blank (no data) by sentinel species (*e.g.*, horse, chicken)
   3. Avian mortality surveillance:
      a. Map showing each county as WNV-positive with a count of positive specimens reported, WNV-negative, or blank (no data)
   4. Veterinary (non-avian) surveillance:
      a. Map showing each county as WNV-positive with a count of positive specimens reported or blank (no data)
   5. Human surveillance:
      a. Map showing each county as WNV-positive with a count of positive specimens reported or blank (no data)

Table 5. Instructions for Submitting Laboratory Specimens to CDC for WNV Testing

Arrangements for Testing:

Mosquito specimens: Specimens will be accepted for confirmatory testing at CDC when requested by a state health department vector surveillance coordinator. For specimens considered by a state health department vector surveillance coordinator to be of high priority and beyond the capacity of the state public health laboratory or collaborating laboratory, initial and confirmatory testing can be obtained at CDC by special arrangement, depending on CDC laboratory capacity. For further information, please contact Dr. Roger Nasci, tel. 970-221-6432, RNasci@cdc.gov; if Dr. Nasci cannot be reached, please phone 970-266-3592.

Sentinel chicken specimens: Serum specimens will be accepted for confirmatory testing at CDC when requested by a state health department vector or vertebrate surveillance coordinator. For specimens considered by a state health department vector or vertebrate surveillance coordinator to be of high priority and beyond the capacity of the state public health laboratory or collaborating laboratory, initial and confirmatory testing can be obtained at CDC by special arrangement, depending on CDC laboratory capacity. For further information, please contact Dr. Rob Lanciotti, tel. 970-221-6440, RSLanciotti@cdc.gov; if Dr. Lanciotti cannot be reached, please call 970-266-3592.

Avian morbidity/mortality specimens: On a case-by-case basis, special arrangements can by made for CDC to conduct initial and/or confirmatory tests of tissue specimens (especially brain, heart, kidney, and spleen) from dead birds that cannot otherwise be tested in state health department laboratories or by the National Wildlife Health Center, USGS. For further information, please contact Dr. Nick Komar, tel. 970-221-6496, NKomar@cdc.gov; if Dr. Komar cannot be reached, please call 970-266-3592.

Veterinary (non-avian) specimens: Specimens will be accepted for confirmatory testing at CDC when requested by a state health department laboratory director. For routine testing of veterinary specimens, contact the state health department laboratory or the National Veterinary Services Laboratory, USDA, in Ames, IA (Tel. 515-663-7751), or another collaborating laboratory. For specimens considered by a state health department laboratory director to be of high priority and beyond the capacity of that state's public health laboratory, initial and confirmatory testing can be obtained at CDC by special arrangement. For further information, please contact Dr. Rob Lanciotti, tel. 970-221-6440, RSLanciotti@cdc.gov; if Dr. Lanciotti cannot be reached, please call 970-266-3592.

Human specimens: Specimens will be accepted for confirmatory testing at CDC when requested by a state health department laboratory director. For specimens considered by a state health department laboratory director to be of high priority and beyond the capacity of the state public health laboratory or collaborating laboratory, initial and confirmatory testing can be obtained at CDC by special arrangement. For further information, please contact Dr. Rob Lanciotti, tel. 970-221-6440, RSLanciotti@cdc.gov; if Dr. Lanciotti cannot be reached, please call 970-266-3592.

General Shipping Instructions:

All shippers should adhere to International Air Transport Association regulations (*http://www.iata.org*).

Specimens should be shipped by overnight courier to arrive at CDC on Tuesday-Friday. *Always notify CDC staff in advance of an impending shipment* (tel. 970-221-6445; if no answer, phone 970-266-3592). Do not ship specimens on Friday unless special arrangements have been

made.

Shipping address: CDC/DVBID
CSU Foothills Campus/Rampart Road
Fort Collins, CO 80521
ATTENTION: Arbovirus Diagnostic Laboratory (tel. 970-221-6445)

Shipping containers: Use only durable containers. Seal specimen containers tightly. Wrap specimen containers in absorbent material and pack them into two different plastic containers to insure that any leakage is contained. Specimens for virus isolation must be sent on enough dry ice to insure that they remain frozen until receipt. Specimens for serologic testing can be shipped on gel-ice and need not remain frozen. Hand-carrying specimens is not recommended but if specimens are hand-carried, the above packing instructions are applicable.

Minimal Information to Accompany Specimens Shipped to CDC:

See information in columns 2, 3, and 4 in Table 2. Please read carefully and supply all available information. Use CDC Form 5034 (the ADASH@ form) Form 5034 is available electronically at: *http://www.cdc.gov/ncidod/dvbid/CDC_form5034.pdf*

Tubes, cryovials, and other specimen containers should be clearly labeled with – at minimum – the specimen's UID, patient's name (human), state, date of onset, date of collection, and specimen type.

Special Collection, Shipping, and Handling Instructions:

Mosquitoes: Ship on dry ice.

Serum: Store in externally threaded plastic tubes. Ship at least 0.5 mL per specimen. Whenever possible, acute and convalescent specimens should be shipped together. Ship fresh-frozen on dry ice (required for virus isolation) or refrigerated on wet ice (acceptable).

CSF: Store in externally threaded plastic tubes. Ship at least 1.0 mL per specimen. Ship fresh-frozen on dry ice (required for virus isolation) or refrigerated on wet ice (acceptable).

Whole blood: In general, send only if requested for virus isolation attempts in fatal cases (heart blood).

Pregnancy-related specimens: In possible cases of intrauterine arboviral infection, tissues collected at the time of delivery can be tested for evidence of infection. The following tissues should be shipped fresh-frozen on dry ice: cross-sections of umbilical cord, placental tissue (approximately 1 cm^3 per sample), cord serum and maternal serum (0.5 ml each), and colostrum or breast milk. For more information, please contact Dr. Dan O'Leary at (970) 266-3525 or DOLeary@cdc.gov.

Autopsy specimens: In suspected cases of arboviral encephalitis in which an autopsy is performed, **fresh-frozen** tissues can be tested, including brain (multiple areas of cortex, midbrain, brainstem, and spinal cord), other solid organs (liver, spleen, pancreas, heart, kidney, etc.), CSF (collected from ventricles), and heart blood (for virus isolation attempts).

After consulting with Dr. Sherif Zaki or other CDC/Atlanta pathology staff member**s** (tel. 404-639-3133), **tissue samples suspended in formalin** should be sent to:

Infectious Disease Pathology Activity
DVRD/NCID/CDC
Building 1, Room 2301
1600 Clifton Road, N. E.
Atlanta, GA 30333

Veterinary (non-avian) tissues: As for human specimens.

Avian tissues: Submit fresh-frozen brain, heart, kidney, and spleen samples.

Appendix B B Surveillance Case Definition for WNV Infection in Equines

Laboratory criteria for diagnosis

Compatible clinical signs[1] plus one or more of the following:

- Isolation of West Nile (WN) virus from or demonstration of specific viral antigen or genomic sequences in tissue, blood, cerebrospinal fluid (CSF) or other body fluid;[2] or
- Detection of IgM antibody against WN virus by IgM-capture ELISA in serum (at 1:400 or greater dilution) or cerebrospinal fluid (CSF) (at dilution 1:2 or greater dilution); or
- An associated 4-fold or greater change in IgG-capture ELISA or plaque-reduction neutralization test (PRNT) antibody titer to WN virus in appropriately timed,[3] paired serum specimens from an equid that is unvaccinated against WN virus; or
- Positive immunohistochemistry (IHC) for WN virus antigen in tissue.

Case classification

Probable: compatible clinical signs occurring during a period when arboviral transmission is likely, and with the following supportive serology: 1) a single or stable (less than or equal to two-fold change) but elevated titer of WN virus-specific IgM-capture ELISA or neutralizing serum antibodies without knowledge of prior WN virus vaccination.

Confirmed: compatible clinical signs with laboratory-confirmed evidence of WN virus infection.

Notes:

[1] Clinical signs are associated with central and/or peripheral nervous system dysfunction. Most horses exhibit secondary CNS-derived neurological manifestations such as ataxia (including stumbling, staggering, wobbly gait, or incoordination) or at least two of the following: circling, hind limb weakness, inability to stand, multiple limb paralysis, muscle fasciculation, proprioceptive deficits, altered mental status, blindness, lip droop/paralysis, teeth grinding. (Ostlund et al, Equine West Nile Encephalitis, United States, Emerging Infectious Diseases, Vol 7, No 4. Jul – Aug 2001) Fever is not a consistent finding.

[2] Preferred diagnostic tissues from equids are brain or spinal cord; isolation of WN virus or detection of WN viral nucleic acid sequences in equine blood or CSF are infrequent. (Bunning et al, Experimental Infection of Horses with *West Nile virus,* Vol 8, No. 4. April 2002)

[3] The first serum should be drawn as soon as possible after onset of clinical signs and the second drawn at least 14 days post-onset.

Assumptions on which case definitions are based:

- IgM-capture ELISA testing may give nonspecific results; cross-reactions to closely related flaviviruses (e.g., St. Louis encephalitis virus) may occur. Because closely related arboviruses exhibit serologic cross-reactivity, positive results of serologic tests using antigens from a single arbovirus can be misleading. In some circumstances (*e.g.*, in areas where two or more closely related arboviruses occur, or in imported arboviral disease cases), it may be epidemiologically important to attempt to pinpoint the infecting virus by conduction cross-neutralization tests using an appropriate battery of closely related viruses.

- Vaccination refers to one or more doses of the current USDA-licensed inactivated WN virus vaccine.
- IgM antibody in equine serum is relatively short-lived; a positive IgM-capture ELISA means infection with WN virus or a closely related flavivirus has occurred, probably within the last three months. (personal communication Eileen N. Ostlund, USDA**)**
- Neutralizing antibody, as detected by PRNT, may not be present in equine serum until two weeks or more after exposure to WN virus; it is possible that clinical signs may be present in an equine before a serum PRNT is positive.
- Neutralizing antibody detected in serum by PRNT indicates past infection with WN virus or vaccination with WN virus vaccine; equines exposed to WN virus in prior years may test positive by PRNT.

Appendix C - National Surveillance Case Definition for Arboviral Encephalitis/Meningitis, 2001

(available at http://www.cdc.gov/epo/dphsi/casedef/encephalitiscurrent.htm)

Encephalitis or Meningitis, Arboviral (includes California serogroup, Eastern equine, St. Louis, Western equine, West Nile, Powassan)

2001 Case Definition

Clinical description

Arboviral infections may be asymptomatic or may result in illnesses of variable severity sometimes associated with central nervous system (CNS) involvement. When the CNS is affected, clinical syndromes ranging from febrile headache to aseptic meningitis to encephalitis may occur, and these are usually indistinguishable from similar syndromes caused by other viruses. Arboviral meningitis is characterized by fever, headache, stiff neck, and pleocytosis. Arboviral encephalitis is characterized by fever, headache, and altered mental status ranging from confusion to coma with or without additional signs of brain dysfunction (e.g., paresis or paralysis, cranial nerve palsies, sensory deficits, abnormal reflexes, generalized convulsions, and abnormal movements).

Laboratory criteria for diagnosis

- Fourfold or greater change in virus-specific serum antibody titer, or
- Isolation of virus from or demonstration of specific viral antigen or genomic sequences in tissue, blood, cerebrospinal fluid (CSF), or other body fluid, or
- Virus-specific immunoglobulin M (IgM) antibodies demonstrated in CSF by antibody-capture enzyme immunoassay (EIA), or
- Virus-specific IgM antibodies demonstrated in serum by antibody-capture EIA and confirmed by demonstration of virus-specific serum immunoglobulin G (IgG) antibodies in the same or a later specimen by another serologic assay (e.g., neutralization or hemagglutination inhibition).

Case classification

Probable: an encephalitis or meningitis case occurring during a period when arboviral transmission is likely, and with the following supportive serology: 1) a single or stable (less than or equal to twofold change) but elevated titer of virus-specific serum antibodies; or 2) serum IgM antibodies detected by antibody-capture EIA but with no available results of a confirmatory test for virus-specific serum IgG antibodies in the same or a later specimen.

Confirmed: an encephalitis or meningitis case that is laboratory confirmed.

Comment

Because closely related arboviruses exhibit serologic cross-reactivity, positive results of serologic tests using antigens from a single arbovirus can be misleading. In some circumstances (e.g., in areas where two or more closely related arboviruses occur, or in imported arboviral disease cases), it may be epidemiologically important to attempt to pinpoint the infecting virus by conducting cross-neutralization tests using an appropriate battery of closely related viruses. This is essential, for example, in determining that antibodies detected against St. Louis encephalitis virus are not the result of an infection with WN (or dengue) virus, or vice versa, in areas where both of these viruses occur.

The seasonality of arboviral transmission is variable and depends on the geographic location of exposure, the specific cycles of viral transmission, and local climatic conditions. Reporting should be etiology-specific (see below; the six encephalitides/meningitides printed in bold are nationally reportable to CDC):

St. Louis encephalitis/meningitis (NETSS Event Code: 10051)

West Nile encephalitis/meningitis (NETSS Event Code: 10056)

Powassan encephalitis/meningitis (NETSS Event Code: 10057)

Eastern equine encephalitis/meningitis (NETSS Event Code: 10053)

Western equine encephalitis/meningitis (NETSS Event Code: 10052)

California serogroup viral encephalitis/meningitis (includes infections with the following viruses: La Crosse, Jamestown Canyon, snowshoe hare, trivittatus, Keystone, and California encephalitis viruses) (NETSS Event Code: 10054)

Other viral CNS infections transmitted by mosquitoes, ticks, or midges (*e.g.*, Venezuelan equine encephalitis/meningitis [NETSS Event Code: 10055] and Cache Valley encephalitis/meningitis [NETSS Event Code: 10058])

Appendix D - CDC-Recommended Surveillance Case Definition for WN Fever

What is a CDC-Recommended Case Definition?
CDC-recommended surveillance case definitions are prepared for use by U.S. States and Territories interested in conducting public health surveillance for diseases or conditions that have not been designated nationally notifiable and have not been officially approved and sanctioned by the Council of State and Territorial Epidemiologists (CSTE). A CDC-recommended case definition may not be approved by CSTE in the future, unless CSTE and the CDC program with responsibility for prevention and control of the selected disease or condition both wish to seek broader and more formalized approval from both organizations.

CASE DEFINITION

Case Description

A non-specific, self-limited, febrile illness caused by infection with WNV, a mosquito-borne flavivirus. Clinical disease generally occurs 2-6 days (range, 2-15 days) following the bite of an infected mosquito. Typical cases are characterized by the acute onset of fever, headache, arthralgias, myalgias, and fatigue. Maculopapular rash and lymphadenopathy generally are observed in less than 20% of cases. Illness typically lasts 2-7 days.

Case Classification

A clinically compatible illness, *plus*:

Confirmed:

1) Fourfold or greater change in WNV-specific serum antibody titer;

2) Isolation of WNV from or demonstration of specific WN viral antigen or genomic sequences in tissue, blood, CSF, or other bodily fluid; or

3) WNV-specific IgM antibodies demonstrated in serum by antibody-capture enzyme immunoassay and confirmed by demonstration of WNV-specific serum neutralizing antibodies in the same or a later specimen.

Probable:

1) WNV-specific serum IgM antibodies detected by antibody-capture enzyme immunoassay but with no available results of a confirmatory test for WNV-specific serum neutralizing antibodies in the same or a later specimen.

(Note: Some WN fever cases progress to WN meningitis or encephalitis. Cases meeting the more restrictive case definition of WN encephalitis/meningitis should be reported as such and only once, using event code 10056 for "WN Encephalitis or Meningitis".)

Comment

The seasonality of arboviral transmission is variable and depends on the geographic location of exposure, the specific cycles of viral transmission, and local climatic conditions. Because closely related arboviruses exhibit serologic cross-reactivity, positive results of serologic tests using antigens from a single arbovirus can be misleading. In some circumstances (*e.g.*, in areas where two or more closely related arboviruses occur, or in imported arboviral disease cases), it may be epidemiologically important to attempt to identify the infecting virus by conducting cross-neutralization tests using an appropriate battery of closely related viruses. This is essential, for example, in determining that antibodies detected against WNV are not the result of an infection with St. Louis encephalitis or dengue virus, or vice versa. Because dengue fever and WN fever can be clinically indistinguishable, the importance of a recent travel history and appropriate serologic testing cannot be overemphasized. In some persons, WNV-specific serum IgM antibody can wane slowly and be detectable for more than one year following infection. Therefore, in areas where WNV has circulated in the recent past, the co-existence of WNV-specific IgM antibody and illness in a given case may be coincidental and unrelated. In those areas, the testing of serially collected serum specimens assumes added importance.

Date case definition was developed: October 2002
Event Code: 10049
Source of the case definition: National Center for Infectious Diseases, Division of Vector-Borne Infectious Diseases, Arbovirus Diseases Branch.
Questions and comments about the case definition should be directed to the following CDC/ADB staff:

Roy Campbell	Phone: (970) 221-6459	E-mail: glc5@cdc.gov
Dan O'Leary	Phone: (970) 266-3525	E-mail: dbo7@cdc.gov
Tony Marfin	Phone: (970) 266-3521	E-mail: aam0@cdc.gov

Appendix E – Recommended Framework for Standardized "Extended" Clinical Variables in Studies of Human WNV Disease

Larger and more detailed case series, as well as studies of short- and long-term outcome, are needed to better understand the clinical features, clinical course, and public health impact of WNV disease in humans. A suggested framework for collecting standardized "extended" clinical variables is shown below. During 2003, CDC will work with its partners to populate this framework with specific questions in each category. The use of standardized questions will allow public health officials and other researchers to compare results more readily.

1. Epi core data (e.g., age, gender, residence location, race/ethnicity, type of West Nile virus illness, etc.) *[Note: These are already standard ArboNET variables.]*
2. Past medical history
3. Previous arboviral infections or vaccinations
4. Immunosuppressed conditions
5. New modes of transmission
6. Clinical presentation – neurology and initial symptoms
7. Clinical presentation – Standardized scale of neuro/physiologic function (e.g., APACHE, Glasgow Coma Scale, PRISM)
8. Clinical presentation – laboratory
9. Clinical presentation – WNV diagnostic studies
10. Clinical presentation – Special diagnostic studies (e.g., MRI, EEG, EMG, lumbar puncture)
11. Treatment (e.g., antivirals, steroids, anti-seizure medications, hyperventilation, interferon, intravenous immunoglobulin, plasmapharesis)
12. Clinical course (e.g., renal function, electrolyte balance, neurologic complications)
13. Morbidity (e.g., number of hospital-, ICU-, and ventilator-days, number and type of nosocomial infections, etc.) *[Note: Many of the morbidity parameters can be used in determining the costs of WNV disease.]*
14. Nosocomial infections
15. Discharge disposition
16. Neurologic and functional status at disposition, at 90 days post-discharge, and 180 days post-discharge
17. Mortality (e.g., cause of death, pathology findings, etc.)

REFERENCES:

1. Centers for Disease Control and Prevention. Outbreak of West Nile-like viral encephalitis--New York, 1999. MMWR Morb Mortal Wkly Rep1999;48:845-9.

2. Nash D, Mostashari F, Fine A, Miller, J, O'Leary D, Murray K, et al. The outbreak of West Nile virus infection in the New York City area in 1999. New Engl J Med 2001;344:1807-14.

3. Anderson JF, Andreadis TG, Vossbrinck CR, Tirrell S, Wakem EM, French RA, et al. Isolation of West Nile virus from mosquitoes, crows, and a Cooper's hawk in Connecticut. Science 1999;286:2331-3.

4. Briese T, Jia XY, Huang C, Grady LJ, Lipkin WI. Identification of a Kunjin/West Nile-like flavivirus in brains of patients with New York encephalitis. Lancet 1999;354:1261-2.

5. Jia XY, Briese T, Jordan I, Rambaut A, Chi HC, Mackenzie JS, et al. Genetic analysis of West Nile New York 1999 encephalitis virus. Lancet 1999;354:1971-2.

6. Lanciotti RS, Roehrig JT, Deubel V, Smith J, Parker M, Steele K, et al. Origin of the West Nile virus responsible for an outbreak of encephalitis in the northeastern United States. Science 1999;286: 2333-7.

7. Centers For Disease Control And Prevention. Update: Surveillance for West Nile virus in overwintering mosquitoes-New York, 2000. MMWR Morb Mortal Wkly Rep 2000;49:178-9.

8. Nasci R, Savage HM, White DJ, Miller JR, Cropp CB, Godsey MS, et al. West Nile virus in overwintering *Culex* mosquitoes, New York City, 2000. Emerg Infect Dis 2001; 7:742-4.

9. De Madrid AT, Porterfield JS. The flaviviruses (group B arboviruses): a cross-neutralization study. J Gen Virol 1974;23:91-6.

10. Calisher CH, Karabatsos N, Dalrymple JM, Shope RE, Porterfield JS, Westaway EG, et al. Antigenic relationships between flaviviruses as determined by cross- neutralization tests with polyclonal antisera. J Gen Virol 1989;70:37-43.

11. Campbell GL, Marfin AA, Lanciotti RS, Gubler DJ, 2002. West Nile virus. Lancet Infect Dis 2002;2:519-29.

12. Hubalek Z, Halouzka J. West Nile fever--a reemerging mosquito-borne viral disease in Europe. Emerg Infect Dis 1999;5: 643-50.

13. Tsai TF, Popovici F, Cernescu C, Campbell GL, Nedelcu NI, for the Investigative Team. West Nile encephalitis epidemic in southeastern Romania. Lancet 1998;352:767-71.

14. Platanov AE, Shipulin GA, Shipulina OY, Tyutyunnik EN, Frolochkina TI, Lanciotti RS, et al. Outbreak of West Nile virus infection, Volgograd region, Russia, 1999. Emerg Infect Dis 2001;7:128-32.

15. Centers For Disease Control And Prevention. Guidelines for surveillance, prevention, and control of West Nile virus infection--United States. MMWR Morb Mortal Wkly Rep 2000;49: 25-8.

16. Gubler DJ, Campbell GL, Petersen L, Komar N, Nasci RS, Roehrig JT. West Nile virus in the United States: Guidelines for detection, prevention and control. Viral Immunol 2000;13:469-75.

17. Centers For Disease Control And Prevention. Preventing emerging infectious diseases: a strategy for the 21st century. Atlanta, GA: U.S. Department of Health and Human Services, 1998.

18. Centers For Disease Control And Prevention. Guidelines for arbovirus surveillance in the United States. Fort Collins, CO: U.S. Department of Health and Human Services, 1993. Available from: URL: http://www.cdc.gov/ncidod/dvbid/arbor/arboguid.htm.

19. Eidson, M, Komar N, Sorhage F, Nelson R, Talbot T, Mostashari F, et al. Crow deaths as a sentinel surveillance system for West Nile virus in the Northeastern United States, 1999. Emerg Infect Dis 2001;7:615-20.

20. Guptill SC, Julian KG, Campbell GL, Price SD, Marfin AA. Early-season avian deaths from West Nile virus as warnings of human infection. Emerg Infect Dis 2003;9:483-4.

21. Julian KG, Eidson M, Kipp AM, Weiss E, Petersen LR, Miller JR, et al. Early season crow mortality as a sentinel for West Nile virus disease in humans, northeastern United States. Vector Borne Zoonotic Dis 2002;2:145-55.

22. Mostashari F, Kulldorff M, Hartman JJ, Miller JR, Kulasekera V. Dead bird clusters as an early warning system for West Nile virus activity. Emerg Infect Dis 2003;641-6.

23. Steele KE, Linn MJ, Schoepp RJ, Komar N, Geisbert TW, Manduca RM, et al. Pathology of fatal West Nile virus infections in native and exotic birds during the 1999 outbreak in New York City, New York. Vet Pathol 2000;37: 208-24.

24. Panella NA, Kerst AJ, Lanciotti RS, Bryant P, Wolf B, Komar N. Comparative West Nile virus detection in organs of naturally infected American crows (*Corvus brachyrhynchos*). Emerg Infect Dis 2001;7:754-5.

25. Kramer LD, Bernard KA. West Nile virus infection in birds and mammals. Ann N Y Acad Sci 2001;951:84-93.

26. Komar N, Lanciotti R, Bowen R, Langevin S, Bunning M. Detection of West Nile virus in oral and cloacal swabs collected from bird carcasses. Emerg Inf Dis 2002;8:741-2.

27. Lanciotti RS, Kerst AJ, Nasci RS, Godsey MS, Mitchell CJ, Savage HM, et al. Rapid detection of West Nile virus from human clinical specimens, field- collected mosquitoes, and avian samples by a TaqMan reverse transcriptase-PCR assay. J Clin Microbiol 2000;38:4066-71.

28. Hunt AR, Hall RA, Kerst AJ, Nasci RS, Savage HM, Panella NA, et al. Detection of West Nile virus antigen in mosquitoes and avian tissues by a monoclonal antibody-based capture enzyme immunoassay. J Clin Microbiol 2002;40: 2023-30.

29. Ryan J, Dave K, Emmerich E, Fernandez B, Turell M, Johnson J, et al. Wicking assays for the rapid detection of West Nile and St. Louis encephalitis viral antigens in mosquitoes (Diptera: Culicidae). J Med Entomol 2003;40 :95-9.

30. Julian KG, Eidson M, Kipp AM, Weiss A, Petersen LR, Miller JR, et al. Early season crow mortality as a sentinel for West Nile virus disease in humans, Northeastern United States. Vector Borne and Zoonotic Dis 2002;2:145-55.

31. Eidson M, Kramer L, Stone W, Hagiwara Y, Schmidt K, New York State West Nile Virus Avian Surveillance Team. Dead bird surveillance as an early warning system for West Nile virus. Emerg Infect Dis 2001;7 631–35.

32. Komar N, Langevin S, Hinten S, Nemeth N, Edwards E, Hettler D, et al. Experimental infection of North American birds with the New York 1999 strain of West Nile virus. Emerg Inf Dis 2003;9:311-22.

33. Nasci RS, Komar N, Marfin AA, Ludwig GV, Kramer LD, Daniels TJ, et al. Detection of West Nile virus-infected mosquitoes and seropositive juvenile birds in the vicinity of virus-positive dead birds. Am J Trop Med Hyg 2002;67:492-6.

34. Guptil SC, Julian KG, Campbell, GL, Price SD, Marfin AA. Early-season avian deaths from West Nile virus as warnings of human infection. Emerg Infect Dis 2003;9:483-4.

35. Mostashari F, Kulldorff M, Hartman JJ, Miller JR, Kulasekera V. Dead bird clusters as an early warning system for west nile virus activity. Emerg Infect Dis 2003;9:641-6.

36. Komar N. West Nile virus surveillance using sentinel birds. Annals N Y Acad Sci 2001;951*:* 58-73.

37. Beaty BJ, Calisher CH, Shope RE. Arboviruses. In: Lennette EH, Lennette DA, Lennette ET, editors. Diagnostic procedures for viral, rickettsial, and chlamydial infections. 7th ed. Washington: American Public Health Association; 1995; p. 189–212.

38. Holden P, Muth D, Shriner RB. Arbovirus hemagglutinin-inhibition in avian sera: inactivation with protamine sulfate. Am J Epidemiol 1966:84:67-73.

39.Johnson AJ, Langevin S, Wolff KL, Komar N. Detection of anti-West Nile virus immunoglobulin M in chicken serum by an enzyme-linked immunosorbent assay. J Clin Microbiol 2003;41:2002-7.

40. Langevin, SA, Bunning M, Davis B, Komar N. Experimental infection of chickens as candidate sentinels for West Nile virus. Emerg Infect Dis 2001;7:726-9.

41. Komar N, Panella NA, Burns, JE, Dusza SW, Mascarenhas TM, Talbot TO. Serologic evidence for West Nile virus infection in birds in the New York City vicinity during an outbreak in 1999. Emerg Infec Dis 2001;7:621-5.

42. Komar N, Burns J, Dean C, Panella NA, Dusza S, Cherry B. Serological evidence for West Nile virus infection in birds in Staten Island, New York after an outbreak in 2000. Vector Borne Zoonotic Dis 2001;1:191-6.

43. Bernard KA, Maffei JG, Jones SA, Kauffman EB, Ebel G, Dupuis AP 2nd, et al and the NY State West Nile Virus Surveillance Team. West Nile virus infection in birds and mosquitoes, New York State, 2000. Emerg Infect Dis 2001;7:679-85.

44. Ebel GD, Dupuis AP 2nd, Nicholas D, Young D, Maffei J, Kramer LD. Detection by enzyme-linked immunosorbent assay of antibodies to West Nile virus in birds. Emerg Infect Dis 2002;8:979-82.

45. Blitvich BJ, Marlenee NL, Hall RA, Calisher CH, Bowen RA, Roehrig JT, et al. Epitope-blocking enzyme-linked immunosorbent assays for the detection of serum antibodies to West Nile virus in multiple avian species. J Clin Microbiol 2003;41:1041-7.

46. Roehrig JT, Nash D, Maldin B, Labowitz A, Martin DA, Lanciotti RS, et al. Persistence of virus-reactive serum immunoglobulin m antibody in confirmed west nile virus encephalitis cases. Emerg Infect Dis 2003;9:376-9.

47. Mostashari F, Bunning ML, Kitsutani PT, Singer DA, Nash D, Cooper MJ, et al. Epidemic West Nile encephalitis, New York, 1999: results of a household-based seroepidemiological survey. Lancet 2001;358:261-4.

48. Centers for Disease Control and Prevention and National Institutes of Health. Biosafety in microbiological and biomedical laboratories. Atlanta, GA: U.S. Department of Health and Human Services, 2000.

49. Monath TP, Nystrom RR, Bailey RE, Calisher CH, Muth DJ. Immunoglobulin M antibody capture enzyme-linked immunosorbent assay for diagnosis of St. Louis encephalitis. J Clin Microbiol 1984;20:784-90.

50. Martin DA, Muth DA, Brown T, Johnson AJ, Karabatsos N, Roehrig JT. Standardization of immunoglobulin M capture enzyme-linked immunosorbent assays for routine diagnosis of arboviral infections. J Clin Microbiol 2000;38:1823-6.

51. Johnson AJ, Martin DA, Karabatsos N, Roehrig JT. Detection of anti-arboviral immunoglobulin G by using a monoclonal antibody-based capture enzyme-linked immunosorbent assay. J Clin Microbiol 2000;38:1827-31.

52. Shieh WJ, Guarner J, Layton M, Fine A, Miller J, Nash D, et al. The role of pathology in an investigation of an outbreak of West Nile encephalitis in New York, 1999. Emerg Infect Dis 2000;6:370-2.

53. Tsai TF, Bolin RA, Montoya M, Bailey RE, Francy DB, Jozan M, et al. Detection of St. Louis encephalitis virus antigen in mosquitoes by capture enzyme immunoassay. J Clin Microbiol 1987;25:370-6.

54. Tsai TF, Happ CM, Bolin RA, Montoya M, Campos E, Francy DB, et al. Stability of St. Louis encephalitis viral antigen detected by enzyme immunoassay in infected mosquitoes. J Clin Microbiol 1988;26:2620-5.

55. Briese T, Glass WG, Lipkin WI. Detection of West Nile virus sequences in cerebrospinal fluid. Lancet 2000;355:1614-5.

56. Shi PY, Kauffman EB, Ren P, Felton A, Tai JH, Dupuis AP 2nd, et al. High-throughput detection of West Nile virus RNA. J Clin Microbiol 2001;39:1264-71.

57. Lanciotti RS, Kerst AJ. Nucleic Acid Sequence-Based Amplification Assays for Rapid Detection of West Nile and St. Louis Encephalitis Viruses. J Clin Microbiol 2001;39:4506-13.

58. Rose RI. Pesticides and public health: Integrated methods of mosquito management. Emerg Infect Dis 2001;7:17-23.

59. American Mosquito Control Association and Environmental Protection Agency. Environmental Protection Agency's Pesticide Environmental Stewardship Program Partnership Strategy for the American Mosquito Control Association, 1997. Available from: URL: www.mosquito.org/PESPAMCA.htm.

60. Florida Coordinating Committee Mosquito Control. Florida mosquito control: The state mission as defined by mosquito controllers, regulators, and environmental managers. Gainesville, FL: University of Florida, 1998. Available from: URL: www.ifas.ufl.edu/~veroweb/whitep/whitep.htm.

61. New Jersey Mosquito Control Association. New Jersey Mosquito Control Association partnership strategy document: Environmental Protection Agency Pesticide Environmental Stewardship Program. New Brunswick, NJ: Cook College, 1997. Available from: URL: www-rci.rutgers.edu/~insects/psd.html.

62. Service MW. Mosquito ecology: Field sampling Methods. New York, NY: John Wiley and Sons; 1976.

63. Newhouse VR, Chamberlain RW, Johnston JF, Sudia WD. Use of dry ice to increase mosquito catches of the CDC miniature light trap. Mosquito News 1966;26:30-5.

64. Reiter PA. A portable, battery-powered trap for collecting gravid *Culex* mosquitoes. Mosquito News 1983;43:496-8.

65. Reiter P, Jakob WL, Francy DB, Mullenix JB. Evaluation of the CDC gravid trap for the surveillance of St. Louis encephalitis vectors in Memphis, Tennessee. J Am Mosq Control Assoc 1986;2:209-11.

66. Andis MD, Sackett SR, Carroll MK, Bordes ES. Strategies for the emergency control of arboviral epidemics in New Orleans. J Am Mosq Control Assoc 1987;3:125-30.

67. Leiser LB, Beier JC, Craig GB. The efficacy of malathion ULV spraying for urban *Culex* control in South Bend, Indiana. Mosquito News 1982;42:617-8.

68. Mitchell CJ, Hayes RO, Holden P, Hill HR, Hughes TB Jr. Effects of ultra-low volume applications of malathion in Hale County, Texas. I. Western encephalitis virus activity in treated and untreated towns. J Med Entomol 1969;6:155-62.

69. Mitchell CJ, Kilpatrick JW, Hayes RO, Curry HW. Effects of ultra-low volume applications of malathion in Hale County, Texas. II. Mosquito populations in treated and untreated areas. J Med Entomol 1970;7:85-91.

70. Mount GA, Biery TL, Haile DG. A review of ultra-low aerial sprays of insecticide for mosquito control. J Am Mosq Control Assoc 1966;12:601-18.

71. Reisen WK, Milby MM, Reeves WC, Eberle MW, Meyer RP, Schaefer CH, et al. Aerial adulticiding for the suppression of *Culex tarsalis* in Kern County, California, using low volume propoxur: 2. Impact on natural populations in foothill and valley habitats. J Am Mosq Control Assoc 1985;1:154-63.

72. Brogdon WG, McAllister JC. Insecticide resistance and vector control. Emerg Infect Dis 1998;4:605-13.

73. Lum MR, Tinker TL. A primer on health risk communication principles and practices. Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 1994. Available from: URL: http://www.astdr.cdc.gov/HEC/primer.html.

74. Hopkins CC, Hollinger FB, Johnson RF, Dewlett HJ, Newhouse VF, Chamberlain RW. The

epidemiology of St. Louis encephalitis in Dallas, Texas, 1966. Am J Epidemiol 1975;102:1-15.

75. Monath TP. Epidemiology. In: Monath TP, editor. St. Louis encephalitis. Washington: American Public Health Association; 1980. p. 239-312.

76. Covello VT, Allen FW. Seven cardinal rules of risk communication. Washington: U.S. Environmental Protection Agency, 1988.

77. Lum MR, Tinker TL. A primer on health risk communication principles and practices. Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 1994. Available from: URL: www.astdr.cdc.gov/HEC/primer.htm.