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CASTLE CREEK KNOWN GEOTHERMAL RESOURCE

AREA: AN ENVIRONMENTAL ANALYSIS

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Editors

MASTER

U.S. Department of Energy

Idaho Operations Office • Idaho National Engineering Laboratory

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Castle Creek KGRA

CASTLE CREEK KNOWN GEOTHERMAL RESOURCE AREA: AN ENVIRONMENTAL ANALYSIS

ABSTRACT

The Castle Creek known geothermal resource area (KGRA) is part of the large Bruneau-Grand View thermal anomaly in southwestern Idaho. The KGRA is located in the driest area of Idaho and annual precipitation averages 230 mm. The potential of subsidence and slope failure is high in sediments of the Glens Ferry Formation and Idaho Group found in the KGRA. A major concern is the potential impact of geothermal development on the Snake River Birds of Prey Natural Area which overlaps the KGRA. Any significant economic growth in Owyhee County may strain the ability of the limited health facilities in the county. The Idaho Archaeological Survey has located 46 archaeological sites within the KGRA.

INTRODUCTION

EG&G Idaho, Inc., has completed an environmental analysis for the Castle Creek KGRA as part of a comprehensive preplanning environmental program related to the KGRAs in the Snake River Basin. EG&G Idaho, Inc., is performing this preplanning environmental program under the auspices of the Office of Health and Environmental Research of the U.S. Department of Energy (DOE). KGRAs included under this program (see Figure 1) are Vulcan Hot Springs, Crane Creek, Castle Creek, Bruneau, Mountain Home, Raft River, Island Park, and Yellowstone. The Castle Creek KGRA is the subject of this report.

The ultimate goal of the preplanning environmental program is to reduce the delays in geothermal development while minimizing environmental impacts by (a) assessing the existing environmental baseline data for the KGRAs (b) evaluating those data for adequacy and applicability, and (c) developing a plan for supplementing the existing data to achieve a sound environmental data base prior to geothermal development.

Figure 1. Map of Idaho KGRAs.

Results from the environmental program thus far include a summary of the environmental concerns related to geothermal development in each of the KGRAs,¹ an annotated bibliography of reference materials, detailed reports on the various program elements for each of the KGRAs, a program plan identifying future research needs, and a comprehensive data file. These will serve as: (a) planning tools for state and federal energy, environmental, and land management agencies, (b) reference documents for developers to shorten and simplify project environmental evaluations, and (c) a tool to identify the significant environmental concerns for each KGRA so that mitigation measures can be incorporated early in the development process.

This report includes available environmental information for the Castle Creek KGRA. The information presented is a compilation of the most recent data available for analyzing the physical, biological, and human environments of this area. The sources providing the data are identified alongside the subject titles throughout the report. Current commitments and environmental concerns that might affect geothermal development in the region are discussed. Other reports in this series, as well as the technical reports which form the basis of this overview are listed in Appendix A and are available from Information Processing in the Information Division at EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83401. Landtype descriptions for the Castle Creek KGRA are provided in Appendix B. Appendix C shows the proposed federal status of threatened plant species.

EVALUATION OF THE ENVIRONMENT

Castle Creek KGRA, the largest in Idaho, is located along the Snake River in Owyhee County (Figures 2 through 6). The river has dissected basalt plateaus, resulting in numerous buttes and steep canyons walls. The majority of the 32 263 ha within the KGRA is controlled by the Bureau of Land Management and utilized for range land. Geothermal leases granted on nine units total 8470 ha. Nearly 2400 ha of the KGRA overlaps the Snake River Birds of Prey Natural Area (BPNA), established in 1971 to protect a large population of raptors.

Figure 2. Map of Castle Creek KGRA

Figure 4. The Snake River Canyon in the Castle Creek KGRA.

Figure 5. Owyhee Mountains from the Castle Creek KGRA.

Figure 6. LANDSAT photograph of southwestern Idaho.

The Castle Creek KGRA is part of the Bruneau-Grand View thermal anomaly, the largest geothermal area in the western United States (excluding Yellowstone Park). The U.S. Geological Survey estimates that 450×10^{18} J of heat are contained in a reservoir underlying 14 800 ha of land.² The area represents a complex geothermal system consisting of several aquifers extracted from over 100 wells which produce from volcanic and sedimentary aquifers. The Anschutz Federal No. 1 well reported a bottomhole temperature of 149°C at 3391 m. Geothermometry of shallower wells indicates a maximum resource temperature of 110°C . The area may have a potential for greenhouse operations and other low-temperature direct-heat applications, utilizing warm water from shallow depths. Chemical analyses from thermal wells in the KGRA are shown in Table 1. Water from sedimentary aquifers is generally higher in total dissolved solids and has low fluoride levels, while water from the volcanic aquifers has significantly higher levels of fluoride but lower total dissolved solids.

Physical Environment

Climate and Meteorology (M. Delisio, GeoTechniques)

Few data exist on the climate and meteorology of the Castle Creek KGRA. The information presented here is taken from several sources, including Climatological Summary, Normals, Means and Extremes, Boise, Idaho;⁴ The Atlas of the Pacific Northwest;⁵ The Mean Annual Precipitation Map, 1937-57, State of Idaho;⁶ and Climatological Data, Idaho.⁷

The KGRA is located in the driest area of the state because of its location immediately in the lee of the Owyhee mountains in the southwestern corner of Idaho. The region is marked by generally clear skies, little inclement weather, and marked fluctuation in diurnal and annual temperatures. Summary data on climate are shown in Table 2. Temperatures average 11°C annually, with extremes of -23°C and 40°C . The mean annual precipitation is 230 mm, most of which falls as snow or as rain in the early spring.

TABLE 1. TYPICAL WATER QUALITY - CASTLE CREEK KGRA WELLS
(in mg/l unless otherwise noted)

	<u>3S-1E-35DAC1</u>	<u>4S-1E-29CCD1</u>	<u>5S-2E-2CDA1</u>	<u>5S-3E-28BCC1</u>
Temperature (°C)	20	70	37	65
Depth (m)	90	927	750	774
Discharge (l/s)	0	93	0.6	0
B	0.0	0.0	0.0	0.0
Ca	43	1.2	9.9	0.8
K	6	0.8	22	1.3
Mg	9.9	0.0	2.00	0.0
Na	35	100	250	97
NH ₃	0.06	0.15	0.2	0.62
SiO ₂	55	83	89	98
Cl ⁻	7.7	12	25	15
CO ₃ ⁼	0	51	0.0	67
F ⁻	2.1	12.0	6.4	21.00
HCO ₃ ⁻	246	69	675	27
NO ₃ ⁻	0.01	0	0.01	0
PO ₄ ⁼	0.07	0.01	0.06	0.02
SO ₄ ⁼	25	39	3.4	9.8
Conductivity (µmhos)	440	476	1099	437
pH	7.8	9.2	7.5	9.4
TDS	304	332	739	323

TABLE 2. SUMMARY OF CLIMATE INFORMATION

Temperature ($^{\circ}\text{C}$)

Average 11

Maximum 41

Minimum -23

Precipitation (mm)

Annual 184

Wind

Surface: No data available

850 mb:

Spring - SE

Summer - SE

Fall - W

Winter - S

Stagnation (%)

Inversions based $\leq$ 150 m above ground:

Summer - 40

Fall - 53

The area is in the zone of the prevailing Westerlies and polar Easterlies wind systems. The contact of the two fronts generates the few clouds and associated weather activity that occurs. Most of the cool or cold air consequent with frontal activity is maritime polar air from the Pacific while some is the result of continental polar air from interior Canada. Surface airflow is greatly affected by landforms, primarily by the Owyhee Mountains directly to the west and to a lesser extent by the Snake River Plain, the Northern Rocky Mountains, and diurnal conditions. No adverse weather conditions have been documented; however, occasional dust storms and thunderstorms can be expected.

Air Quality (E. Bentley, GeoTechniques)

At the present time, there are no monitoring stations in Owyhee County. Ambient air quality for the KGRA can only be extrapolated from observation and from regional data available from the Environmental Protection Agency. The regional data indicate that the air quality is at an acceptable level for all pollutants except particulates. Both the primary and secondary standards for particulate materials are exceeded; most of the particulates are fugitive dust from cultivated fields, unpaved roads, and construction activities. Solid wastes account for over 74% of the total particulate emissions in the region, while stationary fuel combustion accounts for nearly 20%.

Although no noncondensable gas analyses have been conducted on warm wells and springs in the area, slight sulfur odors can be detected at several of the wells. Air stagnation and fog conditions occur in the KGRA during the winter. Venting geothermal fluids to the atmosphere could result in periods of deteriorating air quality.

Geology (R. Hardyman, GeoTechniques)

The Castle Creek KGRA borders the Snake River on the south from the confluence of Shoofly Creek (just southeast of Grand View, Idaho)

and the Snake River northwest to the confluence of Fossil Creek (about 9 km north-northeast of Oreana, Idaho) and the Snake River. From the Snake River the KGRA extends southwest to the mountainous terrain of the Owyhee Mountains. Two prominent drainages, Castle Creek and Birch Creek, extend northeast across the KGRA from the highlands of the Owyhee Mountains to the Snake River.

Rocks exposed in the designated KGRA range in age from Miocene to Recent (Figure 7). Cretaceous batholith rocks form extensive exposures just south-southeast of the area in the uplands of the Birch Creek and Castle Creek drainages. These rocks consist of porphyritic granodiorite and diorite with some large masses of quartz-biotite schist and gneiss. Aplite and pegmatite dikes are locally abundant.

Idaho Group Formations constitute most of the rocks exposed at the surface and form badland topography over much of the area. Miocene siliceous volcanic rocks, mainly densely-welded ash-flow tuffs, form much of the outcrops bordering the mountain from the southeast of the KGRA. Basalt and latite lava flows also occur in the foothills of the Owyhee Mountains that border the KGRA on the south.

Stratigraphy. The oldest rocks comprising the surficial geology within the Castle Creek KGRA are apparently Upper Miocene-Lower Pliocene rocks of the Poison Creek Formation. The presence of these rocks within the KGRA is based on stratigraphic descriptions in the literature; no detailed maps exist that show the distribution of the individual formations of the Idaho Group in the KGRA.

The Poison Creek Formation is at least 75 m thick on the west side of Castle Creek along the southern margin of the KGRA. This unit consists of consolidated but unindurated beds of water-laid siliceous volcanic ash and fine-grained tuffaceous silt and shale, along with some beds of locally derived granitic sand and gravel. Most of the sandstone beds are well-cemented but highly fractured due to minor subsidence and faulting. Much of the Poison Creek Formation displays a high bentonite content. The Poison Creek Formation thickens west and northwest from Castle Creek.

Figure 7. Generalized geologic map of Castle Creek KGRA.

Locally, in the Upper Birch Creek and Castle Creek drainages, the Poison Creek Formation is overlain by olivine basalt lava flows that have been designated Banbury equivalent basalts. Basalts mapped as Banbury basalt in the Bruneau area are known from subsurface information to thin to the west. Correlation of basalts that lie above the Poison Creek Formation, or are in part interbedded with the Poison Creek Formation sediments, is uncertain.

Poison Creek Formation sediments and local Banbury equivalent basalts are overlain by the Glenns Ferry Formation that is well exposed in badlands in the Castle Creek KGRA. The contact between the Glenns Ferry Formation and the underlying Poison Creek Formation is a moderate angular unconformity. Beds of the basal Glenns Ferry Formation rest on beveled, tilted beds of the Poison Creek Formation. Apparently, Chalk Hills Formation sediments, which are present below the Glenns Ferry Formation to the east, are not present or have not been identified in the Castle Creek KGRA.

The Glenns Ferry Formation consists of nonindurated, complexly intertonguing, lacustrine, fluvial, and flood-plain deposits. Massive layers of lacustrine silt deposits with minor sand dominate the section in the Castle Creek KGRA. Oolite limestone up to 30 m thick forms a distinct zone at the base of the lacustrine section south of Grand View, Idaho. A similar bed occurs near the base of the Glenns Ferry Formation as far west-northwest as Murphy, Idaho. In the Castle Creek area the basal oolite is overlain by gypsum-bearing siliceous volcanic ash interbedded with the lacustrine silt beds. The potential of slope failure in the Poison Creek and Glenns Ferry sediments is a concern to geothermal exploration and development.

Thick, even-bedded layers of stream-deposited sand and silt with minor interbeds of clay and shale are also well exposed in the western part of the KGRA. Fine-grained, graded-bedded, flood-plain deposits of silt, grading up into clay in repetitious beds up to 1 m thick,

also make up a significant part of the Glenns Ferry Formation in the Castle Creek KGRA. These silt deposits pass north-westward into lacustrine facies at the Glenns Ferry Formation near Sinker Creek.

Numerous fossil fish from lacustrine deposits and mammal fossils from fluvial and flood-plain sequences have been collected in Glenns Ferry Formation rocks from various locations within the Castle Creek KGRA. The formation is designated Upper Pliocene and Lower Pleistocene in age.

The next youngest sequence of rocks exposed in the Castle Creek KGRA are Middle Pleistocene sediments and interbedded basalts of the Bruneau Formation. These rocks are confined to a relatively narrow strip along the Snake River in the northwest part of the KGRA. The Bruneau Formation consists of lenticular, discontinuous deposits of canyon-fill fluvial sands and lake beds of silt, clay, and minor diatomite. In the Castle Creek KGRA, the Bruneau Formation contains a thick sequence of basalt lava flows, subaqueous basaltic pyroclastic material, and tuffaceous sediments that are derived from local vents along the present course of the Snake River. Basaltic material is at least 300 m thick in the Sinker Creek area which is northeast of the KGRA. Much of the basalt lava and pyroclastic material in the Bruneau Formation in this area was derived from the Montini Volcano, a dissected volcano near the mouth of Sinker Creek and on the Snake River.⁸

Much of the Bruneau Formation sediments in the Castle Creek KGRA were deposited in lakes dammed by locally-derived basalt flows. Breaching of lava dams and subsequent responding of drainages by younger lava flows, canyon cutting, and basalt filling of canyons have produced complex stratigraphic relationships in the Bruneau Formation in the Castle Creek KGRA and the area to the northwest and north. Bruneau Formation rocks in the KGRA are overlain in part by Recent alluvium. These unconsolidated stream deposits primarily occupy the present valleys of Birch Creek and Castle Creek.

Structure. The Castle Creek KGRA lies on the downthrown side of the southern margin of the western Snake River Plain graben. The surface expression of the faults marking the southern margin of the graben in the Castle Creek KGRA region is not as well documented as is the fault zone to the southeast near the Bruneau KGRA. High-angle normal faults displace Miocene silicic volcanic rocks southwest of the KGRA in the foothills of the Owyhee Mountains. Relative displacement on most of these faults is down to the northeast. Northwest-trending faults that cut Banbury equivalent basalts and Glenns Ferry Formation rocks have been mapped in the upper Birch Creek and Castle Creek drainages just south-southeast of the KGRA. Displacement on these faults is down to the north-northeast. The faults in the Castle Creek drainage apparently serve as plumbing for hot artesian water in wells in the vicinity.⁹

Faults separating the Owyhee Mountains from the western Snake River Plain graben in the region of the Castle Creek KGRA are northwest-trending and generally dip 50 to 80° northeast. The amount of total displacement across this boundary fault zone is uncertain. A deep hole (Anchutz Corporation No. 1 well) drilled in Sec. 13, T.55, R.1E in the Castle Creek KGRA encountered silicic volcanic ash and presumably rhyolitic volcanic rock at a depth of 3392 m. Without firm stratigraphic control of the deeper part of the section penetrated by this drill hole, the amount of displacement across the graben boundary fault zone is uncertain but it may be 2000 m.

Subsurface well data from the Oreana area suggest vertical displacement of an artesian aquifer of perhaps 580 m.⁹ Other wells in the Oreana and Grand View areas in the Castle Creek KGRA reportedly encountered "silicic volcanics" at depths of 600 to 900 m. The correlation of the "silicic volcanics" in these wells with lithologies encountered in the Anchutz deep test hole is not known.

Other structures in the Castle Creek KGRA include volcanic vents. At least one vent (Montini Volcano) is exposed at the surface in the Castle Creek KGRA. These vents may create local reversals in the slight northerly dips of the Pliocene-Pleistocene sediments in the area, and basalts from these vents undoubtedly complicate subsurface lithologic correlations.

Geologic History. Silicic volcanism of Miocene Age deposited large volumes of rhyolitic ash-flow tuffs and lavas onto pre-Tertiary uplands of exposed Cretaceous igneous rocks in the area of the present Owyhee Mountains. Some of these silicic volcanics may have been from sources now buried by sedimentary and volcanic rocks of the present western Snake River Plain. Subsidence of the western Snake River Plain graben began in Pliocene time and a graben boundary fault zone was developed along the northern margin of what is now the Owyhee Mountains (uplifted block). Erosion of the volcanic uplands and deposition in the subsiding graben produced the Poison Creek Formation. Along with continued subsidence of the graben, large volumes of basalt (Banbury Basalt and equivalents) were extruded and spread over large areas of Miocene silicic volcanic rocks and the Poison Creek Formation. Minor deformation and erosion of these earlier formations were followed by encroachment of an extensive lake in Upper Pliocene time. A thick sequence of lake and related floodplain and stream deposits accumulated into Pleistocene time. Continued faulting and erosion in Middle Pleistocene time resulted in canyon erosion. Subsequent canyon fill sedimentation and basaltic volcanism, primarily from vents aligned along an axis of the present Snake River, resulted in deposition of the Bruneau Formation. Repetition of a sequence of lava damming of drainage, lake formation, dam breaching, and rapid canyon cutting during Bruneau time produced complex stratigraphic relationships in the Bruneau Formation.

Young volcanism deposited basalt lava flows north of the entrenched Snake River during Upper Pleistocene time (Snake River Group) but most of the Castle Creek KGRA experienced erosion during Upper Pleistocene time.

Subsidence (J. Applegate, GeoTechniques)

Subsidence of the ground surface associated with the production of fluids (petroleum and water) has been documented in many areas of the world. A significant number of these areas are in the American West and include Houston, Texas; portions of southern Arizona; Las Vegas, Nevada; the Wilmington and Inglewood oil fields of southern California; the San Joaquin Valley of California; the South Bay area near San Jose, California; and the Raft River Valley of Idaho. Generalized criteria can be established from assessing these areas where subsidence has occurred. The areas of subsidence generally occur where there are youthful, relatively unconsolidated sedimentary rocks of Cenozoic age.¹⁰ These rocks are generally of lacustrine and or alluvial origin, and include interbedded coarse-grained and fine-grained rocks. The permeable sands and or gravel aquifer have low compressibility and are interbedded with clayey aquitards of low permeability, high compressibility, and variable thickness. The withdrawal of fluids causes a decrease in the hydrostatic head of the aquifers and in turn causes a transfer of additional load to the matrix (grain-to-grain load). The effect results in small amounts of generally elastic compaction in the coarse-grained aquifer and much larger amounts of inelastic compaction in the fine-grained aquitard. In the aquitard, the increase in effective stress results in a dewatering of the clays.¹¹ Montmorillonite is the common clay mineral in many of the aforementioned cases of subsidence,¹⁰ and has the ability to lose large volumes of water.

Withdrawal of fluids appears to be the most likely subsidence mechanism in the Castle Creek KGRA. However, two other potential mechanisms should be assessed. These are hydrocompaction and tectonic related subsidence.

Hydrocompaction is subsidence due to the collapse of the soil structure of certain moisture deficient deposits when these deposits lose their dry strength due to wetting.¹² Hydrocompaction is a one-time process where excess moisture penetrates below the root-zone

into moisture deficient material. The process may continue to intensify as the water percolates downward and deeper deposits become wetted. No documented data on the occurrence of hydrocompactable soils in the KGRA are noted in the literature but the limited data do not preclude their presence in arid portions of the geothermal area.

Tectonic subsidence is subsidence, or uplift, that is related to active tectonic processes within the earth such as movement along faults, aseismic movement, emplacement of igneous bodies, etc. As with subsidence related to fluid withdrawal, tectonic subsidence is best observed with repeated leveling. Again, these data are extremely limited. There is some documentation of tectonic movements of 0.07 m in the Raft River Valley, Idaho.¹³

More detailed studies indicating the potential for subsidence have been undertaken in the area of the Castle Creek KGRA than in other areas. Some of these studies are summarized in Young and Whitehead.¹⁴ The Castle Creek KGRA has undifferentiated Idaho Group rocks of Pleistocene age at or near the surface. These rocks include poorly to well-sorted fluvial and lacustrine deposits with intercalated basalt flows and ash. The underlying rocks are lava flows of olivine basalt (Banbury Basalt) interbedded locally with minor amounts of stream and lake deposits. At depth, these deposits probably overlie the Idavada Volcanics which include silicic latite.

Some sections of the Idaho Group have good well yields while others are very poor. Some sands of this group produce as much as 230 l/s. The Banbury Basalt is an excellent aquifer depending on the degree of alteration. Highly-altered portions produce limited amounts of water, whereas unaltered sections produce large volumes.¹⁵ The underlying Idavada Volcanics are highly fractured and jointed, and consequently have large well yields where the wells penetrate this deep. It is believed that these rocks serve to transmit recharge water to the area from the Owyhee uplift to the south, and then the water moves upward into the overlying units.

The rocks in the Castle Creek area are typical of the unconsolidated to semi-consolidated rocks which have proved to be susceptible to subsidence in other areas. In addition, the heavy irrigation usage could have already caused, or future use could cause, a decline of the water level. This decline could be initiated or accelerated by the production of deeper thermal water, if as speculated earlier, these deeper aquifers are recharging the shallow system. Hence, the Castle Creek KGRA is a potential area of subsidence.

Seismicity (J. Applegate, GeoTechniques)

Seismicity studies to determine levels of micro-earthquake activity have been one of the principal exploration tools to define areas of geothermal activity. It has been observed that many geothermal areas have large numbers of small earthquakes. It is postulated that the microseismic events are a function of the youthful geologic activities (volcanism, faulting, etc.) that are associated with geothermal areas. Thus, it is more common than not to find significant seismic activity in close proximity to geothermal systems.

The Castle Creek KGRA is in Seismic Risk Zone II. However, the data base upon which this recommendation was made was somewhat limited. The problem is that the instrumental seismic data set represents only a limited time period and is a major problem in the evaluation of seismic risk. In the last few years several additional seismic networks have been installed in the state. However, the only two that provide much usable data for this study are the networks surrounding the Idaho National Engineering Laboratory (INEL) and a threestation array in the vicinity of Boise which is operated by Boise State University (BSU).

Regional structural maps show the Castle Creek KGRA to be associated with the southern boundary fault zone of the Snake River Plain.^{16,17} The Castle Creek KGRA is transected by faults which are suspected to have been recurrently active since Middle Miocene.

A look at the historical seismicity for the period 1880 through 1975 (Figure 8) shows no epicenters or felt reports within 80 km of the KGRA. The seismicity data for 1976 through 1977 (Figure 9) from the BSU network shows only a small number of events (less than 10) within 50 km of the area. Short-term microseismic studies¹⁷ in the area of this KGRA during 1972 detected no events. However, the periods of monitoring may have been so short as to be inconclusive. Individuals active in microseismic consulting have stated that if detectors are installed in deep boreholes, it is possible to record significant background microseismic activity. However, there are no published data to support these statements. Considering the relatively high seismic activity in nearby areas (southeast Idaho, the Stanley and Challis areas, the western boundary of the Idaho Batholith, etc.) the lack of activity in the KGRA is quite interesting. Smith¹⁸ postulates that the lack of seismic activity within the Snake River Plain is due to high heat flow. The abnormally high heat flow causes the relief of stress to be limited to aseismic creep.

Detailed geologic mapping²⁰ of areas within the Plain and observations of proprietary seismic reflection data from the Snake River Plain suggest that there are a number of faults that offset youthful horizons and have relatively large throws at shallow depths. Proprietary seismic reflection data are not available immediately within or near the Castle Creek KGRA.

Induced seismicity is a question that is undergoing extensive research to establish the cause and under what conditions it is a problem. Several areas have provided extensive case histories on the relationship of seismicity to injection and or withdrawal of fluids. These include Derby, Colorado;^{21,22} Rangely, Colorado; and more recently near Snyder, Texas. Studies are underway to verify or negate the hypothesis that there is induced seismic activity associated with the geothermal system at the Geysers geothermal field in California.

Figure 8. Historical seismicity from U.S. Coast and Geodetic Survey 1880 to 1975.¹⁹

Figure 9. Seismicity for 1976-1977 from BSU network.

Special problems may result in an area where large quantities of hot water or steam are produced and then cooler water is reinjected. This could possibly result in thermal stresses in the subsurface. This is an interesting hypothesis especially in areas (the Snake River Plain) where plastic creep may be occurring. Perhaps this cooling effect could, over a significant period of time, create areas where the stress might be relieved with brittle deformation instead of plastic deformation, and hence result in seismic activity.

The problem of induced seismicity is a real one and must be addressed with the acquisition of the necessary data. However, the Castle Creek KGRA is not in a highly populous area where even relatively low levels of induced seismicity could be disruptive and destructive to urban structures and facilities. Induced seismicity in the KGRA could however, be highly disruptive to development of facilities necessary to produce and utilize the geothermal energy. With proper control of the injection program, including pressure, volume, and location of injection, induced seismicity may be minimized or eliminated.

Water Resources (C. L. Miller and C. C. Warnick, Idaho Water Resources Research Institute)

The Castle Creek KGRA is drained by Castle Creek and several smaller intermittent streams plus a reach of the Snake River. The drainage area of the streams is 270 ha, with Castle Creek accounting for approximately 120 ha of the drainage area. Castle Creek and the intermittent streams flow to the northeast where they meet the Snake River (Figure 10).

The data base for the hydrology of the drainage area surrounding the Castle Creek KGRA consists of rainfall and snowfall records inside the KGRA at Grand View and rainfall and snowfall records outside the area but close to the drainage area at Reynolds Mountain. Table 3 gives information concerning the gages that form the weather data base of the Castle Creek area.

Figure 10. Map of Castle Creek drainage and Castle Creek KGRA showing normal annual precipitation variation (mm).

TABLE 3. INFORMATION ON WEATHER RECORDS IN AND NEAR THE CASTLE CREEK KGRA

<u>Station</u>	<u>Type of Record</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Period of Records</u>	<u>Length (months)</u>	<u>Annual Average (mm)</u>
Grand View	Rainfall	43° 00'	116° 08'	08/1948 to 12/1976	341	166
	Snowfall			12/1948 to 03/1976	93	155
Reynolds Creek	Rainfall	43° 12'	116° 45'	01/1962 to 12/1976	180	278
	Snowfall			01/1962 to 12/1976	77	420

A stream gage record was obtained on Castle Creek from September, 1910, to December, 1911, and there have been some scattered measurements of crest stage. In general, the stream flow records are of little value in the Castle Creek area. However, there are stream gage records near the Castle Creek area that could be used to synthesize flow characteristics of the streams in the Castle Creek area. The records that are available are for Little Jacks Creek and the experimental watershed at Reynolds Creek. In considering transferring data to Castle Creek it should be pointed out that the area surrounding Castle Creek is subject to high intensity, short-duration rain storms that cause significant amounts of runoff.

The ground water hydrology of the Castle Creek area has been studied by the Idaho Department of Water Resources and the results were published in Water Information Bulletin No. 14.⁹ There are some hydrograph records available for wells inside the Castle Creek KGRA, these are included in Figure 11.

There are currently no surface water quality data available for the Castle Creek area. The available ground water quality data are contained in Water Information Bulletin No. 14⁹ and are included in Figure 12. Representative geothermal water quality data available for the Castle Creek KGRA are contained in Table 1. Fluoride levels in these wells are high and may restrict their use.

There are several water rights that are held inside the Castle Creek KGRA. The major sources of water for these water rights are the Snake River, Castle Creek, and ground water supplies. There are some ground water rights that involve geothermal waters, most of which are for irrigation and stock watering purposes. A search of the water rights files at the Idaho Department of Water Resources revealed one ground water right involving geothermal water that is being used to heat a house and irrigate crops. A summary of the status of other known water rights in the vicinity of the Castle Creek KGRA is presented in Table 4.

Figure 11. Hydrograph of current groundwater observations in the Castle Creek area.

Figure 12. Contours of water quality in northern Owyhee County.

TABLE 4. SUMMARY OF WATER RIGHTS FILINGS IN THE CASTLE CREEK KGRA

Township	Range	Section	IDWR File Number	Quantity	Priority Date	Source
3.S	1E	35	02-2321	544 1/s	6-16-64	Snake River
			02-2327	544 1/s	6-22-64	Snake River
			02-2328	544 1/s	6-22-64	Snake River
			02-2329	544 1/s	6-22-64	Snake River
			02-2330	544 1/s	6-22-64	Snake River
			02-2346	524 1/s	6-24-64	Snake River
			02-2347	544 1/s	6-24-64	Snake River
			02-2348	544 1/s	6-24-64	Snake River
			02-2349	547 1/s	6-24-64	Snake River
			02-2350	542 1/s	6-24-64	Snake River
			02-2351	544 1/s	6-29-64	Snake River
			02-2352	544 1/s	6-30-64	Snake River
		36	02-7086	227 1/s		
			02-2100	423 1/s		
			02-7194	6 1/s		
			02-7194			
			02-7261	85 1/s		
4.S	1E	24	57-2334		lapsed	
			57-2300	47 1/s	8-16-66	well
			57-2021	62 1/s	12-10-07	Castle Creek
			57-2036	28 1/s	5-23-10	Castle Creek
			57-2260	15 1/s	1- 9-63	Castle Creek
		25	57-2299		lapsed	
		26	57-2334		lapsed	
			57-2074		cancelled	
			57-2064	42 1/s	11-13-10	Castle Creek
		29	57-0040	82 1/s	10- 1-1869	Catherine Creek
			57-2235	101 1/s	11-24-59	well
		34	57-7193	1 1/s		well
			57-2253	56 1/s	8-23-62	artesian well (hot)
			57-2246	113 1/s	6-26-61	artesian well (hot)
		35	57-2251	17 1/s	7-18-10	Castle Creek
			57-2037	29 1/s	7-18-10	Castle Creek
			57-7126	91 1/s		well
		36	57-2299		lapsed	
5.S	1E	3	57-2314	170,000 m ³	3-16-31	Castle Creek
			57-2090	11 1/s	9- 3-15	Castle Creek
			57-2046	68 1/s	8-10-12	Castle Creek
			57-2129	63 1/s	3-23-21	Castle Creek
			57-2104	36 1/s	10- 5-20	Castle Creek

TABLE 4. (continued)

Township	Range	Section	IDWR File Number	Quantity	Priority Date	Source
3.S	2E	10	57-2132	137 1/s	3-15-31	Castle Creek
			57-7151	20,000 m ³		Castle Creek
			57-7150	40,000 m ³		Castle Creek
			57-2249	83 1/s	3- 8-67	well
			57-7209	123 1/s		Castle Creek
			57-2084		cancelled	
		16	57-2195	44 1/s	10-18-49	well
			57-4004			
		20	57-2242	14 1/s	6-10-64	well (hot)
			57-2238			
		21	57-2210	21 1/s	8-16-54	
			57-2210			
		29	57-2330	7 1/s	9-19-66	well
4.S	2E	6	02-2353	188 1/s		Snake River
			02-2070	41 1/s		Snake River
			02-2437	137 1/s		Snake River
		8	02-2126	138 1/s		Snake River
			02-2070			Snake River
			02-2437	138 1/s		Snake River
			02-2259	146 1/s	12-18-63	Snake River
			02-2353			
			02-2260	170 1/s	12-19-63	Snake River
			02-2261	181 1/s	12-19-63	Snake River
			02-2267	147 1/s	1-20-64	Snake River
		15	57-7186	249 1/s		waste water
			57-7222	453 1/s		waste water
			02-2384	396 1/s		
		19	57-2230	21 1/s	2-17-59	well
4.S	2E	22	02-7099	181 1/s		
			02-7065	272 1/s		
			02-7090	181 1/s		
		26	63-8989	113 1/s	6-14-77	well
			02-2015			
		28	57-2190	10 1/s	6-28-48	well
		32	57-2218	20 1/s	12-21-56	2 wells
			57-7103	14 1/s		well
		36	02-7253	1 1/s	8-1-77	Snake River
			02-2053			
			02-2118			
			02-2139			

TABLE 4. (continued)

Township	Range	Section	IDWR File Number	Quantity	Priority Date	Source
5.S	3E	13	57-7125	181 1/s		well
		19	57-7049	142 1/s		well
		24	57-2211	75 1/s	1- 4-55	well
			57-7163 57-2211	1 1/s		well
5.S	3E	15	02-7027	92 1/s		
			02-2241	457 1/s		
		20	57-2231	34 1/s	3- 6-59	artesian well (hot)*
		22	57-7059	20 1/s		well
			57-7199	20 1/s		unnamed drain
			02-7212	850 1/s		
		23	57-7037	181 1/s		well
			57-7036	182 1/s		well
			57-7158	1 1/s		well
			57-7109	23 1/s		well
		25	57-2228	63 1/s	7- 7-58	Shoofly Creek
			57-7100	30 1/s		Shoofly Creek
		26	57-2234	634 1/s		well (hot)
5.S	3E	27	57-2224	57 1/s	4-17-58	well
			57-7037			
		34	57-4000	68 1/s		
		35	57-7102	11 1/s		unnamed creek
			57-7072	2 1/s		Shoofly Creek
			57-7198	4 1/s		Shoofly Creek
			57-7105	3 1/s		well
			57-2227	10 1/s	8- 9-60	Shoofly Creek
			57-2234			
		36	57-7147	2 1/s		well

Soils (N. Savage, Idaho Water Resources Research Institute)

Three soil surveys have been or are being conducted on all or parts of the Castle Creek KGRA at different levels of detail:

1. The Owyhee County Soil Conservation Service (SCS) (Grand View office) has completed detailed soil surveys on three parcels of private land south of the Snake River. One parcel is adjacent to the river, one is a quarter section on Henderson Flats, and the other is in the valley of Castle Creek near the southwest corner of the KGRA. These areas were mapped 10 to 20 years ago and the maps are on open file in the Grand View office.

The Ada County SCS (Meridian, Idaho) has completed mapping the entire portion of the KGRA which lies in Ada County (public land). Figure 13 shows the soil map of this area traced from aerial photographs (1:20,000) and transposed onto a topographic map (1:24,000).

2. The Boise District of the BLM has completed land capability class surveys on those portions of the KGRA.
3. Chugg et al.²³ conducted a special survey in Owyhee County which includes all of the Castle Creek KGRA. Soil mapping units are shown in Figure 14. Descriptions are included in Appendix B.

Both the SCS and BLM are mapping additional lands within their jurisdiction. The BLM land capability class surveys are being prepared for inclusion in grazing and agricultural environmental impact statements scheduled for publication in 1981.

Soil erosion is a hazard on scattered land units in the KGRA. Badland topography would limit activities over much of the southern portion of the KGRA.

Figure 13. Soil map of Ada County portion of the Castle Creek KGRA.

Figure 14. Special soil survey of the Castle Creek KGRA.²³

BIOLOGICAL ENVIRONMENT

The terrestrial and aquatic ecologies of the Castle Creek KGRA are discussed in the following. The terrestrial ecology includes data on the endangered plant species and species of vertebrates in the KGRA. The primary fishery habitat and environment are discussed in the aquatic biology section.

Terrestrial Ecology (T. L. Johnson and C. D. Jorgensen, Brigham Young University)

The assessment of the terrestrial ecology of the Castle Creek KGRA examined the habitats associated with the region. The potential impact of geothermal development was assessed with regard to habitats found in the KGRA and their relative abundance in the region. The principal vegetation habitat in the KGRA is the Salt Desert Shrub habitat (Figure 15).

Threatened and endangered plant species are illustrated with respect to their proximity to the KGRA in Figure 16. Specific species information is included in Appendix C. Records of these plant species were usually made from museum collections only, not from extensive studies.

Data for the proposed threatened and endangered plant species were taken directly from Henderson et al.²⁴ Their study not only recommends a status based on the existing state of knowledge, but makes some recommendations of change of status. Only those whose status appears critical because of lack of information or extremely limited distributions are discussed in detail. Because specific efforts have not been made to establish their status, the data are almost incidental and need much more validation to be conclusive.

Plant species that require special consideration for development in the Castle Creek KGRA include Astragalus mulfordiae and Draba douglasii. A. mulfordiae is known from only six sites, all of which

Figure 15. Relative extents of vegetation habitats in Owyhee County.

Figure 16. Recorded distributions of threatened and endangered plant species in Owyhee County.

are limited in size, and is considered "threatened." None of the collections of A. mulfordiae are on the KGRA proper. Draba douglasii, although discontinuous, ranges from San Bernadino County, California, to southern Washington.

Species of vertebrates were compiled for the Castle Creek KGRA based on their reported association with habitats included in the area. These data were collected from numerous sources and represent the best estimate of what might be expected. Specific on-site research would be required to validate species present and relative numbers, but in the absence of such data, these listings represent the best summary of what is included in the resources available. The listings in Tables 5 through 8 are as comprehensive as possible, with reported species being deleted only if there is reason for doing so.

Most of the information included in Tables 5 through 8 were obtained from a limited number of sources, although specific data were collected from many scattered references, some correspondence with Idaho researchers, personal knowledge, and some conversations with strategic researchers. These data sources are summarized in the following listings:

Amphibians and Reptiles - 25, 26, 27, 28, 29, 30, 31
Birds - 25, 28, 29, 30, 31, 32, 33
Mammals - 25, 28, 29, 30, 31, 34, 35.

Tables 5 through 8 represent a convenient compilation of the information obtained from numerous sources. Since several techniques were used to gather these data, it seemed better to assign their numbers to some "relative abundance" category. This was the best way to avoid encouraging conclusions of the reader that could not be supported with data. Where blanks occur in Tables 5 through 8, data were either unavailable and the species were thought to be present or data were too questionable to form an opinion. Habitat types referenced in these tables are those shown in Figures 17 through 25.

TABLE 5. AMPHIBIANS IN THE CASTLE CREEK KGRA WITH RELATIVE ABUNDANCE AND HABITAT LISTINGS

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Long-toed Salamander	<u>Ambystoma macrodactylum</u>	L	L	L	L				X	X	
Great Basin Spadefoot	<u>Scaphiopus intermontanus</u>	L	L	L	L		X		X	X	
Western Toad	<u>Bufo boreas</u>	L	L	L	L		X	X	X	X	
Woodhouse's Toad	<u>Bufo woodhousei</u>	L	L	L	L				X	X	
Chorus Frog	<u>Pseudacris triseriata</u>	L	L	L	L				X	X	
Pacific Treefrog	<u>Hyla regilla</u>	L	L	L	L				X	X	
Spotted Frog	<u>Rana pretiosa</u>	M	M	M	M					X	
Leopard Frog	<u>Rana pipiens</u>	M	M	M	M				X	X	

^aKey To Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

^bKey to Habitat Types: 1=Salt Desert Shrub, 2=Sagebrush, 3=Perennial Grass, 4=Irrigated Farm, 5=Stream Side, 6=Lakes.

TABLE 6. REPTILES IN THE CASTLE CREEK KGRA WITH RELATIVE ABUNDANCE AND HABITAT LISTINGS

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wl	1	2	3	4	5	6
Collared Lizard	<u>Crotaphytus collaris</u>	M	M	M	M		X	X	X	X	
Leopard Lizard	<u>Crotaphytus wislizenii</u>	M	M	M	M	X	X	X	X	X	
Western Fence Lizard	<u>Sceloporus occidentalis</u>	M	M	M	M	X	X	X	X	X	
Sagebrush Lizard	<u>Sceloporus graciosus</u>	H	H	H	H	X	X	X	X	X	
Side-blotched Lizard	<u>Uta stansburiana</u>	L	L	L	L	X	X	X			
Desert Horned Lizard	<u>Phrynosoma platyrhinos</u>	L	M	M	M	X	X	X		X	
Short Horned Lizard	<u>Phrynosoma douglassi</u>	L	L	L	L	X	X	X			
Western Whiptail	<u>Cnemidophorus tigris</u>	M	M	M	M	X	X	X			
Ringneck Snake	<u>Diadophis punctatus</u>	P	M	M	M					X	
Racer	<u>Coluber constrictor</u>	M	M	M	M	X	X	X	X	X	
Striped Whipsnake	<u>Masticophis taeniatus</u>	M	M	M	M	X	X	X			
Gopher Snake	<u>Pituophis melanoleucus</u>	H	H	H	H	X	X	X	X	X	
Common Garter Snake	<u>Thamnophis sirtalis</u>	M	M	M	M		X	X	X	X	
Western Garter Snake	<u>Thamnophis elegans</u>	M	M	M	M	X	X	X	X	X	
Western Ground Snake	<u>Sonora semiannulata</u>	L	L	L	L	X	X			X	
Night Snake	<u>Hypsiglena torquata</u>	H	H	H	H		X				
Western Rattlesnake	<u>Crotalus viridis</u>	L	L	L	L	X	X	X	X	X	

^aKey To Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

^bKey to Habitat Types: 1=Salt Desert Shrub, 2=Sagebrush, 3=Perennial Grass, 4=Irrigated Farm, 5=Stream Side, 6=Lakes.

TABLE 7. BIRDS IN THE CASTLE CREEK KGRA WITH RELATIVE ABUNDANCE AND HABITAT LISTINGS

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Common Loon	<u>Gavia immer</u>	U	U	U	U						
Western Grebe	<u>Aechmophorus occidentalis</u>	L	L	L	L						X
Horned Grebe	<u>Podiceps auritus</u>	U	U	U	U						
Eared Grebe	<u>Podiceps caspicus</u>	L	L	L	P						X
Pied-billed Grebe	<u>Podilymbus podiceps</u>	L	L	L	L						X
White Pelican	<u>Pelecanus erythrorhynchos</u>	L	L	L	P						X
Double-crested Cormorant	<u>Phalacrocorax auritus</u>	L	L	L	P						X
Whistling Swan	<u>Olor columbianus</u>	L	L	L	L					X	X
Canada Goose	<u>Branta canadensis</u>	M	M	M	M				X	X	X
Snow Goose	<u>Chen hyperborea</u>	U	U	U	U						
Mallard	<u>Anas platyrhynchos</u>	M	M	M	H				X	X	X
Pintail	<u>Anas acuta</u>	L	L	L	L				X	X	X
Gadwall	<u>Anas strepera</u>	L	L	L	L				X	X	X
Wigeon	<u>Anas americana</u>	M	M	M	H					X	X
Northern Shoveler	<u>Anas clypeata</u>	L	M	L	L					X	X
Blue-winged Teal	<u>Anas discors</u>	L	M	M	P					X	X
Cinnamon Teal	<u>Anas cyanoptera</u>	L	M	L	P					X	X
Green-winged Teal	<u>Anas crecca</u>	M	M	M	M					X	X
Wood Duck	<u>Aix sponsa</u>	L	L	L	L					X	X
Redhead	<u>Aythya americana</u>	L	L	L	P					X	X
Canvasback	<u>Aythya valisineria</u>	L	L	L	P					X	X
Ring-necked Duck	<u>Aythya collaris</u>	L	P	L	P					X	X
Greater Scaup	<u>Aythya marila</u>	L	P	L	P						X
Lesser Scaup	<u>Aythya affinis</u>	L	L	L	P					X	X
Common Goldeneye	<u>Bucephala clangula</u>	P	P	P	L					X	X

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	W1	1	2	3	4	5	6
Bufflehead	<u>Bucephala albeola</u>	L	L	L	L					X	X
Ruddy Duck	<u>Oxyura jamaicensis</u>	L	M	L	P					X	X
Common Merganser	<u>Mergus merganser</u>	L	L	L	L					X	X
Hooded Merganser	<u>Lophodytes cucullatus</u>	U	U	U	U						
Turkey vulture	<u>Cathartes aura</u>	L	M	L	L	X	X	X	X	X	
Goshawk	<u>Accipiter gentilis</u>	P	P	P	L	X	X	X	X	X	
Cooper's Hawk	<u>Accipiter cooperii</u>	L	L	L	L	X	X	X	X	X	
Sharp-shinned Hawk	<u>Accipiter striatus</u>	L	L	L	L	X	X	X	X	X	
Marsh Hawk	<u>Circus cyaneus</u>	M	M	M	M	X	X	X	X	X	
Rough-legged Hawk	<u>Buteo lagopus</u>	P	P	P	M	X	X	X	X	X	
Red-tailed Hawk	<u>Buteo jamaicensis</u>	H	H	M	M	X	X	X	X	X	
Ferruginous Hawk	<u>Buteo regalis</u>	L	L	L	M	X	X	X	X	X	
Swainson's Hawk	<u>Buteo swainsoni</u>	M	M	M	M	X	X	X	X	X	
Golden Eagle	<u>Aquila chrysaetos</u>	H	H	H	H	X	X	X	X	X	
Bald Eagle	<u>Haliaeetus leucocephalus</u>	L	L	L	L		X			X	X
Osprey	<u>Pandion haliaetus</u>	L	L	L	L					X	X
Prairie Falcon	<u>Falco mexicanus</u>	H	H	H	H	X	X	X	X	X	
Peregrine Falcon	<u>Falco peregrinus</u>	L	L	L	L	X	X				
American Kestrel	<u>Falco sparverius</u>	H	H	H	H	X	X	X	X	X	
Blue Grouse	<u>Dendragapus obscurus</u>	L	L	L	L		X				
Spruce Grouse	<u>Canachites canadensis</u>	U	U	U	U						
Sage Grouse	<u>Centrocercus urophasianus</u>	H	H	H	H		X	X	X	X	
Bobwhite	<u>Colinus virginianus</u>	L	L	L	L	X	X			X	
California Quail	<u>Lophortyx californicus</u>	M	M	M	M	X	X		X	X	
Ring-necked Pheasant	<u>Phasianus colchicus</u>	M	M	M	M	X	X	X	X	X	

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Chukar	<u>Alectoris chukar</u>	M	M	M	M	X	X	X	X	X	
Gray Partridge	<u>Perdix perdix</u>	L	M	M	M	X	X	X	X	X	
Sandhill Crane	<u>Grus canadensis</u>	L	L	L	P				X		X
Great Blue Heron	<u>Ardea herodias</u>	L	L	L	L	X	X		X	X	X
Snowy Egret	<u>Leucophoyx thula</u>	L	L	L	L					X	X
Black-crowned Night Heron	<u>Nycticorax nycticorax</u>	L	L	L	L					X	X
American Bittern	<u>Botaurus lentiginosus</u>	L	L	L	P			X		X	X
Virginia Rail	<u>Rallus limicola</u>	U	U	U	U						
Sora	<u>Porzana carolina</u>	L	L	P	P					X	
American Coot	<u>Fulica americana</u>	U	U	U	U						
American Avocet	<u>Recurvirostra americana</u>	L	L	L	L					X	X
Black-necked Stilt	<u>Himantopus mexicanus</u>	U	U	U	U						
Killdeer	<u>Charadrius vociferus</u>	M	M	M	L	X	X	X	X	X	
Long-billed Curlew	<u>Numenius americanus</u>	U	U	U	U						
Marbled Godwit	<u>Limosa fedoa</u>	U	U	U	U						
Solitary Sandpiper	<u>Tringa solitaria</u>	U	U	U	U						
Spotted Sandpiper	<u>Actitis macularia</u>	L	L	L	L	X	X		X	X	X
Willet	<u>Catoptrophorus semipalmatus</u>	U	U	U	U						
Greater Yellowlegs	<u>Totanus melanoleucus</u>	U	U	U	U						
Lesser Yellowlegs	<u>Totanus flavipes</u>	U	U	U	U						
Long-billed Dowitcher	<u>Limnodromus scolopaceus</u>	U	U	U	U						
Pectoral Sandpiper	<u>Erolia melanotos</u>	U	U	U	U						
Baird's Sandpiper	<u>Erolia bairdii</u>	U	U	U	U						
Least Sandpiper	<u>Erolia minutilla</u>	U	U	U	U						
Western Sandpiper	<u>Ereunetes mauri</u>	U	U	U	U						

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	W1	1	2	3	4	5	6
Wilson's Phalarope	<u>Steganopus tricolor</u>	U	U	U	U						
Northern Phalarope	<u>Lobipes lobatus</u>	U	U	U	U						
Common Snipe	<u>Capella gallinago</u>	U	U	U	U						
California Gull	<u>Larus californicus</u>	H	M	M	M	X	X		X		X
Ring-billed Gull	<u>Larus delawarensis</u>	L	L	L	P	X	X		X		X
Franklin's Gull	<u>Larus pipixcan</u>	L	L	L	P				X		X
Bonaparte's Gull	<u>Larus philadelphia</u>	U	U	U	U						
Forster's Tern	<u>Sterna forsteri</u>	L	L	L	P						X
Black Tern	<u>Chlidonias niger</u>	L	L	L	P						X
Rock Dove	<u>Columba livia</u>	U	U	U	U						
Mourning Dove	<u>Zenaidura macroura</u>	M	H	M	L	X	X	X	X	X	
Yellow-billed Cuckoo	<u>Coccyzus americanus</u>	U	U	U	U						
Black-billed Cuckoo	<u>Coccyzus erythrophthalmus</u>	U	U	U	U						
Barn Owl	<u>Tyto alba</u>	L	L	L	L	X	X	X	X	X	
Screech Owl	<u>Otus asio</u>	L	L	L	L	X	X		X	X	
Great Horned Owl	<u>Bubo virginianus</u>	L	L	L	L	X	X	X	X	X	
Short-eared Owl	<u>Asio flammeus</u>	L	L	L	L	X	X		X	X	
Long-eared Owl	<u>Asio otus</u>	L	L	L	L				X		
Burrowing Owl	<u>Speotyto cunicularia</u>	L	L	L	L	X	X	X	X		
Saw-whet Owl	<u>Aegolius acadicus</u>	L	L	L	L				X		
Poor Will	<u>Phalaenoptilus nuttallii</u>	L	M	L	L	X	X	X			
Common Nighthawk	<u>Chordeiles minor</u>	L	M	L	P	X	X	X	X	X	
Broad-tailed Hummingbird	<u>Selasphorus platycercus</u>	L	L	L	P	X	X	X	X	X	
Rufous Hummingbird	<u>Selasphorus rufus</u>	L	L	L	P				X	X	
Belted Kingfisher	<u>Megasceryle alcyon</u>	L	L	L	L					X	X

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Common Flicker	<u>Colaptes auratus</u>	M	M	M	M	X	X	X	X	X	
Lewis' Woodpecker	<u>Asyndesmus lewis</u>	U	U	U	U						
Hairy Woodpecker	<u>Dendrocopos villosus</u>	L	L	L	L				X		
Downy Woodpecker	<u>Dendrocopos pubescens</u>	L	L	L	L				X		
Eastern Kingbird	<u>Tyrannus tyrannus</u>	L	L	L	P	X	X	X	X	X	
Western Kingbird	<u>Tyrannus verticalis</u>	L	M	L	P	X	X	X	X	X	
Say's Phoebe	<u>Sayornis saya</u>	M	M	L	L	X	X	X	X	X	
Traill's Flycatcher	<u>Empidonax traillii</u>	L	M	L	P	X	X	X	X	X	
Hammond's Flycatcher	<u>Empidonax hammondi</u>	U	U	U	U						
Dusky Flycatcher	<u>Empidonax oberholseri</u>	U	U	U	U						
Western Wood Pewee	<u>Contopus sordidulus</u>	L	L	L	P					X	
Olive-sided Flycatcher	<u>Nuttallornis borealis</u>	L	L	L	P			X			
Horned Lark	<u>Eremophila alpestris</u>	M	M	M	M	X	X	X	X		
Barn Swallow	<u>Hirundo rustica</u>	M	M	M	P	X	X		X	X	X
Cliff Swallow	<u>Petrochelidon pyrrhonota</u>	L	L	L	P				X	X	X
Violet-green Swallow	<u>Tachycineta thalassina</u>	L	L	L	P	X	X	X	X	X	X
Tree Swallow	<u>Iridoprocne bicolor</u>	L	L	L	L	X	X	X	X	X	
Bank Swallow	<u>Riparia riparia</u>	M	M	M	P	X	X		X	X	
Rough-winged Swallow	<u>Stelgidopteryx ruficollis</u>	L	L	L	P					X	X
Steller's Jay	<u>Cyanocitta stelleri</u>	L	L	L	L						
Pinon Jay	<u>Gymnorhinus cyanocephala</u>	P	P	P	L	X					
Black-billed Magpie	<u>Pica pica</u>	H	H	H	H	X	X	X	X	X	
Common Raven	<u>Corvus corax</u>	M	M	M	M	X	X	X	X	X	
Common Crow	<u>Corvus brachyrhynchos</u>	H	H	H	H	X	X		X	X	
Black-capped Chickadee	<u>Parus atricapillus</u>	L	P	L	L		X		X	X	

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Mountain Chickadee	<u>Parus gambeli</u>	P	P	P	L				X	X	
White-breasted Nuthatch	<u>Sitta carolinensis</u>	L	P	L	L					X	
Brown Creeper	<u>Certhia familiaris</u>	L	L	L	P	X	X		X		
House Wren	<u>Troglodytes aedon</u>	L	M	L	L			X	X	X	
Winter Wren	<u>Troglodytes troglodytes</u>	L	P	P	L					X	
Long-billed Marsh Wren	<u>Telmatodytes palutris</u>	U	U	U	U						
Canyon Wren	<u>Catherpes mexicanus</u>	M	H	M	P	X	X				
Rock Wren	<u>Salpinctes obsoletus</u>	L	L	L	P	X	X	X	X		
Gray Catbird	<u>Dumetella carolinensis</u>	L	L	L	L					X	
Sage Thrasher	<u>Oreoscoptes montanus</u>	M	H	M	P	X	X	X	X		
Robin	<u>Turdus migratorius</u>	M	M	M	L	X	X	X	X	X	
Hermit Thrush	<u>Hylocichla guttata</u>	L	P	L	P				X		
Swainson's Thrush	<u>Hylocichla ustulata</u>	L	P	L	P				X		
Veery	<u>Hylocichla fuscescens</u>	U	U	U	U						
Mountain Bluebird	<u>Sialia currucoides</u>	L	M	L	L			X	X	X	
Townsend's Solitaire	<u>Myadestes townsendi</u>	P	P	P	L					X	
Golden-crowned Kinglet	<u>Regulus satrapa</u>	P	P	P	L					X	
Ruby-crowned Kinglet	<u>Regulus calendula</u>	P	P	P	L					X	
Bohemian Waxwing	<u>Bombycilla garrula</u>	P	P	P	L	X	X		X	X	
Cedar Waxwing	<u>Bombycilla cedrorum</u>	L	M	L	L	X	X		X	X	
Northern Shrike	<u>Lanius excubitor</u>	P	P	P	L	X	X	X	X	X	
Loggerhead Shrike	<u>Lanius ludovicianus</u>	L	M	M	L	X	X	X	X	X	
Starling	<u>Sturnus vulgaris</u>	M	M	M	M	X	X	X	X	X	
Red-eyed Vireo	<u>Vireo olivaceus</u>	U	U	U	U						
Warbling Vireo	<u>Vireo gilvus</u>	M	M	M	P					X	

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Orange-crowned Warbler	<u>Vermivora celata</u>	U	U	U	U						
Yellow Warbler	<u>Dendroica petechia</u>	L	L	L	P				X	X	
Yellow-rumped Warbler	<u>Dendroica coronata</u>	L	P	L	P					X	
MacGillivray's Warbler	<u>Oporornis tolmiei</u>	L	L	P	P					X	
Common Yellowthroat	<u>Geothlypis trichas</u>	L	L	L	P	X	X		X	X	
Wilson's Warbler	<u>Wilsonia pusilla</u>	M	M	M	P					X	
Yellow-breasted Chat	<u>Icteria virens</u>	L	L	L	P	X	X		X	X	
House Sparrow	<u>Passer domesticus</u>	M	M	M	M	X	X	X	X		
Western Meadowlark	<u>Sturnella neglecta</u>	M	M	M	M	X	X	X	X	X	
Yellow-headed Blackbird	<u>Xanthocephalus xanthocephalus</u>	U	U	U	U						
Red-winged Blackbird	<u>Agelaius phoeniceus</u>	M	L	M	L			X	X	X	
Northern Oriole	<u>Icterus galbula</u>	L	M	L	P					X	
Brewer's Blackbird	<u>Euphagus cyanocephalus</u>	M	M	M	L	X	X	X	X	X	
Brown-headed Cowbird	<u>Molothrus ater</u>	L	L	L	L	X	X	X	X	X	
Western Tanager	<u>Piranga ludoviciana</u>	L	M	L	P					X	
Black-headed Grosbeak	<u>Pheucticus melanocephalus</u>	L	L	L	L					X	
Lazuli Bunting	<u>Passerina amoena</u>	L	L	L	L			X		X	
Evening Grosbeak	<u>Hesperiphona vespertina</u>	U	U	U	U						
Cassin's Finch	<u>Carpodacus cassinii</u>	L	L	L	L	X	X	X	X	X	
House Finch	<u>Carpodacus mexicanus</u>	L	L	L	L	X	X	X	X	X	
Pine Siskin	<u>Spinus pinus</u>	P	P	P	L				X		
American Goldfinch	<u>Spinus tristis</u>	L	M	L	L	X			X	X	
Green-tailed Towhee	<u>Chlorura chlorura</u>	L	L	L	P	X	X	X	X	X	
Rufous-sided Towhee	<u>Pipilo erythrophthalmus</u>	M	M	M	L			X		X	
Lark Bunting	<u>Calamospiza melanocorys</u>	U	U	U	U						

TABLE 7. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Savannah Sparrow	<u>Passerculus sandwichensis</u>	H	H	H	H	X	X	X	X		
Grasshopper Sparrow	<u>Ammodramus savannarum</u>	L	M	M	L	X	X	X	X		
Vesper Sparrow	<u>Poocetes gramineus</u>	L	L	L	L	X	X	X	X		
Lark Sparrow	<u>Chondestes grammacus</u>	M	M	M	M	X	X	X	X		
Black-throated Sparrow	<u>Amphispiza bilineata</u>	U	U	U	U						
Sage Sparrow	<u>Amphispiza belli</u>	P	P	P	P		X				
Dark-eyed Junco	<u>Junco hyemalis</u>	L	P	L	L	X	X		X	X	
Tree Sparrow	<u>Spizella arborea</u>	U	U	U	U						
Chipping Sparrow	<u>Spizella passerina</u>	L	M	M	L	X	X	X	X	X	
Brewer's Sparrow	<u>Spizella breweri</u>	M	M	M	M	X	X	X	X		
White-crowned Sparrow	<u>Zonotrichia leucophrys</u>	L	L	L	M	X	X	X	X	X	
Fox Sparrow	<u>Passerella iliaca</u>	L	L	L	P	X	X	X	X	X	
Song Sparrow	<u>Melospiza melodia</u>	L	M	L	L	X	X	X	X	X	

^aKey To Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

^bKey to Habitat Types: 1=Salt Desert Shrub, 2=Sagebrush, 3=Perennial Grass, 4=Irrigated Farm, 5=Stream Side, 6=Lakes.

TABLE 8. MAMMALS IN THE CASTLE CREEK KGRA WITH RELATIVE
ABUNDANCE AND HABITAT LISTINGS

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Shrews		M	M	M	M	X	X	X	X	X	
Vagrant Shrew	<u>Sorex vagrans</u>										
Merriam Shrew	<u>Sorex merriami</u>										
Bats		M	M	M	L	X	X	X	X	X	X
Yuma Myotis	<u>Myotis yumanensis</u>										
Long-eared Myotis	<u>Myotis evotis</u>										
Fringed Myotis	<u>Myotis thysanodes</u>										
Long-legged Myotis	<u>Myotis volans</u>										
California Myotis	<u>Myotis californicus</u>										
Small-footed Myotis	<u>Myotis subulatus</u>										
Western Pipistrel	<u>Pipistrellus hesperus</u>										
Big Brown Bat	<u>Eptesicus fuscus</u>										
Spotted Bat	<u>Euderma maculata</u>										
Western Big Eared	<u>Plecotus townsendi</u>										
Raccoon	<u>Procyon lotor</u>	L	L	L	L	X	X	X	X	X	
Weasel		L	L	L	L	X	X	X	X	X	
Shorttail Weasel	<u>Mustela erminea</u>										
Longtail Weasel	<u>Mustela frenata</u>										
Mink	<u>Mustela vison</u>	L	L	L	L					X	
River Otter	<u>Lutra canadensis</u>	P	P	P	P					X	X
Badger	<u>Taxidea taxus</u>	H	H	H	H	X	X	X	X		
Spotted Skunk	<u>Spilogale putorius</u>	L	L	L	L	X	X	X	X	X	
Striped Skunk	<u>Mephitis mephitis</u>	M	M	M	M	X	X	X	X	X	
Coyote	<u>Canis latrans</u>	H	H	H	H	X	X	X	X	X	
Red Fox	<u>Vulpes fulva</u>	L	L	L	L		X		X		
Kit Fox	<u>Vulpes macrotis</u>	U	U	U	U						
Bobcat	<u>Lynx rufus</u>	M	M	M	M	X	X	X	X	X	
Yellowbelly Marmot	<u>Marmota flaviventris</u>	M	M	M	M	X	X	X	X		
Townsend Ground											
Squirrel	<u>Spermophilus townsendi</u>	M	M	M	M	X	X	X	X	X	

TABLE 8. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Richardson Ground Squirrel	<u>Spermophilus richardsoni</u>	P	P	P	P		X	X	X	X	
Belding Ground Squirrel	<u>Spermophilus beldingi</u>	P	P	P	P			X	X	X	
Columbia Ground Squirrel	<u>Spermophilus columbianus</u>	L	L	L	L			X	X	X	
Whitetail Antelope Ground Squirrel	<u>Ammospermophilus leucurus</u>	H	H	H	H	X	X			X	
Least Chipmunk	<u>Eutamias minimus</u>	M	M	M	M	X	X	X	X	X	
Fox Squirrel	<u>Sciurus niger</u>	L	L	L	L					X	
Northern Pocket Gopher	<u>Thomomys talpoides</u>	H	H	H	H	X	X	X	X	X	
Townsend Pocket Gopher	<u>Thomomys townsendi</u>	P	P	P	P				X	X	
Great Basin Pocket Mouse	<u>Perognathus parvus</u>	P	P	P	P		X				
Kangaroo Rat		H	H	H	H	X	X	X	X		
Ord Kangaroo Rat	<u>Dipodomys ordi</u>										
Great Basin Kangaroo Rat	<u>Dipodomys microps</u>										
Beaver	<u>Castor canadensis</u>	M	M	M	M					X	X
Western Harvest Mouse	<u>Reithrodontomys megalotis</u>	M	M	M	M		X	X	X	X	
Deer Mouse	<u>Peromyscus maniculatus</u>	M	M	M	M	X	X	X	X	X	
Canyon Mouse	<u>Peromyscus crinitus</u>	P	P	P	P	X	X			X	
Northern Grasshopper Mouse	<u>Onychomys leucogaster</u>	M	M	M	M	X	X	X	X		
Wood Rats		L	L	L	L	X	X			X	
Bushytail Woodrat	<u>Neotoma cinerea</u>										
Desert Woodrat	<u>Neotoma lepida</u>										
Mountain Vole	<u>Microtus montanus</u>	L	L	L	L				X	X	

TABLE 8. (continued)

Species		Relative Abundance ^a				Habitat Types ^b					
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4	5	6
Sagebrush Vole	<u>Lagurus curtatus</u>	P	P	P	P		X				
Muskrat	<u>Ondatra zibethica</u>	L	L	L	L					X	X
House Mouse	<u>Mus musculus</u>	P	P	P	P				X	X	
Western Jumping Mouse	<u>Zapus princeps</u>	M	M	M	M		X			X	
Porcupine	<u>Erethizon dorsatum</u>	P	P	P	P					X	
Whitetail Jackrabbit	<u>Lepus townsendi</u>	L	L	L	L		X			X	
Blacktail Jackrabbit	<u>Lepus californicus</u>	M	M	M	M	X	X	X	X		
Mountain Cottontail	<u>Sylvilagus nuttalli</u>	M	M	M	M	X	X	X	X	X	
Pygmy Rabbit	<u>Sylvilagus idahoensis</u>	L	L	L	L	X	X	X	X	X	
Mule Deer	<u>Odocoileus hemionus</u>	H	H	H	H	X	X	X	X	X	
Pronghorn Antelope	<u>Antilocapra americana</u>	H	H	H	H	X	X	X	X	X	
California Bighorn Sheep	<u>Ovis canadensis</u>	H	H	H	H		X				

^aKey To Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

^bKey to Habitat Types: 1=Salt Desert Shrub, 2=Sagebrush, 3=Perennial Grass, 4=Irrigated Farm, 5=Stream Side, 6=Lakes.

Figure 17. Distribution of California Bighorn Sheep (*Ovis canadensis*) habitat within Owyhee County.

Figure 18. Distribution of Mule Deer (*Odocoileus hemionus*) overwintering habitat within Owyhee County.

Figure 19. Distribution of Pronghorn (*Antilocarpa americana*) habitat within Owyhee County.

Figure 20. Distribution of Chukar (Alectoris chukar) habitat within Owyhee County.

Figure 21. Distribution of overwintering waterfowl habitat within Owyhee County.

Figure 22. Distribution of Sage Grouse (*Centrocercus urophasianus*) habitat within Owyhee County.

Figure 23. Distribution of Prairie Falcon (*Falco mexicanus*) habitat within Owyhee County.

Figure 24. Distributions of Bald Eagle (Haliaeetus leucocephalus) habitat, Osprey (Pandion haliaetus), and California Quail (Lophortyx californicus) habitat within Owyhee County.

Figure 25. Distributions of Peregrine Falcon (*Falco peregrinus*), White-faced Ibis (*Plegadis chihi*), and Elk (*Cervus canadensis*) habitats within Owyhee County.

Species of special concern, listed in Table 9, have been classified according to whether they are considered game species, furbearer or of extended concern because of restricted range, specific habitat requirements, population numbers so low that they may be easily eliminated from Idaho, and or whether they are threatened or endangered. Because these species have received more consideration in past work, more data are available and Table 9 should be considered rather accurate. Distributions of some species of concern are plotted in Figures 17 through 25, demonstrating their proximities to the KGRA. Species not included in these figures were either ubiquitous or their distributions were unknown, such as would be expected for many of the nongame and migratory species. Data included were taken from the Idaho Environmental Overview³⁶ and must be accepted cautiously. Local habitat variations not included in the diagrams will create many exceptions to what is illustrated.

In 1971, the U.S. Department of Interior established 10 819 ha of public land along the Snake River canyon as the Snake River Birds of Prey Natural Area (BPNA). This region (Figure 26) contains one of the densest populations of nesting raptors ever recorded. More than 600 pairs, representing 15 species, breed and rear their young in the canyon each year. In addition, ten species of raptors use the area during the fall and winter. Two species, the ferruginous hawk (Buteo regalis) and the burrowing owl (Athene cunicularia) are classified as "sensitive," while the bald eagle (Haliaeetus leucocephalus) and the peregrine falcon (Falco peregrinus) are classified as "endangered." The population of prairie falcons (Falco mexicanus) nesting in the canyon represents an estimated 5% of the entire population of this species.³⁷ In 1979, the Bureau of Land Management proposed expanding the BPNA to include 208 500 ha of public land. The BPNA includes lands in the Castle Creek KGRA. The proposed expansion would still allow the Secretary of the Interior to issue leases under the Geothermal Steam Act.

TABLE 9. SPECIES OF SPECIAL CONCERN ON OR IN THE PROXIMITY OF THE
KGRAS AND THEIR RESPECTIVE NONCOMPETITIVE APPLICATION
AREAS: CLASSIFIED ACCORDING TO THE REASON FOR CONCERN

Species		KGRA Areas ^a				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern ^b
<u>Mammals:</u>								
Black Bear	<u>Ursus americanus</u>		/C		X	X		
Raccoon	<u>Procyon lotor</u>	X	X	X	X		X	
Marten	<u>Martes americana</u>				X		X	
Fisher	<u>Martes pennanti</u>				/C			X
Mink	<u>Mustela vison</u>	X	X	X	X		X	
Wolverine	<u>Gulo luscus</u>				/C			X
Gray Wolf	<u>Canis lupus</u>				/C			XE
Red Fox	<u>Vulpes fulva</u>	X	X	X	X		X	
Kit Fox	<u>Vulpes macrotis</u>	/C						X
Mountain Lion	<u>Felis concolor</u>		X		X	X		
Canada Lynx	<u>Lynx canadensis</u>				X		X	X
Bobcat	<u>Lynx rufus</u>	X	X	X	X		X	X
Idaho Ground Squirrel	<u>Spermophilus brunneus</u>			X				X
Beaver	<u>Castor canadensis</u>	X.	X	X	X		X	
Muskrat	<u>Ondatra zibethica</u>	X	X	X	X		X	
Mountain Cottontail	<u>Sylvilagus nuttalli</u>	X	X	X	X	X		
Pygmy Rabbit	<u>Sylvilagus idahoensis</u>	X	X	X		X		
Elk	<u>Cervus canadensis</u>	/C	X		X	X		
Mule Deer	<u>Odocoileus hemionus</u>	X	X	X	X	X		
Whitetail Deer	<u>Odocoileus virginianus</u>				/C	X		
Moose	<u>Alces alces</u>				/C	X		
Pronghorn Antelope	<u>Antilocapra americana</u>	X	X	X		X		
Mountain Goat	<u>Oreamnos americanus</u>				/C	X		
Bighorn Sheep	<u>Ovis canadensis</u>	X				X		

TABLE 9. (continued)

Species		KGRA Areas ^a				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern ^b
<u>Birds:</u>								
Canada Goose	<u>Branta canadensis</u>	X	X	X	X	X		
Snow Goose	<u>Chen hyperborea</u>	/c	/c	/c		X		
Ross' Goose	<u>Chen rossii</u>		/c			X		
Mallard	<u>Anas platyrhynchos</u>	X	X	X	X	X		
Pintail	<u>Anas acuta</u>	X	X	X	/c	X		
Gadwall	<u>Anas strepera</u>	X	X	X	/c	X		
Wigeon	<u>Anas americana</u>	X	X	X	/c	X		
Northern Shoveler	<u>Anas clypeata</u>	X	X	X	/c	X		
Blue-winged Teal	<u>Anas discors</u>	X	X	X	/c	X		
Cinnamon Teal	<u>Anas cyanoptera</u>	X	X	X	/c	X		
Green-winged Teal	<u>Anas crecca</u>	X	X	X	X	X		
Wood Duck	<u>Aix sponsa</u>	X	X	X	/c	X		
Redhead	<u>Aythya americana</u>	X	X	X	/c	X		
Canvasback	<u>Aythya valisineria</u>	X	X	X	/c	X		
Ring-necked Duck	<u>Aythya collaris</u>	X	X	X	/c	X		
Greater Scaup	<u>Aythya marila</u>	X	X	X	/c	X		
Lesser Scaup	<u>Aythya affinis</u>	X	X	X	/c	X		
Common Goldeneye	<u>Bucephala clangula</u>	X	X	X	/c	X		
Barrow's Goldeneye	<u>Bucephala islandica</u>		X	X	/c	X		
Bufflehead	<u>Bucephala albeola</u>	X	X	X	/c	X		
Ruddy Duck	<u>Oxyura jamaicensis</u>	X	X	X	/c	X		
Common Merganser	<u>Mergus merganser</u>	X	X	X	/c	X		
Red-breasted Merganser	<u>Mergus serrator</u>		X	X		X		
Hooded Merganser	<u>Lophodytes cucullatus</u>	X	X	X	/c	X		
Ferruginous Hawk	<u>Buteo regalis</u>	X	X	X	X			X

TABLE 9. (continued)

Species		KGRA Areas ^a				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern ^b
Bald Eagle	<u>Haliaeetus leucocephalus</u>	X	X	X	X			E
Prairie Falcon	<u>Falco mexicanus</u>	X	X	X				X
Peregrine Falcon	<u>Falco peregrinus</u>	X	X		X			XE
Wild Turkey	<u>Meleagris gallopavo</u>		/C			X		
Blue Grouse	<u>Dendragapus obscurus</u>	X	X	X	X	X		
Spruce Grouse	<u>Canachites canadensis</u>	X	X		X	X		
Ruffed Grouse	<u>Bonasa umbellus</u>		X	X	X	X		
Sharp-tailed Grouse	<u>Pedioecetes phasianellus</u>			X		X		X
Sage Grouse	<u>Centrocercus urophasianus</u>	X	X	X		X		
Bobwhite	<u>Colinus virginianus</u>	X				X		X
California Quail	<u>Lophortyx californicus</u>	X	X	X		X		X
Mountain Quail	<u>Oreortyx pictus</u>		X			X		
Ring-necked Pheasant	<u>Phasianus colchicus</u>	X	X	X		X		
Chukar	<u>Alectoris chukar</u>	X	X	X	X	X		
Gray Partridge	<u>Perdix perdix</u>	X	X	X		X		
American Coot	<u>Fulica americana</u>	/C	/C	X		X		
Common Snipe	<u>Capella gallinago</u>	/C	/C	X	/C	X		
Mourning Dove	<u>Zenaidura macroura</u>	X	X	X	X	X		
<u>Reptiles:</u>								
Ringneck Snake	<u>Diadophis punctatus</u>	X						X
Long-nosed Snake	<u>Rhinocheilus lecontei</u>	X	X					X
Western Ground Snake	<u>Sonora semiannulata</u>	X	X	X				X
Night Snake	<u>Hypsiglena torquata</u>	X	X					X

^aKGRA Areas: B=Castle Creek-Bruneau, M=Mountain Home, C=Crane Creek, V=Vulcan.

^bSpecial Concern: "X"=Classified by the Idaho State Fish and Game as species whose restricted range, specific habitat requirements and/or population numbers make them vulnerable to elimination from the state.

"E"=Indicates species that are federally protected as "Endangered Species", according to the Endangered Species Act (Revised List; August, 1978).

^cReported range of species is within close proximity of the non-competitive application areas.

Figure 26. Birds of Prey Natural Area and proposed expansion.

Game and nongame species attracted to the water resources near the Castle Creek KGRA and its associated riparian vegetation are also an important consideration. Although this area seems relatively unimportant as far as migrating species are concerned (it is not a major nesting area), several game species nest within its boundaries. Mallards, Common Goldeneyes, and Common Mergansers nest within the area, although they represent a minor number when compared with the total populations. Care should be taken to protect, perhaps develop more marsh for breeding waterfowl. Other game would not likely be seriously impacted, with the possible exception of Chukar. Continued monitoring of upland game birds in the area would be required to make appropriate management decisions that ensure their protection and that of their respective habitats.

Several snakes are considered by the State Department of Fish and Game to be of special interest because of their limited distribution in the state. Although they have limited distribution in Idaho, their ranges are broad enough that there is not comparable concern for the species as a whole. Species included are: Ringneck Snake, Long-nosed Snake, Western Ground Snake, and Night Snake (Table 17).

Aquatic Ecology - (K. P. McCarthy and J. F. Sullivan, EG&G Idaho, Inc.)

Planning of the Swan Falls and Guffey dams has resulted in several reports concerning the aquatic environment of the area. Sigler et al.³⁸ present a concise discussion of aquatic flora and fauna in the Swan Falls-Guffey area. A preliminary environmental assessment for the Swan Falls-Guffey Hydroelectric Project will soon be published by EDAW, Inc. for the Idaho Department of Water Resources. This report will include a section on aquatic biology. Unpublished data from the Bureau of Land Management provide the only information available on the tributaries of the Snake River in the resource area. These field notes consist of stream survey forms and provide information primarily on macroinvertebrates.

Most of the tributary streams of the Snake River in the Castle Creek KGRA are not perennial. The majority of aquatic information in the area is baseline data of Snake River aquatics for the Swan Falls-Guffey Dam project and the Bruneau-Grand View Environmental Assessment Record (EAR).

A thorough aquatics study was conducted in 1972 above and below Swan Falls Dam. This dam is about 12 km downstream from the northern boundary of the Castle Creek KGRA. The reservoir extends into the KGRA. Table 10 is a summary of fish collected primarily by electroshocking. Gill nets, backpack shockers, and trammel nets were also used. Species diversity was markedly higher below the reservoir.³⁸

Swan Falls reservoir carries a medium-to-heavy silt load which makes a poor habitat for game fish. Mudflats are exposed along the shore during low water levels. Dense stands of hardstem bulrush are common; there are no submerged aquatic plants among the bulrush which further degrades the habitat. A filamentous algae is present. Midge larvae and adults were observed, as well as mayflies and caddis flies.

No quantitative data are available on invertebrates in the reservoir. The existing Swan Falls Reservoir apparently does not have the proper flow characteristics to support either standing water or running-water game fish. Gibson³⁹ used electroshocking equipment to assess fish species distribution and relative abundance from Grand View to C. J. Strike Reservoir. Figure 27 shows the total fish composition found.

The Snake River between Swan Falls Reservoir and C. J. Strike Dam is one of four segments of the river that is considered to be white sturgeon habitat. These fish most likely feed on caddis fly larvae and other bottom invertebrates and may live as long as 100 years and weigh over 30 kg. Spawning occurs every three or four years in May through July at temperatures of 10⁰ to 20⁰C.

TABLE 10. SUMMARY OF GAME AND NONGAME FISH COLLECTED
ABOVE AND BELOW SWAN FALLS DAM

<u>Game Fish</u>	<u>Reservoir</u>		<u>River below Swan Falls Dam</u>	
	<u>Number Collected</u>	<u>Percent of Total</u>	<u>Number Collected</u>	<u>Percent of Total</u>
Yellow Perch	2	.28		
Black Crappie	6	.86	37	3.08
Smallmouth Bass	3	.43	74	6.17
Channel Catfish	1	.14	141	11.76
Redear Sunfish			7	.58
Mountain Whitefish	1	.14	35	2.92
Black Bullhead			3	.25
Bluegill			17	1.41
Largemouth Bass	1	.14	3	.25
Rainbow Trout	—	—	1	.08
Subtotal	14	1.99	318	26.50
<u>Non-Game Fish</u>				
Carp	231	34.02	267	22.28
Squawfish	109	16.05	142	11.85
Largescale Sucker	302	44.47	341	28.46
Peamouth	19	2.79	6	.50
Bridgelip Sucker	3	.44	89	7.42
Chiselmouth			31	2.58
Shorthead Sculpin	1	.14	3	.25
Tadpole Madtom	—	—	1	.08
Subtotal	665	97.91	880	73.42
Totals	679	99.90	1198	99.92

(From Sigler et al., 1972)

N=1467

N=1255

N=212

Figure 27. Percentage composition for total fish, game fish, and nongame fish in an electrofishing sample, Snake River (Grand View, Idaho to C. J. Stike Dam).

The Idaho Fish and Game Department considers the white sturgeon an endangered species in this section of the Snake River. Significant reproduction of the sturgeon in the area has been documented, but survival of the species is by no means guaranteed.⁴⁰

General benthic invertebrate studies of the Snake River have shown amphipods to be the dominant taxa below dams. These amphipods form a good food base for game fish such as smallmouth bass. Typical tributary aquatic insects include mayflies (Tricorhodyes, Stenonema) and caddis flies (Hydropsyche).⁴¹

Specific tributary benthic invertebrate inventories were taken in the fall of 1976 and the spring of 1978 within the resource area. Raw data indicate the following most abundant macroinvertebrates from surber samples (in order of abundance):

Brown's Creek: Diptera Chironomidae, Diptera simuliidae, Ephemeroptera Pseudocleon sp., Plecoptera Capuia sp., Plecoptera Brachyptera, Diptera Blepharoceridae, the following Coleoptera: Oreodytes, Rhantus-Colymbetes, Agabus, Ephemeroptera Siphonvrus, Plecoptera Alloperla, and the Mollusc Physa.

Catherine Creek: Diptera Chironomidae, Simuliidae

Upper Castle: Trichoptera Helicopsyche, Proptila,
Creek Brachcentrus, Hydropsyche, Diptera
Chironomidae, Ephemeroptera Baetis
tricaudatus, Odonata Ophiogomphuys sp.

Castle Creek: 1.6 km below Gordy Ranch: Trichoptera
Hydropsyche, Ephemeroptera, Ephemerella
inermis, Trichoptera Helicopsyche,

Ephemeroptera Rhithrogena hageni, Trichoptera Agapetus, Lepidastoma, Brachycentrus americanus, Coleoptera optioservus.

Castle Creek: Foreman's Reservoir: Diptera Chironomidae, Simuliidae, Trichoptera Hydropsyche, Plecoptera Capnia. Ephemeroptera Baetis propinquus.

Fish collection below Gordy Ranch revealed a high abundance of dace, suckers, and rainbow trout.

A list of aquatic animals compiled for the Bruneau-Grand View geothermal development ERA is presented here and includes caddis flies, dragon flies, scavenger beetles, snails, Pacific tree frogs, mayflies, stoneflies, damsel flies, bullfrogs, rainbow trout, bridge-lip sucker, reddsideshinner, speckled dace, leopard dace, alderflies, fishflies, beaver, water boatman, and water striders. Large and smallmouth bass, bluegill, yellow perch, mountain whitefish, pumpkinseed, channel and bullhead catfish, black crappie, warmouth bass, and Dolly Varden trout are also present.

Table 11 show aquatic plants found in the Snake River from Burley to the Oregon border. It is likely that all can be found in the resource area. The tributaries generally have less aquatic plants due to their often intermittent nature and higher energy lotic water habitat. Whitewater crowfoot and Lotus purshianus are also present in the Grand View area.⁴²

HUMAN ENVIRONMENT

Demography (W. C. Lewis, Lewis and Associates)

The data being reported and evaluated here are summarized from the larger socioeconomic study prepared for the ten-county Southwest Idaho region.⁴³ This summary gives a general overview of

TABLE 11. AQUATIC PLANTS FOUND IN MAIN SNAKE RIVER

<u>Floating</u>	<u>Submersed</u>	<u>Immersed</u>
green & blue algae	stone wart (Chara)	cattail (Typha)
duckweed (Lemna) (Spirodela)	bladder wart (Utricularia)	bull rush (Scirpus)
watershield (Brasenia)	pond weed (Potamogeton)	yellow cress (Rorippa)
pond lily (Nuphar)	horn wart (Ceratophyllum)	buttercup (Ranunculus)
floating pond weed (Potamogeton)	water milfoil (Myriophyllum)	bur-reed (Sparganium)
	water buttercup (Ranunculus)	water persicaria (Polygonum)
	mares tail (Hippuris)	water plantain (Alisma)
	elodea (Elodea)	arrowhead (Sagittaria)
		sedge (Carex)
		spike rush (Eleocharis)
		horsetail (Equisetum)
		cyperus (Cyperus)
		rush (Juncus)
		mannagrass (Glyceria)
		common reed (Phragmites)
		slough grass (Beckmannia)
		reed canary grass (Phalaris)

(From EAR for the Agriculture Development Program, 1976)

demographic and socioeconomic conditions. Detailed socioeconomic impact analysis will require that this summary report be used together with the larger regional study.

Both the Castle Creek and Bruneau KGRAs are located in north-central Owyhee County. The larger share of socioeconomic impacts is expected to accrue to this area, and, particularly, the impacts are projected to concentrate along Highway 78 running from Murphy as an approximate western boundary to some 15 miles east of Bruneau. Although this area accounts for a relatively small part of the land area in Owyhee County, it does account for a significant part of population and economic activity.

Little or no socioeconomic data are reported for cities with less than 2,500 inhabitants. Necessarily, the data are generally reported on a county basis.

Table 12 reports population data for 1970 and 1976 for Owyhee County and the two population centers Grand View and Marsing. Despite being a low-population area (1976 estimated population of 7,900), Owyhee County recorded a 23% increase in population during that period. Principal population centers recorded similar increases. The components of population change are reported in Table 12 and indicate positive net migration of 1,000 during the 1980 to 1976 period. This statistic is an indicator of a healthy socioeconomic environment.

Summary characteristics of population drawn from the 1970 Population Census are reported in Table 13. These data indicate a relatively homogeneous population with less than 7% being non-Caucasian; however, the relative size of minority groups is somewhat higher than it is in surrounding counties.

The data on educational attainment are about average. Ninety-four percent of 16- and 17-year-olds were in school in 1970.

TABLE 12. POPULATION CHANGE FOR OWYHEE COUNTY, 1970-1976^a

County (Cities)	Population		% Change 1970-1976 (1975) ^a
	1970	1976 (1975) ^a	
Owyhee County	6,422	7,900	23.0
(Grandview)	260	348	33.8
(Marsing)	610	708	16.1

Components of Population Change, 1970-1976

Area	Population Change	Births	Deaths	Net Migration
Owyhee County	1,500	900	400	1,000

^aCity data is for 1975.

Source: U. S. Bureau of the Census, 1977. Idaho Department of Health and Welfare, 1977. Idaho Division of Budget, Policy Planning, and Coordination, 1978.

TABLE 13. SUMMARY CHARACTERISTICS FOR THE POPULATION OF OWYHEE COUNTY, 1970

Characteristics	Number	Percent	
Population: White	6,004	93.5	
Black	113	1.8	
Other	304	4.7	

		Male	Female
		%	%
Median school years completed		10.7	12.0
Percent high school graduates		42.4	51.2
16-17 year-olds in school		94.0	
Percent of population foreign born		1.8	

Source: U. S. Bureau of the Census, 1972a.

Projections of population, employment, and labor force are essential in environmental impact studies to meet two objectives: (a) to describe the future socioeconomic environment in the absence of any significant resource development and (b) to provide a baseline or standard against which the impacts of development can be compared. Such projections have been developed by the Idaho Department of Water Resources⁴⁴ and are summarized in Table 14. These data are current, having been developed in July 1978, and provide more than adequate detail for environmental impact assessment.

The projections indicate a steady but slow (0.06% per year) increase in population from 1980 through 2000. Similar increases are projected for employment and labor force. Although the recent past has been characterized by net immigration, the projections indicate net migration through the next 20 years.

These data are especially useful as they project total school enrollment at five different grade levels. Such data are especially useful in measuring the socioeconomic impacts of a potential development. Summary data on the existing school situation in the four school districts in Owyhee County are reported in Table 15. Reported are data on enrollment in elementary and secondary schools, number of teachers, and the student to teacher ratio. District 365 (Bruneau/Grand View) will bear the brunt of any significant population change in the region. In this region, there are two elementary schools, one in Grand View and one in Bruneau, and the Rimrock Junior-Senior High School in Bruneau. The grades and enrollment in each of these schools are reported in Table 16.

Because crime rates have increased in some areas which have experienced rapid economic development and population growth, data on crime seem especially useful. Frequencies and rates of various crimes per 100,000 population for Owyhee County are reported in Table 17. By any national standard, these rates are relatively low and reflect the absence of a significant crime problem in Owyhee County. They are, however, typical of the crime pattern in low-population counties in

TABLE 14. POPULATION AND EMPLOYMENT 1978 FORECAST FOR OUYHEE COUNTY

EMPLOYMENT SUMMARY							
	1972	1975	1980	1985	1990	1995	2000
AGRICULTURE	1572	1372	1292	1207	1127	1066	1008
MINING	2	30	42	60	77	90	99
CONSTRUCTION	44	78	124	151	180	225	281
FOOD AND KINDRED	9	23	26	29	33	37	42
WOOD PRODUCTS	112	85	90	95	100	104	109
OTHER MANUFACTURING	1	6	7	8	9	10	11
TRANS. COMM. AND UTILS	60	51	59	64	71	77	85
WHOLE AND RETAIL TRADE	331	416	477	501	527	551	575
FINANCE, INS. REAL EST	40	54	60	64	68	72	76
SERVICES AND MISC.	149	184	228	256	288	324	365
STATE AND LOCAL GOVT.	253	287	287	287	287	287	287
FEDERAL GOVERNMENT	93	80	80	80	80	80	80
TOTAL	2666	2666	2775	2807	2851	2927	3022

FORECAST SUMMARY							
	1970	1975	1980	1985	1990	1995	2000
TOTAL POPULATION	6420	7180	7700	8090	8490	8660	8730
TOTAL EMPLOYMENT *	2660	2660	2770	2800	2850	2920	3020
LABOR FORCE **	2320	2650	2780	2810	2850	2920	3020
TOTAL SCHOOL ENROLLMENT	1870	1870	1900	2070	2430	2570	2610
NURSERY	0	0	0	0	0	0	0
KINDERGARTEN	70	113	140	173	190	183	173
ELEMENTARY	1170	1120	1140	1400	1640	1670	1580
HIGH SCHOOL	370	560	530	410	530	640	670
COLLEGE	40	60	70	70	70	70	70
HOUSEHOLD HEADS	1870	1980	2150	2180	2250	2190	2170

* EMPLOYMENT BASE YEAR = 1972

** LABOR FORCE BASE YEAR = 1970

** LABOR FORCE IS DEPENDENT UPON UNEMPLOYMENT RATE AND THE AVERAGE NUMBER OF JOBS HELD BY EACH WORKER

COMPONENTS OF POPULATION GROWTH SUMMARY							
	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000	
TOTAL CHANGE	760	526	386	403	167	73	
NATURAL INCREASE	471	701	806	778	773	867	
BIRTHS	814	1062	1185	1164	1167	1259	
DEATHS	343	361	379	366	394	392	
MIGRATION	331	-198	-476	-427	-693	-911	
EMPLOYMENT	331	-198	-476	-427	-693	-911	
RETIREMENT	0	0	0	0	0	0	

Source: Idaho Dept. of Water Resources and Center for Research, Grants and Contracts, Boise State University, July, 1978.

TABLE 15. SUMMARY EDUCATION DATA FOR OWYHEE COUNTY

District	Enrollment			Change From 1976-1977	Teachers	Student/ Teacher Ratio
	Elementary ^a	Secondary ^b	Total			
363 - Marsing	379	259	638	+23	33	19.3
364 - Pleasant View	20	13	33	+2	2	16.5
365 - Bruneau/Grand View	293	287	580	-42	27	21.5
370 - Homedale	<u>473</u>	<u>421</u>	<u>894</u>	<u>-17</u>	<u>46</u>	<u>19.4</u>
Total	1,165	980	2,145	-34	108	19.9

^aGrades K-6.

^bGrades 7-12.

Source: Idaho Department of Education, 1977 and 1978.

TABLE 16. SCHOOLS IN OWYHEE COUNTY, 1977-1978

City	School	Grades	Enrollment
Bruneau	Rimrock Junior-Senior High School	7-12	257
Bruneau	Bruneau Elementary School	K-6	71
Grand View	Grand View Elementary School	K-6	178

Source: Fennell, 1977.

TABLE 17. CRIME RATE FOR OWYHEE COUNTY, 1971-1976

	1971	1972	1973	1974	1975	1976
Part I Crimes (Rates)	115 (1,761.4)	121 (1,704.2)	138 (1,895.6)	225 (3,081.4)	259 (3,361.0)	235 (3,075.5)
Murder	0 (-)	0 (-)	0 (-)	0 (-)	4 (51.9)	0 (-)
Rape	0 (-)	1 (14.1)	1 (13.7)	0 (-)	0 (-)	2 (26.2)
Robbery	0 (-)	0 (-)	1 (13.7)	0 (-)	0 (-)	1 (13.1)
Aggravated assault	4 (61.3)	5 (70.4)	5 (68.7)	18 (246.5)	21 (272.5)	16 (209.4)
Burglary	22 (337.0)	41 (577.5)	44 (604.4)	62 (849.1)	72 (934.3)	42 (549.7)
Larceny	84 (1,286.6)	68 (957.7)	78 (1,071.4)	131 (1,794.0)	144 (1,868.7)	161 (2,107.1)
Motor vehicle theft	5 (76.6)	6 (84.5)	9 (123.6)	14 (191.7)	18 (233.6)	13 (170.1)

Source: Idaho Law Enforcement Planning Commission, 1978.

the intermountain region. Despite this, the crime rate has increased steadily over the period 1971 through 1976. Most of the increase has been in the burglary and larceny categories. Crimes of violence, including murder, rape, and robbery, occur very infrequently.

Although the conventional wisdom suggests that crime rates increase in rapid growth areas, an analysis of several impacted communities suggest that this need not be the case. Certainly, a rapid increase in crime has occurred in some areas, the most notable being Rock Springs, Wyoming. Other places have seen no major change. Given the magnitude and type of development expected at the Castle Creek KGRA, the crime rate should not increase.

The ability of local health care facilities and personnel to service an increased population is another item of concern in environmental assessments. Summary data on health care capability in Owyhee County are reported in Table 18. The secondary source reports only one physician in the entire county. Ambulance services are available, but there are no hospitals. Because of the proximity of the Castle Creek KGRA to the Boise area and Mountain Home in Elmore County, residents may seek medical assistance in those places. Any significant economic growth in Owyhee County will probably strain the ability of the limited health facilities.

Socioeconomics (W. C. Lewis, Lewis and Associates)

Labor force, unemployment, and employment in Owyhee County for the period 1974 through 1977 are reported in Table 19. During this period, employment conditions have been good as reflected by the well below average unemployment rate, which has ranged from 4.6 to 6.8%. The average level of unemployment in 1977 was 208 workers. This level is an indication of a labor pool available to potential new industry, but some of that employment is seasonal and does not reflect the availability of workers to move into other industries. Development at Castle Creek requiring as many as 100 additional workers would not strain the ability of the local labor market to meet the increased

TABLE 18. SUMMARY DATA ON HEALTH CARE CAPABILITY FOR OWYHEE COUNTY, 1975

	Owyhee County
Physicians:	
Number	1
Persons per medical doctor	7,400
Ambulance Services available?	Yes
Hospitals:	
Number	--
Acute care beds	--

Source: Idaho Division of Budget, Policy Planning, and Coordination, 1978

TABLE 19. LABOR FORCE, UNEMPLOYMENT, UNEMPLOYMENT RATE AND
EMPLOYMENT FOR OWYHEE COUNTY, 1974-1977

Year	Labor Force	Unemployment	Unemployment Rate %	Employment
1974	3,602	194	5.4	3,408
1975	3,646	247	6.8	3,399
1976	4,096	225	5.5	3,871
1977	4,515	208	4.6	4,307

Source: Idaho Department of Employment Security, 1977, 1978a, and 1978b.

demand. However, the local labor market is characterized by relatively full employment.

Detailed employment data for 1971 through 1976 are summarized in Table 20, and a detailed analysis of these data is included in Table 21. Total employment has increased steadily over this six year period from 2,515 in 1971 to 3,083 in 1976. The largest percentage gains have been in agriculture, construction, and finance, insurance, and real estate sectors. The location quotients reported in the second of the two tables are of particular interest because they indicate relative specialization of industry when compared to both the nation and the state. A quotient in excess of unity implies that the county has more than a proportionate share of employment in that sector. Relative to the nation, agriculture and state and local government are the relatively important sectors. With a location quotient of 25.7, agriculture is the primary industry in this county.

The only housing data available for this area are from the 1970 Census of Housing. Summary data for Owyhee County are reported in Table 22. Although the data are interesting, they are seriously outdated and are of limited value.

The ability of the local economy to supply residents with goods and services is an area of interest. Data on number and average size of retail and service establishments in Owyhee County are provided in the 1972 Census of Business. These data are summarized in Tables 23 and 24. Again, because there are no cities in excess of 2,500 inhabitants, the only data are for the county. The largest share of the retail and services activity are located in the urban centers along Idaho Highway 78 in the northern part of the county. Perusal of these data indicate a relatively small number of establishments. Some residents undoubtedly travel long distances to meet their retail and services demands.

TABLE 20. EMPLOYMENT BY TYPE AND BROAD INDUSTRIAL SOURCE
(FULL- AND PART-TIME) FOR OUYEE COUNTY, 1971-1976

ITEM	1971 1/	1972 1/	1973 1/	1974 1/	1975 2/	1976 2/
EMPLOYMENT BY PLACE OF WORK						
TOTAL EMPLOYMENT 3/	2,515	2,587	2,691	2,816	2,825	3,083
NUMBER OF PROPRIETORS	878	874	871	886	880	877
FARM PROPRIETORS	647	646	647	649	644	639
NONFARM PROPRIETORS	231	228	224	237	236	238
TOTAL WAGE AND SALARY EMPLOYMENT	1,637	1,713	1,820	1,930	1,945	2,206
FARM	585	605	619	691	691	921
NON-FARM	1,052	1,108	1,201	1,239	1,254	1,285
PRIVATE	533	628	711	745	743	775
AG. SERV., FCR., FISH., AND OTHER 4/	(D)	47	53	48	(D)	(D)
MINING	(D)	(D)	(D)	3	(D)	(D)
CONSTRUCTION	33	43	73	74	77	63
MANUFACTURING	96	128	111	117	119	114
NON-DURABLE GOODS	(D)	(D)	(D)	21	27	(D)
DURABLE GOODS	(D)	(D)	(D)	96	92	(D)
TRANSPORTATION AND PUBLIC UTILITIES	(D)	56	61	63	50	51
WHOLESALE TRADE	(D)	(D)	(D)	29	89	92
RETAIL TRADE	195	212	229	250	193	211
FINANCE, INSURANCE, AND REAL ESTATE	25	27	29	32	36	34
SERVICES	108	102	114	129	121	132
GOVERNMENT AND GOVERNMENT ENTERPRISES	519	480	490	494	511	510
FEDERAL, CIVILIAN	91	90	79	83	85	73
FEDERAL, MILITARY	69	66	61	64	61	59
STATE AND LOCAL	359	324	350	347	365	378

1/ ESTIMATES BASED ON 67 SIC.

2/ ESTIMATES BASED ON 72 SIC.

3/ CONSISTS OF WAGE AND SALARY JOBS PLUS NUMBER OF PROPRIETORS.

4/ INCLUDES NUMBER OF JOBS HELD BY U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.

PRIMARY SOURCE FOR PRIVATE NON-FARM EMPLOYMENT: ES-202 COVERED WAGES - IDAHO DEPT. OF EMPLOYMENT

(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL DATA. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economic Information System, Bureau of Economic Analysis, August, 1978.

TABLE 21. EMPLOYMENT BY TYPE AND BROAD INDUSTRIAL SOURCE
(FULL- AND PART-TIME SUMMARY ANALYTICS) FOR OWYHEE COUNTY, 1971-1976

ITEM	PERCENT OF U.S. 1976	PERCENT OF STATE 1976	* TOTAL W+S EMPL 1976	PERCENT CHANGE 76/71 76/75		LOCATION QUOTIENT U.S. STATE 1976 1976	

EMPLOYMENT BY PLACE OF WORK							

TOTAL EMPLOYMENT 1/	.0033	.80		23	.9		
NUMBER OF PROPRIETORS	.0100	1.54		0	0		
FARM PROPRIETORS	.0224	2.29		-1	-1		
NONFARM PROPRIETORS	.0040	.82		3	1		

TOTAL WAGE AND SALARY EMPLOYMENT	.0026	.67		35	13		
FARM	.0660	3.84	41.75	57	33	25.7048	5.7062
NON-FARM	.0015	.42	58.25	22	2	.5921	.6285
PRIVATE	.0012	.34	35.13	45	4	.4517	.5078
AG.SERV.,FCR.,FISH.,AND OTHER 2/	(D)	(D)	(D)	(D)	(D)	(D)	(D)
MINING	(D)	(D)	(D)	(D)	(D)	(D)	(D)
CONSTRUCTION	.0017	.37	2.86	91	-18	.6781	.5466
MANUFACTURING	.0006	.22	5.17	19	-4	.2331	.3258
NON-DURABLE GOODS	(D)	(D)	(D)	(D)	(D)	(D)	(D)
DURABLE GOODS	(D)	(D)	(D)	(D)	(D)	(D)	(D)
TRANSPORTATION AND PUBLIC UTILITIES	.0011	.31	2.31	(D)	2	.4346	.4565
WHOLESALE TRADE	.0020	.46	4.17	(D)	3	.7837	.6857
RETAIL TRADE	.0016	.40	9.56	8	9	.6181	.5976
FINANCE,INSURANCE,AND REAL ESTATE	.0008	.27	1.54	36	-6	.3039	.4048
SERVICES	.0008	.26	5.98	22	9	.3172	.3891
GOVERNMENT AND GOVERNMENT ENTERPRISES	.0029	.66	23.12	-2	0	1.1224	.9836
FEDERAL, CIVILIAN	.0025	.65	3.31	-20	-14	.9882	.9737
FEDERAL, MILITARY	.0024	.49	2.67	-14	-3	.9206	.7246
STATE AND LOCAL	.0031	.70	17.14	5	4	1.1946	1.0439

1/ CONSISTS OF WAGE AND SALARY JOBS PLUS NUMBER OF PROPRIETORS.

2/ INCLUDES NUMBER OF JOBS HELD BY U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.

PRIMARY SOURCE FOR PRIVATE NON-FARM WAGE AND SALARY EMPLOYMENT: IDAHO DEPT. OF EMPLOYMENT

(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION. DATA ARE INCLUDED IN TOTALS.

-Source: Regional Economic Information System, Bureau of Economic Analysis, August, 1978.

TABLE 22. SELECTED HOUSING CHARACTERISTICS FOR OWYHEE COUNTY, 1970

Characteristics	Total	Rural
Number of year-round units	2,087	2,087
Owner occupied: Number	1,253	1,253
Percent	60.0%	60.0%
Vacant units	215	215
Vacancy rate	10.3%	10.3%
With all plumbing facilities: Number	1,847	1,847
Percent	88.5%	88.5%
On public sewer: Number	767	767
Percent	36.8%	36.8%
Median value--owner occupied	\$9,000	\$9,000
Contract rent--renter occupied	56	56

Source: U. S. Bureau of the Census, 1972c.

TABLE 23. SUMMARY OF RETAIL TRADE DATA FOR OWYHEE COUNTY, 1972

	Owyhee County
All establishments: Number	73
Sales (000)	\$7,499
Establishments with payroll: Number	44
Sales (000)	\$6,696
Payroll (000)	\$691
Employees	170
Number of establishments:	
Building materials, hardware, etc.	5
General merchandise	5
Food stores	9
Automotive dealers	2
Service stations	13
Apparel and accessory stores	--
Furniture and home furnishings	3
Eating and drinking places	20
Drug stores	3
Miscellaneous	13

Source: U. S. Department of Commerce, 1976c.

TABLE 24. SUMMARY SELECTED SERVICES DATA FOR OWYHEE COUNTY, 1972

		Owyhee County
All establishments:	Number	48
	Receipts (000)	\$752
Establishments with payroll:	Number	12
	Receipts (000)	\$370
	Payroll (000)	67
	Employees	16
		Owyhee County
		Number Receipts
Hotels, motels, etc.	7	\$ 84
Automotive repair	5	79
Miscellaneous repair	8	113
Amusement and recreation	10	161
Legal services	1	(D)

(D) -- not reported to avoid disclosure of individual firm data.

Source: U. S. Department of Commerce, 1976f.

Income data by type and industry are reported in Table 25. These data were provided by the Bureau of Economic Analysis, U.S. Department of Commerce from their Regional Economics Information System. Per capita income in Owyhee County is relatively low. The 1976 level of \$3,232 is the lowest in the ten county Southwest Idaho region and is only 50% of the national level. This variable declined significantly from 1974 to 1976 because of a precipitous decline in the level of farm income. Income in agriculture accounted for more than 26% of total earnings in the county in 1976. In 1974 and 1975, agriculture must have accounted for a much larger percentage.

General data on the agricultural sector are reported in Table 26. These data are especially important because the agriculture sector may be significantly impacted by geothermal resource development. As suggested above, agriculture is the most important industry in the county. Farm sizes are large, averaging in excess of 1,100 acres, although the largest share of this is in rangeland. Seventeen percent of farmland is irrigated (only 2% of total county land area). Since geothermal resource development may impact the quantity and quality of water available from wells, the agricultural situation should be assessed in the immediate vicinity of the Castle Creek KGRA.

Summary data on all land use and ownership are reported in Table 27. Urban use accounts for less than 0.05% of total land area. The largest use is in rangeland, accounting for 93.5% of the total county land area. With regard to ownership, the federal government owns 77.3% of all land; this is not atypical in the intermountain west and poses a special set of problems surrounding industrial development.

Land-use control mechanisms are also inventoried in Table 27. While the county has a planning and zoning commission, secondary sources report no comprehensive plan, subdivision ordinance, or zoning ordinance. While this may be a serious disadvantage in planning and directing growth, uncontrolled growth in a low population area like this is not necessarily inefficient.

TABLE 25. PERSONAL INCOME BY MAJOR SOURCES FOR OWYHEE COUNTY,
1971-1976 (thousands of dollars)

ITEM	1971 1/	1972 1/	1973 1/	1974 1/	1975 2/	1976 2/
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK 3/						
BY TYPE						
WAGE AND SALARY DISBURSEMENTS	7,372	8,501	9,679	11,399	12,664	15,312
OTHER LABOR INCOME	274	333	438	524	545	837
PROPRIETORS' INCOME 4/	3,832	4,191	9,810	9,904	1,667	562
FARM	2,507	2,618	8,123	8,133	-330	-1,596
NON-FARM 4/	1,325	1,573	1,687	1,771	1,937	2,158
BY INDUSTRY						
FARM	5,023	5,584	11,399	12,343	4,163	4,427
NON-FARM	6,455	7,441	8,528	9,484	10,703	12,284
PRIVATE	4,026	4,857	5,858	6,549	7,271	8,535
AG. SERV., FOR., FISH., AND OTHER 5/	(U)	326	321	341	(U)	(U)
MINING	(U)	(U)	(U)	(U)	(U)	(U)
CONSTRUCTION	600	754	1,256	1,389	1,431	1,689
MANUFACTURING	618	699	682	789	891	1,090
NON-DURABLE GOODS	(U)	(U)	(U)	203	275	(U)
DURABLE GOODS	(U)	(U)	(U)	586	616	(U)
TRANSPORTATION AND PUBLIC UTILITIES	(U)	524	587	694	626	650
WHOLESALE TRADE	(U)	(U)	(U)	233	820	885
RETAIL TRADE	1,459	1,585	1,878	2,083	1,829	2,089
FINANCE, INSURANCE, AND REAL ESTATE	172	234	197	255	300	345
SERVICES	586	618	654	749	844	944
GOVERNMENT AND GOVERNMENT ENTERPRISES	2,429	2,584	2,670	2,935	3,432	3,749
FEDERAL, CIVILIAN	892	948	915	988	1,145	1,164
FEDERAL, MILITARY	83	95	94	102	110	116
STATE AND LOCAL	1,454	1,541	1,661	1,845	2,177	2,469
DERIVATION OF PERSONAL INCOME BY PLACE OF RESIDENCE						
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	11,478	13,025	19,927	21,827	14,866	16,706
LESS: PERSONAL CONTRIBUTIONS FOR SOCIAL INSURANCE BY PLACE OF WORK	354	419	493	623	658	777
NET LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	11,124	12,606	19,434	21,204	14,208	15,929
PLUS: RESIDENCE ADJUSTMENT	780	901	891	900	960	1,140
NET LABOR AND PROPRIETORS INCOME BY PLACE OF RESIDENCE	11,904	13,507	20,325	22,104	15,168	17,069
PLUS: DIVIDENDS, INTEREST, AND RENT 7/	1,678	1,962	2,395	2,987	3,123	3,477
PLUS: TRANSFER PAYMENT	2,490	2,795	3,181	3,923	4,716	4,989
PERSONAL INCOME BY PLACE OF RESIDENCE	16,072	18,264	25,901	29,014	23,007	25,535
PER CAPITA PERSONAL INCOME (DOLLARS)	2,368	2,571	3,617	3,920	3,052	3,232
TOTAL POPULATION (THOUSANDS)	6.8	7.1	7.2	7.4	7.5	7.9

1/ ESTIMATES BASED ON 1967 SIC.

2/ ESTIMATES BASED ON 1972 SIC.

3/ CONSISTS OF WAGE AND SALARY DISBURSEMENTS, OTHER LABOR INCOME, AND PROPRIETORS' INCOME.

4/ PRIMARY SOURCE FOR PRIVATE NON-FARM WAGES; ES-202 COVERED WAGES - IDAHO DEPARTMENT OF EMPLOYMENT

5/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR NON-FARM PROPRIETORS.

6/ INCLUDES WAGE AND SALARIES OF U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.

7/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR RENTAL INCOME OF PERSONS.

(U) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION; DATA ARE INCLUDED IN TOTALS.

(L) LESS THAN \$50,000. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, July, 1978.

TABLE 25. (continued)

ITEM	PERCENT OF U.S.	PERCENT OF STATE	% TOTAL EARNINGS	PERCENT CHANGE 76/71	PERCENT CHANGE 76/75	LOCATION QUOTIENT U.S.	STATE
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK 3/							
BY TYPE							
WAGE AND SALARY DISBURSEMENTS	.0017	.53		108	21		
OTHER LABOR INCOME	.0011	.35		204	40		
PROPRIETORS INCOME 4/	.0006	.11		-85	-65		
FARM	-.0088	-.85		-164	384		
NON-FARM 4/	.0031	.68		63	11		
BY INDUSTRY							
FARM	.0177	1.29	26.47	-12	6	11.0835	2.8219
NON-FARM	.0012	.37	73.53	90	15	.7533	.8114
PRIVATE	.0010	.32	51.09	112	17	.6399	.7072
AG.SERV.,FOR.,FISH.,AND OTHER 5/	(D)	(D)	(D)	(D)	(D)	(D)	(D)
MINING	(D)	(D)	(D)	(D)	(D)	(D)	(D)
CONSTRUCTION	.0028	.55	10.11	182	18	1.7615	1.2067
MANUFACTURING	.0004	.16	6.52	76	22	.2518	.3557
NON-DURABLE GOODS	(D)	(D)	(D)	(D)	(D)	(D)	(D)
DURABLE GOODS	(D)	(D)	(D)	(D)	(D)	(D)	(D)
TRANSPORTATION AND PUBLIC UTILITIES	.0008	.25	3.89	(D)	4	.5208	.5429
WHOLESALE TRADE	.0013	.36	5.30	(D)	8	.7895	.7941
RETAIL TRADE	.0019	.49	12.50	43	14	1.1922	1.0762
FINANCE,INSURANCE, AND REAL ESTATE	.0006	.24	2.07	101	15	.3919	.5268
SERVICES	.0006	.19	5.95	70	18	.3620	.4190
GOVERNMENT AND GOVERNMENT ENTERPRISES	.0020	.56	22.44	54	9	1.2631	1.2213
FEDERAL, CIVILIAN	.0026	.65	6.97	30	2	1.6204	1.4224
FEDERAL, MILITARY	.0006	.16	.69	40	5	.3942	.3510
STATE AND LOCAL	.0020	.59	14.78	70	13	1.2626	1.2853
DERIVATION OF PERSONAL INCOME BY PLACE OF RESIDENCE							
TOTAL LABOR AND PROPRIETORS INCOME BY							
PLACE OF WORK	.0016	.46		46	12		
LESS: PERSONAL CONTRIBUTIONS FOR SOCIAL							
INSURANCE BY PLACE OF WORK	.0014	.39		119	18		
NET LABOR AND PROPRIETORS INCOME BY							
PLACE OF WORK	.0016	.46		43	12		
NET LABOR AND PROPRIETORS INCOME BY							
PLACE OF RESIDENCE	.0017	.49		43	13		
PLUS: DIVIDENDS, INTEREST, AND RENT 7/	.0018	.59		107	11		
PLUS: TRANSFER PAYMENTS	.0026	.81		100	6		
PERSONAL INCOME BY PLACE OF RESIDENCE	.0019	.54		59	11		

3/ CONSISTS OF WAGE AND SALARY DISBURSEMENTS, OTHER LABOR INCOME, AND PROPRIETORS' INCOME.

PRIMARY SOURCE FOR PRIVATE NON-FARM WAGES; ES-202 COVERED WAGES -IDAHO DEPARTMENT OF EMPLOYMENT

4/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR NON-FARM PROPRIETORS.

5/ INCLUDES WAGE AND SALARIES OF U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.

7/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR RENTAL INCOME OF PERSONS.

(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, July, 1978.

TABLE 26. GENERAL AGRICULTURAL DATA FOR OWYHEE COUNTY, 1974

Number of farms	553
Land in farms (acres)	617,511
Average farm size (acres)	1,117
County land area (acres)	4,889,920
Percent in farms	12.6%
Value of land and buildings	
Total (000)	\$126,450
Per farm	\$228,661
Per acre	\$205
Cropland (acres)	133,038
Percent of all land	2.7%
Percent of all farmland	21.5%
Irrigated land (acres)	107,389
Percent of all land	2.2%
Percent of all farmland	17.4%
Quantity of irrigation water applied (ac ft)	347,928
Per acre (ac ft)	3.3
Value of agricultural products sold--total (000)	\$39,205
Average per farm	\$70,896

Source: U. S. Bureau of the Census, 1977.

TABLE 27. SUMMARY DATA ON LAND USE, LAND OWNERSHIP, AND LAND-USE CONTROL MECHANISMS IN OWYHEE COUNTY, 1976-1977

	Acres	% of Total
Land Use--1976:		
Urban	--	--
Agricultural	191,700	3.9
Rangeland	4,585,000	93.5
Other	126,800	2.6
Land Ownership--1977:		
Federal government	3,777,613	77.3
State government	330,955	6.8
Private	779,641	15.9
Local government	1,711	--
Land-Use Control Mechanisms:		
Planning and Zoning Commission	Yes	
County Comprehensive Plan	No	
Subdivision Ordinance	No	
Zoning Ordinance	No	

Source: Idaho Division of Budget, Policy Planning, and Coordination, 1978

Finally, selected data on assessed value and property tax charges in the county for 1977 are reported in Table 28. Assessed value of all property per capita is almost \$2,500, and property tax charges per capita are \$197. On real and personal property only, per capita tax charges are \$147. The relatively high coefficient of variation and assessment ratios suggest disparities in tax levels among similar properties; this is an indication of equity problems in property tax administration.

Heritage Resources (R. Knudson and M. Pfaff, Idaho Water Resources Research Institute)

Paleontological Resources. The Castle Creek KGRA is within a paleontologically rich area of Pliocene and Pleistocene deposits, though there is more description of fossil localities just outside of the KGRA borders than there are from within. The two basic references relevant to evaluating the paleontological resources of the KGRA are both unpublished graduate theses. The theses focus on the edges of the area one being done on the Jackass Butte deposits⁴⁵ and the other on the bedrock geology of the Oreana quadrangle⁴⁶.

Briefly, the bedrock deposits of the Castle Creek KGRA⁴⁶ include basal Tertiary silicic volcanics, which apparently are evident only to the southwest edge of the area; the early to mid Pliocene Brown Creek of Chalk Hills Formation, including the Sinker Creek basalt member with sedimentary interbeds; the Late Pliocene Oreana or Glens Ferry Formation of stream and lake sands and silts; the sedimentary Mid-Pleistocene Montini or Bruneau Formation; and the Pleistocene Hart Creek Conglomerate. Molluscan, fish, and plant fossils are found in the sedimentary members of the Brown Creek Formation; clams, snails, fish, and plants (including silicified wood) are found within the Oreana or Glens Ferry Formation. The correlative Glens Ferry Formation further east, in the Hagerman section of the Snake River Valley, has produced the famous fossil horse assemblages.^{47,48} Finally, Anderson⁴⁶ noted that the later Montini or Bruneau Formation has a full assemblage of molluscan and plant fossils

TABLE 28. SUMMARY DATA ON ASSESSED VALUE AND PROPERTY TAX
CHARGES FOR OWYHEE COUNTY, 1977

Assessed value of all property--total (000)	\$19,733
Per capita	\$2,498
All property tax charges--total (000)	\$1,557
Per capita	\$197
Property tax charges--real and personal property-- total (000)	\$1,165
Per capita	\$147
Measures of uniformity in assessment ratios:	
Weighted assessment ratio	14.49
Regression index	1.07
Coefficient of variation	56.22

Source: Idaho State Tax Commission, 1977a.

accompanied by sloth, horse, camel, elk, and elephant remains within the general area of the Castle Creek KGRA. The only recorded fossil localities found within the KGRA are Anderson's molluscan sites; nine of them are within the study area and are listed in Table 29. There appears to have been no systematic reconnaissance of the paleontological resources within the Castle Creek area, though several investigators have worked there; there is high probability of finding more fossil-rich localities in the course of a thorough survey of the area. The Boise District BLM office has more information on the paleontological resources in the Castle Creek KGRA, but this information was not available in time to be included in this report.

Prehistoric Resources. Several professional archaeological surveys of prehistoric cultural resources have been conducted within the Castle Creek KGRA, most of them focusing on the Snake River portions of the area. In 1958, Donald R. Tuohy, under the auspices of Idaho State University Museum, conducted a reconnaissance of the proposed Guffey-Swan Falls Reservoir.^{49,50} Idaho State University Museum archaeologists recorded more sites in 1959 and 1961;⁵¹ in 1971 there was a much more extensive reconnaissance of the proposed reservoir area.⁵² Sharon Metzler⁵³ surveyed upper portions of Brown Creek in 1975 and in 1976 recorded prehistoric sites within the KGRA as part of the long-range Owyhee Project. In addition, U.S. Bureau of Land Management archaeologists have noted several historic and prehistoric sites within the Castle Creek unit.⁵⁴ Unfortunately, no sites have been well described yet within the KGRA, and none has been excavated to provide some idea of temporal depth.

At present 46 archaeological sites within the Castle Creek KGRA (50 if several of the continuous distributions of cultural material are divided into separate units; Table 29) have been recorded with the Idaho Archaeological Survey. An estimated 2% of the study unit has been surveyed, and even those existing records are minimal (site locations are provided, but practically nothing in the way of site descriptions). Of these 46 sites, two are historic, one has both historic and prehistoric components, and the rest are prehistoric. Of

TABLE 29. KNOWN HERITAGE RESOURCE SITES IN CASTLE CREEK KGRA

Site Number ^a	Legal description ^b	General description	Reference ^c
AA-1	T3S, R2E	Small prehistoric campsite	
AA-23	T3S, R1E	Small prehistoric campsite	
AA-24	T3S, R1E	Small prehistoric campsite	KK71
AA-25	T3S, R1E	Shoshone housepit village	KK71
AA-26, 27	T3S, R1E	Small prehistoric campsites	KK71
AA-28-30	T3S, R1E	Continuous prehistoric campsite	KK71
AA-31-33	T3S, R1E	Small prehistoric campsites	KK71
AA-34-36	T3S, R1E	Small prehistoric campsites	KK71
AA-59	T3S, R1E	Small prehistoric campsite	
AA-60	T3S, R1E	Small prehistoric campsite	KK71
EL-77	T4S, R2E	Substantial prehistoric village	
EL-78	T4S, R3E	Substantial prehistoric village	
EL-79	T4S, R2E	Small prehistoric campsite	
EL-80	T4S, R2E	Rockshelter	
OE-23, 24	T3S, R1E	Small prehistoric campsites	
OE-25	T3S, R1E	Prehistoric housepit	
OE-26-29	T3S, R1E	Small prehistoric campsites	
OE-30	T3S, R1E	Substantial prehistoric occupation	
OE-38	T4S, R1E	Rockshelter with deep midden	
OE-39	T3S, R2E	Small prehistoric campsite	
OE-257	T3S, R1E	Rockshelter, possible hearth	
OE-258	T3S, R1E	Historic buildings, prehistoric campsite	
OE-259-261	T4S, R1E	Continuous prehistoric campsite	KK71
OE-263-265	T4S, R2E	Small prehistoric campsites	KK71
OE-266	T4S, R2E	Small prehistoric campsite	KK71
OE-267	T4S, R2E	Extensive prehistoric campsite	
OE-268	T4S, R2E	Small prehistoric campsite	
OE-269	T4S, R2E	Small prehistoric campsite	
OE-1004	T4S, R1E	Prehistoric quarry, workshop	
OE-1005	T4S, R1E	Small prehistoric campsite	
OE-1006	T4S, R1E	Prehistoric quarry, campsite	
OE-1007	T4S, R1E	Small prehistoric campsite	
OE-1133	T4S, R1E	Prehistoric quarry, workshop	
OE-1385	T4S, R1E	Historic homestead	
OE-1455	T5S, R2E	Historic homestead	
19135	T4S, R2E	Paleontological site, only one with certain new Pliopholys species	A65:188, 195

TABLE 29. (continued)

Site Number ^a	Legal description ^b	General description	Reference ^c
19136	T4S, R1E	Paleontological site with new <u>Pliophylox</u> , <u>Sphaerium</u> , <u>Thiaridae</u> , <u>Hydrobiidae</u> species	A65:189
19137	T5S, R1E	Paleontological site with new <u>Pliophylox</u> and <u>Thiaridae</u> species	A65:189
19138	T5S, R1E	Paleontological site with new <u>Sphaerium</u> , <u>Pliophylox</u> , <u>Thiaridae</u> species	A65:189
19139	T5S, R1E	Paleontological site with new <u>Pliophylox</u> species	A65:189
19140	T5S, R1E	Paleontological site with new <u>Sphaerium</u> , <u>Pliophylox</u> , and <u>Thiaridae</u> species; this is the reference site for <u>Anodonta</u> and <u>Oxytrema taylori</u> (Gabb)	A65:189
19188	T5S, R2E	Paleontological site	A65:190
19923	T5S, R2E	Paleontological site with new <u>Pliophylox</u> species	A65:190
19925	T4S, R2E	Paleontological site with new <u>Sphaerium</u> , <u>Pliophylox</u> , <u>Thiaridae</u> species	A65:191

- a. Archaeological sites are registered in the Idaho Archaeological Survey, Office of the Idaho State Archaeologist, using the Smithsonian Institution system. Thus, all sites have a trinomial designation for state-county-sequence of registration within county, and Idaho is designated as state 10 within the Smithsonian inventory. For brevity in this table the first segment of the site number has been removed, for example, Site 10-AA-1 (Idaho, Ada County, first site to be registered within the county) is here noted as AA-1. AA is Ada County, EL is Elmore County, OE is Owyhee County, and VY is Valley County. In contrast, paleontological sites have a sequential numerical locality designation.
- b. More specific legal descriptions of these archaeological sites are available on a need to know basis from the Office of the Idaho State Archaeologist, Boise. These are withheld from public disclosure in accordance with 90 Stat. 1942.
- c. A65 is Anderson (1965); KK71 is Keeler and Koko (1971); PH73 is Pavesic and Hill (1973).

the prehistoric sites, three are apparently villages with or without obvious housepits; one is a single housepit; three are quarries, associated with a workshop or camp; four are substantial campsites (the labels are from the site reports; there is no differentiation of large village versus large campsite); three are rockshelters, one with an apparently deep midden; and 30 are small lithic scatters or campsites. Of the 46 sites, all but eight are down in the Snake River canyon; most of them cluster around Big Foot Bar. No statement of temporal depth of these KGRA sites can be made on the basis of the recorded descriptions on file in the Office of the Idaho State Archaeologist or the published comments^{49,51} other than that there certainly are late period Shoshonean materials present in the Big Foot Bar area. Additional information on archaeological sites within the KGRA, unavailable for this report, is on file at the Boise District BLM Office.

Even after 20 years of archaeological research in the Castle Creek KGRA, the area remains relatively unknown territory. Some archaeological reconnaissance has been conducted recently along the Snake River valley from Jackass Butte up to and beyond Grand View by Kelly, Murphey⁵⁵ but that report is not yet available. Catherine Creek, Castle Creek, Garbutt Wash, Birch Creek, Vinson, Jensen Wash, and Shoofly Creek valleys especially need attention. Metzler⁵³ has worked in the upper Brown and Castle Creek drainages but has spent little time within the KGRA. Anderson⁴⁶ in his report on the geology of the Oreana quad, which includes the southwestern segment of the Castle Creek KGRA, notes the presence of medium grey or black vitrophyre within the Tertiary silicic volcanics that outcrop about 7 to 8 km southwest of the KGRA; he also comments that the ash beds of the lower member of the Brown Creek Formation (that outcrops in the same area as the Tertiary volcanics) include dense opalized concretions.⁴⁶ One cannot judge without actually examining sample specimens of these materials, but vitrophyre and opalite are common prehistoric tool stones. Anderson's comments suggest that the Castle Creek area might be rich in workable stone and hence have a high frequency of quarry or workshop sites, and Metzler⁵³ records ten of

these in the upper Brown Creek drainage. Site 10-OE-1133, one of the few recorded prehistoric sites up away from the Snake River (and in the general vicinity of Anderson's Tertiary and Brown Creek outcrops) is described as having a "large, moderately dense...(distribution of) obsidian and ignimbrite (that is, vitrophytre) flakes".⁵⁴ A similar site (10-OE-1006) lies within one-half km of Site 1133. In addition to these lithic resource sites, the abundance of plant and animal resources within the Castle Creek unit and the identification even with minimal survey of large villages down in the Snake River Canyon suggest that a rich prehistoric data base is present within the KGRA. Swanson's⁵⁰ estimate of 20 to 25 sites per Snake River mile downstream of the mouth of Castle Creek (Figure 28) is a clear statement of the need for more survey in the KGRA as a first planning step.

Sites in the general southwestern Idaho area have tools of various ages exhibited in their surface collections, with a full range of projectile point styles representing at least 10,000 years of occupation (see Swanson, Powers, and Bryan, Figures 1-4⁵¹; compare with Tuohy, Pl. 22⁵⁶ Metzler⁵³; and Plew⁵⁷). Without extensive surface site description or excavations except for tests and small salvage projects^{58,59,60,61} it is difficult to postulate a model of cultural variability for the Castle Creek area within which future inventory and research could operate. However, Swanson^{50,62} has suggested that a South Hills Culture was extant in the western Snake River Plain (including the Castle Creek area) during prehistoric time, and this model will merit attention by any future archaeologists working in the KGRA. Briefly, Swanson has suggested that the plateau and bench lands between the Owyhee Uplands and the Snake River Canyon were most heavily exploited during the late Pleistocene; that the Canyon itself was probably not used extensively as a habitation zone until 3000 years ago; that from 8000 years ago to the present there has been continuity of a South Hills cultural tradition in the canyon-plateau-uplands region; that this tradition probably represents Northern Paiute; and that about 1300 A.D. there was a major movement of Plateau peoples into southwestern Idaho. Pavesic⁶³ disagrees with several

Figure 28. Predicted prehistoric archaeological site density in the Swan Falls area.

aspects of the Swanson model, particularly with interpretation of Plateau population movements. The Castle Creek KGRA, with its inclusion of canyonlands, plateau or bench lands, and major stream valleys leading into the Owyhee Uplands, has high potential for producing archaeological data relevant to investigation of the Swanson or Pavesic models of local prehistoric cultural developments and adaptations.

It should be noted that ethnographically the Castle Creek KGRA was probably occupied by the Brunean Shoshoni, with some mixed groups of Northern Shoshoni and Paiute.^{64,65,66,67,68,69} Anadromous fish in the Snake River and lower reaches of the "navigable" streams provided a major resource exploited seasonally by all groups, as did the apparently plentiful tool stone resources and the game populations of the uplands. No clear model of seasonal exploitation has been developed for this area specifically, nor are there demographic models other than comments about small group size (though see Harris⁶⁵ comment on seasonal ceremonies that bring 100 to 400 people together). Almost every bit of retrievable archaeological data have high value in supporting explanations of both prehistoric and ethnographic human settlement and subsistence systems followed in the Castle Creek area.

Historic Resources. Euroamericans have been travelling through the Castle Creek KGRA since the early nineteenth century; Ramsey, Crooks and Stuart⁷⁰ were through there in 1811 and 1812, respectively, as was Peter Skene Ogden in the 1820s^{71,72} (Figure 29). The journals of these travelers provide little description specific to the Castle Creek KGRA. However, Stuart⁷⁰ probably was camped on Henderson Flat in the northern section of the KGRA in August 19, 1812, when he noted, "In the vicinity of our Camp is a Lodge of Shoshonies so miserably poor they could not furnish us even with a fish." He also apparently spent the next night within the KGRA, approximately 2 km northeast of Grand View⁷⁰ but has no further descriptive comments about the area.

Figure 29a. Peter Skene Ogden's routes across southern Idaho; 1824 to 1825 (straight line) and 1825 to 1826 (dashed line).

Figure 29b. Peter Skene Ogden's route across southern Idaho from 1827 to 1828.

The major identified historic feature within the KGRA is the alternate South Route of the Oregon Trail.^{73,74} However, first homesteading in Castle Creek is correlative with the 1862 mining developments in the Owyhees; by 1867, there were already well-established ranches in the KGRA.⁷⁵ Early survey plats for that area⁷⁶ locate cabins or structures there in 1868, 1870, 1895 and 1905; the fact that the area was surveyed as early as the 1860s indicates a demand for property designation and a fairly significant population there. This survey was probably a function of the Snake River ferries that allowed fairly easy movement through the area, as between the mines in the Owyhees and those in the Boise Basin to the north. Grand View⁷⁷ and Clark's⁷⁸ ferries were both operating within the KGRA then. Placer mine tailings are present on Big Foot Bar⁷⁹ within the KGRA and in other localities both up and down the Snake canyon but have not been reliably dated. In any event, even though to date there has been minimal surveying of the historic archaeological and architectural resources within the Castle Creek KGRA (see Table 29 for identification of three such sites), there is good potential for over a century of materials to be remnant in the area. Thus, field survey should be the first step in any development planning in the Castle Creek area.

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APPENDIX A

SNAKE RIVER BASIN OVERVIEW
REPORTS AND SUPPORTING DOCUMENTS

SNAKE RIVER BASIN OVERVIEW
REPORTS AND SUPPORTING DOCUMENTS

The reports which have been prepared as part of the Snake River Basin environmental program are listed below. Copies of these reports are available from the editors at EG&G Idaho, Inc., Box 1625, Idaho Falls, Idaho 83401.

- EGG-2001 The Potential use of Geothermal Resources in the Snake River Basin: An Environmental Overview, S.G. Spencer, B. F. Russell, and J. F. Sullivan, editors.
- EGG-GTH-5001 Vulcan Hot Springs KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors.
- EGG-GTH-5002 Crane Creek KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors.
- EGG-GTH-5003 Castle Creek KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors
- EGG-GTH-5004 Bruneau KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors.
- EGG-GTH-5005 Mountain Home KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors.
- EGG-GTH-5006 Raft River KGRA: An Environmental Analysis, S. G. Spencer and B. F. Russell, editors.
- EGG-GTH-5007 Geothermal Development in Southwest Idaho: The Socioeconomic Data Base, W. C. Lewis, Lewis and Associates.
- PG-G-79-001 KGRA Comprehensive Completion Report: Seismicity, J. K. Applegate, GeoTechniques.

- PG-G-79-002 KGRA Comprehensive Completion Report: Subsidence, J. K. Applegate, GeoTechniques.
- PG-G-79-003 Snake River Basin KGRA Environmental report: Soils, N. Savage, Idaho Water Resources Research Institute.
- PG-G-79-004 KGRA Comprehensive Completion Report: Air Quality, E. Bentley, GeoTechniques.
- PG-G-79-005 KGRA Comprehensive Completion Report: Meteorology, M. Delisio, GeoTechniques.
- PG-G-79-006 Heritage Resources and Known Geothermal Resource Areas in Idaho: A Preliminary Review, R. Knudson and M. Pfaff, Idaho Water Resources Research Institute.
- PG-G-79-007 Assessment of Hydrology and Water Quality Data of the KGRAs of the Snake River Basin, C. L. Miller and C. C. Warnick, Idaho Water Resources Research Institute.
- PG-G-79-008 Literature Review and Assessment of Terrestrial Ecological Data for Selected KGRAs in the Snake River Plain, Idaho, C. D. Jorgensen and R. L. Johnson, Brigham Young University.
- PG-G-79-009 KGRA Comprehensive Completion Report: Geology, R. Hardyman, GeoTechniques.
- PG-G-79-010 Aquatics of Five Snake River Basin KGRAs, K. P. McCarthy and J. F. Sullivan, EG&G Idaho, Inc.
- PG-G-79-011 A Summary of the Assessments of Geothermal Resource Use Limitations of Bruneau, Castle Creek, Crane Creek, Mountain Home, and Vulcan Hot Springs KGRAs, B. Moore, N. Savage, J. S. Gladwell, and C. C. Warnick, Idaho Water Resources Research Institute.

APPENDIX B

**SOIL MAPPING UNITS AND
SOIL DESCRIPTIONS
FOR CASTLE CREEK KGRAs**

APPENDIX B

CASTLE CREEK KGRA SOIL MAPPING UNITS AND SOIL DESCRIPTIONS A-1

The separations on the general soil map are identified by letters or by a combination of letters and numbers such as A1, B1, B2, C1, etc. These symbols represent soil mapping units consisting of a group of identified soils. These maps are of little value unless the soils they represent are described. The following sections on soil mapping units and soil descriptions will discuss the soil characteristics important for interpretation of the individual soil for irrigation.

SOIL MAPPING UNITS OF A

- A1 621-281a-281b-909d Mapping Unit: Deep, well-drained soils on nearly level to sloping lacustrine sediments on lake terraces, terrace escarpments, and mixed alluvium on alluvial fans.
- A2 281a-909b-909a Mapping Unit: Deep, well-drained solid on nearly level to sloping lacustrine sediments on dissected lake terraces and mixed alluvium on alluvial fans.
- A3 034-281a Mapping Unit: Very shallow and deep, well drained soils on nearly level to very steep lacustrine sediments in Badlands and mixed alluvium on alluvial fans.
- A4 909d-909b Mapping Unit: Moderately deep, well-drained soils on steep and very steep lacustrine sediments on dissected lake terraces, terrace escarpments, and mixed alluvium on alluvial fans.
- A5 034-909d Mapping Unit: Very shallow and moderately deep, well-drained soils on very steep dissected lacustrine sediments in Badlands and on terrace escarpments.

- A6 909b-909d-599b Mapping Unit: Moderately deep and deep, well-drained soils on gently sloping to very steep lacustrine sediments on dissected lake terraces and terrace escarpments.
- A7 909d-752 Mapping Unit: Moderately deep and very shallow soils on very steep lacustrine sediments on terrace escarpments and in Canyon Rockland.

The major soils in these mapping units are developing in lacustrine sediments on lake terraces, terrace escarpments, and in mixed alluvium on alluvial fans interspersed with Badlands and some Rockland. They occur on nearly level to very steep slopes.

The major soils occur in seven different combinations of mapping units based on kinds of soils and percent composition. These soils are developing in essentially the same kind of parent materials derived from/or in the Payette Formation and related strata.

The mean annual precipitation is estimated to be about 150 to 230 mm. The mean annual soil temperature is about 9 to 11°C. The frost-free period is more than 120 days. The elevations range from about 650 to 1400 m.

The soils are deep, moderately deep, shallow, very shallow, and are well-drained. The surface textures among the subunits of these mapping units are dominated by silt loam and gravelly loam with miscellaneous land type Badlands that are also silty. Some minor areas include fine sand loam and Rockland. These soils are generally calcareous at or near the surface. The underlying materials are stratified lacustrine sediments ranging from gravelly materials to loamy and silty sediments with some strata high in sodium salts and high concentrations of calcium carbonate. The slopes are variable, ranging from long, uniform nearly level alluvial fans and lake terraces to short, complex, very steep slopes of the terrace escarpments and highly dissected lacustrine sediments of the Badlands.

SOIL MAPPING UNITS OF B

- B1 599a Mapping Unit: Deep, well-drained soils on nearly level to very gently sloping mixed alluvium on alluvial fans, pediments, and stream terraces.
- B2 599a-529a-599b Mapping Unit: Deep and moderately deep, well-drained soils, on nearly level to sloping mixed alluvium on alluvial fans, lake terraces, pediments, and stream bottoms.
- B3 599a-1001 Mapping Unit: Deep, well-drained soils on nearly level mixed alluvium on alluvial fans and stream terraces.
- B4 296-599c-599d Mapping Unit: Moderately deep and deep, well-drained soils on gently sloping to steep, mixed alluvium on hills, alluvial fans, pediments, and stream terraces.
- B5 599b-357-752 Mapping Unit: Deep, shallow and very shallow, well-drained soils on gently sloping to very steep residuum on rhyolitic hills, and mixed alluvium on alluvial fans.
- B6 699a-599a-599b Mapping Unit: Shallow and deep well-drained soils on nearly level to sloping mixed alluvium on pediments and alluvial fans on lake terraces.
- B7 599b-699a Mapping Unit: Deep and shallow, well-drained soils on nearly level to sloping mixed alluvium on alluvial fans, and pediments on stream terraces.
- B8 599a-002-040 Mapping Unit: Deep, well-drained soils on nearly level to very gently sloping mixed alluvium on stream bottoms and alluvial fans.
- B9 476-599f-599e Mapping Unit: Deep, well-drained soils on nearly level to sloping mixed alluvium on alluvial fans and pediments on lake terraces.

The major soils in these mapping units are developing in mixed alluvium alluvial on fans and pediments on lake and stream terraces and on stream bottoms. They occur on nearly level to sloping landforms.

The major soils occur in nine different combinations of mapping units based on kinds of soils and percent composition. These soils are developing in essentially the same kind of parent material derived from the Payette Formation and related strata mixed with basaltic and rhyolitic alluvial materials from the adjacent hills and mountains. Some of the sediments have scattered areas of Rockland and residuum in rhyolitic mountains.

Annual precipitation is estimated to be about 150 to 230 mm. Annual temperature is about 9 to 11°C. The frost-free period is more than 120 days. The elevations range from about 700 to 1400 m.

The soils are deep, moderately deep, shallow, very shallow, and well-drained. The surface textures are dominated by gravelly loam, loam, fine sandy loam, and channery loam. Minor areas among the subunits include loamy sand, silt loam, very stony loam, and sandy loam. These soils are generally calcareous at or near the surface and one soil has a lime-silica hardpan. The underlying materials are stratified stream alluvium, lacustrine sediments or rhyolitic bedrock in some areas. The slopes are variable with the largest portion being rather broad, long, and nearly level to very gently sloping; the remaining areas are rather narrow, short to long, and sloping to steep terraces and terrace escarpments.

SOIL MAPPING UNITS OF C

- C1 1002a-1002b Mapping Unit: Moderately deep, well-drained soils on nearly level to sloping lacustrine sediments on lake terraces.
- C2 350c-529c Mapping Unit: Moderately deep, well-drained soils on nearly level to very gently sloping mixed alluvium on stream terraces.
- C3 350c-350b Mapping Unit: Moderately deep, well-drained soils on nearly level to sloping mixed alluvium on stream terraces.

C4 281a-350c Mapping Unit: Deep and moderately deep, well-drained soils on nearly level to sloping mixed alluvium on alluvial fans and stream terraces.

The major soils in these mapping units are developing in mixed sandy or silty alluvium on stream terraces and alluvial fans. They occur on nearly level to sloping landforms.

The major soils occur in four different combinations of mapping units based on kinds of soils and percent of composition. These soils are developing in essentially the same kind of parent material derived from the Payette Formation and related strata.

The mean annual precipitation is estimated to be about 180 to 230 mm. The mean annual soil temperature is estimated to be about 9 to 11°C. The elevations range from about 750 to 1100 m.

The soils are moderately deep, deep, and well-drained. The surface textures are dominated by gravelly sandy loam, loam, and silt loam. Minor areas within the subunits include sand and sandy loam. These soils are calcareous at or near the surface. The underlying materials are stratified sand and gravel, loamy material, and lacustrine sediments. The slopes are narrow and long.

SOIL MAPPING UNITS D

D1 040 Mapping Unit: Deep, somewhat poorly drained soils on nearly level to very gently sloping, mixed alluvium on stream bottoms.

D2 083a-083b-281a Mapping Unit: Deep, somewhat poorly, and poorly drained soils on nearly level to very gently sloping, mixed alluvium on stream bottoms and alluvial fans.

D3 082-083b Mapping Unit: Deep, very poorly and somewhat poorly drained alkaline soils on nearly level to very gently sloping mixed alluvium on stream bottoms.

- D4 281a Mapping Unit: Deep, somewhat poorly drained soils on nearly level to very gently sloping mixed alluvium on alluvial fans.
- D5 281a-281b-909d Mapping Unit: Deep and moderately deep, somewhat poorly drained and well-drained soils on nearly level to very steep mixed alluvium on alluvial fans and on terrace escarpments.

The major soil in these mapping units are developing in mixed alluvium and lacustrine sediments on stream bottoms, alluvial fans and terrace escarpments. They generally occur on nearly level to very gently sloping landforms with some very steep areas.

The major soils occur in five different combinations of mapping units based on kinds of soils and percent of composition. These soils are developing in alluvium essentially from the same kind of parent material derived from or in the Payette Formation and related strata.

The mean annual precipitation is estimated to be about 150 to 230 mm. The mean annual soil temperature is about 9 to 11°C. The frost-free period is more than 120 days. The elevations range from about 650 to 900 m.

The soils are generally deep with few areas that are moderately deep or shallow. The surface textures are dominated by silt loam and loam. There are minor areas among the subunits that include fine sandy loam, cobbly sandy loam and silty clay loam. These soils are generally calcareous at or near the surface except for some of the sandy soils with drainage problems that may be noncalcareous. The underlying materials are generally stratified sandy or loamy that may or may not be gravelly or cobbly. Alkaline or saline-alkaline areas are associated with somewhat poorly and poorly drained conditions where natural or induced water tables prevail. The soils are generally nearly level to very gently sloping with few areas that are sloping to very steep.

SOIL MAPPING UNITS OF E

- E1 890a Mapping Unit: Deep, well-drained soils on nearly level to very gently sloping mixed sandy alluvium on stream terraces.

- E2 890a-890b-257a Mapping Unit: Deep, well-drained and excessively drained soils on nearly level to sloping mixed sandy alluvium on stream terraces.
- E3 890a-281a Mapping Unit: Deep, well-drained soils on nearly level to very gently sloping mixed sandy alluvium on stream terraces and alluvial fans.
- E4 704a-134b Mapping Unit: Deep and moderately deep, excessively drained and well-drained soils on nearly level to steep sand dunes and mixed sandy alluvium on stream terraces and alluvial fans.
- E5 704a-890a-257b Mapping Unit: Deep, excessively drained and well-drained soils on nearly level to steep sand dunes and mixed sandy alluvium on stream terraces.
- E6 257c-890a Mapping Unit: Deep, excessively drained and well-drained soils on nearly level to very steep mixed sandy alluvium on stream terraces.
- E7 886-389-704a Mapping Unit: Moderately deep and deep, well-drained and excessively drained soils on nearly level to steep eolian sand on stream and lake terraces and in sand dunes.

The major soils in these mapping units are developing in mixed sandy alluvium or in sand dunes on stream terraces, lake terraces, and alluvial fans. They occur on nearly level to very steep landforms.

The major soils occur in seven different combinations of mapping units. These soils are developing in alluvial deposits of essentially the same kind of parent materials derived from or in the Payette Formation and related strata.

The mean annual precipitation is estimated to be about 150 to 230 mm. The mean annual soil temperature is about 9 to 11°C. The frost-free period is more than 120 days. The elevations range from about 650 to 900 m.

The soils are generally deep and excessively drained to well-drained. Some areas are deep to hardpan. The surface textures are dominated by fine

sandy loam, loamy fine sand, sandy loam, loamy sand and sand. Only minor areas include silt loam. Most of these soils are calcareous at or near the surface. Others are strongly calcareous in the subsoil and may have a lime-silica hardpan. The underlying materials are either eolian sand or stratified sand and gravel. The slopes vary from short and narrow to broad and long, nearly level stream terraces and alluvial fans to sand hummocks and sand dunes.

SOIL MAPPING UNITS OF R

- R1 752-1026 Mapping Unit: Rockland, rough broken and stony canyon land, and escarpments.
- R2 752-357 Mapping Unit: Rockland and shallow, well-drained soils on very steep rhyolitic mountains and canyons.
- R3 752-127 Mapping Unit: Rockland and shallow, well-drained soils on very steep granitic mountains and canyons.

These miscellaneous land types and soils consist of Rockland (basaltic and rhyolitic), rough broken and stony canyon land and escarpments of the rhyolitic and granitic mountains and canyons. These landforms are generally very steep and are scattered throughout the county.

The miscellaneous land types and soils occur in three different combinations of kinds of landforms, parent materials, and soils. They are mixed geologically with granitic materials at the highest elevations, and with basaltic and rhyolitic materials in the bottoms of canyons of the basalt areas. Many of these canyons represent fault lines and degradation by stream action.

The climatic conditions in these landforms are widely variable, ranging from 200 mm precipitation in canyons at about 900 m to over 500 mm on rock escarpments at 2100 m. Air temperatures are also widely variable depending on depth of canyon and elevation, but are estimated to range from 4 to 10°C.

Frost-free period is estimated to range from 85 to over 120 days. These canyons range from 15 to 280 m feet deep and effectively isolate many areas across the southern part of the county.

REFERENCE

- A-1 J. C. Chugg, G. A. Moore, et al., Special Soil Survey - Owyhee County,
Idaho, Idaho Water Resource Board Report No. 15, 1968.

APPENDIX C

PROPOSED FEDERAL STATUS
OF THREATENED PLANT SPECIES

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PROPOSED FEDERAL STATUS OF THREATENED PLANT SPECIES

APIACEAE (Umbeliferae)

Erigeron Latus

Location: Idaho: Owyhee County
Oregon: Crook, Jefferson, Wasco, and Wheeler counties
Washington: Spokane County

Land Ownership: Bureau of Land Management (BLM).

Vegetation Type: Sagebrush/grass.

Habitat: Fairly good, not clayey, soil at about 1500 m on ridge tops.

Hazards: Range improvement programs.

Herbarium Data: Number of sites by county: Idaho-Owhyee-1
Number of collections in herbaria searched: BOIS-0, BS-0, CIC-2, ID-1, IDF-0, INT-1.

Remarks: The Owyhee County population may not be Lomatium hender-sonii, and probably is a rare, endangered and endemic species of Lomatium. It is being studied now. Apparently there is only one site known for the Idaho population, but the area is poorly collected. There is another collection reported from western Idaho, probably in the Adams-Washington county area, but it has not been seen by the compiler.

Recommendations: Wait until Bert Brehm finishes his study of the Idaho population and recommend for endangered list if it is a new species. In the meantime, retain on threatened list.

References: Mathias 1938.

Compiler: Packard.

ASTERACEAE (Compositae)

Artemisia papposa

- Location: Idaho: Blaine, Camas, Elmore, Gooding, Lincoln and Owyhee Counties.
Oregon: Malheur County.
- Land Ownership: BLM, private and possibly Idaho Department of Lands.
- Vegetation Type: Artemisia tridentata - A. arbuscula mosaics or Junipenis occidentalis/Artemisia tridentata.
- Habitat: Grows with or replaces A. arbuscula in shallow, stony, clayey, often alkaline soil that receives drainage from surrounding areas, 1350 to 1800 m.
- Hazards: Grazed by sheep. Range improvement programs.
- Herbarium Data: Number of sites by county: Idaho-Blaine-1, Camas-3, Elmore-2, Gooding-1, Lincoln-1, Owyhee-3.
Number of collections in herbaria searched: BOIS-1, CIC-2, ID-5, IDF-3, UTC-1, WS-3, WTU-1.
- Remarks: This plant has a fairly broad range but a highly discontinuous distribution. It is abundant in one area on the north end of its range but rare and apparently decreasing in Owyhee County (Eidemiller 1976). It is confined to one habitat, making it vulnerable to anything affecting that habitat.
- Recommendations: Retain as threatened until we know more about its ecology.
- References: Eidemiller, 1976
Steele 1975
- Compiler: Packard.

FABACEAE (Leguminosae)

Astragalus sterilis

- Location: Idaho. Owyhee County.
Oregon: Malheur County.
- Land Ownership: BLM, possibly private and Idaho Department of Lands.
- Vegetation Type: Artemisia tridentata/Poa sandbergii and shrubby chenopods.
- Habitat: Bare clay soil.
- Hazards: Recreationists with off-road vehicles.

Herbarium Data: Number of sites by county: Idaho-Owyhee-1 (Barneby 1964).
Number of collections in herbaria searched: BOIS-0, BS-0,
CIC-0, CIC-0, ID-0, IDF-0.

Remarks: Barneby collected this species on the western border of Owyhee County but apparently it has not been collected there since. It is very rare in Owyhee County, and it has a discontinuous distribution in adjacent Malheur County, Oregon. The species has a range of about 50 times 25 km but is quite infrequent even there.

Recommendations: Retain as endangered.

References: Barneby 1964.

Compiler: Packard.

FABACEAE (Leguminosac)

Astragalus pushii
var. ophiogenes

Location: Idaho: Blaine, Camas, Elmore, Gooding, Lincoln and Owyhee counties.
Oregon: Malheur County.

Land Ownership: BLM, private and possibly Idaho Department of Lands.

Vegetation Type: Artemisia tridentata/Poa sandbergii.

Habitat: Eroded, dry rocky or sandy river terraces and bluffs or dunes 750 to 1200 m.

Hazards. Range improvement programs.

Herbarium Data: Number of sites by county: Idaho-Blaine-1, Camas-1, Canyon-1, Elmore-3, Gooding-1, Lincoln-1, Owyhee-3 (Barneby 1964).
Number of collections in herbaria searched: BOIS-0, CIC-5, ID-2, IDF-0, WS-2.

Remarks: This variety has a fairly wide range and is probably of fair abundance in that range. There are four to five forms of A. purshii in this area and only three varietal names available for use which leads to filing herbarium material without varietal identification. Also, since one of the key differences is flower color which fades on drying, one soon learns to leave them all in the field. These situations may account for the sparsity of herbarium data.

Recommendations: One season of collecting should be adequate for this variety, if possible, Barneby should verify the identifications. Herbaria should be reviewed for unlabeled varieties. This variety is probably neither threatened nor endangered in spite of the scarcity of herbarium material.

References: Eidemiller 1976.
Barneby 1964.

Compiler: Packard.

ASTERACEAE (Compositae)

Erigeron latus

Location: Idaho: Owyhee, possibly Cassia and Twin Falls Counties
Idaho Endemic.

Land Ownership: BLM, possibly private and Idaho Department of Lands.

Vegetation Type: Juniperus occidentalis/Artemisia tridentata.

Habitat: Rocky soil derived from lava.

Hazards: Range improvement programs.

Herbarium Data: Number of sites by county: Idaho-Cassia-1, Owyhee-3, Twin Falls-1. Number of collections in herbaria searched: BOIs-0, CIC-1, ID-2, IDF-0, RENO-1, UTC-1, WS-3.

Remarks: This has been collected twice for certain. The material deposited at CIC was poorly preserved and although it has the characteristics of the species, identification is uncertain. Some herbaria have a collection of Erigeron from Blaine County. This is not E. latus. The collections for Cassia and Twin Falls counties have not been verified, but these locations are in keeping with the presently known habitat and range.

Recommendations: Retain as endangered until the material from Cassia and Twin Falls counties is verified. If its range is of that extent, it should be reduced to threatened status.

References: Cronquist 1947.

Compiler: Packard.

BRASSICACEAE (Cruciferae)

Drava douglasii

- Location: Idaho: Ada, Cassia, Custer, Elmore, Gooding and Owyhee Counties.
Oregon: Baker, Grant, Harney, Lane, Malheur and Union Counties.
Nevada: Clark, Elko, Humboldt, Lauder, Ormsby, Storey Washoe and White Pine Counties.
California: Mendocino, Modoc, Plumas and San Bernardino Counties.
Washington: Klickitat County.
- Land Ownership: BLM, private and probably Idaho Department of Lands.
- Vegetation Type: Artemisia tridentata/Poa sandbergii.
- Habitat: Dry, bare spots where there is little competition from other plants. Soil type may vary from sand to clay, 1200 to 3300 m.
- Hazards: Range improvement programs.
- Herbarium Data: Number of sites by county: Idaho - Ada-1, Cassia-1, Custer-1, Elmore-1, Gooding-1, Owyhee-3.
Number of collections in herbaria searched: BOIS-2, CIC-5, ID-4, IDF-0, INT-1.
- Remarks: Distribution is highly discontinuous but it ranges from southern Washington to San Bernardino County, California.
- Recommendations: Remove from threatened list.
- References: Hitchcock 1941.
- Compiler: Packard.

BRASSICACEAE (Cruciferae)

Lepidium davisii

- Location: Idaho: Elmore and Owyhee counties.
Oregon: Malheur County.
- Land Ownership: BLM, possibly private and Idaho Department of Lands.
- Vegetation Type: Atriplex-Artemisia zone.

Habitat: Hard bottom playas.

Hazards: These playas are being used for race tracks, stock watering ponds, and water reservoirs. Their shape and locations make them very vulnerable to disturbance.

Herbarium Data: Number of sites by county: Idaho - Elmore-1, Owyhee-1. Number of collections in herbaria searched: BOIS-0, BS-0, CIC-2, ID-1, IDF-0.

Remarks: Only three sites are known for this plant even though it ranges from Elmore County, Idaho, to Malheur County, Oregon. The many highly destructive uses which the habitat receives makes this a very vulnerable species in spite of its range. It is doubtful that more than a few other sites will be found; these will not likely affect the endangered status of this species.

Recommendations: Retain as endangered.

References: Rollins 1948.

Compiler: Packard.

FABACEAE (Leguminosae)

Astragalus mulfordiae

Location: Idaho: Ada, Blaine, Owyhee, and Washington counties. Oregon: Malheur County.

Land Ownership: BLM, private and possibly Idaho Department of Lands.

Vegetation Type: Sagebrush/grass.

Habitat: Grows on old river deposits or in sandy places near rivers, 600 to 900 m.

Hazards: Housing developments, agriculture.

Herbarium Data: Number of sites by county: Idaho - Ada-1, Blaine-1, Owyhee-2, Washington-1. Number of collections in herbaria searched: BOIS-0, BS-0, CIC-1, ID-2, IDF-0, UTC-3.

Remarks: This plant is known from a total of six sites in Idaho and Oregon; one site is near Boise in an area being developed. It is seldom abundant where it occurs and the sites are usually very small in area.

Recommendations: Change to endangered status. It has a fairly broad range but is very infrequent.

References: Barneby 1964.

Compiler: Packard.

LOASACEAE

Mentzelia mollis

Location: Idaho: Owyhee County.
Oregon: Malheur County.

Land Ownership: BLM, private, and possibly Idaho Department of Lands.

Vegetation Type: Desert shrub.

Habitat: Volcanic ash.

Hazards: Recreationists with off-road vehicles (ORVs). Range improvement programs.

Herbarium Data: Number of sites by county: Idaho - Owyhee-3.

Number of collections in herbaria searched: BOIS-0, BS-0, CIC-6, ID-2, IDF-0.

Remarks: This plant is very abundant where it occurs, but its habitat is highly restricted and attracts ORV use. Its range is about 50 x 25 km. It has not been successfully germinated or grown in greenhouse or garden. Range improvement programs have disturbed several sites.

Recommendations: Its small range, restricted habitat and active impact of land use make this plant most vulnerable. Therefore its status should be changed to endangered.

References: Clad 1976.

Compiler: Packard.

PRIMULACEAE

Primula cusickiana

- Location: Idaho: Ada, Adams, Blaine, Boise, Camas, Custer, Elmore, Gem, Gooding, Idaho, Owyhee, Valley, and Washington counties.
Oregon: Wallowa County.
- Land Ownership: BLM, USS (Boise, Payette and Sawtooth N.F.), probably private and Idaho Department of Lands.
- Vegetation Type: Mostly in grass meadows or sagebrush/grass.
- Habitat: The more northern population grows in mountain meadows in heavy clay soil. The southern populations grow in thin, rocky soil on steep slopes of eroded lake terraces and in seeps or where it is wet in spring.
- Hazards: Many populations are subject to grazing; many more have been destroyed by agriculture and housing developments. This plant is attractive and tempting to transfer to the garden but transplants very poorly.
- Herbarium Data: Number of sites by county: Idaho - Ada-9, many since destroyed, Adams-2, Blaine-1, Boise-5, Camas-4, Custer-3, Elmore-7, Gem-1, Gooding-2, Idaho-2, Owyhee-1, Washington-2.
Number of collections in herbaria searched: BOIS-3, BS-5, CIC-18, ID-15, IDF-2, INT-9, WS-3, WTU-2.
- Remarks: Dr. Marion Ownbey once said (pers, comm.) that probably three species of Primula are represented. The Hill City population being one undescribed species, the Boise area population being the now unrecognized P. wilcoxiana, and the more northern population being the type P. cusickiana. The difference in habitat preference indicates that this might be true. If, as Ownbey indicated, this is actually three species, then the Hill City population is truly endangered and the Boise P. wilcoxiana is possibly threatened. The P. cusickiana of the Wallowa Mountains and west-central Idaho is neither endangered nor threatened.
- Recommendations: Retain on endangered list until the taxonomy of these populations has been clarified. Then remove or reduce in status any segment of the complex that does not warrant protection.

References: Eidemiller 1976.
Holmgren and Holmgren 1974.
Williams 1936.

Compiler: Packard.

SCROPHULARIACEAE

Penstemon elegantulus

Location: Idaho: Owyhee County, "overlooking Snake River Canyon in Wallowa County Oregon and adjacent Ida." (Hitchcock & Cronquist 1973).

Land Ownership: Either BLM or private, (judging from single collection in Idaho).

Vegetation Type: The area of the single Idaho specimen is Abies lasiocarpa forest mixed with Artemisia tridentata var. vaseyana shrub.

Habitat: "decaying granite hillside." "trail sides."

Hazards: Unknown - but attractive to wildflower gardeners.

Herbarium Data: Number of sites by county: Idaho-Owyhee-1 Oregon-Wallowa-2 (C. Johnson, USFS, pers. comm.). A collection from Kootenai County is in very poor shape and due to the disjunction in geography and habitat is not counted here.

Number of collections in herbaria searched: BOIS-0, BS-0, CIC-0, ID-12, IDF-0, IDS-0, WS-1.

Remarks: Our information is very poor. The Oregon population seems about as sparse as Idaho's. To be expected at intermediate points above Hell's Canyon.

Recommendations: Retain as threatened.

Compiler: Johnson.