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Ecological Surveys of the Proposed High Explosives Wastewater Treatment Facility Region

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ECOLOGICAL SURVEYS OF THE PROPOSED HIGH EXPLOSIIVES WASTEWATER TREATMENT FACILITY REGION

by Timothy Haarmann

ABSTRACT

Los Alamos National Laboratory (LANL) proposes to improve its treatment of wastewater from high explosives (HE) research and development activities. The proposed project would focus on a concerted waste minimization effort to greatly reduce the amount of wastewater needing treatment. The result would be a 99% decrease in the HE wastewater volume, from the current level of 6,760,000 L/mo (1,786,000 gal./mo) to 41,200 L/mo (11,000 gal./mo). This reduction would entail closure of HE wastewater outfalls, affecting some wetland areas that depend on HE wastewater effluents. The outfalls also provide drinking water for many wildlife species. Terminating the flow of effluents at outfalls would represent an improvement in water quality in the LANL region but locally could have a negative effect on some wetlands and wildlife species. None of the affected species are protected by any state or federal endangered species laws.

The purpose of this report is to briefly discuss the different biological studies that have been done in the region of the project area. This report is written to give biological information and baseline data and the biota of the project area.

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1 PROPOSED ACTION

Los Alamos National Laboratory (LANL) proposes to improve its treatment of wastewater from high explosives (HE) research and development activities. The proposed High Explosives Wastewater Treatment Facility (HEWTF) project would focus on a concerted effort to greatly reduce the amount of wastewater needing treatment. This would entail extensive process modifications, including installation of new equipment and improvements to existing systems. The thrust of these modifications would be to prevent hazardous chemicals and HE from entering the wastewater stream and to curtail water use in the HE operations overall. The result would be a >99% decrease in HE wastewater volume–from the current level of 6,760,000 L/mo (1,786,000 gal./mo) to 41,200 L/mo (11,000 gal./mo).

One treatment plant would be built to handle all HE wastewater and would be located on a mesa top within Operable Unit (OU) 1082, Technical Area (TA) 16 (see Figure 1). The approximately 121-m^2 facility would be served with power by extending an existing 13.2 kV overhead transmission line and would be supplied by a separate transformer at 120/208 volts. The treated wastewater would be discharged either into an existing NPDES outfall at TA-16 or routed to the LANL Sanitary Waste Treatment Facility for processing and discharge. If discharged at TA-16, the number of National Pollutant Discharge Elimination System (NPDES) outfalls for HE-contaminated wastewater would be reduced from 17 to 1. Routing the treated water to the sanitary waste facility would eliminate all HE wastewater outfalls at LANL. In any case, all effluents would meet or exceed effluent quality standards in the recently revised NPDES permit, which took effect on August 1, 1994.

2 PROJECT AREA

The HEWTF project area is situated in the western portion of Department of Energy property within OU 1082 (see Fig. 1). Most activites associated with this project would take place within existing buildings. The treatment plant would be built at TA-16 near the site of the present HE wastewater treatment facility–an area that is already disturbed by roads, fences, parking areas, and nearby burn grounds. The treatment facility site is situated at an elevation of approximately 2195 m (7200 ft), where nearby undisturbed vegetation is dominated by ponderosa pine (*Pinus ponderosa*) and aspen (*Populus tremuloides*), intermixed with a shrub layer composed primarily of Gambel oak (*Quercus gambelii*) and New Mexico locust (*Robinia neomexicana*).

Dominant forbs and grasses include bluegrass (*Poa* sp.), mountain muhly (*Muhlenbergia montana*), blue grama (*Bouteloua gracilis*), pine dropseed (*Blepharoneuron tricholepis*), wormwood (*Artemisia ludoviciana*), false tarragon (*Artemisia dracunculus*), tall lupine (*Lupinus caudatus*), and cinquefoil (*Potentilla* sp.). The more mesic north-facing slopes of Cañon del Valle adjacent to the treatment facility support vegetation dominated by ponderosa pine and Douglas fir (*Pseudotsuga menziesii*). Common shrubs here are wax currant (*Ribes cerceum*) and New Mexico olive (*Forestiera neomexicana*). Slender wheatgrass (*Agropyron trachycaulum*), mountain muhly, spike muhly (*Muhlenbergia wrightii*), western yarrow (*Achillea lanulosa*), various mosses, and wild chrysanthemum (*Bahia dissecta*) are the most common understory plant species. The xeric south-facing slopes of the mesas support ponderosa pine and juniper (*Juniperus monosperma*), shrubs such as Gambel oak and New Mexico locust, and an understory dominated by mountain muhly, little bluestem (*Andropogon scoparius*), pine dropseed, and wormwood. Detailed vegetation data were collected for the project area during surveys for the Environmental Restoration Program, OU 1082.

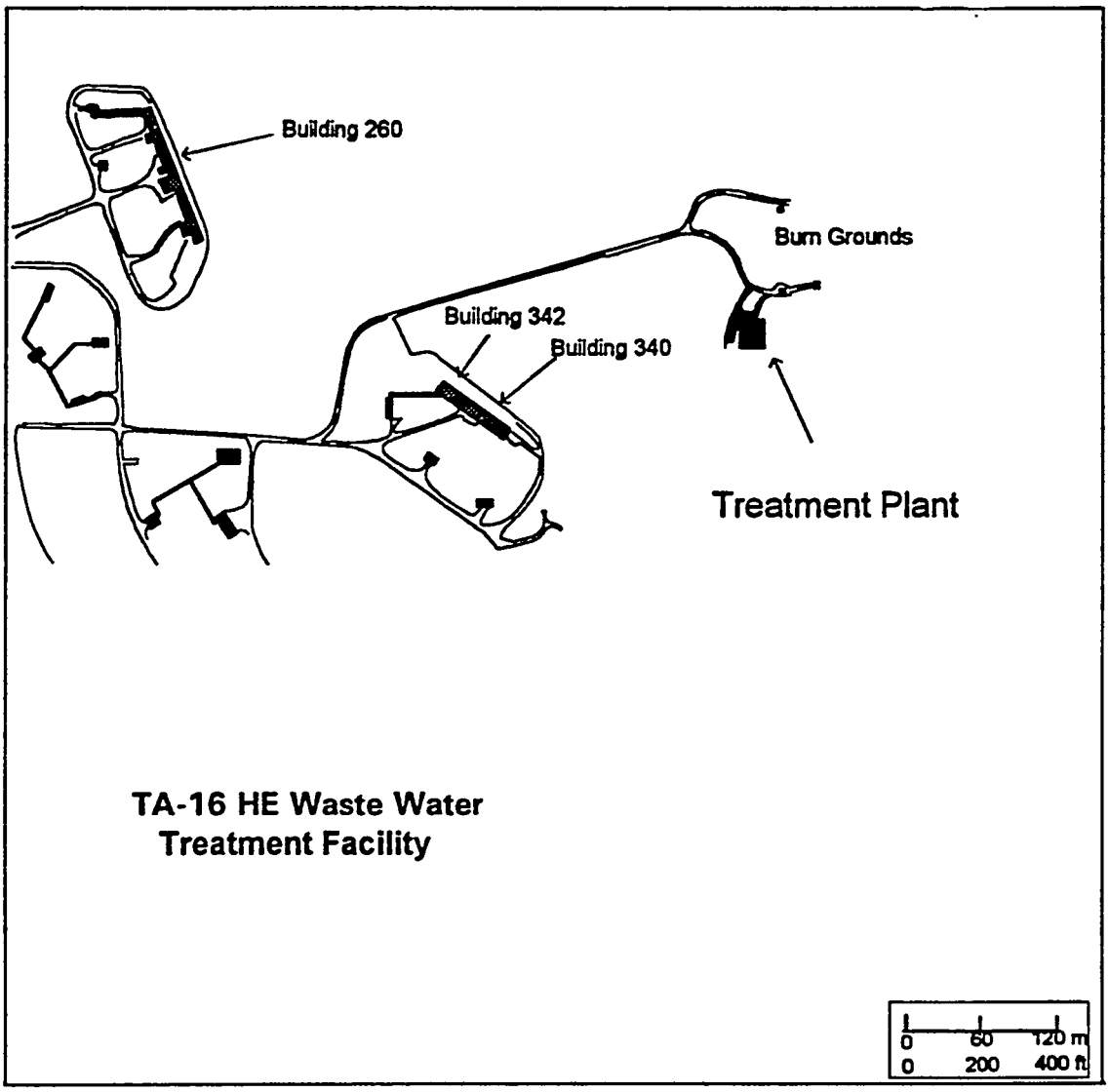

Figure 1. Location of the High Explosive Wastewater Treatment Facility

3 BIOLOGICAL STUDIES

Prior to 1991, few studies, most of which focused on vegetation and small mammals, had been completed in the project area. In 1991 and 1992, the LANL Biological Resource Evaluations Team (BRET) conducted Level 1 (reconnaissance), Level 2 (habitat evaluation), and Level 3 (species-specific) surveys in Operable Unit 1082, an administrative unit of the environmental restoration program at LANL. A study in the area by Edeskuty, Foxx, and Raymer in 1992 sought to determine the use of wastewater outfalls by wildlife and in the process documented vegetation at outfalls (LANL 1992). A follow-up study was done in 1993 to look at small mammal populations in outfall areas, natural wet areas, and dry areas (Raymer and Biggs 1994). Many HE NPDES outfalls were used as study areas for this project. Documents and surveys completed in the project area are listed in Table 1.

Although none of these studies was designed specifically to address the impacts from the HEWTF, taken together they cover the area that would be affected by the project. The 1991-92 BRET survey was particularly thorough, summarizing information from all previous work and in addition analyzed new surveys in the project area. The purposes of the field surveys were (1) to determine if species protected by the state or federal government were present, (2) to determine if sensitive habitats were present, and (3) to gather baseline data for future studies on plant and wildlife species in the area.

While a number of studies were done (Table 1), this report conveniently brings together only the findings of BRET's baseline investigations since 1991. General information on the NPDES outfalls was also collected (Table 2). The issue of threatened and endangered species is not discussed; however, this information can be found in the biological assessment that was written for the project area (Raymer 1993). Besides biological data, general information on the NPDES outfalls was also collected (Table 2).

TABLE 1. A List of Documents and Surveys Previously Completed in or Adjacent to the HEWTF Project Area

PROJECT	DATE	TYPE*	AUTHORS
Baseline biological surveys of HEWTF project area	1994	I,B,R,A,R SM	BRET
Biological/floodplain assessment of OU 1082	1993	TES	Raymer
Inventory survey of bats	unpubl.	M (bats)	BRET
The amphibians and reptiles of the Los Alamos National Research Park	1978	A, R	Bogart
Jemez Mountains salamander survey behind Building 16-260	unpubl.	A	Edeskuty, Raymer, and Bennett
Potential use of NPDES outfalls for wildlife watering	1992	W, I, B, A, R, M	Edeskuty, Foxx, and Raymer
Preliminary vegetation survey of Area P	1985	V, TES plants	Foxx
Vegetation survey of the waste fired boiler site at TA 16	1988	V, TES plants	Foxx
Status of the flora of the Los Alamos Environmental Research Park	1980	V, TES plants	Foxx and Tierney
Status of the flora of the Los Alamos Environmental Research Park: a historical perspective	1985	V, TES plants	Foxx and Tierney
Small mammal survey	unpubl.	SM	Kent
The ants of Los Alamos County, New Mexico (*Hymenoptera: Formicidae*)	1988	I	MacKay et al.
Determination of 100-year floodplain elevations at Los Alamos National Laboratory	1992	F	McLin
Biological evaluation of proposed weapon subsystem Laboratory site	1990	V, TES plants, B, M	Morrison
Atlas of the breeding birds of Los Alamos County, New Mexico	1991	B	Travis
Inventory and mapping of LANL's floodplains and wetlands	1990	F, W	USFWS, NWI
Comparison of small mammal species diversity near wastewater outfalls, natural streams, and dry canyons.	1994	SM	Raymer and Biggs
Biotelemetry studies on elk	1981	M	White

*
F = floodplain W = wetland V = vegetation I = insects B = birds
R = reptiles A = amphibians R = reptiles SM = small mammals
M = mammals TES plants = threatened, endangered, and sensitive plants

TABLE 2. Environmental Conditions at the HE NPDES Outfalls

Outfall Source (TA-Bldg.)	EPA Permit	Size (Acres)	Vegetative Conditions	Observed Wildlife Use	Category *	Other Notes
16-410	053	0.60	Willow wetland	Deer, porcupine, lizard	1	Enters Water Canyon but not watercourse
16-340	054	0.59	Large cattail/rush wetland, significant pools; good water quality indicators present	Deer, elk, porcupine, squirrel	2	Aerating cascade present; enters Cañon del Valle watercourse
16-401-406 (via 363)	055	0.03	Cattail wetland	Game trail, squirrel, lizard	2	Treatment facility outfall; enters Cañon del Valle but not watercourse
16-260	056	0.0	Ponderosa pine, oak; water present	Deer, elk, snake, squirrel	2	Enters Cañon del Valle but not watercourse
16-300-307	058	0.43	Disturbed, large stand of cattail wetland; good water quality indicators present	Deer, elk, rabbit	1	Enters Water Canyon but not watercourse
16-280	061	0.04	Cattail/rush wetland	Deer, elk	2	Entrance to Cañon del Valle possible
16-342	062	0.00	Oak, pine, aspen; water present	Deer, rabbit, squirrel, lizard	3	Dissipates on slope of Cañon del Valle
16-400	063	0.00	Ponderosa pine, grass; water present	Deer, elk, skunk, shrimp, raccoon	3	Dissipates on mesa top
9-21	066	0.16	Rush wetland	Deer, elk, squirrel	2	Enters Pajarito Canyon watercourse
9-43	067	0.00	Ponderosa pine, grass; water present	Elk, coyote	2	Enters Pajarito Canyon watercourse
9-48	068	0.00	Ponderosa pine, grass; water present	Elk game trails, lizard	2	Intermittent pools; enters Pajarito Canyon
11-50, 51 & 52	069, 096, 097	1.10	Disturbed cattail/rush wetland; good water quality indicators present	Deer, elk, bear, coyote, squirrel	2	All enter Water Canyon watercourse
16-430	071	0.35	Disturbed willow, cattail, & rush wetlands	Deer, elk, shrew, lizard	2	Standing water; enters Water Canyon but not watercourse
16-460	072	0..37	Cattail/rush wetland, grass; good water quality indicators present	Deer, elk, coyote, squirrel	1	Enters Water Canyon watercourse
40-41	154	0.04	Sedge and rush wetland	None	3	Enters Two-mile Canyon but not watercourse

*Category 1 - Definite use by wildlife; 2 - Potential or probable use; 3 - No significant use (sources: Raymer 1993; Edeskuty and Foxx 1992

3.1 PLANT SURVEYS

Vegetation surveys were conducted by BRET in 1992 and 1993 to evaluate the understory and overstory components of the following general habitats and locations:

Location	Habitat
TA-16 Mesa	Mesa top: ponderosa pine forest Mesa top: old field Mesa top: burned pondersa pine forest
Cañon del Valle (1992)	South-facing slope: ponderosa pine forest Canyon bottom: ponderosa pine forest North-facing slope: ponderosa forest
Water Canyon	South-facing slope: burned ponderosa pine forest North-facing slope: burned mixed-conifer forest
Cañon del Valle (1993)	South-facing slope: ponderosa pine forest Canyon bottom: ponderosa pine forest North-facing slope: ponderosa pine forest

Information on the 1992 plant surveys was included in the OU 1082 report (Raymer 1993) and appears as follows (see Tables 3-18).

TABLE 3. Plant Species Actually (Confirmed) and Potentially Occurring Within Operable Unit 1082

FAMILY	SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS**
ACERACEAE	*Acer glabrum neomexicanum*	New Mexico maple	FAC
	Acer negundo	Box elder	FACU
ANACARDIACEAE	*Rhus radicans*	Poison ivy	-
	R. trilobata	Squawbush	-
APOCYNACEAE	*Apocynum androsaemifolium* var. *androsaemifolium*	Spreading dogbane	-
ASCLEPIADACEAE	*Asclepias tuberosa*	Butterflyweed	-
BERBERIDACEAE	*Berberis fendleri*	Colorado barberry	-
BETULACEAE	*Betula occidentalis*	Water-birch	FACW
BORAGINACEAE	*Hackelia hirsuta*	Beggerlice	-
	Lappula texana	Stickseed	-
	Lithospermum incisum	Fringed puccoon	-
	L. multiflorum	Many-flowered stoneseed	-
	Mertensia lanceolata fendleri	Bluebells	-
	M. lanceolata secundorum	Bluebells	-
CACTAEAE	*Echinocereus triglochidiatus*	Claret-cup cactus	-

CAMPANULACEAE	*Campanula rotundifolia*	Harebell	FAC
CARYOPHYLLAC-EAE	*Arenaria fendleri*	Fendler sandwort	-
	Cerastium sp.	Chickweed	-
	Stellaria jamesiana	James starwort	-
CELASTRACEAE	*Pachystima myrsinites*	Myrtle boxleaf	-
CHENOPODIACEAE	*Chenopodium album*	Lamb's quarters	FAC,FACU
	C. fremontii	Fremont goosefoot	-
	C. gigantospermum	Chenopodium	-
	C. graveolens	Chenopodium	-
COMPOSITAE	*Achillea lanulosa*	Western yarrow	-
	Ambrosia coronopifolia	Ragweed	-
	A. psilostachya	Western ragweed	FAC
	Anaphalis margaritaceae	Pearly-everlasting	-
	Antennaria parvifolia	Pussytoes	-
	Artemisia bigelovii	Bigelow sagebrush	-
	A. carruthii	Wormwood	-
	A. dracunculus	False tarragon	-
	A. franserioides	Ragweed sagebrush	-
	A. frigida	Estafiata	-
	A. ludoviciana	Wormwood	-
	A. sp.	Wormwood	-
	Aster bigelovii	Bigelow aster	-
	A. laevis	Smooth aster	-
	A. sp.	Golden aster	-
	Bahia dissecta	Wild chrysanthemum	-
	Brickellia californica	California brickellia	FACU
	B. grandiflora	Tasselflower	-
	B. sp.	Bricklebush	-
	Chrysopsis villosa	Golden aster	-
	Chrysothamnus nauseosus	Chamisa, Rubber rabbit-brush	-
	Cirsium neomexicanum	New Mexico thistle	-
	C. pallidum	Thistle	FACW
	C. sp.	Thistle	-
	Conyza canadensis	Horseweed	FAC, FACU

	Erigeron divergens	Fleabane daisy	-
	E. flagellaris	Trailing fleebane	FAC
	E. nudiflorus	Fleabane	-
	E. philadelphicus	Common fleabane	-
	E. sp.	Daisy	-
	E. subtrinervis	Three-nerve fleabane	-
	Franseria acanthicarpa	Bursage	-
	Grindelia aphanactis	Gumweed	-
	G. sp.	Gumweed	-
	Gutierrezia sarothrae	Snakeweed	-
	Helianthus petiolaris	Prairie sunflower	-
	Hymenopappus filifolius	White ragweed	-
	Hymenoxys argentea	Perky Sue	-
	H. richardsonii	Bitterweed	-
	Pericome caudata	Taperleaf	-
	Ratibida columnifera	Prairie coneflower	-
	R. sp.	Coneflower	-
	Rudbeckia hirta	Black-eyed Susan	FACU
	R. lanciniata	Cutleaf coneflower	FACW
	R. sp.	Black-eyed Susan	-
	Senecio bigelovii	Bigelow groundsel	-
	S. cymbalarioides	Groundsel	-
	S. dimorphophyllus	Groundsel	-
	S. eremophilus var. *macdougalii*	Groundsel	-
	S. fendleri	Groundsel	-
	S. mutabilis	Groundsel	-
	Solidago sp.	Goldenrod	FACU
	Taraxacum officinale	Dandelion	FACU
	Thelesperma trifidum	Greenthread	-
	Townsendia escapa	Easter daisy	-
	T. incana	Townsend's aster	-
	Tragopogon dubius	Salisfy, Goatsbeard	-
	T. sp.	Salisfy	-
	Verbesina encelioides	Crownbeard	FAC
	Viguiera multiflora	Showy goldeneye	-

CRUCIFERAE	*Arabis fendleri*	Fendler's rockcress	FACU
	Capsella bursa-pastoris	Shepherd's purse	FAC
	Descurainia richardsonii subsp. *incisa*	Tansy mustard	-
	D. sophia	Tansy mustard	-
	Erysimum capitatum	Western wallflower	-
	Rorippa nasturtium-aquaticum	Watercress	-
	Thlaspi alpestre	Mountain candytuft	FACU
CUPRESSACEAE	*Juniperus monosperma*	One-seeded juniper	-
	J. scopulorum	Rocky Mountain juniper	-
CYPERACEAE	*Carex* sp.	Sedge	FACW/FAC/OBL
	Cyperus esculentus	Nutsedge	FACW
	Scirpus sp.	Bulrush	-
EQUISETUM	*Equisetum hiemale*	Horsetail	-
	E. laevigatum	Smooth Horsetail	FACU
ERICACEAE	*Arctostaphylos uva-ursi*	Bearberry	-
	Pterospora andromedea	Pinedrop	-
FAGACEAE	*Quercus gambelii*	Gambel oak	-
	Q. sp.	Oak	-
	Q. undulata	Wavyleaf oak	-
FUMARIACEAE	*Corydalis aurea*	Golden smoke	-
GENTIANACEAE	*Gentiana bigelovii*	Bigelow gentian	-
	G. sp.	Gentian	-
GERANIACEAE	*Geranium caespitosum*	James geranium	-
	G. richardsonii	Richardson geranium	FAC
	G. sp.	Geranium	FAC
GRAMINEAE	*Agropyron cristatum*	Crested wheatgrass	-
	A. desertorum	Russian wheatgrass	-
	A. sp.	Wheatgrass	-
	A. smithii	Western wheatgrass	FAC
	A. trachycaulum	Slender wheatgrass	FAC
	Agrostis alba	Redtop bent	FACW
	Andropogon gerardii	Big bluestem	FAC
	A. scoparius	Little bluestem	-
	Aristida sp.	Threeawn	-

	Blepharoneuron tricholepsis	Pine dropseed	-
	Bouteloua curtipendula	Side-oats grama	-
	B. gracilis	Blue grama	-
	Bromus anomalus	Nodding brome	-
	B. inermis	Smooth brome	-
	B. japonicus	Japanese brome	FACU
	B. sp.	Bromegrass	FACU
	B. tectorum	Downy chess	-
	Dactylis glomerata	Orchard grass	-
	Echinochloa colonum	Junglegrass	-
	E. crusgalli	Barnyard grass	-
	Elymus canadensis	Canada wildrye	FAC
	Festuca ovina	Sheep fescue	-
	Koeleria cristata	Junegrass	-
	Muhlenbergia montana	Mountain muhly	-
	M. wrightii	Spike muhly	FACU
	Phleum pratense	Common timothy	FACU
	Poa fendleriana	Mutton grass	-
	P. interior	Inland bluegrass	-
	P. pratensis	Kentucky bluegrass	FACU
	P. sp.	Bluegrass	FAC/FACU
	Sitanion hystrix	Bottlebrush squirreltail	-
	Stipa sp.	Needle grass	-
JUNCACEAE	*Juncus interior*	Inland rush	FACW
	J. sp.	Rush	FACW
LABIATAE	*Moldavica parviflora*	Dragonhead	-
	Monarda menthaefolia	Beebalm, Horsemint	-
	M. pectinata	Ponymint	-
LEGUMINOSAE	*Lathyrus arizonicus*	Peavine	-
	Lotus wrightii	Deervetch	-
	Lupinus caudatus	Tall lupine	-
	L. sp.	Lupine	-
	Medicago sativa	Alfalfa	-
	Melilotus albus	White sweet clover	FACU
	M. officinalis	Yellow sweet clover	FACU

	M. sp.	Clover	-
	Robinia *neomexicana*	New Mexico locust	-
	Thermopsis pinetorum	Pine goldenpea	-
	Trifolium procumbens	Clover	-
	T. repens	White clover	-
	Vicia americana	American vetch	-
LILIACEAE	*Allium cernuum*	Nodding onion	-
	A. sp.	Wild onion	-
LINACEAE	*Linum neomexicana*	New Mexico yellow flax	-
LOASACEAE	*Mentzelia pumila* var. *pumila*	Blazing star	-
LORANTHACEAE	*Phoradendron juniperinum*	Juniper mistletoe	-
MORACEAE	*Humulus americanus*	Hop	-
NYCTAGINACEAE	*Mirabilis linearis*	Four-o'clock	-
	Oxybaphus linearis	Desert four-o'clock	-
OLEACEAE	*Forestiera neomexicana*	New Mexico olive	FACU
ONAGRACEAE	*Epilobium angustifolium*	Fireweed	FAC
	E. ciliatum	Willowweed	FACW
	E. sp.	Fireweed	-
	Gaura coccinea	Gaura	-
	Oenothera coronopifolia	Cutleaf evening primrose	-
	O. hookeri	Hooker's primrose	-
ORCHIDACEAE	*Corallorhiza maculata*	Spotted coralroot	-
	Habenaria sparsiflora	Bog orchid	-
OXALIDACEAE	*Oxalis violacea*	Violet wood-sorrel	-
PINACEAE	*Abies concolor*	White fir	-
	Pinus edulis	Piñon pine	-
	P. flexilis	Limber pine	-
	P. ponderosa	Ponderosa pine	FACU
	Pseudotsuga menziesii	Douglas fir	-
PLANTAGINACEAE	*Plantago purshii*	Woolly indianwheat	-
POLEMONIACEAE	*Ipomopsis aggregata*	Desert trumpet	-
POLYGONACEAE	*Eriogonum jamesii*	Antelope sage	-
	E. racemosum	Wild buckwheat	-
	E. sp.	Wild buckwheat	-

	Polygonum convolvulus	Black bindweed	FACU
	Rumex sp.	Dock	FACW
POLYPODIACEAE	*Cystopteris fragilis*	Brittle fern	-
PRIMULACEAE	*Androsace septentrionalis* var. *subulifera*	Rock-jasmine	FAC
RANUNCULACEAE	*Actaea arguta*	Western baneberry	-
	Clematis pseudoalpina	Rocky Mountain clematis	-
	Pulsatilla ludoviciana	Pasque flower	-
	Runnunculus cardiophyllus	Buttercup	FACW
	Thalictrum fendleri var. *fendleri*	Meadowrue	FACU
RHAMNACEAE	*Ceanothus fendleri*	Buckbrush	-
ROSACEAE	*Agrimonia striata*	Agrimony	FAC
	Cercocarpus montanus	Mountain mahogany	-
	Fallugia paradoxa	Apache plume	-
	Fragaria americana	Wild strawberry	-
	Potentilla fruticosa	Shruby potentilla	FACW
	P. hippiana	Cinquefoil	-
	P. norvejica	Norway potentilla	FAC
	P. pulcherrima	Beauty cinquefoil	-
	P. sp.	Cinquefoil	OLB/FACU/ FACW
	Prunus virginiana	Chokecherry	FAC
	Rosa woodsii var. *fendleri*	Fendler's rose	FACU
	Rubus strigosus	Wild raspberry	FAC
RUBIACEAE	*Galium asperrimum*	Rough-stemmed bedstraw	-
	G. boreale	Northern bedstraw	FAC
	G. sp.	Bedstraw	-
SALICACEAE	*Populus tremuloides*	Aspen	FACU
	Salix exigua	Sandbar willow	-
	S. sp.	Willow	FACW
SAXIFRAGACEAE	*Heuchera parvifolia*	Alumroot	-
	Jamesia americana	Cliff bush	FACU
	Philadelphus microphyllus	Mockorange	-
	Ribes cereum	Wax current	-
	R. inerme	Gooseberry	FACW

SCROPHULARIA-CEAE	*Castilleja integra*	Indian paintbrush	-
	Orthocarpus luteus	Yellow owl-clover	FACU
	Penstemon barbatus var. *torreyi*	Scarlet bugler	-
	P. sp.	Penstemon	-
	P. secundiflorus	Beardstongue	-
	P. virgatus	Variegated penstemon	FACU
	Verbascum thapsus	Mullein	-
	Veronica americana	American brooklime	OBL
SOLANACEAE	*Physalis neomexicana*	Ground cherry	-
TYPHACEAE	*Typha angustifolia*	Narrow-leaved cattail	OBL
	T. latifolia	Cattail	OBL
UMBELLIFERAE	*Heracleum lanatum*	Cow parsnip	OBL
	Ligusticum porteri	Lovage	-
	Pseudocymopterus montanus	Mountain parsley	-
VALERIANACEAE	*Valeriana acutiloba*	Valeriana	-
	V. capitata	Tabacco root	-
	V. sp.	Valeriana	-
VIOLACEAE	*Viola adunca*	Western dog violet	FAC
	V. canadensis	Canada violet	-
	V. pedatifida	Larkspur violet	-
VITACEAE	*Parthenocissus inserta*	Virginia creeper	-
LICHEN	*Usnea* sp.	Old man's beard lichen	
	Xanthroparmelia sp.	Green rock lichen	

**INDICATOR STATUS definitions:

FAC= Facultative:	Equally likely to occur in wetlands or non-wetlands
FACU= Facultative Upland:	Usually occurs in nonwetlands, but occasionally found in wetlands
FACW= Facultative Wetland:	Usually occurs in wetland, but occasionally found in nonwetlands
OBL= Obligate Wetland:	Occurs almost always under natural conditions in wetlands
UPL= Obligate Upland:	Occurs in wetland in another region, but occur almost always under natural conditions in nonwetlands in the region specified; if a species does not occur in wetlands in any region, it is not on the National List

TABLE 4. Plant Species Code List for 1992/1993 Surveys in Operable Unit 1082

SCIENTIFIC NAME	CODE	COMMON NAME
Achillea lanulosa	Acla	Western yarrow
Agrostis alba	Agal	Redtop bent
Agropyron desertorum	Agde	Russian wheatgrass
Agropyron sp.	Agox	Wheatgrass
Agropyron smithii	Agsm	Western wheatgrass
Allium cernuum	Alce	Nodding onion
Andropogon gerardii	Ange	Big bluestem
Anaphalis margaritaceae	Anma	Pearly-everlasting
Antennaria parvifolia	Anpa	Pussytoes
Andropogon scoparius	Ansc	Little bluestem
Artemisia carruthii	Arca	Wormwood
Artemisia dracunculus	Ardr	False tarragon
Aristida sp.	Arix	Threeawn
Artemisia ludoviciana	Arlu	Wormwood
Bahia dissecta	Badi	Wild chrysanthemum
Berberis fendleri	Befe	Colorado barberry
Blepharoneuron tricholepis	Bltr	Pine dropseed
Bouteloua gracilis	Bogr	Blue grama
Bromus anomalus	Bran	Nodding brome
Bromus sp.	Brox	Bromegrass
Campanula rotundifolia	Caro	Harebell
Carex sp.	Carx	Sedge
Ceanothus fendleri	Cefe	Buckbrush
Cercocarpus montanus	Cemo	Mountain mahogany
Chrysothamnus nauseosus	Chna	Chamisa, Rubber rabbit brush
Chrysopsis villosa	Chvi	Golden aster
Cirsuim sp.	Cirx	Thistle
Clematis pseudoalpina	Clps	Rocky Mountain clematis
Conyza canadensis	Coca	Horseweed
Cyperus esculentus	Cyes	Nutsedge
Epilobium sp.	Epix	Fireweed
Erigeron divergens	Erdi	Fleabane daisy
Erigeron flagellaris	Erfl	Trailing fleebane
Erigeron philadelphicus	Erph	Common fleabane

Fallugia paradoxa	Fapa	Apache plume
Franseria acanthicarpa	Frac	Bursage
Fragaria americana	Fram	Wild strawberry
Geranium caespitosum	Geca	James geranium
Gentiana sp.	Genx	Gentian
Grindelia aphanactis	Grap	Gumweed
Habenaria sparsiflora	Hasp	Bog orchid
Hymenopappus filifolius	Hyfi	White ragweed
Hymenoxys richardsonii	Hyri	Bitterweed
Ipomopsis aggregata	Ipag	Desert trumpet
Jamesia americana	Jaam	Cliff bush
Juncus interior	Juin	Inland rush
Juniperus monosperma	Jumo	One-seeded juniper
Juniperus scopulorum	Jusc	Rocky Mountain juniper
Koeleria cristata	Kocr	Junegrass
Lithospermum multiflorum	Limu	Many-flowered stoneseed
Linum neomexicana	Line	New Mexico yellow flax
Lotus wrightii	Lowr	Deervetch
Lupinus caudatus	Luca	Tall lupine
Melilotus albus	Meal	White sweet clover
Melilotus officinalis	Meof	Yellow sweet clover
Medicago sativa	Mesa	Alfalfa
Monarda menthaefolia	Mome	Beebalm, Horsemint
Muhlenbergia montana	Mumo	Mountain muhly
Muhlenbergia wrightii	Muwr	Spike muhly
Oenothera caespitosa	Oeco	White stemless evening-primrose
Oenothera hookeri	Oeho	Hooker's primrose
Orthocarpus luteus	Orlu	Yellow owl-clover
Parthenocissus inserta	Pain	Virginia creeper
Penstemon barbatus var. torreyi	Peba	Scarlet bugler
Pericome caudata	Peca	Taperleaf
Penstemon virgatus	Pevi	Variegated penstemon
Pinus ponderosa	Pipo	Ponderosa pine
Plantago purshii	Plpu	Woolly indianwheat
Poa sp.	Poax	Bluegrass

Polygonum convolvulus	Poco	Black bindweed
Poa interior	Poin	Inland bluegrass
Populus tremuloides	Potr	Aspen
Potentilla sp.	Potx	Cinquefoil
Prunus virginiana	Prvi	Chokecherry
Pseudotsuga menziesii	Psme	Douglas fir
Pseudocymopterus montanus	Psmo	Mountain parsley
Pterospora andromedea	Ptan	Pinedrop
Pulsatilla ludoviciana	Pulu	Pasque flower
Quercus sp.	Quex	Oak
Quercus gambelii	Quga	Gambel oak
Ratibida sp.	Ratx	Coneflower
Ribes cerceum	Rice	Wax current
Ribes inerme	Riin	Gooseberry
Rorippa nasturtium-aquaticum	Rona	Watercress
Robinia neomexicana	Rone	New Mexico locust
Rosa woodsii var. fendleri	Rowo	Fendler's rose
Rumex sp.	Rumx	Dock
Rubus strigosus	Rust	Wild raspberry
Senecio bigelovii	Sebi	Bigelow groundsel
Sitanion hystrix	Sihy	Bottlebrush squirreltail
Solidago sp.	Solx	Goldenrod
Thalictrum fendleri	Thfe	Fendler meadowrue
Thermopsis pinetorum	Thpi	Pine goldenpea
Townsendia incana	Toin	Townsend's aster
Tragopogon dubius	Trdu	Salisfy, Goatsbeard
Typha angustifolia	Tyan	Narrow-leaved cattail
Valeriana acutiloba	Vaac	Tobacco root
Verbesina encelioides	Veen	Crownbeard
Verbascum thapsus	Veth	Mullein
Vicia americana	Viam	American vetch

TABLE 5. Operable Unit 1082: TA-16, Cañon del Valle, Behind Building 340, Canyon Bottom, Ponderosa Pine, 8/26/92, Overstory

Trees	Number of Trees	Trees Per Acre	Rel. Density	AVG DBH	%Cover	Rel. Cover	%Freq.	Rel. Freq.	Importance Index
JUMO	1.00	2.20	1.79	0.10	5.00	14.61	0.14	7.69	8.03
JUSC	1.00	2.20	1.79	2.50	0.10	0.29	0.14	7.69	3.26
PIPO	47.00	103.30	83.93	7.98	19.01	55.57	1.00	53.85	64.45
PSME	6.00	13.19	10.71	13.15	10.00	29.23	0.29	15.38	18.44
SNAG	1.00	2.20	1.79	0.29	0.10	0.29	0.29	15.38	5.82
Total	56.00	123.08	100.00	24.02	34.21	100.00	1.86	100.00	100.00

Shrubs	#Stems	#Stems Per Acre	Rel. Density	AVG DBH	%Cover	Rel. Cover	%Freq.	Rel. Freq.	Importance Index
QUGA	267.00	586.81	41.46	1.30	16.86	48.52	0.86	25.00	38.33
RIIN	45.00	98.90	6.99	0.10	1.33	3.81	0.29	8.33	6.38
ROWO	8.00	17.58	1.24	0.10	0.10	0.29	0.29	8.33	3.29
RONE	74.00	162.64	11.49	0.10	2.55	7.34	1.00	29.17	16.00
PRVI	13.00	28.57	2.02	0.10	5.00	14.39	0.29	8.33	8.25
BEFE	32.00	70.33	4.97	0.10	5.00	14.39	0.14	4.17	7.84
JAAM	202.00	443.96	31.37	0.10	3.81	10.97	0.43	12.50	18.28
RUST	3.00	6.59	0.47	0.10	0.10	0.29	0.14	4.17	1.64
Total	644.00	1415.38	100.00	2.00	34.75	100.00	3.43	100.00	100.00

TABLE 6. Operable Unit 1082: TA-16, Cañon del Valle, Behind Building 340, Canyon Bottom, Ponderosa Pine, 8/26/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	8.41					
ROCK	6.71					
LITTER	49.84					
MOSS/LICHEN	5.07					
TYAN		1.21	4.05	0.13	6.47	5.26
EPIX		0.16	0.52	0.04	2.16	1.34
AGAL		0.57	1.91	0.06	2.88	2.39
ROWO		0.57	1.91	0.09	4.32	3.11
POAX		7.86	26.23	0.40	20.14	23.19
BROX		0.89	2.96	0.17	8.63	5.79

TRDU		0.21	0.72	0.01	0.72	0.72
UNK GRASSES		8.93	29.80	0.36	17.99	23.90
AGOX		0.14	0.48	0.03	1.44	0.96
HASP		0.09	0.29	0.03	1.44	0.86
VETH		0.43	1.43	0.03	1.44	1.43
SIHY		0.07	0.24	0.01	0.72	0.48
JUIN		3.14	10.49	0.13	6.47	8.48
QUGA		0.57	1.91	0.06	2.88	2.39
RONE		2.57	8.58	0.14	7.19	7.89
BEFE		0.50	1.67	0.03	1.44	1.55
ANGE		0.36	1.19	0.01	0.72	0.96
RUST		0.21	0.72	0.04	2.16	1.44
RICE		0.37	1.24	0.03	1.44	1.34
CIRX		0.37	1.24	0.03	1.44	1.34
THFE		0.21	0.72	0.04	2.16	1.44
RONA		0.14	0.48	0.03	1.44	0.96
VAAC		0.14	0.48	0.03	1.44	0.96
FRAM		0.14	0.48	0.03	1.44	0.96
CLPS		0.07	0.24	0.01	0.72	0.48
PTAN		0.01	0.05	0.01	0.72	0.38
Total	70.04	29.96	100.00	1.99	100.00	100.00

TABLE 7. Operable Unit 1082: TA-16, Cañon del Valle, Behind Building 340, North-Facing Slope, Ponderosa Pine, 8/25/92, Overstory

Species	No. Trees	Trees Per Acre	Rel. Density	AVG. DBH	%Cover	Rel. %Cover	Freq	Rel. Freq	Importance Index
JUMO	3.00	9.33	2.42	1.60	0.00	0.00	0.21	17.65	6.69
PIPO	129.00	376.48	97.58	5.18	49.49	100.00	1.00	82.35	93.31
Total	132.00	385.82	100.00	6.78	49.49	100.00	1.21	100.00	100.00

Species	No. Stems	Stems/ Acre	Rel. Density	Cover	Rel. Cover	Freq	Rel. Freq	Importance Index
QUGA	190.00	591.17	95.48	13.69	100.00	0.50	63.64	86.37
FAPA	6.00	18.67	3.02	0.00	0.00	0.07	9.09	4.04
RONE	3.00	9.33	1.51	0.00	0.00	0.21	27.27	9.59
Total	199.00	619.17	100.00	13.69	100.00	0.79	100.00	100.00

TABLE 8. Operable Unit 1082: TA-16, Cañon del Valle, Behind Building 340, North-Facing Slope, Ponderosa Pine, 8/26/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	15.10					
ROCK	0.00					
LITTER	73.17					
SOIL CRUST	3.36					
MOSS/LICHEN	0.79					
SIHY		0.17	2.24	0.06	4.04	3.14
ANSC		0.14	1.87	0.01	1.01	1.44
MUMO		2.21	28.91	0.34	24.24	26.58
BLTR		0.86	11.19	0.13	9.09	10.14
POAX		0.43	5.60	0.07	5.05	5.32
ANPA		0.59	7.65	0.07	5.05	6.35
BADI		0.01	0.19	0.01	1.01	0.60
ALCE		0.09	1.12	0.03	2.02	1.57
FAPA		0.00	0.00	0.00	0.00	0.00
KOCR		0.07	0.93	0.01	1.01	0.97
ANGE		0.07	0.93	0.01	1.01	0.97
ROWO		0.07	0.93	0.01	1.01	0.97
ACLA		1.11	14.55	0.19	13.13	13.84
ERDI		0.10	1.31	0.04	3.03	2.17
LOWR		0.01	0.19	0.01	1.01	0.60
PEBA		0.00	0.00	0.00	0.00	0.00
ORLU		0.00	0.02	0.01	1.01	0.51
SEBI		0.07	0.93	0.01	1.01	0.97
BRAN		0.30	3.92	0.06	4.04	3.98
GECA		0.21	2.80	0.04	3.03	2.91
RONE		0.21	2.80	0.04	3.03	2.91
ERFL		0.07	0.93	0.01	1.01	0.97
FRAM		0.14	1.87	0.03	2.02	1.94
ARLU		0.16	2.05	0.04	3.03	2.54
THPI		0.21	2.80	0.04	3.03	2.91
CARX		0.14	1.87	0.03	2.02	1.94
PULU		0.10	1.31	0.04	3.03	2.17
PSMO		0.07	0.93	0.01	1.01	0.97
VAAC		0.01	0.19	0.01	1.01	0.60
Total	92.41	7.66	100.00	1.41	100.00	100.00

Plants found in area but not recorded in the transect:

TOIN

ERPH

POTX

IPAG

HYFI

CHVI

ARCA

CEFE

ARDR

LINE

QUGA

GENX

TABLE 9. Operable Unit 1082: TA-16, Cañon del Valle, South-Facing Slope, Ponderosa Pine, 8/26/92, Overstory

Species	No. Trees	Trees/ Acre	Rel Density	AVG. DBH	%Cover	Rel %Cover	Freq	Rel Freq	Importance Index
JUMO	6.00	15.56	16.67	0.10	0.00	0.00	0.36	25.00	13.89
PIPO	24.00	71.56	76.67	8.83	21.31	49.80	0.64	45.00	57.16
QUGA	1.00	3.11	3.33	13.50	21.49	50.20	0.36	25.00	26.18
SNAG	1.00	3.11	3.33	20.10	0.00	0.00	0.07	5.00	2.78
Total =	32.00	93.34	100.00	42.53	42.80	100.00	1.43	100.00	100.00

Species	No. Stems	Stems/ Acre	Rel Density	Cover	Rel Cover	Freq	Rel Freq	Importance Index
QUGA	163.00	507.16	56.21	21.49	97.16	0.86	50.00	67.79
QUEX	90.00	280.03	31.03	0.63	2.84	0.36	20.83	18.24
RONE	4.00	12.45	1.38	0.00	0.00	0.21	12.50	4.63
CEMO	12.00	37.34	4.14	0.00	0.00	0.14	8.33	4.16
JAAM	21.00	65.34	7.24	0.00	0.00	0.14	8.33	5.19
Total =	290.00	902.32	100.00	22.11	100.00	1.71	100.00	100.00

TABLE 10. Operable Unit 1082: TA-16, Cañon del Valle, South-Facing Slope, Ponderosa Pine, 8/26/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	13.20					
ROCK	13.21					
LITTER	67.94					

MUMO		1.36	24.05	0.23	27.12	25.58
ANSC		2.30	40.76	0.24	28.81	34.79
ANGE		0.50	8.86	0.04	5.08	6.97
ARLU		0.47	8.35	0.13	15.25	11.80
SIHY		0.09	1.52	0.03	3.39	2.45
RONE		0.14	2.53	0.03	3.39	2.96
ARIX		0.07	1.27	0.01	1.69	1.48
BRAN		0.21	3.80	0.03	3.39	3.59
POAX		0.36	6.33	0.07	8.47	7.40
CARX		0.07	1.27	0.01	1.69	1.48
BLTR		0.07	1.27	0.01	1.69	1.48
Total	94.36	5.64	100.00	0.84	100.00	100.00

Plants found in area but not recorded in the transect:

LOWR
CHVI
POIN
CIRX

TABLE 11. Operable Unit 1082: TA-16, Mesatop, Behind Building 460, Old Field, 8/27/92, Overstory

Species	No. Trees	Trees/Acre	Rel Density	AVG. DBH	%Cover	Rel %Cover	Freq	Rel Freq	Importance Index
PIPO	5.00	15.56	100.00	4.62	0.14	100.00	0.21	100.00	100.00
Total =	5.00	15.56	100.00	4.62	0.14	100.00	0.21	100.00	100.00

TABLE 12. Operable Unit 1082: TA-16, Mesatop, Behind Building 460, Old Field, 8/27/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	14.86					
ROCK	0.00					
LITTER	30.09					
POAX		23.07	41.87	0.81	27.40	34.64
SIHY		0.21	0.39	0.04	1.44	0.92
AGOX		0.21	0.39	0.04	1.44	0.92
BOGR		0.71	1.30	0.09	2.88	2.09
MUMO		0.14	0.26	0.01	0.48	0.37
AGSM		6.00	10.89	0.24	8.17	9.53
GECA		0.23	0.41	0.06	1.92	1.17

ARDR		5.29	9.59	0.43	14.42	12.01
FRAC		1.44	2.62	0.17	5.77	4.19
BADI		0.01	0.03	0.01	0.48	0.25
VETH		0.01	0.03	0.01	0.48	0.25
LUCA		7.79	14.13	0.31	10.58	12.35
POTX		1.86	3.37	0.11	3.85	3.61
MEAL		0.43	0.78	0.03	0.96	0.87
ERFL		3.86	7.00	0.20	6.73	6.87
ARCA		0.57	1.04	0.10	3.37	2.20
AGDE		0.14	0.26	0.03	0.96	0.61
MUWR		0.36	0.65	0.01	0.48	0.56
ANPA		0.57	1.04	0.03	0.96	1.00
LINE		0.00	0.01	0.03	0.96	0.48
HYRI		0.07	0.13	0.01	0.48	0.31
COCA		0.16	0.29	0.03	0.96	0.62
RATX		1.71	3.11	0.09	2.88	3.00
VEEN		0.07	0.13	0.01	0.48	0.31
OECO		0.01	0.03	0.01	0.48	0.25
ERDI		0.16	0.29	0.03	0.96	0.62
Total	44.94	55.10	100.00	2.97	100.00	100.00

Plants found in area but not recorded in the transect:

PHPA
AGAL
JUIN
VIAM
TRDU
ALCE
PEVI
PLPU
GRAP
OEHO

TABLE 13. Operable Unit 1082: TA-16, Mesatop, Behind Building 460, Ponderosa Pine, 8/27/92, Overstory

Species	No. Trees	Trees/Acre	Rel Density	AVG. DBH	%Cover	Rel %Cover	Freq	Rel Freq	Importance Index
PIPO	64.00	213.44	100.00	4.06	36.98	100.00	1.00	100.00	100.00
Total	64.00	213.44	100.00	4.06	36.98	100.00	1.00	100.00	100.00

Species	No. Stems	Stems/ Acre	Rel Density	Cover	Rel Cover	Freq	Rel Freq	Importance Index
QUGA	1.00	4.36	100.00	0.00	0.00	0.10	100.00	66.67
Total	1.00	4.36	100.00	0.00	0.00	0.10	100.00	66.67

TABLE 14. Operable Unit 1082: TA-16, Mesatop, Behind Building 460, Ponderosa Pine, 8/27/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	19.40					
ROCK	0.64					
LITTER	58.44					
MOSS/LICHEN	0.43					
SIHY		1.57	7.45	0.33	11.86	9.65
LUCA		4.86	23.00	0.34	12.37	17.69
POTX		1.94	9.16	0.31	11.34	10.25
BOGR		6.93	32.81	0.57	20.62	26.71
ARCA		0.91	4.30	0.30	10.82	7.56
CHVI		0.14	0.68	0.01	0.52	0.60
PLPU		0.00	0.01	0.01	0.52	0.26
HYRI		0.21	1.01	0.04	1.55	1.28
MUMO		0.07	0.34	0.01	0.52	0.43
ALCE		0.00	0.01	0.03	1.03	0.52
LINE		0.00	0.01	0.01	0.52	0.26
ERFL		0.72	3.39	0.10	3.61	3.50
ARLU		0.00	0.01	0.01	0.52	0.26
CARX		0.14	0.68	0.04	1.55	1.11
PSMO		0.14	0.68	0.04	1.55	1.11
AGSM		0.57	2.71	0.11	4.12	3.42
BADI		0.00	0.01	0.01	0.52	0.26
IPAG		0.00	0.01	0.01	0.52	0.26
GECA		0.14	0.68	0.04	1.55	1.11
ARDR		0.79	3.72	0.09	3.09	3.41
POCO		0.01	0.07	0.01	0.52	0.29
ANPA		0.36	1.69	0.01	0.52	1.10
MESA		0.07	0.34	0.01	0.52	0.43
POAX		1.21	5.75	0.19	6.70	6.22
CHVI		0.09	0.41	0.03	1.03	0.72
CIRX		0.07	0.34	0.01	0.52	0.43
VIAM		0.01	0.07	0.01	0.52	0.29

FRAC		0.14	0.68	0.03	1.03	0.85
Total =	78.92	21.13	100.00	2.77	100.00	100.00

Plants found in area but not recorded in the transect:

ORLU

ANGE

TABLE 15. Operable Unit 1082: TA-28, Mesatop, Behind Bunker 1, Burned Ponderosa Pine, 8/27/92, Overstory

Species	No. Trees	Trees/ Acre	Rel Density	AVG. DBH	%Cover	Rel %Cover	Freq	Rel Freq	Importance Index
PIPO	14.00	24.89	66.67	0.76	0.00	0.00	0.57	80.00	48.89
SNAG	1.00	3.11	8.33	15.70	0.00	0.00	0.07	10.00	6.11
POTR	4.00	12.45	33.33	2.85	0.00	0.00	0.14	20.00	17.78
Total	18.00	37.34	100.00	3.61	0.00	0.00	0.71	100.00	66.67

Species	No. Stems	Stems/ Acre	Rel Density	Cover	Rel Cover	Freq	Rel Freq	Importance Index
QUGA	337.00	1048.55	48.98	10.09	31.10	0.71	38.46	39.52
RONE	337.00	1048.55	48.98	22.34	68.90	1.00	53.85	57.24
BEFE	6.00	18.67	0.87	0.00	0.00	0.07	3.85	1.57
RUST	8.00	24.89	1.16	0.00	0.00	0.07	3.85	1.67
Total	688.00	2140.66	100.00	32.43	100.00	1.86	100.00	100.00

TABLE 16. Operable Unit 1082: TA-28, Mesatop, Behind Bunker 1, Burned Ponderosa Pine, 8/27/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	16.84					
ROCK	29.99					
LITTER	41.09					
MOSS/LICHEN	4.00					
BLTR		2.29	28.26	0.19	17.11	22.68
MUMO		1.43	17.66	0.19	17.11	17.38
KOCR		0.09	1.06	0.03	2.63	1.85
RONE		1.71	21.19	0.24	22.37	21.78
ERDI		0.29	3.53	0.04	3.95	3.74
CHFO		0.01	0.18	0.01	1.32	0.75
ARCA		0.09	1.06	0.03	2.63	1.85
COCA		0.14	1.78	0.04	3.95	2.87
VETH		0.29	3.53	0.04	3.95	3.74
BADI		0.09	1.06	0.03	2.63	1.85
RUST		0.57	7.06	0.06	5.26	6.16
AGAL		0.07	0.88	0.01	1.32	1.10
CARX		0.17	2.14	0.07	6.58	4.36
QUGA		0.43	5.30	0.03	2.63	3.97
POAX		0.21	2.65	0.03	2.63	2.64
POTR		0.14	1.77	0.03	2.63	2.20
ARDR		0.07	0.88	0.01	1.32	1.10
Total	91.91	8.09	100.00	1.09	100.00	100.00

Plants in area but not recorded in the transect:

ANSC
IPAG
CYES
THPI
FRAM

TABLE 17. Operable Unit 1082: TA-28, Water Canyon, South-Facing Slope, Burned Ponderosa Pine, 8/27/92, Overstory

Species	No. Trees	Trees/ Acre	Rel Density	AVG DBH	%Cover	Rel %Cover	Freq	Rel Freq	Importance Index
PIPO	2.00	6.22	28.57	6.30	1.00	100.00	0.07	25.00	51.19
SNAG	5.00	15.56	71.43	11.22	0.00	0.00	0.21	75.00	48.81
Total	7.00	21.78	100.00	17.52	1.00	100.00	0.29	100.00	100.00

Species	No. Stems	Stems/ Acre	Rel Density	Cover	Rel Cover	Freq	Rel Freq	Importance Index
QUGA	223.00	693.85	77.97	7.24	65.42	0.57	53.33	65.57
CHNA	6.00	18.67	2.10	0.00	0.00	0.07	6.67	2.92
RONE	52.00	161.79	18.18	3.83	34.58	0.36	33.33	28.70
RUST	5.00	15.56	1.75	0.00	0.00	0.07	6.67	2.80
Total	286.00	889.87	100.00	11.07	100.00	1.07	100.00	100.00

TABLE 18. Operable Unit 1082: TA-28, Water Canyon, South-Facing Slope, Burned Ponderosa Pine, 8/27/92, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
BARE SOIL	34.90					
ROCK	4.93					
LITTER	44.79					
MOSS/LICHEN	2.71					
BLTR		2.29	18.04	0.33	20.72	19.38
MUMO		6.71	52.99	0.71	45.05	49.02
ANSC		0.14	1.13	0.03	1.80	1.46
QUGA		0.07	0.56	0.01	0.90	0.73
RONE		0.57	4.51	0.06	3.60	4.06
ARDR		0.07	0.56	0.01	0.90	0.73
VETH		0.14	1.13	0.03	1.80	1.46
SOLX		0.21	1.69	0.04	2.70	2.20
BADI		0.09	0.68	0.03	1.80	1.24
CEFE		0.71	5.64	0.01	0.90	3.27
CARX		0.29	2.25	0.04	2.70	2.48
ANPA		0.07	0.56	0.01	0.90	0.73
ANGE		0.07	0.56	0.01	0.90	0.73
GECA		0.14	1.13	0.03	1.80	1.46
ERDI		0.01	0.11	0.01	0.90	0.51

POA		0.36	2.82	0.06	3.60	3.21
FRAC		0.29	2.25	0.06	3.60	2.93
ACLA		0.07	0.56	0.01	0.90	0.73
POTX		0.07	0.56	0.01	0.90	0.73
RUST		0.07	0.56	0.01	0.90	0.73
BRAN		0.07	0.56	0.01	0.90	0.73
FRAM		0.14	1.13	0.03	1.80	1.46
Total	87.33	12.67	100.00	1.59	100.00	100.00

Plants in area but not recorded in transect:

IPAG
PECA
TOIN
ANMA
PLPU
CARO
MUWR

Again in 1993, BRET members returned to the general project area to conduct further vegetation studies (see Tables 19-24).

TABLE 19. TA-16, Cañon del Valle, Canyon Bottom, West of Burnyard, Ponderosa Pine, 7/1/93, Overstory

Shrubs	#Shrubs	#Shrubs Per Acre	Rel. Density	%Cover	Rel. Cover	%Freq.	Rel. Freq.	Import. Index
QUGA	114	250.5495	8.913213	18.53529	29.08569	1	20	19.33297
RIIN	768	1687.912	60.04691	12.404	19.46443	1	20	33.17045
RICE	2	4.395604	0.156372	0.1	0.156921	0.142857	2.857143	1.056812
ROWO	17	37.36264	1.329163	0.325	0.509992	0.285714	5.714286	2.517814
RONE	84	184.6154	6.567631	6.133333	9.62446	0.428571	8.571429	8.254507
PRVI	16	35.16484	1.250977	3.366667	5.282992	0.285714	5.714286	4.082752
BEFE	180	395.6044	14.07349	9.555556	14.99463	0.714286	14.28571	14.45128
ROSX	8	17.58242	0.625489	1.08	1.694742	0.571429	11.42857	4.582934
JAAM	67	147.2527	5.238468	9.166667	14.38438	0.285714	5.714286	8.445712
RUST	23	50.54945	1.79828	3.06	4.801769	0.285714	5.714286	4.104778
Total	1279	2810.989	100	63.72652	100	5	100	100

TABLE 20. TA-16, Cañon del Valle, Canyon Bottom, West of Burnyard, Ponderosa Pine, 7/1/93, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
Bare Soil	1.86					
Rock	0.14					
Litter	26.64					
MOSS/LICHEN		0.14	0.2	0.01	0.38	0.29
WATER		2.43	3.42	0.06	1.54	2.48
QUGA		0.07	0.1	0.01	0.38	0.24
RONE		0	0	0.01	0.38	0.19
BEFE		0	0	0	0	0
AGAL		6.5	9.14	0.33	8.85	9
UNK1		0.86	1.21	0.09	2.31	1.76
GAAP		0.14	0.2	0.03	0.77	0.49
FEOB		0.5	0.7	0.04	1.15	0.93
RULA		1.86	2.61	0.2	5.38	4
VIOX		1.5	2.11	0.24	6.54	4.33
POTX		7.22	10.15	0.51	13.85	12
CIRX		1.5	2.11	0.14	3.85	2.98
UNKJUNCX		24.36	34.27	0.54	14.62	24.44
RUCR		1.86	2.61	0.17	4.62	3.61
AMRE		2.07	2.91	0.19	5	3.96
SEVI		0.43	0.6	0.04	1.15	0.88
CARX1		3.14	4.42	0.06	1.54	2.98
UNK2		0.21	0.3	0.03	0.77	0.54
CARX2		0.43	0.6	0.06	1.54	1.07
CARX3		0.21	0.3	0.03	0.77	0.54
UNK2		0.36	0.5	0.04	1.15	0.83
RIIN		2.79	3.92	0.13	3.46	3.69
UNKGRASS		3.64	5.13	0.14	3.85	4.49
MERA		3.86	5.43	0.26	6.92	6.17
FEOV		2.64	3.72	0.1	2.69	3.21
PRVU		0.43	0.6	0.07	1.92	1.26
GERI		0.07	0.1	0.01	0.38	0.24
RONA		0.29	0.4	0.03	0.77	0.59

ACLA		0.07	0.1	0.01	0.38	0.24
RUST		0.14	0.2	0.03	0.77	0.49
AGRE		0.14	0.2	0.01	0.38	0.29
PSMO		0.21	0.3	0.03	0.77	0.54
UNKJUNK1		1	1.41	0.04	1.15	1.28
Total	28.634	71.08	100	3.7143	100	100

TABLE 21. TA-16, Cañon del Valle, North-Facing Slope, West of Burnyard, Ponderosa Pine, 7/1/93, Overstory

Species	#Tree	#Trees Per Acre	Rel. Density	Avg. DBH	%Cover	Rel. %Cover	Freq.	Rel. Freq.	Importance Index
Trees									
JUMO	1	2.397143	0.513715	0.1	0	0	0.071429	2.631579	1.048431
PIPO	17	40.75143	8.733162	10.38824	13.65714	14.98668	0.714286	26.31579	16.67854
PSME	120	287.6571	61.64585	4.58	45.08571	49.47484	0.785714	28.94737	46.68935
ABCO	41	97.69714	20.93681	2.22439	19.7	21.61781	0.642857	23.68421	22.07961
QUGA	16	38.12571	8.170463	5.64375	12.68571	13.92068	0.5	18.42105	13.50406
-	-	-	-	-	-	-	-	-	-
TOTAL	195	466.6286	100	22.93638	91.12857	100	2.714286	100	100

Species	#Stems	#Stems per acre	Rel. Density	% Cover	Rel. Cover	Freq.	Rel. Freq.	Importance Index
Shrubs								
QUGA	104	322.8457	44.82759	12.2	93.53779	0.571429	50	62.78846
RICE	6	18.62571	2.586207	0.071429	0.547645	0.142857	12.5	5.211284
ROWO	5	15.52143	2.155172	0.142857	1.09529	0.071429	6.25	3.166821
RONE	5	15.52143	2.155172	0.142857	1.09529	0.071429	6.25	3.166821
BEFE	112	347.68	48.27586	0.485714	3.723987	0.285714	25	25.66662
Total	232	720.1943	100	13.04286	100	1.142857	100	100

TABLE 22. TA-16, Cañon del Valle, North-Facing Slope, West of Burnyard, Ponderosa Pine, 7/1/93, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
Bare Soil	22.05					
Rock	5.583333					
Litter	60.66333					
MOSS/LICHEN		0.583333	4.984335	0.05	3.703704	4.344019
CLPS		0.266667	2.278553	0.066667	4.938272	3.608412
QUGA		1.916667	16.3771	0.166667	12.34568	14.36139
RICE		0.5	4.272287	0.066667	4.938272	4.605279
CARX		0.5	4.272287	0.066667	4.938272	4.605279
BROX		0.168333	1.438337	0.05	3.703704	2.57102
KOCR		0.083333	0.712048	0.016667	1.234568	0.973308
GABO		0.25	2.136144	0.05	3.703704	2.919924
LYPH		0.925	7.903731	0.1	7.407407	7.655569
FRAM		0.418333	3.57448	0.083333	6.17284	4.87366
THFE		0.25	2.136144	0.033333	2.469136	2.30264
BEFE		1	8.544574	0.066667	4.938272	6.741423
MUMO		2.416667	20.64939	0.166667	12.34568	16.49753
RONE		0.666667	5.696383	0.05	3.703704	4.700043
GECA		0.083333	0.712048	0.016667	1.234568	0.973308
ANPA		0.416667	3.560239	0.033333	2.469136	3.014688
ACLA		0.003333	0.028482	0.033333	2.469136	1.248809
PEBA		0.086667	0.74053	0.05	3.703704	2.222117
PSME		0.001667	0.014241	0.016667	1.234568	0.624404
VIOX		0.083333	0.712048	0.016667	1.234568	0.973308
BRTE		0.166667	1.424096	0.033333	2.469136	1.946616
FEOV		0.166667	1.424096	0.016667	1.234568	1.329332
POFE		0.083333	0.712048	0.016667	1.234568	0.973308
TRDU		0.083333	0.712048	0.016667	1.234568	0.973308
AGSM		0.083333	0.712048	0.016667	1.234568	0.973308
VROX		0.166667	1.424096	0.016667	1.234568	1.329332
RIIN		0.333333	2.848191	0.033333	2.469136	2.658664
Total	88.29667	11.70333	100	1.35	100	100

TABLE 23. TA-16, Cañon del Valle, South-Facing Slope, West of Burnyard, Ponderosa Pine, 7/1/93, Overstory

Species	#Trees	# Trees Per Acre	Rel. Density	Avg. DBH	%Cover	Rel. % Cover	Freq.	Rel. Freq.	Import. Index
Trees									
JUMO	1	2.397143	1.75751	3	0	0	0.071429	4.166667	1.974725
PIPOSNAG	1	2.397143	1.75751	19.1	0	0	0.071429	4.166667	1.974725
PIPO	28	67.12	49.21027	7.992857	25.87143	75.61587	0.642857	37.5	54.10871
PIFL	2	4.794286	3.515019	0	3.571429	10.43841	0.142857	8.333333	7.428922
PSME	8	19.17714	14.06008	0	4.585714	13.40292	0.428571	25	17.48767
POTR	3	7.148571	5.241108	0	0.157143	0.45929	0.071429	4.166667	3.289022
QUGA	14	33.36	24.4585	1.642857	0.028571	0.083507	0.285714	16.66667	13.73623
TOTAL	57	136.3943	100	31.73571	34.21429	100	1.714286	100	100

Species	#Stems	# Stems Per Acre	Rel. Density	%Cover	Rel. Cover	Freq.	Rel. Freq.	Importance Index
Shrubs								
QUUN	90	279.3857	23.87268	5	9.951663	0.642857	21.95122	18.59185
QUGA	140	434.6	37.13528	26.38571	52.51635	1	34.14634	41.26599
QUEX	39	121.0671	10.34483	1.5	2.985499	0.214286	7.317073	6.882467
RICE	16	49.66857	4.244032	0.371429	0.739266	0.142857	4.878049	3.287116
RONE	10	31.04286	2.65252	0.285714	0.568666	0.285714	9.756098	4.325761
PRVI	14	43.46	3.713528	1.242857	2.473699	0.214286	7.317073	4.501433
CEMO	11	34.14714	2.917772	0	0	0.142857	4.878049	2.598607
JAAM	57	176.9443	15.11936	15.45714	30.76486	0.285714	9.756098	18.54677
Total	1131	2340.631	200	100.4857	200	5.857143	200	200

TABLE 24. TA-16, Cañon del Valle, South-Facing Slope, West of Burnyard, Ponderosa Pine, 7/1/93, Understory

Species	Cover	Plant Cover	Rel. Plant Cover	Freq.	Rel. Freq.	Importance Index
Bare Soil	5.071429					
Rock	30.64286					

Litter	56.70714					
MOSS/LICHEN		1.284286	16.94628	0.014286	2.857143	9.90171
ANSC		1.431429	18.88784	0.071429	14.28571	16.58678
MOME		0	0	0	0	0
MUMO		1.071429	14.13761	0.1	20	17.0688
LINU		0	0	0	0	0
IPAG		0	0	0	0	0
RONE		0.5	6.597549	0.028571	5.714286	6.155918
QUGA		0.002857	0.0377	0.028571	5.714286	2.875993
CEMO		0	0	0	0	0
VRIX		0	0	0	0	0
LOWR		0	0	0	0	0
PTAN		0	0	0	0	0
SENX		0	0	0	0	0
RHRA		0.5	6.597549	0.042857	8.571429	7.584489
BRAN		0.214286	2.827521	0.014286	2.857143	2.842332
HEPA		0	0	0	0	0
UNKM AC		0.357143	4.712535	0.014286	2.857143	3.784839
THPI		0.071429	0.942507	0.014286	2.857143	1.899825
PEBA		0.43	5.673893	0.042857	8.571429	7.122661
UNK1		0.071429	0.942507	0.014286	2.857143	1.899825
CLPS		0	0	0	0	0
THFE		0.357143	4.712535	0.014286	2.857143	3.784839
PRVI		0.928571	12.25259	0.042857	8.571429	10.41201
QUUN		0.214286	2.827521	0.014286	2.857143	2.842332
GECA		0.072857	0.961357	0.028571	5.714286	3.337821
ROWO		0.071429	0.942507	0.014286	2.857143	1.899825
Total	92.42143	7.578571	100	0.5	100	100

3.2 Terrestrial Arthropod Studies

In research done by Haarmann, wetland areas of the Laboratory generally support more diverse insect communities. Based on information gathered from around the Laboratory, Haarmann predicts that the following insect families are likely to be found near the project area (Tables 25 and 26):

TABLE 25. Terrestrial insects found on LANL property as of November 1994

ORDER	FAMILY	COMMON NAME
Thysanura (Bristletails)	Lepismatidae	Silverfish
	Machilidae	Jumping bristetail
Collembola (Springtails)	Sminthuridae	Globular springtail
	Entomobryiidae	Elongate-bodied springtail
	Isotomidae	Smooth springtail
	Hypogastruridae	Elongate-bodied springtail
Odonata (Dragon and Damselflies)	Aeshnidae	Darner
	Libellulidae	Common skimmer
	Coenagrionidae	Narrow-winged damselfly
	Gomphidae	Clubtail
Phasmida (Walkingsticks)	Heteronemiidae	Common walkingstick
Orthoptera (Grasshoppers and Crickets)	Acrididae	Short-horned grasshopper
	Gryllacrididae	Camel cricket
	Gryllidae	True cricket
Plecoptera (Stoneflies)	Perlidae	Common stonefly
Dermaptera (Earwigs)	Forficulidae	Common earwig
Thysanoptera (Thrips)	Thripidae	Common thrip
	Phlaeothripidae	Tube-tailed thrips
Hemiptera (True bugs)	Belostomatidae	Giant water bug
	Miridae	Plant bug
	Reduviidae	Assassin bug
	Phymatidae	Ambush bug
	Lygaeidae	Seed bug
	Cydnidae	Burrower bug
	Scutelleridae	Shield-backed bug
	Pentatomidae	Stink bug
	Anthocoridae	Minute pirate bug

	Piesmatidae	Ash-gray leaf bug
	Rhopalidae	Scentless plant bug
	Coreidae	Squash bug
	Gerridae	Water strider bug
	Nabidae	Damsel bug
Homoptera (Cicadas and kin)	Cicadidae	Cicada
	Aphididae	Aphid
	Cercopidae	Spittlebug
	Cicadelidae	Leafhopper
	Coccidae	Soft scale insect
	Delphacidae	Delphacid planthopper
	Psyllidae	Jumping plantlice
Neuroptera (Net-veined insects)	Myrmeleontidae	Antlion
	Hemerobiidae	Brown lacewing
	Raphidiidae	Snakefly
Coleoptera (Beetles)	Cicindelidae	Tiger beetle
	Carabidae	Ground beetle
	Silphidae	Carrion beetle
	Lampyridae	Firefly
	Cantharidae	Soldier beetle
	Lycidae	Net-winged beetle
	Buprestidae	Metallic wood-boring beetle
	Staphylinidae	Rove beetle
	Erotylidae	Pleasing fungus beetle
	Nitidulidae	Sap beetle
	Coccinellidae	Ladybird beetle
	Tenebrionidae	Darkling beetle
	Meloidae	Blister beetle
	Cerambycidae	Long-horned beetle
	Lucanidae	Stag beetle
	Scarabaeidae	Scarab beetle
	Chrysomelidae	Leaf beetle
	Curculionidae	True weevil
	Dermestidae	Dermestid beetle
	Bruchidae	Pea weevil

	Cleridae	Checkered beetle
	Cucujidae	Flat bark beetle
	Melyridae	Soft-winged flower beetle
	Mordelidae	Tumbling flower beetle
	Scolytidae	Bark beetle
Lepidoptera (Butterflies, Moths)	Papilionidae	Swallowtail
	Lycaenidae	Copper
	Hesperiidae	Skipper
	Pieridae	White, sulphur, and orange
	Nymphalidae	Brush-footed butterfly
	Satyridae	Satyr, nymph, and artic
	Noctuidae	Noctuid moth
	Sphingidae	Sphinx moth
	Saturniidae	Giant silkworm moth
	Gelechiidae	Gelechiid moth
	Geometridae	Measuringworms
	Pterophoridae	Plume moth
Diptera (Flies)	Tabanidae	Horse and deer flies
	Therevidae	Stiletto fly
	Asilidae	Robber fly
	Bombyliidae	Bee fly
	Syrphidae	Hover fly
	Tachinidae	Tachinid fly
	Calliphoridae	Blow fly
	Cecidomyiidae	Gall midge
	Chironomidae	Midge
	Dolichopodidae	Long-legged fly
	Drosophilidae	Pomace fly
	Empididae	Dance fly
	Heleomyzidae	Heleomyzid fly
	Muscidae	House fly
	Mycetophilidae	Fungus gnat
	Phoridae	Humpbacked fly
	Pipunculidae	Big-headed fly
	Sarcophagidae	Flesh fly

	Simuliidae	Black fly
	Trichoceridae	Winter crane fly
	Tephritidae	Fruit fly
Siphonaptera (Fleas)	Pulicidae	Common fly
Hymenoptera (Bees, Ants, Wasps)	Ichneumonidae	Ichneumonid wasp
	Cynipidae	Gall wasp
	Mutillidae	Velvet ant
	Scoliidae	Scoliid wasp
	Formicidae	Ant
	Pompilidae	Spider wasp
	Eumenidae	Euminid wasp
	Vespidae	Vespid wasp
	Sphecidae	Sphecid wasp
	Halictidae	Metallic wasp
	Megachilidae	Leafcutting bee
	Apidae	Honey and bumble bees
	Chalcidiidea	Chalcidid wasp
	Mymaridae	Fairfly
	Tiphiidae	Tiphiid wasp
	Chrysididae	Cuckoo wasp
	Braconidae	Braconid wasp

TABLE 26. Non-Insect Terrestrial Arthropods Found on LANL Property as of October 1993

CLASS/ORDER	FAMILY
Chilopoda (Centipedes)	Geophilidae
	Lithobiidae
Diplopoda (Millipedes)	Julidae
Arachnida/Acarina (Mites)	Anystis
	Bdelidae
	Ascidae
	Bryobiidae
	Calligonellidae
	Cryptognathidae

	Cunaxidae
	Erythraeidae
	Eupodidae
	Gymnodamaeidae
	Laelapidae
	Nanorchestidae
	Paratydaeidae
	Phytoseiidae
	Rhagidiidae
	Rhaphignathidae
	Scutacaridae
	Stigmaeidae
	Tenuipalpidae
	Terpnacaridae
	Trombidiidae
	Tydeidae
	Tarsonemidae
	Zerconidae
Archnida/Araneida (Spiders)	Agelenidae
	Amaurobiidae
	Anyphaenidae
	Araneidae
	Clubionidae
	Dictynidae
	Gnaphosidae
	Hahniidae
	Linyphiidae
	Lycosidae
	Micryphantidae
	Miryphantidae
	Oonopidae
	Pholcidae
	Tetragnathidae
	Salticidae
	Theridiidae

	Thomisidae
Arachnida/Opiliones (Harvestmen)	Phalangiidae

3.3 Aquatic Insect Studies

BRET's aquatic enotomologist, Saul Cross, conducted two studies in the project area. Following are his two reports on his findings:

3.3.1 Starmer's Gulch Macroinvertebrate Samples, by Saul Cross

On 1 July 1994, Ralph Ford-Schmid of AIP and members of BRET)sampled three sites near Starmer's Gulch in TA-22. BRET measured dissolved oxygen, temperature, pH, and conductivity at station 2. Both Ralph and I also performed a rapid bioassessment protocol (RBP) habitat assessment there (his score was 135; mine was 128). Ralph said that this would be an "ideal reference station" and that "it doesn't get any better than this." I agreed that it looked optimal. Ralph took two 1-gallon water samples. James Alarid later picked up one of them from the Jomar Building for QA/QC.

Both Ralph and I kick-sampled three riffles areas, each taking separate macroinvertebrate samples. We flipped a coin to see who would get the upper riffle area (usually better quality), and I won all three times. Station 1 was 50 ft above the confluence with Pajarito Canyon; Station 2 was 50 ft below the confluence; and Station 3 was 100 ft below the confluence. We placed the collected macroinvertebrates and associated litter in whirl packs and immersed them in 70% alcohol.

Ralph sub-sampled using the technique recommended in the 1989 RBP manual and sent his macroinvertebrates to Dr. Gerald Jacobi of Highlands University for identification. I used the same sub-sampling technique and identified ours on 7 September 1994.

Sub-Sample 1A-1 (total 103)

Non-insects
- 1 Gastropoda (108)
- 1 Nematomorpha

Plecoptera
- 3 Perlidae, Hesperoperla pacifica (18)
- 7 Chloroperlidae (24)

Ephemeroptera
- 24 Baetidae, Baetis (72)

Trichoptera
- 1 Hydropsychidae, Hydropsyche (108)
- 2 Limnephilidae, Hesperophylax (108)
- 2 Lepidostomatidae, Lepidostoma (18)

Diptera
- 59 Chironomidae, type I (108)
- 2 Simulidae (108)
- 1 Tipulidae, Dicranota (24)

The numbers in parentheses are the tolerance quotients (TQs) taken from the USDA Fisheries Habitat Surveys Handbook of 1989. TQs range from 1 to 108, with the upper numbers indicating the greatest tolerances. The system is based upon tolerances to sulfate, alkalinity, and sedimentation. The average TQ of a site is its community tolerance quotient (CTQ). This site had a CTQ of 88.5, far higher than I had anticipated.

I wanted to be sure we used a truly representative sub-sample to evaluate the area under consideration as a reference for LANL waterways. Therefore, I identified two further sub-samples. The CTQ of the second was 87.4; and the third was 86.6. The average CTQ of the three sub-samples was 87.5. Several good-quality indicator taxa (mostly stoneflies) were present, but 62% of the 346 individuals analyzed had TQs of 108 (the highest possible).

Further assessment of Lab waterways using these techniques is required. However, at this point, I feel that using Starmer's Gulch as a reference site (the best that an area is capable of supporting) for comparable stream stretches would not be unreasonable.

Sub-Sample 1A-2 (total 135)

Non-insects
- 3 Annelida, Oligochaeta (108)
- 1 Nematomorpha
- 1 Platyhelminthes, Turbellaria (108)
- 1 Hydracarina

Plecoptera
- 12 Perlidae, Hesperoperla pacifica (18)
- 4 Chloroperlidae (24)
- 2 Nemouridae, Amphinemura (6)

Ephemeroptera
- 31 Baetidae, Baetis (72)

Trichoptera
- 1 Hydropsychidae, Hydropsyche (108)

Diptera
- 75 Chironomidae, type I (108)
- 3 Simulidae (108)

Sub-Sample 1A-3 (total 108)

Non-insects
- 1 Platyhelminthes, Turbellaria (108)
- 2 Annelida, Oligochaeta (108)

Plecoptera
- 8 Perlidae, Hesperoperla pacifica (18)
- 5 Chloroperlidae (24)
- 2 Nemouridae, Amphinemura (6)

Ephemeroptera
- 27 Baetidae, Baetis (72)

Diptera
- 61 Chironomidae, type I (108)
- 1 Chironomidae, type B (108)
- 1 Simulidae (108)

Sample 2A (total 107)
3 squares sorted, much debris including Pipo needles, fine roots, broken up deciduous leaves, small twigs

Non-insects - 7
- 6 Annelida, Oligochaeta (108)
- 1 Hydracarina

Plecoptera - 13
- 8 Perlidae, Hesperoperla pacifica (18)
- 4 Chloroperlidae (24)
- 1 Nemouridae, Amphinemura (6)

Ephemeroptera - 44
- 42 Baetidae, Baetis (72)
- 2 Siphlonuridae, Ameletus (48)

Trichoptera - 2
- 2 Limnephilidae, Hesperophylax (108)

Coleoptera - 8
- 5 Elmidae, Heterlimnius corpulentus (108)
- 3 Elmidae adults, Heterlimnius corpulentus (108)

Diptera - 33
- 22 Chironomidae A (108)
- 9 Simulidae (108)
- 2 Tipulidae, Dicranota (24)

The 2A CTQ is 80.1 with 44% of the individuals having a TQ of 108.

Sample 3A (total 150)
4 squares sorted, sample contained fir needles, fine fragments, some oak leaves

Non-insects - 19
- 10 Annelida, Oligochaeta (108)
- 8 Platyhelminthes, Turbellaria (108)
- 1 Ostracoda, Cyprididae (108)

Plecoptera - 28
- 15 Chloroperlidae (24)
- 13 Perlidae, Hesperoperla pacifica (18)

Ephemeroptera - 75
- 64 Baetidae, Baetis (72)
- 11 Siphlonuridae, Ameletus (48)

Trichoptera - 7
- 6 Limnephilidae, Hesperophylax (108)
- 1 unidentifiable pupa

Coleoptera - 6
- 3 Elmidae, Heterlimnius corpulentus (108)
- 3 Elmidae adults, Heterlimnius corpulentus (108)

Diptera - 15
- 12 Chironomidae, Type A (108)
- 2 Simulidae (108)
- 1 Tipulidae Dicranota (24)

The 3A CTQ is 70.4 with 42% of the individuals having a TQ of 108.

The average CTQ value of Starmer's Gulch samples from the three sites is 79.3.

3.3.2 Outfall 128, TA-22, by Saul Cross

Background: On October 5, 1994, members of BRET of ESH-20 conducted a preliminary biological survey of Outfall 128 in TA-22. This outfall discharges approximately 300,000 gallons/year from the circuit board facility. It is augmented by sporadic inputs from Outfall 078 (photographic waste) and possibly some natural flow.

Instrument Readings: Physico-chemical measures were taken at the discharge pipe although water flow was very reduced at the time of sampling. All readings (Table 27) fall within natural ranges for streams of the area. However, the dissolved oxygen readings are suspect since the average is 118% of the saturation value at 17.5∞ C.

TABLE 27. Physico-chemical measures taken at outfall 128, 5 October 1994.

Reading	Dissolved Oxygen (mg/l)	Temperature (° Celsius)	Conductivity (mmhos/cm)	pH
1	8.65	17.5	756	8.5
2	8.85	17.5	765	8.4
3	9.0	17.5	763	8.3
Average	8.83	17.5	761	8.4

Vegetation: Immediately below the discharge pipe is an area of scattered cattails (*Typha latifolia*) and sedges (*Carex* sp.). Approximately 40 yards below the discharge pipe, the cattails become much more concentrated and a "true" wetlands area commences at an elevation of 2,211 m (7,300 ft). The cattail marsh covers approximately 0.8 acre.

The overstory is Ponderosa pine (Pinus ponderosa), with a few small one-seeded junipers (*Juniperus monosperma*). Surrounding the cattails are wax currant (*Ribes inerme*), Canadian wildrye (*Elymus canadensis*), redtop (*Agrostis alba*), bluegrass (*Poa* sp.), and rushes (*Juncus* sp.). Most of these species are associated with damp or riparian habitats. The thick marshy vegetation was approximately 50 feet wide at its maximum. Although no flow was observed, the cattails grew in a narrow ribbon downstream along the drainage. Isolated pools had apparently been used as wallows for elk, and possibly other mammals.

Aquatic Macroinvertebrate Sampling: We used a kick net to sample standing water in pools and within the cattail thickets (Table 28). The disjunct open water areas did not permit the collection of a quantitative sample. In addition to the aquatic insects listed below, over 300 ostracods (phylum Crustacea, order

Ostracoda, family Candodidae) were collected. These are very hardy crustaceans (tolerance quotient = 108) and often encountered in stagnant pools.

TABLE 28. Aquatic insects found at Outfall 128, 5 October 1994.

Number of individuals	Order	Family	Genus	Tolerance quotient
17	Ephemeroptera	Baetidae	Baetis	72
5	Diptera	Tabanidae	Chrysops	108
1	Diptera	Chironomidae	Type A	108
1	Diptera	Chironomidae	Type C	108
4	Diptera	Culicidae	Culex	108
2	Diptera	Culicidae	Culiseta	108
2	Diptera	Culicidae	pupae	108

Tolerance quotients measure an aquatic invertebrate's endurance to stressful conditions. Those invertebrates with adaptations to living in an impacted zone have high tolerance quotients, with 108 being the highest possible. A community tolerance value may be calculated by averaging the quotients of all invertebrates collected. The community tolerance value for Outfall 128 was 106. Omitting the ostracods causes it to fall to 89, still a relatively high value. All except one of the Baetid mayflies were collected in one pool, and this single refugium greatly lowered the community value. The pool containing the mayflies was thoroughly sampled to ensure that no other "sensitive" biological indicators were overlooked; none were found. Undoubtedly, the lack of consistent flow in the marsh is a major contributory factor in the high tolerances of the macroinvertebrates found.

All aquatic invertebrates found in this marsh, except the Baetid mayflies, are rapid dipteran (true fly) colonizers of poor habitats. The wetlands area below Outfall 128 does not support a well-established aquatic macroinvertebrate community. The discharges that permit the development of the cattail swamp below Outfall 128 are too infrequent and/or sporadic to support such a community in the foreseeable future.

3.4 Reptile and Amphibian Surveys

Surveys were conducted twice during 1994 in TA-16. These surveys were conducted by two trained biologists who combed the area looking for all reptile and amphibian species. Elimination of the wastewater outfalls will probably eliminate the majority of these species from the area.

The following species were found in or near the wetlands:

Canyon Treefrog (*Hyla arenicolor*)
Eastern Fence Lizard (*Sceloporus undulatus*)
Many-lined Skink (*Eumeces multivirgatus*)
Plateau Striped Whiptail (*Cnemidophorus velox*)
Western Terrestrial Garter Snake (*Thamnophis elegans*)

Based on information gathered in other wetland areas of the Laboratory, the following species have a very high probability of being present in the project area (although none were found during the surveys):

Tiger Salamander (*Ambystoma tigrinum*)
Southern Spadefoot Toad (*Spea multiplicatus*)
Woodhouse Toad (*Bufo woodhousei*)
Striped Chorus Frog (*Pseudacris triseritata*)
Short-Horned Lizard (*Phrynosoma doublassii*)
Gopher Snake (*Pituophis melanoleucus*)
Western Rattlesnake (*Crotalus viridis*)

3.5 Bird Surveys

No specific bird surveys have been done in the project area. However, BRET's ornithologist, Dave Keller, states that there are three bird species that are dependent on the wetland areas (Keller 1994). These include the song sparrow (*Melospiza melodia*), the red-winged blackbird (*Agelaius phoeniceus*), and the willow flycatcher (*Epidonax traillii extimus*).

3.6 Mammal Studies

In the most extensive mammal study done to date, Raymer and Biggs (1994) concluded that the elimination of wet areas within LANL boundaries could cause a significant reduction in overall mammal species diversity at LANL. Reductions in water flow could also significantly decrease small mammal speicies diversity and eliminate water-dependent species at outfall-watered sites. Additionally, the authors concluded that species diversity may be reduced in other groups, including medium-sized mammals. It was also noted that while changes in volume and location of discharged wastewater may not affect species diversity of large mobile animals such as black bear, deer, and elk, such changes could greatly disrupt the local migration patterns of these animals.

Included is a report written by James Biggs on small mammal surveys conducted during 1992 and 1994:

3.6.1 Mammal Surveys, by James Biggs

PURPOSE

Field surveys were conducted in 1992 and 1994 to characterize small mammal species diversity and population characteristics below HE outfalls. The data provided in this report are a compilation of studies done in 1992 and 1994.

METHODS

Although the primary focus of this study was to collect small mammal population data, during 1994, unique techniques were used to address health and safety issues associated with the recent outbreak of hantavirus. These procedures are briefly discussed; however, a more detailed description can be found in Biggs, et al. (in preparation). Also presented within this document is a summarization of data from a study conducted in 1992 that examined small mammal species diversity near outfalls (Raymer and Biggs 1994).

The following methodology describes the 1994 field studies. A detailed description of methods used during the 1992 field studies is given in Raymer and Biggs (1994).

Trapping took place in the latter part of May 1994. Three 10 x 10 grids (100 traps) were laid along across the canyon bottom below the outfall. The grid began immediately below the outfall effluent. Only general field clothes and standard procedures were required for setting up the trap grids. However, due to the hantavirus additional clothing requirements were necessary. These requirements were followed for the remaining portion of the study. One Sherman live-trap was placed within 2 m of each trap station. Traps were placed at least 1 m from obvious deer, elk, or other large mammal trails or bedding sites to avoid accidental destruction of the traps. Where possible, traps were set next to small mammal burrows or tracks, or near rocks, logs, brush, etc. Traps were baited with sweet feed (a molasses-coated horse feed) rolled in a light cover of peanut butter.

For purposes of data analysis, traps were assigned two numbers corresponding to an x-y coordinate (i.e., 1-1, 1-2, 1-3, etc.) with the first station (1-1) located at the northwest corner of the grid. The numbers were printed on pin flags placed at each trap station (the x-y coordinate).

Trapping took place over 3-4 consecutive nights. Traps were baited in late afternoon and checked in early morning to record nocturnal species. Species name, weight, body length, tail length, ear and foot length, and location of capture (x-y coordinate) were recorded. Animals were marked with size #FF rodent ear tags from the Salt Lake Stamp Co., Salt Lake City, Utah.

Program CAPTURE (White et al. 1982) was used to estimate population size. Due to insufficient sample sizes of individual species, in addition to all species pooled, only rough estimates of density could be made. Although CAPTURE could produce population estimates, sample sizes were insufficient for the program to attempt density calculations.

RESULTS

Three species of nocturnal small mammals were captured during the 1994 trapping session and 4 species were caught during the 1992 session. In the 1992 session, deer mice (*Peromyscus maniculatus*), brush mouse (*Peromyscus boylii*), long-tailed vole (*Microtus longicaudus*),and Mexican woodrat (*Neotoma mexicana*), were captured. In the 1994 session deer mice, brush mice, and Mexican woodrat were captured.

A total of 23 individual animals (excluding diurnal species) were recorded in 1994 and 27 during the 1992 session. The individual capture rate for nocturnal species in 1992 was 9% (27 captures/300 trap nights) and 8% (23/300) for the second session. The overall recapture rates were 63% and 59% for 1992 and 1994, respectively. Weight data for each species is given in Figure 2.

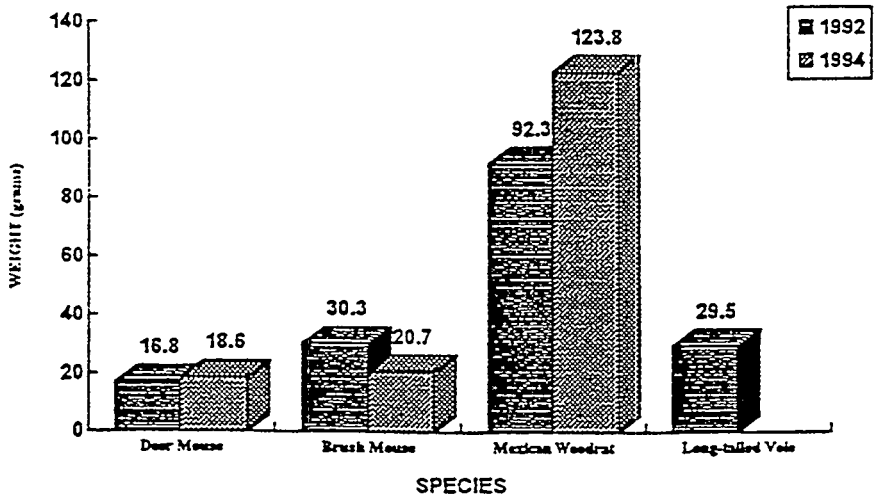

Figure 2. Mean Body Weight by Species; 1992, 1994.

Information is also provided on sex ratios of each species captured during the 1992 and 1994 surveys (Figure 3).

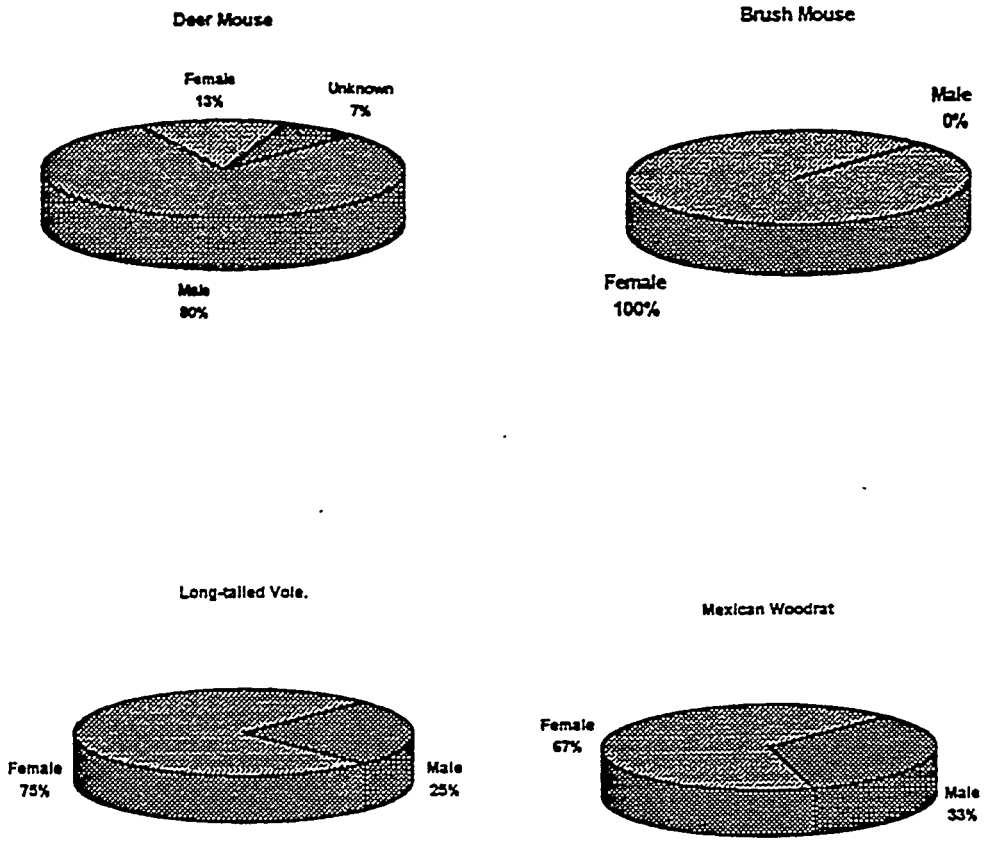

Figure 3. Relative Percent of Sex Ratios by Species, 1992.

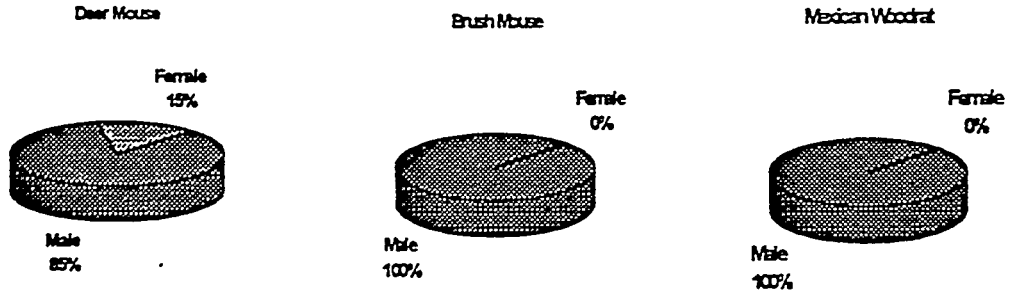

Figure 4. Relative Percent of Sex Ratios by Species, 1994.

Deer mice were the most frequently captured species in both 1992 and 1994 (Figure 5). Long-tailed voles were relatively common in 1992 but were not captured during the 1994 trapping sessions.

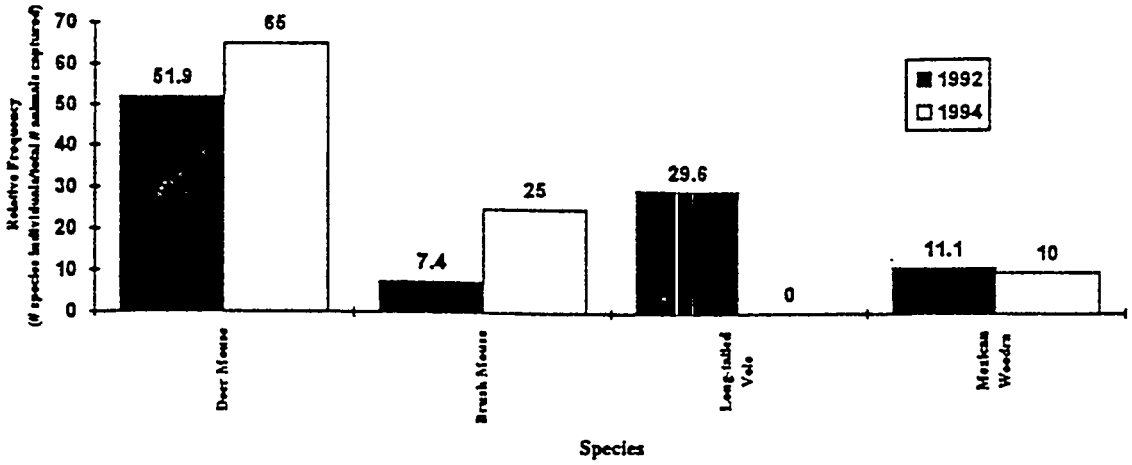

Figure 5. Relative Species Composition for Each Session.

Population and Density Estimates

Program CAPTURE was used to estimate population size and density was estimated using rough hand calculations based on a 10-m boundary strip thereby making the grid an 11 x 11. Density estimates include all species captured for each grid. Overall population estimates are given for each year and individual estimates are given for each grid for 1994 data.Table 29 lists density estimates and population estimates and their accompanying standard error for each of the grids.

TABLE 29. Population and Density Estimates for TA-16, 1992 and 1994.

GRID NUMBER	NO. OF ANIMALS CAPTURED	TOTAL NUMBER OF CAPTURES	POPULATION ESTIMATE	STANDARD ERROR	DENSITY ESTIMATE (animals/ha.)
1992	23	39	26	2.44	19
1994					
1	5	9	9	8.06	4.1
2	8	13	10	2.64	6.6
3	6	11	4	0.00	5.0

Species diversity indices were calculated for each trapping session and subsequently both years averaged (Figure 6).

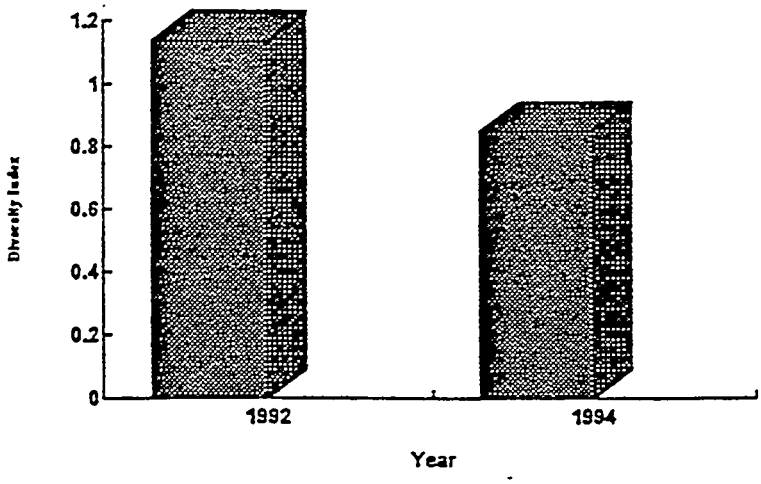

Figure 6. Small Mammal Species Diversity Indices; 1992, 1994.

Population and density estimates, as well as species diversity indices, are shown to be lower for the surveys conducted in 1994 compared to those conducted in 1992. This is likely a result of two reasons. One being that capture rates were generally much lower in 1994 than in 1992 throughout Laboratory property. The second reason is based on grid design, which differed slightly between the two years, and on the fact that small mammal densities are usually greater along the stream channel. In 1992, a 5 x 20 grid was used that concentrated the trapping effort along the stream channel. However, in 1994, 10 x 10 grids were used, which reduced the overall concentrated effort along the stream channel.

REFERENCES

Bogart, C., "The Amphibians and Reptiles of the Los Alamos National Research Park," Los Alamos National Laboratory unpublished report (1978).

Edeskuty, B., T.S. Foxx, and D.F. Raymer, "Potential Use of NPDES Outfalls for Wildlife Watering," internal document (1992).

Foxx, T. S. and G.D. Tierney, "Status of the Flora of the Los Alamos National Environmental Research Park, Vol. I," Los Alamos National Laboratory report LA-8050-NERP (May 1980a).

Foxx, T.S. and G.D. Tierney, "Status of the Flora of the Los Alamos National Laboratory Environmental Research Park, A Historical Perspective, Vol. II," Los Alamos National Laboratory report LA-8050-NERP (May 1980b).

Foxx, T.S. and Tierney, G.D., "Status of the Flora of the Los Alamos National Environmental Research Park. Checklist of Vascular Plants of the Pajarito Plateau and Jemez Mountains, Vol. III," Los Alamos National Laboratory report LA-8050-NERP (June 1985).

Keller, D., Los Alamos National Laboratory, personal communication, November 1994.

LANL, "Potential Use of NPDES Outfalls for Wildlife Watering," Los Alamos National Laboratory unpublished report (1992).

Morrison, J.L., "Biological Evaluation of Proposed Weapons Subsystems Laboratory Site," Los Alamos National Laboratory unpublished report (1990).

MacKay, W., D. Lowrie, A. Fisher, E. Mackay, F. Barnes and D. Lowrie., "The Ants of Los Alamos County, New Mexico" *Advances in Myrmecology*, ed. E.J. Brille, New York (1988).

McLin, S.G., "Determination of 100-Year Floodplain at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-12195-MS (1992).

Raymer, D.F., "Biological and Floodplain/Wetland Assessment for Environmental Restoration Program Operable Unit 1082, Technical Areas 11, 13, 16, 24, 25, 38 and 37, Los Alamos National Laboratory, Los Alamos, New Mexico," Los Alamos National Laboratory unpublished report (September 1993).

Raymer, D. and J. Biggs, "Comparison of Small Mammal Species Diversity Near Wastewater Outfalls, Natural Streams, and Dry Canyons," Los Alamos National Laboratory report LA-12725-MS (1994).

Travis, J.R., "Atlas of the Breeding Birds of Los Alamos County, New Mexico," Los Alamos National Laboratory report LA-12206 (1992).

White, G.C., "Biotelemetry Studies on Elk," Los Alamos National Laboratory report LA-8529-NERP (1981).

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis, "Capture-Recapture and Removal Methods for Sampling Closed Populations," Los Alamos National Laboratory report LA-8787-NERP (1982).