## EXECUTIVE SUMMARY

Groundwater is the sole source of water for the cities of Pullman and Moscow, the UI and WSU, and people and industry in the surrounding rural areas of Latah County, Idaho and Whitman County, Washington. PBAC is charged with the task of planning to insure a reliable long-term quality water supply for the basin. The PBAC is a voluntary, cooperative, multijurisdictional committee comprised of six entities: the two cities, the two universities, and the counties of Whitman and Latah. The Palouse Basin Aquifer Committee's mission is: *to provide for future beneficial use of the basin groundwater without depleting the basin aquifers while protecting the quality of the water.*

Groundwater in the Palouse Basin is pumped from two basalt aquifer systems. The primary municipal drinking water source is the deeper aquifer, the Grande Ronde. The shallower Wanapum (Priest Rapids) aquifer is the primary water supply for rural residents of Latah County and parts of Whitman County. Since groundwater development began in the late 1890's, groundwater pumpage has steadily increased while the basalt aquifers in the Palouse Basin have experienced consistent annual drops in water level.

Recent research indicates that groundwater recharge to the Grande Ronde aquifer is considerably less than assumed in previous basin-wide modeling efforts. Continually declining water levels in spite of nearly constant annual pumping rates suggest that the amount pumped is more than the amount that is being recharged, or replaced, naturally to the Grande Ronde aquifer.

The total combined groundwater pumpage by the two cities and two universities during 1999 was 2,672 million gallons—a 2 percent increase from 1998. Of this total Moscow used 34 percent, Pullman used 33 percent, WSU used 21 percent, and the UI used 12 percent. Groundwater pumpage for all four pumping entities has been increasing at an average of 0.5 percent since 1976.

Despite a slowing in the rate of increased pumpage each year, groundwater levels in municipal wells in the Grande Ronde aquifer continue to decline at a rate of 1 to 1.5 feet per year. Water levels in the Wanapum aquifer fluctuate in response to pumping and in 1999 decreased an average of 2 feet from 1998.

Water quality in the Palouse basin remains very high. No violations of health-based standards for analyzed constituents were reported in 1998, the year for which most recent data are available. Consumers were notified of drinking water quality in 1999 through Consumer Confidence Reports that were prepared by all four potable water suppliers. Beginning in 1999, the Environmental Protection Agency (EPA) requires that water quality reports be mailed annually to consumers.

In 1999, PBAC committed to three years of funding for research into basin hydrogeology. The research will provide a better understanding of the rate and mechanism of aquifer recharge and will assist in development of long-term strategies for sustainable management of the limited groundwater resource. The research is being conducted jointly by a team of UI and WSU scientists. PBAC also brought a web site on-line in 1999.

Goals for 2000 include the continued support of basin research, an attempt to secure funding for additional research and related projects from states of Idaho and Washington, an update to the PBAC Groundwater Management Plan, and increasing the awareness of community leadership about groundwater and local water supply issues.

## 1999 PBAC Members

| | |
|---|---|
| **Moscow** | • Gary Presol; Director of Public Works; and Tom Scallorn, Water Dept.<br>• Steve Busch; City Council) |
| **Pullman** | • Mark Workman; Director of Public Works<br>• Sue Hinz; City Coucncil |
| **Univ. Idaho** | • Larry Kirkland, Chair; Physical Plant<br>• vacant seat |
| **WSU** | • Craig Benjamin, Vice-Chair; Facilities Operations<br>• Jay Becker; Facilities Operations* |
| **Latah County** | • Tom Townsend; Citizen<br>• Loreca Stauber; Board of County Commissioners |
| **Whitman County** | • Derek Pohle; County Engineer<br>• Les Wigen; Board of County Commissioners |

| |
|---|
| Executive Secretary and Technical Advisor - Juliet McKenna, R.G. |

*In 2000 J. Becker is serving on the Committee as a representative of the University of Idaho.

The purpose of the Palouse Basin Aquifer Committee (PBAC) Annual Report is to report on groundwater pumpage, aquifer water levels, and drinking water quality for the past year. The report summarizes progress toward understanding the hydrogeology of the Palouse Basin and also provides information on PBAC activities of the past year and planned activities for the coming year.

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# 1.0 INTRODUCTION

The communities of the Palouse region rely on groundwater from the Palouse Basin as their sole source of drinking water. Groundwater usage in the Palouse region includes four potable water suppliers (Moscow Pullman, the University of Idaho, and Washington State University) and thousands of rural residents who live in unincorporated areas of the Latah County, Idaho and Whitman County, Washington. A location map of the Palouse Basin and the major towns is shown in Figure 1. Concern over declining groundwater levels in local aquifers led to the formation of the Pullman-Moscow Water Resources Committee, which is now called the Palouse Basin Aquifer Committee (PBAC) in 1987. PBAC was formed to ensure a long-term supply of high quality water for the region.

PBAC is a voluntary, cooperative, multijurisdictional committee comprised of six stakeholders: the cities of Pullman, Washington and Moscow, Idaho; Washington State University (WSU) and the University of Idaho (UI); and Whitman and Latah Counties. Two state water management agencies, the Washington Department of Ecology (WDOE) and the Idaho Department of Water Resources (IDWR), support PBAC in the implementation of a groundwater management plan for the area. The long-term goal of the Groundwater Management Plan adopted by the committee in 1992 is to stabilize the water levels in municipal wells such that groundwater recharge is equal to or greater than groundwater pumping (PMWRC 1992).

PBAC publishes an annual report to provide an update on local water supply issues, groundwater use, and drinking water quality and to report on progress toward ensuring a long-term supply of high quality drinking water for the Palouse region. This 1999 Annual Report of the Palouse Basin Aquifer Committee is an update of 1998 PBAC Annual Water Use Report (PBAC, 1998). The 1999 report includes 1) a historical overview of water resource management in the Palouse region, 2) a summary of groundwater pumpage in the Palouse region, 3) groundwater water level data, 4) drinking water quality, and 5) a review of 1999 accomplishments and a workplan for 2000.

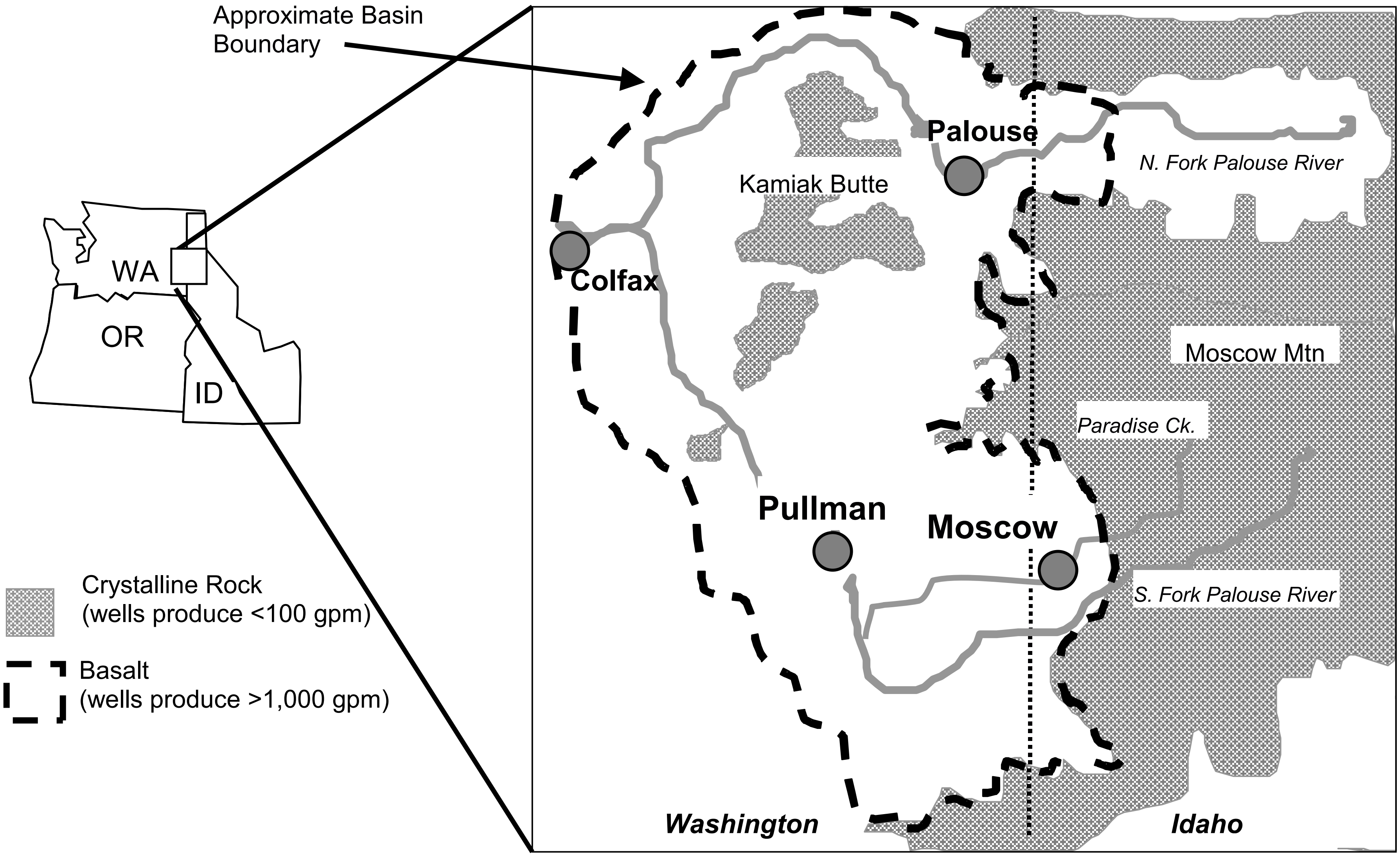



**Figure 1. Location of Palouse Basin in eastern Washington and northern Idaho.**

## 1.1 History of the Palouse Basin Aquifer Committee

The Pullman-Moscow Water Resources Committee (PMWRC), now the Palouse Basin Aquifer Committee (PBAC), was formed in 1967 to address concern over the decline in groundwater levels of the Pullman-Moscow aquifers. Originally, the committee was comprised of representatives from Moscow, Pullman, UI, and WSU. In 1969, at the request of the Committee, the consulting firm of Stephens, Thompson and Runyan studied options for obtaining water from surface water sources including pipelines from the Palouse River near Laird Park and the Snake River at Wawawai (Stevens, Thompson & Runyan, 1970). Another reconnaissance-level study commissioned by the US Army Corps of Engineers (USCOE) examined the feasibility of pumping Snake River water and storing it in the Union Flat Creek and Almota Creek drainages at higher elevations to be used for both power generation and water supply for the Pullman-Moscow area (Stevens, Thompson & Runyan, 1973). These projects were beyond the financial scope of local communities; therefore, local stakeholders continued to use groundwater exclusively.

In cooperation with the local agencies and the WDOE, the U.S. Geological Survey (USGS) made an initial attempt at modeling the deep aquifer system of the basin and predicted continued water level declines with increased pumping rates (Barker, 1979). The Barker study, one of two major groundwater studies of the Pullman-Moscow basin aquifers co-sponsored by the USGS, predicted the decline of groundwater using a mathematical model. Barker predicted that water levels would decline approximately 1.5 feet per year with an annual increase in pumping of 3 percent per year. During the next several years, positive steps were taken toward the development of a groundwater management plan; however, the PMWRC lost momentum and became inactive in 1976.

In 1982, Professor James Crosby of WSU called a meeting of the PMWRC to share his concern over the continuing decline in groundwater levels. Crosby showed that the water levels were declining faster than predicted by the USGS groundwater study (Barker, 1979). In actuality, between 1976 and 1985 groundwater levels declined by 1.5 feet per year with an annual increase in pumping of 1 percent per year (Lum and others, 1990). This is the rate of decline predicted by Barker with an annual increase of 3 percent. The continued decline prompted a call for renewed modeling efforts.

In 1984, representatives from the four stakeholders discussed the need to update the well records and develop a groundwater model that more accurately reflected and predicted reality. At that time the cities, the two universities, and the USGS began negotiations with Dr. Dale Ralston of UI for development of a groundwater model that could be utilized to guide groundwater management in the Palouse basin. The results of this research suggested that if the total amount of groundwater pumped in the basin were to stabilize, water levels in the municipal wells would also stabilize. Further declines of groundwater levels would result if the rate of pumping were increased each year (Lum and others, 1990).

In 1987, IDWR became concerned about the possible “mining” of Palouse area groundwater resources and threatened state action. Idaho water resource guidelines state that it is unlawful to pump greater quantities of water from an aquifer than is recharged to the aquifer. The possibility of regulatory intervention coupled with local concern over a water supply shortage resulted in the official reactivation of the PMWRC in October of 1987 followed by an invitation to Latah and Whitman Counties to join the PMWRC. The addition of the counties increased the representation on PMWRC to twelve members, which typically consist of an administrative representative and a technical representative from each of the six stakeholders. In 1997, the PMWRC changed its name to the Palouse Basin Aquifer Committee (PBAC) in acknowledgement of the regional extent of the aquifers and the thousands of rural residents in unincorporated areas of the counties that also depend on the aquifers for water. Since 1987, PBAC has been staffed part-time by an Executive Secretary and Technical Advisor who administers Committee functions and provides technical guidance.

### 1.2 Groundwater Management Plan

The Groundwater Management Plan (GMP) for the Palouse Basin consists of intergovernmental agreements signed by the six stakeholder representatives and an interagency agreement signed by IDWR and WDOE (PMWRC, 1992). The GMP was published in 1992 after holding a series of public meetings to obtain input from local municipalities, universities, and residents. PBAC adopted groundwater management goals and strategies, which the stakeholders are voluntarily undertaking to overcome the obstacles of governmental boundaries and to avoid state-mandated management. In accordance with the GMP, PBAC will:

- Provide a forum for the exchange of effective groundwater management strategies;
- Collaborate on public education and outreach;
- Maintain a database of well locations, water consumption, and water levels for the basin;
- Fund projects to characterize the basin hydrology and evaluate alternative water sources;
- Publish an annual report;
- Review and modify, as necessary, the GMP every five years.

The GMP will be updated in 2000.

### 1.3 Entity Action Plans

The GMP includes individual Action Plans adopted by each entity to help achieve its goals. The role of the PBAC is to encourage the entities to implement the GMP, monitor success of entities in achieving Action Plans, and provide guidance on water use and conservation strategies. Each of the four water suppliers agreed "to attempt to limit annual aquifer pumping increases to one percent of the pumping volume based on a five year moving average starting with 1986, and to remain below 125 percent of the 1981-85 average". In addition to the voluntary pumping limits, each entity proposed other specific actions that would reduce water use and agreed to report to the PBAC annually on the progress in implementing each action. Action Plan Compliance Reports for Moscow, Pullman, UI, and WSU for 1999 are included in Appendix A. Action Plan Compliance Reports were not available for Whitman and Latah Counties.

## 2.0 HYDROGEOLOGY OF THE PALOUSE BASIN

The Palouse region consists of three main geologic units from oldest to youngest: crystalline basement rock, Columbia River Basalt Group (CRBG) and associated sedimentary interbeds, and Palouse Loess and overlying sediments in the Moscow area. The two primary aquifers in the region are within the CRBG. A conceptual hydrogeological cross-section of the Palouse groundwater basin (after Lum and others, 1990) is shown in Figure 2.

### 2.1 Geology and Structure

The pre-Tertiary crystalline basement rocks form an irregular buried surface beneath the Palouse Basin. The rocks are primarily granite with some metamorphosed granitic rocks. This rock type is exposed in Moscow Mountain and other hills that form the basin boundary to the north and east including Kamiak Butte and Smoot Hill in Washington (Figure 2). Depth to the basement rocks ranges from less than 1000 feet in the Moscow area to perhaps 2,500 feet in Pullman (Lum and others, 1990).

The Miocene (Tertiary) age Columbia River Basalt Group (CRBG) consists of thousands of feet of individual basalt lava flows, which erupted between 17 million and 5 million years ago from volcanic centers located near present-day northeastern Oregon and southeastern Washington (Swanson and others, 1979). The CRBG are referred to as "flood basalts" because of the extensive area covered by basalt, which now cover most of present-day Washington east of the Cascades (Swanson and others, 1980). Some of this basalt flowed as far west as Puget Sound in western Washington. The CRBG flows ponded at the base of Moscow Mountain, which marks the eastern extent of the Palouse groundwater basin (Figure 1).

Basalt typically has many pores, or vesicles, formed by trapped air in the cooling lava. Fractures form at the top and bottom of the basalt flows, and internal vertical fractures forming "columns" 0.5 to 6 feet in diameter are also a common feature in basalt flows. Groundwater is held in the many pore spaces and fractures typical of this rock type. Sedimentary layers up to 100 feet thick or more and soil horizons are interbedded with the basalt flows, representing periods of minimum volcanic activity when sediments were deposited by lakes and rivers and soils were formed on the tops of the basalt flows.

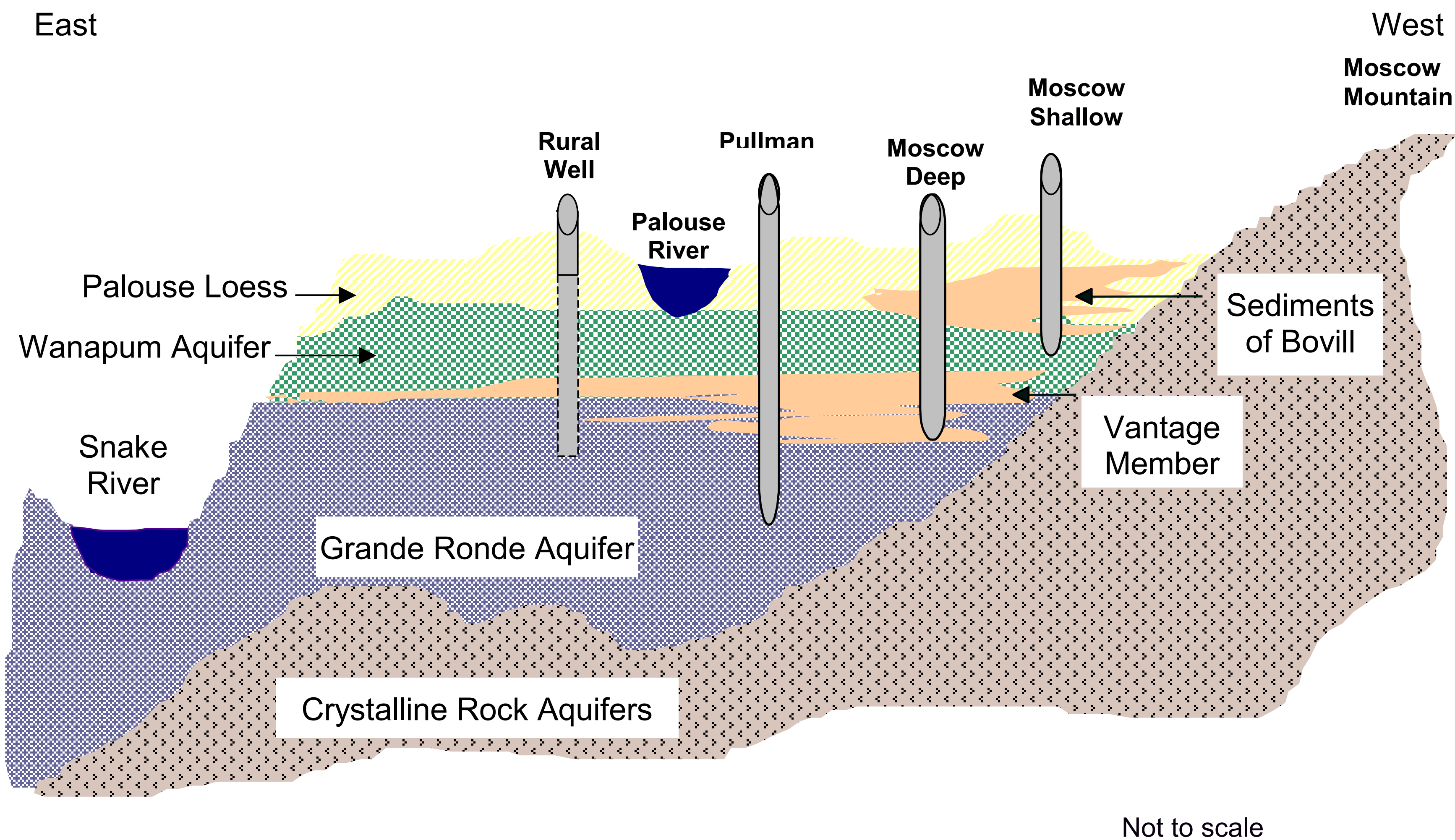



**Figure 2. Conceptual hydrogeologic cross section of Palouse groundwater basin.**

There are four formations that comprise the CRBG, each of which are subdivided into members that contain numerous individual basalt flows. Only two of the CRBG formations, the Grande Ronde and the Wanapum are hydrologically important in the Palouse region. Individual basalt flows range from 3 to 150 feet in thickness and average between 40 and 80 feet thick. Most of the individual basalt flows are distinguishable by a unique chemical composition ("fingerprint") and stratigraphic (relative) position.

The well log for Well 7 drilled on WSU's campus in 1987 revealed the base of the Grande Ronde Formation to be 1,900 feet deep in Pullman (J. Bush, unpublished data). As the depth to basement rock decreases eastward towards Moscow, the thickness of the Grande Ronde also decreases. East of the state line around Moscow, there is much a greater percentage of sediments interbedded with the basalt flows than is present in the Pullman area west of the state line.

The sediments of the Vantage Member (of the Miocene Ellensburg Formation of Swanson and others, 1979) separates the older Grande Ronde basalt from the younger basalt flows of the Wanapum Formation. In the Palouse basin, the unit consists of clays, sands, and gravels. The unit is up to 300 feet thick in Moscow, but becomes thinner and the sediments become finer (smaller) towards the west. West of the state line, the unit thins to only a few feet.

The Wanapum Formation consists of four members. Only the Priest Rapids Member is exposed in the Moscow-Pullman area. Locally, the Priest Rapids Member is often referred as the Wanapum. Based on well log and water level elevation data, the Wanapum is as much as 250 feet thick in the Moscow area and is likely not more than 100 feet thick in Pullman (J. Bush, unpublished data).

The Palouse Loess overlies the CRBG throughout the entire basin. Loess is a wind-blown dune deposit of fine (small) silt and clay sediments. Most of the Palouse Loess was deposited less than 1 million years ago. The loess forms the dune-shaped hills characterizing the Palouse landscape and is now a silt-loam soil. The high water retention ability of this soil supports the productive dry-land agriculture of the region. The loess ranges in thickness from zero to several hundred feet.

In the easternmost portion of the Palouse basin, the Palouse Loess is separated from the uppermost basalt unit by a sedimentary unit referred to as the sediments of Bovill (Bush, unpublished data). The unit is as much as 250 feet thick between Moscow Mountain and downtown Moscow, and thins out to less than 50 feet in Moscow (Pierce, 1996). In general, it is not present west of the state line. Similar to earlier sedimentary deposits, this unit was deposited by streams draining Moscow Mountain. Much of the sediment was deposited in small lakes. Sediments range from sands and gravels to predominantly clay (Pierce, 1996).

Bush (unpublished data) has hypothesized that northwest trending folds in the basalt control the direction of groundwater movement in the Palouse Basin.

## 2.2 Hydrology

The crystalline rocks of Moscow Mountain, Kamiak Butte, and other topographic highs surrounding Moscow on the north, east, and south contain very little groundwater and effectively serve as the basin boundary. A limited amount of water is available in the fractures in these rocks and is used as a water supply in residential wells. Residential wells drilled in the crystalline rocks on the northern and eastern edges of the basin typically produce less than 20 gallons per minute (gpm).

The Columbia River Basalt Group and related sedimentary layers form the major water-bearing units, or aquifers, in the region. These units provide the entire public water supply for the Palouse region. The Grande Ronde aquifer is the source of approximately 90 percent of the drinking water to the four municipal suppliers. The aquifer is capable of producing up to 3,000 gpm. Static water levels in Pullman, Moscow, and Palouse are approximately 2,250 feet mean sea level (msl) in the Grande Ronde aquifer. Static water elevations of other wells in the basin indicate that the groundwater flow direction is west-northwest (Heinemann, 1994).

East of the state line, Moscow and UI operate several wells that are developed in the Wanapum (Priest Rapids) aquifer. The aquifer is capable of producing up to 1,500 gpm. Well logs for Moscow Wells 2 and 3 indicate that the Vantage Member, consisting of sands and silts, is approximately 300 feet thick and is hydraulically connected to the Wanapum aquifer. In Pullman, wells less than 200 feet deep (WSU Test Well, Pullman Wells 2 and 3) have static water levels indicating that they are developed in the Grande Ronde aquifer, thus the Wanapum is much thinner in Pullman and is not used for municipal water supply.

The unconfined aquifers in the sediments that overlie the basalt aquifers (sediments of Bovill and Palouse Loess) are not used as municipal aquifers. Unconfined groundwater in these zones supplies water to springs and streams and water levels respond to the seasonal precipitation cycles (Lum and others, 1990). Rural domestic wells in this unit are used primarily for minor irrigation or stock watering and typically produce less than 30 gpm.

## 2.3 Models for Recharge of the Aquifers

There is considerable uncertainty about the rates and pathways of recharge to the local groundwater system and how recharge is partitioned among the various aquifers. Both aerial infiltration of precipitation and localized mountain-front are possible recharge mechanisms. Basin-wide modeling has shown that recharge to the subsurface is considerably less than aerial precipitation (Lum and others, 1990). A better understanding of the mechanisms for groundwater recharge in the basin is a key component of the research that is now being funded by the PBAC (refer to Section 6.2).

Recent research by Dr. Dale Ralston of UI on aquifer recharge and the interconnection between surface water and groundwater suggests that the groundwater recharge rate estimate for the Grande Ronde used in the USGS model (Lum and others, 1990) is too high, based on a water balance approximation in the Genesee basin (Lawrence, 1995).

Water isotope analyses by Dr. Kent Keller of WSU indicates that the isotopic signature of groundwater in the Grande Ronde is consistent with water that is 10,000 years or older (O'Brien and others, 1996; Larson and others, 2000) indicating a very slow rate of groundwater recharge. The research suggests that groundwater recharge rate for the Grande Ronde Basalt are much less than the original recharge rate estimate assumed in the USGS model.

Research by Dr. John Bush of UI suggests that groundwater recharge into the Grande Ronde may occur through coarse-grained sediments of Bovill at the Moscow Mountain front (Bush, unpublished data). Bush suggests that the sediments of Bovill may be a significant source of more recent groundwater recharge for the eastern portion of the Palouse Basin.

## 3.0 GROUNDWATER PUMPAGE

This section provides annual water pumpage data for the two cities and two universities and an estimate of groundwater pumpage for the areas of Latah County, Idaho that are within the basin boundary but outside Moscow city limits. This section includes (1) a summary of municipal wells pumping in the basin, (2) groundwater pumpage and comparisons with the voluntary pumping limits established in the GMP for each entity, and (3) an estimate of the amount of water used in the basin for outdoor irrigation purposes during the summer months. The pumpage summary is prepared from data provided to the PBAC by Pullman, Moscow, WSU, UI, and Latah County.

### 3.1 Municipal Wells

There are a total of 24 wells maintained by the four main water suppliers in the Palouse region (Moscow, Pullman, UI and WSU), 18 of which are active. Construction details of these wells provided by each of the entities are summarized in Table 1. Details on the UI aquaculture wells are from Kopp (1994). The other eight wells are maintained for emergency use or as monitoring points.

Presently, Moscow gets its water from five wells in two separate aquifers. Moscow Wells 2 and 3, located near the water works building on A and Jackson Streets, are developed in the shallow Wanapum aquifer. Wells 6, 8, and 9 are all located in the deeper Grande Ronde aquifer. Moscow plans on drilling a new Grande Ronde well within the next five to ten years. The City of Pullman gets its water from four Grande Ronde wells. Pullman Well 1 has been abandoned and Well 2 is now being used as a standby unit, while pumping occurs in Wells 3, 4, 5, and 6. During 2000, Pullman plans to drill Well 7, which is expected to be approximately 700 feet deep in the Grande Ronde aquifer.

The University of Idaho gets its water from Wells 3 and 4 in the Grande Ronde Basalt and maintains three Wanapum wells, Wells 5, 6, and 7, for its aquaculture facilities. WSU gets its water from four Grande Ronde wells: Wells 1, 3, 4, 6, and 7. The other three WSU wells are on standby for emergency use, or maintained for monitoring purposes.

The two wells operated by the city of Palouse, Washington are included in this table; however Palouse is not represented on the PBAC and did not sign the GMP (PMWRC, 1992). Data are provided to the PBAC by the city of Palouse.

## Table 1
## Municipal Well Data

| Owner | Well No. | Status | Date Drilled | Aquifer | Depth | Interval Open to Aquifer (ft bgs) | Pumping Rate (gpm) | Pumped in 1999 (mil gals) | Elevation (ft msl) | Water Level (ft bgs 12/99) | Water Level (ft msl 12/99) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Moscow | 2 | active | 1925 | WP | 240 | 240 | 1150 | 156 | 2568 | 66 | 2502 |
| | 3 | active | 1930 | WP | 569 | 240-569 | 1250 | 76 | 2569 | 67 | 2502 |
| | 6 | active | 1959 | GR | 1305 | 905-1305 | 1350 | 181 | 2586 | 342 | 2244 |
| | 8 | active | 1965 | GR | 1458 | 1458 | 1250 | 169 | 2616 | 376 | 2240 |
| | 9 | active | 1982 | GR | 1242 | 1242 | 2350 | 307 | 2557 | 314 | 2243 |
| | cmtry | inactive | 1955 | | 508 | 456-508 | 700 | -- | 2604 | -- | -- |
| Pullman | 2 | abandon 00 | 1947 | GR | 213 | 154-213 | 250 | -- | 2342 | 83 | 2259 |
| | 3 | active | 1947 | GR | 167 | 41-167 | 870 | 225 | 2340 | 83 | 2253 |
| | 4 | active | 1957 | GR | 932 | 406-932 | 850 | 248 | 2342 | 92 | 2250 |
| | 5 | active | 1969 | GR | 712 | 674-712 | 1666 | 195 | 2447 | 95 | 2252 |
| | 6 | active | 1968 | GR | 560 | 235-560 | 785 | 219 | 2424 | 170 | 2254 |
| | 7 | in design | 2000 | GR | -- | -- | -- | -- | -- | -- | -- |
| UI | 3 | active | 1963 | GR | 1337 | 890-1337 | 2185 | 303 | 2567 | 317 | 2250 |
| | 4 | active | 1976 | GR | 747 | 687-747 | 1935 | 8 | 2552 | 290 | 2262 |
| | 5 | aquaculture | 1991 | WP | 247 | 160-170; 220-240 | 70 | 3 | 2617 | 130 | 2487 |
| | 6 | aquaculture | 1993 | WP | 351 | 316-342 | 75 | <1 | 2619 | 140 | 2479 |
| | 7 | aquaculture | 1993 | WP | 350 | 290-350 | -- | -- | 2617 | 137 | 2480 |
| WSU | test | monitor | -- | GR | 144 | 144 | -- | -- | 2364 | 109 | 2255 |
| | 1 | active | 1934 | GR | 247 | 247 | 500 | <1 | 2364 | -- | -- |
| | 2 | monitor | 1938 | GR | 214 | 214 | 350 | -- | 2358 | -- | -- |
| | 3 | active | 1946 | GR | 223 | 158-213 | 1000 | 58 | 2365 | 109 | 2256 |
| | 4 | active | 1962 | GR | 275 | 165-275 | 1500 | 60 | 2363 | -- | -- |
| | 5 | stand-by | 1963 | GR | 396 | 303-396 | 500 | -- | 2505 | -- | -- |
| | 6 | active | 1975 | GR | 702 | 340-702 | 1500 | 359 | 2535 | 282 | 2253 |
| | 7 | active | 1987 | GR | 1814 | ??--1814 | 2500 | 96 | 2416 | 160 | 2256 |
| Palouse | old | active | 1903 | GR | 297 | 220-297 | 900 | 61 | 2433 | 179 | 2254 |
| | new | 2000-active | 1999 | GR | 438 | 400-435 | 795 | -- | -- | 251 | -- |

-- not available or not applicable; ft msl = feet above mean sea level; ft bgs = feet below ground surface (depth)

### 3.2 1999 Pumpage

The combined groundwater pumpage for all reported wells from the four water suppliers in 1999 was 2,672 million gallons per year (mgy) versus 2,608 mgy in 1998, after adjusting 1998 figures for Moscow's miscalibrated meters (see Section 3.2, below for an explanation). This represents an annual increase of 2.5 percent compared to an increase in 1998 of 4 percent. In 1997, pumping actually decrease by 5 percent from the previous year. Total pumpage by each entity for each aquifer system is shown in Table 2 and pumpage data is presented in Appendix B. The percentage pumped by each entity remained the same in 1999 as in 1998.

The Grande Ronde Basalt is the primary aquifer for public water supply. Not including Palouse, fourteen wells currently pump from the Grande Ronde aquifer accounting for 91 percent of the production among the four entities in 1999. During the period from 1891 to 1975 total pumpage in the basin increased at an annual rate of about 4 percent from about 73 mgy to about 2,226 mgy in 1975 (Lum and others, 1990). Since 1975, pumpage of groundwater from the Grande Ronde has increased at an annual average rate of about 0.8 percent.

Moscow Well Nos. 2 and 3 UI Well Nos. 5 and 6 (operated for the aquaculture facility) are the only public water supply wells that pump from the Wanapum aquifer. The two Moscow Wanapum wells accounted for 34 percent, about 232 mgy, of Moscow's water in 1999, compared to approximately 19 percent of the City's production in 1998. Pumping from the Wanapum aquifer for UI aquaculture facility during 1999 accounted for only 1 percent of the UI's total pumpage.

**Table 2**
**Quantity and Percentage of Groundwater Pumped by Each Entity in 1999**

| | Pumped (millions of gallons per year) | | | Percent |
|---|---|---|---|---|
| | Wanapum | Grande Ronde | Total | |
| Moscow | 232 | 657 | 889 | 34% |
| Pullman | 0 | 896 | 896 | 33% |
| UI | 3 | 312 | 315 | 12% |
| WSU | 0 | 572 | 572 | 21% |
| Total | 235 | 2,437 | 2,672 | |

## 3.3 Voluntary Pumping Limits

As part of the Groundwater Management Plan (GMP) (PMWRC, 1992) the pumpers agreed to attempt to limit yearly pumping increases, based on a five-year moving average, to a 1 percent increase from the average during the years 1982 to 1986, and would not exceed 125-percent of the average pumpage during the period of 1981 to 1985. Annual pumping quantities for the period 1976 through 1999 are shown in Figure 3 through Figure 7. Two charts are provided for each entity and for all entities combined showing: (a) the annual pumpage compared to the 125-percent ceiling and (b) the five year moving average of annual pumpage compared to an annual increase of 1 percent from the average between 1982 to 1986. Pumpage for the entire groundwater basin is shown in Figure 3. The rate of increase in pumpage basin-wide has been 0.5 percent since 1976. The basin remains below the 125-percent ceiling and the 1-percent curve.

### 3.3.1 Moscow

Moscow's annual pumpage figures were adjusted in 1999 because it was discovered that the meters for Well Nos. 2 and 8 were reading high by 22 percent and 14 percent, respectively. It is not known how long the meters have been miscalibrated; however because they had never been calibrated previously, it was assumed that reported quantities of water pumped have been high since at least 1986, the first year after the base period. Annual pumpage quantities from 1986 to 1999 were adjusted down by the percentage pumped by both wells for each year. Incorporating this adjustment, Moscow's pumping rate increased 5 percent in 1999 (889 mgy in 1999 versus 846 mgy in 1998) and Moscow continued to pump at a rate above the 1-percent curve (Figure 4).The adjustments for the faulty flow meters resulted in lowering Moscow below the 125-percent ceiling for all years prior to 1999; however, in 1999, Moscow's pumpage exceeded the 125-percent ceiling limit of 875 mgy.

It should be noted that the City of Moscow's water system has extenuating demands when compared to the other three pumpers due to the higher concentrations of iron and manganese in the city's wells, particularly in Wells 2 and 3, which pump from the Wanapum aquifer. The city regularly flushes hydrants to reduce iron and manganese build-up in water lines in response to customer complaints. In 1999, hydrant flushing accounted for 2 mgy. The treatment system used to remove the Fe and Mn requires regular backwashing, which amounted to 6.4 mgy in 1999 (T. Scallorn, personal communication). Combined, hydrant flushing and backwashing of the treatment system accounted for 8.4 mgy or approximately 1 percent of the total groundwater pumped by Moscow during 1999.

### 3.3.2 Pullman

Annual pumpage in Pullman increased 3 percent in 1999 (896 mgy in 1999 versus 869 mgy in 1998) although the 1999 pumpage is less than the average of the previous five years. Pullman remains below the 125-percent ceiling and the 1-percent curve (Figure 5).

### 3.3.3 University of Idaho

In 1999, the annual pumpage at UI was the same as 1998 (315 mgy) and was slightly greater than the 5-year average (Figure 6). For the last three years, UI has remained below the 1-percent curve. In addition to pumping groundwater, UI utilizes recycled water supplied by Moscow's wastewater treatment plant and the UI's aquaculture lab for outdoor irrigation. Recycled water use (shown Figure 11) amounted to 71 mgy, or 18 percent of its total usage water usage (386 mgy) in 1999.

### 3.3.4 Washington State University

Washington State University annual pumpage decreased approximately 1 percent (572 mg in 1999 versus 579 mg in 1998). WSU pumped less in 1999 than the average of the previous five-years and remains well below the 1-percent curve and the 125 percent ceiling (Figure 7).

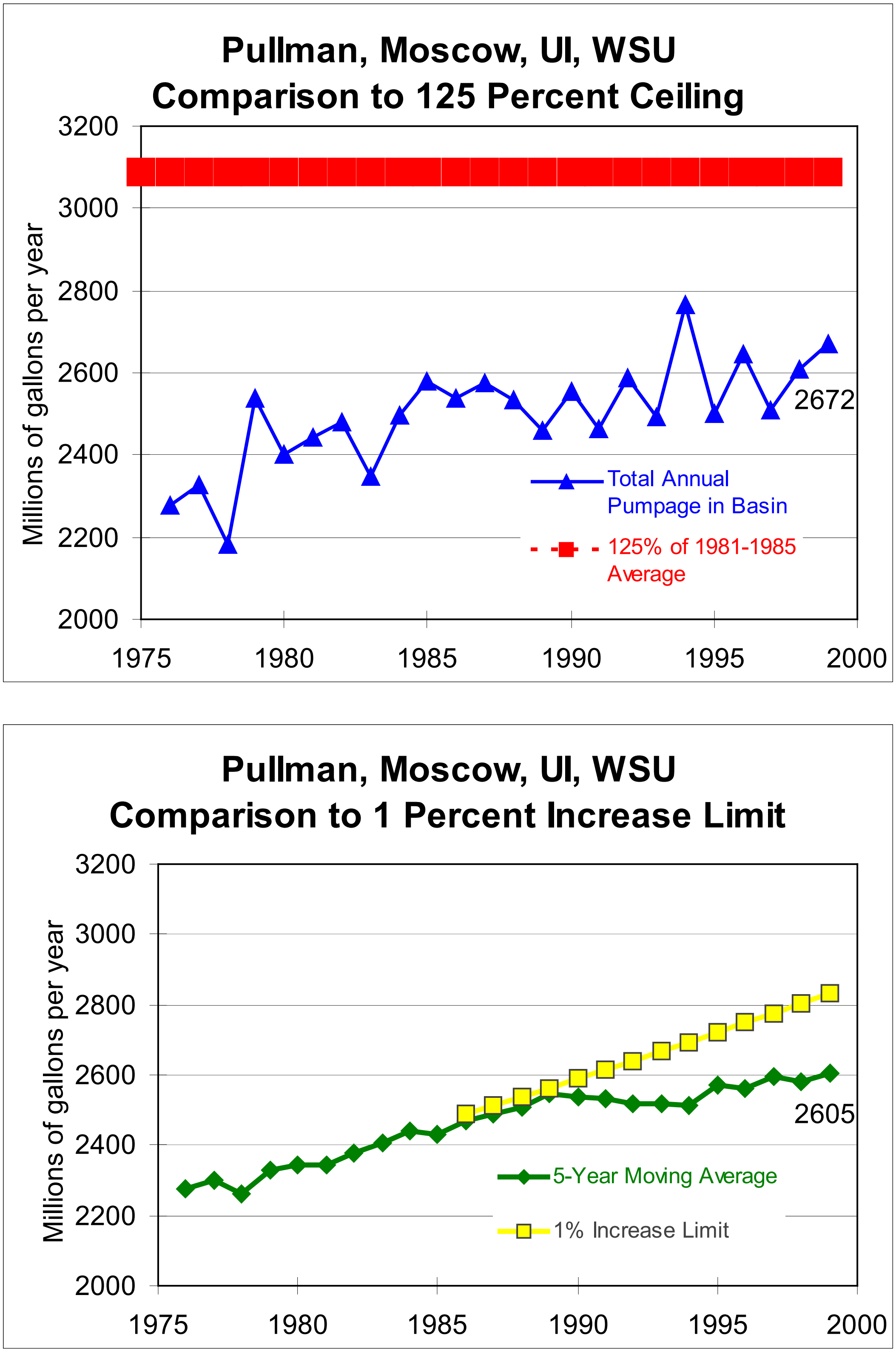
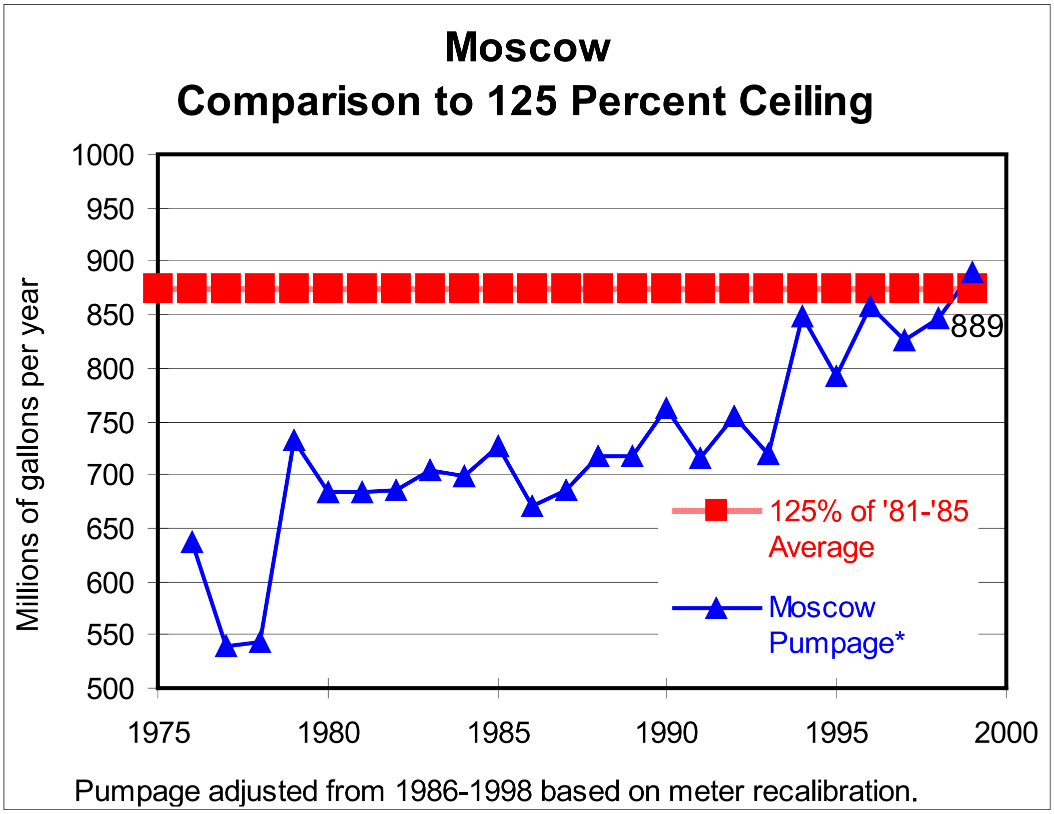



**Figure 3. Actual pumping (top) and comparison to 5-year moving average (bottom) for total annual pumpage by Pullman, Moscow, University of Idaho, and WSU from 1976 to 1999.**



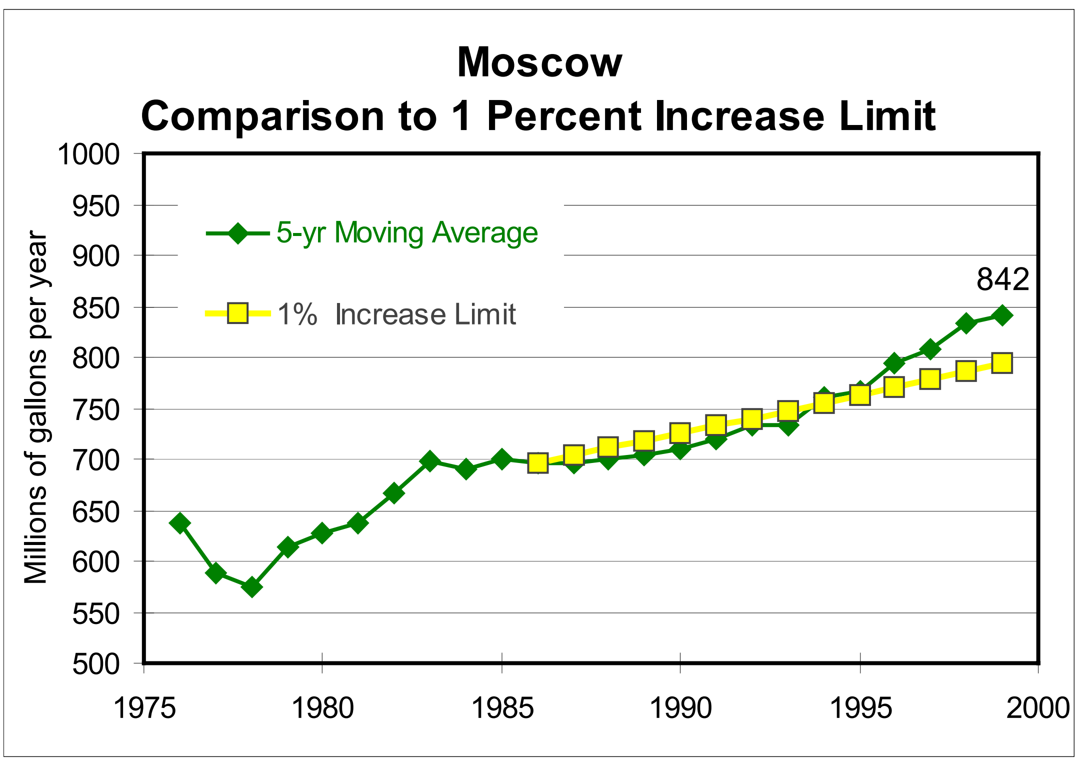
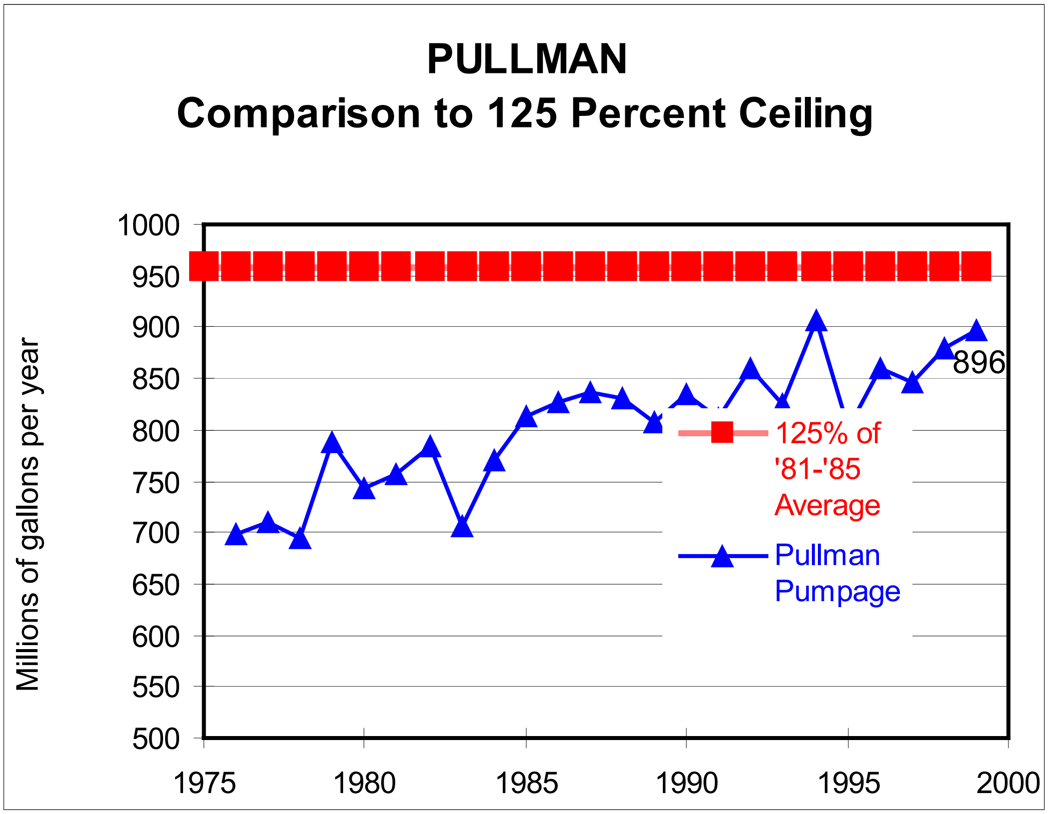




**Figure 4. Actual pumping (top) and comparison to 5-year moving average (bottom) for total annual pumpage by Moscow from 1976 to 1999 compared to voluntary pumping limits.**



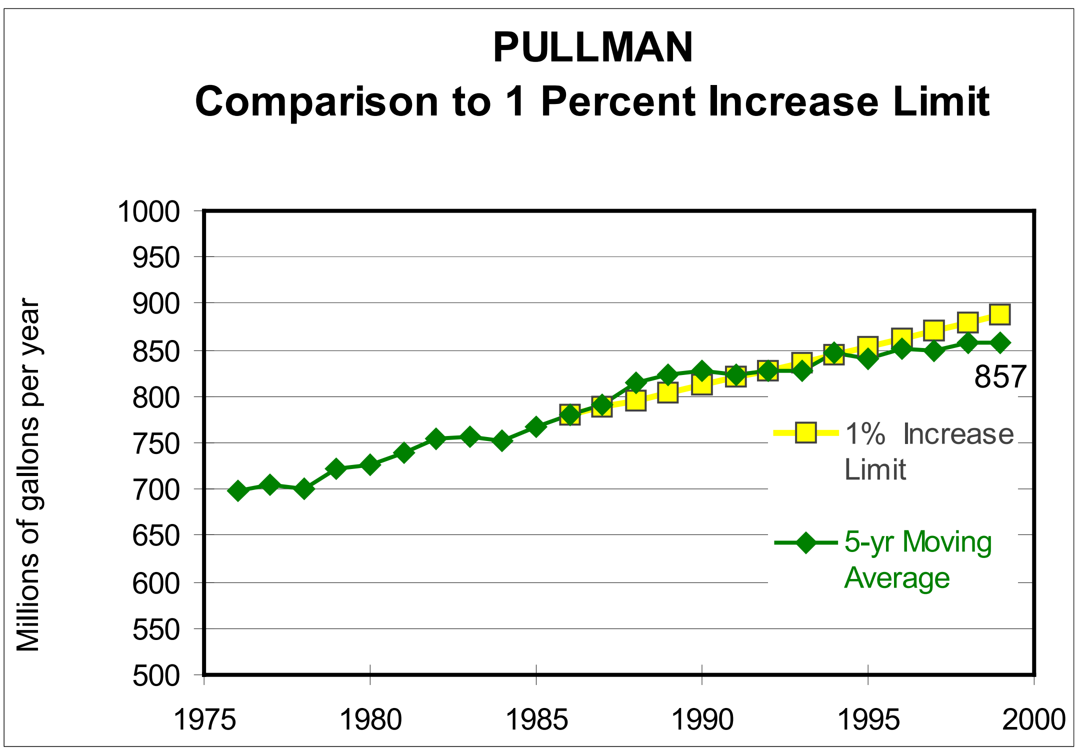
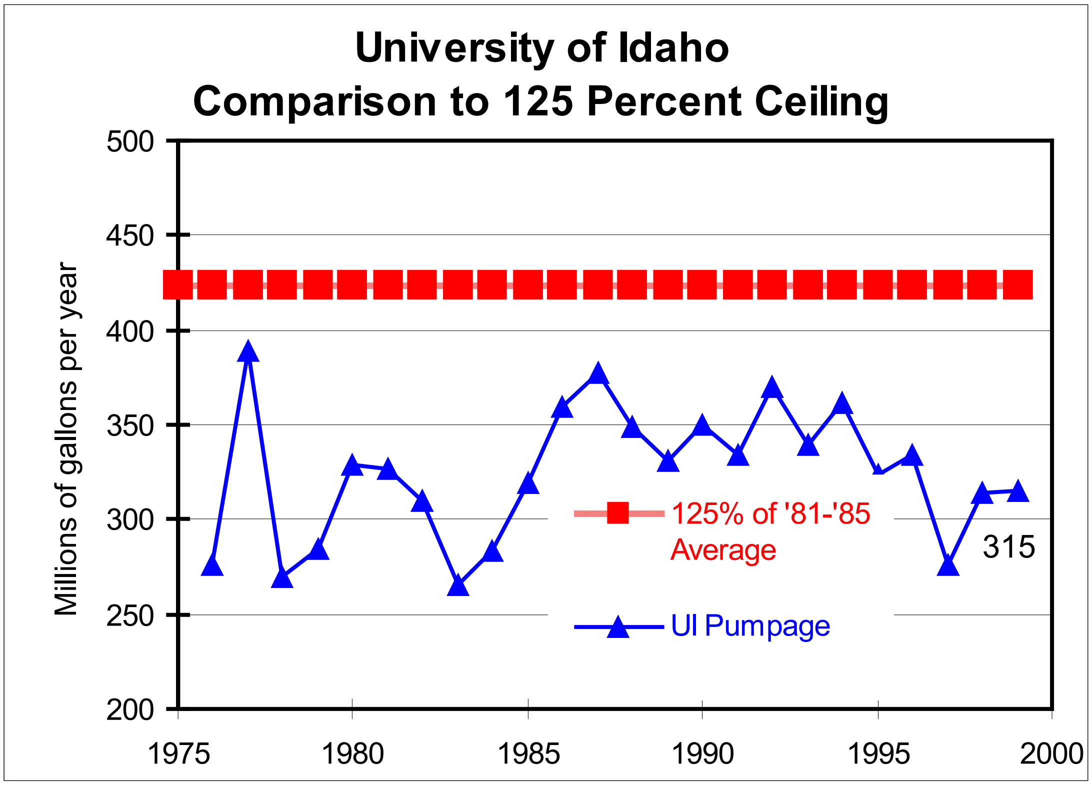




**Figure 5. Actual pumping (top) and comparison to 5-year moving average (bottom) for total annual pumpage by Pullman from 1976 to 1999 compared to voluntary pumping limits.**



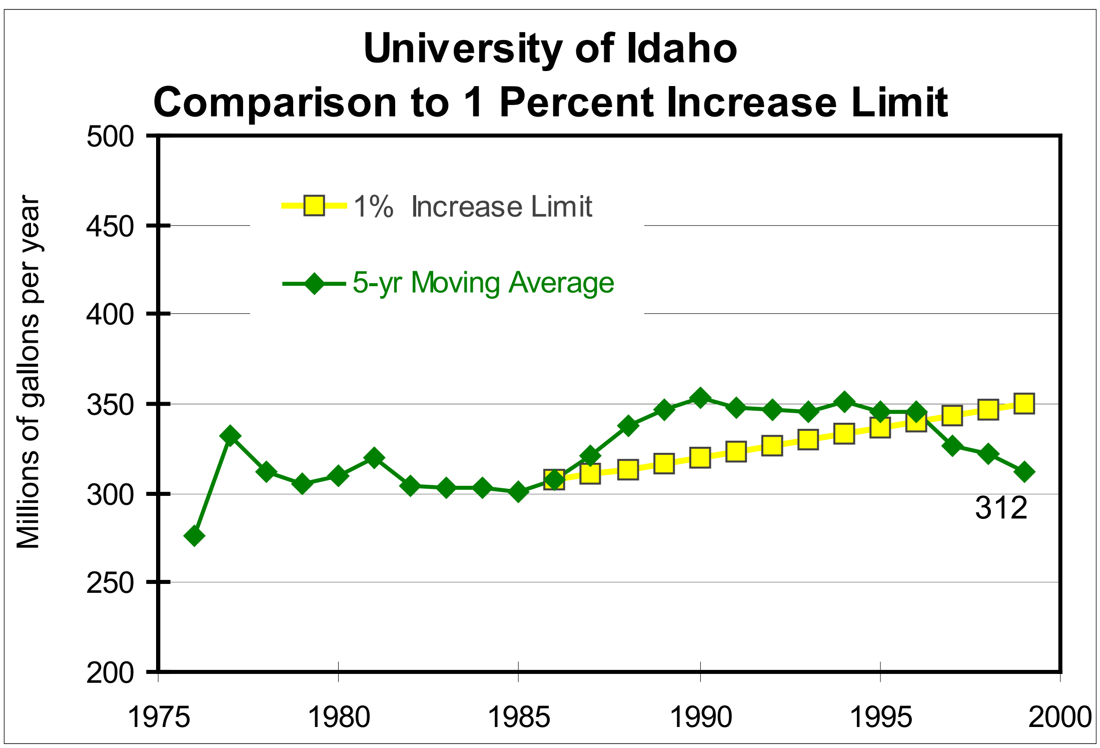
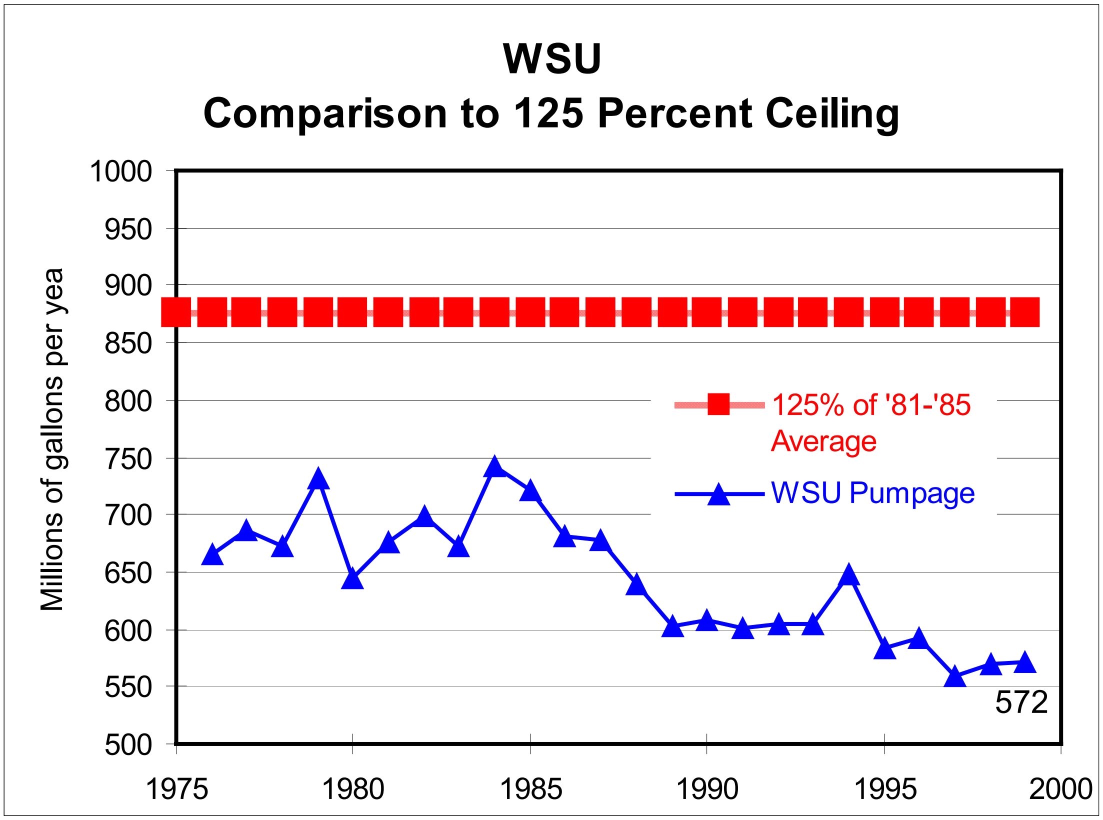




**Figure 6. Actual pumping (top) and comparison to 5-year moving average (bottom) for total annual pumpage by University of Idaho from 1976 to 1999 compared to voluntary pumping limits.**



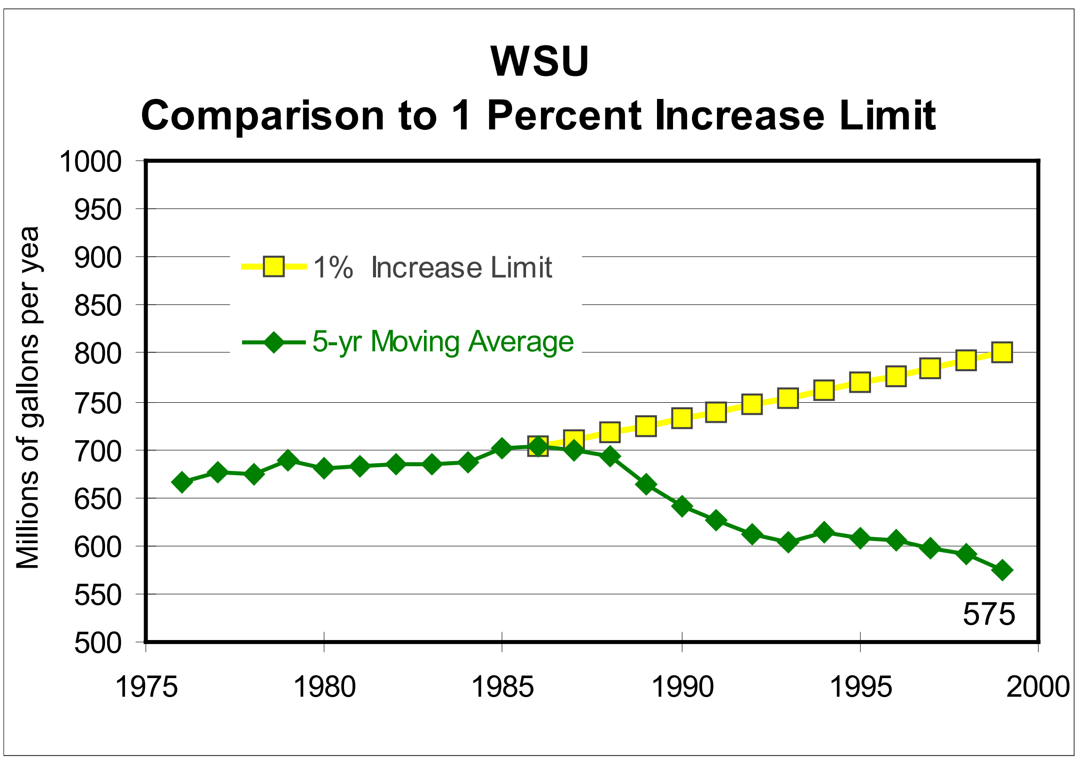




**Figure 7. Actual pumping (top) and comparison to 5-year moving average (bottom) for total annual pumpage by WSU from 1976 to 1999 compared to voluntary pumping limits.**

### 3.3.5 Latah County

In the past, pumpage in unincorporated areas of Whitman and Latah Counties has not been tracked because residential well owners are not required to monitor or report pumping. Residential wells in rural areas of Latah County are typically shallow (less than 250 feet) and pump from the Wanapum aquifer. In 1999, Latah County provided PBAC with an estimate of the number of wells within the basin boundary using tax assessor records. The basin area within unincorporated Latah County in terms of township, range, and section is shown in Table 3.

**Table 3**
**Area of Latah County within Palouse Basin**

| | |
|---|---|
| T40N | R6W sections 13, 24, 25, 36<br>R5W sections 9, 10, 13-36<br>R4W sections 17-19, 30, 31 |
| T39N | R6W sections 1, 12, 13, 24, 25, 36<br>R5W sections 1-24, 26-34<br>R4W sections 6, 7 |
| T38N | R6W sections 1<br>R5W sections 5,6 |

According to 1999 tax assessor records, there are 675 homesites in this area. Assuming the number of homesites is equal to the number of wells, an average of 3 people per home, and water use at the national average residential rate of 70 gallons per person per day (AWWARF, 1999), 142,000 gallons per day or 52 mgy was pumped in unincorporated Latah County within the basin boundary in 1999. This is equal to approximately 2 percent of total groundwater pumped by the four municipal entities. This estimate accounts for indoor residential use only and does not include an estimate for water used for irrigation or other outside uses in these areas.

Whitman County has not provided data on the number of residential wells within basin boundaries in the county. The area of the basin in Whitman County is larger than Latah County (Figure 1); however homesite density may be less. If it is assumed that areas of unincorporated Whitman County pump a similar amount to unincorporated Latah County, then rural areas account for approximately 4 percent of total pumping by the four pumping entities.

## 3.4 Monthly and Peak Water Use

The difference between average winter and summer pumping rates provides a general indication of the amount of water pumped for outdoor use during the summer months. Water demand for residences are much greater in the hotter and drier summer months than during the rest of year, a water use pattern that is typical in the arid western part of the country. This is a water-use pattern that is common for most urban areas in the west. The following section shows the baseline water-use for each of the entities and the peak water-use during the summer months (Figure 8 through Figure 12). The baseline water use, shown as a blue area on each figure, is the average monthly pumpage for November through February for the five previous years (1994 through 1998). Peak water use for 1999, the green area above the baseline, is equal to the additional water used during the warmer months, presumably for non-essential activities including lawn and garden watering, swimming pool filling, car washing, sidewalk cleaning, and other activities.

Table 4 compares the baseline to peak water use on both a monthly and annual basis. During the month of maximum water use in 1999 (July for Moscow and UI; August for Pullman; September for WSU), water use is between 181 percent (UI) and 230 percent (Moscow and Pullman) greater than the baseline. In 1999, peak usage accounted for between 25 percent (UI) and 41 percent (Pullman) of total water usage for the entire year.

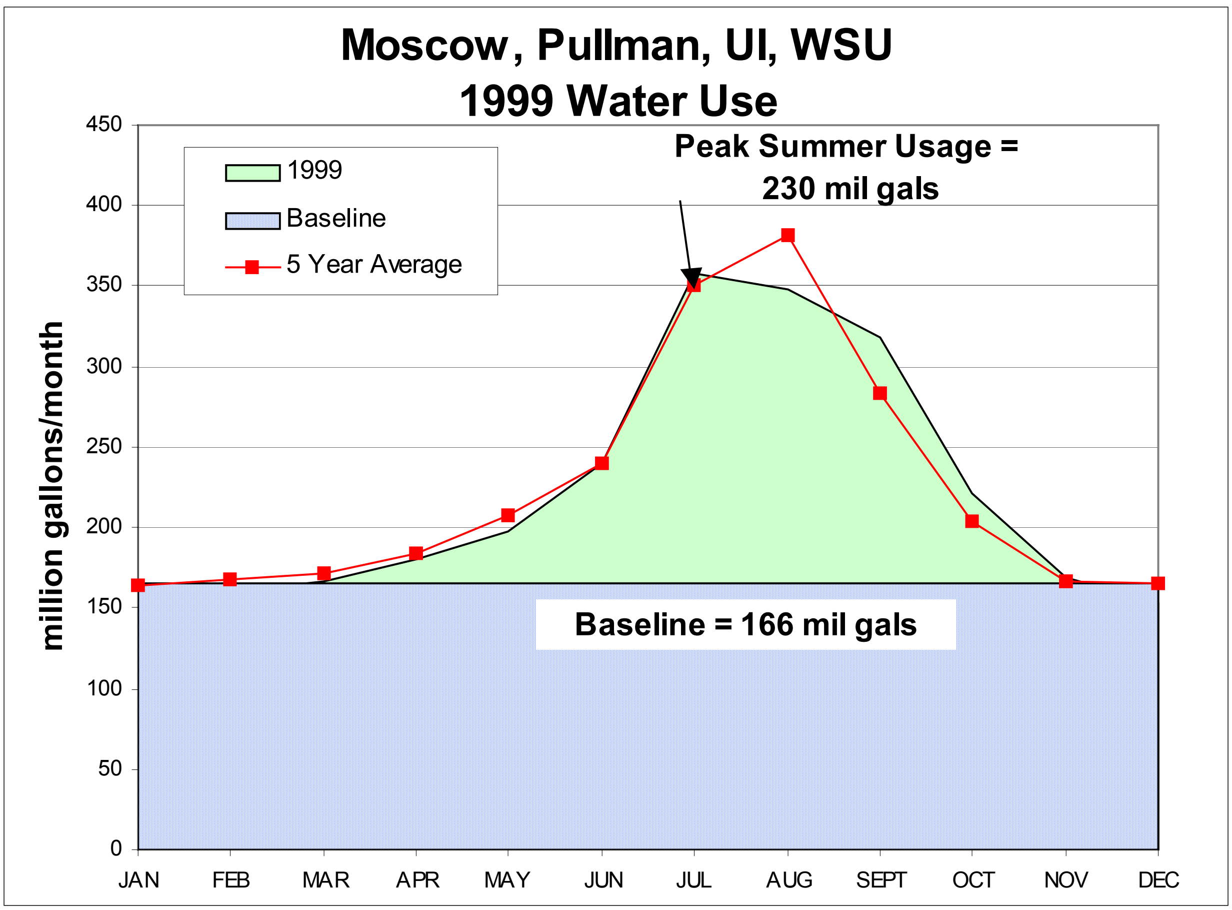



**Figure 8. Moscow, Pullman, University of Idaho, and WSU combined monthly water use, showing baseline and peak water use for 1999.**

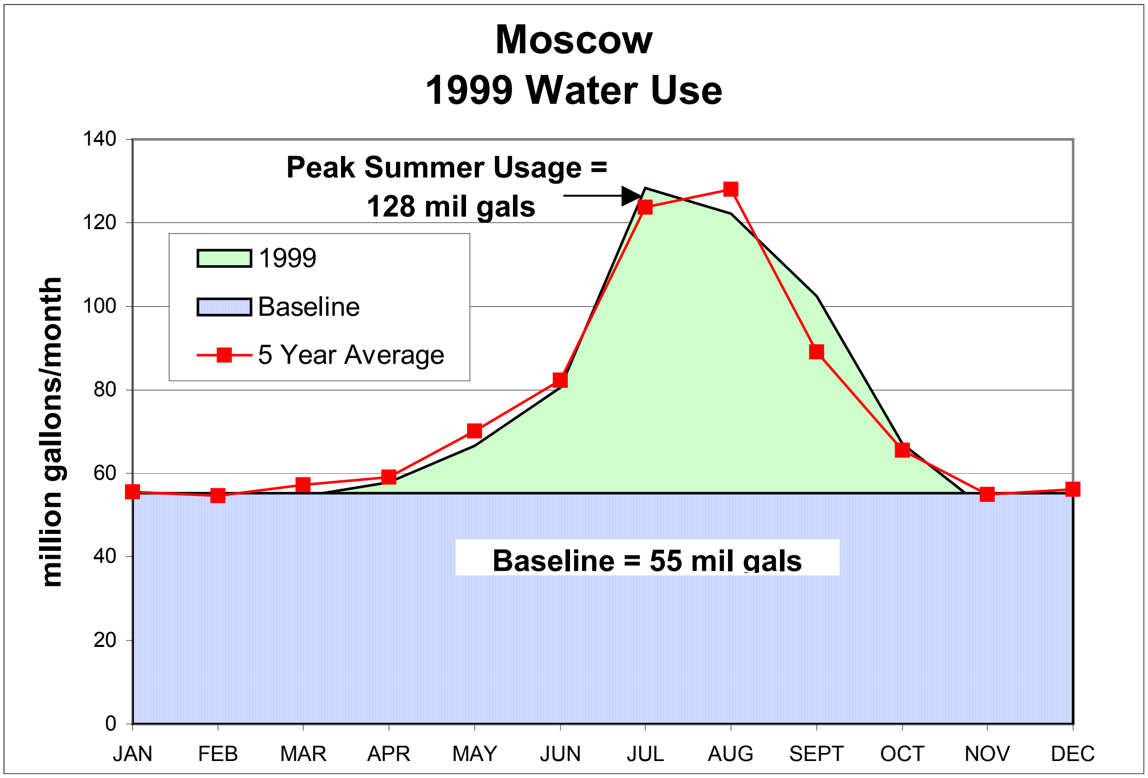



**Figure 9. Moscow monthly water use, showing baseline and peak water use for 1999.**

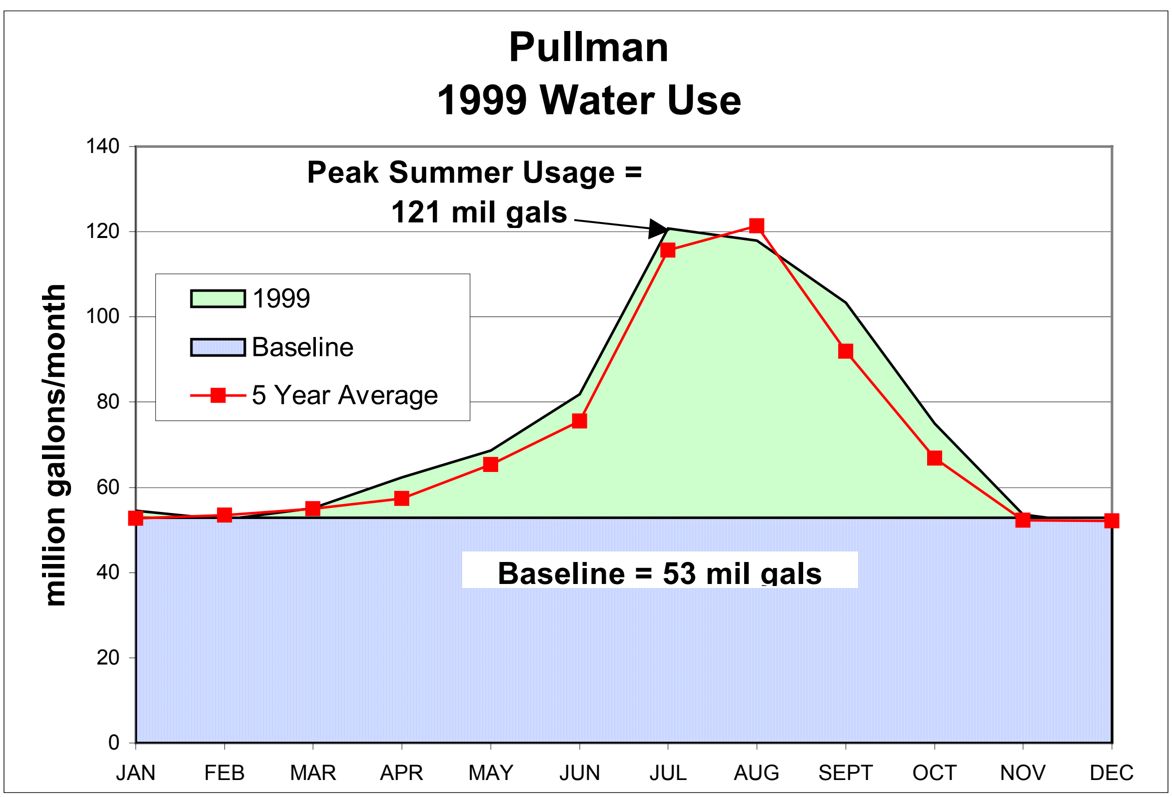



**Figure 10. Pullman monthly water use, showing baseline and peak water use for 1999.**

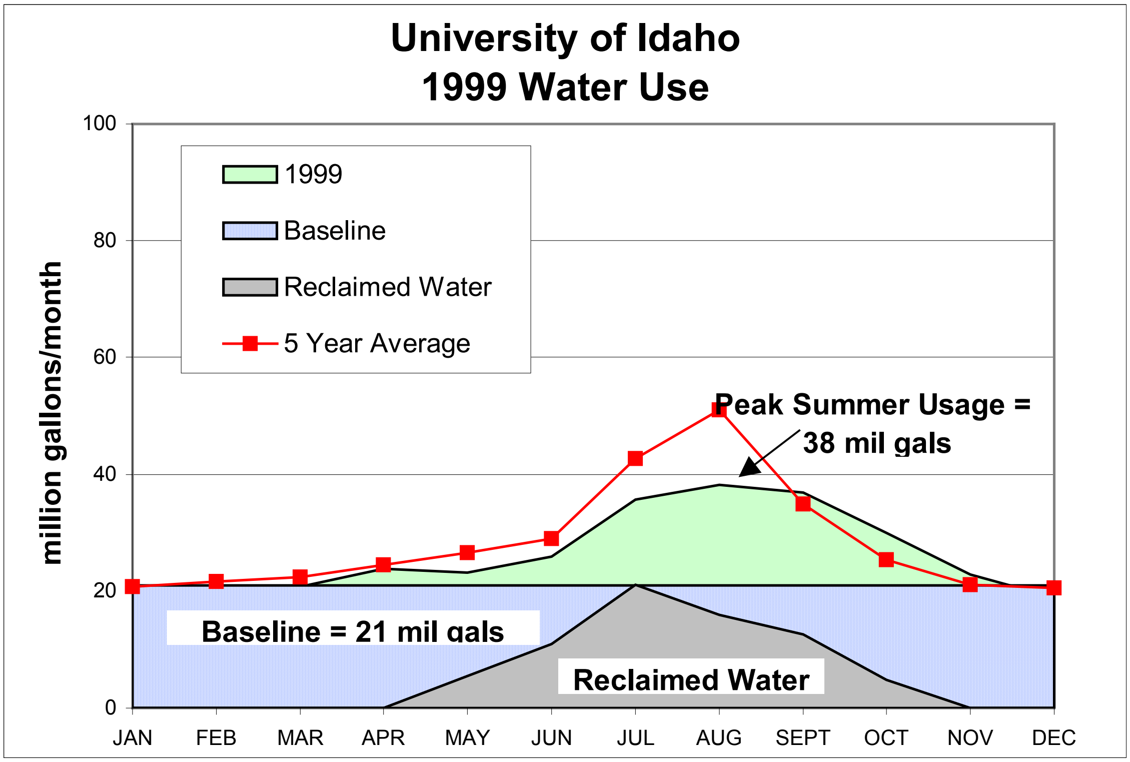



**Figure 11. University of Idaho monthly water use, showing baseline and peak water use for 1999.**

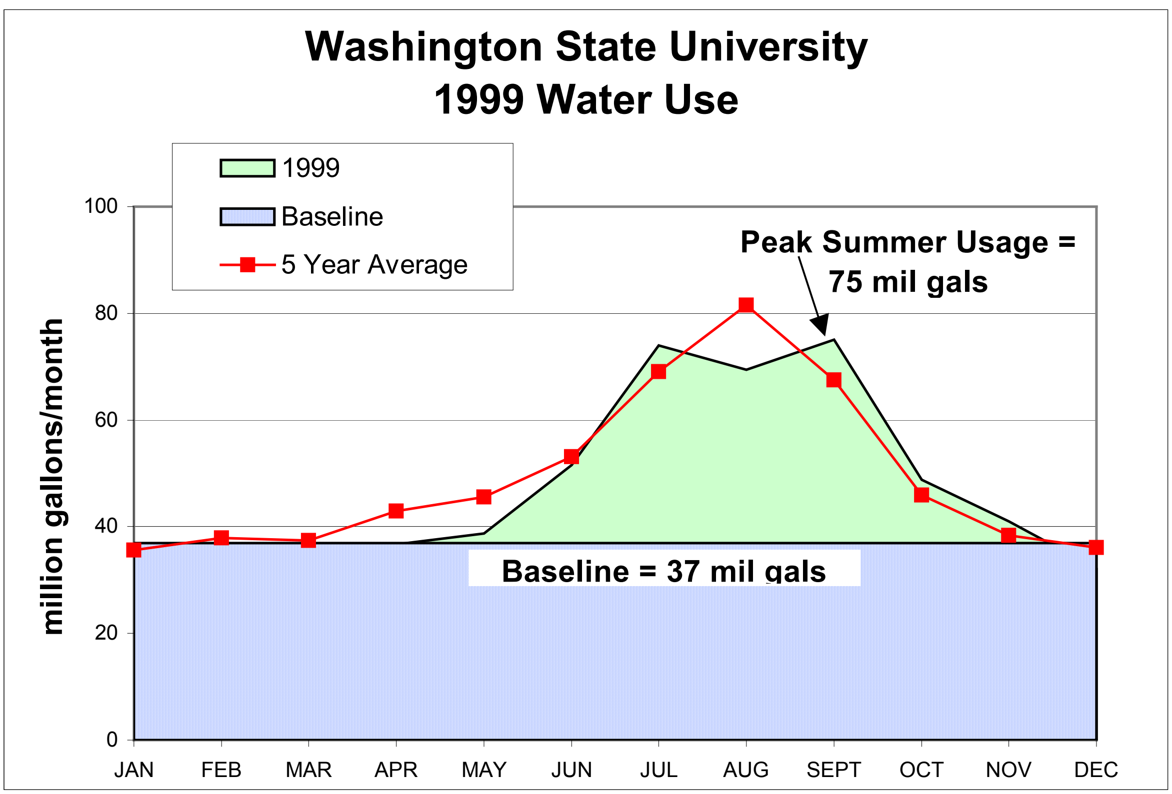



**Figure 12. Washington State University monthly water use, showing baseline and peak water use for 1999.**

**Table 4**
**Comparison of Monthly and Annual Baseline and Peak Water Use**

| | Monthly | | | Annual | | |
|---|---|---|---|---|---|---|
| | Baseline (mgm) | Peak Month (mgm) | Peak (% of baseline) | Baseline (mgy) | 1999 Peak (mgy above baseline) | 1999 Peak (% of baseline) |
| Moscow | 55 | 128 (July) | 233 % | 664 | 225 | 34 % |
| Pullman | 53 | 121 (July) | 228 % | 634 | 262 | 41 % |
| UI | 21 | 38 (Aug) | 181 % | 252 | 63 | 25 % |
| WSU | 37 | 75 (Sept) | 203 % | 444 | 130 | 29 % |
| **All 4 Entities** | **166** | **359 (July)** | **216 %** | **1,991** | **682** | **34 %** |

mgm = millions of gallons per month; mgy = millions of gallons per year
Baseline is equal to the average gpm for 1994-1998 for November through February.
Peak is the maximum pumped during any month in 1999.

As presented in Section 3.3.3, the UI used an additional 71 mgy of recycled water in 1999 for irrigation (Figure 11). This recycled water irrigation system was installed in 1977-78 by the UI as a means of good water stewardship to reduce the demand on the area's groundwater supply. The majority of the large green areas on the UI campus use recycled water for irrigation needs including the 18-hole golf course, Arboretum, Central Mall, UI-Tank Hill, Guy Wicks Field, Hartung Theater lawn, West Field, Law Building lawn, Dan O'Brien Running Track, North Field, and the football practice field. Future expansion of the recycled water irrigation system will include the Administration Building lawn.

## 3.5 Per Capita Water Use

The per capita water-use is defined as the amount of water used by one person in one day. The only water use data readily available for the Palouse Basin is the total amount of water pumped by each of four entities. Population data provided by both cities include the populations of each university. The available data can be used for preliminary comparisons of per capita water use, where *per capita is defined as the total water pumped by an entity divided by the population of that entity* (in this case the water pumpage and populations of each city and its respective university are combined). Because user type is not separated out of this data set, the total amount pumped includes industrial and public uses of water (swimming pools, irrigation of public spaces, etc.) and should not be confused with *residential per capita data*, which quantifies the amount of water used at a residence by an individual for personal needs (showers, laundry, toilets, dishwasher etc). Although there is no data on residential end use of water in the Palouse, it is useful to present national averages of water use, in anticipation of developing this data for the Palouse. The national average for residential end uses is 69.3 gallons per capita per day (gpcd) (including leakage) according to a study by released by the American Water Works Association Research Foundation (AWWARF, 1999).

Figure 13 presents the per capita water use obtained by dividing total pumpage by population. Population data for Pullman includes WSU (City of Pullman, 1999) and population data for Moscow includes the UI (City of Moscow, 2000). Given the limitations of the data set, it is difficult to compare these data with national averages of per capita (residential end user) water use. However, this figure is useful in demonstrating that per capita water use has declined in the last two decades.

The decline in per capita usage can be attributed in part to more efficient water use practices implemented by the four major water suppliers (WSU, UI, Pullman, and Moscow), following enactment of the GMP (PMWRC, 1992). For example, during the past decade (1990-1999), considering all four entities, overall water use has increased a total of 4.6 percent while the population increased by approximately 13 percent from 42,000 to 47,445 residents. During this period, despite the population of Pullman (including WSU) increasing nearly 10 percent, water use by Pullman and WSU remained at nearly the same level in 1999 as in 1990. During the same period, the population of Moscow (including UI) grew at a rate of 1.9 percent per year, or a total of 18 percent, and water use increased by only 11 percent. Population estimates supplied by Moscow and Pullman are included in Appendix B.

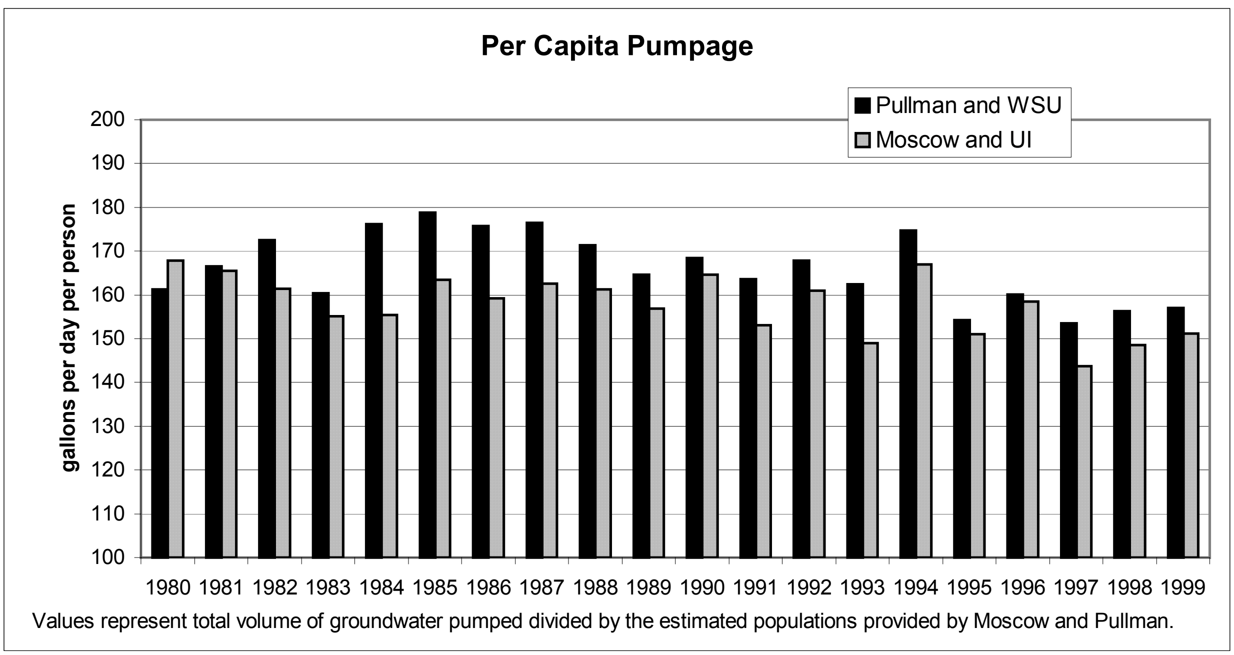



**Figure 13. Per capita water use (defined as total water pumped divided by total population) in Idaho (Moscow and University of Idaho) and Washington (Pullman and WSU) from 1980 to 1999.**

## 4.0 GROUNDWATER LEVELS

Since groundwater development began in the late 1890's, the water levels in the basalt aquifers have been declining. Before the initiation of groundwater pumping, the groundwater-surface water system was in a state of equilibrium, with groundwater recharge equaling groundwater discharge. Pumping groundwater resulted in an imbalance and the system responded with a reduction in the volume of water stored in the aquifer resulting in a drop in groundwater levels. By lowering water levels, the surface water–groundwater system responds with decreases in natural groundwater discharge to springs and streams resulting in a reduction in streamflow. Lower water levels can also serve to increase recharge to groundwater. Groundwater level data is presented in Appendix B.

The historic rate of pumpage and groundwater level decline exhibited in the Grande Ronde aquifer in the Pullman area from 1890 to present is shown in Figure 14. This historic data show that the rate of groundwater decline for wells in the Grande Ronde is approximately 1.5 feet per year. Trendlines for both groundwater pumpage and groundwater elevation on Figure 14 indicate that since 1980 there has been a slowing in the rate of annual pumpage increases and a slowing in the rate of groundwater level decline.

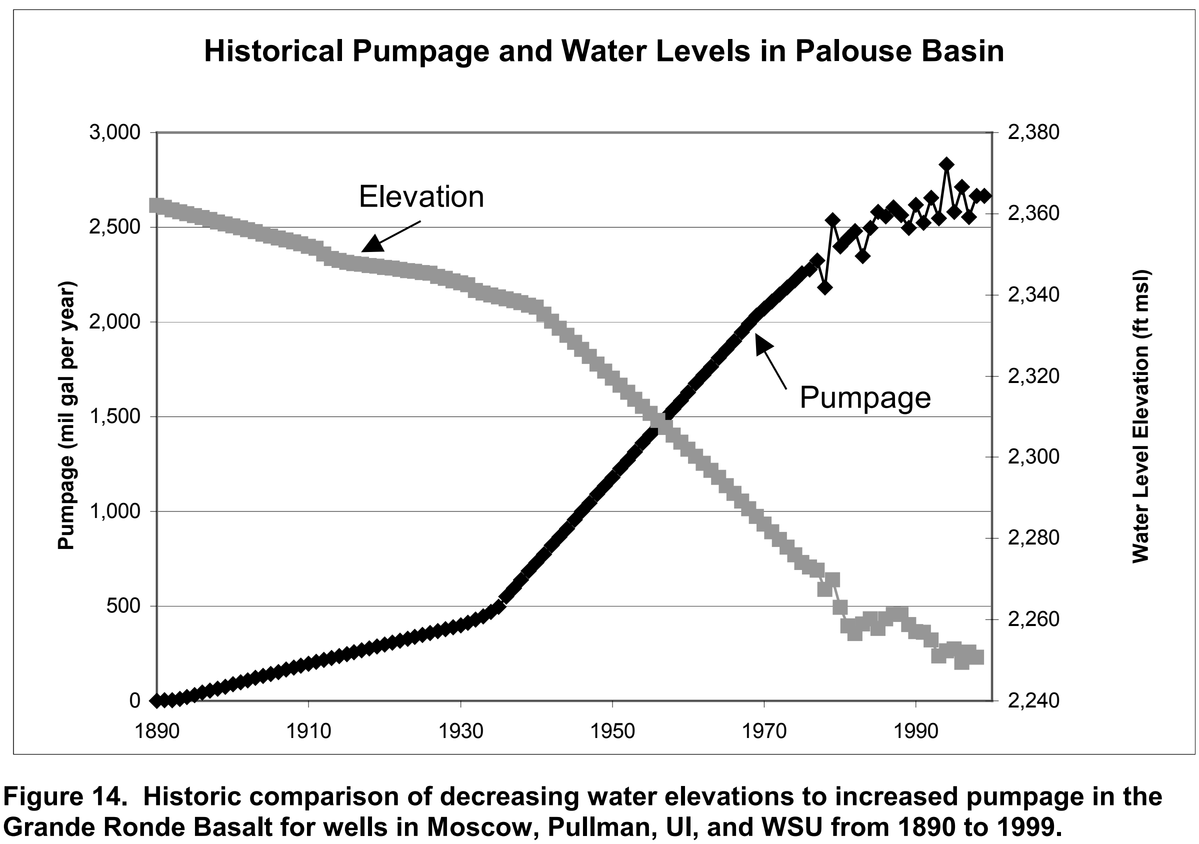



**Figure 14. Historic comparison of decreasing water elevations to increased pumpage in the Grande Ronde Basalt for wells in Moscow, Pullman, UI, and WSU from 1890 to 1999.**

In the past, water level data for the basin has been limited to the measurement systems installed in some of the municipal wells in the basin. The precision of these water level measurements is variable, and some systems have never been calibrated to test accuracy. Both Pullman and Moscow have begun updating all their wells to electronic water level devices in the wells to provide more accurate data. The cities have a program of regular water level monitoring in all wells, whereas the universities infrequently monitor the water levels in only a few of their wells. For these reasons, existing water level data have been useful for basin-wide generalizations, but have not permitted a more detailed analysis of water level fluctuations and responses to pumping in various wells. Research funded by the PBAC in 1999 includes equipping up to a dozen wells at one time with continuously recording water level devices that are accurate to within a foot in order to better characterize the basin hydrogeology (refer to Section 6.2, below).

## 4.1 Wanapum (Priest Rapids) Aquifer

Historical water level data for the Wanapum aquifer is obtained from water leveling devices installed in Moscow Wells 2 and 3 (Figure 15). Pumpage from the Wanapum has decreased since the 1950s when declining groundwater levels and poor water quality prompted the city of Moscow and UI to drill new wells into the Grande Ronde. The development of the deeper Grande Ronde aquifer resulted in significant reductions in pumpage from the Wanapum. (Lum and others, 1990). Water levels in these two wells fluctuate more than water levels in most Grande Ronde wells. The groundwater levels increased in 1998 and declined in 1999. The increase in Well 2 of 18 feet in 1998 is due to the installation of a new, more accurate groundwater level measurement device (PBAC, 1998).

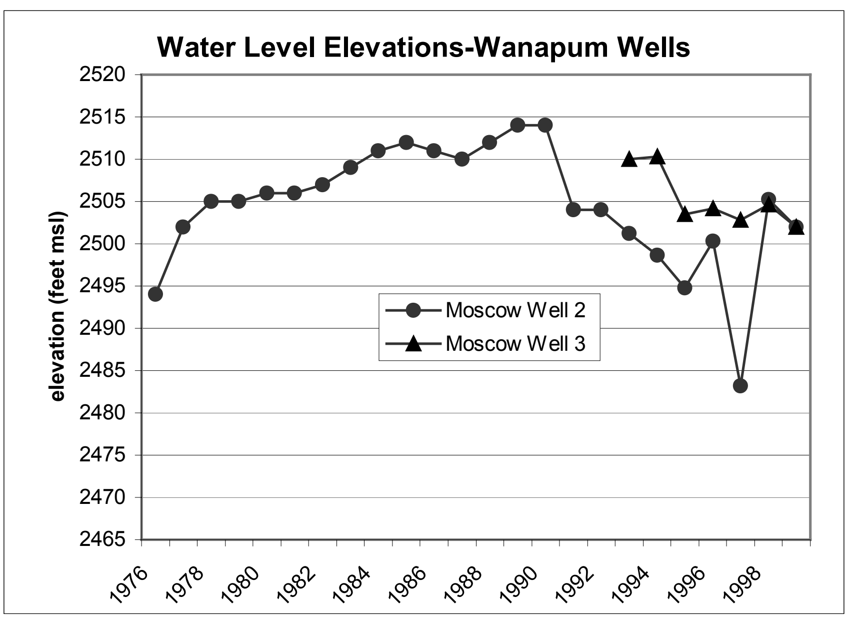



**Figure 15. Groundwater level elevations in Wanapum wells from 1976-1999.**

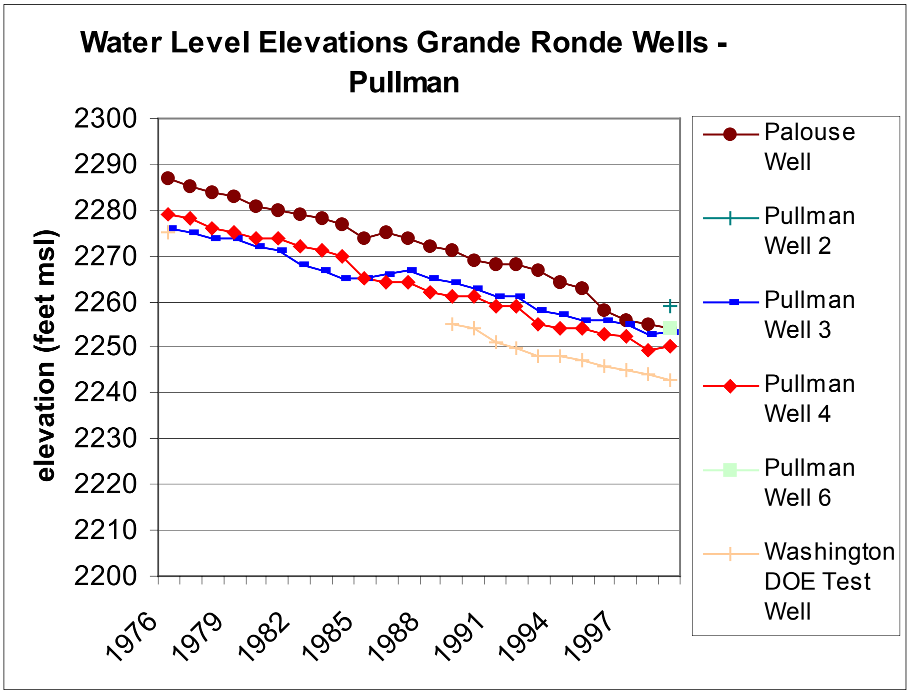



**Figure 16. Groundwater level elevations for selected wells in the Grande Ronde Basalt in the Pullman-Palouse area during the period 1976-1998.**

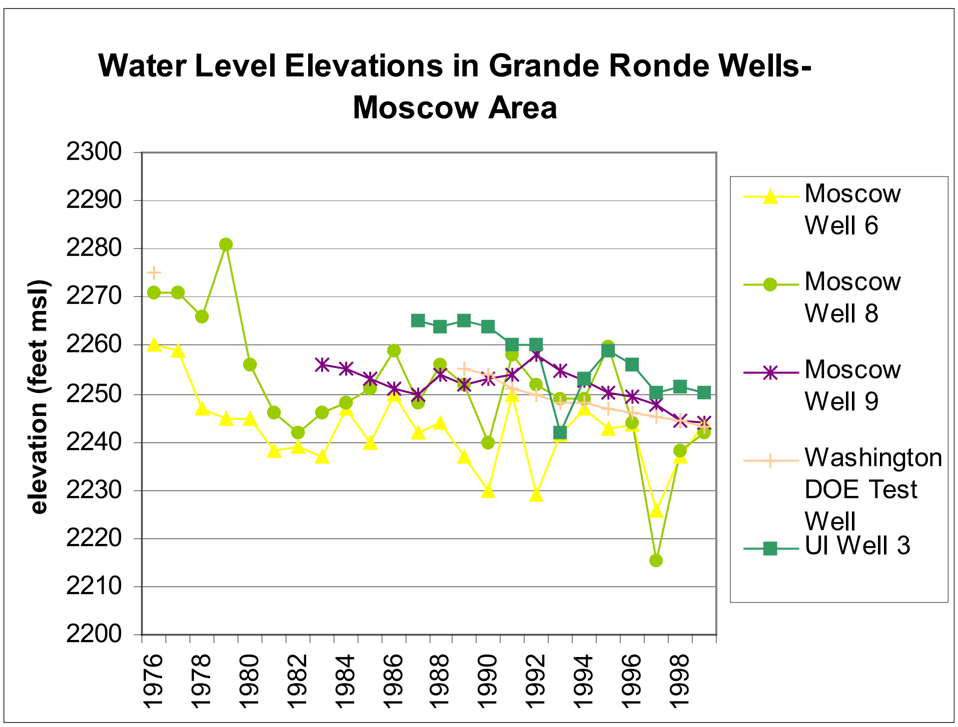



**Figure 17. Groundwater level elevations for selected wells in the Grande Ronde Basalt in the Moscow area during the period 1976-1998.**

## 4.2 Grande Ronde Aquifer

On average, groundwater levels in the Grande Ronde Basalt continue to decline at a rate of 1 to 1.5 feet per year. Data for Grande Ronde wells in Pullman and Moscow (including Palouse and the WDOE Well (DOE Well) located between Moscow and Pullman are shown on Figure 16 and Figure 17, respectively. These data suggest that the groundwater levels in the Grande Ronde Basalt in the Pullman-Palouse area is declining at a rate of 1 to 1.5 feet per year. Groundwater levels in the Moscow area have historically declined at rate of nearly 1.5 feet per year but this decline appears to have stabilized in recent years (Figure 17). The data suggest that the rate of groundwater decline occurring in the Pullman area is much more uniform than the rate of groundwater decline in the Moscow area. Although the water levels presented are representative of static (not pumping) water levels, the greater fluctuation in Moscow Grande Ronde wells may be due to the longer recovery period required for these wells to reach equilibrium (T. Scallorn).

The City of Palouse has two municipal wells: one was constructed in 1903, and the other was drilled in late 1999 and will be operational in 2000 (Table 1). Both wells are developed in the top of the Grande Ronde aquifer. Comparison of the historic groundwater level elevation declines at the cities and universities to the Palouse well shows similar rates of decline. However, while the cities and universities have increased pumpage since 1986, Palouse has significantly decreased the amount of groundwater pumped annually (Figure 18). Despite decreasing pumpage, water levels in Palouse continue to decline at a rate similar to the rates of decline in the Pullman and Moscow area municipal wells. These data support the theory that the Palouse area north of Kamiak Butte is hydraulically connected to the Pullman-Moscow groundwater basin and that pumpage from the Grande Ronde aquifer at the Pullman and Moscow city centers are affecting groundwater levels in City of Palouse. This theory is being tested as part of the research that the PBAC began funding in 1999.

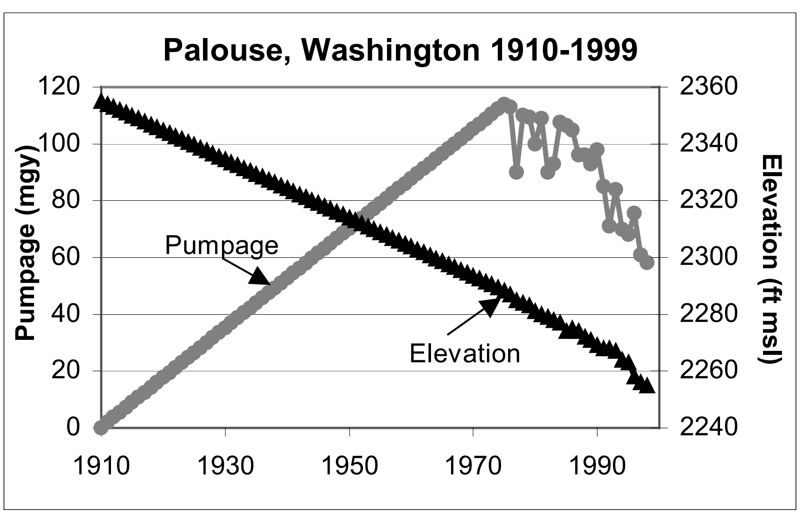



**Figure 18. Average groundwater elevation and pumpage in Palouse, Washington.**

# 5.0 WATER QUALITY

The quality of the groundwater in the basalt aquifers in the Palouse basin is very high. No contamination was detected in water supplied by the four entities in 1998, the most recent year for which data are available. Concentrations in water supplied to the public were below federal drinking water standards, or Maximum Contaminant Limits (MCLs), for all analyzed constituents. Because of the high quality of groundwater, the water suppliers need only treat the water with a small amount of chlorine to prevent bacteria growth from occurring in the water supply system. No additional treatment is necessary, except to remove iron and manganese in from water pumped from several of Moscow's wells, as discussed below in Section 5.2.

In response to growing concern about groundwater contamination by methyl tertiary-butyl ether (MTBE), a gasoline additive that results in cleaner burning fuel. All City of Pullman and Moscow wells were tested for MTBE in early 2000. Results were negative for all wells in both cities.

The shallowest occurring groundwater in the area is encountered in the Palouse Loess, or related sediments (refer to Section 2.1). Land use practices at the surface, particularly leaking underground fuel storage tanks, have resulted in localized contamination of this shallow groundwater. Although the hydraulic connection between the shallow zone and the deeper municipal aquifers is unclear, to date, none of these shallow contaminants (primarily fuel and related compounds) have been detected in water supply wells that pump from deeper zones.

## 5.1 Consumer Confidence Reports

As part of the 1996 Amendments to the Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) required water suppliers nationwide to provide annual reports on the quality of their drinking water, called Consumer Confidence Reports (CCRs), and to compare water quality to federal drinking water standards. In accordance with this regulation, the annual water quality reports for 1998 were provided to the public by October 1999. CCRs for 1999 and each year thereafter will be provided to the public by July 2000 and in July for each subsequent year. Copies of the 1998 CCRs for each of the four water suppliers on the Palouse are available from the individual water suppliers or from PBAC.

## 5.2 Iron and Manganese

Although iron (Fe) and manganese (Mn) pose no known health risks in moderate concentrations, the presence of these elements in drinking water is undesirable due to aesthetic considerations because they affect the taste, odor, and color of the water. These constituents precipitate in water distribution systems and constrict flow through pipes. Federal standards for constituents posing no known health risks, called secondary MCLs, are frequently exceeded in groundwater of the

Palouse Basin. All wells drilled in the Moscow area in the Wanapum and Grande Ronde have naturally occurring iron and manganese concentrations that are significantly higher than similar wells drilled in the Pullman area (Idaho Dept. of Health, 1994 and Washington Dept. of Health 1997). By treating the water from the shallow aquifer and blending water from these wells with water from wells lower in these constituents, the water delivered to Moscow customers is lower in Fe and Mn than naturally occurs in the groundwater.

Higher concentrations of iron and manganese in Moscow's water supply are attributed to a greater abundance of sedimentary interbeds enriched in iron and manganese in eastern portion of the Palouse Basin. Moscow operates a green sand filtration plant to remove Fe and Mn from water from Wells 2 and 3, which pump from the Wanapum aquifer. During the 1990's, the city invested over $250,000 for major reconditioning of the filtration plant, allowing continued pumping from the Wanapum aquifer in Moscow and thus alleviating some of the demand on the Grande Ronde aquifer. In addition, the City of Moscow maintains an active flushing program through its fire hydrants to remove Fe and Mn that has accumulated in the distribution pipes.

Water from the Wanapum aquifer in Moscow sometimes has an odor of rotten eggs caused by high concentrations of harmless, naturally occurring sulfates. These sulfates convert to hydrogen sulfide gas when the water is exposed to oxygen. The problem can be eliminated by turning up the water heater to 150 degrees to kill the bacteria or by replacing the magnesium anode in the hot water heater with an aluminum anode, which will also reduce corrosion potential in the walls the hot water tank.

# 6.0 1999 ACCOMPLISHMENTS AND 2000 WORKPLAN

## 6.1 1999 Accomplishments

The 1999 tasks for PBAC identified in the 1998 Annual Report and the progress on each item by the end of 1999 are summarized in Table 5.

**Table 5**
**1999 Workplan Tasks and Status**

| 1999 Workplan Task | Status (end of 1999) |
|---|---|
| 1. Increase data collection on groundwater levels in the aquifers | Through funding of research, water levels are being monitored in many wells around the basin |
| 2. Explore the possibility of increasing groundwater recharge | Through funding of research, this task is being addressed |
| 3. Update the groundwater management plan | Ongoing, to be completed in 2000 |
| 4. Collect and analyze hydrogeologic data obtained from drilling the new municipal supply well in the City of Palouse | Data were collected during well drilling in late Dec 99 and Jan 00. Data analysis will be completed in 2000 |

In addition to these stated goals, other notable achievements of 1999 include creation and maintenance of a PBAC web site and the commitment to fund a major basin research project for three years. The PBAC web site is hosted by UI and can be accessed at http://www.uidaho.edu/pbac.

## 6.2 Basin Research

The basin research project funded by the PBAC is entitled "Evaluation of Hydrostratigraphic Conditions in the Palouse Basin" or the "OK Project", referring to the names of the two principle investigators, Dr. Jim Osiensky of UI and Dr. Kent Keller of WSU. Dr. John Bush of UI is also participating in this research. In June 1999, the four water suppliers agreed to provide up to $20,000 each per year for three years to fund a study that will provide a much clearer understanding of the hydrogeologic characteristics of the Palouse basin. Results from this study will help PBAC make decisions on how best to utilize the limited groundwater resources and to determine what sources of water could supplement these dwindling groundwater supplies. One of the primary goals of this three-year study is to evaluate the fate of precipitation in the basin. The USGS study (Lum and others, 1990) indicated that much more precipitation falls on the basin each year than is pumped from the ground. Because groundwater levels continue to decline in the deep aquifer, it is clear that most of the precipitation left after evapotranspiration does not enter the deep aquifer, but flows out of the basin either in streams and creeks, or via the shallow aquifer. It is also important to understand where and how groundwater exits the basin to determine if some of it could be captured for beneficial use. As part of this research, local stream water isotope geochemistry is being compared to the isotope geochemistry of groundwater in both aquifers to estimate the amount of groundwater being discharged into streams.

The UI and WSU team is also investigating potential connections between the two aquifers. In August 1999, the research team installed a dozen probes in wells around the basin to continuously record water levels in the wells. By comparing changes in water levels with pumping data supplied by the cities and universities, the research team will gain an understanding of how the aquifers respond to groundwater withdrawal at the pumping centers and whether there is any detectable response between aquifers.

### 6.3 2000 Workplan

Continually declining water levels in spite of reduced pumping increases suggest that basin-wide pumping is greater than the amount of water that is being recharged, or replaced, naturally to the Grande Ronde aquifer. Additional research is needed to determine if this is a correct assumption.. Recognizing this possibility, PBAC efforts are aimed at better understanding the groundwater basin and investigation of strategies to increase recharge and to halt or reverse the falling water levels. Specific goals for 2000 include:

1. Continue to improve understanding of hydrogeological conditions of Palouse Basin through support of the basin research and the Osiensky-Keller Project.
2. Attempt to secure supplemental funding for additional research and related projects from states of Idaho and Washington.
3. Complete update Groundwater Management Plan.
4. Regularly update and continued improvements to PBAC website.
5. Collect and analyze hydrogeologic data obtained from drilling the new municipal supply Well 7 in Pullman and new Whitman County well at the Colfax Airport.
6. Increase community leadership awareness of groundwater and local water supply issues.
7. Initiate an economic evaluation of supplemental water sources for the entities.
8. Continue efforts to encourage water conservation by entities and citizens that rely on groundwater from the basin for all their water supply needs.
9. Develop a long-term funding mechanism for halting the water level decline in the deep aquifer.

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