ATTACHMENT 3

WATER RESOURCE ASSESSMENT

This attachment contains a summary of the surface water and groundwater resources of White Pine County. The summary provides information on the sources, quantity, and quality of those resources, and the committed and applied for water rights.

Climate

The general climatic conditions are summarized in Figures 1 and 2. White Pine County has a semi-arid climate and its Basin and Range topography results in a cold desert climate where seasonal shifting of the sub-tropical high is influential less than six months of the year. Interior locations are dry because of their distance from moisture sources or their location in rain shadow areas on the lee side of mountain ranges. This combination of interior location and rain shadow positioning produces the cold desert. The dryness, generally clear skies, and sparse vegetation lead to high heat loss and cool evenings.

White Pine County's average annual precipitation is nine inches, the average for the state of Nevada (which is the driest state in the nation). Precipitation is normally light at lower elevations during all months of the year and land is mainly used for range. At higher elevations, precipitation is much greater and snow accumulates to considerable depths. Much of the snow melt irrigates crops in nearby valleys. Drought is common and expected.

In a mid-latitude, dry climate, like White Pine County's, the average potential evaporation rate exceeds the average annual precipitation, with actual average evaporation ranging from 45 to 51 inches. On an annual basis, as much as 90 to 95 percent of the total annual precipitation is lost through evaporation and transpiration; only an estimated 5 to 10 percent recharges the ground water regime.

In western White Pine County, summers are hot, especially at the lower elevations and winters are cold. The length of the growing season ranges from about 100 to 120 days with the shorter season in the western part of the County. The lowest temperature on record for Ely is -30 on February 6, 1989, and the highest recorded temperature was recorded in Ely on July 5, 1988 at 100 degrees.

Surface Water Resources

Although White Pine County has no major lakes, reservoirs, or rivers, there are important surface water resources in many locations. Surface water flows are important sources of irrigation water in the agricultural areas of Huntington, Railroad, Snake, Spring, Steptoe, and White River valleys. Groundwater that discharges to the surface at springs is also an important surface water resource. Many springs in White Pine County have been developed for irrigation, livestock watering, municipal and domestic water supplies, and the mining industry. The surface water resources of White Pine County are also extensively used for recreational purposes including fishing, hunting, boating and skiing, swimming, camping, picnicking, and relaxation. Finally, but of no less importance, wildlife cannot thrive without a dependable source of water and the many springs, streams, and lakes in White Pine County support the habitat for many desirable species.

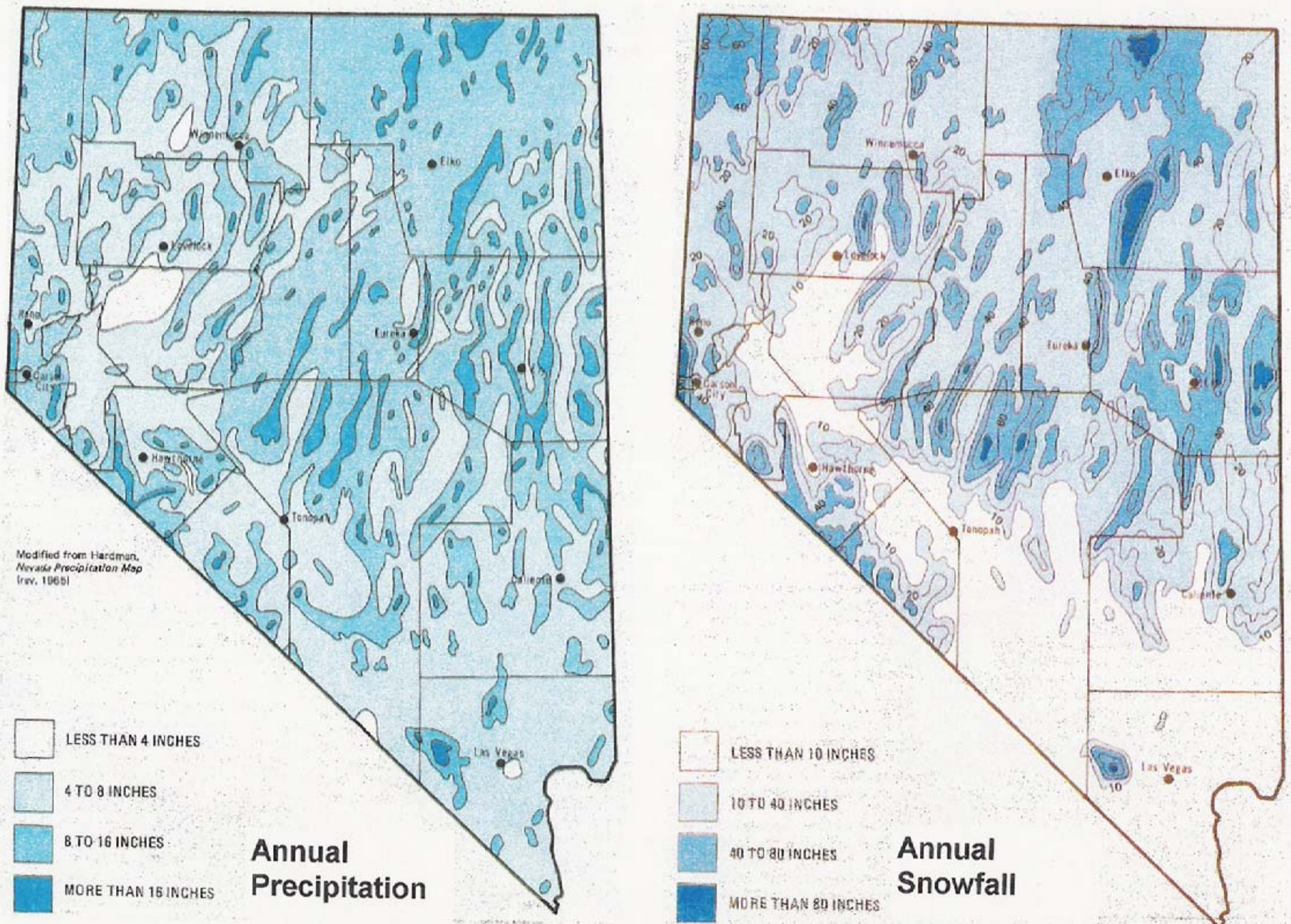
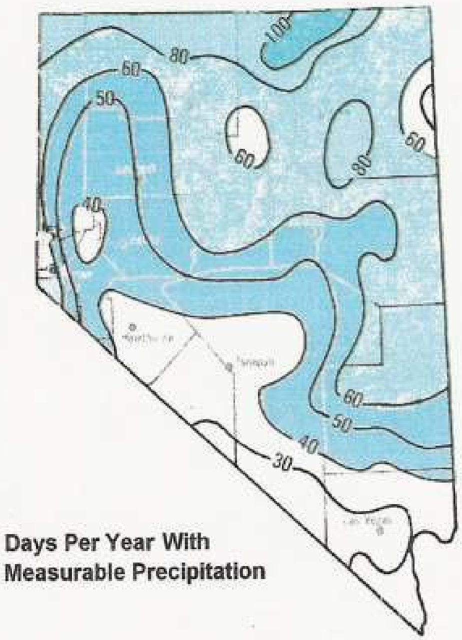
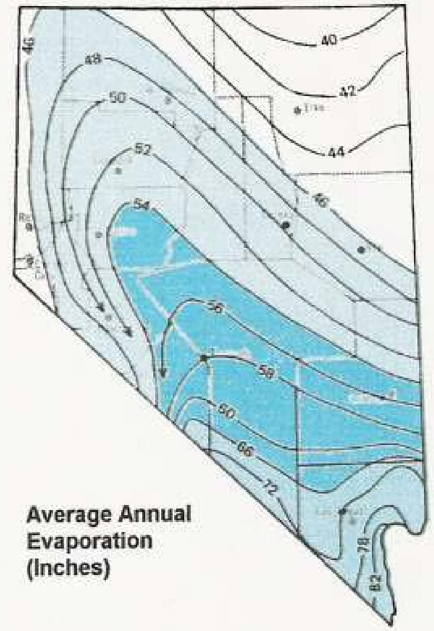


Figure 1. Statewide Annual Precipitation and Snowfall. Source: NBMG Special Publication 2, Nevada's Weather and Climate, 1975





White Pine County Climate Stations
Ely WSO Airport - Elev. 6,253 Great Basin National Park - Elev. 6,830 Lages - Elev. 5,960 Lund - Elev. 5,570 McGill - Elev. 6,300 Ruth - Elev. 6,840 Shoshone - Elev. 5,930
US Geological Survey High-Elevation Precipitation Stations in White Pine County
Cherry Creek Range - Elev. 9,700 Northwest of Mt. Moriah - Elev. 9,300 Mt. Hamilton - Elev. 10,600 Cave Mountain - 10,650 Mt. Washington - 10,440

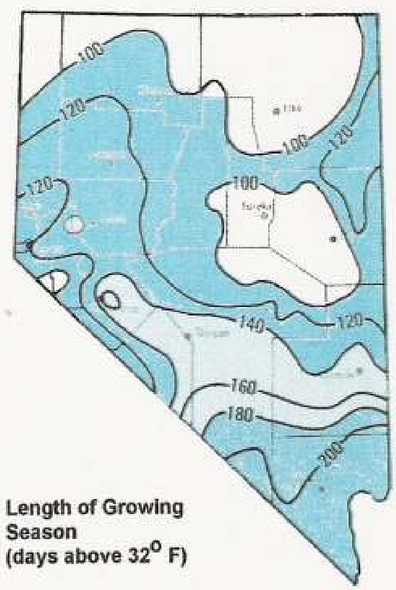


Figure 2. Statewide Precipitation Days, Evaporation, Growing Days and White Pine County Climate Stations. Sources: BMG Special Publication 2, Nevada's Weather and Climate 1975, US Geological Survey Records, and NOAA data.

All of the surface water resources (and groundwater resources as well) are derived from the precipitation that falls over the County. Figure 3 shows a conceptual representation of the interrelationships between the precipitation that falls over the mountainous areas and the surface and groundwater regimes.

Lakes - A complete inventory of all lakes and reservoirs has not been completed for White Pine County. Table 3-1 lists the 18 lakes and reservoirs which are identified in various published sources and the files of the Nevada Division of Water Resources. Ruby Lake extends across portions of both White Pine and Elko counties and is the largest lake in the region.

There are six subalpine lakes near the crest of the South Snake Range in Great Basin National Park: Baker Lake, Brown Lake, Johnson Lake, Stella Lake, Teresa Lake, and Dead Lake. These lakes, all at elevations above 9,500 feet, provide recreational water resources for Park visitors and, perhaps more importantly, water supplies for wildlife and habitat for a number of species of plants and fishes. Lakes of this type are a rarity in White Pine County (and elsewhere in Nevada) and they are especially susceptible to the inadvertent impacts of human activities. As the subalpine lakes of White Pine County are all with the boundaries of Great Basin National Park, they will be preserved in perpetuity by the National Park Service.

Streams - Although there are no major rivers in White Pine County, there are many streams that drain the upland areas. These streams derive their flow from three main sources: spring discharges, groundwater discharge along the stream channel, and snow melt.

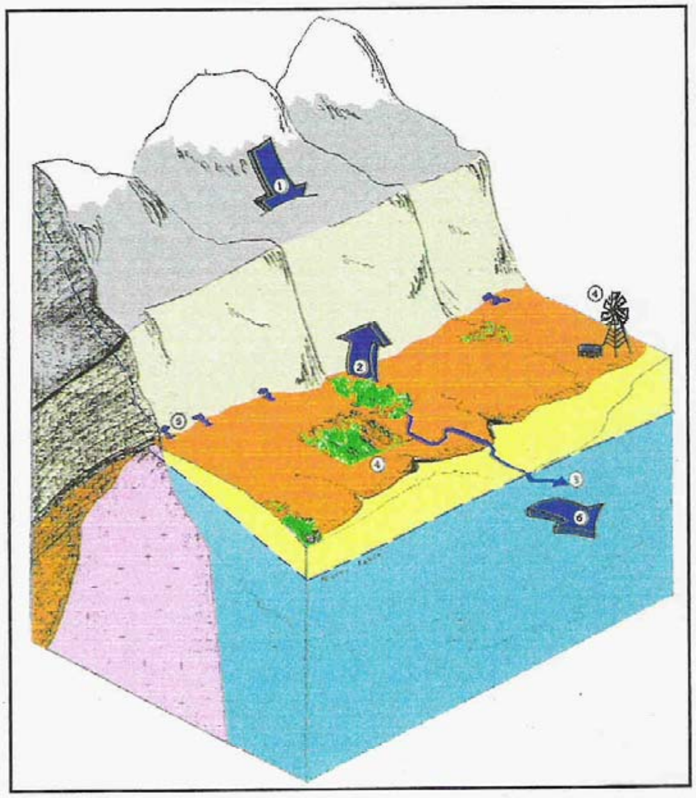
The streams of White Pine County provide the aquatic habitat for many types of fishes including four types of trout (rainbow, brook, brown, and cutthroat), a number of native species such as the Steptoe Dace, the White River Mountain sucker, the White River Speckled Dace, the White River Springfish, the Duckwater Tui Chub, and many other types of fishes.

The streams also support extensive riparian and wetland areas. According to Bureau of Land Management documents, there are at least 62 streams in White Pine County that support more than 200 miles of riparian habitat. The riparian areas of White Pine County provide not only habitat for the fishes listed above and other aquatic species, they provide nesting for a number of bird species including the Black Tern and Long-billed Curlew and a number of important raptors including the Bald Eagle, Peregrine Falcon, Northern Goshawk, Golden Eagle, Prairie Falcon, American Kestrel, and several species of owls.

Springs **–**USGS records show over seven hundred springs in White Pine County. Springs occur wherever groundwater intercepts the land surface and discharges water to the surface water regime. The US Geological Survey conducted a survey of 100 springs in the County and reported a combined discharge rate of over 78,000 gallons per minute, equivalent to more than 126,000 acre feet per year. Data available to update spring inventories include the National Hydrologic Data Set springs and seeps, the National Water Information System springs and seeps monitoring sites for USGS, and the Death Valley Regional Flow System springs. Figure 4 shows the location of measurements in White Pine County for each of the data systems.

Figure 3. Conceptual Hydrogeologic Model for White Pine County

1. The water resources of White Pine County originate as the rain and snow that falls over the upland areas. Rain and snowmelt run off into the channels and into the fractures in the rock. Some of this water is consumed by the plants and some infiltraties downward to the water table, a process known as *recharge*. Most of the recharge occurs at elevations above 6,000 feet.



2. The streams in White Pine County are important water resources. The streams are fed by runoff from the mountains and by springs that discharge in the upland areas. The streams often support lush riparian areas and wildlife. Along the mountain front, additional recharge occurs through the channels that drain the upland areas. The vegetation that is supported by the streams and springs consume a considerable amount of water through *evapotranspiration*.

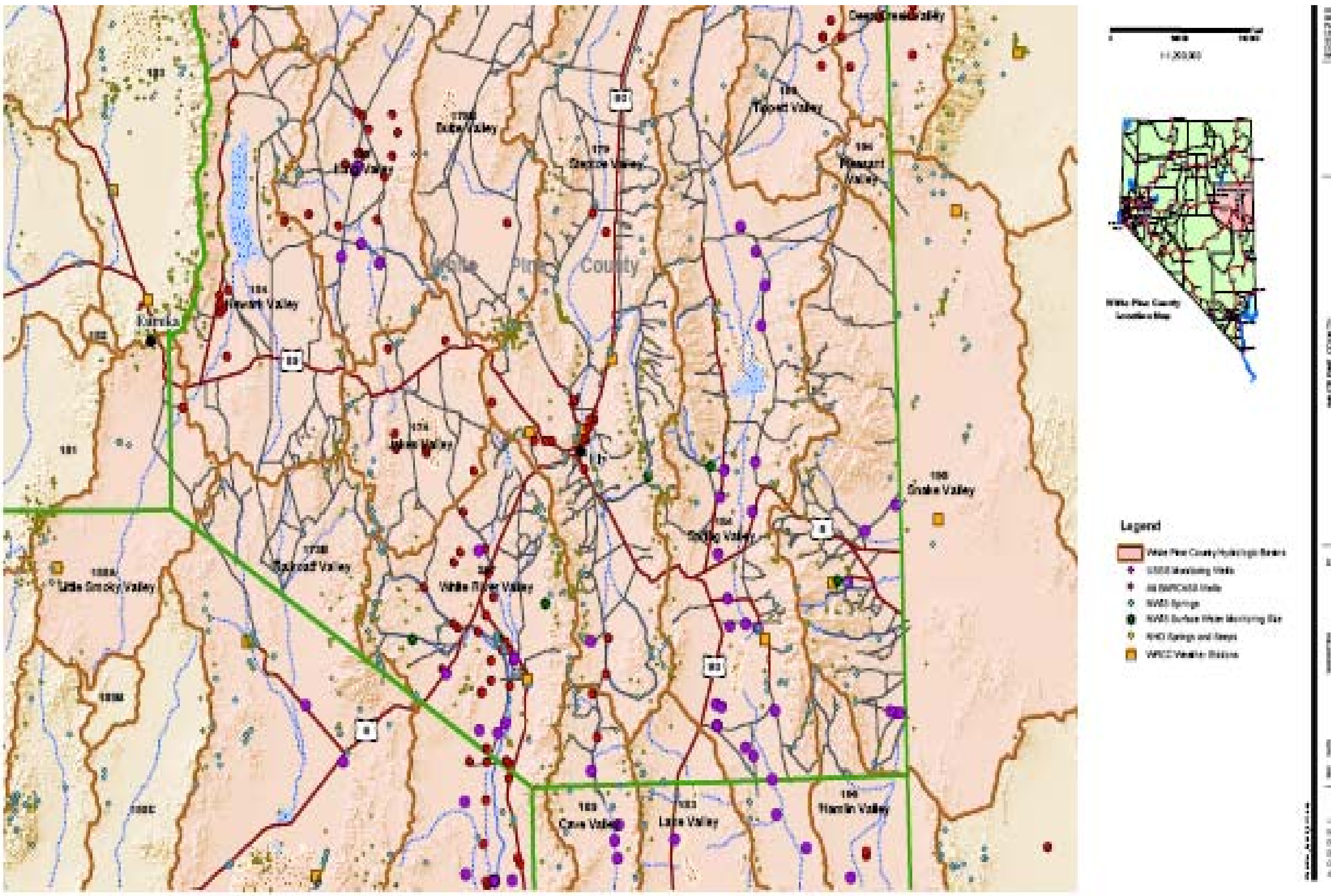
3. Surface water flows year round in some springs and streams, but the amount of flow is often quite variable. Following the snowmelt in the late spring, there is usually a surge of discharge in the streams and springs that drain the mountain areas. This surge of flow is also referred to as *rejected recharge* as it represents the excess water that the rocks are not able to intake. Streams that are fed by springs with seasonal flow may dry up completely in the dry months. Streams and springs that flow year round are called *perennial* and seasonal flows are referred to as *ephemeral*.

4. The water that is used by man for irrigation, stockwater, and quasi-municipal purposes is not completely consumed. Water stored in ponds and irrigation canals leaks back into the groundwater system. Some portion of the irrigation water (about 25 percent) infiltrates back into the ground. Even domestic septic systems may return a small quantity of water back into the ground. Collectively, the infiltration of water from these sources is called *secondary recharge*. Secondary recharge can be a large component of the water budget in basins where irrigation is widespread.

5. Spring lines often occur where geologic controls such as faults or contacts are present. These controls cause groundwater to rise to the surface and discharge. In some of the more water-rich basins of White Pine County, there are spring lines that are tens-of-miles long with hundreds of individual springs and seeps.

6. In most basins, the water that recharges the aquifers ultimately flows from up-gradient basins to down-gradient basins. Basins that are hydraulically linked in this manner are referred to as *flow systems*.

Table A 3-1. Lakes and Reservoirs of White Pine County (Modified from Scott et al, 1971 and the dam safety records of the Nevada Division of Water Resources)			
Lake or Reservoir	***Source***	***Surface Area (acres)***	***Storage Capacity (acre feet)***
Baker Lake	Natural Lake	10	50 (estimated)
Bassett Lake	Steptoe Slough	120	1,300 (estimated
Brown Lake	Natural Lake	5 (estimated)	Unknown
Bull Creek #3	Bull Creek	<5 acres	10
Cave Creek	Steptoe Creek	320	784
Cold Creek Reservoir	Cold Spring	20 (estimated)	Unknown
Comins Lake	Steptoe Valley Creek Willow Creek	400	290
Dead Lake	Natural Lake	3	10 (estimated)
Geyser Dam 2,3, and 5	North Creek	Unknown	89
Goshute Reservoir	Chokecherry and Weaver Canyons	200	300
Illipah Reservoir	Illipah Creek	15(estimated)	1,300
Johnson Lake	Natural Lake	5	25 (estimated)
Preston Reservoir	Jakes Valley Wash	109	1,271
Ruby Lake (with Elko County)	Natural Lake	9,000	30,000
Silver Creek Reservoir	Silver Creek	13	165
Spring Valley Wash	Spring Valley Creek	20 (estimated)	121
Stella Lake	Natural Lake	5	25 (estimated)
Sunset Reservoir	Chin Creek	10 (estimated)	Unknown


Eureka
White Pine County
Newark Valley
Butte Valley
Long Valley
Steptoe Valley
Tippett Valley
Pleasant Valley
Jakes Valley
Snake Valley
Spring Valley
Railroad Valley
White River Valley
Little Smoky Valley
Cave Valley
Lake Valley
Hamlin Valley
Legend

igure 4

Surface Water Right Commitments

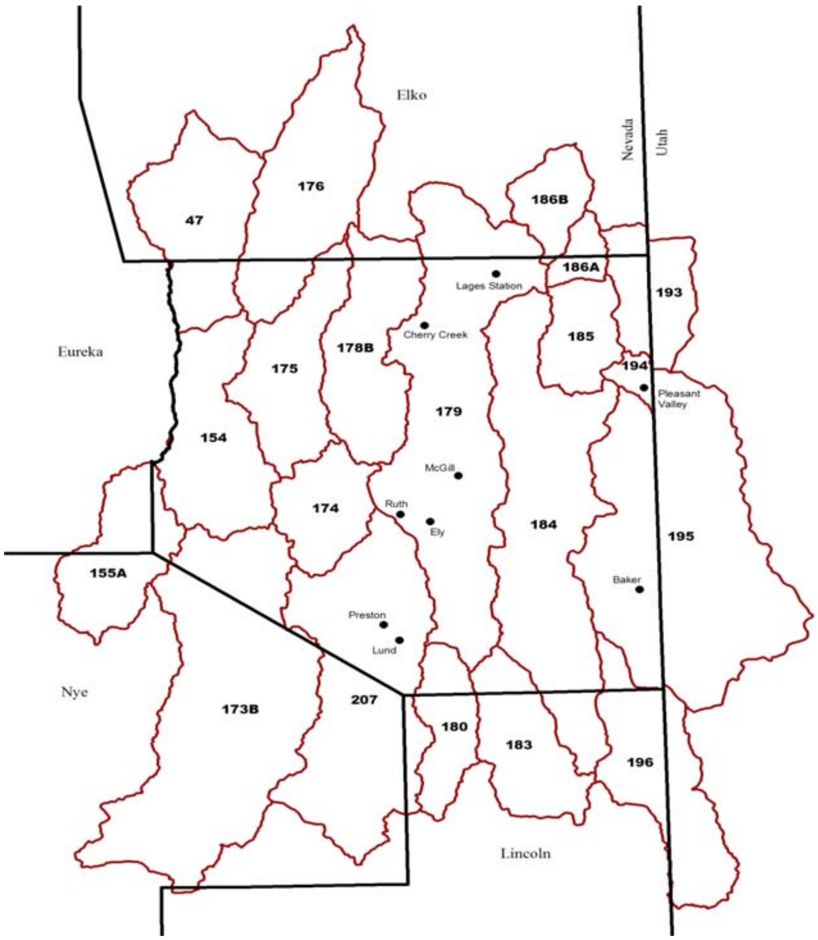
Table A 3-2 Estimate of Active Surface Water Commitment

Basin No.	Basin Name	NV Counties/ State**	Data Source	Duty, AFA: By Water Right Status: CER	PER	VST	RES	DEC	APP	RFA	RFP	By Manner of Use: COM	CON	DOM	ENV	IND	IRR	MM	MUN	PWR	QM	REC	STK	STO	WLD	OTH	DEC	IRD	Total Rights	Total Demand	Yield
047	Huntington Valley	WP,EL	Basin	3904	725	11	3			315		24		2			4038						557		19	3	315		4,643	4,957	25000***
			WPC	318																			318						318	318	
154	Newark Valley	WP	Basin	21359		1538		5560									27643	61					268					485	28,457	28,457	18000
			WPC	21352		1538		5560									27643	61					261					485	28,450	28,450	
155A	ittle Smoky Valley (N	WP,EU,NY	Basin	6483	1536	43	454										7506	82	80				393			454			8,516	8,516	5000
			WPC	291													200						92						291	291	
173B	Railroad Valley (N.)	WP,NY,LI	Basin	10238	22158	11843	67										40504	499					631			61		2611	44,306	44,306	75000
			WPC	179	8158	0											8188	27					123						8,337	8,337	
174	Jakes Valley	WP	Basin	2199		68								2			783				8		174	1301					2,267	2,267	12000
			WPC	2196		68								2			783				6		172	1301					2,263	2,263	
175	Long Valley	WP, EL	Basin	286													132						155						286	286	6000
			WPC	286										132									155						286	286	
176	Ruby Valley	WP, EL	Basin	10675	23	289447	94240	4241		27403	66727						310805				27	62720	834			94233	4137		378,626	472,756	53000
			WPC	29		26																	56						55	56	
178B	Butte Valley (S.)	WP, EL	Basin	1315	2803	1619					3						5556				3		182						5,737	5,741	14000
			WPC	1315	2803	1035					3						4971				3		182						5,153	5,157	
179	SteptoeValley	WP,EL	Basin	89917	54267	6202	23			3289						42714	60298	10305	6924	4706	323	2069	986	290	25072	31			150,409	153,697	70000
			WPC	89700	54267	6202				3289						42714	60164	10305	6924	4706	323	2069	882	290	25072	8			150,169	153,458	
180	Cave Valley	WP, LI	Basin	775	80	47											787						115						901	901	2000
			WPC	10		47																	57						57	57	
183	Lake Valley	WP, LI	Basin	4075	50	4440											7038		977		10		540						8,565	8,565	12000
			WPC	815		1234											1974						74						2,048	2,048	
184	Spring Valley	WP, LI	Basin	48286	862	173890	467	1396		3524	9817			1			234299	2865			3		606			467			224,900	238,240	100000
			WPC	48257	862	173882	461	1396		3524	9817			1			234299	2865			3		570			461			224,858	238,199	
185	Tippett Valley	WP	Basin	475		12											384						103						487	487	3500
			WPC	475		12											384						103						487	487	
186A	Antelope Valley (S.)	WP, EL	Basin	96		119											56						159						215	215	800
			WPC	72		119											56						135						191	191	
186B	Antelope Valley (N.)	WP, EL	Basin	498			6										40		326		11		121		6				504	504	1700
			WPC	40													40												40	40	
193	Deep Creek Valley	WP, EL, UT	Basin	711													682						28						711	711	2000
			WPC	711													682						28						711	711	
194	Pleasant Valley	WP, UT	Basin	924	180	236				1600							2793						146						1,340	2,940	1500
			WPC	924	180	236				1600							2793						146						1,340	2,940	
195	Snake Valley	WP, UT	Basin	11141	800	3694	26	16319	638	12670							14564			5430	14	109.5	215		5792	7266	11899		31,980	45,289	25000
			WPC	11141	800	3294	26	16319	638	12670							14164			5430	14	110	215		5792	7266	11899		31,580	44,889	
196	Hamlin Valley	WP, LI, UT	Basin	400	270	90											582						178						759	759	5000
			WPC																										0	0	
207	White River Valley	WP, NY, LI	Basin	44838	3137	23463				3	836			9		840	59467	72		2172	726		2921		6070				71,438	72,277	37000
			WPC	26001	62	9170				3	36			9		840	27550	72		2172	724		2675		1230				35,233	35,273	
	Total		Basin	258,593	86,890	496,760	95,285	27,516	638	48,803	77,384	24	0	13	0	43,554	777,957	13,884	8,307	12,308	1,125	64,898	9,289	1,591	36,959	102,514	16,351	3,096	965,045	2,056,917	468500
			WPC	204,112	67,132	196,862	487	23,275	638	21,085	9,856	0	0	143	0	43,554	383,892	13,330	6,924	12,308	1,074	2,178	6,244	1,591	32,094	7,735	11,899	485	491,868	1,015,318	

*DOML is the duty committed to DOM wells w/o an appropriative right issued based on well log data.

**Basin totals are for NV PODs only.

***Combined Yield for basins 46, 47, and 48



Basin Number	Basin Name
47	Huntington Valley
154	Newark Valley
155A	Little Smoky Valley N.
173B	Railroad Valley N.
174	Jakes Valley
175	Long Valley
176	Ruby Valley
178B	Butte Valley S.
179	Steptoe Valley
180	Cave Valley
183	Lake Valley
184	Spring Valley
185	Tippett Valley
186A	Antelope Valley S.
186B	Antelope Valley N.
193	Deep Creek Valley
194	Pleasant Valley
195	Snake Valley
196	Hamlin Valley
207	White River Valley

Basin	Perennial Yield[1]
Huntington Valley	25000*
Newark Valley	18,000
Little Smoky Valley N.	5,000
Railroad Valley N.	75,000
Jakes Valley	12,000
Long Valley	6,000
Ruby Valley	53,000
Butte Valley S.	14,000
Steptoe Valley	70,000
Cave Valley	2,000
Lake Valley	12,000
Spring Valley	100,000
Tippett Valley	3,500
Antelope Valley S.	800
Antelope Valley N.	1,700
Deep Creek Valley	2,000
Pleasant Valley	1,500
Snake Valley	25,000
Hamlin Valley	5,000
White River Valley	37,000

* Combined yield for basins 46, 47, and 48

1 Perennial Yields per Division of Water Resources Hydrographic Basin Summaries

Water Quality - The general quality of White Pine County's surface water is in compliance with the 1972 Clean Water Act; however, surface water quality is subject to impacts from human activities and natural causes. The groundwater vulnerability assessments conducted for public water supply systems did not identify any contamination of surface water drinking sources in the County.

Committed Resources - The total quantity of surface water resources in White Pine County is not known and the quantity of committed resources is not known with precision. Table 3-2 lists surface water right data obtained from the Nevada Division of Water Resources. These data have not in all cases been supplementally adjusted, and may overstate the amount of surface water committed because they include supplemental water commitments Figure 5 shows the impact of pumping on springs. Figure 6 shows the general hydrologic characteristics of riparian areas and the management practices that can be employed for their protection.

Groundwater Resources:

In addition to their surface water resources, White Pine County has considerable groundwater resources. Groundwater occurs at various depths under the entire county and has been developed for municipal, agricultural, and mining supplies as well as for other purposes. In recent years, the demand on the groundwater resources has grown significantly, in part reflecting the growth of the various economic sectors of the County, and in part reflecting the interest in exporting water from White Pine County through large-scale inter-basin transfers of water. Because most of the surface water resources of White Pine County have already been appropriated, the groundwater resources represent the only remaining source of water that is available to support the future well-being of the County, through diversification and expansion of the economy.

In this section, an overview of the groundwater resources of White Pine County is presented. This overview includes a description of the hydrologic conditions and sources of water, the quantity of water that is present, the quality of that water, and the committed groundwater resources.

General Geologic Conditions - With respect to their significance to groundwater, the geologic units of White Pine County may be grouped into seven categories: 1) the valley-fill deposits, comprising mixtures of gravel, sand, silt and clay that include the alluvial and playa deposits; 2) younger volcanic rocks, comprising ash-flow tuff and basalt; 3) older volcanic rocks, comprising dacite, latite, andesite, and tuffs; 4) Triassic sediments, comprising freshwater limestone, conglomerate, sandstone, siltstone, and tuff; 5) intrusive rocks, comprising granitic plutons; 6) upper Paleozoic carbonate rocks, comprising predominantly limestone and dolomite, but with inter-bedded shale and siltstone aquitards; and 7) lower Paleozoic and older rocks, comprising predominantly clastic rocks including shale and quartzite, but with some inter-bedded carbonate units. Figure 7 is a generalized geologic map that shows the distribution of these units in White Pine County. For a more detailed map and description of the geologic units present, the reader is referred to Nevada Bureau of Mines and Geology Bulletin 85, Geology and Mineral Resources of White Pine County, Nevada Part I Geology, 1976, by Richard Hose and M.C. Blake.

Figure 8 shows the vertical distribution of the aquifers and aquitards of White Pine County as a generalized hydrostratigraphic column. In general, the geologic units of White Pine County can be divided into eight aquifer systems. The regional carbonate aquifer is divided into six systems, an upper carbonate system, an upper clastic aquitard, a lower carbonate system, a Cambrian aquitard, a middle Cambrian carbonate aquifer, and a lower clastic aquitard.

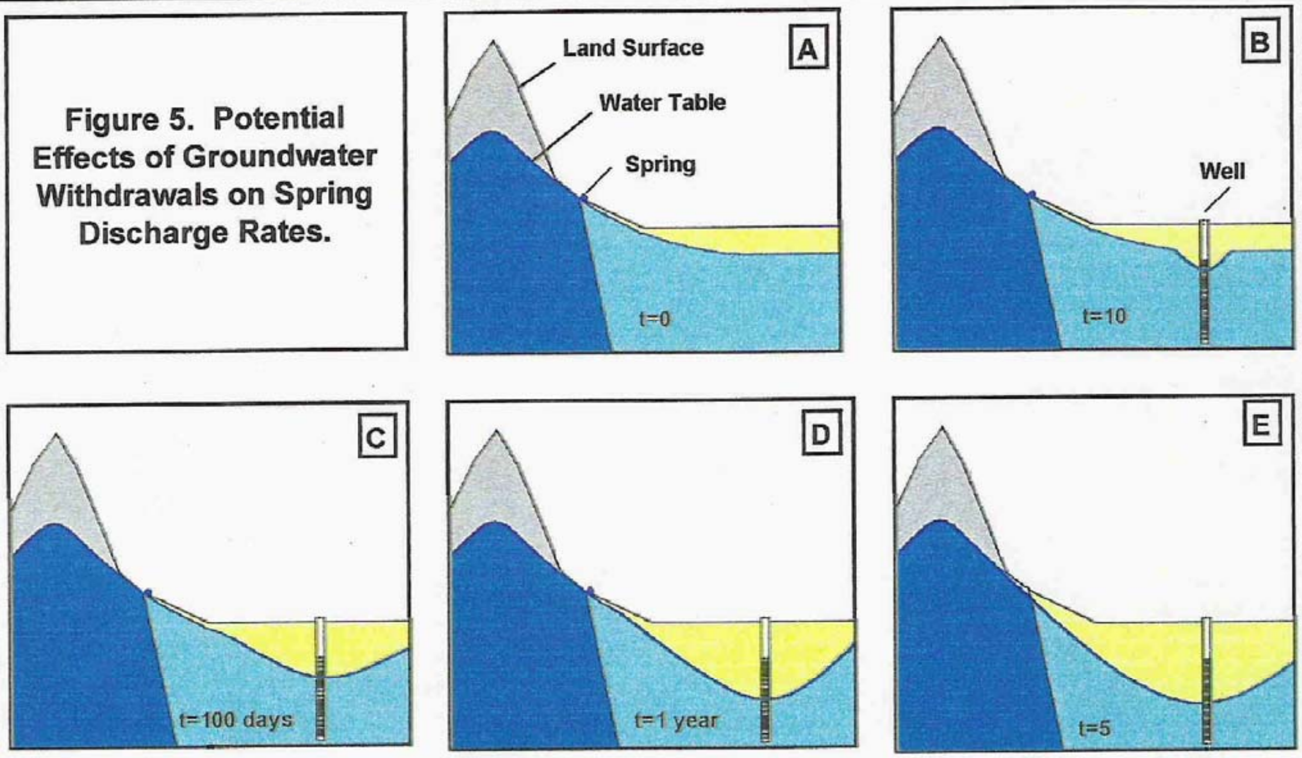


Figure 5. Potential Effects of Groundwater Withdrawals on Spring Discharge Rates.

A. Prior to pumping, the natural hydrologic system is in balance with flow from recharge areas over the mountains to discharge areas along the valley axis or out of the basin via underflow. Where the water table intercepts the land surface, groundwater discharges to the surface as springs.

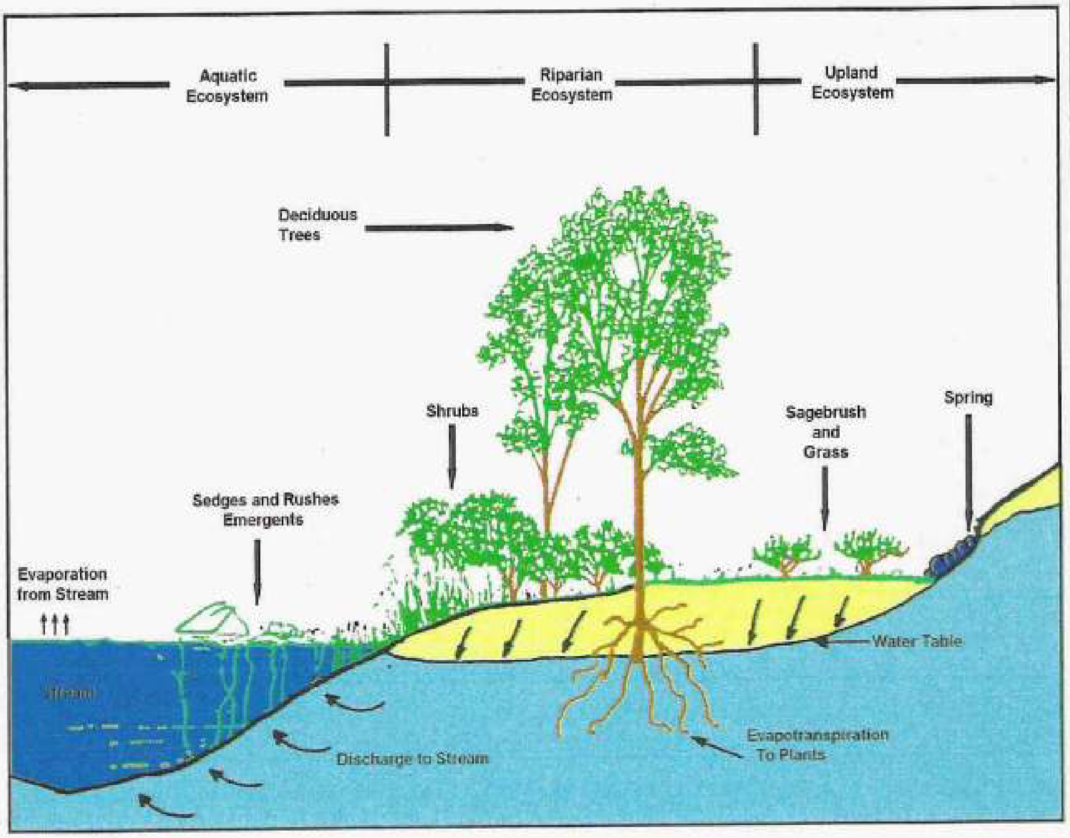
B. With the onset of pumping, water levels are lowered in the vicinity of the production wells. The amount of water level decline that will occur depends upon a number of factors, including the pumping rate and duration, and the abiltiy of the underground aquifers to store and transmit groundwater. If more than one production well is present a pumping center may develop where the cones of depression of each well begin to overlap.

C. With continued pumping, the area over which water level declines occur begins to expand outward from the pumping well or wells.

D. As water withdrawals continue over time, the area of influence of the wells begins to approach the edges of the valley-fill aquifer and spring discharges may begin to decline.

E. The effects of long-term withdrawals can expand beyond the valley-fill aquifer and can eliminate the natural discharge of springs. Springs have been dried up in this manner in a number of Nevada basins including Las Vegas Valley, Pahrump Valley, and Clayton Valley. Wetlands and habitats associated with the springs can also be eliminated or significantly reduced in size.

Figure 6. Riparian Area Issues & Management Practices



ISSUES

- o Livestock production is an important economic sector in White Pine County.
- o The ranching industry, in accordance with Nevada Water Law, has obtained the legal right to divert water from streams and springs and to withdraw groundwater for livestock watering.
- o Livestock and wildlife may trample vegetation and overgraze forage in riparian areas.
- o Livestock and wildlife may disturb the soils in riparian areas.
- o Wildlife may be trapped and drowned in troughs and spring developments.
- o Livestock and wildlife may impact water quality in riparian areas.

MANAGEMENT PRACTICES

- o Convey water from streams to watering sites away from riparian areas.
- o Move salt blocks away from riparian areas.
- o Fence selected riparian areas on Great Basin National Park.
- o Monitor impacts of grazing on riparian areas.
- o Installation of walkways to prevent trapping and drowning.
- o Promote cooperation between the ranching industry and federal land management agencies for the long-term management of range lands outside of Great Basin National Park.

The ability of the aquifer systems of White Pine County to store and transmit groundwater, and to yield water to wells, depends upon the type of aquifer and its characteristics. Typically, the alluvial deposits are more productive where they comprise coarse-grained gravels and sand deposits, but exhibit low well yields in the playa areas where clay predominates. The production of the consolidated volcanic and carbonate aquifers depends largely on the degree of faulting and fracturing. The limestone and dolomite units, where fractured, can be quite productive aquifers, with yields of 3,000 gallons per minute reported for some wells drilled into similar units in Clark County.

Some geologic units have little or no productivity because of their fine-grained nature. These units include shale, quartzite, and granite. Where fractured, these units may be capable of producing only low to moderate well yields (a few tens of gallons per minute), but generally act as aquitards (units that tend to retard the movement of water horizontally and vertically between aquifers).

The distribution of geologic units and the relationships between aquifers and aquitards is quite variable because of the past geologic history of White Pine County. The carbonate and other sedimentary rock units that were originally deposited as flat lying sediments on the ocean floor have since been faulted, folded, fractured, and in some instances, intruded by granite rocks. Low-angle faults have resulted in older rocks being thrust over younger rocks while high-angle basin and range faults have resulted in significant offsets in geologic units. The intrusion of plutons has further disturbed the rocks and aquifers. The net result of this deformation is that the aquifers in White Pine County are not continuous. Rather, they are broken into discrete compartments that are usually bounded either by fault zones or contacts between rocks with contrasting hydraulic properties. This compartmentalization is an important, but poorly understood, aspect of the regional hydrologic conditions. The regional carbonate aquifer, for example, is commonly perceived as a continuous aquifer while in reality, it has been broken up both horizontally and vertically into dozens, and perhaps hundreds, of individual compartments. A better understanding of how these compartments interact can only be achieved through further testing and study.

Groundwater Occurrence and Flow - Figure 9 shows the conceptual hydrogeologic conditions in White Pine County. Recharge derived from precipitation over the upland areas replenishes the groundwater reservoir each year. Groundwater flows from the upland areas toward the valley floors. In undrained basins, all of the groundwater stays within the basin where the recharge fell and is discharged to the surface or consumed by plants (a process referred to as evapotranspiration). Where two or more basins are hydraulically connected, they form a flow system. The presence of a north-south “corridor” sixty to ninety miles wide of carbonate rock stretches from east central Nevada to south of the Spring Mountains in southern Nevada creating a major flow system that help to determine the water resources available throughout the region. The Colorado flow system (sometimes referred to as the White River flow system) links ground water beneath dozens of valleys over distances exceeding three hundred miles. The sources of ground water flowing into the aquifer are recharge from precipitation or mountain runoff and regional inflow from carbonate rock aquifers. The regional carbonate aquifer stores hundreds-of-millions of acre feet of water. However, the US Geological Survey has estimated that if the water stored in the upper 100 feet were extracted, the central carbonate aquifer could yield about six million acre feet of stored water. It is important to note, however, that the extraction of such huge volumes of water, and the subsequent lowering of water levels, could have significant adverse impacts on the groundwater regime of the basins where extraction occurs.

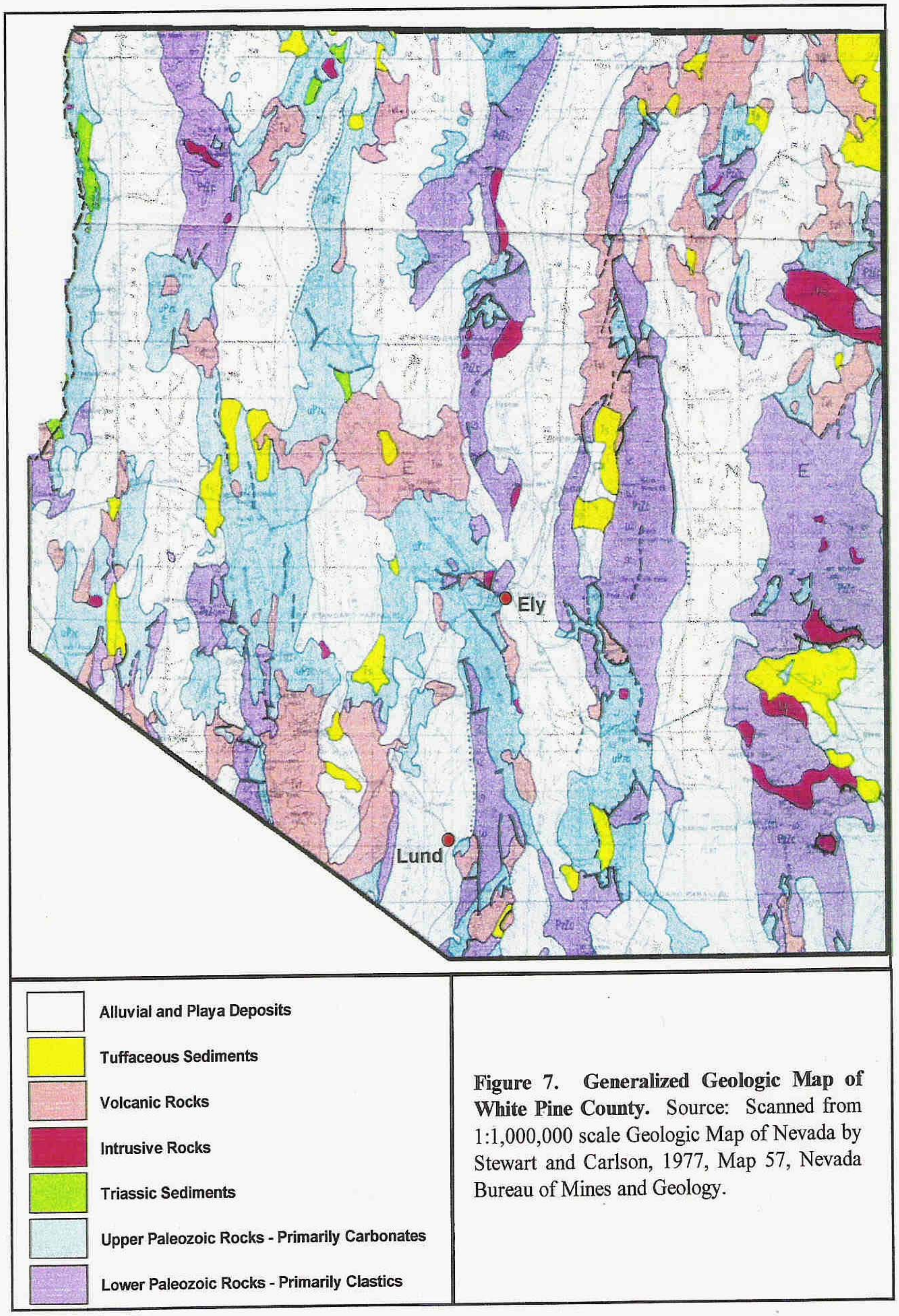
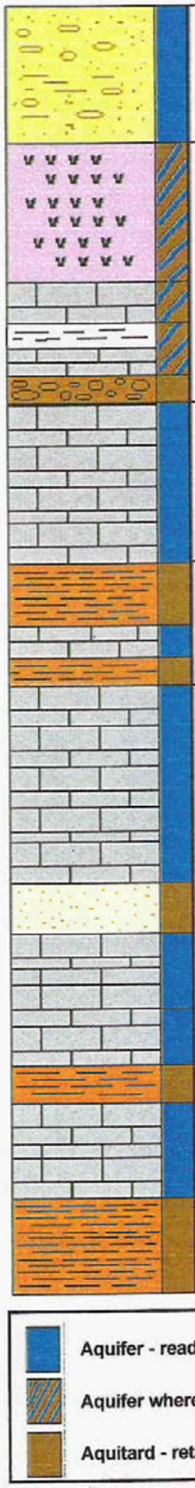


Figure 7. Generalized Geologic Map of White Pine County. Source: Scanned from 1:1,000,000 scale Geologic Map of Nevada by Stewart and Carlson, 1977, Map 57, Nevada Bureau of Mines and Geology.



Formations	Description
Valley-Fill Deposits	**Valley-fill Aquifer System** - Primarily sands and gravels with increased clay toward playa areas. Primary source of water for domestic and farm wells in the lowland areas. Ranges from a few feet to several thousand feet in total thickness in the valley floor areas.
Tertiary Volcanic rocks **Sheep Pass Fm.** **Newark Canyon Fm.**	**Tertiary Aquifer System** - Primarily volcanic rocks that can be productive aquifers when fractured but elsewhere typically yield low to moderate pumping rates to wells. Development is generally limited to stock wells, water supply wells for mines, and domestic wells in upland areas. Maximum thickness depends upon units present but may exceed 3,000 feet. Occurs in scattered locations in the White Pine County.
Park City Group **Arcturus Fm** **Rib Hill Sandstone** **Carbon Ridge Fm** **Ely and Riepe Spring Limestones**	**Upper Carbonate Aquifer System**- Primarily Pennsylvanian and Permian limestones with minor sandstone. Source rocks for many springs but not developed for groundwater. Where fractured or cavernous, may be capable of producing very large well yields. Thickness varies but is generally about 1,100 feet where present. Widespread occurrence in the mountains and under the valley-fill deposits.
Diamond Peak Fm **Chainman Shale** **Joana Limestone** **Pilot Shale**	**Upper Clastic Aquitard** - Primarily shale and siltstone with little or no water production potential except for the Joana Limestone. The shale units total 550 to 2,950 in thickness while the limestone ranges from 90 to 705 feet in thickness where it is present. Widspread occurrence.
Guilmette Fm **Simonson Dolomite** **Sevy Dolomite** **Laketown Dolomite** **Ely Springs Dolomite** **Eureka Quartzite** **Pogonip Group** **Windfall Fm** **Notch Peak Limestone**	**Lower Carbonate Aquifer System**- A thick sequence of limestone overlain by quartzite which in turn is overlain by dolomites. Source rocks for many springs but not developed for groundwater. Where fractured or cavernous, may be capable of producing very large well yields. The thickness varies considerable but more than 12,000 feet may be present in some areas. The Eureka Quartzite, where flat lying, is probably not effective as an aquitard but, where it has been tilted by faulting, it may inhibit the flow of groundwater in some areas. In some areas where extensive thrust faulting has occurred, the lower carbonate aquifer system may be thrust over younger rocks or may be overlain by thrust plates of older rocks. Widespread occurrence but aquifer has been extensively deformed through faulting and fracturing.
Dunderburg Shale	**Cambrian Aquitard** - Shale, 300 to 1,400 feet thick.
Johns Wash Limestone **Lincoln Peak Fm** **Pole Canyon Limestone**	**Middle Cambrian Carbonate Aquifer** - Primarily limestone with thicknesses of as much as 6,000 feet. Water production capability is not known but probably moderate to high where fracutured.
Pioche Shale **Prospect Mtn Quartzite** **McCoy Creek Group**	**Lower Clastic Aquitard** - Primarily shale and quartzite with thicknesses of as much as 5,600 feet. Little or no water production capacity.

Aquifer - readily transmits water

Aquifer where fractured or faulted

Aquitard - retards flow of water

Figure 8. Aquifers and Aquitards of White Pine County.

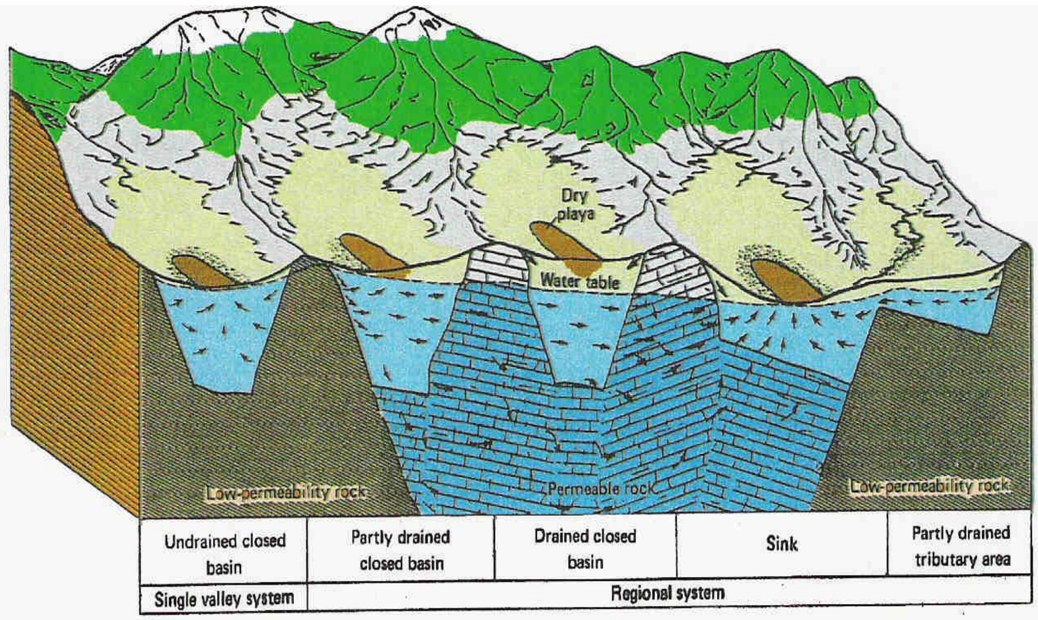


Figure 9. Conceptual hydrogeology of the basins of White PineCounty. Modified from U.S. Geological Survey Professional Paper 813-G.

General Basin Hydrology: White Pine County has all, or portions of 20 individual hydrographic basins. Figure 10 provides summary of the perennial yield per basin.. A water budget in its simplest form, is an accounting of the inputs to and outputs from a basin. The water budget is a balance where the groundwater recharge from all sources equals the total discharge.

Recharge to the groundwater system in each basin is derived primarily from the precipitation that falls above an elevation of about 6,000 feet above mean sea level. The figure at left shows the distribution of recharge areas in White Pine County and adjacent areas. The bulk of the recharge over the County occurs over the Schell Creek Range, Snake Range, the Egan Range, and the White Pine Range. Lesser recharge is contributed over the Diamond Range, Buck Mountain, the Ruby Mountains, and the Cherry Creek Range.

The quantity of recharge that is contributed each year is not known. Crude estimates of recharge have been developed based on estimates of discharge. Secondary recharge occurs where water used for irrigation infiltrates to the water table, from leakage from canals, ditches, and natural stream channels, and from septic systems. Secondary recharge can total several thousand acre feet per year in some basins

Groundwater flows from the upland recharge areas to discharge areas at springs and areas where shallow groundwater is discharged to evapotranspiration. In recent years, White Pine County has been the focus of studies by the US Geological Survey to better define evapotranspiration rates. These studies have found that the quantity of groundwater being discharged to evapotranspiration is generally more than double that estimated in the old reconnaissance evaluations.

The results of these studies suggest that the recharge in White Pine County is significantly greater than previously thought. There is still considerable uncertainty, however, in these estimates, and a greater understanding of both recharge and discharge is needed to help guide water resources evaluations and planning in the region.

Groundwater Quantity and Availability - White Pine County has significant groundwater resources but they are poorly defined. The perennial yields listed in Figure 10 represent the 1971 estimates accepted by the Division of Water Resources and offer only a first order approximation of how much water can actually be drawn on an annual basis. The perennial yield, defined as the difference between inputs (deep percolation from precipitation, seepage from surface water, groundwater underflow into the aquifer, artificial recharge, and leakage between outputs including evapotranspiration, seepage, groundwater underflow from the aquifer, discharge to springs, and artificial discharge, is based on the best available data. The evapotransipiration rates accepted by the State Engineer reflect a conservative view of the combined evaporation from surface water and transpiration from plants. Recent evaluationas (Nichols, 2000) indicate that this rate may be higher but these evaluations are still under study. A more complete understanding of the groundwater regime is available, the existing perennial yield values must serve as the basis for planning.

Determining the quantity of water available within White Pine County is further complicated by the fact that only four basins (Newark, Jakes, Pleasasnt, and Tippett valleys) are wholly situated within the County. In the north, White Pine County shares eight hydrographic basins with Elko County. Of these, Long, southern Butte, and Steptoe valleys are largely within White Pine County while Huntington, Ruby, and Antelope Valley are largely within Eureka County. On the southeast, north Little Smoky Valley is shared with Eureka and Nye counties. Only about one-sixth of Northern Railroad Valley is in White Pine County; the remainder is in Nye County. On the south, White River Valley is shared with Nye and Lincoln White Pine County. Cave, Lake, Spring, and Hamlin Valleys are all shared with Lincoln County. Of these, only Spring Valley is largely situated within White Pine County. To the east, Deep Creek, Snake, and Hamlin Valleys all have significant recharge over a limited area within the County. Groundwater flow from these basins flows generally eastward toward points of discharge in Utah.

Because of the rural development of the counties in Nevada and Utah that share hydrographic basins, there have not been conflicts in the past over water ground commitments and use. This situation may change, however, as growth is expected to occur across the entire region and a number of entities are looking at the water resources of the shared basins as sources of water for exportation to urban areas.

The estimated committed groundwater resources in White Pine County are large and the estimated total is summarized in Table 3-3. Table 3-3 lists the water commitments by status and type of use category in each basin. The valleys with the highest level of committed water resources are Steptoe Valley, Newark Valley, and White River Valley.

In addition to the water resource commitment shown in Figure 3-3, there are large water right filings in some basins that are ready for protest by the Division of Water Resources. White Pine County submitted applications for 25,000 acre-feet per year in Spring and Butte Valleys as alternate sites for the White Pine Power Project. In 2006, the Spring Valley applications were denied. The Butte Valley applications are still in place. The Las Vegas Valley Water District has applications for 78,192 acre feet in Spring Valley and for 50,680 acre feet in Snake Valley. In addition it has filed three applications for 13,032 acre feet in Spring Valley in Lincoln County and two applications with points of diversion in Lincoln County in Cave Valley for 11,594 acre feet of water. The White Pine County applications in Butte Valley and none of the applications for the Las Vegas Valley Water District have not received final action from the Nevada State Water Engineer.

The total current demand for water as defined by the sum of existing water rights, and applications that are ready for action, exceeds the perennial yields in eight basins. The greatest demand for water is in the water rich basins already discussed above. The current demand also exceeds the established value of perennial yield in northern Little Smoky Valley, Long Valley, Lake Valley, and Hamlin Valley.

***Groundwater Quality* -** The general quality of the ground water in White Pine County is suitable to marginally suitable with limited exceptions based on specific locations and proposed uses. With the exception of total dissolved solids in Spring Valley, Newark Valley, and Long Valley, the chemical concentrations do not exceed state or federal drinking water standards. In these basins, the total dissolved solids are elevated because of the natural process of salt buildup through evaporation in areas of shallow groundwater

Underground Water Right Commitments

Table 3-3, Estimated Active Groundwater Commitments

Basin		NV Counties/ State**	Underground Supplemental Adjustments Completed	Data Source	Duty, AFA – By Water Right Status								
No.	Name				CER	PER	VST	RES	DEC	DOML*	APP	RFA	RFP
047	Huntington Valley	WP,EL	Yes	Basin	3,024	6,117				91	4,000	1,252	192
				WPC	0	5,249							
154	Newark Valley	WP	Yes	Basin	8,457	19,627				17		1,280	
				WPC	8,462	19,627				17		1,280	
155A	Little Smoky Valley (N.)	WP,EU,NY	Yes	Basin	5,054		2			8		1,920	
				WPC	4,781					4		1,920	
173B	Railroad Valley (N.)	WP,NY,LI	Yes	Basin	19,508	7,061	11			57		90,760	109,655
				WPC	5	16							
174	Jakes Valley	WP	Yes	Basin	50					2	15,204		16
				WPC	50					2	15,204		16
175	Long Valley	WP, EL	Yes	Basin	344	4,405				6			
				WPC	344	4,405				2			
176	Ruby Valley	WP, EL	No	Basin	18,794	7,148	77			187		8,974	11
				WPC	7	1,471							
178B	Butte Valley (S.)	WP, EL	Yes	Basin	298	0.4					15,204	26,064	
				WPC	284	0.4					15,204	26,064	
179	SteptoeValley	WP,EL	Yes	Basin	46,790	50,103	49			736	20,313	1,479	575
				WPC	45,644	50,103	49			723	20,313	1,479	575
180	Cave Valley	WP, LI	Yes	Basin	35					6		34	24,564
				WPC	0					2		11	
183	Lake Valley	WP, LI	Yes	Basin	23,080	1,607				25		640	29,294
				WPC	2,074								
184	Spring Valley	WP, LI	Yes	Basin	10,373	9,725				32	1,280	56,142	182,381
				WPC	10,286	9,725				32	1,280	56,142	128,210
185	Tippett Valley	WP	Yes	Basin	475								
				WPC	475								
186A	Antelope Valley (S.)	WP, EL	Yes	Basin	25	614							1
				WPC	25								
186B	Antelope Valley (N.)	WP, EL	Yes	Basin	622	7				2			
				WPC									
193	Deep Creek Valley	WP, EL, UT	Yes	Basin									
				WPC									
194	Pleasant Valley	WP, UT	Yes	Basin	1,976								
				WPC	1,976								
195	Snake Valley	WP, UT	Yes	Basin	3,212	7,200				81		5,793	50,720
				WPC	3,212	7,200				81		5,793	50,720
196	Hamlin Valley	WP, LI, UT	Yes	Basin	377		20			2			
				WPC						2			
207	White River Valley	WP, NY, LI	No	Basin	20,767	10,378				316		95,361	
				WPC	18,163	4,777				244		24,081	
Total				Basin	163,260	123,992	158	0	0	1,569	56,001	289,698	397,409
				WPC	95,787	102,573	49	0	0	1,109	52,001	116,770	179,521

Basin No.	Data Source	Duty, AFA – By Manner of Use																Total Rights	Total Demand	Yield
		COM	CON	DOM	DOML*	ENV	IND	IRR	MM	MUN	PWR	QM	REC	STK	STC	WLD	OTH			
047	Basin	271			91			8,350	329					155		19	18	9,233	14,676	25000***
	WPC							4,920	329									5,249	5,249	
154	Basin			3	17		14	22,750	63			18		251		3		28,100	29,380	18000
	WPC			3	17		14	22,750	63			18		251		3		28,106	29,386	
155A	Basin				8			4,938						118				5,064	6,984	5000
	WPC				4			4,757						24				4,785	6,705	
173B	Basin	2			57		72	24,323	5				1,994	183				26,637	227,052	75000
	WPC								5					16				21	21	
174	Basin				2									50				52	15,272	12000
	WPC				2									50				52	15,272	
175	Basin				6			480	4,000					270				4,756	4,756	6000
	WPC				2			480	4,000					270				4,752	4,752	
176	Basin	4		34	187			23,745	1,457			18		759			2	26,206	35,191	53000
	WPC								1,449					29				1,478	1,478	
178B	Basin								172					126				298	41,566	14000
	WPC								172					112				284	41,552	
179	Basin	18		7	736	146	25,056	42,651	21,280	5,066		2,483	32	199		2		97,677	120,043	70000
	WPC	18		4	723	146	25,056	41,535	21,280	5,066		2,483	32	172		2		96,518	118,885	
180	Basin				6									35				42	24,639	2000
	WPC				2													2	13	
183	Basin				25			24,125	217			13		331				24,712	54,646	12000
	WPC							2,032						41				2,074	2,074	
184	Basin				32			18,239	1,361			79		399		20		20,129	259,932	100000
	WPC				32			18,239	1,361			79		313		20		20,043	205,675	
185	Basin							466						9				475	475	3500
	WPC							466						9				475	475	
186A	Basin								614					25				638	640	800
	WPC													25				25	25	
186B	Basin				2				506			11		111				631	631	1700
	WPC																	0	0	
193	Basin																	0	0	2000
	WPC																	0	0	
194	Basin							1,976										1,976	1,976	1500
	WPC							1,976										1,976	1,976	
195	Basin			2	81			10,325				56		29				10,492	67,006	25000
	WPC			2	81			10,325				56		29				10,493	67,006	
196	Basin				2									388			9	399	399	5000
	WPC				2													2	2	
207	Basin	7			316			30,361				55	14	708				31,461	126,821	37000
	WPC	7			244			22,472				40		422				23,184	47,265	
Total	Basin	301	0	46	1,569	146	25,143	212,729	30,004	5,066	0	2,731	2,041	4,146	0	44	29	288,979	1,032,086	468500
	WPC	25	0	8	1,109	146	25,070	129,953	28,658	5,066	0	2,676	32	1,762	0	25	0	199,518	547,809	

*DOML is the duty committed to DOM wells w/o an appropriative right issued based on well log data.

**Basin totals are for NV PODs only.

***Combined Yield for basins 46, 47, and 48