Open-file Report 79-760

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Mail Stop 954, Federal Center, Box 25046
Denver, Colorado 80225

INVENTORY OF CLAY-RICH BEDROCK AND METAMORPHIC DERIVATIVES IN EASTERN NEVADA, EXCLUDING THE NEVADA TEST SITE

Compiled by

H. E. Simpson[1], J. W. Weir, Jr.[1], and L. A. Woodward[2]

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[1]U.S. Geological Survey, Denver, Colo.
[2]University of New Mexico under contract with Sandia Laboratories, Albuquerque, N. Mex.

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SUMMARY

Six counties of eastern Nevada contain 36 localities that include areas of exposed clay-rich sedimentary bedrock, slightly to moderately metamorphosed derivatives of such rocks, or both (fig. 1). In each locality one or more of these kinds of rocks constitute one or more geologic units greater than 152 m (500 ft) in thickness and 0.8 km^2 (0.3 mi^2) in area at the ground surface.

The several kinds of sedimentary and metamorphic rocks considered here, kinds in which nuclear wastes might be stored below the ground surface, are referred to, for the purpose of this report, as "clay-rich rocks." These rocks locally meet or exceed arbitrarily selected minimum conditions of lithology, thickness, and areal extent. These places are grouped into localities and may be deemed suitable for further investigation. The localities identified are in Clark, Elko, Eureka, Lincoln, Nye, and White Pine Counties.

The types of clay-rich rocks that might be useful include claystone, siltstone, shale, and various mixtures of them, together with metamorphic derivatives which include argillite, metasiltstone, slate, phyllite, schist, and gneiss. The geologic units that contain such clay-rich rocks also commonly contain mixtures, interlayers, and lenses of sandstone, conglomerate, and limestone, and their metamorphic derivatives: quartzite, conglomerite, and marble.

Initially, the principal areas in Nevada where clay-rich rocks more than 31 m (100 ft) thick are exposed at the ground surface were identified by searching published geologic literature. From those areas, localities that contain exposed clay-rich rocks more than 152 m (500 ft) thick and of more than 0.8 km^2 (0.3 mi^2) in area were selected. For each locality a brief descriptive text was prepared. Seven factors that might be significant in selecting specific localities best suited for further investigation are summarized therein. The factors are: (1) geographic location, (2) land ownership, (3) accessibility, (4) proximity to population concentrations, (5) geologic setting, (6) hydrologic setting, and (7) mineral-resource activity.

INTRODUCTION

Purpose and Scope

The possibility of using rock as a medium for the underground storage or disposal of nuclear waste materials has been recognized for several years (National Academy of Sciences/National Research Council, 1957; U.S. Department of Energy/Office of Science and Technology Policy, 1978). Several very different kinds of rock have been suggested for this purpose. Notably these include salt, shale, granite, basalt, and welded tuff, each of which might have one or more useful physical or chemical properties for the purpose.

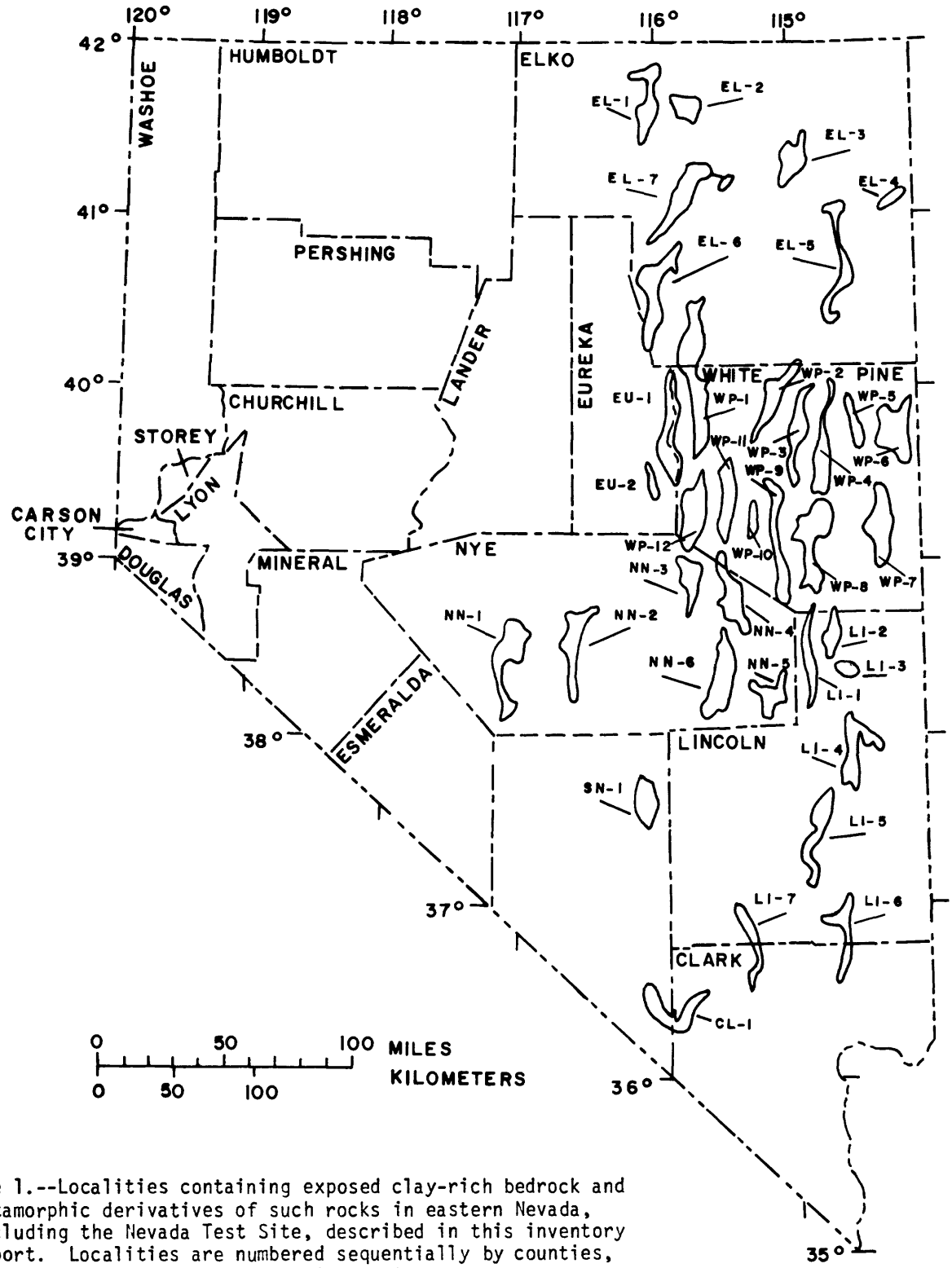

Figure 1.--Localities containing exposed clay-rich bedrock and metamorphic derivatives of such rocks in eastern Nevada, excluding the Nevada Test Site, described in this inventory report. Localities are numbered sequentially by counties, and Nye County is arbitrarily divided into two parts.

This report contains the results of the first phase of an investigation of the geologic and hydrologic potential for such use of exposed shale in Nevada, other clay-rich rocks, and slightly to well-metamorphosed derivatives of such rocks. The NTS (Nevada Test Site) is excluded from consideration here as comparable studies are being made there by others. This investigation was made by the USGS (U.S. Geological Survey) at the request of the DOE (U.S. Department of Energy).

The first phase of this investigation was based mainly on an examination of published geologic and hydrologic literature, as only a few of numerous unpublished theses and dissertations on the area are readily accessible. In many cases, however, the data and conclusions in such unpublished reports are included or summarized by others, perhaps with modification, in the published literature. Nearly all of the published geologic material was prepared by geologists of the Nevada Bureau of Mines and Geology, the USGS and various colleges and universities. A few of the publications were prepared by geologists in commercial enterprise or private consulting practice. Sources of hydrologic data consist predominantly of reconnaissance-series and water-resources reports prepared by USGS personnel for publication by the Nevada Department of Conservation and Natural Resources.

Procedure

Geologic literature was scanned for information about clay-rich rocks in Nevada. Effort then was concentrated mainly on the eastern part of the State for it was evident from the geologic history, and from the literature scanned, that the finer grained, thicker geologic units are located there. A map compilation was made of those areas in eastern Nevada where clay-rich rocks are known to be exposed and are known to be 31 m (100 ft) or more thick. From this compilation were selected those places where the clay-rich rocks were known to be 152 m (500 ft) thick or more, and the surface exposure is apparently larger than 0.8 km^2 (0.3 mi^2).

These constraints were arbitrarily selected on the following inferences: (1) a minimum unit thickness of nearly 31 m (100 ft) might be required for underground operations as presently contemplated, (2) a minimum unit thickness of 152 m (500 ft) might be needed for any useful properties that clay-rich rocks might possess to be significantly effective in containment of stored nuclear wastes, and (3) a surface area of 0.8 km^2 (0.3 km^2) might be the minimum extent required for surface facilities at a storage location. These constraints were derived by the senior author from concepts illustrated in figures prepared by the Office of Waste Isolation, Union Carbide Corp., Oak Ridge, Tenn., for the U.S. Energy Research and Development Administration (now DOE) (see figs. OWI-76-118R1, p. 1-13; OWI-76-141, p. 1-14; OWI-301, p. 6-7; and OWI-6-272, p. 1-12 in Office of Waste Isolation/Union Carbide Corp., 1976).

The places were then divided into geologically and geographically related groups, or localities, by counties and plotted on the county-outline maps (pls. 1-7). The identified localities are in Clark, Elko, Eureka, Lincoln, Nye, and White Pine Counties. Nye County is represented on two maps because of its large size. Each locality was named for appropriate geographic feature, and given a symbol consisting of two letters from the county name, and a numerical designation. The distinctly separate parts of some localities were given letter designations as well. Places where the thickness of a unit has been determined in the field

are indicated on the plates, and marginal information summarizes the lithologic and thickness information available. Hydrologic information is also represented on plates 1-7. In addition, the county maps show some highways to help the reader orient the locality within the county. Other geographic information is not compiled on the county maps for this report; it can be obtained from sources listed in the bibliography, notably maps in the 1:250,000-scale (2.5 km/cm or 4 mi/in.) series published by the USGS, Lockard (1970), Lutsey and Nichols (1972), Schilling (1976), Garside and Schilling (1977), and Payne and Papke (1977).

The main body of this report includes a brief characterization of each county as a whole, a short description of the geologic, hydrologic, and geographic features within a 40-km (25-mi) radius of the boundary of each locality, and a listing of source materials including bibliographic references and lists of topographic maps.

Seven topical considerations are included in each locality description. These are listed below with brief explanatory comments.

Geographic location.--The general location within the county, the geographic coordinates and land-survey data for each locality constitute a major part of this topic.

Geographic coordinates are given to the nearest minute of latitude and longitude, and land-survey data are located within 1.6 km (1 mi). The information was obtained from USGS topographic maps published at a scale of 1:250,000. Where land-net data represents an unsurveyed location, that fact is indicated.

Generalized land ownership.--Land mainly in open-space use is classed as under Federal, State, or private ownership. The principal Federally controlled lands include the following subclasses, together with the name and symbol of the supervisory or trustee agency.

Subclass	Federal agency	Abbreviation
Public lands	U.S. Bureau of Land Management	BLM
National forests	U.S. Forest Service	USFS
Wildlife ranges, refuges, and management areas	U.S. Fish and Wildlife Service	FWS
National monuments and recreation areas	U.S. National Park Service	USNPS
Withdrawn land	U.S. Bureau of Reclamation	USBR
Indian reservations	U.S. Bureau of Indian Affairs	BIA
Military facilities	U.S. Air Force	USAF
Energy research facilities	U.S. Department of Energy	DOE
Wilderness areas	(Various agencies share responsibilities within specific areas of expertise.)	

Land owned by the State of Nevada includes the following subclasses, but the supervisory State agencies are not identified in this report.

- Wildlife areas
- Scenic areas
- Stock driveways
- Recreation lands
- Highways (both State and Federal) and secondary roads
- Natural areas
- State parks

Areas and distances given are intended to characterize the locality and its vicinity, and are not intended to be encyclopedic. Where given, these data are estimated mainly from Lutsey and Nichols (1972) and partly from topographic maps of the 1:250,000-scale series published by the USGS.

Distances were measured to the nearest one-tenth of a mile, converted to kilometers, then reduced to the nearest whole mile and kilometer, unless the distance was found to be less than 1.6 km (1 mi). In that case the distance was converted, but no reduction was made. Some areas were estimated by counting square miles. These were then converted to square kilometers, and are reported to the nearest square mile and square kilometer. In other areas, the relative percentages of different kinds of open-space land ownership were estimated by inspection. Areas were estimated and converted, and are reported to the nearest square mile and square kilometer.

Accessibility.--This topic considers the proximity of a locality to Federal highways, State routes, secondary roads, trails, railroads, petroleum, and natural-gas pipelines, power-transmission lines, and public water-supply pipelines. Distances from a locality boundary to such features were measured and are reported as were distances for land ownership. The features reported, and their distances from localities, are taken mainly from Lockard (1970), and in part from topographic maps published at a scale of 1:250,000 by the USGS.

Remoteness.--The proximity of localities to cities, towns, and villages for which the population was reported in the 1970 Federal census is given. Place names and census data are taken from Rand McNally (1977); distances were measured and reported in the same manner as were those in land ownership.

Geologic setting.--This topic includes the names of all clay-rich units present, and briefly describes the lithology and thickness of those more than 152 m (500 ft) thick as reported in geological publications. The information is compiled from numerous publications by many geologists; their maps were prepared at differing scales, and so can differ in the degree of detail represented.

Most thicknesses given in the literature for geologic units are calculated from map data, and are approximate. Places where the thickness of units were measured in the field are shown on the county maps, and the thickness given. Unit thicknesses are consistently reported in feet and inches in the literature. Here they are converted and reported to the nearest meter or centimeter and shown to the nearest foot or inch.

Hydrologic setting.--The generalized position of each area in the regional ground-water flow system or systems, and the drainage basin or basins in which the locality is located, is given. The nearest significant discharge areas are identified insofar as the available literature permits, and distances to these areas were measured and are included in the text.

Mineral-resource activity.--The direction and distance to active metal and nonmetal mines, inactive mining districts, patented lode-mining claims, petroleum and natural-gas test holes, and oil fields are given. Sand, gravel, and crushed-rock pits are not included. The data is taken from Schilling (1976), Payne and Papke (1977), and Garside and Schilling (1977). Distances are measured and reported as are those for land ownership.

Regional Setting

Eastern Nevada is characterized geomorphically by numerous rugged, assymetrical mountain ranges that trend northward and that are separated by flat-floored alluvium-filled valleys. The ranges are tilted segments of the Earth's crust that are bounded by normal faults, and that are broken by other normal faults into blocks that differ in size, shape, cross section, and the attitude of the geologic units that compose them.

The rocks, faults, and folds of the ranges commonly are readily apparent, for the soil mantle is thin. Igneous, sedimentary, and metamorphic rocks are present in all of the ranges. Those rocks of sedimentary origin, in part more or less modified by metamorphism, constitute four groups of strata that represent the four eras (fig. 2) of geologic time. Strata of the first, second, and fourth groups are included in this report. Strata of the second group commonly are present in the localities described herein, in part because clay-rich rocks are relatively common in the group, and in part because normal faulting has caused repeated occurrence of the clay-rich units.

The character of the environment in which the first, or Precambrian, group of sedimentary strata--now more or less well metamorphosed--was deposited, and the time or times during which the metamorphism occurred is not clear. Their mineral composition indicates that in part they are metamorphosed equivalents of sedimentary units similar to those of the second group and they had a similar depositional environment.

Sedimentary strata of the second, or Paleozoic, group--also now more or less metamorphosed--were derived from a probably mountainous source area (geanticline) and deposited in a broad, elongate sea adjacent on the east. The sea occupied a trough (geosyncline) that trended north-northeast across eastern Nevada. Clastic sediments were deposited in this sea mainly adjacent to the source area, whereas deposits that later became limestone and dolomite were dominant farther east. Local changes, mainly in the elevation of the source area, the capacity and competency of the drainage, the character of the marine currents, and depth of the sea floor, caused continuing local changes in the lithology and thickness of the sedimentary beds as they were deposited. Late in the early part of the accumulation process (about Late Devonian time), horizontal stresses in the Earth's crust caused folding of the strata, and a major system of thrust faults (the Roberts Overthrust System) developed. These thrust faults caused lateral displacement of successive sheets of the deposits eastward, and a sequence of such sheets has been identified in most of the ranges.

Strata that accumulated during the third (Mesozoic) era were deposited in separate marine basins, and are sparse in eastern Nevada. None meet the arbitrary constraints selected for this report. The era, however, is noted for development of a second (Sevier) overthrust-fault system located chiefly in what is now the State of Utah. The thrust faulting was accompanied, and perhaps followed, by extensive normal faulting that formed the faulted, tilted crustal segments that now constitute the mountain ranges. Most ranges in eastern Nevada are tilted downward toward the east, but there are some exceptions. Igneous activity also became significant during this era.

During the fourth (Cenozoic) era, sediments that accumulated in eastern Nevada were wholly continental rather than wholly or partly marine. One of the geologic units deposited was clay rich and sufficiently thick to be included in this report. At this time the plutonic and

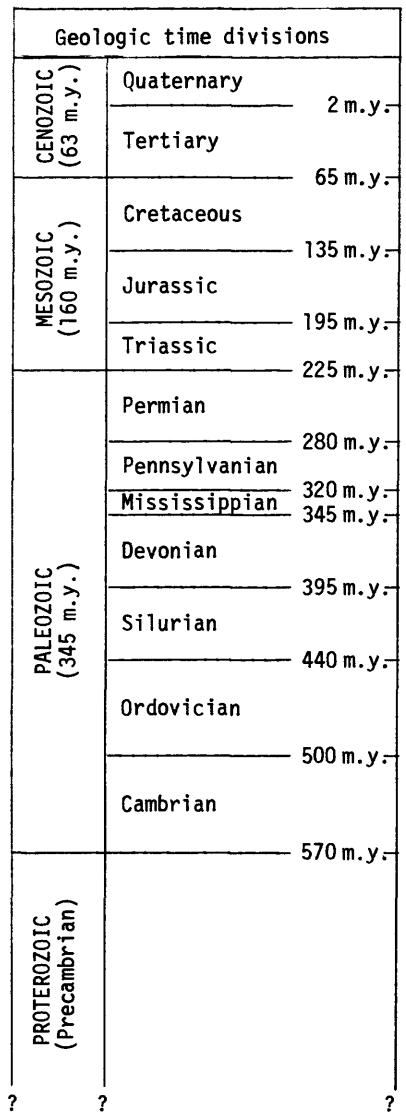

Figure 2.--Diagrammatic representation of the principal divisions of geologic time. Height of space between boundaries is proportional to known or inferred duration of each division; time approximate; all figures in million of years.

volcanic activity that had become significant during the Mesozoic Era now became dominant; this activity is represented today by the basaltic lava flows commonly observed and the widespread deposits of acidic volcanic tuff. Normal faulting continued as well. In addition, erosion continued to shape the fault-block ranges, and the eroded sediment was deposited between the ranges, accumulating to depths as great as about 400 m (1,200 ft), to form the nearly level modern valley floors.

The stratigraphic sequence of eastern Nevada is thus very complex. One geologic unit may be identifiable in various parts of several adjacent ranges, whereas another unit of equal significance in this report may be known only in a single range. In addition, significant differences in the lithology and thickness of a geologic unit can occur both from range to range and even from one part of a single range to another part. These changes in lateral extent, lithology, and thickness all reflect the continuing change in the environment of deposition mentioned above, and in part reflect the observations and opinions of the individual geologists who mapped different areas.

Table 1 of this report lists alphabetically only those geologic units named in this text, shows the geologic age of each unit as accepted by the USGS, and identifies the localities where the unit is described and may be suitable for further investigation. Those readers who wish to relate a unit to its position in geologic history and thus to geologic events outlined above, can ascertain the age in table 1 and then determine its proper group from figure 2. Actually, the geologic age of a unit is not of itself a direct factor in determining physical or chemical characteristics of the unit, and so is of little concern in this report. The best and most comprehensive effort at correlation of geologic units in Nevada is that prepared by the Stratigraphic Committee of the Eastern Nevada Geological Society (1973); it systematically includes references published prior to 1965.

Eastern Nevada is considered arid, but the amount of precipitation differs locally; in general, it increases from south to north and with increasing altitude. The valley floors, which are characterized by a desert climate, receive as little as 8 cm (3 in.) of rain per year. Vegetation on them is thin to sparse, and is most dense around springs and in areas of shallow ground water. The mountains, which rise 1,000-2,000 m (3,000-6,000 ft) above the valley floors, receive larger amounts of moisture, and precipitation can exceed more than 62 cm (25 in.) per year on the crests of the northern ranges. Vegetation on ranges in the southern part of the State is generally sparse or absent, but conifer forests commonly mantle those in the north.

The present surface drainage in Nevada is distinctive for its basically internal character (fig. 3). Extensive master drainage routes are recognizable, but none has experienced through flow on the ground surface in historic time, and hydrologic evidence indicates that these routes have not had significant surface through flow since the Great Ice Age--the Pleistocene Epoch. The perennially flowing Colorado River is the dominant river of the region. In Nevada, the sole perennially flowing tributary is the Virgin River of Utah, which enters the Colorado River in Clark County, Nev. Neither river receives through flow from the four other master surface drainage routes of eastern Nevada. These routes are: (1) the Las Vegas Valley route of southern Nye and Clark Counties, which trends southeastward through Las Vegas directly to the Colorado River, (2) the White River Valley drainage route which heads in southern White Pine County and

Table 1.--Alpahbetical list of major geologic units and subunits referred to in this report, together with the geological age of each as used by the U.S. Geological Survey and a listing of those localities wherein the unit may be suitable for further investigation

Geologic unit or subunit	Geologic age	Localities where described
Argillite of Lee's Canyon (informal name used by Smith and Ketner, 1975)	Early Mississippian(?)	EL-6
Cabin Shale	Early Cambrian	(none)
Carrara Formation	Early and Middle Cambrian	CL-1, NS-1
Chainman Shale	Early and Late Mississippian	EL-3, EL-5, EL-6, EL-7, EU-1, EU-2, LI-1, LI-2, LI-3, LI-6, NN-3, NN-4, NN-5, NN-6, WP-1, WP-2, WP-3, WP-4, WP-5, WP-6, WP-7, WP-8, WP-9, WP-10, WP-11, WP-12
Dunderberg Shale	Late Cambrian	NN-2, NN-4, WP-4
Eleana Formation	Late Devonian to Late Mississippian; locally Mississippian only	NN-2
Kanosh Shale	Middle Ordovician	WP-6
Lincoln Peak Formation	Middle and Late Cambrian	WP-8
Mayflower Schist	Ordovician(?)	(none)
McCoy Creek Group of Misch and Hazzard (1962)	Late Proterozoic	EL-4, WP-3, WP-4
Osceola Argillite, possible correlative of subunit G, both of Misch and Hazard (1962)	Late Proterozoic	WP-3, EL-4
Strawberry Creek Formation, possible correlative of subunit E, both of Misch and Hazzard (1962)	Late Proterozoic	WP-3, WP-4
Subunit C of Misch and Hazzard (1962)	Late Proterozoic	WP-3, WP-4
Subunit B of Misch and Hazzard (1962)	Late Proterozoic	WP-3, WP-4
Ninemile Formation	Early and Middle Ordovician	(none)
Ordovician-Cambrian shale and limestone (informal name used by Kleinhampl and Ziony, 1967)	Ordovician and Cambrian	NN-1
Patterson Pass Shale of Kellogg (1963)	Middle Cambrian	LI-2
Pilot Shale	Late Devonian and Early Mississippian; locally Late Devonian only	WP-2, WP-3, WP-4, WP-5, WP-6, WP-7
Pioche Shale	Early and Middle Cambrian; locally Early Cambrian only	LI-2, LI-4, LI-5, LI-7, WP-2, WP-3, WP-4
Poorman Peak Formation of Coash (1967)	Permian(?)	EL-2
Secret Canyon Shale	Middle Cambrian	EU-2, WP-3, WP-11
Schoonover Formation of Fagan (1962)	Mississippian to Permian	EL-1
Sheep Pass Formation	Cretaceous(?) to Eocene	WP-9
Stoneberger Shale of Kay and Crawford (1964)	Ordovician	NN-4
Toquima Formation	Ordovician	(none)
Unnamed clay-shale unit (informal name of Ekren and others, 1971)	Middle Cambrian	NS-1
Webb Formation	Early Mississippian	EL-6
Wood Canyon Formation	Late Proterozoic and Early Cambrian	NS-1
Woodruff Formation	Early to Late Devonian	EL-6

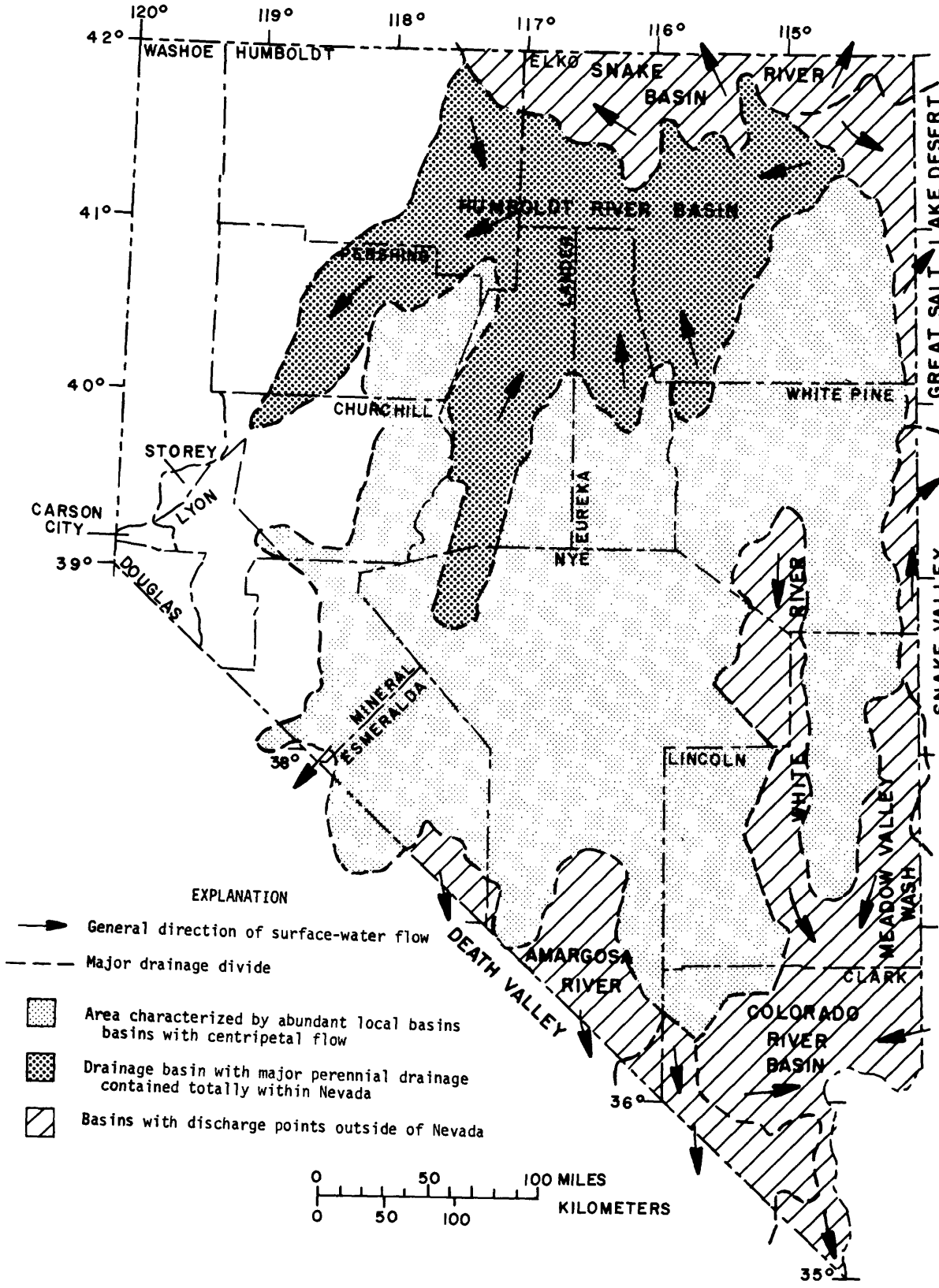

Figure 3.--Major surface-drainage basins of Nevada excluding the western one-fourth.

extends south and southeast into the Moapa Valley, a tributary of the Virgin River valley; (3) the Amargosa River valley drainage route of southwestern Nye County; it follows a circuitous route southwest to Death Valley, Calif.: and (4) the perennially through-flowing Humboldt River of Elko County and northeastern Nevada, which disappears in the Humboldt Sink of western Nevada.

Most precipitation on the mountain ranges evaporates; the remainder migrates toward the valleys, in part as surface flow and in part as ground water. The surface runoff generally sinks into the ground on reaching the valley alluvium, but occasionally can flow across the surface to temporarily flood playas that are commonly present on the floors of undrained (closed) valleys. Ground water in the ranges locally reaches the alluvial surface near the valley margins, or it may enter the valley alluvium well below the ground surface. Wherever ground water is at or near the alluvial surface, large amounts are lost by evaporation and by transpiration from vegetation.

The ground water that saturates the alluvial beds and underlying volcanic rocks of most valleys is part of an underground flow system that is represented on the county maps and summarized on figure 4. Each system includes one or more of several valleys, and one system may be tributary to another. Discharge from a system ultimately may be into an adjacent State, or it may be totally within Nevada.

There are 10 ground-water flow systems wholly or partly in eastern Nevada that eventually discharge into adjacent States. These externally drained systems are the Snake River, Great Salt Lake Desert, Snake Valley, Sevier Desert, Virgin River Valley, Sarcobatus Flat, Pahute Mesa, Ash Meadows, White River Valley, and the Las Vegas Valley ground-water systems.

Nine ground-water systems wholly or partly in eastern Nevada have internal drainage, and thus do not discharge into an adjacent State. Three of these systems involve only a single valley, and are wholly in eastern Nevada; they are the Gabbs Valley, Monte Cristo Valley, and Pennoyer (Sand Springs) Valley ground-water systems. Five of the nine involve more than one valley, and are wholly or partly in eastern Nevada; the five are the Newark Valley, Diamond Valley, Railroad Valley, Clayton Valley, and Ruby Valley ground-water systems. The last of the nine, the Humboldt Valley ground-water system, is intimately associated with the perennially flowing Humboldt River surface drainage system of northeastern Nevada, and like it flows southwest to terminal discharge in the Humboldt Sink of western Nevada.

Future Investigations

As this report is the first phase of an investigation of clay-rich geologic units in which nuclear wastes might be stored in eastern Nevada, consideration has been given only briefly to the seven geographic, geologic, hydrologic, and mineral-resource factors previously listed. Subsequent phases of the investigation should develop in greater thoroughness three of the factors already touched upon, these are (1) the geologic character of the rocks, especially their lithology and structure; (2) the hydrologic character of the localities and adjacent regions; and (3) mineral-resource assessment of mineral-resource areas. In addition, investigation of at least two additional factors not included in this report should be undertaken for any locality that might be selected for further study. These factors are (1) the topographic characteristics of relief, slope, and terrain; and (2) geophysical and seismic characteristics, location of earthquake epicenters and intensities, and tectonics.

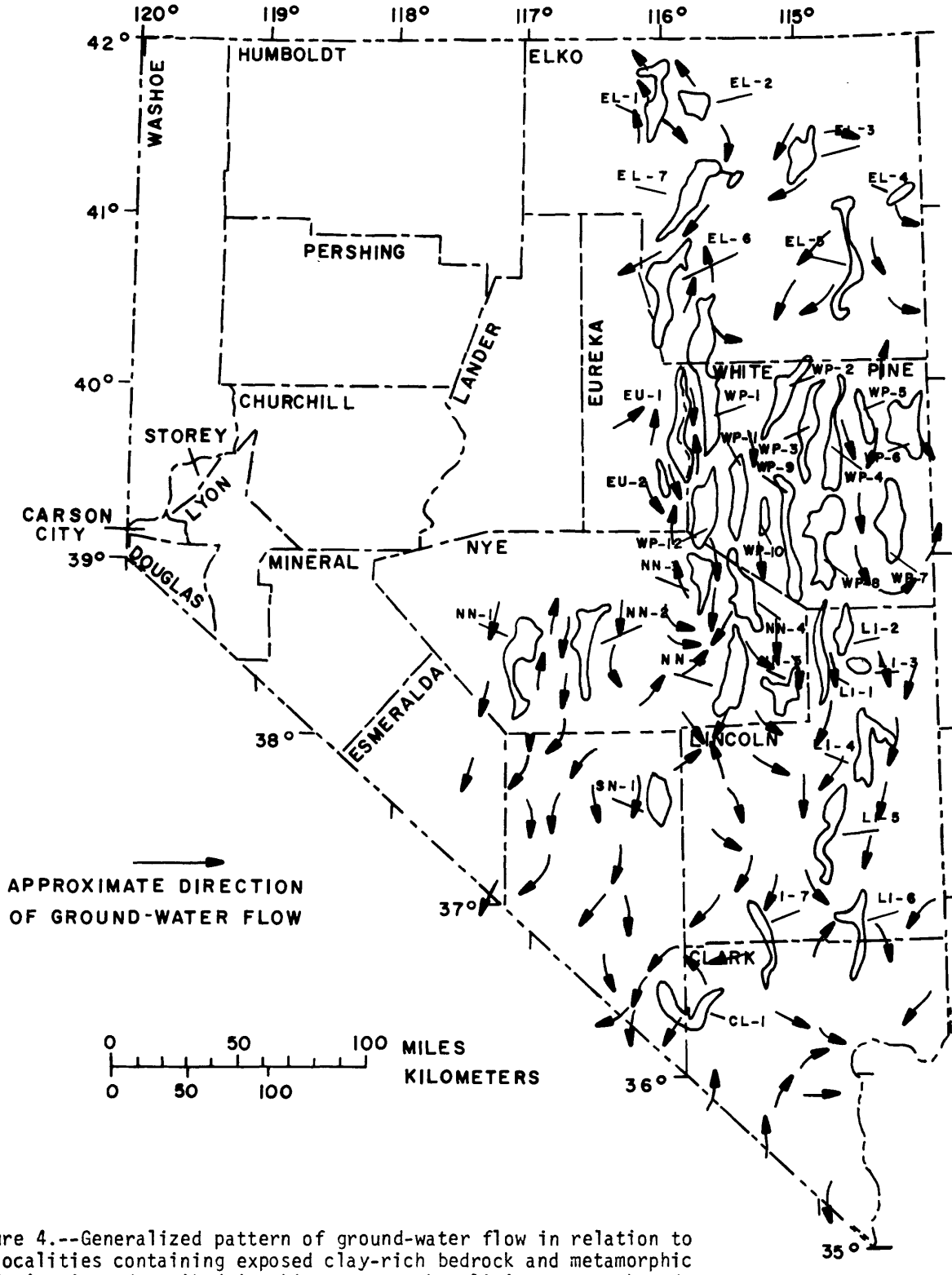

Figure 4.--Generalized pattern of ground-water flow in relation to localities containing exposed clay-rich bedrock and metamorphic derivatives described in this report. Localities are numbered sequentially by counties, and Nye County is arbitrarily divided into two parts.

The present investigation has considered only the lithology, thickness, and areal extent of exposed clay-rich bedrock. Thus, neither the attitude of the formation, nor the character of any folding has been considered. Examination of these structural characteristics might increase the potential for nuclear waste storage in some geologic units.

From the imposed constraint of exposed clay-rich rock it is inferred that (1) construction of an underground storage facility in a single, homogeneous, structurally simple geologic unit of considerable areal extent at the ground surface is preferred, and (2) the thickness of the unit should be great enough to permit sufficient depth of emplacement to provide a factor of safety for long-term containment. Thorough field investigation will be essential in order to confirm the favorable attributes of a potential storage area.

Future field investigations must include studies performed both within the area of exposure and in its vicinity, perhaps in part at a distance of some miles from the outcrop. Moreover, the studies must include both surface study and mapping, and subsurface exploration by means of drilling and geophysical techniques, together with sampling for laboratory analysis. Drilling exploration must be planned in a manner consistent with criteria imposed for borehole proximity to possible storage chambers. Hydrologic data will be obtained in conjunction with other geologic information.

If appropriate structural conditions are found, neither the constraint of exposed clay-rich rock nor the constraint of thickness may continue to be applicable, and additional geologic situations then may be acceptable for emplacement. As an example: a gently to moderately tilted, essentially planar rock unit that is locally exposed topographically low on the flank of a mountain range adjacent to a broad, alluvium-filled valley, may permit downdip tunneling perhaps to a location beneath the bedrock floor of the valley. Although such an emplacement position might be saturated with water, so also might a location be saturated in the general emplacement concept of a geologic unit that is exposed at the ground surface. However, the emplacement concept of a moderately tilted unit can offer a much greater thickness of roof rock above the emplacement, and thus perhaps greater security.

Another example is a desirable clay-rich geologic unit that is overlain by a geologic unit of little attractiveness for nuclear waste storage. This relation might be a geologic succession of units, or the result of low-angle (thrust) faulting that caused overriding of one unit by another. In such a situation it might be feasible to sink a shaft into the clay-rich unit and then tunnel laterally, if necessary, to a location beneath the overlying formation. This might achieve greater thickness, strength, or both, in the roof, thus increasing security.

Future investigations also should include hydrologic studies. Closed valleys, those lacking both surface and subsurface through flow from the valley, are hydrologically attractive, but additional evidence that ground water does not leak from them must be obtained.

Annotated definitions

This preliminary report contains the results of a technical and scientific study. As such, it has been the goal of the authors to be technically correct, and yet to express findings in terms that can be understood by interested nongeologists. Technical words used are definable generally from their context, or with the aid of a desk-type dictionary. A few terms are defined below as they are used in this report. These definitions are based on those contained in the "Glossary of Geologic Terms," second edition, published by the American Geological Institute, Washington, D.C.

Attitude.--The position of a planar bed or surface relative to an imaginary horizontal plane, expressed quantitatively by two components: (1) dip, the angle between the bed or surface and a horizontal plane, and (2) strike, the compass direction of the line of intersection of the bed or surface with the horizontal plane.

Block (of land).--An area of land ownership that is not contiguous with other, similarly owned areas of land, except perhaps at area corners.

Clay minerals.--Loosely defined and chemically complex silicates characterized by extremely small particle size, flakelike or feathery form, and the ability to absorb substantial quantities of water and other dissolved ions on particle surfaces.

Clay-size particles.--Fragments of any mineral that are the general size of clay minerals, and thus constitute a particle-size class finer than that of silt.

Clay-rich rock.--Normally sedimentary bedrock estimated to contain more than 30 percent by volume of clay minerals, clay-size particles, or some combination of both; here extended to include those clay-rich units which have been slightly to thoroughly altered by consolidation and recrystallization of the minerals originally present through regional metamorphism.

Cleavage.--The quality a rock or mineral has of splitting in a direction independent of bedding planes.

Fissility.--The quality a rock has of splitting parallel to bedding planes.

Metamorphism.--The mineralogical and structural adjustment of rock to change in physical and chemical conditions of its environment, resulting principally from heat, moisture, and pressure imposed below the near-surface zones of weathering and cementation.

Vicinity.--The area within a distance of 40 km (25 mi) from a locality boundary.

The following rock types are also defined here as they are used in this report:

Claystone.--Slightly indurated rock containing approximately twice as much clay-mineral material and clay-size particles as it does silt-size particles, and lacking fissility; it may contain as much as 10 percent sand-size particles. Commonly subject to slaking. Includes the "clay shale" of some geologists and civil engineers.

Mudstone.--Slightly indurated rock containing about equal amounts of clay-mineral material and clay-size particles combined, and of silt-size particles; lacks fissility. Commonly subject to slaking. Includes the "clay shale" of some geologists and civil engineers.

Shale.--Slightly indurated rock consisting of claystone, mudstone, or siltstone in composition, but characterized by fissility. Includes the "clay shale" of some geologists and civil engineers.

Argillite.--Somewhat indurated rock derived from claystone or mudstone by slight metamorphism; lacks the fissility of shale and the cleavage of slate. Term used by some geologists for slightly metamorphosed siltstone.

Conglomerite.--Somewhat indurated rock derived from conglomerate by slight metamorphism. Is the"metaconglomerate" of some geologists.

Metasiltstone.--Used by some geologists for somewhat indurated rock derived from siltstone by metamorphism; lacks the fissility of shale and the cleavage of slate. Includes the "siltite" of some geologists.

Slate.--Moderately indurated rock derived from any of the above rock types by metamorphism, and characterized by cleavage.

Phyllite.--Moderately metamorphosed rock derived from any of the above, and characterized by a silky sheen caused by the nearly parallel orientation of sericite mica or chlorite.

Schist.--Thoroughly metamorphosed rock derived from any of the above; characterized by parallel orientation of platy to prismatic minerals which constitute more than 50 percent of the rock, with some minor lenticles of equidimensional minerals.

Gneiss.--Very thoroughly metamorphosed rock derived from any of the above; characterized by alternation of bands or lenticles of equidimensional minerals which constitute more than 50 percent of the rock, with bands or lenticles of coarsely platy or prismatic minerals.

Conversions and Abbreviations

Both metric and English units of measurement are used in this report. Units of measurement, abbreviations, and conversion factors are shown below.

Multiply English unit	By	To obtain Metric unit
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.59	square kilometer (km^2)

Multiply Metric unit	By	To obtain English unit
centimeter	0.3937	inch
meter	3.281	foot
kilometer	0.6214	mile
square kilometer	0.3861	square mile

Compilation and Acknowledgments

This report involved the compilation and evaluation of information from geologic, hydrologic, and geographic disciplines. The geologic material was compiled by Howard E. Simpson, the geographic material and the county maps were prepared mainly by Simpson and in part by James E. Weir, Jr., and the hydrologic material by Weir. Lee A. Woodward served as stratigraphic consultant. Simpson and Weir are geologist and hydrologist, respectively, with the USGS, Denver, Colo.; Woodward, a member of the geological faculty at the University of New Mexico, Albuquerque, is under contract with Sandia Laboratories of the same city. Mark Parchman and Duncan Edwards, both then employed by Sandia Laboratories, assisted briefly in the compilation. Critical, helpful reviews of the report were made by Klaus Keil, petrologist, also of Sandia Laboratories, J. R. Connolly, geologist, University of New Mexico, F. E. Rush, hydrologist, and W. C. Swadley, geologist, USGS, Denver, Colo.

CLARK COUNTY

Parts of three localities that contain clay-rich rock suitable for further investigation are present in northwestern Clark County, Nev. One, the Spring Mountain locality (CL-1), probably extends northwestward into adjacent southern Nye County. The other two, the Meadow Valley locality (LI-6) and the Desert Range locality (LI-7) extend into Clark County from Lincoln County, where the characteristics of the bedrock units are perhaps better described. These localities are described, therefore, in the Lincoln County section of this report.

In the Spring Mountain locality, one geologic unit that might be suitable for further investigation is exposed. It is the Carrara Formation, a varied assemblage of shale and limestone about 274 m (900 ft) thick. The relative areal extent of surface exposures is moderate to small.

Few readily available geologic references contain detailed information about the three localities, or the Carrara Formation, in Clark County. Perhaps the single most useful report contains a geologic map at a scale of 1:250,000 (2.5 km/cm or 4 mi/in.) prepared by Longwell, Pampeyan, Bowyer, and Roberts (1965).

Clark County occupies the southernmost part of Nevada. It has a total area of 20,324 km^2 (7,847 mi^2), and a 1970 census population of 273,288 (Rand McNally, 1977). Las Vegas, the county seat, had a 1970 census population of 125,787, and is surrounded by suburban development. The city is located in the center of the county, about 56 km (35 mi) from the nearest parts of the three localities of exposed clay-rich bedrock. The community is situated on U.S. Interstate Highway 15 and U.S. Highway 95, and is additionally served by U.S. Highway 93 and State Routes 52 and 41. These, as well as others, radiate across much of the county. The city is oriented to recreation and to commerical service for southern Nevada, an area of cattle ranches and mines that produce various metallic ores or nonmetallic minerals. As of 1970 (Lockard), Las Vegas, and thus the county, was served by several power transmission lines that ranged in size from 14,000 to more than 80,000 V ac. Natural-gas pipelines serve the Las Vegas area and the southern tip of the county, and a single railroad traverses the county in a north-south direction, passing through Las Vegas. Parts of the county are occupied by a large national recreational area and part of a national forest, plus State-controlled parks, recreation lands, and natural areas. In addition, Nellis Air Force Base occupies great amounts of land in the central and northwestern parts of the county.

Two topographic maps of the 1:250,000-scale series together represent the county. These maps are at a scale of 2.5 km/cm (4 mi/in.), have a contour interval of 200 ft, and are identified in the list of reference materials following the Reference list.

CL-1: Spring Mountains Locality

Locality CL-1 is located in the central part of the Spring Mountains, in the west-central part of Clark County. It is a very slender, sinuous area of irregular form that extends from the northeasterly end of Indian Ridge southwestward to the Nye County line. From there it probably continues northwestward into southern Nye County, very likely to the northwestern end of the Spring Mountains, but detailed lithologic descriptions are not readily available for the part in Nye County. Thus, the Nye County part of the locality is not included in the description below. CL-1 consists of a single part.

Geographic location.--The northeastern end of the locality is at lat 36°29' N., long 115°38' W.; the southernmost extremity is just east of the western boundary of Clark County at lat 36°16' N., long 115°52' W. Thus, the locality extends from the W 1/2 sec. 7, T. 17 S., R. 57 E., to the SE cor. sec. 22, T. 19 S., R. 54 E.

Locality CL-1 is represented topographically on maps at two different scales; these maps are listed following the Reference list.

Approximate area.--The minimum width of the locality is 0.8 km (0.3 mi), the maximum width is 3 km (2 mi) and the average width is estimated at 2 km (1 mi). Its sinuous length is about 40 km (25 mi), so the total area is approximately 65 km^2 (25 mi^2).

An estimated 80 percent of the locality is exposed bedrock containing some clay-rich rock, but the actual extent of the clay-rich rock is not determined.

Land ownership.--Part of the locality occupies about 0.8 km^2 (0.3 mi^2) of private land, and about the same amount of the Charleston Peak segment of the Toiyabe National Forest. The remainder of the locality is Federal public land. In the vicinity of the locality, that is the area within a radius of about 40 km (25 mi) of the locality boundary, there are 29 blocks of privately-owned land. Two of these are very large; one is 8 km (5 mi) west of CL-1; the corner of the other, an area centered about Las Vegas, is 33 km (20 mi) from the locality. In addition, there are some 27 small, scattered blocks of privately-owned land in the vicinity. The large Nevada Test Site is 24 km (15 mi) from CL-1, the extensive USAF Bombing and Gunnery Range is as close as 10 km (6 mi), and the Desert National Wildlife Range is 10 km (6 mi) distant. Nevada's Desert View Natural Area is 9 km (6 mi) southeast, and the Red Rock Canyon Recreational Lands are 27 km (17 mi) southeast of CL-1.

Accessibility.--The northeast end of the locality is 8 km (5 mi) southwest of U.S. Highway 95. The locality boundary is as little as 9 km (6 mi) northeast of State Route 16, it is 12 km (7 mi) to the northeast end of State Route 52 at its junction with Route 16 at Pahrump, and it is 13 km (8 mi) from the western end of State Route 39 into the Charleston Peak area from U.S. Highway 95. An access road to the Desert View Natural Area and to private land within the Toiyabe National Forest is as little as 10 km (6 mi) from the locality, and a secondary road that extends northeast from Pahrump crosses the southern part of the area.

Remoteness.--The intersection of U.S. Interstate Highway 15 and U.S. Highway 95 in the city of Las Vegas is 60 km (38 mi) from the northeastern part of the locality. The population of the Las Vegas area ("Ranally Las Vegas Metropolitan-Area," a trade name) was 321,000 (Rand McNally, 1977) in the 1970 census. Three other places had populations reported in that census; they are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Indian Springs, Nev.	900	11	7	N	northern end
Charleston Park, Nev.	150	13	8	SE	SE margin
Pahrump, Nev.	500	11	7	SW	SW extremity

Mercury, headquarters for the NTS, generally has people in temporary residence, but it had no population reported in the 1970 census; it is 31 km (20 mi) from the middle part of the locality CL-1.

Geologic setting.--The Spring Mountains are distinctive chiefly for their northwestward rather than northward trend and for the several spurlike ridges that trend northeastward along the northeastern flank of the range. Lateral movement along a fault zone beneath Las Vegas Valley is inferred from local differences in the attitudes of the strata that compose the spurs. The crustal block that constitutes the southwest side of the valley moved northwest relative to the crustal block that constitutes the northeast side.

One clay-rich bedrock unit, the Carrara Formation, is present at the ground surface in the locality. For geologic reasons, this unit here includes three stratigraphic units that can be identified individually in the eastern part of the State (Longwell and others, 1965). The Carrara Formation is not mapped as an individual unit either on available reference maps (Longwell and others, 1965) or on the map accompanying this section of the report; it is instead combined with adjacent units stratigraphically above and below.

The formation is described (Longwell and others, 1965, p. 18) as ". . .a varied assemblage of shale and limestone," and is shown (pl. 3) to be about 274 m (900 ft) thick in Indian Ridge, 11 km (7 mi) south-southeast of Indian Springs village. One of the three units in eastern Clark County believed to be equivalent to part of the Carrara Formation in Indian Ridge is the Pioche Shale. In Indian Ridge this unit may be represented as an especially shaly part of the Carrara Formation, but neither the presence of such a part, nor a thickness for it, is reported.

Hydrologic setting.--The CL-1 locality is in the Pahrump Valley and Ash Meadows groundwater systems. Runoff from the outcrops flows to Pahrump, Mercury, Indian Springs, and Three Lakes Valleys.

The two most significant nearby discharge areas are (1) at Indian Springs, 10 km (6 mi) north of the northeast outcrop and (2) at Pahrump, 13 km (8 mi) southwest of the southern outcrop. The water is used for public supply and military purposes at Indian Springs. The ground water is used in Pahrump Valley for irrigation, public supply, and domestic purposes.

Mineral-resource activity.--No active mines are situated in the Spring Mountains locality nor are there any active or inactive mines reported (Payne and Papke, 1977) within a radius of about 40 km (25 mi). Several patented lode-mining claims of the Johnnie mining district are located in the northwestern Spring Mountains in southern Nye County, about 17 km (10 mi) west of the locality.

Two test holes for oil and gas have been drilled (Garside and Schilling, 1977) within a distance of about 40 km (25 mi) from the locality. One is located 24 km (15 mi) to the southeast, the other about 33 km (21 mi) east-southeast; both are reported as abandoned.

ELKO COUNTY

Seven localities of clay-rich rock suitable for further investigation are situated wholly within Elko County. Another, the Ruby Mountain Locality (WP-1), extends into the county from adjacent White Pine County, where the larger part of the locality is located; it is therefore described in the White Pine County section of this report.

Seven geologic units that might be suitable for further consideration are represented in one or more of these seven localities. The rock types in the units range from slate, metasiltstone, marble, and argillite, all of Unit G of the McCoy Creek Group of Misch and Hazzard (1962), through a broad variety of sedimentary materials that are in part interbedded; these materials include fissile to non-fissile claystone, siltstone, sandstone, and small amounts of conglomerate and limestone, together with their mildly metamorphosed equivalents, chiefly argillite, metasiltstone, quartzite, and conglomerite. The strata are assigned to the Chainman Shale for the most part, and to the Poorman Peak Formation, Webb Formation, Woodruff Formation, the informally named Argillite unit of Lee's Canyon of Smith and Ketner (1975), the Schoonover Formation, and the McCoy Creek Group.

Commonly these units are not differentiated from adjacent units above and below on the geologic reference maps, and so may or may not be differentiated on the accompanying map of Elko County localities.

Thicknesses of these units, or the more useful parts of them, range from "several hundred feet" to about 1,524 m (5,000 ft), and the areal extent of surface exposure is good to excellent. The relative areal extent of surface exposures of each geologic unit ranges from moderate to large.

Elko County is moderately well studied geologically, so some information is available in published literature on nearly all localities. The single most useful report on the county is by Stewart and Carlson (1974). It contains a geologic map at a scale of 1:500,000 (5.0 km/cm, or about 8 mi/in.) and its explanation, although there is no descriptive text.

Elko County constitutes the northeasternmost county of Nevada. It has a total area of 44,452 km^2 (17,163 mi^2), and a 1970 population of 13,958 (Rand McNally, 1977). The county seat is the town of Elko, with a 1970 census of 7,621. The community is situated somewhat southwest of the center of the county, adjacent to two of the localities and 55 km (34 mi) or more from the others. The town is on U.S. Interstate Highway 80 and U.S. Highway 40, plus State routes 46 and 11. It is oriented to local service in an area of cattle ranches and some active mines, and to the needs of highway travelers. As of 1970 (Lockard), one natural-gas pipeline reached Elko from the west, and another crossed the northwest corner of the county. Power lines that carry from 14,000 to more than 80,000 V ac serve Elko and some of the northeastern parts of the county.

The entire county is represented on parts of four topographic maps published by the USGS. These maps are at a scale of 1:250,000, or 2.5 km/cm (about 4 mi/1 in.) with a contour interval of 200 ft. The maps are listed following the Reference list.

EL-1: Independence Mountains Locality

Locality EL-1 in northwestern Elko County is partly in the northern Independence Mountains and partly in the mountainous terrain north thereof, yet south of the Idaho boundary. The locality consists of two parts: A, the northern, and B, the southern. Part B is situated on both flanks of the Independence Range, and part A is 17 km (11 mi) north of part B.

Geographic location: Part A is nearly rectangular and trends east-west. Its northeast corner is at lat 41°53' N., long 115°51' W., and the southwest corner is at lat 41°52' N., long 116°04' W. Part B is roughly oval and trends north-south. Its northern extremity is at lat 41°43' N., long 115°59' W.; its southern extremity is at lat 41°28' N., long 116°04' W. In land-survey terminology the NE corner of Part A is in the (unsurveyed) NW 1/4 sec. 14, T. 46 N., R. 54 E., and the southwest corner is in the SW 1/4 sec. 19, T. 46 N., R. 53 E. The northern extremity of part B is in the NE 1/4 sec. 15, T. 44 N., R. 53 E., and the southern extremity is in the NW 1/4 sec. 7, T. 41 N., R. 53 E.

Idaho-Nevada boundary is 8 km (5 mi) north from the nearest part of the locality boundary.

The locality is represented on parts of topographic maps at different scales; these maps are listed following the Reference list.

Approximate area: Part A of Locality EL-1 is about 17 km (11 mi) long by an average width of about 4 km (3 mi); thus the area is about 67 km^2 (26 mi^2). Of this an estimated 35 percent is exposed bedrock, but the extent of clay-rich rock is not determined. Part B is 28 km (17 mi) long, by a maximum width of 16 km (10 mi), or an estimated area of 223 km^2 (86 mi^2). About 75 percent of this part is estimated to be underlain by exposed bedrock, but the extent of clay-rich rock is not determined.

The total area of the locality is thus about 290 km^2 (112 mi^2), and an estimated 80 percent is exposed bedrock that consists in pa t of clay-rich rock; the extent of such rock has not been determined.

Land ownership: A map by Lutsey and Nichols (1972) shows the ownership subclasses of land in Locality EL-1, and within a 40 km (25 mi) radius of the locality boundary for the State of Nevada. A somewhat similar map (USBLM, 1965) covers that part of the vicinity that lies within the adjacent State of Idaho.

The Lutsey and Nichols (1972) map indicates that the western one-third of part A lies within the Duck Valley Indian Reservation. The remainder of part A is within the boundary of the Humboldt National Forest. The boundary of part B lies mainly within the same segment of that forest, but an estimated 52 km^2 (20 mi^2), or roughly 30 percent of the area of part B, is privately owned lands. It constitutes about 70 blocks, which range in size from about 0.7 to 5 km^2 (0.3 to 2.0 mi^2) in area. In addition, four blocks of Federal public land lie within the boundary of part B. These total about 5 km^2 (2 mi^2) in area. In addition, two blocks of withdrawn land, one a quarter section, the other an area of 6.5 sections, lie 7 km (5 mi) east of the boundary of part B.

Land controlled by the State of Nevada essentially constitutes four major stock driveways near the locality. One, on the west is 7 km (4 mi) from the western boundary of part B. The head of another driveway is 12 km (7 mi) south of the southern extremity of part B. Two other driveways are east of part B; the nearest of them is 14 km (9 mi) from part B.

Beyond the boundaries of parts A and B, yet within a radius of 40 km (25 mi), are extensive privately-owned land holdings. These are in part checkerboarded or scattered, and in part contiguous. Most of the intervening space in the checkerboarded and scattered area is Federal public land or is the stock driveway land mentioned above.

The USBLM (1965) map of Idaho indicates that within the 40 km (25 mi) radius of Locality EL-1 about 202 km^2 (78 mi^2) belong to the Duck Valley Indian Reservation, 12 small blocks of land totaling about 117 km^2 (45 mi^2) are inferred to be privately owned, and about 32 scattered blocks totaling 135 km^2 (52 mi^2) are controlled by the State. The remainder, about 1,647 km^2 (636 mi^2) is Federal public domain.

Accessibility: State Route 51 traverses the western one-third of part A and crosses the vicinity of the locality from north to south. The route is roughly parallel to the eastern side of part B, at a distance of about 7 to 20 km (5 to 12 mi). State Route 11 is west of the locality, 6 to 15 km (4 to 9 mi) from part A, and 0.16 to 10 km (0.1 to 6 mi) from part B. State Route 11-A lies just within the northwest boundary of part B. Secondary roads are nearby, and unmapped trails accessible by 4-wheel-drive vehicles are likely to exist.

A powerline from Idaho to the Mountain City area (Lockard, 1970) carries 50,000 to 80,000 V ac, and lies about 5 km (3 mi) south of the southeast corner of part A. Railroads and all other transmission lines are more than 40 km (25 mi) from the locality.

Remoteness: Ten places are mapped (Lutsey and Nichols, 1972; USBLM, 1965) within 40 km (25 mi) of the boundary of part A or of B of Locality EL-1. Only five of these are reported (Rand McNally, 1977) to have a 1970 census population; they are as follows:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Jarbidge, Nev.	30	35	22	E	SE cor., part A
Mountain City, Nev.	70	4	3	S	center, part A
Owyhee, Nev.	500	8	5	NW	NW cor., part A
Tuscarora, Nev.	50	21	13	SW	S extremity, part A
Riddle, Idaho	25	37	23	N	center, part A

Geologic setting: The Independence Mountains constitute a distinct range from just north of Carlin, in Elko County, northward to the headwaters of the North Fork, Humboldt River. Part B of Locality EL-1 is located mainly in this range. Farther north are scattered peaks and ridges that include The Mahoganies. Part A and the northern part of B are located in this terrain. The Independence Range itself is part of the Basin and Range province, and the general characteristics of the range are similar to other ranges in that province. The northern end of the range marks the northern margin of the province. The rugged but irregular terrain to the north is included in the adjacent Owyhee Upland, a part of the

Columbia Intermontane Plateau. The Owyhee Upland is essentially a dissected, structurally domed plateau in which lava flows of acidic composition are common. Where these have been removed by erosion, sedimentary and igneous rocks might be exposed.

The Independence Mountains Locality is underlain extensively by the Schoonover Formation, which is divided (Fagan, 1962) into 10 members. These members are named and can be numbered consecutively from the base unit upward. Of the 10 members, 2 might be included here.

The Dorsey Creek Member, subunit 2 of the formation, consists of two facies. One is a thinly bedded claystone, interbedded with scattered thin beds of chert, sparse beds of quartzose silt, and a few thin flows of amygdaloidal lava. This facies grades laterally into the other facies, which is composed dominantly of successive lava flows interbedded locally with volcanic agglomerate. The member is reported to be 198 m (650 ft) thick.

The Frost Creek Member is subunit 7 of the series. It also consists of two facies, but these are vertically gradational from one to the other. The lower facies consists of interlayered chert beds and clay-rich beds plus beds of siltstone. This facies grades upward into a facies of more attractive lithology which consists of thin-bedded to fissile claystone. The thickness of the member is believed by Fagan (1962) to be less than 198 m (650 ft), although it appears to be thicker because of folding.

In the Owyhee Quadrangle, the area within part A is underlain in part by the Upper Mississippian Banner Formation, containing a black slate member, and the Carboniferous(?) Mountain City Formation, largely a quartz-muscovite-biotite schist. A cross section suggests considerable thickness for the latter formation.

Hydrologic setting: Part A of Locality EL-1 is in the Owyhee River ground-water system and drainage basin. The river flows through west-central part A. Although the Owyhee River probably receives some ground-water influx within part A, discharge downstream in Duck Valley, about 10 km (6 mi) northwest of the center of the part is larger and more significant. Wells pump ground water for domestic supplies in Duck Valley, and streamflow, related closely to the ground water, is used for livestock and irrigation.

Part B of Locality EL-1 is predominantly in the South Fork, Owyhee River, and the Owyhee River ground-water system and drainage basin. About one-tenth of the eastern part of B drains to the North Fork Humboldt River, and is in Humboldt River basin ground-water system. Discharge occurs, less than 1 km (0.6 mi) from the southern outcrop, in Independence Valley, which is drained by the South Fork Owyhee River. Sufficient ground-water discharge occurs in the eastern one-third of segment B to support perennial flow in several streams, including the North Fork Humboldt River. The water is used in the region mainly for domestic, livestock, and irrigation purposes.

Mineral-resource activity: A map that shows active mines in Nevada (Payne and Papke, 1977) is available, but no similar map is readily available for the State of Idaho.

No active mines are located within either part of Locality EL-1. About 19 km (12 mi) southeast of the southeast corner of part A is an active tungsten mine; a single silver mine is located 6 km (4 mi) south of that mine, and a gold mine is 4 km (2 mi) southeast of it. One active silver mine is located 9 km (5 mi) west-southwest of the northern extremity of part B, and one barite mine is 7 km (5 mi) south-southeast of the southern extremity.

Garside and Schilling (1977) show locations of three oil-test holes that have been drilled outside the boundary of Locality EL-1. The nearest of two adjacent holes located on either side of State Route 11-A is 8 km (5 mi) from the western boundary of part B. One hole had shows of oil and natural gas; the other is reportedly abandoned. The third test hole is located 25 km (16 mi) southeast of the southern extremity of part B; it, too, is reportedly abandoned.

No patented mining claims are located in either part of Locality EL-1, but there are several such claims nearby. Most lie within a belt that extends from just north of Mountain City, thus about 5 km (3 mi) south of the center of part A, southwestward to a point about 28 km (17 mi) southwest of the southern extremity of part B. This belt includes (Lutsey and Nichols, 1972) 12 individual patented claims, plus 5 small blocks of claims. Another block of claims plus two individual claims is at Tuscarora, 21 km (13 mi) west-southwest of the southern extremity of part B, one claim is 14 km (9 mi) and two claims are 34 km (21 mi) northeast from the easternmost point on the boundary of part B. A moderately large block of claims is located at Jarbidge, 35 km (22 mi) east of the eastern extremity of part A, and two small blocks are 18 km (11 mi) southeast of that extremity. Other claims are more than 40 km (25 mi) from either part.

EL-2: Wild Horse Locality

Locality EL-2 is located in north-central Elko County in mountainous terrain that lies east of Wild Horse Reservoir and the community of Wild Horse, and west of the community of Charleston. The locality consists of a single part.

Geographic location: The small, somewhat dumbbell-shaped locality trends approximately east-southeast. Its approximate center is at lat 41°42' N., long 115°41' W. In land-survey terminology this point is in the SE 1/4 sec. 17, T. 44 N., R. 56 E. The entire locality lies within T. 44 N., R. 6 and 7 E.

The Idaho-Nevada boundary is 28 km (18 mi) north from the nearest part of the locality boundary.

The locality is represented on topographic maps at two scales; these maps are listed following the Reference list.

Approximate area: The locality is about 15 km (9 mi) long by an estimated average width of 7 km (5 mi) wide, and has a total area of about 117 km^2 (45 mi^2). Of this, perhaps 25 percent is exposed bedrock, and of this an estimated 75 percent is probably clay-rich rock.

Land ownership: A map showing subclasses of land ownership in Nevada (Lutsey and Nichols, 1972) is published, and a somewhat similar map (USBLM, 1965) is available for the adjacent State of Idaho and covers that part of the vicinity that lies within that State.

Within the locality boundary (Lutsey and Nichols, 1972) an estimated 80 km^2 (31 mi^2) is privately-owned land, 3 km^2 (1 mi^2) is Federal public land, 10 km^2 (4 mi^2) is in the Humboldt National Forest, and 4 km^2 (2 mi^2) is stock driveway controlled by the State of Nevada.

Within a distance of 40 km (25 mi) from the locality boundary, and within Nevada, roughly 40 percent of the land is in the Humboldt National Forest. Part of that forest area includes the Jarbidge Wilderness, the western boundary of which is 14 km (9 mi) east of the locality boundary. About 20 percent of the vicinity is privately-owned, and is in scattered, checkerboarded, or contiguous holdings. Another estimated 20 percent is Federal public land, interspersed with the private land. Nearly 10 percent of land in the vicinity is within the Duck Valley Indian Reservation. The southeast corner of this reservation is 18 km (11 mi) from the locality boundary. Of the remainder, 19 km^2 (8 mi^2) constitutes two blocks of withdrawn land, and about 194 km^2 (75 mi^2) is in four stock driveways under State control.

The USBLM (1965) map indicates that approximately 660 km^2 (255 mi^2) of the vicinity within a radius of 40 km (25 mi) of the boundary of EL-2 lies within the adjacent State of Idaho. Of this, about 80 percent is Federal public land, 8 percent is part of the Duck Valley Indian Reservation, 6 blocks totaling about 44 km^2 (17 mi^2), or 6 percent, is private land, and 14 checkerboarded blocks totaling 36 km^2 (14 mi^2), or about 5 percent, is controlled by the State of Idaho.

Accessibility: Nevada's State Route 51 is 4 km (3 mi) west of the locality, and Routes 11 and 11-A are 35 km (22 mi) and 16 km (10 mi) west, respectively. One secondary road that leaves State Route 51 is 2 km (6 mi) north of Wild Horse and traverses the locality in a north-northeast direction. A second secondary road locally lies 9 km (6 mi) to the south,

and a third lies 8 km (5 mi) to the east of EL-2. Except for the second of the three secondary roads, all the above roads extend northward into Idaho. In Idaho a fourth secondary road extends southward to about 3 km (2 mi) from the Nevada boundary, and is thus 31 km (19 mi) from the locality. Scattered trails are present, and unmapped trails accessible by 4-wheel-drive vehicles might be available.

No railroad, or petroleum or natural-gas pipeline is within 40 km (25 mi) of the locality (Lockard, 1970), but a single powerline that extends from Idaho south to Jarbidge and west to the Mountain City area is about 11 km (7 mi) from the locality boundary. The line carries from 50,000 to 80,000 V ac.

Remoteness: Eight places in Nevada are mapped (Lutsey and Nichols, 1972) within a distance of 41 km (26 mi) of the locality; none lie within the locality or in Idaho. Of the eight, only three have a population reported in the 1970 census (Rand McNally, 1977). They are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Jarbidge, Nev.	30	23	14	NE	NE boundary
Mountain City, Nev.	70	20	12	NW	NW extremity
Owyhee, Nev.	500	36	22	NW	NW extremity

Geologic setting: Like the northern part of Locality EL-1, the Wild Horse Locality is situated in the Owyhee Upland, a part of the Columbia Intermontane Province. The upland is a dissected, structurally domed plateau in which lava flows of acidic composition are common. Where these have been removed by erosion, sedimentary and other igneous rocks can be exposed.

Coash (1967) has mapped and described the Poorman Peak Formation in the Mt. Velma quadrangle. In a measured section in secs. 10 and 11, T. 44 N., R. 55 E., he found two subunits of shale in a series of 13 subunits he designated numerically from the base upward; the total thickness of the entire section is 1,177 m (3,860 ft). The basal subunit, composed of alternating beds of shale and chert, is approximately 305 m (1,000 ft) thick. The sixth subunit is a black shale approximately 305 m (1,000 ft) thick. As the formation is cut by faults, true thicknesses are not known.

Hydrologic setting: Locality EL-2 is in Owyhee River and Bruneau River ground-water systems and drainage basins. Significant ground-water discharge occurs within the locality along Penrod and Hay Meadow Creeks, perennial streams that empty into Wild Horse Reservoir located 5 km (3 mi) west-southwest of the southwestern boundary of the locality. Ground water and closely related surface water is used in the region primarily for irrigation, livestock, and domestic purposes.

Mineral-resource activity: From Payne and Papke's (1977) map for Nevada, it appears that one active mine producing gold lies just within the locality boundary. An active mercury mine nearby is just north of the boundary, and an active tungsten mine is about 2 km (1 mi) north of the mercury mine. The only other active mines in Nevada within 40 km (25 mi) of the locality are: a silver mine about 31 km (19 mi) west of EL-2, and a barite mine about 35 km (22 mi) southwest. Patented lode-mining claims in Nevada are located mainly to the

northeast and northwest of EL-2. A block of claims is mapped (Lutsey and Nichols, 1972) at Jarbidge, 22 km (13 mi) northeast, with two single claims just south of there. Two small blocks of claims lie about 5 km (3 mi) north. Four small blocks of claims plus 13 individual claims constitute a belt that trends northeast and that lies about 21 km (13 mi) northwest of the locality.

Two petroleum and natural-gas test holes are located within 40 km (25 mi) of the locality boundary. They are 34 km (21 mi) southwest of the northwest extremity of the locality.

No map similar to the Payne and Papke (1977) map for Nevada is readily available for that part of the EL-2 vicinity that is in Idaho.

EL-3: HD Range Locality

Locality EL-3 is moderately large, very irregular in form, and consists of two parts that are located north and northeast of the town of Wells in northeastern Elko County. The more northern part, A, occupies a prominent saddle in the ridge that extends south from Knoll Mountain of the HD Range. Part B lies 15 km (9 mi) southwest of part A, and consists of three areas of exposed bedrock. One area is on Summer Camp Ridge, one in the Windemere Hills, and one is on the southern end of the Snake Mountains, just north of Wells. This range, called the Snake Range on the Wells quadrangle of the 1:250,000-scale topographic map series of the USGS, can be confused with a range of the same name about 185 km (115 mi) southeast in eastern White Pine County.

Geographic location: Part A is a small, narrow, elongate area of exposed clay-rich rock. The area trends north, and is centered at lat 41°32' N., long 114°41' W. Part B is very roughly triangular in shape; it is about 20.9 to 27.4 km (13 to 17 mi) on a side, and is centered at about the village of Melandco, at lat 41°17' N., long 114°49' W. Thus part A extends from the S 1/2 sec. 36, T. 43 N., R. 64 E., to the NW 1/4 sec. 30, T. 42 N., R. 64 E. The locations of the approximate extremities of part B are: northern, SE 1/4 sec. 27, T. 41 N., R. 63 E.; southeastern, SE 1/4 sec. 27, T. 39 N., R. 64 E.; southwestern, SE 1/4 sec. 15, T. 38 N., R. 62 E.

The locality is represented on topographic maps of two different scales; these maps are listed following the Reference list.

Approximate area: Part A is about 8 km (5 mi) long by an average width of 3 km (2 mi). Its area is thus approximately 23 km^2 (9 mi^2). Nearly the entire part is underlain by exposed clay-rich rock. Part B has an estimated area of roughly 228 km^2 (88 mi^2). Its maximum dimension is 30 km (19 mi), and the perpendicular dimension is 16 km (10 mi). Nearly half of this part is underlain by exposed clay-rich rock.

Thus, the total area of the locality is about 251 km^2 (97 mi^2), of which about 111 km^2 (43 mi^2) is exposed clay-rich rock.

Land ownership: Within a distance of 40 km (25 mi) of the locality boundaries, almost the entire area is equally divided between private land and Federal public land. Much of the land thus owned and controlled is checkerboarded, although some irregular areas of moderate size are entirely privately owned or entirely publicly controlled. South-southwest of part B about 15 km (9 mi) is the north end of a segment of the Humboldt National Forest. This segment, like the land around, is mainly a checkerboard pattern of mostly private land versus forest land. Finally, 54 km^2 (21 mi^2) of land constitute parts of two stock driveways supervised by the State of Nevada. One begins 7 km (4 mi) south of part B, and extends south; the other 27 km (17 mi) southwest and extends northwest.

Accessibility: U.S. Interstate 80 is from 5 to 10 km (3 to 6 mi) south of part B in the vicinity of Wells. North from Wells, U.S. Highway 93 traverses the middle of part B, and is about 7 km (4 mi) west of part A. A secondary road leaves U.S. 93 about midway between parts A and B, and leads northeastward. At the nearest point it is 6 km (4 mi) southeast of part A, and is about 7 km (4 mi) northeast of part B. An additional secondary road and a few trails extend into the locality along the lower slopes and valleys, but except in the Windemere Hills, none reach or cross exposure areas. Additional trails accessible by 4-wheel-drive vehicles may also be available.

Three railroad companies operate on trackage in the vicinity of Wells. One line extends north from Wells, approximately parallel and adjacent to U.S. 93; it traverses part B, and is about 10 km (6 mi) west of part A. Double and triple tracks extend east and west from Wells, and are as little as about 3 km (2 mi) south of part B.

Powerlines that carry from 50,000 to 80,000 V ac follow the rail lines and highways east and west from Wells, and are less than about 10 km (6 mi) from the southern boundary of part B. Another powerline extends north from Wells along U.S. 93, and so lies about 10 km (6 mi) west of part A. No petroleum or natural-gas pipelines are within 40 km (25 mi) of Locality EL-3.

Remoteness: Twenty places are mapped (Lutsey and Nichols, 1972) within 40 km (25 mi) of the locality boundaries. Of these only four had a 1970 census figure (Rand McNally, 1977); they are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Contact	15	23	14	N	north end, part A
Deeth	50	30	19	SW	SW corner, part B
Wells	1,081	6	4	S	SW corner, part B
Wilkins	15	5	3	N	north corner, part B

Geologic setting: Locality EL-3 lies within the Basin and Range province, and just south of the Owyhee Upland of the Columbia Intermontane Province. The geologic character of the locality is typical of most other ranges to the south, and is attributed mainly to thrust faulting and later block faulting. The latter raised elongate crustal blocks on their west side, tilting them downward to the east. Other faults have broken the main blocks so that their parts differ in shape, cross section, and attitude of the sedimentary rock layers in them.

One clay-rich rock unit is exposed in this locality. It is the Chainman Shale, and in some of the locality it is not differentiated from the overlying Diamond Peak Formation, a coarse-grained unit. The shale, which is poorly exposed in the HD Range, is described (Riva, 1970) as brittle, black, shale with some siltstone and a few thin interbeds of sandstone. The rock has been deformed and folded. Riva inferred its thickness to be "hundreds of feet." Oversby (1972) describes the unit in this area as containing thin beds of chert and small siliceous, argillitic nodules, plus a sandy limestone bed less than 1 m (3 ft) thick.

The formation is widely exposed in the Windemere Hills, where it is described by Oversby (1972) as fissile, black argillite, with sporadic beds of sandstone composed of quartzose chert. The thickness here he believes to be about 610 m (2,000 ft).

Hydrologic setting: Part A of Locality EL-3 is in the Thousand Springs Valley groundwater system and drainage basin. The nearest significant discharge is 18 km (11 mi) eastward at the confluence of the Thousand Springs and Rock Springs Creeks, where the water is used for domestic and livestock purposes.

Segment B of Locality EL-3 is in the Humboldt River basin, Thousand Springs Valley, and Independence-Clover Valley ground-water systems. Runoff flows to the Humboldt River, Thousand Springs Creek, and Independence Valley (or eastern Elko County). Discharge occurs within the segment along the upper reaches of the Humboldt River, where the water is used for domestic, livestock, and irrigation purposes. At Wells, Nevada, a short distance downstream, the ground water is used for public supply.

Mineral-resource activity: No active mines are located in this locality, and only two active mines are located within 40 km (25 mi) of it (Payne and Papke, 1977). One is a barite mine 26 km (16 mi) west of part A. The other is a tungsten mine about 15 km (9 mi) southwest of the southwestern extremity of the locality.

Patented lode-mining claims are located 16 to 28 km (10 to 18 mi) north of part A; four blocks of claims and one single claim in this group are situated just west of the village of Contact. An additional single claim is 13 km (8 mi) northeast of Contact.

Six widely scattered oil and gas-test holes have been drilled in the vicinity of EL-3; none are within its boundaries. The six holes range from about 3 to 39 km (2 to 24 mi) from the boundary, of part B, and are located in all four compass quadrants.

EL-4: Pilot Range Locality

Locality EL-4 is on the northeast flank of the Pilot Range in central eastern Elko County, and consists of one part. The locality is a very small, short, narrow area.

Geographic location: The approximate center of EL-4 is at lat 41°02' N., long 114°05' W. The locality extends from NW 1/4 sec. 28, T. 37 N., R. 70 E., to SW 1/4 sec. 1, T. 36 N., R. 69 E., and at the closest point is about 2 km (1 mi) west of the Utah-Nevada boundary.

The locality is represented topographically on maps at two different scales; these are listed following the Reference list.

Approximate area: This locality is about 6 km (4 mi) long, and 1 km (0.6 mi) wide. Thus its total area is about 5 km^2 (2 mi^2). The entire exposure area is believed to be underlain by clay-rich rock.

Land ownership: A map showing land ownership for Nevada (Lutsey and Nichols, 1972) is published; no similar map for Utah is available.

Private land, and Federal public land is well checkerboarded over about 90 percent of that part of Nevada that lies within 40 km (25 mi) of EL-4. In the southernmost part of the vicinity, land is wholly in the Federal public domain except for about 39 km^2 (15 mi^2) included in Wendover Air Force Range.

In Utah, the northwest corner of the Wendover Air Force Range is 29 km (18 mi) south-southeast of EL-4, and the Wendover Air Force Auxiliary Field is 5 km (3 mi) farther in the same direction. To the southeast of EL-4 35 km (22 mi) is the Bonneville Salt Flats Race Track. An estimated 90 percent of that part of the EL-4 vicinity that lies in Utah constitutes the western margin of the Great Salt Lake Desert; the remainder includes the Silver Island and Little Pidgeon Mountains, and the eastern flank of the Pilot Range.

Accessibility: U.S. Highway 40, Interstate 80, U.S. Highway Alternate 50, and the Western Pacific Railroad all pass through the town of Wendover; of these routes only U.S. Highway 50-A trends southwestward from the town, and thus is no closer than 32 km (20 mi) south-southwest of EL-4. The other routes trend northwest from Wendover and are about 22 km (14 mi) southwest of the center of the locality. Nevada Route 30 and trackage of the Southern Pacific Railroad lie 19 km (12 mi) north-northwest of the center of the locality. A secondary road is 3 km (2 mi) west of the southwest tip of the locality, and another about 34 km (21 mi) northeast passes through Lucin. Mapped trails are common in the vicinity, and other unmapped trails accessible by 4-wheel-drive vehicles probably are present.

Lockard (1970) shows that a powerline carrying 14,000 to 50,000 V ac from Utah passes through Montello, one branch extending to Cobre, another to the west flank of the Pilot Range; thus much of the line is within 23 to 26 km (14 to 16 mi) of EL-4. In addition a powerline adjacent to U.S. Highway 40 and carrying 50,000 to 80,000 V ac lies 19 km (12 mi) southwest of the locality.

No pipelines are reported by Lockard (1970) within 40 km (25 mi) of EL-4.

Remoteness: Wendover, Nevada, is 23 km (20 mi) south-southeast of EL-4 and in 1970 had a census population of 60 persons (Rand McNally, 1977). Wendover, Utah, just across the State boundary, had a population of 781 reported. Montello, with a population of 150 in 1970, is 23 km (14 mi) northwest of EL-4. Seven other mapped places in Utah and Nevada, that lie within a 40-km (25-mi) radius of the locality, had no populations reported in 1970.

Geologic setting: The geologic character of the Pilot Range is similar to that of most other ranges in the province. Here normal faulting has raised elongate crustal segments on the west side, tilting them downward to the east.

One rock unit, defined for the purpose of this report as a clay-rich rock, is present in the locality. The rock is believed to represent subunit G (O'Neill, 1968) of the McCoy Creek Group of Misch and Hazzard (1962), a thick sequence of metamorphosed clay-rich sediments. The rock consists mainly of greenish-gray slate and metasiltstone, and green to gray argillite, with about 23 m (75 ft) of black-and-white marble. Large crystals of chlorite, biotite, and epidote are present in the finer grained groundmass. The subunit is believed to be 348 m (1,140 ft) thick.

Hydrologic setting: Locality EL-4 is in the Great Salt Lake Desert ground-water system. Runoff flows to Pilot Creek valley and the Great Salt Lake Desert in Utah. The nearest significant discharge is 13 km (8 mi) south-southeast of the center of the locality, where the water is used for livestock and domestic purposes.

Mineral-resource activity: No active mining is present in Nevada within 40 km (25 mi) of Locality EL-4 (Payne and Papke, 1977). Two oil and gas exploratory holes were drilled about 27 km (17 mi) west-northwest, and northwest, of the locality. The former had a reported show of oil (Garside and Schilling, 1977). No similar map for the State of Utah is readily available.

EL-5: Spruce Mountain and Pequop Range Locality

Locality EL-5, located in central eastern Elko County, consists of three parts, designated A through C from north to south. Part A occupies the north end of the Pequop Range, part B lies on both flanks of the middle part of that range, and part C is on both the east and west flanks of Spruce Mountain. Parts A and B are separated by a distance of 11 km (7 mi) and parts B and C by 26 km (16 mi). The locality has a long, generally slim, somewhat sinuous shape.

Geographic location: Part A extends from about lat 41°09' N., long 114°34' W. to lat 41°01' N., long 114°34' W. Part B extends from lat 40°56' N., long 114°35' W. to lat 40°45' N., long 114°36' W. Part C extends from lat 40°38' N., long 114°51' W. to lat 40°32' N., long 114°48' W.

The northern and southern extremities of part A thus are in the SE 1/4 sec. 31, T. 38 N., R. 66 E., and the NE 1/4 sec. 12, T. 36 N., R. 65 E., respectively. The extremities of part B are in the SE 1/4 sec. 13, T. 35 N., R. 65 E., and the (unsurveyed) NW 1/4 sec. 13, T. 33 N., R. 65 E., respectively. The north end of part C is in the NE 1/4 sec. 28, T. 32 N., R. 63 E., and the southern end is in the NW 1/4 sec. 31, T. 31 N., R. 64 E.

The three parts of EL-5 are represented on topographic maps at three different scales. These maps are listed following the Reference list.

Approximate area: Part A, which is roughly triangular in shape, has an area of approximately 62 km^2 (24 mi^2). Part B, relatively longer and slimmer, has an area of 21 km^2 (8 mi^2). Part C has a total area of about 10 km^2 (4 mi^2). In each case, 90 to 95 percent of the part is underlain by an undivided geologic unit, but the extent of clay-rich rock is not determined.

Land ownership: The narrow width and the considerable length of EL-5 gives an oval shape to its vicinity, the area that lies within 40 km (25 mi) of the locality boundary. The northern half of this vicinity is about 90 percent a checkerboard of private land and Federal public domain (Lutsey and Nichols, 1972). The eastern margin of the East Humboldt Range segment of the Humboldt National Forest is 35 km (22 mi) west of the locality. Much of the forest land is also checkerboarded with private land. The small area remaining, about 39 km^2 (15 mi^2), constitutes a north-south livestock driveway. The southern half of the vicinity is about 95 percent Federal public land, with about 35 blocks of private land scattered about; only one of these is larger than about 10 km^2 (4 mi^2). The Ruby Mountains segment of the Humboldt National Forest occupies the westernmost part of the area, and two additional north-south livestock driveways, together with the eastern extensions of one, are at the southern end. The driveways are 6 km (4 mi) and 30 km (18 mi), respectively, from the southern end of part C.

Accessibility: U.S. Highway 40 and U.S. Interstate Highway 80 cross the southern portion of part A, and a secondary road crosses the middle portion of part B. U.S. Highway 93 lies west of the locality; the highway is 20 km (12 mi) northwest of part A, 29 km (18 mi) west of part B, and 7 km (5 mi) west of part C. State Route 11 is 33 km (21 mi) west of part B and 16 km (10 mi) northwest of part C. Other minor roads are numerous in the vicinity, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

Railroads lie 4 km (3 mi) northeast of part A, and 5 km (3 mi) east of part B, and 17 km (10 mi) southeast of part C.

Power-transmission lines carrying 80,000 V ac and more follow Federal highways east, west, and north from Wells. Thus, one line crosses the southern portion of part A; the line north is about 21 km (13 mi) northwest of part A and 37 km (23 mi) northwest of part B.

No pipelines are within 40 km (25 mi) of the locality.

Remoteness: No populated places lie within any part of the locality, but three are within 40 km (25 mi) of it (Rand McNally, 1977). Wells, the largest town, is 26 km (16 mi) from part A, and in 1970 had a population of 1,081. Montello, with a 1970 census population of 150, is 30 km (19 mi) northeast of part A, and Currie, with a 1970 population of 30 is 29 km (18 mi) south of part C. Eleven other mapped places in the vicinity of EL-5 had no population.

Geologic setting: The Pequop Range and Spruce Mountain are similar in geologic character to most other ranges in the Basin and Range province; normal faulting raised elongate crustal blocks on their west side, tilting them downward to the east. The southern part of the Pequop Range and Spruce Mountain apparently constitute two contiguous crustal segments.

One clay-rich rock unit, the Chainman Shale, is exposed in Locality EL-5, but on reference maps the unit has not been separated from the overlying Diamond Peak Formation. The Chainman Shale consists chiefly of shale interbedded with siltstone. Lithologic details differ locally, but the black rock is in places well indurated (argillitic?), fissile to nonfissile and from thinly bedded to thickly bedded. Sandstone and pebble conglomerate are locally interbedded. Thickness of the undivided unit also varies from place to place. Thorman (1970, plate II) indicates a thickness of about 905 m (2,970 ft) in the northern Pequop Range, and Robinson (1961) gives a thickness of 366 to 457 m (1,200 to 1,500 ft) for the central part of the range. In Spruce Mountain, Hope (1972) gives a figure of 762 m (2,500 ft).

Hydrologic setting: Segments A and B of Locality EL-5 are in the Independence-Clover and Goshute Valleys ground-water systems. Runoff flows to Goshute Valley and Independence Valley (of eastern Elko County). Discharge occurs as evapotranspiration in Independence Valley 8 km (5 mi) southwest of the center of part A and 5 km (3 mi) west of the center of part B. Ground water is used in Independence Valley principally for domestic and livestock purposes.

Segment C of Locality EL-5 is in Butte Valley and Independence-Clover Valley ground-water systems. Runoff flows to Butte and Clover Valleys. Discharge occurs by evapotranspiration in northern Butte Valley, 11 km (7 mi) southwest of the center of the segment. Ground water is used in northern Butte Valley mainly for domestic and livestock purposes.

Mineral-resource activity: Active mines are shown (Payne and Papke, 1977) at two places near the locality. One is about 8 km (5 mi) southwest of Wells and 37 km (23 mi) west of part A of the locality; the other is about 16 km (10 mi) northeast of Currie and 24 km (15 mi) southeast of part C. Tungsten is mined near Wells and copper, molybdenum, silver, and gold near Currie. A block of patented lode-mining claims is near the center of

part C, and six single claims are nearby. Two other single claims are located 30 km (19 mi) southeast of part C.

Seven exploratory boreholes have been drilled for oil and gas within 40 km (25 mi) of the approximate centers of the three parts of the locality (Garside and Schilling, 1977). Two of these holes, about 27 km (17 mi) north and northeast, respectively, of part A, reportedly had oil shows, and the other five widely scattered holes are reported as abandoned.

EL-6: Pinon Range Locality

Locality EL-6 is located just southwest of Elko in southwest Elko County. The locality occupies parts of both flanks of the Pinon Range, and both flanks of the northern part of the Sulphur Spring Range, which extends into Elko County from adjacent northern Nye County. EL-6 consists of a single part; it is large, long, extremely irregular, and somewhat doglegged in general shape.

Geographic location: The northern extremity of EL-6 is at lat 40°50' N., long 115°47' W. The western extremity, the outside angle of the dogleg, is at lat 40°37' N., long 116°07' W. The southern extremity is at lat 40°10' N., long 116°00' W. These extremities are located on land-survey maps as follows: northern extremity, SE 1/4 sec. 28, T. 34 N., R. 55 E.; western extremity, SE 1/4 sec. 34, T. 32 N., R. 3 E.; southern extremity, NE 1/4 sec. 4, T. 26 N., R. 53 E.

The topography of the locality is represented on parts of maps at three different scales. These maps are listed following the Reference list.

Approximate area: EL-6 is about 81 km (50 mi) long and from less than 2 km (1 mi) to as much as 14 km (9 mi) wide. The total area is estimated at approximately 647 km^2 (250 mi^2). Of this an estimated 65 percent is exposed bedrock containing in part clay-rich rocks. The extent of the exposed bedrock area that is clay-rich is not known.

Land ownership: The vicinity of Locality EL-6, determined by the length and width of EL-6 plus a radius of 40 km (25 mi) from the locality boundary, is approximately oval in shape. Within this vicinity, land use is highly varied. The vicinity adjacent to the northern four-fifths of the locality is notable for a widespread checkerboard of private land with Federal public land (Lutsey and Nichols, 1972). West of the locality this checkerboard encloses scattered large areas of wholly private land; east of the locality are comparable large areas of enclosed wholly Federal public land. Also east of the locality at a minimum distance of 14 km (9 mi) is the moderately small southern segment of the South Fork Indian Reservation. The smaller northern segment of the reservation consists of five separate blocks of land that together constitute 12 km^2 (5 mi^2) located 4 km (2 mi) east of the northern part of EL-6 and 8 km (5 mi) north of the southern segment. The western boundary of the Ruby Mountains segment of the Humboldt National Forest is 24 km (15 mi) east of Locality EL-6.

The vicinity adjacent to the southern one-fifth of the locality is mainly Federal public land, with about 50 scattered blocks of private land plus four blocks of withdrawn land that total about 4 km^2 (2 mi^2). The Ruby Lake National Wildlife Refuge is 38 km (24 mi) east of the south end of the locality. Scattered about the entire vicinity are parts of seven extensive State-controlled livestock driveways. These mainly trend north-south, but in part trend northwest-southeast.

Accessibility: Locality EL-6 lies just south of the Humboldt River valley, which constitutes a major east-west transportation corridor. Within the corridor are various highways, two railroads, power transmission lines, and a pipeline. All these facilities generally lie within about 2 to 5 km (1 to 3 mi) of the nearest point along the EL-6 boundary. The major highways present are U.S. Interstate Highway 80 and U.S. Highway 40,

which are in part combined. The powerline, which carries from 50,000 to 80,000 V ac, ties a generating station at Elko to another at Wells and to points beyond. Two subsidiary powerlines carry from 14,000 to 50,000 V ac; one extends northwestward from Elko, the other southeastward from Elko 27 km (17 mi) to Lemoille; it is as little as 3 km (2 mi) from EL-6. The pipeline carries natural gas, and extends from the west to Elko. State Route 46 extends southeastward from Elko, and at the nearest point is 5 km (3 mi) from EL-6. State Route 11 heads northwest from Elko, and is as close as 3 km (2 mi) to EL-6. A southerly extension of Route 11 leaves the corridor at Halleck, northeast of Elko and is 30 km (19 mi) from the northeast end of the locality. State Route 51 in adjacent Eureka County trends north-south, and is from 3 to 5 km (2 to 3 mi) west of the locality. A secondary road extends across the northern part of EL-6, and local roads are present. Unmapped trails, some perhaps accessible only by 4-wheel-drive vehicles, probably are present.

Remoteness: Eleven places are mapped (Lutsey and Nichols, 1972) within 40 km (25 mi) of Locality EL-6; five of these had populations reported (Rand McNally, 1977) in the 1970 census:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Elko	7,621	2	2	N	NE extremity
Carlin	1,313	5	3	NW	NW edge
Beowawe	100	30	19	W	W edge, northern part
Lamoille	40	24	15	E	E edge, northeast part
Halleck	25	31	19	NE	NE extremity

Geologic setting: The Pinon Range and Sulphur Springs Range are similar geologically to most other ranges in the Basin and Range province. Normal faulting raised elongate crustal blocks on their west side, and tilted them downward toward the east.

Within this locality there are four bedrock units that can be defined as clay-rich for this report and each of them is present in sufficient thickness to warrant further consideration. The units are the Chainman Shale, the Webb Formation, the Woodruff Formation, and the informally named argillite unit of Lee Canyon of Smith and Ketner (1975).

The Chainman Shale in this locality is more coarsely grained than it is farther east (Smith and Ketner, 1975). The rock consists mainly of shale, mudstone, and siltstone, with thin interbeds of sandstone and limestone. The shale, mudstone, and siltstone are mainly very carbonaceous, gray, soft, locally micaceous, and locally nonfissile. These beds include pebbly mudstones, representing the deposits of mudflows and density currents. In the deposits the pebbles are also composed of claystone, mudstone, or siltstone. The beds are locally metamorphosed to a siliceous argillite.

The interbeds of sandstone are lenticular and thinly layered, ranging from 1.3 to 15 cm (0.5 to 6 in.) in thickness, but constituting individual beds as much as 31 m (100 ft) or more thick. The rock is composed of quartzite or quartzitic material, plus chert, clay, and micaceous material. These beds constitute at least as much as 15 percent of the section locally.

The interbeds of limestone include layers of sandy limestone and calcareous sandstone. They are generally less than 0.4 m (1 ft) thick, constitute less than 1 percent of the section, and locally display coatings and fracture fillings of solid bitumens.

Smith and Ketner give no thickness for the Chainman Shale but indicate a composite thickness of 1,904 m (6,245 ft) for the undivided Chainman Shale and Diamond Peak Formation. The Chainman Shale overlies the Webb Formation. A measured section of the Chainman Shale is shown in table 2.

Table 2.--Section of Chainman Shale in the NW 1/4 sec. 18, T. 31 N., R. 53 E., and S 1/2 sec. 12, T. 31 N., R. 52 E. (from Smith and Ketner, 1975, p. 48)

	Feet
Mississippian System:	
Diamond Peak Formation:	
Conglomerate	
Contact between Diamond Peak Formation and Chainman Shale is covered along line of section.	
Chainman Shale:	
15. Covered; probably gray shale; cover includes some gravel on ridge crest (same stratigraphic position as Chainman Shale at base of section S8).....	45
14. Shale, gray; weathers gray; very small amount of sandstone. A thin calcareous and sandy bed containing fossil fragments occurs 150 ft above base.....	220
13. Shale, gray; weathers gray; some beds are hard and black; very small amounts of sandstone and quartzite; uncommon layers of ferruginous siltstone 1/4 in. or less thick. Fossils occur in top 5 ft of unit; this fossiliferous zone contains scattered pebbles as much as 2 in. in diameter and is probably a pebbly mudstone; the shale is contorted as a result of penecontemporaneous sliding or slumping.....	255
12. Sandstone and quartzite and subordinate gray shale.....	110
11. Sandstone, tan, fine-grained with rounded quartz and angular gray chert grains; well cemented; slightly ferruginous.....	35
10. Shale, similar to that in unit 9, contains some sandstone but less than in unit 9.....	165
9. Shale, soft, gray; weathers to form soft gray slope; thin interbeds of fine-grained sandstone in beds generally 1/4-1/2 in. thick, some 2 in.; sandstone consists largely of quartz in sand and some silt-size grains, some angular chert grains and small flakes of mica; sandstone weathers tan and gray and reddish brown in places and forms platy fragments. Shale makes up most of unit, some thin beds are of ferruginous siltstone. Plant fragments were seen on bedding surfaces of some sandstone pieces; a poorly preserved goniatite was found in a loose piece of sandstone 65 ft above base of unit.....	200
8. Shale, soft, gray; weathers gray.....	85

	Feet
7. Shale, soft, gray; weathers gray; some coarse sandstone and some "mudflow" conglomerate or pebbly mudstone; upper 10 ft of unit lacks "mudflow" conglomerate but contains ferruginous sandstone.....	75
6. Sandstone, similar to that in unit 4, and conglomerate; some of conglomerate is mudflow type containing pebbles, cobbles, and boulders of brown limestone, of quartz- and chert-grain sandstone similar to that elsewhere in the section, and of chert, quartzite, and gray limestone; gray limestone clasts probably derived from Devils Gate Limestone [Middle and Upper Devonian].....	40
5. Shale, soft, gray; weathers gray; some "mudflow" conglomerate (pebbly mudstone) with well-rounded pebbles, cobbles, and boulders of sandstone, brown limestone, and chert. A lens of conglomerate about 12 ft thick and 30 ft long contains pebbles and cobbles of black and green chert and pebbles to boulders of gray limestone that probably were derived from the Devils Gate Limestone; largest limestone boulder is 1 ft in diameter.....	115
4. Sandstone (possibly subgraywacke), medium- and coarse-grained; composed chiefly of angular to subrounded black, tan, and green chert grains and fewer rounded quartz grains; also contains angular, mostly elongate, pebbles of gray chert and some fragments of black mudstone (similar to some mudstone in Webb Formation) and gray siltstone. Beds are 1 1/2-6 ft thick. Unit is a lens that extends about 900 ft along the strike...	45
3. Shale, soft, light-gray; weathers gray; shale breaks into small pieces, mostly less than 1/4 in. across; contains scattered pebbles in places. Basal 80 ft of unit contains subspherical to elliptical gray claystone nodules 1/2-2 in. across, some of which contain barite. Scattered grains of quartz in some shale layers. Thirty-five ft above base is a lens of sandstone made up of coarse-grained chert fragments.....	185
Total thickness of Chainman Shale.....	1,575
Contact between Chainman Shale and Webb Formation is gradational.	
Webb Formation:	
2. Shale, siliceous, dark-gray to almost black; weathers gray, brown, and bluish gray and breaks into plates 1/16-1/4 in. thick and 2 in. across. Unit is transitional into Chainman Shale.....	25
1. Mudstone, hard, siliceous, gray and tan and some black; weathers gray and tan; makes scree slope.....	12

The Chainman Shale is locally mapped (Smith and Ketner, 1975) as a separate unit composed mainly of shale and sandstone, but in places the Chainman is mapped as undivided from the overlying Diamond Peak Formation because shale, sandstone and conglomerate are about equally

prominent. The contact between the two units is gradational and interfingering, and so is not readily traceable. An exposed section of the Chainman Shale and the underlying Webb Formation, measured by Smith and Ketner, has been given.

The Webb Formation (Smith and Ketner, 1975) consists mainly of laminated to shaly, locally thin-bedded, mudstone and claystone, interbedded with limestone and thin layers of sandstone. The mudstone and claystone are gray to black, and contain angular grains about 0.05 mm (0.002 in) in diameter of quartz and chert that constitute about 10 percent of the rock. The limestone interbeds are in some cases marl, and form lenses from about 0.3 m (1 ft) to almost 61 m (200 ft) in thickness, and from approximately 1 m (3 ft) to 3 km (2 mi) in diameter. The rock is porous to dense, weak to strong, and thinly bedded to platy. The sandstone contains sparse rounded grains as large as 2 mm (0.06 in.) in diameter and is cemented by chert.

The Webb Formation at its type locality near the north edge of sec. 19, T. 31 N., R. 53 E. and in the SE 1/4 sec. 13, T. 31 N., R. 52 E. is believed to be 224 m (735 ft) thick, but in its northern exposures has a maximum thickness of at least 244 m (800 ft). This formation is overlain by the Chainman Shale; the contact varies locally from gradational to abrupt.

The Woodruff Formation consists of a considerable variety of rock types, but siliceous mudstone and chert are dominant. In the southern part of the locality, along the east side, a thick chert bed is underlain by 152 to 183 m (500 to 600 ft) of shale. The shale is gray to black, carbonaceous, and characterized by "pencil" cleavage. Farther north the shale (siliceous mudstone?) is interbedded with thinly layered chert, and the total thickness is about 914 m (3,000 ft).

A clay-rich unit informally named the argillite unit of Lee Canyon of Smith and Ketner (1975) is a local unit believed to be a correlative of the lower part of the Chainman Shale and the Webb Formation. The rock is a black, fine-grained, very carbonaceous, mostly homogeneous argillite composed mainly of silt-sized grains of quartz, plus about 10 percent clay minerals and less than 10 percent potassium feldspar. Pyrite, generally oxidized, is common along fractures, and in two thin sections diopside constituted 30 percent of the rock. Most beds are from 2 to several centimeters thick. Interbeds of conglomerate and quartzite are present. The conglomerate beds are as much as a "few feet" thick and 213 m (700 ft) across. The quartzite beds are composed of quartz and chert grains. An aeromagnetic survey by the USGS (Philbin and others, 1963; USGS, 1967) revealed that a pronounced large magnetic high underlies the outcrop of argillite and the surrounding area. This high is interpreted by D. R. Mabey of the USGS to indicate a large, buried intrusive body (Smith and Ketner, 1975, p. A39-A40). The argillite appears to have fault contacts. If there is no structural repetition of beds, the thickness of the unit is about 1,524 m (5,000 ft). No important repetition or omission of beds was observed, but the rock is cut by a few small faults.

Hydrologic setting: Locality EL-6 is in the Humboldt River basin ground-water system and drainage basin. Runoff flows to Pine Valley, Humboldt River, Dixie Flats, and Huntington Valley. Discharge occurs within 2 km (1 mi) of the northwestern and western edges of the area, into the Humboldt River and Pine Valleys. Water in these areas is used for public supply, domestic, livestock, and irrigation purposes.

Mineral-resource activity: Five active mines exist (Payne and Papke, 1977) within 40 km (25 mi) of Locality EL-6. Less than about 34 km (21 mi) northwest of Carlin, gold and some silver are being mined from three workings. Iron is mined 11 km (7 mi) west of the western edge of the locality near Palisade, Nevada. Gold and silver are mined about 39 km (24 mi) west of the western edge of the southern extremity of the locality.

A total of 22 holes have been drilled exploring for oil and gas (Garside and Schilling, 1977) within 40 km (25 mi) of Locality EL-6; 16 of these holes are from 8 to 33 km (5 to 21 mi) from the southern extremity of the locality, and one of these was being drilled in 1976. Six boreholes are in the Elko area, from 2 to 29 km (1 to 18 mi), from the town. Oil shows were reported for two of the exploratory holes, and oil and gas shows were reported for eight of the holes.

EL-7: Adobe Range Locality

Locality EL-7 is located in central Elko County and consists of two parts. Part A is an elongate area that trends northeast, and includes both flanks of the Adobe Range. Part B is a small elliptical area that occupies much of the Elko Hills, and is thus located about 10 km (6 mi) east of the northeast end of part A. The locality has a somewhat dogleg shape; it is long, moderately wide, relatively large, and is located just north of Elko.

Geographic location: The northern extremity of part A is at lat 41°10' N., long 115°40' W.; the southern extremity is at lat 40°47' N., long 115°58' W. The approximate center of part B is at lat 41°06' N., long 115°28' W.

In land-survey terminology the northern extremity of part A is in the SE 1/4 sec. 17, T. 38 N., R. 56 E.; the southern extremity is in the SE 1/4 sec. 35, T. 34 N., R. 53 E. The center of part B is at the SE corner sec. 7, T. 37 N., R. 58 E.

The locality is represented on topographic maps at two different scales. These maps are listed following the Reference list.

Approximate area: Part A is 51 km (32 mi) long and from about 2 to 10 km (1 to 6 mi) wide, with an estimated average width of about 8 km (5 mi). Thus its total area is about 414 km^2 (160 mi^2). Of this perhaps 90 percent is underlain by exposed bedrock containing clay-rich rock, but the extent of the clay-rich rock is not determined. Part B is 14 km (8 mi) long by a maximum width of 6 km (4 mi). Thus, its area is about 83 km^2 (32 mi^2). Of this about 60 percent is exposed bedrock which contains clay-rich rock; the extent of the clay-rich rock is not determined.

The total area is thus about 725 km^2 (280 mi^2), of which approximately 80 percent is underlain by exposed bedrock that contains clay-rich rock. A map by Ketner (1970) indicates that perhaps 57 km^2 (22 mi^2) of the locality is underlain by the Chainman Shale.

Land ownership: The vicinity of Locality EL-7, determined by a radius of 40 km (25 mi) from the locality boundary, is roughly oval in shape, and land ownership within it is highly varied. Most of the vicinity consists of a checkerboard pattern of private land and Federal public land (Lutsey and Nichols, 1972). Moderate to large irregular areas consist of holdings mainly by the one or the other, but contain small blocks of alternate ownership. Large areas of land in the Independence Mountains, Ruby Mountains, and the East Humboldt Range segments of the Humboldt National Forest lie within the vicinity, but these, too, are in part checkerboarded with privately-owned land. From the nearest part of the locality these segments are, respectively, 21 km (13 mi), 34 km (21 mi), and 26 km (14 mi). South-southeast of Elko are two segments of the South Fork Indian Reservation. The more northerly, checkerboarded segment is 17 km (10 mi) from the southern portion of part A, and the more southerly segment is 30 km (18 mi). Many generally connecting sections of land have been designated parts of seven different State-controlled livestock driveways; two of these actually traverse the locality, the others are in the vicinity. Two small blocks of land totaling 2 km (1 mi) in area have been withdrawn; they lie 13 km (8 mi) and 24 km (15 mi) northwest of part A.

Accessibility: Locality EL-7 lies just north of the Humboldt River valley transportation corridor. Lying within this corridor are U.S. Highway 40 and U.S. Interstate Highway 80, which in places are combined; two railroads; a power-transmission line; and a natural-gas pipeline. The powerline, which carries from 50,000 to 80,000 V ac, ties a generating station at Elko to another in Wells and to points beyond. Two smaller lines that each carry from 14,000 to 50,000 V ac are present also. One extends southeast from Elko to Lamoille, about 27 km (17 mi) distant; the other line extends northwest from Elko about 13 km (8 mi). The pipeline extends from the west to a terminus at Elko. All of these facilities are essentially parallel to one another, and quite consistently lie within about 2 to 5 km (1 to 3 mi) of the nearest points on the boundaries of parts A and B.

State Route 11 extends northwest from Elko, then north, crossing part A 13 km (8 mi) from its southern extremity. State Route 46 extends from Elko southeast and south, and at Elko is 10 km (6 mi) from the nearest point in part A. The southern extension of Route 11 turns south from the corridor at Halleck, about 11 km (7 mi) northeast of Elko, and at that point is 11 km (7 mi) from part A. Other secondary roads are present in the vicinity of EL-7, and unmapped trails, some perhaps accessible only by 4-wheel-drive vehicles, are probably present.

Remoteness: A total of 13 places where population might be concentrated (Lutsey and Nichols, 1972) are within 40 km (25 mi) of the locality, but only 5 had populations (Rand McNally, 1977) reported in the 1970 census:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Elko	7,621	8	5	SE	SE edge, part A
Carlin	1,313	14	8	SW	SW tip, part A
Wells	1,081	38	24	E	E edge, part B
Lamoille	40	32	20	SE	SE edge, part A
Halleck	25	11	7	S	S edge, part B

Geologic setting: The Adobe Range, like most other ranges in the Basin and Range province, is characterized locally by thrust faulting and later normal faulting. In addition, this range is broadly folded into a geosyncline that extends the entire length of the range.

Of three geologic units in the locality that contain significant quantities of shale and siltstone, only one, the Chainman Shale, is thick enough for further consideration. The Chainman Shale is described by Ketner (1970) as consisting mainly of black siliceous shale and sandstone composed mainly of chert grains, and as having an estimated thickness of at least 1,524 m (5,000 ft). The contact with the overlying Diamond Peak Formation is described as conformable and abrupt.

Hydrologic setting: Locality EL-7 is in the Humboldt River basin ground-water system. Runoff flows to the Humboldt River, North Fork Humboldt River, and Susie Creek.

The nearest significant discharge to the center of the A segment is 10 km (6 mi) southeast, near the Humboldt River. The nearest discharge to the center of the B segment is 5 km (3 mi) west, near the North Fork Humboldt River. The water is used in both segments for domestic, livestock, and irrigation; the water also is used in the valley of Humboldt River for public supply.

Mineral-resource activity: No active mines are reported within the locality (Payne and Papke, 1977), but eight are located within a radius of 40 km (25 mi). An iron mine is 32 km (20 mi) southwest of the southern extremity of part A, and three gold mines and one gold and silver mine are in a group about 34 km (21 mi) northwest of that extremity. Two clay mines are located to the north and northwest of the northern extremity of part A at distances of 38 and 35 km (23 and 22 mi), respectively, and a single tungsten mine is situated 35 km (22 mi) east of part B. Very few patented lode-mining claims are in the vicinity. A group of three are in the same approximate locality as the gold mines mentioned above, and may represent their locations; two others lie 13 km (8 mi) west of part A.

No exploratory oil and gas tests are reported within the locality (Garside and Schilling, 1977) but 11 holes have been drilled in the vicinity. Two of these are just west of, but adjacent to, Elko. The other nine have been drilled at distances ranging from about 8 km (5 mi) to 39 km (24 mi) in various radial directions from the nearest point on the boundary of part B. Three of the 11 holes are reported to have had shows of oil and gas.

EUREKA COUNTY

Two localities of clay-rich bedrock suitable for further investigation are situated in southeastern Eureka County. One, the Diamond Mountain Locality (EU-1), extends eastward into adjacent White Pine County. It is described in this section of the report as most of the locality is in Eureka County, and more geological information is available for that portion of the locality in Eureka County. The other locality is located wholly within Eureka County. Both localities lie north of the 39th Parallel of Latitude.

Strata that might be suitable for further investigation are assigned geologically to the Chainman Shale and Pioche Shale. These rocks are highly fissile to nonfissile, and in part contain some thin interbeds of sandstone. Argillitic and quartzitic rocks, the mildly metamorphosed counterparts of the sedimentary rocks, are locally present. Commonly these geologic units of interest are not differentiated on available maps from adjacent geologic units above and below. Thicknesses of the geologic units are known to range from at least 154 m (505 ft) for the Secret Canyon Shale to a maximum measured of 1,300 m (4,265 ft) for the Chainman Shale. The relative areal extent of surface exposures is moderate to extensive.

Data about the Pioche Shale and the Chainman Shale in the following pages is summarized from several geologic references and from geologic maps at differing scales of various parts of the localities. The single most useful report contains a geologic map of the entire county at a scale of 1:250,000 (2.5 km/cm, or about 4 mi/in.), prepared by R. J. Roberts, K. M. Montgomery, and R. E. Lehner (1967).

Eureka County is located in eastern-central Nevada. The county has a total area of 10,831 km^2 (4,182 mi^2) and a 1970 population of 948 (Rand McNally, 1977). Eureka, the county seat, had a 1970 population of 500 and is located in the southeastern part of the county approximately midway between two adjacent clay-rich bedrock localities. The town is situated on U.S. Highway 50 and State Highways 20 and 46. The community is oriented toward local service in an area of cattle ranches and generally inoperative mines in the nearby mountain ranges. As of 1970 (Lockhard), no railroad, powerline, or pipeline served the area.

Four contour maps of the 1:250,000-scale series published by the USGS represent the county. These maps are at a scale of 2.5 km/cm (about 4 mi/in.), and have a contour interval of 200 ft. The maps are listed following the Reference list.

EU-1: Diamond Mountains Locality

Locality EU-1 straddles the boundary between southeastern Eureka and western White Pine Counties, Nevada, and extends from just north of U.S. Highway 50 northward to the Elko County line. The locality is very elongate and narrow, and locally includes both the eastern and western flanks of the Diamond Mountains. EU-1 consists of a single part, and is assigned to Eureka County because of the proximity of the town of Eureka and the apparently somewhat greater accessibility of clay-rich bedrock on the western flank.

Geographic location.--The northern extremity of Locality EU-1 is at lat 40°08' N., long 115°42' W.; the southern extremity is at lat 39°25' N., long 115°42' W. These points are in the SE 1/4 sec. 14, T. 26 N., R. 54 E., and the NW 1/4 sec. 27, T. 18 N., R. 54 W.

The locality is wholly represented on topographic maps at two scales. The several maps are listed following the Reference list.

Approximate area.--The minimum width of the locality is about 2 km (1 mi), and the maximum is 6 km (4 mi); the estimated average width is 4 km (3 mi). As the length is about 81 km (50 mi), the area of the locality is about 389 km^2 (150 mi^2). An estimated 75 percent of the locality is exposed bedrock which is in part clay-rich rock, but the extent of clay-rich rock is not known.

Land ownership.--About 21 km^2 (8 mi^2) of private land are scattered as small blocks within the locality, and 23 km^2 (9 mi^2) of livestock driveway are in the western-central part. The remainder of land within the locality is Federal public land.

Within about 40 km (25 mi) of the locality boundary are many scattered blocks of private land. These blocks differ greatly in size, and to the north, sections of private land are checkerboarded with Federal public land. The south end of the Ruby Mountains segment of the Humboldt National Forest is 10 km (6 mi) east of the northern portion of EU-1. The south end of the Ruby Lake National Wildlife Refuge is 23 km (14 mi) east of the northern portion. The north end of the White Pine segment of the National Forest is 26 km (16.2 mi) southeast of the southern extremity. Two State-controlled livestock driveways lie west of and approximately parallel to the locality; one is in the Diamond Valley and extends south-southeast from the locality, the other is in the Sulphur Springs Range to the west. A third driveway starts at the Elko County line 6 km (4 mi) east of the northern extremity of EU-1 and trends north.

Accessibility.--The southern extremity of EU-1 is about 5 km (3 mi) north of U.S. Highway 50 which trends northwest to Eureka and beyond. State Route 46 leads north from Eureka along the western margin of the range, and another road lies along the east base, thus connecting U.S. 50 with Route 46. Local roads and trails extend up several canyons. and the range is crossed by two roads. Other unmapped trails accessible by 4-wheel-drive vehicles might be present.

Remoteness.--The town of Eureka in Diamond Valley is 15 km (9 mi) northwest of the southern extremity of EU-1; the town had a reported (Rand McNally, 1977) population of 948 in the 1970 census. One other place is mapped (Lutsey and Nichols, 1972) in the vicinity of EU-1 but it had no 1970 census population reported.

Geologic setting.--The geologic character of the Diamond Mountains is typical of most other ranges in the Basin and Range province. Normal faulting raised an elongate crustal block on the west side, and tilted it downward to the east.

Two clay-rich bedrock formations, the Chainman Shale and the Pilot Shale, are present at the ground surface in the locality. As only the Chainman Shale exceeds 152 m (500 ft) in thickness, it alone is described below.

The Chainman Shale is exposed as a broad belt as much as 2 km (1 mi) wide along the range from lat 39°30' N. to lat 39°57' N. (Nolan and others, 1971). Within that distance the formation forms the western margin of the range at its junction with the adjacent alluvial fans of the valley floor from lat 39°49' N. (near Walters Canyon) to lat 39°57' N. (near Judd Canyon). On the east side of the range, the formation is similarly accessible only between lat 39°33' N. and lat 39°34' N., the Sadler Canyon vicinity.

The Chainman Shale is composed here of two parts. The lower part consists mainly of somewhat brittle siltstone showing slaty ("pencil") cleavage, interbedded with a few thin layers of sandstone; the upper part is somewhat coarser grained and consists mainly of siltstone with a little pebbly mudstone, conglomerate, sandstone, and locally, shale. No distinct contact separates them. A measured thickness of the formation is reported as 1,300 m (4,265 ft) by F. G. Poole (written commun., 1978); no thicknesses for the two parts are reported.

Hydrologic setting.--The exposed clay-rich rock lies within the Diamond Valley, Newark Valley, and the Humboldt River basin ground-water systems. Surface runoff flows to the topographically closed Diamond Valley and Newark Valley drainage basins, and to Huntington Valley which is a north-flowing tributary of the Humboldt River. The nearest ground-water discharge points from south to north are:

1. Newark Valley Playa: 5 km (3 mi) east of Diamond Peak, the approximate center of the southern part of the locality.
2. Diamond Valley Playa: 5 km (3 mi) west of the approximate geographic center of the locality.
3. Huntington Valley: 31 km (19 mi) north-northeast of the north-central portion of the locality.

In all three discharge areas the ground water is used for irrigation, livestock, and domestic purposes.

Mineral-resource activity.--No active mines are situated within the Diamond Mountains Locality, but Payne and Papke (1977) show two active mines near its southern end. One produces gold from underground operations and is located 11 km (7 mi) northwest of the extreme southern end of the Diamond Mountains Locality in an unsurveyed area on the east flank of the Fish Creek Range, Eureka County. The other mine is situated 5 km (3 mi) northeast of the southern end of the locality, and produces lead and silver, and perhaps zinc and copper from underground.

Also within 40 km (25 mi), two small blocks of patented lode-mining claims and a single claim are west-northwest of the northern extremity; five claims are roughly 24 km (15 mi) to the east in the Bald Mountains area, and about 32 claims plus three blocks of claims encircle the southern extremity; these are mainly located just southwest of Eureka. Finally, a pair of single claims are on the western central flank of the range. None of the claims are situated within the locality.

Twenty-seven exploratory test holes for oil and gas have been drilled within 40 km (25 mi) of the locality. Fourteen are north and northwest of the northern extremity, one just west of the middle of the locality, and 12 are southeast and east of the southern extremity. Of the northerly group five reported shows of oil and gas, and one a show of oil. Of the southerly group two had shows of oil and gas, and two had shows of oil.

EU-2: Prospect Ridge Locality

Locality EU-2 is located in the southeastern part of Eureka County on the north end of the Fish Creek Range. The small, compact, roughly elliptical area extends from a point about 3 km (2 mi) northwest of the town of Eureka southeast 16 km (10 mi) to the mouth of Secret Canyon. The locality consists of one part.

Geographic location.--The approximate center of the small locality is lat 39°27' N., long 115°49' W. The northwestern extremity of the small locality is in the SW 1/4 sec. 3, T. 19 N., R. 53 W.; the southeastern extremity is in the NW 1/4 sec. 6, T. 17 N., R. 54 W.

The locality is represented topographically on maps of two scales; the several maps are listed following the Reference list.

Approximate area.--This locality is 17 km (11 mi) long, and has an average width of 6 km (3 mi); thus the approximate area is 86 km^2 (33 mi^2). An estimated 50 percent of the locality is exposed bedrock that contains clay-rich rock, but the extent of the clay-rich strata is not determined.

Land ownership.--Within the locality boundary there are two small blocks of private land that total about 2 km^2 (3/4 mi^2), and about 3 km^2 (1 mi^2) designated by Nevada as livestock driveway; the remainder is designated Federal public land.. Within 40 km (25 mi) of the boundary there are about 63 blocks of private land which range from very small to very large, and the remainder is Federal public land. From the southern extremity of EU-2 it is 26 km (16 mi) southeast to the White Pine Range segment of the Humboldt National Forest, and from the western part of the locality it is 32 km (20 mi) to the Monitor Range segment of the Toiyabe National Forest. Two State livestock driveways lie west of the locality. The nearest driveway heads within locality EU-1 and trends southwest, crossing the northern tip of locality EU-2. The second trends southward from the Sulphur Springs Range, which lies northwest of EU-2 and is about 19 km (12 mi) west of EU-2.

Accessibility.--The eastern margin of the locality lies as little as 2 km (1 mi) from U.S. Highway 50 and State Route 20, which trend north through Eureka. Local roads extend into the area, mainly from U.S. 50, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

No railroad, pipeline, or powerline serves the locality or the town of Eureka (Lockard, 1970), but power is generated locally in the community.

Remoteness.--The town of Eureka, which had a population of 948 in the 1970 census (Rand McNally, 1977) is 2 km (1 mi) east of EU-2. No other places are shown within 40 km (25 mi) of the locality.

Geologic setting.--The geologic character of the Fish Creek Range is typical of most other ranges in the Basin and Range province. Normal faulting raised an elongate crustal block on the west side, tilting it downward to the east.

Five clay-rich bedrock formations are present at the ground surface in the locality. They are the Pioche Shale, Secret Canyon Shale, Dunderberg Shale, Pilot Shale, and Chainman Shale. The Chainman Shale is believed (Nolan, Merriam, and Williams, 1956) to exceed 152 m (500 ft) in thickness and so is described in detail below. The lower of two members of the Secret Canyon Shale is reported to be 154 m (505 ft) thick locally and so is briefly

described also. Nolan, Merriam, and Williams also believe the Pioche Shale is perhaps 122-152 m (400-500 ft) thick, but that crumpling of shale and lensing-out of limestone layers makes detailed measurements questionable.

The Chainman Shale is exposed in small areas along the east side of the locality; the largest of these is about 3 km (2 mi) long by 3 km (2 mi) wide. Nolan, Merriam, and Williams (1956) describe the unit as composed of shale, with a few thin interbeds of sandstone. The formation is reported by these authors as having an "apparent thickness of about 5,000 feet," but they believe that it is actually "much less." A thickness of 1,300 m (4,265 ft) is reported by F. G. Poole (written commun., January 1978) 28 km (17 mi) north of Eureka near the Phillipsburg Mine in the adjacent Diamond Mountains (Locality EU-1), so a thickness of more than 883 m (2,896 ft) here seems reasonable. The great apparent thickness is probably caused by repetition of strata, a result of faulting and perhaps folding.

The lower of two subunits of the Secret Canyon Shale is exposed at various places in the locality. The type section of the formation is in the gap between the heads of Secret Canyon and Windfall Canyon. The areas of specific exposures are not reported. Wheeler and Lemmon (1939) describe the lower member as black, papery, argillaceous shale. The reported stratigraphic thickness of the unit is 154 m (505 ft) in a drill hole between the drifts of the Credo and Bowman Mines on the eastern edge of Adams Hill, 3 km (2 mi) west of Eureka.

Hydrologic setting.--The exposure is in the Newark Valley ground-water system and the Fish Creek valley drainage basin, tributary to Newark Valley. The nearest discharge point is 19 km (12 mi) south along Fish Creek. Ground water is used in Fish Creek valley for irrigation, livestock, and domestic purposes.

Mineral-resource activities.--Payne and Papke (1977) show two active mines in or near the Prospect Ridge locality. One produces gold from underground operations 6 km (4 mi) south-southwest of Eureka. The other mine is located near the western margin of T. 18 N., R. 55 E. (probably in the Alhambra Hills, N 1/2 sec. 30); it produces lead and silver, and perhaps zinc and copper. The location is about 11 km (7 mi) east of the southeastern end of the Prospect Ridge locality.

Five test holes for oil and gas have been drilled in the vicinity of EU-2. All are located in an arc from north-northeast to south-southeast of the locality center. Four were reported as dry, but one had an oil show.

LINCOLN COUNTY

Four localities of clay-rich rock suitable for further investigation lie within Lincoln County. Two others extend from Lincoln County southward several miles into Clark County, and a third extends northward into adjacent White Pine County a short distance. These three localities are described here because more information about them is available for Lincoln County, and the larger part of each locality is in Lincoln County. The localities are concentrated in a broad belt that extends north-south across the county.

Three geologic units present in this county are believed to be suitable for further investigation. The principal rock types are siltstone and shale, with interbedded sandstone, limestone, and chert. The several strata are assigned to the Chainman Shale, Patterson Pass Shale, and Pioche Shale. In some references these units are not differentiated from adjacent stratigraphic units above and below, and so may or may not be differentiated on the accompanying map of Lincoln County localities. Thickness of the three units ranges from about 183 to 645 m (600 to 2,115 ft). The relative surface extent of exposures of these units is from small to moderate.

Lincoln County has been moderately well studied geologically, and the amount of information available for the localities ranges from relatively little to considerable. Applicable references are listed in the Bibliography. Perhaps the single most useful report is that by Tschanz and Pampeyan (1970), which contains a geologic map at a scale of 1:250,000 (2.5 km/cm or 4 mi/in.).

Situated in east-central Nevada, Lincoln County has an area of about 27,581 km^2 (10,649 mi^2), and in 1970 had a population of 2,557 (Rand McNally, 1977). Pioche, the county seat, is located in the east-central part of the county on U.S. Highway 93; in 1970 it had a population of 600. U.S. Highway 93 traverses the county from north to south, with an east-west offset of several miles in the central part of the county. The offset segment is also part of State Highway 25, which trends mainly east-west. Railroad trackage owned by the Union Pacific Railroad Co. extends northward across the eastern part of the county from the southern boundary through the villages of Caliente and Panaca to Pioche.

Panaca is served by a power transmission line from Las Vegas that carries more than 80,000 V ac. Spur lines carrying 50,000-80,000 V ac serve Pioche and Caliente and other lines carrying 14,000-50,000 V ac supply mines in Ursine, Bristol Silver Mines, and the Highland Range (Lockard, 1970).

The county is represented on three contour maps of the 1:250,000-scale series published by the USGS. These topographic maps are at a scale of 2.5 km/cm (4 mi/in.) and have a contour interval of 200 ft. They are identified in the list of reference materials following the Reference list.

LI-1: Southern Egan Range Locality

Locality LI-1 is in the southern part of the Egan Range. It is mainly located in northern Lincoln County, but a very small part extends northward into adjacent White Pine County. That portion situated in White Pine County is included in this Lincoln County locality because of the continuity of exposure, remoteness from White Pine localities, and small areal extent. The locality consists of two small parts; both are situated on the eastern flank of the range. Together they constitute an elongate, slender locality.

Geographic location.--The north end of part A is located in White Pine County, and is at lat 38°42' N., long 114°54' W. The northern end of part A thus is 3 km (2 mi) northeast from the Lincoln County boundary along the trend of the locality. The south end of part B is at lat 38°20' N., long 114°59' W. In land survey terms, part A extends from sec. 28, T. 10 N., R. 63 E., southward to sec. 2, T. 8 N., R. 62 E.; part B lies within secs. 1, 12, 13, and 24, T. 6 N., R. 63 E.

Only that part of the locality which lies in White Pine County is not mapped in detail topographically; it is, however, represented on 1:250,000-scale topographic maps of the USGS. The several maps are listed following the Reference list.

Approximate area.--Part A is 14 km (9 mi) long by an estimated 1 km (0.7 mi) in average width, and thus has an area of about 15 km^2 (6 mi^2). Part B is 10 km (6 mi) long and has an estimated average width of 2 km (1 mi) and an estimated area of about 15 km^2 (6 mi^2). The total area is therefore about 31 km^2 (12 mi^2). About 90 percent of the total area appears to be exposed bedrock containing clay-rich rock. Probably nearly all of the exposed bedrock is clay rich.

Land ownership.--A total (Lutsey and Nichols, 1972) of about five quarter-sections of privately-owned land is partly underlain by shale in this locality. Four of the quarter-sections are located in White Pine County, one in Lincoln County, and all are in part A of the locality. The State of Nevada's Mount Crafton Scenic Area is 12 km (8 mi) east of part A, and the Wayne Kirch Wildlife Management Area is 6 km (4 mi) west of the north end of part B. The Grant Range segment of the Humboldt National Forest is 37 km (23 mi) west of part B, and the White Pine Range segment is 28 km (17 mi) northwest of part A. About 85 blocks of privately-owned land lie within 40 km (25 mi) radius of the locality; these vary considerably in size, and are mainly concentrated along drainages. All other land is Federal public land.

Accessibility.--Part A can be reached by trails from Shingle Pass Road, which joins State Route 38, located on the west side of the Egan Range, at a point 10 km (6 mi) north of the townsite of Sunnyside. Part B is 6 km (4 mi) east of, and parallel to, State Route 38, and 5 km (3 mi) west of two secondary roads that follow the west side of Cave Valley. Trails from both secondary roads extend toward the two areas of exposure, and other unmapped trails accessible by 4-wheel-drive vehicle may be available.

As of 1970 (Lockard), neither railroad line nor gas or petroleum pipeline, lay within 40 km (25 mi) of the locality.

One power transmission line carrying 80,000 V ac or more from Las Vegas into Panaca is about 33 km (21 mi) south-southeast from part B of the Egan Range locality at a point 12 km (8 mi) west of Panaca. A line carrying 50,000-80,000 V ac extends from Panaca north to Pioche;

from there lines carrying 14,000-50,000 V ac lead east of Ursine, and west across the Bristol Range to active mines. The nearest, most northerly, of these branches comes within 18 km (11 mi) of part B.

Remoteness.--In White Pine County the village of Lund, with a 1970-census population of 250 (Rand McNally, 1977) is 19 km (12 mi) north-northwest of part A, the townsite of Preston is 4 km (3 mi) farther in the same direction. The townsite of Sunnyside in northern Nye County, lies 5 km (3 mi) due west of part B; it had no population reported in 1970.

Geologic setting.--The geologic character of the Egan Range is typical of most other ranges in the Basin and Range province. Normal faulting has raised an elongate crustal block along the west side, and tilted it downward to the east.

Two clay-rich bedrock units, the Chainman Shale and the Dunderberg Shale, are exposed in the locality LI-1, but the Dunderberg Shale is too thin for further consideration.

The Chainman Shale in this locality (Kellogg, 1960) consists of two subunits. The upper subunit consists of black to olive-gray fissile shale with a few calcareous interbeds. Its thickness is 183 to 213 m (600 to 700 ft). The lower subunit is mudstone and platy shale, with a few thin black bands of chert at the base. The thickness of this subunit is 46 to 91 m (150 to 300 ft). Kellogg (1963) concluded the total thickness of the unit may be between 274 and 305 m (900 and 1,000 ft). He measured 273 m (897 ft) at the south end of part A, in sec. 2, T. 8 N., R. 62 E. In 1956 J. W. James reported to Kellogg a measured thickness of 305 m (1,001 ft) in the NE cor. sec. 1, T. 6 N., R. 62 E., the north end of part B. Kellogg thinks these figures might be questionable because of possible faulting.

Hydrologic setting.--Both parts of LI-1 are in the White River ground-water system. Runoff flows to Cave Valley and White River.

The nearest discharge is about 63 km (39 mi) west of the centers of both segments and along the White River channel. Ground water is used in this part of the valley for domestic and livestock purposes.

Mineral-resource activity.--No active mines are located within either part of the southern Egan Range locality (Payne and Papke, 1977). No inactive mining areas are known within 41 km (25 mi) radius of the locality, but four patented lode-mining claims are scattered about; three of them are located farther north in the Egan Range, and one to the southeast.

No oil fields lie within a 40 km (25 mi) radius of the locality (Garside and Schilling, 1977), but 17 reported dry holes, and 2 with reported oil shows, have been drilled within that distance. Four of the dry holes are within a distance of 6 to 8 km (4 to 5 mi) from the locality, and are in the floor of adjacent Cave Valley. All the other holes were drilled from 4 to 20 km (3 to 12 mi) away in the floor of the White River valley, which is adjacent on the west. Together the several scattered holes nearly surround the locality.

LI-2: Southern Schell Creek Range Locality

Locality LI-2 is situated on both sides of Patterson Pass and mainly on the crest and western flank of the southern part of the Schell Range, which the pass crosses. The small, relatively compact locality is roughly lenticular in general form and consists of a single part. It is located in central northern Lincoln County, immediately south of the White Pine County boundary.

Geographic location.--The locality is approximately at the intersection of lat 38° N. and long 114°44' W. Thus, it lies at the corner common to T. 8-9 N., R. 64-65 E. It extends north and south from this mid-point for a distance of about 9-10 km (6 mi). It is represented only on a single topographic map, listed following the Reference list.

Approximate area.--The locality is 21 km (13 mi) long and has a maximum width of 6 km (4 mi). Its elliptical area is about 40 km (25 mi). An estimated 50 percent of the locality is exposed bedrock containing clay-rich rock, but the extent of the clay-rich rock has not been determined.

Land ownership.--Within the locality boundary, the area south of Patterson Pass is Federal public land (Lutsey and Nichols, 1972). North of the pass most of the area is part of Nevada's Mount Grafton Scenic Area, which includes most of the range for a distance of 23 km (14 mi) northward from the pass and thus extends into White Pine County 8 km (5 mi). In the vicinity of LI-2, that is, within a radius of 40 km (25 mi) from the boundary, most of the land is Federal public domain. From the northern end of the locality it is 38 km (24 mi) north to the southern end of the Schell Creek Range segment of the Humboldt National Forest and 31 km (19 mi) northeast to the southern Snake Range segment. From the southern extremity it is 24 km (15 mi) west-southwest to the northeasterly end of the State of Nevada's Wayne Kirch Wildlife Management Area located near Sunnyside. Private land consists of about 88 blocks which vary in size; some are scattered, but others are concentrated along major drainage routes.

Accessibility.--Patterson Pass lies 6 km (4 mi) west of U.S. Highway 93 on a local secondary road that joins U.S. Highway 93 about midway between Pioche and Ely. Other than this road there are no mapped routes into LI-2; however, some unmapped trails accessible by 4-wheel-drive vehicles probably are present.

Remoteness.--The village of Lund, with a 1970-census population of 250 (Rand McNally, 1977) lies 32 km (20 mi) to the northwest of the locality. Preston and Sunnyside are places mapped, but no 1970 population is reported for them; both lie within the vicinity of LI-2.

Geologic setting.--The geologic character of the Schell Creek Range is typical of many other mountain ranges in the Basin and Range province. The range owes its existence mainly to normal faulting, which raised an elongate crustal block along its west side, and tilted it downward to the east. Patterson Pass apparently was caused by relative displacement along one such fault.

Five clay-rich bedrock units are exposed in that part of the southern segment of the Egan Range that is in Lincoln County. These units are the Chainman Shale, Kanosh Shale, Dunderberg Shale, Patterson Pass Shale, and Pioche Shale (Kellogg, 1963). Only the Chainman Shale and Pioche Shale are thick enough for further consideration.

The Patterson Pass Shale underlies the lower slope on the southern side of the pass, and chiefly on the western side of the range crest. The shale reportedly (Kellogg, 1963) consists of about 469 m (1,539 ft) of calcareous mudstone and shale interbedded with paper-thin laminae of limestone that increase in number upward. These overlie 178 m (584 ft) of shale and thinly bedded calcareous siltstone.

The correct total thickness of the Patterson Shale is not known. It may be about 644 m (2,113 ft) thick (Kellogg, 1963) but faulting within the formation may have caused repetition of strata giving a false apparent thickness.

The Pioche Shale underlies that part of the southern Schell Creek Range locality which lies north of Patterson Pass. Tschanz and Pampeyan (1970) described the rock as micaceous, sandy to clayey shale with a few interbeds of sandstone, and of limestone as much as 15 m (50 ft) thick. They report a thickness in this locality from 229 to 305 m (750 to 1,000 ft). They also report that Pioche Shale of this thickness is present in Cave Valley. There it is known in a mine, located in the NW 1/4 sec. 16, T. 9 N., R. 64 E., and is locally exposed. The locality is not included on the accompanying map as the ground-surface area is small.

Strata assigned to the Chainman Shale by Tschanz and Pampeyan (1970) are exposed in a valley on the western flank of the Schell Creek Range in the southern part of this locality. They do not indicate (p. 48) that a complete section is exposed here, but neither do they indicate the lithologic character or the thickness of what is exposed. Complete sections approximately 305 m (1,000 ft) thick are exposed in the southern Egan Range to the west, and in the Dutch John Mountain locality to the south. Although this exposure area thus may be lithologically attractive, the fact that the area is bounded by faults suggests the thickness present may be insufficient.

Hydrologic setting.--The LI-2 locality is in the Lake Valley and White River ground-water systems. Runoff flows to Lake Valley and Cave Valley drainage basins. Discharge occurs 8 km (5 mi) east of the center of the locality in Lake Valley. Ground water is used in Lake Valley for domestic, livestock, and irrigation purposes.

Mineral-resource activities.--Payne and Papke (1977) show that the nearest active mine as of 1976 is located 37 km (23 mi) southeast of Patterson Pass in T. 7 N., R. 68 E., where it produces gold and silver. Two patented lode-mining claims are 32 km (20 mi) northwest, and one is 39 km (24 mi) to the south of the locality.

Garside and Schilling (1977) indicate that oil shows were recovered in two oil-test holes about 30 km (19 mi) northwest of the pass. Fifteen other oil-test holes, reportedly abandoned, lie in an area of about 90° W. from the locality at various distances of not less than 14 km (9 mi) and within 40 km (25 mi).

LI-3: Dutch John Mountain Locality

Locality LI-3 is a small oblong area of irregular shape that consists of one part that occupies the saddle between Dutch John Mountain and Grassy Mountain in central northern Lincoln County. The axis of the area trends west-northwest across the length of this low range.

Geographic location.--The locality is approximately centered at lat 38°23' N., long 114°41' W., and extends from the SE 1/4 sec. 8 to the SE 1/4 sec. 13, T. 6 N., R. 65 E.

The only topographic map that represents the locality is in the 1:250,000-scale series; the map is listed following the Reference list.

Approximate area.--The locality is about 6 km (4 mi) long and 3 km (2 mi) wide, and is about 21 km^2 (8 mi^2) in area. About 95 percent of the locality is exposed bedrock that is wholly clay-rich rock.

Land ownership.--All land included in LI-3 is Federal public domain (Lutsey and Nichols, 1972). About 55 blocks of private land are scattered within a radius of 40 km (25 mi) of the locality; nearly all are of small size, and none are larger than moderate in size. The south end of Nevada's Mount Grafton Scenic Area is 22 km (13 mi) north of LI-3, and the Wayne Kirch Wildlife Management Area is 28 km (17 mi) west. The remainder of the vicinity is Federal public land.

Accessibility.--U.S. Highway 93 touches the eastern margin of the locality. No other mapped roads are near, but unmapped trails, perhaps accessible only by 4-wheel-drive vehicles, probably are present.

Lockard (1970) shows a powerline carrying from 14,000 to 50,000 V ac about 30 km (18 mi) to the south-southeast of the locality, but no railroad or pipelines are shown in the vicinity.

Remoteness.--The only named place within a radius of 40 km (25 mi) of this locality that is mapped is Sunnyside, which had no population reported in the 1970 census (Rand McNally, 1977).

Geologic setting.--Dutch John Mountain and Grassy Mountain together constitute a northern continuation of the Bristol Range, about 24 km (15 mi) south. The two mountains largely owe their existence to normal faults.

A single clay-rich formation, the Chainman Shale, underlies this locality. On the accompanying county map of localities it is differentiated from adjacent formations both above and below. Three subunits of the formation can be recognized in the field (Langenheim and Peck, 1957). The upper subunit is a silty shale with interbeds of limestone and sandy shale; it is 140 m (460 ft) thick between Dutch John Mountain and Grassy Mountain. The middle subunit consists of black shale and is 128 m (420 ft) thick; disclike concretions mark its base. The basal subunit is a calcareous siltstone or silty limestone and is about 43 m (140 ft) thick here. It contains bedded chert in individual beds as much as 5 m (15 ft) thick and having a total thickness of about 18 m (60 ft). The total thickness of the three subunits here is 341 m (1,120 ft).

Hydrologic setting.--The LI-3 locality, both segments A (northern) and B, is in Lake Valley and White River ground-water systems. Runoff from the A segment flows to Cave Valley and Lake Valley. Runoff from the B segment flows to Lake Valley and Muleshoe Valley, a tributary to Dry Lake Valley.

Discharge occurs by evapotranspiration from the floor of Lake Valley 5 to 6 km (3 to 4 mi) east of the center of the two segments of the locality. Also, irrigation and ranch wells are scattered about the flat valley floor east of the locality segments.

Mineral-resource activity.--No active mines are situated in the Dutch John Mountain locality (Payne and Papke, 1977). In the Atlanta mining district, about 27 km (17 mi) east of the locality, gold and silver are mined. In addition, a patented lode-mining claim lies 24 km (15 mi) south of the locality (Lutsey and Nichols, 1972), and a block of patented lode-mining claims is 29 km (18 mi) south at Bristol Silver Mines.

Garside and Schilling (1977) report that within a radius of 40 km (25 mi) of the locality there are eight oil-test holes; all are located within an arc of 80^{o} to the northwest, and the closest is 16 km (10 mi) distant; none were reported to have oil or gas shows.

LI-4: Bristol-Highland Ranges Locality

Locality LI-4 is a moderately large area of very irregular shape, situated in north-central Lincoln County adjacent to the village of Pioche. Although the locality consists of a single part, it includes four small ranges: the Bristol Range, Highland Range, Chief Range, and the Pioche Hills (Ely Range). The first three ranges trend north-south, but the Pioche Hills constitute an eastern spur that trends southeast from near the southern end of the Bristol Range.

Geographic location.--The north end of the locality is at lat 38°07' N., long 114°36' W., and the south end at lat 37°44' N., long 114°33' W. A southwestern corner is at lat 37°48' N., long 114°39' W.; and the tip of the area from secs. 17 and 18, T. 3 N., R. 66 E. southward to sec. 25, T. 2 S., R. 66 E., the spur extends southeastward to sec. 31, T. 1 N., R. 68 E. Locality LI-4 is 30 km (19 mi) west of the Nevada-Utah boundary.

Approximate area.--This locality contains about 233 km^2 (90 mi^2). Its main part is about 42 km (26 mi) long by an estimated average width of 5 km (3 mi). The eastern prong has a length of 17 km (11 mi), and has an estimated average width of 2 km (1 mi). An estimated 75 percent of the locality is exposed bedrock that contains clay-rich rock, but the amount of clay-rich strata is not determined.

Land ownership.--A map showing the various classes of land ownership in Nevada (Lutsey and Nichols, 1972) is available, and somewhat similar maps covering that part of Utah that lies within a 40 km (25 mi) radius of the locality boundary, are published by the USBLM (1975, 1977a).

Within the locality boundary most of the land is Federal public domain; a single quarter-section about 3 km (2 mi) northwest of Pioche is privately owned, and a small corner of another block of land on the north edge of Pioche projects into the locality. Outside the locality boundary but within that part of Nevada that lies within the vicinity of the locality an estimated 90 percent of the land is Federal public domain. A total of about 8 km^2 (3 mi^2) of withdrawn land lies east and south of the locality. Two small blocks are about 10 km (6 mi) northwest of Pioche, and three are about 32 km (20 mi) northeast of Pioche in Dry Valley Wash. Three more lie from 21 km (13 mi) to 35 km (22 mi) southeast of the southern extremity of LI-4. About 50 blocks of private land are scattered about the vicinity; in addition, private holdings are concentrated along Meadow Valley Wash, Dry Valley Wash, and at Barclay. Land controlled by the State of Nevada within the vicinity of the locality consists of Eagle Valley Recreation area 24 km (15 mi) northeast of Pioche, Cathedral Gorge State Park 10 km (6 mi) south-southeast of Pioche, and the Kershaw-Ryan Recreation area located 16 km (10 mi) south of the southern extremity of LI-4.

In Utah (USBLM, 1975, 1977a), about 74 percent of the land is Federal public domain, 10 percent is checkerboarded sections under State control, and 15 percent, which constitutes about 25 blocks of land, is privately owned, and 1 percent is in the Dixie National Forest. The northwest corner of the forest is 43 km (24 mi) southwest of the locality.

Accessibility.--Federal and State roads give access to the locality, especially along its eastern side. A segment of U.S. Highway 93 that extends west from Caliente, is, at its nearest point, 13 km (8 mi) from the southern end of the locality. From Caliente the route trends

northeast to Panaca, northwest to Pioche, thence northwest to Ely. Between Panaca and Pioche it crosses the locality in the Pioche Hills. North and south thereof it approximately parallels the main body of the locality, from which it is 0.5 to 12 km (0.3 to 8 mi) west. State routes are located mainly east of U.S. Highway 93. These include Route 25, which extends east and west from Panaca and in Utah becomes Route 56, as well as 55, 75, 85, and 86, all in the neighborhood of Pioche. State Route 54 extends from Pioche to the west side of the Highland Range around the southern end. Numerous other secondary roads and trails provide access to other parts of the Highland and northern Chief Ranges, and to the north end of the Bristol Range. Except for State Route 83, only scattered trails service the western side of the locality, and there only locally. Additional unmapped trails might be present and traversible by 4-wheel-drive vehicles.

Lockard (1970) shows the Union Pacific Railroad extends northward along Meadow Valley Wash to Caliente, and thence northeast into Utah. A spur extends from Caliente northeast to the northwest end of the Pioche Hills.

Lockard (1970) also shows a power transmission line carrying 80,000 V ac and more from the southwest that turns eastward to Panaca at a point about 23 km (15 mi) west thereof. This line crosses the southern tip of the locality. He also shows a subsidiary power transmission line carrying 80,000+ V ac that enters the Pioche area from Panaca. This line has three branches that carry from 14,000 to 50,000 V ac that serve mines at Ursine about 7 km (4 mi) east, Bristol Silver Mines, 6 km (4 mi) to the northeast, and the Highland mining district 4 km (2 mi) to the southwest.

No petroleum or natural-gas pipelines are reported within 40 km (25 mi) of the area.

Remoteness.--Two communities are situated within the LI-4 locality. They are Caselton, with a 1970 census population of 40 (Rand McNally, 1977), and Pioche with a reported 1970 population of 600. Two townsites within the area are Prince and Bristol Silver Mines; neither have a reported 1970 census figure.

Two populated communities and nine other places are located outside the locality boundary but within a radius of 40 km (25 mi). Panaca with a 1970-census population of 500 (Rand McNally, 1977) is 14 km (9 mi) east of the locality, and Caliente, with a population of 916, is 14 km (9 mi) south.

Geologic setting.--Locality LI-4 includes three mountain ranges that constitute a single crustal element. A minor crustal element flanks the principal element on each side. Geologically the more significant of these minor elements is the Pioche Hills (Ely Range), which lies to the east of the Highland Range and trends southeast. The minor element to the west consists of the Black Canyon Range and The Bluffs immediately south. Faults have raised the major crustal block on its west side and tilted it downward to the east.

Both the Pioche Shale and the Chisholm Shale are exposed (Tschanz and Pampeyan, 1970) in the Bristol-Highland Range locality, but only the Pioche exceeds 152 m (500 ft) in thickness. The Pioche Shale has been well studied because of its relation to ore production from the Pioche mining district and others within this locality. In general, the shale is a sequence of micaceous, sandy, or clayey shales with a few thin sandstone beds, and many limestone layers as much as 15 m (50 ft) thick, interbedded. Its thickness is about 271 to 296 m (890-970 ft).

The formation is divided into seven subunits, or members; four are of shale, and the intervening units are of sandstone or limestone. The four shale units are designated by capital letters from the top downward. The designations, lithologies, and thicknesses of the subunits are shown on figure 5.

Hydrologic setting.--Locality LI-4 is in Meadow Valley and White River ground-water systems. Runoff flows to Patterson and Meadow Valley Washes, east of the mountain chain, and Dry Lake Valley, west of the chain, Patterson Wash is a tributary to Meadow Valley Wash.

The town of Pioche derives its water supply from springs and wells within the eastern arm of locality LI-4. Significant discharge also occurs in Meadow Valley Wash near Panaca, 19 km (12 mi) southeast of the center of the locality. Ground water is used near Panaca for public supply, domestic, and irrigation purposes.

Mineral-resource activity.--The Bristol-Highland Range locality formerly was an area of extensive mining activity (Tschanz and Pampeyan, 1970). The Pioche mining district occupied much of the Pioche Hills, and the Bristol district the Bristol Range. The west flank of the Highland Range contained the Highland district to the north, and the Comet district to the south. Finally, the Chief district was located in the Chief Range. In these districts the Pioche Shale yielded ores mainly of silver, lead, and zinc from limestone interbeds, notably the Combined Metals Member, which is between shale beds C and D.

The only active mine (Payne and Papke, 1977) is in the Comet mining district on the southwest flank of the Highland Range in the southern part of the locality. It produced lead and silver, and perhaps zinc and copper in addition.

Other interests within the locality consist (Lutsey and Nichols, 1972) of patented lode-mining claims. They include several scattered claims at the north end of the Highland Range, two blocks of claims on the west flank of that range, a large block of claims in the Pioche Hills at Pioche, and a smaller block in the Bristol Silver Mines area at the north end of the Bristol Range.

Outside the locality boundary, six scattered patented lode-mining claims and one small block of claims lie within 40 km (25 mi) of the locality, and from 8 km (5 mi) to 29 km (18 mi) distant from its boundary, within the State of Nevada. Within the State of Utah, within the vicinity of Locality LI-4, are two groups of mines located about 32 km (20 mi) east of Pioche (USBLM, 1975).

No tests for oil or natural gas have been drilled within a distance of 40 km (25 mi) of this locality (Garside and Schilling, 1977).

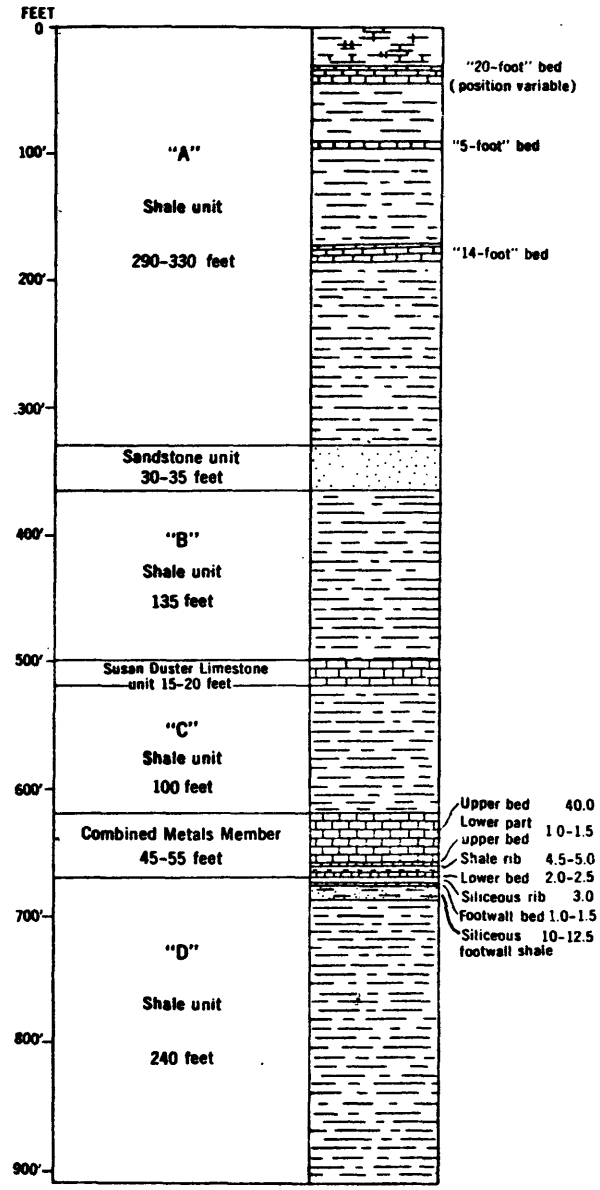

Figure 5.--Subunits of the Pioche Shale in the Pioche mining district area [Tschanz and Pampeyan, 1970, fig. 5]. The Susan Duster Limestone is a member; shale unit "D" can range from 240 to 375 feet in thickness.

LI-5: Delamar Mountains Locality

Locality LI-5 is a moderately long, sinuous area of very irregular width. It consists of a single part that lies along the western flank of the Delamar Mountains in central Lincoln County. Its northern extremity includes a prominent butte known at The Bluffs. About two-thirds of the locality's length lies north of the townsite of Delamar, which is situated about 18 km (11 mi) south of U.S. Highway 93.

Geographic location.--The northern end of this locality is at lat 37°48' N., long 114°39' W. The southern end is at lat 37°18' N., long 114°49' W. Thus, the locality extends from secs. 10 and 11, T. 2 S., R. 65 E., to secs. 26 and 27, T. 7 S., R. 64 E. The names of topographic maps on which the locality is represented are listed following the Reference list.

Approximate area.--The elongate locality is an area estimated at 225 km^2 (87 mi^2). It is about 54 km (33 mi) long by an estimated average width of 4 km (3 mi). The minimum width is 2 km (1 mi), and the maximum is 6 km (4 mi). An estimated 75 percent of the locality is exposed bedrock containing clay-rich strata, but the extent of the clay-rich rock is not determined.

Land ownership.--Very irregular, discontinuous blocks of private land (Lutsey and Nichols, 1972) scattered along the floor of Meadow Valley Wash lie from 3 to 19 km (2 to 12 mi) east of the locality, and along the White River, some 28 to 38 km (17 to 23 mi) to the west. Additional private land occurs as scattered sections or parts of sections within 40 km (25 mi) of the north end of the locality, and as close as 12 km (7 mi) to the north and east.

From the southern end of the locality it is 23 km (14 mi) to the northeast corner of the Desert National Game Range and 23 km (14 mi) to the State of Nevada's Pahranagat National Wildlife Refuge along the White River. Cathedral Gorge State Park is 21 km (13 mi) east of the northern end of the locality, and the Kershaw-Ryan State Recreation Area is 14 km (9 mi) east of the middle. Two small parcels of withdrawn land are about 27 km (17 mi) and 35 km (22 mi) east of the northern part.

Accessibility.--U.S. Highway 93 crosses the locality in an east-west direction about midway between its north end and the village of Delamar. The same highway turns north at Caliente, and thus lies subparallel to, and from 16 to 19 km (9 to 12 mi) to the east of LI-5. West of the locality the highway bends southwest, then turns southeast; thus it lies about 24 km (15 mi) southwest of the southern end.

State Route 25 extends east and west from Panaca, in part following U.S. Highway 93. Route 55 follows Meadow Valley Wash south from Caliente, and is from 4 to 24 km (2 to 15 mi) east of the locality. All or parts of State Routes 54, 75, 85, and 86 are within the northeastern part of the vicinity. Trails cross that part of the locality north of U.S. Highway 93, but none either cross or enter that part to the south. Unmapped routes accessible by 4-wheel-drive vehicles probably are available in places.

Lockard (1970) shows that a railroad occupies part of Meadow Valley Wash, together with the secondary road described above. These tracks extend northward to Caliente, and continue north to Panaca adjacent to part of U.S. Highway 93, thence north to Pioche. From Caliente additional trackage extends eastward.

A power transmission line carrying 80,000 V, ac and more approximately parallels the western margin of the locality, crossing U.S. Highway 93 about 23 km (14 mi) west of Caliente,

and also crossing the extreme north end of the locality. A subsidiary branch serving Pioche carries 50,000-80,000 V ac to nearby mines; all these lines lie within 40 km (25 mi) of locality LI-5.

No pipelines lie within 40 km (25 mi) of LI-5 (Lockard, 1970).

Remoteness.--Only the townsite of Delamar, with no population reported in the 1970 census (Rand McNally, 1977), lies within the locality. Within 40 km (25 mi) of the locality boundary there are eight mapped communities that had populations reported; they are:

Town or village	1970 population	Distance km	Distance mi	Direction	From
Alamo	250	29.9	18.6	W	southern part
Caliente	916	14.6	9.1	E	central part
Carp	35	34.3	21.3	SE	southern end
Caselton	40	21.7	13.5	NE	northern end
Elgin	15	18.7	11.6	E	southern part
Hiko	15	38.5	23.9	W	south-central part
Panaca	500	24.8	15.4	E	northern part
Pioche	600	24.9	15.5	NE	northern end

In addition, five other places mapped within the vicinity had no population reported.

Geologic setting.--The Delamar Mountains, like most other ranges in the Basin and Range province, owes its existence mainly to both thrust and normal faulting. In the vicinity of Delamar the normal faulting has tilted the elongate crustal segment downward toward the east, although farther northward the dip is westward. Among the ranges in Lincoln County the Delamar Mountains is distinctive for the enormous quantities of volcanic rocks exposed over a very large area.

In locality LI-5, three clay-rich bedrock units are exposed. They are the Dunderberg Shale, Chisholm Shale, and Pioche Shale. The Dunderberg and Chisholm Shales are too thin for further consideration. The Pioche Shale in the Delamar mining district and vicinity consists of micaceous shale, which is in part sandy or calcareous, interbedded with thinly layered to massive limestone as much as 5 m (17 ft) thick, and one bed of quartzite 0.6 m (2 ft) thick. The thickness of the formation is 271 m (888 ft) (Callaghan, 1937). A Pioche Shale section measured by Callaghan (p. 17-18) is shown in table 3.

Hydrologic setting.--The Delamar locality is in the White River ground-water system. Runoff from part A of the locality drains to Dry Lake Valley and runoff from part B drains to Delamar Valley.

The nearest discharge is along the White River in Pahranagat Valley 39 to 40 km (24-25 mi) west-southwest of the center of each segment. Water is used in Pahranagat Valley for wildlife management, irrigation, domestic, and public supply.

Mineral-resource activity.--The Delamar mining district, which formerly produced gold and silver, lies within the Delamar Mountains locality. No active mines are located now within this locality, but two active mines are located (Payne and Papke, 1977) within a radius of 40 km (25 mi). They are a perlite mine, located 18 km (11 mi) west of the southern part of the locality, and a mine 14 km (9 mi) north-northeast of the northern end of the locality, producing lead and silver, and perhaps zinc and copper.

Table 3.--Stratigraphic section of the Pioche Shale measured on western flank of the Delamar Mountains, about 3.2 km (2 mi) north of Monkey Wrench Wash (From Callaghan, 1937, p. 17-18.)

	Feet
Pioche Shale 888 ft:	
Brownish sandy shale; uppermost 2 ft a shaly quartzite	25
Massive limestone	12
Brown shaly limestone	2
Massive limestone	17
Shale	30
Calcareous shale	4
Thin-bedded limestone with red bands and lenses	7
Greenish shale	3
Thin-bedded brown and black limestone	6
Black limestone	12
Shale	9
Thin-bedded limestone	11
Brown sandy shale	2
Shale with thin limestone beds	68
Limestone	2
Shale with thin limestone beds	93
Brownish shale with thin limestone beds	75
Thin-bedded limestone	8
Brownish calcareous and sandy shales	77
Thin-bedded limestone	10
Greenish shale with some calcareous beds	157
Limestone	6
Shale	24
Limestone	5
Shale	38
Covered; possible faults; might include some Prospect Mountain Quartzite	185

Inactive mining interests are represented by patented lode-mining claims. Such claims cover an irregular area of about 8 km^2 (3 mi^2) at the townsite of Delamar. Beyond the boundary of the locality the nearest claims are those of the Comet mining district 11 km (7 mi) northeast of the north end of LI-5, and the Highland district, 18 km (11 mi) to the northeast.

Within a 40-km (25-mi) radius are the numerous claims in the north end of the Highland Range, those at Pioche, and those of the Bristol Silver Mines area. All lie to the northeast of this locality. In addition, one claim is located in the southern part of the Chief Range, and one in the floor of Meadow Valley Wash, 17 km (11 mi), directly east of Delamar.

No drill holes for oil and natural-gas tests are within 40 km (25 mi) of any part of the locality.

LI-6: Meadow Valley Mountains Locality

This locality, which consists of three parts, is chiefly a slim, curved, moderately long locality that lies along the east flank of the Meadow Valley Mountains in central-southern Lincoln County and extends southward into Clark County along the east flank of the Arrow Canyon Range. In addition, it includes at its north end in Lincoln County, two small, well-separated areas of exposure which constitute discrete parts. Of these, one part is located on the eastern flank of the Delamar Mountains. The other is on the east flank of the Meadow Valley Mountains. The three segments all are about 11 km (7 mi) apart.

Geographic location.--Part A of this locality is centered at about lat 37°06' N., long 114°52' W., and is thus in (unsurveyed) secs. 21, 22, 27, 28, T. 9 S., R. 65 E., and in sec. 5, T. 10 S., R. 65 E. Part B is centered at about lat 37°08' N., long 114°43' W., and is in about (unsurveyed) sec. 29, T. 10 S., R. 64 E. Part C, the largest, extends from lat 36°58' N., long 114°47' W., in the (unsurveyed) SE cor. sec. 14, T. 11 S., R. 64 E., southward some 40 km (25 mi) to lat 36°37' N., long 114°49' W. in the (unsurveyed) center sec. 22, T. 15 S., R. 64 E. The three parts are represented topographically on maps listed following the Reference list.

Approximate area.--The total area of the three parts is estimated to be about 16 km^2 (6 mi^2). The area of each part is approximately as follows: A: 1 km^2 (0.5 mi^2); B: 3 km^2 (1 mi^2); and C: 11 km^2 (4 mi^2). An estimated 85 percent of the locality is exposed bedrock; about 90 percent of that is believed to be clay-rich rock.

Land ownership.--All land within this locality (Lutsey and Nichols, 1972) is Federal public domain. Beyond the locality boundaries, scattered small areas of private land are located as near as 15 km (10 mi) east of part B, along the floor of Meadow Valley Wash. Two small areas are also located 9 km (6 mi) west of part A along the upper part of the Muddy River.

The Desert National Wildlife Range is about 11 km (7 mi) west of part A, as is the Pahranagat National Wildlife Refuge.

The northern portion of part C is about 15 km (9 mi) east of both the wildlife range and the refuge. The southern portion is about 9 km (5 mi) west of scattered private holdings of land along the lower Meadow Valley Wash.

Between 3 and 40 km (2 and 25 mi) from the southern half of part C, there are, in Clark County, moderately large areas of privately held land, and withdrawn land, Nevada's large Valley of Fire State Park, the northwest end of Overton Arm of Lake Mead, the Las Vegas Dunes Recreation Lands, Nellis Air Force Base and its ground gunnery range, and the very large National Wildlife Range.

Accessibility.--U.S. Highway 93, which is roughly parallel to the locality, is 9 km (6 mi) west of part C, 9 km (6 mi) west of part A, and 23 km (14 mi) west of part B. State Route 7, which trends southeast, extends from U.S. 93 at a point 7 km (4 mi) south of the Lincoln-Clark County line to Moapa, and thus traverses part C. A trail extends northeast up Kane Spring Wash on the northwest side of the Meadow Valley Mountains, and unmapped trails accessible by 4-wheel-drive vehicle probably offer access to the locality at various points.

A railroad extends (Lockard, 1970) northeast from Las Vegas to Moapa, Clark County, and thence northward to Panaca, Lincoln County, following Meadow Valley Wash. The track is essentially parallel to locality LI-6 and from 10 to 13 km (6 to 8 mi) east therefrom.

Lockard (1970) shows that a power-transmission line carrying 80,000 V ac and more extends from Las Vegas to Moapa, and from there a line carrying 14,000-50,000 V ac turns southeast to Overton. The southern end of part C is 9 km (5 mi) from the Las Vegas-Moapa segment of the line. Another major powerline extends northward along the west side of the Arrow Canyon Range and the Meadow Valley Mountains. This line is about 10 km (6 mi) west of parts A and C of the locality.

The northern end of a natural-gas pipeline is 30 km (19 mi) south of LI-6.

Remoteness.--No centers of population lie within any part of this locality. Four centers of population are in the vicinity of LI-6, and had populations reported in the 1970 census (Rand McNally, 1977); three other mapped places had no reported population. The four villages are:

Village	1970 Population	Distance Kilometers	Miles	Direction	From
Carp	35	18	11	E	part B
Elgin	15	26	16	NE	part B
Logandale	320	28	17	E	southern end part C
Overton	900	32	20	ESE	southern end part C

Geologic setting.--Part C of the Meadow Valley Mountains locality is situated in the low, rough terrain of the southeast flank of the Meadow Valley Mountains. Part B is on the northwest flank, and part A on the southeast flank of the Delamar Mountains which lie to the northwest beyond Kane Spring Wash.

The Meadow Valley Mountains, like other ranges in the Basin and Range province, owe its existence chiefly to both thrust and normal faulting. In addition, some folding of the rock formations has occurred, and extensive volcanic eruptions have added to the complexity of the geologic sequence. The western margin of the range is raised along an important normal fault, and strata of the western half of the range are tilted downward toward the east.

Both the Chainman Shale and Pioche Shale are exposed in the Meadow Valley Mountains, but only the Chainman Shale exceeds 152 m (500 ft) in thickness.

The Chainman Shale is divisible into two members at this locality (Tschanz and Pampeyan, 1970). The upper member, exposed on the northwest flank of the range in part B, is composed of black shale, which near the base typically contains rusty weathering disclike concretions containing disseminated pyrite. The thickness of this member in part B is reportedly 216 m (707 ft) (D. H. Duley, written commun., 1957, in Tschanz and Pampeyan, 1970).

The lower member is a moderately resistant calcareous siltstone or silty limestone that is black when unweathered. D. H. Duley (written commun., 1957, in Tschanz and Pampeyan, 1970) reports a thickness of 69 m (225 ft) near Kane Springs--part A of this locality.

The total thickness of the Chainman Shale in parts A and B is thus 284 m (932 ft). Tschanz and Pampeyan (1970), however, report that the thickness of the formation decreases rapidly to the southeast and that the unit was unrecognized east of Meadow Valley Wash. They report a thickness of about 61 m (200 ft) for the formation on the east side of the Meadow Valley Range, and in the Canyon Range, Clark County. These areas constitute part C of this locality.

Hydrologic setting.--Segments A and B of locality LI-6 are in White River ground-water system, and runoff from these outcrops flows to Kane Springs Wash. The nearest significant discharge to the A and B segments is about 40-50 km (25-31 mi) down the flow-line gradient at Muddy Spring in upper Moapa Valley (Clark County) where water is used primarily for irrigation and domestic purposes.

Segment C is in the Meadow Valley ground-water system and drainage basin. The nearest discharge is 13 km (8 mi) east along Meadow Valley Wash, where water is used for domestic, livestock, and--a short distance downstream--irrigation purposes.

The southern part of segment C in northern Clark County is in the White River and Meadow Valley ground-water systems. Runoff flows to Meadow Valley, White River, and Muddy River. The nearest discharge to the approximate center of southern segment C is 5 km (3 mi) east at Muddy Spring, where water is used for domestic and irrigation purposes.

Mineral-resource activity.--No active mines are situated within this locality, but seven are located within a radius of 40 m (25 mi) (Payne and Papke, 1977). All produce nonmetallic minerals, and constitute two groups. One cluster consisting of five mines is located east-southeast of the southern end of part C, just west of the northwest end of Overton Arm of Lake Mead. The center of this compact group is thus about 34 km (21 mi) from locality LI-6. The other two mines are located south of the southern end of part C at distances of 29 and 39 km (18 and 24 mi).

No patented lode-mining claims are within the locality, but one single claim and one small block of claims lie within a radius of 40 km (25 mi). The single claim is about 5 km (3 mi) west of the southern end of part C, and the block of claims is 18 km (11 mi) east-southeast of that end, in the North Muddy Mountains.

Garside and Schilling (1977) show eight holes have been drilled within 40 km (25 mi) of the locality as oil and natural-gas tests. One of the holes had oil and gas shows reported. A single dry test hole is located in Lincoln County 5 km (3 mi) east of the northern portion of part C. All other holes are situated in Clark County within a 90° arc that extends from a point just southeast of Moapa and 27 km (17 mi) from part C, southwestward to the southern end of the Arrow Canyon Range and 24 km (15 mi) from part C.

LI-7: Desert Range Locality

This locality is a slim, curved, moderately long locality that lies along the west flank of the Desert Range in southwestern Lincoln County and extends southward into northwestern Clark County. It consists of a single part.

Geographic location.--The northern end of this locality is at lat 37°00' N., long 115°26' W. The southern end is at lat 36°42' N., long 115°23' W. The north end is thus in the (unsurveyed) center sec. 11, T. 11 S., R. 58 E., and the south end is in the (unsurveyed) SE cor. sec. 29, T. 14 S., R. 59 E. All or part of the locality is represented on topographic maps published at two different scales. These maps are listed following the Reference list.

Approximate area.--The locality has a length of about 34 km (21 mi), and an estimated average width of about 0.5 km (0.3 mi). Thus the total area is about 16 km (6 mi). An estimated 90 percent of the locality is exposed bedrock consisting chiefly of clay-rich rock; about 80 percent of the bedrock area is believed to be clay rich.

Land ownership.--The entire locality lies within the boundaries of both the Nellis Air Force Base Bombing and Gunnery Range and the Desert National Wildlife Range (Lutsey and Nichols, 1972). The north end of LI-7 is 39 km (24 mi) southwest of the Pahranagat National Wildlife Refuge. The eastern boundary of the NTS is 40 km (25 mi) west from the north end of the locality. Two blocks of private land lie 33 km (20 mi) east of the north part of the locality and five small blocks are within 40 km (25 mi) south of the southern end. The northeast end of the State of Nevada's Desert View Natural Area is 27 km (17 mi) southwest of the southern end of the locality.

Accessibility.--Because the locality and the adjacent area is within the Nellis Air Force Bombing and Gunnery Range, access is strictly controlled by the USAF. U.S. Highway 93 is roughly parallel to the locality, and is 32 km (20 mi) or more to the east, and U.S. Highway 95 is 27 km (17 mi) to the southwest from the southern end. Trails follow the valley floors on both sides of the Desert Range, and unmapped routes in and across the range accessible to 4-wheel-drive vehicles probably are present.

No railroads, or petroleum or natural-gas pipelines, lie within 40 km (25 mi) of the locality.

A power-transmission line that carries 80,000 V ac or more extends from Las Vegas northwest to and beyond Indian Springs, and a branch extends 8 km (5 mi) north therefrom. This main transmission line is as little as 27 km (17 mi) from the south end of the locality.

Remoteness.--The village of Indian Springs, with a 1970-census population of 900 (Rand McNally, 1977), is 32 km (20 mi) southwest of the south end of the locality. It is the only populated place within 40 km (25 mi) of any part of LI-7.

Geologic setting.--Longwell, Pampeyan, Bower, and Roberts (1965), characterized the Desert Range as the eastern limb of a large north-plunging anticline, the axis of which can be traced southwest to near Indian Springs. Like most other ranges in the Basin and Range province, this range is mainly characterized by faulting, but thrust faulting appears to be less significant than in many other ranges. The curved pattern of the range suggests that it has been in part rotated from a southern to a southwestern trend because of movement along a major northwest-trending fault zone on which the northeast block moved southeast; this strike-slip fault zone causes Las Vegas Valley.

Three clay-rich units are exposed in the Desert Range. They are the Dunderberg, Chisholm, and Pioche Shales, but of these only the Pioche is reported to be more than 152 m (500 ft) thick. Because of the thinness of the Pioche Shale it is not differentiated from the associated Chisholm Shale and Lyndon Limestone on the reference map (Tschanz and Pampeyan, 1970) or on the county map accompanying this report.

No detailed description of the Pioche Shale as it is exposed in the Desert Range is readily available. Tschanz and Pampeyan (1970) described it as micaceous, sandy, or clayey shale with a few thin sandstone beds, and many thin limestone layers interbedded. Longwell (oral commun., 1960, in Tschanz and Pampeyan, 1970) reported the thickness of the formation in this range to be 183 to 213 m (600 to 700 ft).

Hydrologic setting.--The outcrops in the LI-7 locality are on the west flank of the Desert Range. The locality is in the Ash Meadows ground-water system. Runoff from the outcrops flows west to the Three Lakes Valley drainage basin.

The nearest discharge is 42 km (26 mi) southwest at Indian Springs, where water is used for public supply and military purposes.

Mineral-resource activity.--Within a radius of 40 km (25 mi) of this locality there are no active or inactive mines, no patented lode-mining claims, and no oil or natural-gas fields or test holes (Payne and Papke, 1977; Garside and Schilling, 1977).

NYE COUNTY, NORTHERN PART

Nye County is a relatively large area which is characterized by a T-like shape, and which is situated in south-central Nevada. Because of its shape and large size the county is divided arbitrarily for the purpose of this report into two parts by the 39th Parallel of Latitude. This parallel approximately marks the junction of the crossbar of the T with its vertical part. For convenience, the two parts are hereafter referred to as northern and southern Nye County.

Northern Nye County contains five localities of clay-rich rocks suitable for further investigation. A sixth locality, the Southern White Pine Range Locality (MN-4) extends northward into adjacent White Pine County; this locality is described here with other northern Nye County localities mainly because the larger part of the locality lies in Nye County. The localities are well scattered about the easternmost two-thirds of the northern part of the county, and all lie wholly or mainly south of the 39th Parallel of Latitude.

Five geologic units of potential interest are represented in one or more of the six localities. The rock types range from argillite with some interbedded quartzite, crystalline limestone, and conglomerite, all like those in the Eleana Formation, to a variety of sedimentary rocks. These are in part intermixed and interbedded, and include fissile to nonfissile claystone, siltstone, sandstone,and limestone. Locally these are slightly metamorphosed to rocks somewhat similar to those of the Eleana Formation, but slate, phyllite, schist,and gneiss are also present. The various kinds of rocks are assigned to seven geologic units in addition to the Eleana; these units are the Carrara Formation, Pioche Shale, Dunderberg Shale, Mayflower Schist, Toquima Formation, Chainman Shale, and Ninemile Formation. In some places these units are not differentiated from adjacent units stratigraphically above or below on reference maps, and so might or might not be differentiated on the accompanying map of the northern Nye County localities.

Thickness of the units, or the attractive part of some units, ranges from about 152 to 501 m (500 to 1,644 ft). The relative areal extent of surface exposure of the units is moderately small to large.

The northern part of Nye County is not as thoroughly studied geologically as are some Nevada Counties, but some information is available relative to each of the localities mapped here. Applicable references are listed in the Bibliography. The single most useful report is a geologic map at a scale of 1:200,000 (2 km/cm, or about 2.9 mi/in.) prepared by Kleinhampl and Ziony (1967).

The northern part of Nye County is centrally located in Nevada. It has a total area of about 28,065 km^2 (10,836 mi^2), but the population is undetermined here; it is inferred to be somewhat more than half of the 5,599 total population of Nye County reported in the 1970 census (Rand McNally, 1977). The county seat is Tonopah, which is situated in the extreme southwestern corner of the area, about 16 km (10 mi) from the nearest locality. This town had a 1970 census population of 1,716 (Rand McNally, 1977), and is primarily a local service center for nearby cattle ranches and for mining activity in the western part of northern Nye County. It also serves the needs of travelers, for it is located on U.S. Highways 6 and 95, plus State Routes 89 and 8-A. As of 1970 (Lockard), parts of Nye County

were serviced by 14,000 to 50,000 V ac power-transmission lines; in addition a natural-gas pipeline enters the extreme western end of the area.

Northern Nye County is represented on parts of six topographic maps published by the USGS. These maps are at a scale of 1:250,000 (2.5 km/cm or about 4 mi/in.). The maps are identified in the list of resource materials following the Reference list.

NN-1: Toquima Range Locality

Locality NN-1 is located in the west-central part of northern Nye County, north-northeast of Tonopah. The moderately large, widespread locality is divided geographically into two parts. Part A is a large oval area situated on both flanks of the Toquima Range near its southern end. Part B is a relatively small peanut-shaped area located on the floor of Ralston Valley and adjacent to Thunder Mountain; part B thus is about 23 km (15 mi) south of part A.

Geographic location.--Part A extends from lat 38°45' N. southward to lat 38°26' N., and from long 116°50' W. westward to long 117°13' W. Part B extends from lat 38°14" N. southward to lat 38°09' N., and westward from long 117°01' W., to long 117°05' W. Thus part A extends from (unsurveyed) secs. 10 and 11, T. 10 N., R. 44 E., southward to about secs. 25 and 26, T. 7 N., R. 43 E., and from secs. 19 and 30, T. 9 N., R. 46 E. westward to sec. 31, T. 8 N., R. 43 E. Part B mainly occupies secs. 2, 3, 9, 10, 11, and 12, plus secs. 30, 31, and 32,T. 4 N., R. 44 E. The entire locality is represented topographically on maps of the 1:250,000-scale series, and in addition is partly shown on maps of both the 1:62,500-scale series and the 1:24,000-scale series. These maps are listed following the Reference list.

Approximate area.--Part A has a maximum length of 37 km (23 mi) and a maximum width of 21 km (13 mi) and an estimated area of 648 km^2 (250 mi^2). Of this area an estimated 259 km^2 (100 mi^2) is underlain by bedrock containing clay-rich strata, but the extent of the clay-rich strata is not determined. Part B is 12 km (8 mi) long, and has an estimated average width of 3 km (2 mi). It thus has a total estimated area of about 39 km^2 (15 mi^2). Of this an estimated 10 km^2 (4 mi^2) is exposed bedrock containing clay-rich strata, but the extent of clay-rich strata is not determined.

The total estimated area of the two parts is thus 686 km^2 (265 mi^2) but the actual extent of clay-rich strata is not determined.

Land ownership.--Part A lies almost wholly within the boundaries of the Toquima segment of the Toiyabe National Forest, and partly on Federal public land. About eight quarter-sections of private land that lie within 5 km (3 mi) to the south and east of the village of Manhattan are within the locality and may be partly underlain by clay-rich rocks. At least 40 additional blocks of privately-owned land lie within 40 km (25 mi) of Part A; nearly all is located on the floors of Big Smoky and Monitor Valleys. The Yomba Indian Reservation is 36 km (22 mi) northwest of the northern portion of part A.

Part B lies wholly on Federal public land. Two blocks of privately-owned land that are reported to contain Tonopah's water-supply wells are within about 3 km (2 mi) to the northwest of the boundary, and 10 blocks of private land are within 40 km (25 mi). The private land is widely scattered about the floors of Stone Cabin, Ralston, and Big Smoky Valleys. The northwest corner of Nellis Air Force Base Bombing and Gunnery Range is 29 km (18 mi) south of part B.

Accessibility.--From a junction with U.S. Highway 6 at a point 9 km (6 mi) east of Tonopah, combined State Routes 8A and 82 lead north-northeast, crossing the western edge of part B of Locality NN-1. Just northwest of part B the two routes separate. Route 82 trends northeastward along Monitor Valley on the east side of the Toquima Range, and crosses part A near Belmont. Route 8A follows Big Smoky Valley northward along the west side of the Toquima Range, and for several kilometers (a few miles) is within 2 km (1 mi) of part A. The two subparallel routes are connected by State Route 69 through the village of Manhattan. This route crosses part A in an area containing exposed clay-rich rock. From Route 8A State Route 93 leads east to the village of Round Mountain. Trails afford access to some parts of the range, and unmapped trails accessible by 4-wheel-drive vehicles probably are present. No railroads or petroleum or natural-gas pipelines are within 40 km (25 mi) of this locality. A buried aqueduct that carries Tonopah's water supply from wells in Ralston Valley skirts the west side of part B.

Two power lines carrying 50,000 to 80,000 V ac lie near or in the locality. One is about 8 km (5 mi) south of the southern end of part B; the other line crosses the west-central portion of part A, terminating at the town of Round Mountain.

Remoteness.--The county seat of Tonopah with a 1970 census population of 1,716 (Rand McNally, 1977), is 40 km (25 mi) south of the southern end of part A, and 15 km (9 mi) southwest of the southern end of part B. Other places within 40 km (25 mi) of either part are:

Town or Village	1970 Population	Location
Manhattan	30	in south-central portion of part A
Round Mountain	100	1.6 km (1 mi) northwest of boundary of part A

Geologic setting.--The Toquima Range geologically is somewhat similar to other ranges in the Basin and Range province. The range is mainly the result of both thrust and normal faulting, with some folding of the rock formations and some volcanic eruptions. The eastern margin of this crustal segment has been raised by faulting, and the segment broken into blocks so that different parts of the range differ in shape, cross section, and attitude. That part of the range in part A of Locality NN-1 is characterized by a broad anticline that trends northwest, and smaller folds overturned toward the northeast.

Two subunits of a single geologic unit warrant further investigation in this locality. Strata mapped as undifferentiated Ordovician-Cambrian shale and limestone by Kleinhampl and Ziony (1967) are mildly to moderately metamorphosed derivatives from shale, mudstone, and other rocks. Phyllite, schist, argillite, and slate thus constitute most of the map unit, and any one may dominate locally. In the vicinity of Manhattan the sequence includes

three subunits, here designated by letters from the basal subunit upward.

Subunit C consists mainly of slate and chloritic schist containing scattered quartzite layers as much as 15 m (50 ft) thick plus chert, limestone, and argillite beds (the Toquima Formation of Ferguson, 1924). The thickness of this subunit is not definite, but it is believed to be at least 305 m (1,000 ft) (Kleinhampl and Ziony, written commun., 1978). Subunit A is cordierite ("knotty") mica schist that grades laterally to a fine-grained chloritic schist and phyllite (the Mayflower Schist of Ferguson, 1924). This subunit may be about 244 m (800 ft) thick. It is underlain by subunit B, a limestone also about 244 m (800 ft) thick (Zanzibar Limestone of Ferguson, 1924).

Hydrologic setting.--Locality NN-1 is in the Clayton Valley ground-water system. Runoff from part A flows to Big Smoky, Ralston, and Monitor Valleys. Runoff from part B flows to Ralston Valley.

Ground-water discharge occurs at Belmont, in the eastern portion of part A, and at several springs scattered in and around part A of the locality, where the water is used primarily for domestic, livestock, and some mining purposes. The water supply for Tonopah is derived from a well field about 3 km (2 mi) northwest of part B.

Mineral-resource activity.--Six active mines are reported (Payne and Papke, 1977) within part A of Locality NN-1. One, a silver mine, is located 16 km (10 mi) northeast of Manhattan. One gold mine is 3 km (2 mi) south of Round Mountain, another at the townsite of Belmont, another at Manhattan and two others close to Manhattan lie along a line west of the community. A seventh active mine yields gold at Round Mountain, just outside the northwest boundary of part A. An active tungsten mine is located 33 km (20 mi) northwest of Round Mountain, and two active barite mines are 29 and 33 km (18 and 21 mi) northeast.

At least five patented lode-mining claims lie just west and southwest of Manhattan, within the boundary of part A. Another is found 32 km (20 mi) north-northwest of Round Mountain, and two others are located 36 km (22 mi) northeast of Belmont. A large block of claims plus a single claim are located 14 km (9 mi) southwest of the southern end of part A, and 22 km (14 mi) northwest of part B. Another large block of claims is located at Tonopah, 38 km (24 mi) from the southern end of A, and 12 km (7 mi) from part B. Additional claims are located a short distance south of Tonopah, 45 km (28 mi) from A and 18 km (11 mi) from B.

No oil or natural-gas fields or test holes lie within 40 km (25 mi) of either part of the Toquima Range Locality.

NN-2: Hot Creek Range Locality

This locality consists of one part composed of several scattered areas where clay-rich rocks that warrant further investigation are exposed. Individual exposures differ considerably in size, and together constitute a somewhat boomerang-shaped locality of moderate size. It is situated in central northern Nye County, mainly on the east flank of the Hot Creek Range and in the Squaw Hills northeast of Tonopah.

Geographic location.--The northeastern end of the locality is located at about lat 38°45' N., long 116°05' W., and the southern end is at lat 38°14' N., long 116°23' W. The bend in the locality is roughly at lat 38°45' N., long 116°18' W. The locality thus extends from its northeasterly end in secs. 26, 27, 34, and 35, T. 10, 11 N., R. 52 E. in the Squaw Hills, westward to a bend at T. 10, 11 N., R. 50, 51 E. in the Hot Creek Range; from there it extends southward to the southern extremity in sec. 6, T. 4 N., R. 50 E., also in the Hot Creek Range.

NN-2 is represented topographically wholly, or partly, on maps at three different scales. These maps are listed following the Reference list.

Approximate area.--The locality is about 76 km (47 mi) long by an average width of about 8 km (5 mi). This gives an area of roughly 609 km^2 (235 mi^2). Of this, an estimated 60 km^2 (23 mi^2) is exposed bedrock containing in part clay-rich rock; the extent of the clay-rich rock is not determined.

Land ownership.--Seven quarter-sections of privately-owned land lie within the locality, and about 55 additional scattered small blocks of privately-owned land lie within 40 km (25 mi) of the locality boundary. Five of the largest of these are along the floor of Little Fish Lake Valley, about 8 km (5 mi) from the western boundary.

Four small blocks of Federal land (Lutsey and Nichols, 1972) controlled by the USDOE are from 2 to 11 km (1 to 7 mi) east of the eastern boundary. The westernmost three blocks of land of a total of four in the Federal Railroad Valley Wildlife Management Area are just within 40 km (25 mi) of the locality boundary. That part of the Toiyabe National Forest in the Monitor Range is as close as 5 km (3 mi) west of NN-2. The Duckwater Indian Reservation is located some 35 km (22 mi) northeast of the eastern extremity. All other land in the locality and within 40 km (25 mi) of it is Federal public domain.

Accessibility.--Just northeast of Warm Springs, U.S. Highway 6 is about 2 km (1 mi) southeast of the southern end of the locality, and 26 km (16 mi) south of the northeast end. State Route 25 from the southeast joins U.S. 6 at Warm Springs, and is there 3 km (2 mi) from the southern end. State Route 82, which follows Monitor Valley on the west side of the Monitor Range, is as little as 37 km (23 mi) from the western boundary of NN-1. An undesignated secondary road leaves U.S. 6 about 21 km (13 mi) west of Warm Springs. This road leads northeast up Stone Cabin Valley, crosses both the range and locality into Hot Creek Valley, turns north and again crosses the locality between Hot Creek Range and Squaw Hills. Thus, a very large part of its length is in or adjacent to the locality. Scattered trails afford access to the locality, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

Lockard (1970) shows no railroad, or petroleum or natural-gas pipeline within 40 km (25 mi) of NN-2. There is one power line; it carries from 50,000 to 80,000 V ac, and is about 3 km (2 mi) south of the southern end of the locality.

Remoteness.--The village of Warm Springs, with a 1970 census population of 25 (Rand McNally, 1977), is located 3 km (2 mi) southeast of the southern end of NN-2, and the village of Duckwater, 1970 census population 20, is about 39 km (24 mi) northeast of the eastern end. No other mapped places with populations reported in the 1970 census are within 40 km (25 mi) of the locality.

Geologic setting.--The Hot Creek Range Locality is located on both the north and south segments of the Hot Creek Range, and on the Squaw Hills to the east. Like most ranges in the Basin and Range province its geologic character is caused mainly by thrust and normal faulting. This crustal segment, like some others, is raised along the east side, and tilted westward. Normal faulting has broken the segment into blocks, which differ in shape, cross section, and attitude. The strata are locally somewhat folded, and volcanic deposits are locally numerous.

Two clay-rich formations crop out in this locality: The Dunderberg Shale and the Eleana Formation (Kleinhampl and Ziony, written commun., 1978). Both are believed to exceed 152 m (500 ft) in thickness. The Dunderberg Shale consists mainly of fissile claystone, and contains minor amounts of calcareous shale and limestone as interbeds and lenses 8 to 15 cm (3 to 6 in.) thick. The formation ranges from 152 to 244 m (500 to 800 ft) thick in the vicinity of the townsite of Tybo to about 457 to 549 m (1,500 to 1,800 ft) in Hot Creek Canyon.

Kleinhampl and Ziony (written commun., 1978) describe the Eleana Formation only as a "silicious, clastic, sedimentary rock". They report a thickness of about 457 m (1,500 ft) in the southern part of the Hot Creek Range.

Hydrologic setting.--The locality is in the Railroad Valley, Newark Valley, Clayton Valley ground-water systems. Ground-water migrates southeastward in the Hot Creek Valley portion of the Railroad Valley system and water moves south-southwest in the Stone Cabin Valley part of the Clayton Valley system; runoff flows to Hot Creek, Little Fish Lake, Little Smoky (northern and southern (Big Sand Springs)),and Stone Cabin Valleys.

Significant discharge occurs in Hot Creek Canyon (in the locality) and at Warm Springs near the southern end of the locality. The hot spring water flows into a swimming pool at Warm Springs, and in Hot Creek Canyon the water is used primarily for domestic and livestock purposes. Discharge also occurs in Little Fish Lake Valley, 2 km (1 mi) west of the westernmost outcrop, where water is also used for domestic and livestock purposes. Several scattered springs, used for livestock, occur within the limits of the locality.

Mineral-resource activity.--No active mines are located within the locality boundary, and only one gold mine, about 37 km (23 mi) west of the central part of NN-2, is within 40 km (25 mi) distance of it. Four patented lode-mining claims are present in the southern part of the locality, and one claim is in the central part. Patented claims at the townsite of Belmont, in the Toquima Range, are 37 km (23 mi) west of the locality and two patents are 16 km (10 mi) west in the Monitor Range.

No oil or natural-gas wells are in the locality (Garside and Schilling, 1977). The Trap Springs Field in Railroad Valley is 39 km (24 mi) east of NN-2, and a single abandoned test hole is 40 km (25 mi) northeast of its northeast end. No others are reported within 40 km (25 mi) of the locality.

NN-3: Southern Pancake Range Locality

Locality NN-3 consists of three small areas of exposure that constitute a single part, located in northeastern Nye County. The moderately large, moderately widespread locality is somewhat triangular in shape, and occupies the southern part of the Pancake Range and adjacent areas.

Geographic location.--The northernmost corner of the triangular locality is located at lat 39°04' N., long 115°52' W. The eastern corner is at lat 38°59' N., long 115°41' W., and the southern corner is at lat 38°38' N., long 115°50' W. These locations are found in (unsurveyed) sec. 27, T. 14 N., R. 54 E., in sec. 21, T. 13 N., R. 56 E., and in (unsurveyed) sec. 19, T. 9 N., R. 55 E.

The locality is represented on parts of three series of topographic maps. These are listed following the Reference list.

Approximate area.--The locality has a length of 48 km (30 mi) and an estimated average width of about 6 km (4 mi). Thus, the area is roughly 311 km^2 (120 mi^2). Of this, an estimated 10 percent is exposed bedrock that consists in part of clay-rich rock, but the extent of the clay-rich rock is not determined.

Land ownership.--Almost all land within the locality is Federal public land. At least 9 km^2 (4 mi^2) of land within the locality belongs to the Duckwater Indian Reservation. About 48 small to moderately sized blocks of privately-owned land are from 0.2 to 40 km (0.1 to 25 mi) from the locality boundary; a few of these are concentrated along principal drainage routes. Land in four separate blocks constitutes the Federal Railroad Valley Wildlife Management Area; these blocks are located from 8 to 21 km (5 to 13 mi) south and southeast of the southern end of Locality NN-3. A single quarter-section of land 34 km (21 mi) west of the locality is withdrawn. The Monitor Range, White Pine Range, and Quinn Canyon and Grant Ranges segments of the Humboldt National Forest are from 13 to 31 km (8 to 19 mi) from the nearest part of NN-3. The Duckwater Indian Reservation also includes about 13 km^2 (5 mi^2) of land that lies just outside the locality boundary. Northwest of the northwest extremity a distance of 36 km (22 mi) is the southern end of a Nevada livestock driveway that extends northward across Eureka County. All other land within 40 km (25 mi) of the NN-3 is Federal public domain.

Accessibility.--U.S. Highway 6 is 8 km (5 mi) southeast of the southern corner of Locality NN-3, and U.S. Highway 50 is 34 km (21 mi) north of the northwest corner. State Route 20 crosses the locality 2 km (1 mi) west of the northeast corner, and an undesignated road that follows Hot Creek and Little Smoky Valleys is from 28 to 20 km (17 to 12 mi) west of the western locality boundary. Several trails afford access to the flanks of the Pancake Range, and cross it in at least three places. Other unmapped trails probably accessible by 4-wheel-drive vehicles might be present.

Lockard (1970) shows no railroads, or petroleum or natural-gas pipelines within 40 km (25 mi) of NN-3. There are two power lines, however; one carries from 50,000 to 80,000 V ac, and is about 13 km (8 mi) south of the southern end of NN-3. The other carries from 14,000 to 50,000 V ac and terminates about 37 km (23 mi) east of the locality boundary.

Remoteness.--Duckwater, 2 km (1 mi) from the locality boundary, had a 1970 census population of 20 (Rand McNally, 1977). Currant, located on U.S. 6 had no census population. No other mapped places with populations reported in the 1970 census are within 40 km (25 mi) of the locality.

Geologic setting.--The Southern Pancake Range Locality exposure areas are located mainly in the southern part of that range, partly on the east flank of Moody Mountain, and partly on a broad, low bedrock ridge in the northern end of Railroad Valley. Like many other ranges in the Basin and Range province, the character of the Pancake Range is caused by both thrust faulting and normal faulting, and volcanic activity. Elongate crustal segments have been tilted downward to the east and broken by faulting into blocks which differ in shape, cross section, and attitude.

Both the clay-rich Pilot Shale and Chainman Shale are exposed in the locality, but only the Chainman exceeds 152 m (500 ft) in thickness. This formation generally consists mainly of black fissile carbonaceous clay shale, with siliceous shale locally dominant. Both of these are interbedded with some siltstone, limestone, and a little sandstone and conglomerate. The sandstone is commonly very hard and tough, and graded bedding and cross stratification are present locally. The conglomerate forms massive beds as thick as 31 m (100 ft). Some beds of limestone are dense, bituminous, and very fine-grained, others are lighter colored and coarser grained. Limestone beds rarely exceed 31 m (100 ft) in thickness (Kleinhampl and Ziony, written commun., 1978).

Hydrologic setting.--Locality NN-3 is in the Railroad Valley ground-water system. Runoff flows to Railroad Valley and southern Little Smoky (Big Sand Springs) Valleys drainage basins.

The nearest ground-water discharge is along Duckwater Creek, 2 km (1 mi) southwest of the northeastern outcrop area, 15 km (9 mi) southeast of the northwestern outcrop area and about 18 km (11 mi) northeast of the southwestern outcrop area of the locality. Duckwater Creek is used for irrigation, domestic, and livestock purposes. Scattered small springs in the southwestern outcrop area and near the northwestern outcrop area of the locality are used for livestock watering.

Mineral-resource activity.--No active mines or patented lode-mining claims lie within the locality (Payne and Papke, 1977). Within 40 km (25 mi) of the locality there is one active silver and lead mine, located almost due north and at a distance of about 40 km (25 mi) from the northwest corner of Locality NN-3. In the vicinity of the mine and within about the same distance of the locality are at least six individual claims and one block of claims. Another claim is located about 40 km (25 mi) due west of the northwest extremity of the locality, on the west flank of the Fish Creek Range.

Within 40 km (25 mi) of NN-3 some 55 oil-test holes have been drilled, and 12 had oil shows reported; the others apparently were dry. Nearly all are located east of the southern part of the locality (Garside and Schilling, 1977). The drilling led to the development of the Eagle Springs Field consisting of 14 producing wells, and the Trap Spring Field consisting of two producing wells. Both are located in Railroad Valley, 26 and 14 km (16 and 9 mi), respectively, east of the southern extremity of the locality.

NN-4: Southern White Pine Range Locality

Locality NN-4 is partly in northern Nye County and partly in southwestern White Pine County. This moderately large, moderately long irregularly shaped locality consists of one part, and includes both flanks and the crest of the southern part of the White Pine Range and the Horse Range. Although part of the locality is in adjacent White Pine County, the locality is assigned to northern Nye County for descriptive purposes because the larger part of its area is located in, and more information is available for, northern Nye County.

Geographic location.--The northern extremity of this locality is at lat 39°01' N., long 115°29' W; the southern extremity is at lat 38°32' N., long 115°00' W. These places are in the NW 1/4 sec. 3, T. 13 N., R. 58 E., and in the (unsurveyed) SW 1/4 sec. 4, T. 8 N., R. 60 E.

All or part of the topography of the locality is represented on two series of maps; these maps are listed following the Reference list.

Approximate area.--Locality NN-4 is approximately 53 km (33 mi) long, by an average width of about 7 km (5 mi). The width ranges from a minimum of about 2 km (1 mi) to a maximum of about 10 km (6 mi). Thus, the total area is estimated to be roughly 389 km^2 (150 mi^2); of this area, about 25 percent is exposed bedrock containing clay-rich rock at least in part; the extent of the clay-rich units is not determined.

Land ownership.--One block of private land that contains about one quarter-section lies within the boundary of this locality. About 98 blocks that vary greatly in size lie within 40 km (25 mi) of the locality boundaries; these blocks are mainly concentrated along major drainage routes.

The State of Nevada's Wayne Kirch Wildlife Management Area lies along the White River and is 22 km (13 mi) southeast from the southern end of the locality.

About 60 percent of NN-4 lies within the White Pine and Horse Ranges segment of the Humboldt National Forest. The Ward Mountain segment of that forest is 37 km (23 mi) northeast of the northern extremity of the locality, and the Quinn Canyon and Grant Ranges segment of the forest is 25 km (15 mi) to the south-southwest of the southern extremity. Three of the four segments of the Federal Railroad Valley Wildlife Management Area lie 18 to 38 km (11 to 24 mi) west-southwest of the southern extremity of the locality. The two parts of the Duckwater Indian Reservation are 19 km (12 mi) west of the northern part of the locality.

Accessibility.--U.S. Highway 6 crosses the approximate middle of the locality. State Route 20 leaves U.S. Highway 6 at Currant and trends northwest, roughly parallel to the middle part of the locality, and 6 km (4 mi) southwest of the locality boundary. State Route 38 which trends northward through Sunnyside and Preston to U.S. 6, is 15 km (9 mi) or more east of the locality. A secondary road that extends north from U.S. 6 is 14 km (8 mi) distance east from the north part NN-4. Scattered trails enter, but very few cross, the locality. Unmapped trails traversible by 4-wheel-drive vehicles probably are present.

No railroad or petroleum or natural-gas pipeline is present within 40 km (25 mi) of the locality (Lockard, 1970). Two powerline branches terminate within or near the locality; both carry 14,000 to 50,000 V ac. One ends where U.S. Highway 6 crosses the northeastern boundary of the locality, the other at Lund, 20 km (12 mi) northeast of the eastern arm.

Remoteness.--Of five mapped places, three had no reported (Rand McNally, 1977) population in the 1970 census. The two places with reported populations are Duckwater, with a population of 20, located 18 km (11 mi) west of the westernmost part of the locality, and Lund, with a population of 250, located 20 km (12 mi) east of the eastern arm.

Geologic setting.--Like many other ranges in the Basin and Range province, the White Pine Range is the result of both thrust faulting and normal faulting, and to a lesser extent to folding of the strata and to igneous activity. Basically an elongate crustal segment has been raised on the west and south and tilted downward to the east. Faulting has broken the segments into blocks which differ in shape, cross section, and attitude.

At least two and perhaps three clay-rich units present in this locality have enough thickness to warrant further consideration. They are the Chainman Shale, Dunderberg Shale, and the Stoneberger Shale. The Pilot Shale is also present but is only a few meters thick. The Chainman and Dunderberg Shales are mapped individually for the most part, but the Dunderberg is included, in part, in an unnamed shale and limestone unit. The Stoneberger Shale is considered by Kay and Crawford (1964) to be part of the Pogonip Group, and from the source maps (Kleinhampl and Ziony, written commun., 1978; Stewart and Carlson, 1974) it may be the same as, or similar to, the Dunderberg Shale.

Lithologically the Chainman Shale is a black fissile, carbonaceous shale, with siliceous shale locally dominant. Both of these are interbedded with some siltstone, limestone, and a little sandstone and conglomerate. The sandstone commonly is very hard and tough, and graded bedding and cross stratification are present locally. The conglomerate forms massive beds as much as 31 m (100 ft) thick. Some beds of limestone are dense, bituminous, and very fine grained. Others are lighter colored and coarser grained. Limestone beds rarely exceed 31 m (100 ft) in thickness. Lumsden (1964) reported a thickness of 431 m (1,415 ft) for the Chainman Shale in the White Pine Range.

The Dunderberg Shale in the White Pine Range is not well described in readily available literature. In the Hot Creek Range to the west it is described (Kleinhampl and Ziony, written commun., 1978) as "typically an olive- to dark-gray fissile shale with minor thinly interbedded calcareous shale and limestone in beds and lenses 3 - 6 inches (7.5-15 cm) thick." The thickness of this unit in the White Pine Range is reported by Lumsden (1964) to be about 274 m (900 ft).

The Stoneberger Shale is correlated by Kleinhampl and Ziony (written commun., 1978) with part of the Pogonip Group, and particularly with the Ninemile Formation. Lithologically the Stoneberger Shale is black argillite interlayered with very thin-bedded platy quartzose siltstone (Kay and Crawford, 1964). They obtained a thickness of more than 305 m (1,000 ft) for the shale.

Hydrologic setting.--The southern White Pine Range Locality is in the Railroad Valley and White River ground-water systems and drainage basins. The nearest discharge is along Currant Creek 10 km (6 mi) westward from the approximate center of the locality. Water is used in the area mainly for domestic and livestock purposes.

Mineral-resource activity.--No active mines are located either within the locality, or within a distance of 40 km (25 mi) (Payne and Papke, 1977). Neither are there patented lode-mining claims within the locality, but about 25 single claims plus two blocks of claims are present in the White Pine (Hamilton) mining district 19 to 30 km (12 to 18 mi) to the north of the locality. A group of three claims are located 34 km (21 mi) southwest of the southern end of NN-4, in the southern part of the Grant Range.

No drill holes for oil and gas tests are within the locality, but some 57 scattered test holes are within 40 km (25 mi) of it (Garside and Schilling, 1977). Of these, 15 had oil shows reported, and one had both oil and gas shows reported. Most of the test holes are located in Railroad Valley south-southwest of NN-4, and some to the east and southeast of NN-4 in the White River Valley. A few are scattered, mainly in valleys, to the north of the locality.

The drilling in Railroad Valley resulted in the development of 14 producing oil wells in the Eagle Springs Field, about 26 km (16 mi) west of the southern end of the locality, and the Trap Spring Field of two producing wells about 37 km (23 mi) west of that end.

NN-5: White River Valley Locality

This locality is small, and consists of a few widely scattered areas of exposed bedrock located on both sides of the White River valley in the southeastern corner of northern Nye County. The locality is geographically divisible into three parts. Part A is a single area of exposure at the north end of a ragged ridge of the Golden Gate Range southwest of Whipple Reservoir. Part B, 17 km (10 mi) east thereof, consists of four areas of exposure east of that reservoir, and thus on the west flank of a ridge of hills marking the southern end of the Egan Range. Part C is a single small exposure low on the west flank of the Seaman Range; it is 22 km (14 mi) from part A, and 15 km (10 mi) from part B.

Geographic location.--The single exposure of part A is at lat 38°15' N., long 115°16' W. The north end of part B is at lat 38°18' N., long 115°02' W., and the south end at lat 38°10' N., long 115°02' W. Part C is at lat 38°04' N., long 115°11' W. If described by standard land survey, part A is in (unsurveyed) sec. 25, T. 5 N., R. 59 E.; part B extends from sec. 18, T. 5 N., R. 62 E.; and part C is in (unsurveyed) sec. 6, T. 2 N., R. 61 E.

The locality is represented on topographic maps of two series; these maps are listed following the Reference list.

Approximate area.--Part A is about 4 km (2 mi) long, by 2 km (1 mi) wide, thus having an area estimated at about 3 km^2 (1 mi^2) of exposed clay-rich bedrock. Part B is 15 km (9 mi) long by about 2 km (1 mi) wide, and so has an estimated area of 23 km^2 (9 mi^2). Of this area an estimated 15 percent is exposed by clay-rich bedrock. Part C has an area of about 1 km^2 (0.4 mi^2), essentially all of which is exposed clay-rich bedrock.

Land ownership.--No private land lies within the boundaries of the three parts, but about 54 blocks of private land that vary from small to moderate in size are scattered between the three parts and within a radius of 40 km (25 mi) of them. Part of this private land is concentrated along the White River between parts A and B of the locality.

The State of Nevada's Wayne Kirch Wildlife Management Area is located along the White River, 8 km (5 mi) northwest of part B, and the southwest part of the Mt. Grafton Scenic Area is 40 km (25 mi) northeast of the north end of part B.

The Federal Railroad Valley Wildlife Management Area is 37 to 50 km (23 to 31 mi) northwest of part A. The Quinn Canyon and Grant Ranges segment of the Humboldt National Forest lies 7 km (4 mi) west of that part. All other land within 40 km (25 mi) of the locality is Federal public land.

Accessibility.--No Federal highway is within 40 km (25 mi) of any part of Locality NN-5. State Route 38 lies east of part B about 1.5 km (0.9 mi) from the northeasternmost exposure, and 16 km (10 mi) east of part C. A secondary road along the west side of Garden Valley is 3 km (2 mi) from part A at the nearest point. Trails are numerous in the area, and all parts of the locality probably are accessible by 4-wheel-drive vehicles.

No railroad or petroleum or natural-gas pipeline, is within 40 km (25 mi) of any of the locality parts (Lockard, 1970).

Remoteness.--The townsite of Sunnyside is 16 km (10 mi) north of the northern end of part B; the townsite had no population reported (Rand McNally, 1977) in the 1970 census.

Geologic setting.--The well separated parts of this locality lie on the flanks of ridges marking the extremities of mountain ranges bordering the White River valley. The ridges, like the ranges, are the result of faulting that raised elongate segments of the Earth's crust along their western margins, and tilted them downward to the east. Normal faulting has broken the segment into blocks characterized by differing shape, cross section, and attitude.

Two clay-rich bedrock formations, the Pilot Shale and the Chainman Shale are exposed locally in the White River Valley Locality, but only the Chainman is thick enough for consideration here. In these ranges (Kleinhampl and Ziony, written commun., 1978) this formation consists chiefly of shale and siltstone; conglomerate is absent, and interbedded fine- to medium-grained sandstone layers occur only in the uppermost 91 m (300 ft). The thickness is not reported for northern Nye County in readily available references, but Kellogg (1963) reported about 335 to 427 m (1,100 to 1,400 ft) in the southern Egan Range in the adjacent northwestern corner of Lincoln County.

Hydrologic setting.--Locality NN-5 is in the large White River ground-water system of dominantly southward ground-water migration extending about 385 km (239 mi) from northern Long Valley in southern Elko County to Moapa Valley in eastern Clark County. Locality NN-5 is near the center of this flow system where it is the widest, about 112 km (70 mi).

Runoff from the locality flows to Garden and Coal Valleys and White River. The White River intermittent stream joins the Colorado River (via Muddy River) to the south, although it has not historically flowed throughout this full reach.

The nearest discharge to the center of the exposures that are east of the river is 6 km (4 mi) west. A windmill well at the river, approximately 13 km (8 mi) east of the center of the exposures west of the river, is the nearest discharge to that part of the locality. Water is used in this reach of the river valley mainly for livestock.

Mineral-resource activity.--No active or inactive mines are known within Locality NN-5, or within 40 km (25 mi) of it (Payne and Papke, 1977). Within that radius, however, two patented lode-mining claims are located 32 km (20 mi) west of part A, and a group of three others 19 km (12 mi) northwest; all are in the adjacent Quinn Canyon and Grant Ranges. One additional claim is about 32 km (20 mi) east of the southern end of part B.

About 35 oil and natural-gas tests have been drilled within 40 km (25 mi) of the locality (Garside and Schilling, 1977). Mainly they constitute two groups that lie to the northwest and north of NN-5. The larger group is located in Railroad Valley about 32 km (20 mi) northwest of part A; of the numerous wells there, 25 are within the radius specified above. Nine of these had oil shows reported when drilled. Two small oil fields in Railroad Valley are beyond the radius specified.

The other group, consisting of 13 reportedly abandoned holes, lies about 11 km (7 mi) north of the northern end of part B, although one hole is only about 9 km (5 mi) northwest of that end. Several other drill holes of this group lie beyond the specified radius.

NN-6: Quinn Canyon and Grant Ranges Locality

The Quinn Canyon and Grant Ranges Locality, NN-6, is a large, somewhat tear-drop shaped area containing numerous exposure areas that range in size from small to large. The locality lies on both flanks of the Quinn Canyon and Grant Ranges in the eastern part of northern Nye County, and consists of a single part.

Geographic location.--The north end of the locality is at lat 38°39' N., long 115°25' W. The southern extremity is at lat 38°06' N., long 115°42' W. These places are in the center of (unsurveyed) sec. 14, T. 9 N., R. 58 E., and in the (unsurveyed) NW 1/4 sec. 28, T. 3 N., R. 56 E.

The locality is represented wholly or in part on topographic maps at two different scales; these maps are listed following the Reference list.

Approximate area.--Locality NN-6 is about 66 km (41 mi) long. It ranges from about 0.8 km (0.5 mi) to 22 km (14 mi) in width, with an estimated average of about 15 km (9 mi). This gives a total area of roughly 777 km^2 (300 mi^2). Of this an estimated 25 percent is exposed bedrock and perhaps half of that is clay-rich rock. The extent of clay-rich rock is not determined.

Land ownership.--Five blocks of privately-owned land are wholly or partly within the boundary of the southern part of the locality. About 70 additional blocks that range from small to moderate in size are in part widely scattered beyond the locality boundary but within a distance of 40 km (25 mi) from it, and are in part, concentrated along Currant Creek and the White River.

The State of Nevada's Wayne Kirch Wildlife Management Area along the White River is 16 km (10 mi) east of the locality boundary. Federally-controlled land within 40 km (25 mi) of the locality includes the Duckwater Indian Reservation, 35 km (22 mi) northwest of the northern extremity; the four segments of the Railroad Valley Wildlife Management Area, which lie from 6 to 18 km (4 to 11 mi) northwest; and the Quinn Canyon and Grant Ranges segment of the Humboldt National Forest, which includes most of the southern half of the locality. The remainder of the land within a radius of 40 km (25 mi) is Federal public land.

Accessibility.--U.S. Highway 6 is 11 km (7 mi) northwest of the north end of the locality. Similarly, State Route 38 is from 27 km (17 mi) east of the northern part of the locality. A secondary road follows the foot of the western flank of the range, and is from 2 to 6 km (1 to 4 mi) west of the locality boundary. A similar road borders the southern half of the eastern flank, turning eastward to join State Route 38 at Sunnyside. This secondary road lies within the locality boundary for a short distance, and is no more than about 8 km (5 mi) from the boundary. Cherry Creek Canyon, which separates the two ranges, is the site of the only mapped road that crosses the locality. Unmapped trails may be accessible by 4-wheel-drive vehicles.

Lockard (1970) shows no railroad, or petroleum or natural-gas pipeline, within 40 km (25 mi) of the locality boundaries. One power transmission line that carries from 50,000 to 80,000 V ac terminates about 27 km (17 mi) northwest of NN-6 near Black Rock Summit on U.S. Highway 6.

Remoteness.--The village of Duckwater, 39 km (24 mi) northwest of the north end of the locality, is reported by Rand McNally (1977) to have a 1970 census population of 20. Neither Currant, 12 km (7 mi) northwest, nor Sunnyside, 28 km (17 mi) east of the locality, had any population reported.

Geologic setting.--The Quinn Canyon and Grant Ranges, like many other ranges in the Basin and Range province is chiefly the result of both thrust faulting and normal faulting, and in part of volcanism. Basically the range is an elongate crustal element raised on the west by faulting, and tilted downward to the east. Other faults have broken the element into blocks that are characterized by differing shape, cross section, and attitude.

Five clay-rich bedrock units are exposed in the combined Quinn Canyon and Grant Ranges (Kleinhampl and Ziony, written commun., 1978). They are the Pioche Shale, Dunderberg Shale, Ninemile Formation, Pilot Shale, and the Chainman Shale. Of these, the Pilot Shale and Dunderberg Shale are too thin for further consideration.

The Chainman Shale consists mainly of fissile black shale or, locally, siliceous shale, with interlayers of siltstone. Beds of sandstone, mostly fine- to medium-grained, occur in the uppermost 91 m (300 ft). No specific thickness of the Chainman Shale is available for the Quinn Canyon or Grant Ranges, but as the formation farther north in the White Pine Range is known to be 431 m (1,415 ft) (Lumsden, 1964), it is inferred to be more than 152 m (500 ft) thick here. In the Grant Range, the Chainman Shale and Diamond Peak Formation, undivided, is reported (Hyde and Huttrer, 1970) to range from 198 to 427 m (650 to 1,400 ft).

The Ninemile Formation (Kleinhampl and Ziony, written commun., 1978) is the middle of three units that constitute the Pogonip Group, and is a correlative of the Stoneberger Shale (Kleinhampl and Ziony, written commun., 1978). In the Grant Range the formation is described as clay shale, calcareous shale and siltstone, plus shaly and silty limestone, with a thickness of about 427 m (1,400 ft).

The Pioche Shale is reported to be "perhaps as much as" 213 m (700 ft) thick near Troy Canyon (Cebull, 1970), however Hyde and Huttrer (1970) measured "at least" 122 m (400 ft) in Grant Canyon. The latter describes the Pioche Shale as 75 percent quartzite and shale, and 25 percent limestone.

Hydrologic setting.--The Quinn Canyon and Grant Range locality is in Railroad Valley and White River ground-water systems. Runoff flows to Railroad Valley, White River, and Garden Valley. The nearest significant discharge is 10 km (6 mi) west of the approximate center of the locality near the east edge of Railroad Valley, where the water is used for livestock and domestic purposes. Numerous small springs in the Quinn Canyon and Grant Ranges are used periodically for livestock watering.

Mineral-resource activity.--No active mines are located (Payne and Papke, 1977) within the locality, or within a radius 40 km (25 mi) of it. Five patented lode-mining claims that constitute two groups are located in the southern part of NN-6, on the west flank of the ranges; none occur outside the locality but within the radius mentioned.

Garside and Schilling (1977) have mapped two small oil fields in Railroad Valley. One, the Eagle Springs Field which contains 14 producing wells, is about 10 km (6 mi) west-southwest of the north end of the locality. The other, the Trap Spring Field, with two producing wells, is about 21 km (13 mi) west of the north end. Garside and Schilling also mapped 34 additional test holes for oil and gas in the Railroad Valley area. Of these, 12 had oil shows reported. Garside and Schilling also mapped a group of 16 drill holes in the White River Valley, from 6 to 40 km (4 to 25 mi) east of the northern part of the locality. Two of these had oil shows. A few scattered holes in each of these two groups lie beyond the 40 km (25 mi) radius.

NYE COUNTY, SOUTHERN PART

One locality of clay-rich rock suitable for further investigation is situated in southern Nye County. In addition, southern Nye County may contain a northwestward extension from adjacent Clark County of the Spring Mountain locality (CL-1) described in the Clark County section of this report. Such an extension is not shown on the accompanying southern Nye County map because sufficient information to warrant inclusion is presently unavailable.

Clay-rich sedimentary strata present in the single locality are assigned mainly to the Carrara Formation and the Wood Canyon Formation, and in part to an unnamed unit. The remainder are assigned to the Dunderberg Shale and the Eleana Formation, but these units are both too thin for further consideration. The rock present in the three units of interest is mainly shale and siltstone interbedded with layers of quartzite, sandstone, and limestone. These units, or the attractive parts of them, range in thickness from 213 to 401 m (700 to 1,315 ft). In some places the Carrara and Wood Canyon Formations, and the unnamed unit, are not differentiated from the adjacent stratigraphic units above and below, and so may or may not be differentiated on the accompanying map of White Pine County localities. The relative areal extent of surface exposure is moderately small.

Nye County is a relatively large county which is characterized by a T-like shape and is situated in south-central Nevada. Because of its size and shape the county is divided arbitrarily for the purpose of this report into two parts by the 38th Parallel of latitude. This parallel approximately marks the junction of the crossbar of the T with its vertical part. For convenience the two parts are referred to as northern Nye County and southern Nye County. Only the southern part of Nye County is discussed in this segment of this report.

Most of the southern part of Nye County is relatively well studied geologically, especially the NTS and its vicinity which has received extensive attention. The single most useful report on the county contains a geologic map prepared at a scale of 1:250,000 by H. R. Cornwall (1972).

The southern part of Nye County is centrally located in southern Nevada. The southern part has a total area of about 18,721 km^2 (7,228 mi^2), but the population of the area is undetermined here; it is inferred to be somewhat less than half of the 5,599 total population of Nye County reported in the 1970 census (Rand McNally, 1977). The county seat, Tonopah, is located in northern Nye County, and is situated 10 km (6 mi) northwest of the northwest corner of southern Nye County.

The southernmost part of southern Nye County is served by U.S. Highway 95 from Tonopah to Las Vegas, and power-transmission lines carrying 80,000 V ac and more service the extreme southeast corner of the county; no petroleum or natural-gas pipelines are present (Lockard, 1970).

Southern Nye County is represented on parts of four topographic maps published by the USGS. These maps are at a scale of 1:250,000. The specific topographic maps that represent these areas are listed following the Reference list.

The Eleana Formation

The argillitic Eleana Formation crops out extensively in southern Nye County. Nearly all of the exposure area lies within the boundaries of the NTS, but one small exposure is adjacent to the Belted Peak locality (SN-1), and two other small exposures are in the western

part of southern Nye County. The Eleana Formation with the NTS is being studied by others, and is not evaluated here. For comparative use by the reader, the formation as it is presently known from published mapping on the NTS is described briefly below.

Eight principal exposure areas of differing size occupy an area about 51 km (31 mi) long by 11 km (7 mi) wide that trends north-northeast across the central part of the NTS. Together they occupy the southern end of the Shoshone Range, the Eleana Range, and Mine Mountain. In general, the geologic character of these ranges is somewhat similar to that of the other ranges in the Basin and Range province. The ranges portray a history of thrust faulting and later block faulting, so that segments of the ranges differ in shape, cross section, and attitude of the sedimentary rock layers in them. These ranges are distinguished by the folded nature of the constituent strata from many of the ranges in eastern Nevada; this folding probably developed during the time of thrusting.

The strata of the Eleana Formation have been studied in detail, mainly during quadrangle mapping in and adjacent to the NTS. Poole, Houser, and Orkild (1961) divided the strata into 10 major subunits, or members, designated by letters and beginning with the basal subunit. Subunits B, E, H, and J are of greatest interest here as they are composed chiefly of argillite. The remaining subunits in part contain some argillite, but limestone, quartzite, and conglomerite are dominant. Scattered layers composed of these lithologies are interbedded with the thinly laminated to thinly layered argillite, which may compose as much as 85 percent of the more argillitic subunits. Thickness of the more attractive subunits differ, but range from 73 to 1,067 m (240 to 3,500 ft). Total thickness of the units is greater than 2,347 m (7,700 ft).

Outside the boundary of the NTS, strata assigned to the Eleana Formation are exposed at three general places in southern Nye County. These places are as follows: (1) on the southwest flank of Meiklejohn Peak just northeast of Bare Mountain, (2) on the southwest flank of the southern part of the Cactus Range, and (3) in the flat terrain east of Belted Peak in the Belted Range. The first and second places have not been studied in detail, and apparently nothing specific reagrding their lithology or thickness has been published. The third place was mapped (Ekren and others, 1967) and is known to contain argillitic strata assigned to unit H of the Eleana Formation. More than 76 m (250 ft) of this unit are exposed, but the unit is less than 152 m (500 ft) thick in the northern part of the test site, and evidence suggests the formation may thin toward the northeast. None of these three places is believed to be suitable for further investigation because either insufficient information is available, or the rock is believed to be too thin.

NS-1: Belted Range Locality

Locality NS-1 is situated on the western flank of the northern part of the Belted Range, in the northeastern part of southern Nye County. The locality consists of a single part that is relatively small, compact, and roughly elliptical in shape.

Geographic location.--The northern end of the locality is at lat 37°39' N., long 116°08' W.; the southern end is at lat 37°29' N., long 116°07' W. These locations place the two ends in the (unsurveyed) NE 1/4 sec. 33, T. 3 S., R. 52 E., and the (unsurveyed) SW 1/4 sec. 22, T. 5 S., R. 52 E., respectively

The entire area of NS-1 is represented topographically on maps at two different scales; these maps are listed following the Reference list.

Approximate area.--The length of the locality is 18 km (11 mi) and the average width is estimated at 3 km (2 mi); thus, the area of NS-1 is about 57 km^2 (22 mi^2). An estimated 75 percent of the locality is exposed bedrock containing clay-rich rock, but the extent of clay-rich rock is not determiend.

Land ownership.--The entire area of NS-1 lies within the boundaries of the Nellis Air Force Base Bombing and Gunnery Range. Land in the vicinity of the locality, that is, within a radius of about 40 km (25 mi) of the locality boundary, is mostly under Federal control. About 50 percent is land within the bombing and gunnery range, about 35 percent is Federal public land,about 10 percent lies within the northern boundary of the NTS, and 5 percent is private land. The test site boundary is 13 km (8 mi) south of the locality, and the larger and nearer of two blocks of private land is 22 km (14 mi) east-northeast.

Accessibility.--Access to the locality is forbidden without specific authorization by the USAF because of bombing and gunnery hazards caused by its location within the boundaries of the bombing and gunnery range. The nearest highway is State Route 25 which lies 18 km (11 mi) northeast of the locality and trends northwest. One secondary road that trends southwest lies 17 km (11 mi) east of NS-1, and a second, which trends west, is 12 km (7 mi) north. Unmapped trails accessible by 4-wheel-drive vehicles probably are present.

As of 1970 (Lockard), no railroad, powerline, or pipeline served the locality or lay within 40 km (25 mi) of it.

Remoteness.--Only one concentration of population lies within 40 km (25 mi) of the locality boundary. The village of Tempiute is located on a circuitous secondary road adjacent to State Route 25; the village is 40 km (25 mi) east-northeast of the locality. Rand McNally (1977) reports the 1970-census population was 10.

Geologic setting.--The Belted Range is an elongate faulted block that is raised on the west and tilted downward toward the east; unlike many ranges it is marked by folded strata, notably on the west flank.

Four named clay-rich formations and one unnamed unit are present at the ground surface in this locality. One named unit, the Dunderberg Shale, is only about 61 m (200 ft) thick, and another, unit H of the Eleana Formation, although more than 76 m (250 ft) thick, is inferred to be no more than about 152 m (500 ft) thick. Neither is considered further. Those units that are thick enough for further investigation include the Carrara Formation, the Wood Canyon Formation, and the unnamed unit.

The Wood Canyon Formation has been divided in the field (Ekren and others, 1971) into three subunits; these are designated by letters beginning with the basal subunit. The uppermost subunit, C, appears suitable for further investigation. Subunit C is dominantly micaceous siltstone with smaller amounts of quartzite, and "carbonate rock" (which might be limestone, dolomite, or marble containing less than 10 percent silt). The amount of interbedded quartzite increases upward, and may become dominant. The carbonate rock largely constitutes a zone about 31 m (100 ft) thick that lies some 259 m (850 ft) above the base of the subunit. The thickness of this subunit is reportedly 401 m (1,315 ft).

The Carrara Formation is divisible in the field (Ekren and others, 1971) into four subunits, designated by letters beginning with the basal unit. Of the four parts, subunits B and C are here considered suitable for further investigation. Subunit C mainly is a homogeneous shale containing abundant fine-grained sericite (mica), and characterized by papery fissility. This grades downward into subunit B, a shale with minor interbeds of siltstone, sandstone, and limestone, which are more abundant in the top part of the subunit. This upper part also contains considerable coarse mica giving the rock a somewhat "schistose" appearance. Subunit C is about 122 m (400 ft) thick, and the underlying unit B has a thickness of about 216 m (710 ft); a total thickness for the two subunits of about 338 m (1,110 ft).

The unnamed strata consists of three subunits that are identifiable in the field. These also are designated by letters, beginning with the basal unit. Subunits A and B are predominantly limestone and not considered further. Subunit C consists of a fissile shale that breaks into platy to elongate fragments, and is about 213 m (700 ft) thick.

Hydrologic setting.--The rock exposures are on the west flank of the Belted Range. The locality is in the Pahute Mesa ground-water system of generally southwestward flow.

Surface-water runoff drains westward into Kawich Valley, a basin of interior drainage with dry playas.

The closest significant ground-water discharge is 72 km (45 mi) southwest of the center of the locality in Oasis Valley. Water is used in Oasis Valley for livestock, domestic, and public supply. Cliff Spring, within the Belted Peak locality, discharges a small amount of water used mainly by wild animals.

Mineral-resource activity.--No active mines are reported within this locality (Payne and Papke, 1977), but active mines that produce tungsten are located near Tempiute in the western part of the Tempiute Range. These mines are about 39 km (24 mi) east-northeast of the Belted Peak locality.

No oil or gas wells are reported (Garside and Schilling, 1977) within 40 km (25 mi) of the locality.

WHITE PINE COUNTY

Eleven localities of clay-rich rock suitable for further investigation lie wholly within White Pine County. Another, the Ruby Mountains Locality (WP-1) extends northward from White Pine County into adjacent Elko County; it is described here because the larger part of the locality lies in, and better descriptive information is available for, White Pine County. Two localities extend into White Pine County from adjacent counties. One, the Southern White Pine Range Locality (NN-4), extends northward into White Pine County from the adjacent northern part of Nye County; the other is the Diamond Mountains Locality (EU-1), most of which is located in adjacent Eureka County on the west. The White Pine County portion is not shown on this map. These two localities are described in those county sections of this report for similar reasons. The several localities described here are well scattered about the county.

Thirteen geologic units of potential interest are represented among the localities. The dominant rock types are both metamorphic and sedimentary in origin, and range from mudstone, claystone, and shale, to argillite, phyllite, slate, schist, and gneiss. Sandy, conglomeratic, and calcareous layers can be interbedded with them, as are conglomerite and marble. The various kinds of rocks are assigned to the Sheep Pass Formation, Chainman Shale, Pilot Shale, Lincoln Peak Formation, Kanosh Shale, Secret Canyon Shale, Dunderberg Shale, Cabin Shale, Pioche Shale, and to the Osceola Argillite, Strawberry Creek Formation, subunit C, and subunit B, all of the McCoy Creek Group of Misch and Hazzard (1962). In some places these units are not differentiated from the adjacent stratigraphic units above and below, and so may or may not be differentiated on the accompanying map of White Pine County localities.

Thickness of the units, or the attractive parts of units, range from about 152 to 762 m (500 to 2,500 ft). The areal extent of surface exposures of each unit relatively is from small to large.

White Pine County has been relatively well studied geologically, so some published information is available for each locality. The applicable references are listed in the Bibliography. The single most useful report contains a geologic map of the county at a scale of 1:250,000 (2.5 km/cm, or about 4 mi/in.); this report was prepared by Hose and Blake (1976).

White Pine County, situated in the northeastern part of Nevada, has an area of 23,061 km^2 (8,904 mi^2) and a 1970 census population of 10,150 (Rand McNally, 1977). The county seat is the town of Ely, with a 1970 population of 4,176 (Rand McNally, 1977). It lies just south of the center of the county, adjacent to one locality and less than 16 km (10 mi) from three others. The community is situated on U.S. Highways 6, 50, and 93. It is oriented to local service in an area of cattle ranches and some active mines, and to the needs of highway travelers. The county contains no petroleum or natural-gas pipelines, but does have power-transmission lines carrying from 14,000 to 50,000 V ac in the vicinity of Ely. A railroad extends as far southward as Ely from the town of Wells in adjacent Elko County.

The county is represented on parts of three topographic maps published by the USGS. These maps all are at a scale of 1:250,000 (2.5 km/cm or about 4 mi/in.), and are listed following the Reference list.

WP-1: Ruby Mountains Locality

Locality WP-1 consists of a single part, but is composed of several scattered areas of exposed bedrock; together these form an elongate locality of very irregular shape. The exposure areas are somewhat scattered about the flanks of the southern Ruby and southwestern Maverick Spring Ranges, the Bald Mountains and Buck Mountain, in northwestern White Pine County. The locality extends northward into adjacent Elko County a distance of about 35 km (22 mi), but it is assigned to White Pine County and described here because more geologic information is available in this county.

Geographic location: The northern extremity of Locality WP-1 is at lat $40^{o}25'$ N., long $115^{o}28'$ W.; the southern extremity is at lat $39^{o}36'$ N., long $115^{o}40'$ W. These points are in the (unsurveyed) SE corner NE 1/4 sec. 6, T. 29 N., R. 58 E., and the SW 1/4 sec. 15, T. 20 N., R. 56 E.

The locality is wholly represented on topographic maps at a scale of 1:250,000, but only part is represented on maps of either the 1:62,500-scale series or the 1:24,000-scale series. The various maps are listed following the Reference list.

Approximate area: Locality WP-1 has a total length for both counties of 98 km (61 mi). Its minimum width is 0.5 km (0.3 mi), and its maximum width is 13 km (8 mi); the estimated average width is 8 km (5 mi). Thus, the approximate area is 790 km^2 (305 mi^2). Of this area, perhaps 30 percent is exposed bedrock, but the extent of the clay-rich bedrock is not determined.

Land ownership: The southern half of this locality is predominantly Federal public land (Lutsey and Nichols, 1972). All or part of six small to medium-size blocks of private land also lie within this half of the locality. Within the northern half the land enclosed is chiefly part of the Ruby Mountains segment of the Humboldt National Forest. Six small blocks of private land are enclosed by the boundary of this half, together with a similar-size area of Federal public land.

Within a radius of 40 km (25 mi) of WP-1 an estimated 20 percent of the area is Federal public land. About 10 percent that is privately owned is located mainly north of the northern part, in Elko County, in part in large blocks and in part checkerboarded with either public land or national forest land. Land in the vicinity of the middle and southern parts of the locality is predominantly Federal public land, with many scattered blocks of private land; of small to moderate size, some of these are festooned along drainage routes. The White Pine Range segment of the national forest is 32 km (20 mi) southeast of the southern extremity of WP-1. The Ruby Lake National Wildlife Refuge is located just east of the northern part of the locality, and touches the locality boundary at one point. The southern part of the South Fork Indian Reservation is 16 km (10 mi) northwest of the northern extremity, and the northern part is 32 km (20 mi) northwest. The nearest part of the Odgers Ranch Indian Reservation is 34 km (21 mi) east of the northern part of WP-1. The USBR has withdrawn one section of land 19 km (12 mi) east of the middle section. Parts of four State-controlled livestock driveways lie within 1.1 to 37 km (0.7 to 23 mi) from the locality; one driveway is west of the southern part, two are west of the northern part, and one is east of the

northern part. The north end of the locality extends about 0.5 km (0.3 mi) into the southern end of the Ruby Mountains Scenic Area.

Accessibility: U.S. Highway 50 passes within 19 km (12 mi) of the southern tip of the locality. State Highway 46 passes within 4 km (2 mi) of the west edge of the area. Secondary and ranch roads provide access to many parts of this large locality, and unmapped trails accessible by 4-wheel-drive vehicles probably are available.

There are no pipelines, powerlines, or railroads within 40 km (25 mi) of the locality. Electric power is locally generated at Eureka.

Remoteness: Eureka, with a 1970 census population of 500 (Rand McNally, 1977) is 28 km (17 mi) southwest of the southern extremity, and Ruby Valley, with a 1970 population of 20 located on the west margin of Franklin Lake, Elko County, lies at the locality boundary.

Geologic setting: The ranges within this locality are typical of many in the Basin and Range province. They are mainly the result of both thrust and normal faulting. Elongate crustal segments generally were raised on the west, and tilted downward to the east.

Within Locality WP-1 are three units that consist mainly of clay-rich bedrock, and each warrants further consideration. The three units are the Chainman Shale, Pilot Shale, and Dunderberg Shale. An unnamed argillitic unit of Late Cambrian age geologically described by Sharp (1942) is perhaps more or less equivalent to the Dunderberg Shale, also of Cambrian age, which is described by others (Hose and Blake, 1976; Rigby, 1960).

The Chainman Shale consists (Rigby, 1960; Hose and Blake, 1976) of three subunits. The upper subunit is carbonaceous graywacke and claystone that locally contains interbeds of limestone from 8 to 15 cm (3 to 6 in.) thick; the middle subunit is gray limestone, and the lower subunit is chiefly gray to black soft shale with interbeds of silty claystone to platy siltstone. Rigby found the upper subunit to be about 229 m (750 ft) thick in the Buck Mountain-Bald Mountains area, the middle subunit to be approximately 31 m (100 ft) thick, and the basal subunit to be about 47 m (155 ft) thick. This is a total thickness for the entire unit of 306 m (1,005 ft).

The Pilot Shale consists mainly of tan to gray, platy, dolomitic siltstone that is interbedded with silty shale. Beds of clayey to silty limestone from 8 to 15 cm (3 to 6 in.) thick, and of claystone, are present locally (Hose and Blake, 1976). Rigby (1960) found the unit to be from 122 m to 183 m (400 to 600 ft) just north of that boundary.

The Dunderberg Shale consists mainly of soft, gray to black, silty shale with local interbeds of finely crystalline limestone from 5 to 15 cm (2 to 6 in.) thick; the limestone is most abundant in the upper part of the unit (Hose and Blake, 1976). The unnamed argillite of Late Cambrian age described by Sharp (1942) that might be a correlative of the Dunderberg Shale consists of gray to black thin-bedded argillite, with interbeds of gray-green quartzitic argillite and thin gray limestone. Hose and Blake estimated a thickness of 366 to 427 m (1,200 to 1,400 ft) for the Dunderberg Shale, and Sharp measured by pace and compass a thickness of 472 m (1,550 ft) for his unnamed argillite. Rigby (1960) differentiated about 122 m (400 ft) of the Dunderberg Shale.

Hydrologic setting: Locality WP-1 is in four ground-water systems; they are the Newark Valley, Ruby Valley, Humboldt River basin, and White River systems. Surface runoff flows to Newark, Ruby, Huntington, and Long Valleys.

The two nearest significant discharge areas are: (1) in Newark Valley, 11 km (7 mi) west of the approximate center of the southern half of the locality, and (2) in Ruby Valley, 10 km (6 mi) eastward from the approximate center of the northern half; near the north end of the locality, discharge occurs 2 km (1 mi) east of the eastern boundary. Ground water is used in both valleys for irrigation, domestic, and livestock purposes, and for wildlife management in Ruby Valley only.

Mineral-resource activity: Two active mines exist (Payne and Papke, 1977) within 40 km (25 mi) of the southern tip of Locality WP-1; a lead, silver, zinc, and copper mine about 29 km (18 mi) south-southwest and a gold mine 34 km (21 mi) southwest, both in the Eureka area.

A group of five patented lode-mining claims lie within the southern half of the locality. Outside the locality a single claim is 10 km (6 mi) northeast of the northern end; a group of 24 individual claims plus two blocks of claims mark the White Pine mining district, which is centered 40 km (25 mi) south of the southern tip, and about 30 claims plus three blocks of claims lie about 31 km (19 mi) southeast in the Eureka mining district. Three claims are located 17 km (11 mi) west of the southern half of WP-1, and one claim is 35 km (22 mi) west of the middle of the locality.

A total of 31 oil-and-gas exploratory holes (Garside and Schilling, 1977) have been drilled within 40 km (25 mi) of the locality. Of these, 2 reported oil shows and 11 reported oil and gas shows. A moderately large group of holes is north and west of the Diamond Mountains. Several holes are scattered about the southern part of the vicinity, and a few are widely scattered.

WP-2: Cherry Creek Range Locality

Locality WP-2 is an elongate, slightly curved area of somewhat irregular form that is located mainly on the western flank of the Cherry Creek Range in north-central White Pine County. The locality, which consists of a single part, extends northeastward 2 km (1 mi) into adjacent Elko County, but is assigned to White Pine County and described here because the areal extent in Elko County is very small, and most geologic information for the range is obtained from studies in White Pine County.

Geographic location: The northern extremity is at lat 40°08' N., long 114°48' W.; the southern extremity is at lat 39°42' N., long 115°06' W. These locations are in the E 1/2 sec 4(?), T. 21 N., R. 61 E., and the NE 1/4 sec. 13, T. 26 N., R. 63 E.

The locality is represented on topographic maps only of the 1:250,000-scale series; these sheets are listed following the Reference list.

Approximate area: Locality WP-2 is 54 km (34 mi) long. It has a maximum width of 8 km (5 mi) and a minimum width of 0.5 km (0.3 mi), and an estimated average width of 2 km (1 mi). Thus, the area of the locality is about 86 km^2 (33 mi^2). An estimated 50 percent is exposed bedrock containing clay-rich units, but the extent of those clay-rich units is not determined.

Land ownership: All or part of five small blocks of privately-owned land lie within the locality; the remainder is Federal public land. Within the vicinity, a radius of 40 km (25 mi), land is mostly Federal public domain. The Schell Creek segment of the Humboldt National Forest is 30 km (18 mi) east of the southern portion of WP-2. The USBR has withdrawn three small blocks of land: one section is 30 km (18 mi) south of the southern end, another section is 16 km (10 mi) west of the middle portion, and a half-section lies 33 km (20 mi) east of the middle. The nearest part of the Odgers Ranch Indian Reservation is 21 km (13 mi) north-northwest of the northern end. Within 40 km (25 mi) of the locality boundary are roughly 85 blocks of private land that range in size from small to moderately large. These are generally scattered, but some are concentrated along drainage routes. All or part of two State-controlled livestock driveways located in Elko County are within 19 km (12 mi) of the northern end of WP-2.

Accessibility: U.S. Highway 93, which follows Steptoe Valley, is as little as 14 km (9 mi) from the southeastern margin of the locality. State Route 35 extends from U.S. 93 to the village of Cherry Creek, and a secondary road continues northwest and north across the middle of WP-2. Local roads provide access to most parts of the locality, and unmapped trails, some perhaps only accessible by 4-wheel-drive vehicles probably are present. A railroad along Steptoe Valley is from 5 to 25 km (3 to 15 mi) east of the locality. There are no powerlines, or pipelines (Lockard, 1970) within 40 km (25 mi) of WP-2.

Remoteness: Of five places mapped, only two had populations reported in the 1970 census (Rand McNally, 1977). Cherry Creek, with a population of 30, is located 7 km (5 mi) east of the middle of the locality. Currie, also with a population of 30, is located 15 km (9 mi) north-northeast of the northern extremity of WP-2.

Geologic setting: The Cherry Creek Range is similar to most other ranges in the Basin and Range province. Like several other ranges in eastern White Pine County, however, it differs somewhat by having a major normal fault along the eastern margin, so that the elongate segment of the Earth's crust is raised on the east and tilted downward to the west.

Six bedrock formations in the Cherry Creek Range are clay-rich; they are the Chainman Shale, Pilot Shale, Kanosh Shale, Dunderberg Shale, Secret Canyon Shale, and Pioche Shale (Fritz, 1968). Of these, three are believed by Fritz to exceed 152 m (500 ft) in thickness; they are described below. He found the Dunderberg Shale has a maximum thickness of about 151 m (495 ft), the Kanosh Shale a thickness of 100 m (300 ft), and the Secret Canyon Shale to consist mainly of limestone; none of the three is considered further.

The Chainman Shale is described (Hose and Blake, 1976) as dark-gray to black shale and olive-gray platy siltstone or silty shale; the lower part includes thin interbeds of bituminous, dark, fine-grained limestone and some lighter beds of organic limestone, plus thin beds of detrital limestone in the uppermost 15 m (50 ft). They estimate the maximum thickness to be 488 m (1,600 ft), but indicate the thickness varies greatly. Fritz (1968) mentions about 11 m (35 ft) of fine- to medium-grained light-colored quartzite near the middle of the unit; Hose and Blake attribute his thickness of 309 m (1,015 ft) to the northern Egan Range (see Locality WP-3).

The Pilot Shale (Hose and Blake, 1976) consists mainly of olive-gray, platy, dolomitic siltstone, with interbeds of quartzose silty shale; locally there are thin beds of nodular, clayey and silty limestone and claystone that are calcareous in places. Fritz (1968) reports the limestone beds as about 5 m (16 ft) in thickness, and about 31 m (100 ft) above the faulted base of the unit. He reports a total thickness of 188 m (615 ft).

The Pioche Shale is described by Fritz (1968) as consisting of two subunits. The upper subunit is siltstone interbedded with gray, fine-grained limestone. The lower subunit is brown micaceous siltstone, with some thin quartzitic interbeds near the base, and thickly bedded limestone 46 to 49 m (150 to 160 ft) above the base. Thickness of the upper subunit, 262 m (860 ft), and of the lower subunit is 128 m (420 ft). Hose and Blake (1976) characterize the formation as greenish-gray, silty to clayey shale interlaminated with siltstone, some layers of sandstone near the base, and some thin layers of limestone in the upper part. They make no reference to thickness in the Cherry Creek Range.

Hydrologic setting: Locality WP-2 is in the Butte Valley and Steptoe Valley groundwater systems and drainage basins. The nearest discharge to the approximate center of the southern part of the locality is evapotranspiration from the floor of Butte Valley, about 8 km (5 mi) west; the nearest discharge to the northern part is about 10 km (6 mi) east in Steptoe Valley. The water is used in both discharge areas for domestic, livestock, and irrigation purposes.

Mineral-resource activity: One active mine producing copper, molybdenum, silver, and gold is about 27 km (17 mi) northeast of the northern tip of the locality (Payne and Papke, 1977). Four single patented lode-mining claims and three blocks of claims are centered about the village of Cherry Creek, 7 km (5 mi) east of the middle of WP-2. A single claim is 40 km (25 mi) southeast, near McGill, and a total of eight single claims and one block of claims mark the Aurum mining district centered about 40 km (25 mi) east of the southern end. Five single claims are 33 km (20 mi) east of the northern end, and two more are 31 km (19 mi) northeast.

Ten holes have been drilled in search of oil and natural gas within 40 km (25 mi) of the locality (Garside and Schilling, 1977). One had a show of oil and gas, one a show of oil only. Nine of the holes are scattered about the southern end of WP-2.

WP-3: Northern Egan Range Locality

Locality WP-3 is sinuous, long, and moderately large; the southern termination is just north of Ely. It mainly occupies the north-central part of the Egan Range and includes the southeastern flank of the central part of the adjoining Cherry Creek Range on the north. The locality consists of a single part, and is situated in the north-central part of White Pine County.

Geographic location: The northern extremity of Locality WP-3 is at lat 39°57' N., long 114°51' W.; the southern extremity is at lat 39°23' N., and long 114°53' W. These extremities are in the SW 1/4 sec. 12, T. 24 N., R. 63 E., and the SE 1/4 sec. 36, T. 18 N., R. 63 E., respectively.

The entire locality is represented topographically only on maps at the scale of 1:250,000, but the southern extremity is represented also on a map at the scale of 1:62,500. These maps are listed following the Reference list.

Approximate area: The straight-line length of Locality WP-3 is about 64 km (40 mi). Its minimum width is 1.1 km (0.7 mi), and the maximum is 11 km (7 mi); the average width is estimated at 3 km (2 mi). The estimated area is thus about 207 km^2 (80 mi^2). Of this an estimated 20 percent is exposed bedrock containing clay-rich strata, but the extent of the clay-rich rock is not determined.

Land ownership: All or part of six small blocks of private land lie within the locality, mainly its northern half. The remainder of the area is Federal public land. Within a distance of 40 km (25 mi) from the locality boundary, there are three segments of the Humboldt National Forest. The White Pine Range segment is 38 km (24 mi) west of the southern end of WP-3, the Egan Range segment is 17 km (11 mi) south, and the Schell Creek Range segment, which roughly parallels the locality, is as little as 11 km (7 mi) from the middle of WP-3. Three blocks of land have been withdrawn. They are: a half-section located 15 km (10 mi) west-northwest of the south end, a section of land 26 km (16 mi) west-northwest of the north end, and a half-section 33 km (21 mi) due east of the north end. The nearest part of the Odgers Ranch Indian Reservation is 37 km (23 mi) northwest of the north end. More than 100 blocks of privately-owned land are in the vicinity of the locality. These range in size from small to large, and are mainly grouped along the drainage routes of Steptoe Valley and Spring Valley, which is just east of the adjacent Schell Creek Range.

Accessibility: U.S. Highway 93, combined with U.S. Alternate Highway 50, roughly parallels the locality, and is as little as 6 km (4 mi) east of the southern extremity and 11 km (7 mi) southeast of the northern extremity of the locality. State Highway 35 and its extension west from Cherry Creek crosses the northern part of the locality. Secondary roads along the flanks of the range provide vehicle access to most parts of the area, and unmapped trails accessible by 4-wheel-drive vehicles probably are present. A railroad is within 5 km (3 mi) of the northern end of the area and within 2 km (2 mi) of the southern end of the locality.

A powerline with a capacity of 14,000 to 50,000 V ac passes within about 5 km (3 mi) of the southern tip of the locality; the power is generated at McGill, 8 km (5 mi) east of the southern extremity. No pipelines exist in the vicinity (Lockard, 1970).

Remoteness: Eleven places are mapped within a distance of 40 km (25 mi) of Locality WP-3; of these, six had populations reported in the 1970 census (Rand McNally, 1977). They are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ely	6,216	15	9	S	Southern tip
East Ely	1,992	13	8	S	Southern tip
McGill	2,164	8	5	NE	Southern tip
Ruth	750	14	9	SW	Southern tip
Cherry Creek	30	0.3	0.2	--	E edge, north part
Currie	30	35	22	N	Northern tip

Geologic setting: The northern Egan Range owes its character mainly to both thrust and normal faulting. Like many ranges in eastern White Pine County this range is raised on the east side along a normal fault and tilted downward to the west.

Clay-rich bedrock units represent both sedimentary and metamorphic rock types in this locality. Sedimentary formations include (Fritz, 1968) the Chainman Shale, Pilot Shale, Kanosh Shale, Dunderberg Shale, Secret Canyon Shale, and the Pioche Shale. Of these, the Kanosh Shale and Dunderberg Shale are too thin for further consideration, although the Dunderberg Shale is reported to be as much as 152 m (500 ft) thick. Metamorphic strata represent the McCoy Creek Group of Misch and Hazzard (1962). They identified eight subunits of this formation in the nearby Schell Creek Range, and Woodward (1963) extended these subunits by correlation to the southern end of the northern Egan Range. Of Woodward's eight subunits, four apparently warrant further consideration. These subunits are Woodward's B, C_b, E, and G, which he correlates with the Misch and Hazzard units "Pre-Prospect Mountain Quartzite", the upper part of the "Pre-Willard Creek Quartzite" formation, the Strawberry Creek Formation", and the "Osceola Argillite".

The Chainman Shale is described (Hose and Blake, 1976) as dark-gray to black shale and olive-gray platy siltstone or silty shale. The lower part of the unit includes thin interbeds of bituminous, dark, fine-grained limestone, and some lighter-colored beds of organic limestone, plus thin beds of detrital limestone in the uppermost 15 m (50 ft). Fritz (1960) reports a thickness of 309 m (1,015 ft) in the northern Egan Range.

The Pilot Shale (Hose and Blake, 1976) consists mainly of olive-gray, platy, dolomitic siltstone, with interbeds of quartzose silty shale. Locally included are thin beds of nodular, clayey and silty limestone and claystone that is calcareous in places. No specific thickness figure for the northern Egan Range is readily available, but it is reported to be 188 m (615 ft) thick in the adjacent Cherry Creek Range, and Dechert (1967) reports 213 m (700 ft) in the adjacent northern Schell Creek Range. In ranges to the south and west the formation generally is thin to absent, except for the southern Ruby Range, where Rigby (1960) found 122 to 183 m (400 to 600 ft) of Pilot Shale. These data suggest that a thickness of 152 m (500 ft) is available in the northern Egan Range.

The Secret Canyon Formation of Fritz (1968) together with his Hamburg Formation are considered by Hose and Blake (1976) as approximately correlative with their Lincoln Peak Formation. Fritz describes his Secret Canyon strata as composed of siltstone and shale, with interbeds of platy, fine-grained limestone. Fritz indicates a thickness of 541 m (1,775 ft) for the Secret Canyon Formation in the Cherry Creek and northern Egan Ranges.

The Pioche Shale is described by Fritz (1968) as composed of two subunits. The upper subunit is siltstone, interbedded with gray fine-grained limestone. The basal subunit is brown micaceous siltstone with some thin quartzitic interbeds near the base, and thickly bedded limestone 46 to 49 m (150 to 160 ft) above the base. He reports a thickness of 262 m (860 ft) for the upper subunit, and of 128 m (420 ft) for the basal subunit. Hose and Blake (1976) characterize the formation as composed of greenish-gray silty to clayey shale interlaminated with siltstone, some layers of sandstone near the basal contact, and some thin layers of limestone in the upper part; they make no reference to thickness of the unit in the northern Egan Range.

The Osceola Argillite (Misch and Hazzard, 1962) is correlated by Woodward (1963) with his subunit G in the southern end of the northern Egan Range. He describes the subunit as composed of varicolored metasiltstone, argillite, slate, and phyllite, with 29 m (95 ft) of thickly bedded, very coarse grained quartzite and pebble conglomerate in the lower part, characterized by distinctive purplish to reddish color in places. The upper part is characterized by slaty cleavage in the more clayey layers, and absent in the more silty layers. Woodward concluded that nearly 427 m (1,400 ft) of strata constitute this unit.

The Strawberry Creek Formation of Misch and Hazzard (1962) is correlated by Woodward (1963) with his subunit E. He describes the subunit as composed predominantly of green slate and metasiltstone, with a weakly developed schistosity. However, the lower part consists mainly of greenish-gray quartzite with thin interbeds of the metasiltstone, and near the middle of the subunit is a thick bed of quartzite, and a quartz-pebble conglomerate 43 m (140 ft) thick. He indicates the subunit is 338 m (1,110 ft) thick.

A pre-Willard Creek Quartzite formation (unnamed) of Misch and Hazzard (1962) is correlated by Woodward (1963) with his subunit C. The subunit consists of two parts: the basal part is designated C_a, the upper part C_b. Only part C_b is of concern here. The basal 37 m (120 ft) consists of coarse-grained to conglomeratic quartzite. Above it is 96 m (315 ft) of phyllite and thinly slabby, silty slate, succeeded in turn by 37 m (120 ft) of interbedded fine- to coarse-grained quartzite and silty slate, and by 221 m (725 ft) of silty slate only.

Unit B (unnamed) of Misch and Hazzard (1962) is correlated by Woodward (1963) with his subunit B. He describes the subunit, the basal contact of which is not exposed, as consisting of more than 139 m (455 ft) of dark phyllite with a little fine-grained, thinly bedded, white quartzite in its lower strata, overlain by 163 m (535 ft) of gray quartz-mica phyllite. Woodward indicates that 302 m (990 ft) of this subunit are exposed.

Hydrologic setting: Locality WP-3 is in the Steptoe and Butte Valleys ground-water systems and drainage basins. Significant discharge occurs in the vicinity of Steptoe and Duck Creeks about 2 to 6 km (1 to 4 mi) east of the eastern boundary of the locality. The water is used in these parts of Steptoe Valley for domestic and public supply, livestock, and irrigation.

Mineral-resource activity: Four active mines are shown (Payne and Papke, 1977) within 40 km (25 mi) of Locality WP-3. The largest is the open-pit copper mine at Ruth, 16 km (10 mi) southwest of the southern tip of the locality; this large mining operation shut down in July 1978. Between Ruth and Ely a gold and silver mine is operating, and about 19 km (12 mi) south of Ely a lead and silver mine is active. Near McGill, approximately 6 km (4 mi) east of the southern extremity of the locality, is an active limestone operation.

Within the locality are five single patented lode-mining claims and two blocks of claims near the village of Cherry Creek, the old mining district; in the southern half of the locality is a single claim. Beyond the locality boundary but within a distance of 40 km (25 mi) claims are numerous. A single claim is 21 km (13 mi) east-southeast of the north end of WP-3; eight single claims and one block of claims, the Aurum mining district, are centered about 50 km (31 mi) southeast of the north end; a single claim is 30 km (19 mi) northeast of the south end; three single claims are 13 km (8 mi) southeast of the south end; another single is 37 km (23 mi) southeast of the same end; four single claims and one block of claims are 33 km (20 mi) south of the same end; and five single claims and five blocks of claims, the Robinson mining district, are centered about 15 km (9 mi) south of the south end.

Within 40 km (25 mi) of the locality, 19 holes have been drilled for oil or gas. One of these exploratory holes had a reported show of oil; two reportedly had shows of oil and gas. The holes are well scattered in the vicinity of WP-3, but are mainly located to the west and south.

WP-4: Northern Schell Creek Range Locality

Locality WP-4 is a long, sinuous, moderately large area, distinguished by the A-like form of its southern portion. It consists of a single part that occupies both the east and west flanks of the northern Schell Creek Range from the approximate latitude of Ely, located just west of the southern end, northward to State Route 2. From there to about its northern extremity, the locality occupies the crest of the range. The southern boundary of the locality is arbitrarily drawn to separate this locality of Cambrian and Precambrian bedrock from a locality of mainly younger rocks in the central part of the Schell Creek Range (see Locality WP-8).

Geographic location: The northern extremity of Locality WP-4 is at lat 40°00' N., long 114°36' W. The western of its two southern extremities is at lat 39°15' N., long 114°41' W., and the eastern is at lat 39°14' N., long 114°32' W. The northern extremity is thus located in the SW 1/4 sec. 35, T. 25 N., R. 65 E.; the southern extremities are in the (unsurveyed) SE 1/4 sec. 17, T. 16 N., R. 65 E., and the (unsurveyed) NW 1/4 sec. 22, T. 16 N., R. 66 E., respectively. The Utah-Nevada boundary is 38 km (24 mi) east of the southern part of the locality.

The entire locality is represented topographically only on a map at the scale of 1:250,000; the southern part is also represented on two maps at a scale of 1:62,500. These maps are listed following the Reference list.

Approximate area: This locality is about 89 km (55 mi) long. Its width ranges from a minimum of 1.1 km (0.7 mi) to a maximum of 18 km (11 mi); the average width is estimated at 7 km (5 mi). Thus, the total area is estimated at 712 km^2 (275 mi^2). Of this an estimated 40 percent is exposed bedrock containing clay-rich strata, but the extent of the clay-rich rock is not determined.

Land ownership: A map of Nevada showing land ownership is available (Lutsey and Nichols, 1972), and somewhat similar maps published by the USBLM (1977b, 1977c) cover that part of Utah that lies within 40 km (25 mi) of the locality boundary.

Within Locality WP-4 there are eight small blocks of private land, mainly in the north-central part. Federal public land constitutes the northernmost 26 km (16 mi) of the area, plus a narrow fringe chiefly along the eastern margin of the southern half. An estimated 85 percent of the locality is Humboldt National Forest land in the Schell Creek segment. A single block of withdrawn land is 16 km (10 mi) south of the northern extremity.

Outside the boundary of WP-4, but within a radius of 40 km (25 mi), the land is chiefly Federal public domain. Nearly 200 privately held blocks that range in size from small to large are scattered along both range flanks, many of the larger ones along drainage routes. Land in the Egan Range segment of the Humboldt National Forest is 15 km (10 mi) southwest of the southwestern extremity, and the northern and southern Snake Range segments are 14 km (8 mi) east and 23 km (14 mi) southeast of the southeast extremity, respectively.

Also southeast of the southeastern extremity 10 km (6 mi) is the State of Nevada's Swamp Cedar Natural Area. The State's Mt. Wheeler Scenic Area is 30 km (19 mi), and the Lehman Caves National Monument is 36 km (22 mi) southeast of the same extremity. The State's

Cave Lake Recreation area is 6 km (4 mi) southwest of the southwestern extremity, and two small blocks of State recreation land lie 26 km (16 mi) in the same direction from that extremity. One small block of withdrawn land is 11 km (7 mi) east of the northern part of the locality, and the Goshute Indian Reservation is 31 km (19 mi) east of that part. About 52 km^2 (20 mi^2) of livestock driveway land are 14 km (9 mi) north of the northern extremity, and thus in adjacent Elko County.

That part of Utah that lies within the vicinity of WP-4 contains about 57 km^2 (22 mi^2). Of this, approximately 52 km^2 (20 mi^2) is Federal public domain, the remainder is controlled by the State of Utah.

Accessibility: The combined U.S. Highway 93 and U.S. Highway Alternate 50 traverse Steptoe Valley west of the locality, and is from 5 to 11 km (3 to 7 mi) from its boundary. A secondary road closely parallels the eastern margin of the locality, and lies within 2 km (2 mi) of it. State Route 2 crosses WP-4 at Shellbourne, about 24 km (15 mi) south of the northern extremity. Local roads provide access to various parts of the locality, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

A railroad also traverses Steptoe Valley, and is from 9 to 11 km (6 to 7 mi) from the locality boundary. Electric power is generated at McGill, 10 km (6 mi) west of the middle part of WP-4, and a powerline that carries from 14,000 to 50,000 V ac trends west from it (Lockard, 1970). No pipelines are present in the vicinity of WP-4 (Lockard, 1970).

Only trails accessible by 4-wheel-drive vehicles are in that part of the vicinity that is within Utah.

Remoteness: A total of 13 places are mapped in Nevada (Lutsey and Nichols, 1972) within a distance of 40 km (25 mi) of the locality; none are in Utah. Of the 13, 6 had populations reported in the 1970 census (Rand McNally, 1977). They are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ely	6,216	17	11	W	SW extremity
East Ely	1,992	15	10	W	SW extremity
McGill	2,164	11	7	W	W margin, central part
Ruth	750	27	17	W	SW extremity
Cherry Creek	30	31	11	W	W margin, northern part
Currie	30	32	20	NW	N extremity

Geologic setting: The northern Schell Creek Range owes its character mainly to both thrust faulting and normal faulting. This range, like most in northeastern White Pine County, is raised on the east along an extensive normal fault, and tilted downward to the west.

Both sedimentary and metamorphic clay-rich rock types are represented in this locality. Clay-rich sedimentary rock units present include the Chainman Shale, Pilot Shale, Dunderberg Shale, Secret Canyon Shale, and Pioche Shale. Of these only the Secret Canyon Shale needs no further consideration, chiefly because it is mainly limestone (Dechert, 1967). The metamorphic rock units represent the McCoy Creek Group of Misch and Hazzard (1962). Units B, C, E, and G are clay-rich, but G is too thin for further consideration.

The Chainman Shale in the northern Schell Creek Range is described by Dechert (1967) as dark fissile shale interbedded with apparently lenticular lenses of quartzite as much as 76 m (250 ft) thick. He concluded shale thicknesses of as much as 457 m (1,500 ft) probably are structurally repetitive, but that structural thinning is more common. From thicknesses of about 305 to 335 m (1,000 to 1,100 ft) reported by both Fritz (1960) and Avent (1962) in adjacent ranges to the west and east, respectively, and by Drewes (1967) in the northern part of the southern Schell Creek Range it seems a thickness of approximately 305 m (1,000 ft) in this range is expectable.

Hose and Blake (1976) describe the Chainman broadly as consisting mainly of very dark shale and olive-gray platy siltstone or silty shale, commonly with a few beds of quartzite and quartzitic siltstone in the upper half. They give no thickness. Bauer, Cooper, and Breitrick (1960) say that the formation is from 122 to 457 m (400 to 1,500 ft) thick in the Ely area.

The Pilot Shale is mainly (Dechert, 1967) dark, thinly platy, calcareous siltstone interbedded with some shale and, in the lower part, a few thin limestone layers. Thickness of the deformed unit is not clear; Dechert used the figure of 213 m (700 ft) obtained in less deformed areas adjacent, and Young (1960) found the formation to be absent in places but ranging in thickness to as much as 183 m (600 ft).

Most of the ledge-forming Dunderberg Shale is composed (Dechert, 1967) predominantly of olive-gray, fissile shale with many thin beds of nodular limestone and limestone lenticles. Thicker limestone beds are less abundant, but increase in number upward, and in the upper part of the unit limestone predominate over shale. Dechert measured nearly 220 m (720 ft) of Dunderberg Shale north of Spring Gulch, where he concluded the rock was essentially undisturbed. Young (1960) reports a thickness of at least 183 m (600 ft) that was pieced together by A. R. Palmer (personal commun. to Young, 1959), but that at most places it appeared less due to faulting and tectonic thinning.

The Pioche Shale is chiefly (Dechert, 1967) dark, laminated, micaceous siltstone in platy to crinkly beds as much as 3 cm (1 in.) thick; it is interbedded with fine-grained, calcareous, micaceous sandstone layers that increase in numbers upward in the unit. Dechert measured 180 m (590 ft) on the north side of Silver Canyon, a section he considered relatively undisturbed.

Unit E of the McCoy Creek Group (Misch and Hazzard, 1962) appears to be a correlative of their Strawberry Creek Formation of that group in the adjacent southern Snake Range. The rock is described by them as composed of two parts: a basal, or transitional subunit, and an upper, or main subunit. The upper, or main, subunit consists of interbedded to interlaminated, very fine grained, schistose, platy phyllite to slaty argillite, with non-schistose metasiltstone. Scattered beds of quartzite from "a few inches" to 0.6 m (2 ft) in thickness are present, notably near the middle of the unit, and in increasing numbers toward the base.

The basal subunit consists of commonly crossbedded, locally laminated, dark to medium-gray to purple, fine-grained to pebbly, quartzose quartzite, with metasiltstone and very fine grained, silty, phyllitic argillite. Both rock types commonly fill channels. A total thickness for the unit is about 457 m (1,500 ft) (Misch and Hazzard, 1962).

Unit C of the McCoy Creek Group (Misch and Hazzard, 1962) is apparently a correlative of their unnamed unit that is older than the Willard Creek Quartzite. The unit is divisible into four subunits: a basal C_1 subunit overlain successively by C_2, C_3, and C_4. Units C_1 and C_2 are lithologically similar, and consist predominantly of dark, slaty, in part lustrous, thinly bedded to slabby and locally fissile phyllite, which grades into and is thinly interbedded with dark, slabby to platy, mostly non-schistose metasiltstone. The presence of quartzite beds in C_1 is distinctive. Subunit C_2 contains minor interbeds of gray, slabby quartzite that increase upward both in number and thickness within the upper part. The combined thickness of these two subunits is about 366 m (1,200 ft).

Subunit C_3 is chiefly thinly to thickly bedded, white quartzite containing some interbeds of silty phyllite. This subunit is about 244 m (800 ft) thick.

Subunit C_4 consists of gray, somewhat lustrous, very fine grained, slaty phyllite interlaminated with gray metasiltstone, and with quartzite interbeds in the lower part. Thickness of this subunit is from 61 to 91 m (200 to 300 ft).

Unit B of the McCoy Creek Group (Misch and Hazzard, 1962) has no correlative in their McCoy Creek sequence in the northern part of the southern Snake Mountains (Locality WP-7 of this report). The unit is a uniform sequence of dark phyllitic schist that grades upward into phyllite. A few interbeds of marble are present about one-third of the way upward from the base, and a few layers of amphibolite are present slightly higher. The subunit is about 549 m (1,800 ft) thick.

Hydrologic setting: Locality WP-4 is in Spring Valley and Steptoe Valley ground-water systems and drainage basins. Discharge occurs to the east in Spring Valley as near as 2 km (1 mi) from the eastern edge, and to the west in upper Duck Creek about 3 km (2 mi) west of the western edge of the locality. The water is used in both discharge areas for domestic, livestock, and irrigation purposes. In the Duck Creek area the water is also used for public supply and industrial purposes. Several springs and perennial creeks occur within the limits of the locality.

Mineral-resource activity: No mines are located within WP-4, but nine are present within 40 km (25 mi) of it (Payne and Papke, 1977). Two copper mines that reportedly also produce some molybdenum, silver, and gold, are nearby, one at Currie, 18 km (11 mi) north of the northern extremity, and at Ruth, 13 km (8 mi) west of the southern extremity. Three gold-placer mines are grouped 10 km (6 mi) southeast of that extremity. A lead and silver mine is 13 km (8 mi) south of the southwestern extremity, and a mine 11 km (7 mi) west of that tip produces gold and silver. Finally, a limestone mine is located at McGill, 11 km (7 mi) west of the middle portion of WP-4.

About 50 individual claims and 9 blocks of claims are mapped (Lutsey and Nichols, 1972) in or near Locality WP-4. Five single claims lie within the locality: three are in the

northern portion, and two in the middle. The others are well scattered in all principal compass directions, and are within a distance of 40 km (25 mi) from the locality boundary. Most of these are individual claims, but some constitute groups of two to five, in part with associated blocks of claims. Such associations commonly mark mining districts. Here these include the Osceola mining district, about 19 km (12 mi) south-southeast of the southwestern extremity; the Robinson (Ely) mining district, 18 km (11 mi) west of the southwestern extremity; and the Cherry Creek mining district, about 19 km (12 mi) west of the northern portion of WP-4. Another group of five claims is near McGill, about 8 km (5 mi) west of the middle portion.

Ten exploratory holes for oil and natural gas have been drilled within 40 km (25 mi) of the locality boundary. One hole is located about 6 km (4 mi) southwest of the northern extremity, three scattered holes are located as much as 39 km (24 mi) west of the middle portion of WP-4, and six holes that constitute three groups of from one to three each are as much as 40 km (25 mi) southwest of the southwestern extremity. None of the holes had a reported show of oil or gas.

WP-5: Antelope Range Locality

Locality WP-5 is a narrow, moderately short, somewhat club-shaped area that is in the southern end of the Antelope Range and on the west flank of the Red Hills south thereof. The locality consists of a single part, located in northeastern White Pine County.

Geographic location: The northern extremity is at lat 39°54' N., long 114°27' W., and the southern extremity is at lat 39°37' N., long 114°22' W. In land-survey terminology, these extremities are in the NE 1/4 sec. 1, T. 23 N., R. 66 E., and in the SW 1/4 sec. 7, T. 20 N., R. 68 E., respectively. The Utah-Nevada boundary is about 28 km (17 mi) east of the southern extremity of the locality.

The locality is represented topographically only on a map at the scale of 1:250,000. The map is listed following the Reference list.

Approximate area: This locality is 35 km (21 mi) long; its minimum width is about 0.8 km (0.5 mi), and its maximum width is about 3 km (2 mi). The area of the locality is estimated at 52 km^2 (20 mi^2); of this an estimated 50 percent is exposed bedrock containing clay-rich rock, but the extent of that clay-rich rock is not determined.

Land ownership: Lutsey and Nichols (1972) have published a map of Nevada showing land ownership; somewhat similar maps published by the USBLM (1977b, 1977c) include that part of Utah that lies within 40 km (25 mi) of the locality boundary.

Locality WP-5 is wholly Federal public land. Within 40 km (25 mi) of the locality boundary the land is Federal public domain except for numerous scattered blocks of privately-owned land that range in size from small to large. These blocks are somewhat concentrated in the Kern Mountains adjacent to the Utah and Nevada boundary, lie along the east base of the Schell Creek Range to the west, and just across the Schell Creek Range, and extend along the principal drainage of Steptoe Valley. National forest land consists of two segments; one is the Schell Creek Range segment of the Humboldt National Forest, located 14 km (9 mi) west of and roughly parallel to Locality WP-5, and the smaller Northern Snake Range segment, located 27 km (17 mi) southeast of the southern end of WP-5. The Goshute Indian Reservation lies 16 km (10 mi) east of the northern portion of the locality. Finally, there are two small blocks of withdrawn land; one is 5 km (3 mi) north of the northern extremity, and the other is 17 km (11 mi) west of the northern portion. About 52 km^2 (20 mi^2) of livestock driveway lie 27 km (17 mi) northwest of the northern extremity.

That part of the vicinity of WP-5 that lies in Utah is about 13 km (8 mi) wide at the maximum; only about 75 percent of it is mapped by the USBLM (1977b, 1977c). Of the mapped area about 91 km^2 (35 mi^2) is part of the Goshute Indian Reservation, about 27 blocks of land constitute roughly 73 km^2 (28 mi^2) of State-controlled land, and 14 blocks constitute about 18 km^2 (7 mi^2) of private land.

Accessibility: In Nevada State Route 2 crosses the locality about 13 km (8 mi) southwest of Tippett enroute westward through Shellbourne to a junction with combined U.S. Highway 93 and U.S. Highway Alternate 50 just west of Shellbourne. Combined U.S. Highway 93 and U.S. Highway Alternate 50 is 27 km (17 mi) west of the middle part of the locality, and a railroad, which is approximately parallel to the highway, is 6 km (4 mi) farther west.

One secondary road and several trails accessible by 4-wheel-drive vehicle are in that part of the WP-5 vicinity that lies within Utah.

No powerlines nor pipelines are shown by Lockard (1970) within 40 km (25 mi) of the locality boundary. Such information for Utah is not included on the USBLM maps.

Remoteness: Of seven places mapped in Nevada and one place in Utah that lie within 40 km (25 mi) of the locality, only one had a population reported (Rand McNally, 1977) in the 1970 census. Cherry Creek, 36 km (22 mi) west of the northern tip of the locality, had 30 residents in 1970.

Geologic setting: The southern part of the Antelope Range owes its general character, to both thrust faulting and normal faulting. Like most ranges in northeastern White Pine County, this range is raised on the east along a normal fault, and tilted downward to the west. The Red Hills, however, appear to be the result of intersecting, major normal faults that trend roughly north-south and east-west.

Avent (1962) reports both Chainman Shale and Pilot Shale in the Antelope Range, and Hose and Blake (1976) map them, undifferentiated, in the Red Hills. As the results of detailed studies are not readily available for the Red Hills, Avent's report is assumed to be applicable for them. The Kanosh Shale is also present, but is too thin for further consideration.

The Chainman Shale consists (Avent, 1962) chiefly of dark shale with interbeds of siltstone. In the upper half of the unit are several discontinuous lenses of evenly bedded, quartzose sandstone as much as 61 m (200 ft) thick. The thickness of this unit is about 305 m (1,000 ft).

The Pilot Shale (Avent, 1962) is predominantly dark gray, calcareous siltstone that yields small chips about 0.5 cm (0.2 in.) thick on weathering, and so might be crudely fissile. The unit contains a medium-grained, blue-gray, evenly bedded, crinkly limestone 8 m (25 ft) thick about 26 m (85 ft) above the unit's base. At one unnamed locality little disturbed by faulting the thickness of the unit is 227 m (744 ft).

Hydrologic setting: The WP-5 locality is in the Spring Valley ground-water system. Runoff flows to Spring Valley and southern Antelope (Tippett) Valley. The nearest discharge to the southern outcrops is about 19 km (12 mi) southward. The nearest discharge to the northern outcrops is 6 km (4 mi) west. The principal uses of ground water in Spring Valley are domestic, livestock, and a small amount of irrigation.

Mineral-resource activity: There are no active mines in Nevada (Payne and Papke, 1977) in, or within 40 km (25 mi) of, Locality WP-5.

No patented lode-mining claims are mapped (Lutsey and Nichols, 1972) within Locality WP-5, but they are present in Nevada at five general localities within a distance of 40 km (25 mi). A group of five single claims is centered about 26 km (16 mi) north-northeast of the northern extremity. From the southern extremity a group of three single claims are centered about 13 km (8 mi) east-northeast, five are centered about 23 km (14 mi) southwest in the vicinity of McGill, 12 plus two blocks of claims are scattered west of the locality along the Schell Creek Range both north and south from the Aurum mining district, and five

with three associated blocks of claims are centered about 39 km (24 mi) west of the northern extremity of WP-5 in the Cherry Creek mining district.

Three oil-and-gas exploratory holes have been drilled (Garside and Schilling, 1977) in Nevada within 40 km (25 mi) of the locality; none had a show of oil or gas reported. One is 19 km (12 mi) northeast of the northern extremity, and one is 14 km (9 mi) west. The third is 19 km (12 mi) southwest of the southern extremity.

USBLM (1977b, 1977c) maps do not show any mineral-resource activity in that part of the WP-5 vicinity within Utah.

WP-6: Kern Mountains Locality

Locality WP-6 is a moderately small area of trapezoidal shape located in northeastern White Pine County. The locality, which consists of a single part, includes outcrop areas in the western Deep Creek Range and on the northwest end and southern flank of the Kern Mountains.

Geographic location: The approximate center of the locality is at lat 39°43' N., long 114°08' W., and thus is in the NE 1/4 sec. 2, T. 21 N., R. 69 E. At one place the locality boundary is in contact with the Nevada-Utah boundary. WP-6 is represented only on a map of the 1:250,000-scale series, listed following the Reference list.

Approximate area: Locality WP-6 extends 30 km (19 mi) from north to south, and, along the southern flank of the Kern Mountains, 18 km (11 mi) from east to west. Its estimated area is 323 km^2 (125 mi^2). Of this area an estimated 45 percent is exposed bedrock, that contains clay-rich rock, but the extent of the clay-rich rock is not determined.

Land ownership: A map of Nevada showing land ownership is available (Lutsey and Nichols, 1972), and somewhat similar maps published by the USBLM (1977b, 1977c) include that part of Utah that lies within 40 km (25 mi) of the locality boundary. In Nevada about 31 km^2 (12 mi^2) of privately-owned land, which constitutes 10 scattered blocks, is located within the locality boundary, and two other blocks that contain about 10 km^2 (4 mi^2) are just outside. In addition about 25 other blocks that differ greatly in size are scattered along Spring Valley Creek, about 26 km (16 mi) west of the locality and on both flanks of the northern Schell Creek Range just west thereof. The southern part of the Goshute Indian Reservation is occupied by the northeastern part of WP-6. A single half-section of withdrawn land is 26 km (16 mi) northwest of the locality, and the Schell Creek Range segment and the northern Snake Range segment of the Humboldt National Forest are 26 km (16 mi) west and 21 km (13 mi) south of the WP-6 boundary, respectively. All other land in Nevada in the vicinity of the locality is Federal public domain.

In Utah, about 3,367 km^2 (1,300 mi^2) are within 40 km (25 mi) of the locality boundary, but about one-third of this is not mapped yet by USBLM. Of the more than two-thirds that are mapped, approximately 1,930 km^2 (745 mi^2) or nearly 80 percent is Federal public domain, 4 percent is part of the Goshute Indian Reservation, about 14 percent is State-controlled, and about 3 percent is private.

Accessibility: In Nevada a secondary road lies 23 km (15 mi) west of the locality along the western margin of the Spring Valley. It connects combined U.S. Highways 50 and 6, located more than 40 km (25 mi) to the south of WP-6, with State Route 2, which is 11 km (7 mi) to the northwest. Minor roads give access to the locality, and unmapped trails accessible by 4-wheel-drive vehicles probably are available. In Utah a single secondary road reaches Gandy, and thus is about 15 km (9 mi) from WP-6. Scattered trails accessible by 4-wheel-drive vehicles are also present.

No powerlines, pipelines, or aqueducts are present within 40 km (25 mi) of the locality, in either Nevada or Utah.

Remoteness: Within 40 km (25 mi) of this locality are six mapped (Lutsey and Nichols, 1972; Rand McNally, 1977) places in Nevada, none of which had a reported population in the 1970 census (Rand McNally, 1977). The two places mapped in Utah had no population reported in the 1970 census either.

Geologic setting: The west end of the Deep Creek Range and the Kern Mountains are less characteristic of the Basin and Range province than most of the ranges in White Pine County. The Kern Mountains are bounded on the south by major normal faulting that trends nearly east-west, rather than typically north-south. Thus the Kern Mountains are raised on the south and tilted somewhat downward to the north. However, both thrust and normal faults are present.

In this locality six clay-rich bedrock units are exposed (Nelson, 1966). They are the Chainman Shale, Pilot Shale, Kanosh Shale, Dunderberg Shale, Cabin Shale, and an argillite-phyllite-quartzite unit correlated with subunit E of the McCoy Creek Group of Misch and Hazzard (1962). The Dunderberg Shale is too thin, and the argillitic subunit appears to lack a satisfactory lithology, for further consideration.

The Chainman Shale in the Deep Creek Range is described by Nelson (1966) as mainly dark, highly fissile shale with interbeds of very finely crystalline black limestone; the lower part of the unit contains clayey and sandy platy limestone and calcareous shale. Nelson gives no thickness for the unit, but his figure 4, a columnar section, graphically represents about 335 m (1,100 ft). In the Kern Mountains the Chainman Shale is predominantly dark fissile shale with interbeds of dark quartzite and thinly bedded, dark, clayey limestone. Here Nelson reports a thickness of 457 to 610 m (1,500 to 2,000 ft) for this formation. Locally, deformation and isoclinal folding are severe.

The Pilot Shale is thin in the Deep Creek Range, but in the Kern Mountains it consists (Nelson, 1966) chiefly of light-colored calcareous and silty shale, and clayey limestone, with a distinctive bed of gray limestone from 6 to 15 m (20 to 50 ft) above the base. Nelson indicates from 122 to 165 m (400 to 540 ft) of Pilot Shale is present in the Kern Mountains.

The Kanosh Shale in the Deep Creek Range is described (Nelson, 1966) as dark, fissile shale more than 152 m (500 ft) thick, but it is too thin in the Kern Mountains for consideration.

The Cabin Shale in the Deep Creek Range is described by Nelson (1966) as dark, micaceous siltstone, with interlaminae of micaceous shale. Its thickness is more than 152 m (500 ft). It is apparently absent from the Kern Mountains.

Hydrologic setting: The locality is in the Spring Valley and Snake Valley (located mainly in Utah) ground-water systems. Runoff flows to the Snake and southern Antelope (Tippett) Valleys.

Ranch wells in upper Pleasant Valley pump water for domestic and livestock uses. Ground water is used in Spring Valley mainly for domestic and livestock uses, and a small amount is used for irrigation.

Mineral-resource activity: No active mines lie within the locality, or within 40 km (25 mi) of the locality boundary either in Nevada (Payne and Papke, 1977) or in Utah (USBLM, 1977b, 1977c). Two adjacent lode-mining claims are situated within the southwestern part of the locality, and one about 6 km (4 mi) northwest is just outside the boundary. Four other claims are located 37 km (23 mi) north-northwest of the boundary.

A single oil-and-gas exploration hole was drilled about 31 km (19 mi) north of the locality, in Nevada (Garside and Schilling, 1977).

WP-7: Snake Range Locality

Locality WP-7 is a moderately elongate area of irregular form. Exposures are located mainly on the western flank and the crestal part of the Snake Range, in the vicinity of Sacramento Pass. The locality consists of a single part, and is in northeastern White Pine County.

Geographic location: The northern extremity is at lat 39°22' N., long 114°32' W., and the southern extremity is at lat 38°58' N., long 114°20' W. These extremities are in the NW 1/4 sec. 24, T. 17 N., R. 68 E., and the (unsurveyed) SE 1/4 sec. 21, T. 13 N., R. 68 E., respectively. The Nevada-Utah boundary is 15 km (10 mi) west of the locality boundary.

The locality is represented wholly on topographic maps at a scale of 1:250,000, and partly on maps at a scale of 1:62,500. These maps are listed following the Reference list.

Approximate area: The locality is 39 km (25 mi) long and has an estimated average width of 6 km (4 mi). Thus, the estimated area is 259 km^2 (100 mi^2). An estimated 50 percent of the area is exposed bedrock containing clay-rich units, but the area extent of all units is not determined.

Land ownership: A map of Nevada showing land ownership has been published by Lutsey and Nichols (1972). For Utah, somewhat similar maps have been published by the USBLM (1977b, 1977c, 1977d). About 3 km^2 (1 mi^2) of privately-owned land lies within the locality, where it constitutes all or part of three blocks (Lutsey and Nichols, 1972). In Nevada about 75 other blocks of private land that range greatly in size lie within 40 km (25 mi) of the locality. They lie mainly along adjacent Spring Valley on the west, at the base of both flanks of the Schell Creek Range just west of that valley, and along Sacramento Pass, which crosses the middle of the locality. Snake Range segments of the Humboldt National Forest occupy extensive areas both north and south of Sacramento Pass and constitute an estimated 75 percent of WP-7. Another segment of that forest occupies most of the Schell Creek Range, and is 14 km (9 mi) west of the locality. Lehman Caves National Monument is 10 km (6 mi) east-northeast of the southern extremity of the locality. Nevada's Swamp Cedar Natural Area is 2 km (1 mi) west of WP-7, Cave Lake State Recreation Area is on the west flank of the Schell Creek Range and 25 km (16 mi) west of WP-7, and a half-section of State recreation land is located 15 km (9 mi) east of the locality at the town of Baker. The remainder of the vicinity is Federal public land.

In Utah a total of about 1,598 km^2 (617 mi^2) lie within a radius of 40 km (25 mi) of the boundary of WP-7. Of these about 17 blocks of land that constitute about 60 km^2 (23 mi^2), or 4 percent, are privately controlled, about 80 blocks totaling approximately 171 km^2 (66 mi^2), or about 10 percent, are administered by the State of Utah, and the remainder of 1,383 km^2 (534 mi^2), or approximately 86 percent, is Federal public land.

Accessibility: In Nevada combined U.S. Highways 50 and 6 cross the middle of the locality. Part of U.S. Highway 93 is 13 km (8 mi) west of the southern extremity of WP-7. A secondary road on the west side of Spring Valley parallels the northern part of WP-7 at a distance of

10 to 17 km (6 to 10 mi), and another secondary road is 5 km (3 mi) west of the southern end. Unmapped trails probably are accessible by 4-wheel-drive vehicles. In that part of Utah within the vicinity of WP-7, U.S. Highways 6 and 50 (combined) extend eastward from the Nevada-Utah boundary. State Route 21 leads north-northwest into Nevada where it becomes State Route 73 and joins U.S. Highways 6 and 50. An irregular network of secondary roads is present, and numerous trails accessible by 4-wheel-drive vehicles are also present.

A powerline (Lockard, 1970) that carries from 14,000 to 50,000 V ac extends along U.S. Highway 50 from Ely to the Osceola mining district on the south side of Sacramento Pass and about 3 km (2 mi) west of WP-7.

No railroad, pipeline, or aqueduct is within 40 km (25 mi) of the locality.

Remoteness: Five named places in Nevada and Utah lie within a radius of 40 km (25 mi) of the locality, but only Baker had a reported population, 20, in the 1970 census (Rand McNally, 1977).

Geologic setting: The Snake Range is more like most ranges of western White Pine County than those in the northeastern part of the county. Perhaps the most noticeable difference is that, like the adjacent Snake Range, the northern part of this range is raised on the east along a major normal fault and tilted downward to the west, whereas the southern part is the reverse. The two segments are separated by a normal fault that trends northwest through Sacramento Pass.

In the southern Snake Range, six clay-rich units are exposed. They are the Chainman Shale, Pilot Shale, Kanosh Shale, Corset Spring Shale, Pioche Shale and the Osceola Argillite of Misch and Hazzard (1962) (Drewes, 1958; Whitebread, 1969). Of these, only the Chainman Shale, Pilot Shale, and Osceola Argillite exceed 152 m (500 ft) in thickness.

The Chainman Shale is described by Whitebread (1969) as mainly gray shale and siltstone, with interbeds of sandy limestone and calcareous sandstone; the upper part is an alternation of shale and sandstone beds. A complete section is not exposed, but the thickness estimated by Whitebread is between 305 and 610 m (1,000 and 2,000 ft).

The Pilot Shale he describes as mainly gray, platy, calcareous siltstone and calcareous to noncalcareous shale with some interbeds of dark gray limestone; the upper part is interbedded silty limestone and limestone. Thickness of the unit varies, but is estimated to range from 122 to 244 m (400 to 800 ft).

The Osceola Argillite is described by Misch and Hazzard (1962) as medium to dark gray but commonly bluish or purplish and locally color banded with light-gray or bluish-green. The rock ranges from clayey to silty argillite in alternating laminae. Locally the rock is more phyllitic than argillitic and is marked by cleavage. Misch and Hazzard report a presumably complete section 244 m (800 ft) thick.

Hydrologic setting: Locality WP-7 is in Snake and Spring Valleys ground-water systems and drainage basins. Lehman Caves National Monument near the eastern part of the locality derives its water supply from springs that feed Lehman Creek. Water from other creeks in this area is used nearby for ranching and domestic supplies. Discharge also occurs 2 to 3 km (1 to 2 mi) west of the western locality boundary, where ground water is used for domestic, livestock, and irrigation purposes.

Mineral-resource activity: Three placer-gold mines are active in the Osceola mining district 2 km (1 mi) west of the southern part of the locality, and a tungsten mine is located 9 km (5 mi) southeast of the southern extremity (Payne and Papke, 1977). In addition, several patented lode-mining claims, both as single claims and as blocks of claims, lie within 40 km (25 mi) of the boundary. A group of three claims are centered about 39 km (24 mi) north of the northern extremity, a single claim is about 16 km (10 mi) southeast of the southern extremity, a group of three are centered south of that extremity, and two single claims plus a block are part of the Osceola mining district mentioned above. Nine single claims are scattered north and south of McGill, about 40 km (25 mi) northwest of WP-7, and a single claim and one block of claims mark the Piermont mining district, a similar distance north-northwest.

Two oil and natural-gas exploratory holes were drilled about 39 km (24 mi) west of the locality near East Ely; both holes were reported to be dry.

No mineral-resource activity is indicated on USBLM (1977b, 1977c, 1977d) maps for that portion of Utah within a 40 km (25 mi) radius of Locality WP-7.

WP-8: Southern Schell Creek Range Locality

Locality WP-8 is long, extremely irregular in shape, and consists of a single part. It occupies both flanks of the Schell Creek Range in southeastern White Pine County, and is contiguous with Locality WP-4 to the north. The boundary between the two localities is drawn arbitrarily to separate the older Cambrian and Precambrian rocks of WP-4 from the younger Paleozoic rocks of this locality.

Geographic location.--The northwestern extremity of the locality is at lat 39°14' N., long 114°46' W., and the northeastern extremity is at lat 39°17' N., long 114°38' W. The southwestern extremity is at lat 38°51' N., long 114°45' W., and the southeastern extremity is at lat 38°47' N., long 114°39' W. These locations are, in land-survey terminology, in the SW 1/4 sec. 22, T. 16 N., R. 64 E., the (unsurveyed) SW 1/4 sec. 2, T. 16 N., R. 65 E., the SE 1/4 sec. 2, T. 11 N., R. 64 E., and the NE 1/4 sec. 35, T. 11 N., R. 65 E., respectively.

Topographically, the locality is represented wholly on maps of one scale, and is partly represented on maps at two other scales. These maps are listed following the Reference list.

Approximate area.--This locality is about 56 km (35 mi) long. The maximum width is 21 km (13 mi), and its minimum width is 2 km (1 mi). The average width is estimated at 11 km (7 mi). Thus, the area is estimated at 635 km^2 (245 mi^2). Of this, an estimated 25 percent is exposed bedrock that includes clay-rich strata, but the extent of such strata exposed is not determined.

Land ownership.--The northern half of the locality almost wholly lies within the Schell Creek segment of the Humboldt National Forest, and the southern half is largely Federal public land. About 18 small scattered blocks of private land lie within the locality boundary. The Cave Lake Recreation Area, controlled by the State of Nevada, also lies within the WP-8 boundary.

Outside the boundary of WP-8 but within a distance of 40 km (25 mi) the land is chiefly Federal public domain. State-controlled land includes the Mount Grafton Scenic Area 8 km (5 mi) southwest of the southern extremity of the locality, the Wheeler Peak Scenic Area 21 km (13 mi) east of the middle portion, the Swamp Cedar Natural Area 7 km (5 mi) east of the north portion, and two small blocks of State recreation land 13 km (8 mi) west of the middle portion. The southern Snake Range segment of the Humboldt Forest is 17 km (10 mi) east of the north portion of WP-8, the northern Snake Range segment of that forest is 14 km (9 mi) northeast, and the Egan Range segment is 6 km (4 mi) west of the same portion. One section of withdrawn land is located 21 km (13 mi) northwest of the northern extremity. Private land consists of small to large blocks that are in part scattered and in part concentrated along drainage routes such as the White River.

Accessibility.--U.S. Highways 6, 50, and 93 join at the eastern boundary of the north half of Locality WP-8, cross the locality through Connors Pass and extend northwest to Ely where they divide. Thus, several miles of each road lies within 40 km (25 mi) of the locality boundary. Southwest of Ely, State Route 38 extends from its junction with U.S. 6 southeastward to Preston and beyond; thus, several miles of this road also lie within the vicinity of WP-8. A secondary road extends northward along Spring Valley subparallel to the northern half of the locality, and as little as 5 km (3 mi) from it. Local roads

extend into the Schell Creek Range at various places, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

An electric-power generating plant at McGill is 18 km (11 mi) northwest of the northern extremity of the locality, and a power line with a capacity of from 14,000 to 50,000 V ac extends to Ely and thence southeastward subparallel to combined U.S. Highways 6, 50, and 93 through Connors Pass, and southwest from Ely toward Currant with a branch to Preston and Lund (Lockard, 1970). Most of these power lines lie within the vicinity of WP-8.

No pipelines are mapped within 40 km (25 mi) of the locality (Lockard, 1970).

Remoteness.--Thirteen named places are mapped (Lutsey and Nichols, 1972) within 40 km (25 mi) of locality WP-8. Of these the following six places had reported populations (Rand McNally, 1977) in the 1970 census:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ely	6,216	11	7	WNW	NW corner
East Ely	1,992	9	6	WNW	NW corner
McGill	2,164	18	11	NW	N extremity
Ruth	750	19	12	WNW	NW corner
Lund	250	22	14	W	W edge, south portion
Baker	20	39	24	E	E edge, middle portion

Geologic setting.--This range is like the adjacent Snake Range in that the northern part is heaved up along a major normal fault on the east boundary, whereas the southern part is heaved up along a major normal fault on the west boundary. Thus, the northern part is tilted downward to the west, and the southern part is tilted downward to the east.

Six clay-rich formations are exposed in the central Schell Creek Range; they are the Chainman Shale, Pilot Shale, Lincoln Peak Formation, Pioche Shale, an unnamed shale subunit of Cambrian-Ordovician age, and an argillitic, phyllitic part of unnamed, undifferentiated metasedimentary rocks of Precambrian age. The unnamed shale unit of Cambrian and Ordovician age (Drewes, 1967) is inferred here to be a correlative of either the Dunderberg Shale or the Corset Spring Shale (both as of Hose and Blake, 1976). The argillitic, phyllitic part of the undifferentiated metasedimentary rocks of Precambrian age (Drewes, 1967) is inferred here to correlate with part of the McCoy Creek Group of Misch and Hazzard (1962). Of these, only the Chainman Shale and the Lincoln Peak Formation will be considered further, as the others are too thin.

The Chainman Shale consists (Drewes, 1967) chiefly of dark, noncalcareous, very carbonaceous clay shale, with a small amount of coarser strata. The formation is roughly divisible into three subunits that are not feasibly mappable. The upper unit is clay shale interbedded with light-colored beds of quartzose, crossbedded sandstone, and quartzite from 3 to 56 cm (1 to 22 in.) thick, but commonly 10 cm (4 in.) cemented by a variety of minerals including clay, silica, and calcite. The beds are in groups of from three to six, and total as much as 3 m (10 ft) in thickness. Some thin beds of argillite, conglomerate, and mudstone are also present, and limestone becomes increasingly common in the "uppermost few feet." Thickness of the subunit is about 91 m (300 ft).

The middle subunit contains few sandstone beds, but a layer of thickly bedded sandstone about 15 m (50 ft) thick is present locally, and in many places there are a few selenite veins.

The lower subunit is chiefly an alternation of shale and siltstone. These beds are from 1.3 to 31 cm (0.5 to 12 in.) thick, show conchoidal fracture, and weather to irregular blocky slabs. This unit is about 91 m (300 ft) thick.

Total thickness of the Chainman Shale is about 335 m (1,100 ft) in the northern part of this locality.

The Chainman Shale in the southern part of the locality (Conway, 1965) is dark, platy to slightly fissile, silty shale and siltstone, with thin interbeds of platy siltstone in the upper part locally, and some well-cemented, light-colored quartzite. Conway found the formation extremely variable in thickness, and to range from 91 to 366 m (300 to 1,200 ft), due to faulting and tectonic modification.

The Lincoln Peak Formation is divisible (Drewes, 1967) into two shale subunits with a third, or middle, limestone subunit between. The upper shale member contains limestone beds from 3 to 5 cm (1 to 2 in.) but as much as 23 cm (9 in.) thick. These increase from about 30 percent of the subunit in its lower part to about 75 percent near the top. Locally the subunit is metamorphosed to phyllitic or slaty shale. No thickness is given for the subunit.

The middle subunit consists of thin, platy limestone with some silty partings. No thickness is given for the subunit.

The lower shale unit is composed of medium-gray, fissile to platy, silty to limy, partly micaceous shale, interbedded with scattered layers of limestone from about 3 to 5 cm (1 to 2 in.) thick, that together make up less than 10 percent of the subunits volume.

Thickness of the structurally complicated formation is estimated at about 488 m (1,600 ft) and not more than 585 m (1,800 ft).

Hydrologic setting.--Locality WP-8 is in Steptoe Valley and Spring Valley ground-water systems and drainage basins. Discharge occurs 10 km (6 mi) west of the center of the area in Steptoe Valley, where the ground water is used for domestic and livestock purposes.

Mineral-resource activity.--No active mines are within Locality WP-8, but eight lie within 40 km (25 mi) of the locality boundary (Payne and Papke, 1977). They are: a copper, molybdenum, silver, and gold mine which is near Ruth and about 19 km (12 mi) west-northwest of the westernmost extremity, a gold and silver mine which is near Ely and about 14 km (9 mi) west-northwest from the same point, a lead and silver mine about 15 km (9 mi) southwest of that extremity, a limestone mine near McGill and about 18 km (11 mi) northwest of the northern extremity, three gold-placer mines centered about 13 km (8 mi) southeast of the same extremity, and a tungsten mine 19 km (12 mi) northwest of that point. The large mine at Ruth was closed down in July 1978.

A total of 27 exploratory holes for oil and natural gas have been drilled within 40 km (25 mi) of the locality (Garside and Schilling, 1977). Two of these exploratory borings, about 24 km (15 mi) west of the southwestern edge of the locality, had reported shows of oil. Most of these are located in a 90^{0} arc that lies west-northwest to south-southwest from the southern portion of the locality. Seven lie in a northwesterly arc.

Two well separated patented lode-mining claims are in the north half of WP-8. Within a distance of 40 km (25 mi) of the locality are about 25 single claims, and 6 blocks of claims (Lutsey and Nichols, 1972). From the northern extremity, a single claim and one block of claims 37 km (23 mi) north mark the Piermont mining district, six single claims and five blocks 28 km (17 mi) west constitute the Robinson (Ely) mining district, and five single claims about 16 km (10 mi) northwest represent the McGill area, and three single claims lie about midway between Ely and McGill. Two single claims and a block about 16 km (10 mi) east of the middle of the locality mark the Osceola mining district, and four singles plus a block west of the middle about 18 km (11 mi) represent the Ward mining district. Finally, a single claim is about 32 km (20 mi) east of the southern portion.

WP-9: Central Egan Range Locality

Locality WP-9 is a long, moderately slender, somewhat arcuate area with a broad northern end. The locality consists of a single part, which is in south-central White Pine County. Exposures are located on both flanks and the crest of the Egan Range.

Geographic location.--The northwestern extremity of the locality is at lat 39°19' N., long 115°02' W., the northeastern extremity is lat 39°18' N., long 114°44' W., and the southern extremity is at lat 38°41' N., long 114°59' W. These locations are in the SE 1/4 sec. 20, T. 17 N., R. 62 E., the NW 1/4 sec. 33, T. 17 N., R. 63 W., and the center, sec. 35, T. 10 N., R. 62 E., respectively.

The whole of Locality WP-9 is represented topographically on maps of one scale, and in part on maps of two other scales. These maps are listed following the Reference list.

Approximate area.--Locality WP-9 is about 74 km (46 mi) long. Its minimum width is 0.8 km (0.5 mi), its maximum about 13 km (8 mi), and the average width is estimated at 5 km (3 mi). The area of the locality is thus about 357 km^2 (138 mi^2). Of this an estimated 50 percent is exposed bedrock that includes clay-rich strata, but the amount of clay-rich rock exposed is not determined.

Land ownership.--All or part of 17 small blocks of private land totaling about 47 km^2 (18 mi^2) lie within the boundary of Locality WP-9, together with about 47 km^2 (18 mi^2) of land in the Ward Mountain segment of the Humboldt National Forest. The State of Nevada's Garnet Field Rockhound Area, which consists of about 7 km^2 (3 mi^2) just west of Ely, is also included; the remainder is Federal public land.

In the vicinity of WP-9, the area within a radius of 40 km (25 mi) from the locality boundary, most land is also Federal public domain. Private land is extensive, and constitutes small to large blocks that are in part scattered and in part concentrated along drainage routes in the Steptoe and White River Valleys. In addition, one section of withdrawn land is located 10 km (6 mi) north of the northern extremity, and large areas are assigned to the Humboldt National Forest. Included in the latter is the remainder of the Ward Mountain segment mentioned above, the Schell Creek Range segment 10 km (6 mi) east of the north portion of the locality, the southern Snake Range segment 39 km (24 mi) east of the southern portion, and the White Pine segment 21 km (13 mi) west of the same portion.

In addition, the State of Nevada's Cave Lake Recreation Area is 16 km (10 mi) east of the northern portion, the Swamp Cedar Natural Area is 39 km (24 mi) east of the same portion, the Mount Grafton Scenic Area is 11 km (7 mi) southeast of the southern portion, and the Wayne Kirch Wildlife Management Area is 27 km (17 mi) south of the southern extremity.

Accessibility.--Both U.S. Highways 6 and 50 cross the northern portion of the locality, and these highways plus U.S. Highway 93, which are combined southeast of Ely and separate elsewhere, all lie within the vicinity of WP-9 for several miles of their lengths (Lutsey and Nichols, 1972). State Route 38 southward from its junction with U.S. 6 is within 2 km (1 mi) of the southern portion of the locality. A secondary road along the foot of the east flank of the Schell Creek Range is within 35 km (22 mi) east of the north portion, and another secondary road along the foot of the east flank of the White Pine Range is as little as 20 km (12 mi) west of the southern portion of WP-9 at its junction with U.S. 6. Local roads from the U.S. highways, State Route 38, and the secondary roads provide access in

places to various parts of the locality. Unmapped trails accessible by 4-wheel-drive probably are available.

Power transmission lines that carry from 14,000 to 50,000 V ac extend southwest from Ely along U.S. Highway 6 and southeast along combined U.S. Highways 6, 50, and 93 (Lockard, 1970). These lines are supplied by a line from the generating station at McGill; another line from McGill leads to Ruth, west of Ely. All are within the vicinity of WP-9.

Lockard (1970) shows no pipelines within the vicinity of WP-9, a radius of 40 km (25 mi).

Remoteness.--The village of Ruth is located within the northern portion of the locality, and 10 other named places are within 40 km (25 mi) of WP-9. Only Ruth and five of the other places had populations reported in the 1970 census (Rand McNally, 1977). They are:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ruth	750				
Ely	6,216	2	1	E	N portion
East Ely	1,992	3	2	E	N portion
McGill	2,164	15	9	NE	NE extremity
Lund	250	8	5	W	S portion

Geologic setting.--The central Egan Range has been heaved upward along a major normal fault that forms its western boundary, and dropped along another major fault that forms the eastern boundary, thus tilting the range downward to the east.

Five clay-rich formations are present in the Central Egan Range Locality; they are the Sheep Pass Formation of Winfrey (1960), the Chainman Shale, Pilot Shale, Kanosh Shale, and Pioche Shale. Of these only the Sheep Pass Formation and the Chainman Shale are thick enough for further consideration.

The Sheep Pass Formation (Winfrey,1960) consists of six members, designated sequentially by letters from the base upward. The uppermost member, F, is composed of siltstone and claystone that are calcareous in the lower part; this member is 45 m (147 ft thick). It is separated from clay-rich member D by member E, limestone 27 m (90 ft) thick. Member D is composed of white siliceous, extremely fine-grained siltstone containing white to black chert nodules; the member is 223 m (731 ft) thick in the Sheep Pass Canyon vicinity. It is present but of undesirable lithology farther north (Playford, 1961) in this locality.

The Chainman Shale is characterized (Hose and Blake, 1976) as chiefly dark shale and olive, platy siltstone or silty shale, with thin interbeds of fine-grained, dark limestone and lighter-colored beds of organic limestone. Brokaw and Shawe (1965) report that in the northern part of the locality beds of limestone totaling from 31 to 46 m (100 to 150 ft) in thickness lie about 76 m (250 ft) below the upper contact, and that the shale above the limestone is limy. They give no thickness for the unit. Playford (1961) describes the formation in the southern part of the locality as consisting of 274 m (900 ft) of black shale over 15 m (50 ft) of siltstone. In the southern part of the locality also, Kellogg

(1960, 1963) reported the formation consists of two subunits, the lower from 46 to 91 m (150 to 300 ft) thick composed of brown mudstone and platy shale with bands of chert at the base. The upper subunit he described as black to olive-gray shale with calcareous siltstone interbeds.

The thickness of the Chainman Shale as reported in the Central Egan Range Locality varies greatly, mainly because of folding and faulting of the unit here as well as elsewhere in this county. Kellogg (1963) concluded the unit is from 274 to 305 m (900 to 1,000 ft) thick in "the southern Egan Range", and measured 221 m (724 ft) at Sheep Pass Canyon. Brokaw (1967) gives a thickness of 457(?) m (1,500(?) ft) in the Ely (7.5-minute) quadrangle, and Brokaw and Barosh (1968) report a range in thickness of from 122 to 762 m (400 to 2,500 ft) in the Riepetown quadrangle, and considered the variation to be caused by folding and faulting. As indicated above, Playford (1961) concluded the thickness in the northern part of the locality to be 290 m (950 ft).

Hydrologic setting.--Locality WP-9 is in White River and Steptoe Valley ground-water basins and drainage basins. The nearest significant discharge to the northern outcrops is at Murry Spring, about 5 km (3 mi) southwest of Ely, and about 2 km (1 mi) east of the locality boundary. The nearest discharge to the approximate center of the southern group of outcrops is 6 km (4 mi) west at Lund. Murry Spring is part of Ely's water supply and wells at Lund are used for domestic and public supplies.

Mineral-resource activity.--Payne and Papke (1977) show two mines active within the northern end of Locality WP-9. One, a copper, molybdenum, silver, and gold mine is located at Ruth; however, this mine was shut down in July 1978. The second mine produces gold and silver and is just east of Ruth. Two other mines are active within 40 km (25 mi) of the locality. Lead, silver, zinc, and copper are produced at a mine due south of Ely and about 3 km (2 mi) east of the middle portion of the locality boundary. The second is a limestone mine at McGill, about 15 km (9 mi) northeast of the northeast corner of WP-9.

The large Robinson (Ely) mining district with six single claims and five blocks of claims (Lutsey and Nichols, 1972), occupies much of the northern end of the locality and some adjacent area; the Ward district with four single claims and one block of claims is located in the middle portion of the locality and in a small area adjacent thereto. Two well separated single claims are located in the northern Egan Range, and another single claim is situated in the Schell Creek Range east from the middle portion of WP-9. A group of five single claims is centered just east of McGill and thus 15 km (9 mi) northeast of the northeast corner of WP-9, and another group of three is centered 11 km (7 mi) east-northeast of that corner.

Garside and Schilling (1977) show no oil and natural-gas exploratory holes have been drilled within Locality WP-9. Nineteen well-scattered holes have been drilled within 40 km (25 mi) of the northern portion of the locality, and 18 have been drilled in the vicinity of the southern portion, mainly in the White Pine River Valley. Four of the 37 holes had shows of oil, and 2 had shows of oil and gas.

WP-10: Jakes Wash Locality

Locality WP-10 is a short, straight, narrow area that includes most of two low ridges situated on either side of the north end of Jakes Wash, which extends southward from the south end of Jakes Valley. The wash thus lies between the central Egan Range and the northern White Pine Range. The locality consists of one part, situated in southwest White Pine County.

Geographic location.--The northern extremity of the locality is at lat 39°10' N., long 115°08' W.; the southern extremity is at lat 39°04' N., long 115°09' W. In land-survey terminology these points are in the NW 1/4 sec. 20, T. 15 N., R. 61 E., and the SE 1/4 sec. 19, T. 15 N., R. 61 W.

Topographically the locality is represented on maps at two different scales. These maps are listed following the Reference list.

Approximate area.--WP-10 is 13 km (8 mi) long, and has an average width of about 2 km (1 mi) wide; its total area is about 21 km^2 (8 mi^2). Of this area, an estimated 85 percent is exposed bedrock that includes clay-rich strata. The extent of the clay-rich strata is not determined.

Land ownership.--Locality WP-10 is wholly Federal public land (Lutsey and Nichols, 1972). Within a radius of 40 km (25 mi) of the locality boundary the land is mainly Federal public also, with about 75 blocks of private land that range in size from small to large concentrated chiefly along drainage routes. Large areas belong to segments of the Humboldt National Forest. The Ward Mountain segment in the Egan Range is 11 km (7 mi) east of the northern extremity, the Schell Creek Range segment is 14 km (8 mi) east of that extremity, and the White Pine Range segment is 8 km (5 mi) west of the southern extremity. One section of withdrawn land is 27 km (17 mi) north-northeast of the northern extremity. Land controlled by the State of Nevada consists of three small blocks of recreation land located 23 km (15 mi) east-southeast of the southern extremity, the Garnet Fields Rockhound Area, 19 km (12 mi) northeast of the northern extremity, and the Cave Lake Recreation area, 34 km (21 mi) east of that extremity.

Accessibility.--Several miles of U.S. Highways 6, 50, and 93 all lie within 40 km (25 mi) of the locality, in part as a combined highway, in part as separate highways. U.S. 6 is as little as 4 km (3 mi) east of the southeast corner of the locality, U.S. 50 is 20 km (12 mi) northeast of the northern extremity, and U.S. 93 is 24 km (15 mi) northeast of the same point. The junction of State Route 38 with U.S. 6 is 6 km (4 mi) southeast of the southeast corner, and several kilometers of the route are within the vicinity of WP-10. A north-south secondary road along the west side of Jakes Valley is as little as 7 km (4 mi) west of the southwest corner of the locality.

A powerline carrying from 14,000 to 50,000 V ac extends from a generating plant at McGill to Ely and southwest subparallel to U.S. 6 as far as the Nye County boundary, and is about 3 km (2 mi) from the southern extremity.

No pipelines are shown by Lockard (1970) in the vicinity of WP-10.

Remoteness.--Seven named places are mapped (Lutsey and Nichols, 1972) within 40 km (25 mi) of Locality WP-10. Five of these had populations reported in the 1970 census (Rand McNally, 1977):

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ely	6,216	23	14	NE	N extremity
East Ely	1,992	24	15	NE	N extremity
McGill	2,164	39	25	NE	N extremity
Ruth	750	17	11	NE	N extremity
Lund	250	25	16	SE	S extremity

Geologic setting.--This locality is marked by a low north-south ridge, that, like most of the mountain ranges of western White Pine County, is the result of faulting. Principal normal faults along the western margin of the ridge have raised that margin, tilting the crustal segment downward to the east.

Two clay-rich formations are exposed in the Jakes Wash Locality; they are the Chainman Shale and the Pilot Shale. Only the Chainman Shale is thick enough for further consideration. Lloyd (1959) describes the formation as consisting of three parts; from the upper part downward these are predominantly sandstone, shale, and limestone, respectively. The shale is very fissile, noncalcareous, and bituminous, with interbeds of thinly layered, clayey limestone. Lloyd does not give thicknesses for the individual parts, but gives a total thickness for the individual parts, and gives a total thickness for the formation of 512 m (1,680 ft).

Hydrologic setting.--Locality WP-10 is in the White River ground-water system. Runoff drains to Jakes Wash tributary to the White River. The nearest significant discharge is at springs about 23 km (14 mi) southward from the locality center and near Preston, but closer wells used for stock watering would intercept part of this ground-water flow. Ground water is used in the area primarily for domestic and livestock purposes.

Mineral-resource activity.--Payne and Papke (1977) show four active mines within 40 km (25 mi) of WP-10. One, a copper, molybdenum, silver and gold mine near Ruth and 18 km (11 mi) northeast of the northern extremity of the locality, closed down in July 1978. A gold and silver mine is also 18 km (11 mi) northeast of the same point and just west of Ely; a lead and silver mine is 21 km (13 mi) east of WP-10, and a limestone mine is 39 km (24 mi) northeast of the northern extremity, and so just south of McGill.

No patented lode-mining claims or blocks of claims are within the locality, but about 36 single claims and 8 blocks of claims are in the vicinity. Six single claims and five blocks of claims in the Robinson (Ely) mining district are centered 18 km (11 mi) northeast of the northern extremity of the locality, three single claims are centered 34 km (21 mi) northeast of the same point, and a single claim is 34 km (21 mi) east-northeast of the same point. The Ward mining district, with four single claims and one block of claims lies 23 km (14 mi) east of the southern extremity, two single claims lie 24 km (15 mi) southeast of that extremity, and the Hamilton mining district with 20 single claims and two blocks of claims is 37 km (23 mi) northwest of the same point.

A total of 23 exploratory holes for oil and natural gas have been drilled in the vicinity of WP-10; none lie within the locality itself (Garside and Schilling, 1977). These drill holes are well scattered, although locally two or three may be very close together. Three of the holes had reported shows of oil, and four had reported shows of both oil and gas.

WP-11: Northern White Pine Range Locality

Locality WP-11 is a moderately long, moderately wide, somewhat arcuate, semirectangular area. It includes much of the northern part of the White Pine Range, notably excluding most of the Mount Hamilton area on the western flank. The area consists of a single part, which is located in southwestern White Pine County.

Geographic location.--The northwestern extremity is at lat 39°29' N., long 115°33 W., and the northeastern extremity at lat 39°32' N., long 115°27' W. The southwestern extremity is at lat 39°06' N., long 115°27' W., and the southeastern at lat 39°04' N., long 115°24' W. These places are in the NE 1/4 sec. 34, T. 19 N., R. 57 E., the NW 1/4 sec. 9, T. 19 N., R. 58 E., the SW 1/4 sec. 4, T. 14 N., R. 57 E., and the SW 1/4 sec. 24, T. 14 N., R. 58 E., respectively.

The entire locality is represented topographically on a single map at one scale, and almost entirely on maps at a larger scale. These maps are listed following the Reference list.

Approximate area.--The locality has a maximum length of 53 km (33 mi). Its maximum width is 16 km (10 mi) and its minimum width is 6 km (4 mi). The estimated average width is 8 km (5 mi), and the total area is thus about 427 km^2 (165 mi^2). Of this area an estimated 40 percent is exposed bedrock that includes clay-rich strata, but the extent of the strata is not known.

Land ownership.--Approximately the northern half of Locality WP-11 is Federal public land, which encloses one small block of private land. The southern half is chiefly part of the White Pine Range segment of the Humboldt National Forest; a very small amount of Federal public domain and about 13 small blocks of private land are enclosed. The total amount of private land within WP-11 is about 18 km^2 (7 mi^2).

Within a radius of 40 km (25 mi) of the locality boundary, an estimated 85 percent of the land is public domain. Most of it is Federal public land; some is part of the White Pine Range segment of the National Forest. The Ward Mountain (Egan Range) segment of that forest is 35 km (22 mi) east-northeast of the southern extremity. The Duckwater Indian Reservation is 28 km (17 mi) southwest of the same extremity, and one section of withdrawn land lies 37 km (23 mi)southeast of the northern extremity. The State of Nevada's small Garnet Fields Rockhound Area is 36 km (22 mi) east of the easternmost portion of the locality boundary, and in adjacent Eureka County about 39 km^2 (15 mi^2) belong to a northeast-trending livestock driveway.

Accessibility.--U.S. Highway 50 crosses the northern half of the locality, and U.S. Highway 6, which trends southwest, is as little as 24 km (15 mi) from WP-11. The junction of State Route 38 is 25 km (16 mi) east-southeast of that extremity, and the junction of State Route 20 with U.S. Highway 6 is 36 km (22 mi) south of that extremity at Currant. All of these roads thus have extensive portions within the vicinity of the locality. Secondary roads flank the locality on both sides. The road on the east is as little as 5 km (3 mi) from the eastern boundary, and the road on the west apparently follows the boundary for several miles. Local roads permit access to the locality in places, and trails accessible by 4-wheel-drive vehicles probably are present.

A railroad from the north extends southward to McGill and Ely, and terminates near Ruth, 35 km (22 mi) east of the easternmost part of the WP-11 boundary.

A power line with a capacity of from 14,000 to 50,000 V ac extends from a generating plant at McGill southwest to Ely, then continues subparallel to U.S. Highway 6 to terminate near the Nye County line at a point about 35 km (22 mi) south of the southern extremity of the locality. Electric power is also generated at Eureka, 35 km (22 mi) west of the northwestern corner of the locality.

Lockard (1970) shows no pipelines in the vicinity of Locality WP-11.

Remoteness.--Six named places within 40 km (25 mi) of the locality are shown on a map by Lutsey and Nichols (1972); four of these places reported populations in the 1970 census (Rand McNally, 1977):

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Ruth	750	34.6	22	E	E boundary
Eureka	500	35.2	22	W	W boundary
Lund	250	40.1	25	E	S extremity
Duckwater	20	29.1	18	W	S extremity

Geologic setting.--The White Pine Range is basically similar to most of the ranges in southern and western White Pine County. A major normal fault along the western margin of the range raised that margin, tilting the crustal segment downward to the east.

Four clay-rich units are exposed (Humphrey, 1960) in this locality. They are the Chainman Shale (White Pine Shale of former usage), Pilot Shale, Dunderberg Shale, and Secret Canyon Shale. Of these the Pilot Shale and Dunderberg Shale are too thin for further consideration.

Humphrey (1960) describes what appear to constitute two subunits of the Chainman Shale in this locality. The upper subunit is black, fissile, carbonaceous shale with a few sandy interbeds in the upper part. The lower subunit is thin-bedded, varicolored, fine-grained limestone. North of Hamilton, the shale subunit is about 579 m (1,900 ft) thick if not faulted; in Illipah Canyon the shale subunit is more than 152 m (500 ft) thick.

McJannet and Clark (1960) report that an oil-test hole drilled in the NW 1/4 NW 1/4 sec. 17, T. 15 N., R. 59 E., entered hard, black, limy shale at a depth of 780 m (2,558 ft). The hole penetrated 369 m (1,212 ft) of the shale, correlated as Chainman Shale. The test hole apparently was located on or near the crest of an anticline, but the attitude of the strata is not reported; thus, the corrected stratigraphic thickness of the shale may be somewhat less. The drill then penetrated 88 m (288 ft) of limestone that constitutes the lower part of the Chainman Shale, 28 m (91 ft) of the Joana Limestone, and 85 m (279 ft) of Pilot Shale.

The Secret Canyon Shale is divided by Humphrey (1960) into four subunits; he designated them by the numbers 1 through 4, beginning with the basal unit. Only the basal subunit is thick enough for consideration. Humphrey describes it as micaceous, thinly bedded, calcareous shale. About 244 m (800 ft) of this unit is exposed near the Trench Mine, but the total thickness is not known as the lowermost part is unexposed.

Hydrologic setting.--Locality WP-11 is in Railroad Valley, White River, and Newark Valley ground-water systems. Runoff drains to Railroad, Newark, and Long Valleys, Jakes Valley via Illipah Creek, and White River via Ellison Creek.

One important nearby discharge area is 27 km (17 mi) southwest of the center of the locality, and along Duckwater Creek in northern Railroad Valley. Within the northern third of the locality are numerous springs and the headwaters of Illipah Creek, which usually has flow to the point where it enters Jakes Valley. Ground water is used in the region primarily for domestic, livestock, and irrigation purposes.

Mineral-resource activity.--No active mines lie within Locality WP-11, but four are within 40 km (25 mi) of its boundary (Payne and Papke, 1977). A lead and silver mine is located 18 km (11 mi), and a gold mine is 24 km (15 mi), west-southwest of the northern extremity of the locality. A copper, molybdenum, silver and gold mine is 18 km (11 mi), and a gold and silver mine is 19 km (12 mi), east of the easternmost part of the locality boundary.

Within Locality WP-11 are eight single patented lode-mining claims, and one block of claims, that are part of the Hamilton mining district (Lutsey and Nichols, 1972). This district straddles the western boundary of the southern half of the locality (Lutsey and Nichols, 1972). The remainder of the district, about 15 single claims plus another block of claims is located just outside the boundary. Elsewhere in the vicinity of WP-11, there are 25 single claims plus 3 blocks centered 37 km (23 mi) west of the northwest corner of the locality, in the Eureka mining district; two other single claims are located 11 km (7 mi) west-southwest from the same corner. In addition, five single claims and five blocks of claims are centered 35 km (22 mi) east of the middle part of the eastern boundary, in the Robinson (Ely) mining district, and three single claims and two blocks of claims are in the Ward mining district, centered 29 km (18 mi) east of the southern extremity.

Three exploratory holes for oil and natural gas have been drilled near the U.S. Highway 50 right-of-way in the northern part of the locality (Garside and Schilling, 1977). One had a show of oil and gas, but the others were reported as dry. About 24 other test holes have been drilled within 40 km (25 mi) of the locality boundary. These are well scattered about the vicinity, but there is a slight concentration near the southernmost margin. These are part of the numerous holes drilled, mainly in Railroad Valley, in the neighborhood of two producing oil fields in Railroad Valley.

WP-12: Pancake Range Locality

Locality WP-12 is a moderately short, relatively broad area of somewhat irregular form. It includes much of the terrain, composed of low ridges, scattered buttes, and gently sloping valley floors, that together constitute that part of the Pancake Range located in southwestern White Pine County. The area consists of a single part.

Geographic location.--The northern extremity is located at lat 39°26' N., long 115°41' W., the southern extremity at lat 39°03' N., long 115°43' W., and the southwestern extremity at lat 39°09' N., long 115°53' W. These locations are in the NW 1/4 sec. 17, T. 18 N., R. 56 E., the NE 1/4 sec. 30, T. 14 N., R. 56 E., and the W 1/2 sec. 26, T. 15 N., R. 54 E., respectively.

The entire locality is represented topographically on a single map at a scale of 1:250,000, as well as on more detailed maps. These maps are listed following the Reference list.

Approximate area.--The area is 43 km (27 mi) long. It has a maximum width of 21 km (13 mi), a minimum width of 2 km (1 mi), and an estimated average width of about 11 km (7 mi). Thus, the total area is approximately 490 km^2 (189 mi^2). Of this area, an estimated 50 percent consists of exposed bedrock that includes clay-rich rock; the extent of the clay-rich rock is not determined.

Land ownership.--Locality WP-12 is wholly Federal public land (Lutsey and Nichols, 1972). Most of the land within a radius of 40 km (25 mi) from the locality is Federal public land also. The White Pine Range segment of the Humboldt National Forest is as little as 2 km (1 mi) east of the easternmost extremity of WP-12, and the small Duckwater Indian Reservation is 10 km (6 mi) south of the southern extremity. An estimated 233 km^2 (90 mi^2) of land controlled by the State of Nevada constitutes most of a livestock driveway in Eureka County that extends southwestward from the west flank of the Diamond Mountains to the southern boundary of that county. Private land consists of about 90 blocks that range in size from small to large; these are located mainly along the east side of Diamond Valley, some are in Newark Valley and a few are enclosed by the National Forest.

Accessibility.--U.S. Highway 50 crosses the northern end of the locality, and State Route 20 crosses the southwestern portion. A secondary road that extends north-south along the west flank of the White Pine Range is 10 km (6 mi) east, and another secondary road on the east flank of the White Pine Range is 29 km (18 mi) east, of the easternmost extremity of the locality. Extensive portions of all four roads lie within the vicinity of WP-12. Local roads provide access to some portions of the locality, and unmapped trails accessible by 4-wheel-drive vehicles probably are present.

No railroads, powerlines, or pipelines are within 40 km (25 mi) of the locality (Lockard, 1970). Electrical power is generated at Eureka.

Remoteness.--Three named places (Lutsey and Nichols, 1972) are within 40 km (25 mi) of the locality; two of these had residents reported (Rand McNally, 1977) in the 1970 census:

Town or village	1970 Population	Distance km	Distance mi	Direction	From
Eureka	500	24	15	NNW	N extremity
Duckwater	20	29	18	S	S extremity

Geologic setting.--The northern Pancake Range differs somewhat from the typical range of the Basin and Range province and of western White Pine County. This range is less distinctly the result of major thrust faulting and normal faulting, although both are significant. The range is more the result of folding.

The Pancake Range Locality contains (Hose and Blake, 1976) two exposed, clay-rich formations. These are the Chainman Shale and the Pilot Shale; the Pilot Shale, however, is too thin for further consideration.

The Chainman Shale in and near the Pancake Range was studied by Stewart (1962). He found no distinction could be made between the Chainman and the overlying Diamond Peak Formation where studied, and so describes them as undifferentiated. The undifferentiated unit is divisible into four major lithologic subunits; these are, from the basal subunit upward, a lower siltstone, a lower sandstone and siltstone, an upper siltstone, and an upper sandstone and siltstone.

The lower siltstone subunit consists of olive- to dark-gray siltstone to silty claystone, with a bed of gray silty limestone 3 m (10 ft) thick, 18 m (60 ft) below the top. The subunit is about 326 m (1,070 ft) thick.

The lower sandstone and siltstone subunit consists of about 58 percent olive-gray siltstone, 40 percent sandstone, 1 percent silty limestone, and less than 1 percent conglomerate. The quartzose to feldspathic sandstone forms beds from about 1 to 61 m (3 to 200 ft) thick. Limestone beds are from 15 to 31 cm (6 to 12 in.) thick. This subunit is about 366 m (1,200 ft) thick.

The upper siltstone subunit is composed of about 93 percent silty claystone to clayey siltstone, 5 percent sandy siltstone, and 2 percent quartzose to feldspathic sandstone. The unit is about 180 m (590 ft) thick.

The upper sandstone and siltstone unit is lithologically similar to the lower comparable subunit, and is at least 201 m (660 ft) thick.

The total thickness of the undifferentiated unit is thus about 1,073 m (3,520 ft).

Stewart concluded that abrupt lateral changes are expectable in this locality as well as abrupt vertical changes.

McJannet and Clark (1960) report that an oil-test hole was drilled in the SW 1/4 NE 1/4 SE 1/4 sec. 31, T. 16 N., R. 56 E. It entered the upper clay-rich part of the Chainman Shale at the ground surface, and penetrated about 680 m (2,230 ft) of the unit. The drill then penetrated about 76 m (250 ft) of limestone, correlated as the middle, or limestone-rich, part of the Chainman, and about 137 m (450 ft) more of shale, correlated with the lower clay-rich part of the formation. The total thickness of the Chainman Shale at this location thus is about 893 m (2,930 ft). As these data are all interpreted from figure 1 of McJannet and Clark, and as the locality is both faulted and folded, the figures are somewhat inaccurate.

Hydrologic setting.--Locality WP-12 is in Newark and Railroad Valleys ground-water systems. Runoff flows to Little Smoky, Newark, and Railroad Valleys. The nearest significant discharge areas to the center of the locality are near Fish Creek, 18 km (11 mi) westward in the Newark Valley system, and near Duckwater Creek 29 km (18 mi) southward in Railroad Valley. Ranch wells in both these directions intercept some of the ground-water flow. The ground water is used in the region mainly for domestic, livestock, and irrigation purposes.

Mineral-resource activity.--Two mines are active (Payne and Papke, 1977) within 40 km (25 mi) of the locality boundary; none is active within its boundary. One mine is located in the Eureka mining district, an area of 25 single patented lode-mining claims and three blocks of claims. It is a gold mine located 25 km (15 mi) west of the northern extremity of WP-12. The second mine is 11 km (7 mi) southwest of the same extremity, and is associated with two single claims. The Hamilton mining district, an area of 23 single claims and 2 blocks is centered about 8 km (5 mi) east of the easternmost extremity of WP-12.

One exploratory hole for oil and natural gas has been drilled in the locality (Garside and Schilling, 1977); it had a show of oil reported. Fifteen other test holes have been drilled within 40 km (25 mi) of the locality. Well scattered, they are located mainly to the north, east, and south of the locality.

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Topographic Maps

The topographic maps in the following list are all published by the USGS. Three quadrangle series at differing scales are represented in the list, and the series differ in the amount of detail shown. In addition, there is a topographic map of the State of Nevada published at a scale of 1:500,000. It has a contour interval of 500 ft (about 152.4 m) and shows the least detail, for 5 km equals 1 cm (about 8 mi equals 1 in.). Maps listed below that have a scale of 1:250,000 have a contour interval of 80 ft (about 24.4 m), and 2.5 km equals 1 cm (about 4 mi equals 1 in.). Maps at a scale of 1:62,500 have a contour interval of 40 ft (about 12.2 mi), and 0.625 km equals 1 cm (about 1 mi equals 1 in.). Maps at a scale of 1:24,000 have a contour interval of 20 ft (6.1 m), and 0.24 km equals 1 cm (about 1 mi equals 2.64 in.).

These maps can be purchased by mail from Branch of Distribution, MS-306, USGS, Box 25046, Denver Federal Center, Denver, Colo. 80225. In some of the larger towns and cities of Nevada they may be locally available over the counter from various blueprinting, recreational, and book stores.

Clark County Localities

CL-1: 1:250,000-scale series
- Kingman Quadrangle (NI 11-3)
- Las Vegas Quadrangle (NJ 11-12)

1:62,500-scale series
- Charleston Peak Quadrangle
- Mercury Quadrangle
- Mount Sterling Quadrangle

Elko County Localities

EL-1: 1:250,000-scale series
- Elko Quadrangle (NK 11-12)
- Jordan Valley Quadrangle (NK 11-5)
- Twin Falls Quadrangle (NK 11-6)
- Wells Quadrangle (NK 11-9)

1:62,500-scale series
- Bull Run Quadrangle
- Mountain City Quadrangle
- Tuscarora Quadrangle
- Wild Horse Quadrangle

1:24,000-scale series
- Owyhee Quadrangle
- Ugina Wonga Quadrangle

EL-2: 1:250,000-scale series
- Jordan Valley Qaudrangle (NK 11-5)
- Twin Falls Quadrangle (NK 11-6)
- Wells Quadrangle (NK 11-9)

1:62,500-scale series
- Mount Velma Quadrangle

EL-3: 1:250,000-scale series

Wells Quadrangle (NK 11-9)

1:62,500-scale series

Holborn Quadrangle

Knoll Mountain Quadrangle

Loomis Mountain Quadrangle

Melandco Quadrangle

Oxley Peak Quadrangle

Summer Camp Quadrangle

Wells Quadrangle

Wells Peak Quadrangle

Wilkins Quadrangle

Wine Cup Ranch Quadrangle

Wine Cup Ranch SW Quadrangle

EL-4: 1:250,000-scale series

Brigham City Quadrangle (NK 12-7)

Tooele Quadrangle (NK 12-10)

Wells Quadrangle (NK 11-9)

1:24,000-scale series

Pilot Peak Quadrangle

EL-5: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Wells Quadrangle (NK 11-9)

1:62,500-scale series

Spruce Mountain Quadrangle

Spruce Mountain 4 Quadrangle

1:24,000-scale series

Holborn Quadrangle

Independence Valley NE Quadrangle

Independence Valley SE Quadrangle

Pequop Quadrangle

Pequop Summit Quadrangle

Pequop Summit SW Quadrangle

EL-6: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Winnemucca Quadrangle (NK 11-11)

1:62,500-scale series

Carlin Quadrangle

Dixie Flats Quadrangle

Mineral Hill Quadrangle

Pine Valley Quadrangle

Railroad Pass Quadrangle

Robinson Mountain Quadrangle

1:24,000-scale series

Elko West Quadrangle

EL-7: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Winnemucca Quadrangle (NK 11-11)

1:24,000-scale series

Adobe Summit Quadrangle

Coal Mine Basin Quadrangle

Coal Mine Canyon SE Quadrangle

Dinner Station Quadrangle

Elko West Quadrangle

Hunter Quadrangle

Kittridge Springs Quadrangle

Morgan Hill Quadrangle

Osino Quadrangle

Peko Peak Quadrangle

The Buttes Quadrangle

The Narrows Quadrangle

Wieland Flat

Eureka County Localities

EU-1: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Ely Quadrangle (NJ 11-3)

1:62,500-scale series

Diamond Springs Quadrangle

Eureka Quadrangle

Railroad Pass Quadrangle

Pinto Summit Quadrangle

EU-2: 1:250,000-scale series

Ely Quadrangle (NJ 11-3)

Millett Quadrangle (NJ 11-2)

1:62,500-scale series

Bellevue Peak Quadrangle

Eureka Quadrangle

Pinto Summit Quadrangle

Whistler Mountain Quadrangle

Lincoln County Localities

LI-1: 1:250,000-scale series

Lund Quadrangle (NJ 11-6)

1:24,000-scale series

Cave Valley Well Quadrangle

Hagerty Spring Quadrangle

Shingle Pass Quadrangle

Silver King Well Quadrangle

LI-2: 1:250,000-scale series

Lund Quadrangle (NJ 11-6)

LI-3: 1:250,000-scale series
Lund Quadrangle (NJ 11-6)

LI-4: 1:250,000-scale series
Caliente Quadrangle (NJ 11-9)
Cedar City Quadrangle (NJ 12-7)
Lund Quadrangle (NJ 11-6)
Richfield Quadrangle (NJ 12-4)

1:24,000-scale series
Bennett Pass Quadrangle
Bristol Range SE Quadrangle
Bristol Well Quadrangle
Chief Mountain Quadrangle
Ely Springs Quadrangle
Highland Peak Quadrangle
Pioche Quadrangle
The Bluffs Quadrangle

LI-5: 1:250,000-scale series
Caliente Quadrangle (NJ 11-9)

1:24,000-scale series
Caliente Quadrangle
Chokecherry Mountain Quadrangle
Delamar Quadrangle
Gregerson Basin Quadrangle
Pahroc Spring NE Quadrangle
Pahroc Spring SE Quadrangle
Slidy Mountain Quadrangle
The Bluffs Quadrangle

LI-6: 1:250,000-scale series
Caliente Quadrangle (NJ 11-9)
Las Vegas Quadrangle (NJ 11-9)

1:62,500-scale series
Arrow Canyon Quadrangle

1:24,000-scale series
Delamar 3 SE Quadrangle
Delamar 3 SW Quadrangle
Wildcat Wash NE Quadrangle
Wildcat Wash SE Quadrangle

LI-7: 1:250,000-scale series
Caliente Quadrangle (NJ 11-9)
Las Vegas Quadrangle (NJ 11-12)

1:24,000-scale series
Dead Horse Ridge Quadrangle
White Sage Flat Quadrangle

Northern Nye County Localities

NN-1: 1:250,000-scale series
- Topopah Quadrangle (NJ 11-5)

1:62,500-scale series
- Baxter Spring Quadrangle

1:24,000-scale series
- Belmont West Quadrangle
- Jefferson Quadrangle
- Manhattan Quadrangle
- Round Mountain Quadrangle
- Seyler Peak Quadrangle

NN-2: 1:250,000-scale series
- Tonopah Quadrangle (NJ 11-5)

1:62,500-scale series
- Fish Springs Quadrangle
- Morey Peak Quadrangle
- Moores Station Quadrangle
- Pritchard's Station Quadrangle
- Tybo Quadrangle
- Warm Springs Quadrangle

1:24,000-scale series
- Bluejay Spring Quadrangle
- Chaos Creek Quadrangle
- Fish Springs SE Quadrangle
- Flagstaff Mountain Quadrangle
- Hobble Canyon Quadrangle
- Little Fish Lake Quadrangle
- Moores Station Quadrangle
- Moores Station SW Quadrangle
- Park Mountain Quadrangle
- Pritchards Station Quadrangle
- Red King Mountain Quadrangle
- Tybo Quadrangle
- Tybo SE Quadrangle
- Warm Springs Quadrangle
- Warm Springs NW Quadrangle

NN-3: 1:250,000-scale series
- Ely Quadrangle (NJ 11-3)
- Lund Quadrangle (NJ 11-6)

1:62,500-scale series
- Duckwater Quadrangle
- Moody Peak Quadrangle

1:24,000-scale series
- Brown Summit Quadrangle
- Portugese Mountain Quadrangle
- Sand Spring Quadrangle

NN-4: 1:250,000-scale series

Ely Quadrangle (NJ 11-3)

Lund Quadrangle (NJ 11-6)

1:62,500-scale series

Blue Eagle Springs Quadrangle

Currant Mountain Quadrangle

Duckwater Quadrangle

Treasure Hill Quadrangle

NN-5: 1:250,000-scale series

Lund Quadrangle (NJ 11-6)

1:24,000-scale series

Gap Mountain Quadrangle

Timber Mountain Pass NE Quadrangle

Timber Mountain Pass NW Quadrangle

Timber Mountain Pass W Quadrangle

NN-6: 1:250,000-scale series

Lund Quadrangle (NJ 11-6)

1:62,500-scale series

Blue Eagle Springs Quadrangle

Currant Quadrangle

Forest Home Quadrangle

Troy Canyon Quadrangle

Southern Nye County Localities

NS-1: 1:250,000-scale series

Goldfield Quadrangle (NJ 11-8)

1:62,5000-scale series

Belted Peak Quadrangle

Wheelbarrow Peak Quadrangle

White Pine County Localities

WP-1: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Ely Quadrangle (NJ 11-3)

1:62,000-scale series

Buck Mountain Quadrangle

Cold Creek Range Quadrangle

Jiggs Quadrangle

Sherman Mountain Quadrangle

1:24,000-scale series

Franklin Lake SW Quadrangle

Franklin Lake SE Quadrangle

Ruby Lake NW Quadrangle

Station Butte Quadrangle

WP-2: 1:250,000-scale series

Elko Quadrangle (NK 11-12)

Ely Quadrangle (NJ 11-3)

WP-3: 1:250,000-scale series
Elko Quadrangle (NK 11-12)
Ely Quadrangle (NJ 11-3)
WP-4: 1:250,000-scale series
Ely Quadrangle
1:62,500-scale series
Connors Pass Quadrangle
Schell Peak Quadrangle
WP-5: 1:250,000-scale series
Delta Quadrangle (NJ 12-1)
Ely Quadrangle (NJ 11-3)
Tooele Quadrangle (NK 12-10)
WP-6: 1:250,000-scale series
Delta Quadrangle (NJ 12-1)
Ely Quadrangle (NJ 11-3)
Tooele Quadrangle (NK 12-10)
WP-7: 1:250,000-scale series
Delta Quadrangle (NJ 12-1)
Ely Quadrangle (NJ 11-3)
Lund Quadrangle (NJ 11-6)
Richfield Quadrangle (NJ 12-4)
1:62,5000-scale series
Sacramento Pass Quadrangle
Wheeler Peak Quadrangle
WP-8: 1:250,000-scale series
Ely Quadrangle (NJ 11-3)
Lund Quadrangle (NJ 11-6)
1:62,500-scale series
Connors Pass Quadrangle
Ely Quadrangle
1:24,000-scale series
Comins Lake Quadrangle
WP-9: 1:250,000-scale series
Ely Quadrangle (NJ 1103)
Lund Quadrangle (NJ 11-6)
1:62,500-scale series
Ely Quadrangle
McGill Quadrangle
Riepetown Quadrangle
1:24,000-scale series
Haggerty Springs Quadrangle
Ruth Quadrangle

WP-10: 1:250,000-scale series
Ely Quadrangle (NJ 11-3)
1:62,500-scale series
Preston Reservoir Quadrangle

WP-11: 1:250,000-scale series
Ely Quadrangle (NJ 11-3)
1:62,500-scale series
Green Springs Quadrangle
Illipah Quadrangle
Pancake Summit Quadrangle
Treasure Hill Quadrangle

WP-12: 1:250,000-scale series
Ely Quadrangle
1:62,500-scale series
Green Springs Quadrangle
Moody Peak Quadrangle
Pancake Summit Quadrangle
Pinto Summit Quadrangle