REPORT ON

WATER SUPPLY AND HYDROLOGY OF

THE INDIAN BATHTUB AREA

OWYHEE COUNTY, IDAHO

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FOR

U.S. FISH AND WILDLIFE SERVICE

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SITUATION:

The Indian Bathtub is located in Hot Creek in Owyhee County, Idaho and is the type location for the Bruneau Hot Springs snail. The water supply for the Indian Bathtub issues from springs fed by the geothermal system underlying the area south of the Snake River. Measured flows of these springs and others in the Hot Creek drainage have decreased significantly since 1954. This decrease in flow has resulted in diminution of the Bruneau Hot Springs snail habitat on the surface of basalt rock exposed in the bathtub. Snail habitat has historically been formed by dispersed spring flow issuing from fissures and vents above vertical rock surfaces enhancing algal growth on the rock face. The extent of the wet rock surface covered with brown algae, which constitutes the apparent snail habitat, was approximately 50 square inches on April 4, 1989.

Along with the decrease in spring flows, recent (post 1984 or 1985) surface runoff events have carried sediments into the Indian Bathtub area, and the channel downstream. These sediments, mostly fine to coarse sands and gravels, have not been flushed from the bathtub or channel and the current sediment surface is some 2 to 3 feet or more above the pre-flood event level. There is no depression or ‘tub’ of any magnitude at the present time.

The decrease in flow of the springs in the Indian Bathtub has been documented by the U.S. Geological Survey by a small number of miscellaneous measurements since 1922 and by the Idaho Department of Water Resources with monthly measurements of the spring flow and creek flow since January 1986. These recent records show that the spring flows peak about March of each year at about 80 to 100 gpm and have been near zero in September of the last three years. Historical measurements have indicated flows as high as 2200 gpm.

AQUIFER SYSTEM

The geothermal aquifer system consists of deeper northward—dipping silicic volcanic rocks overlain by younger less permeable basaltic flows and even younger unconsolidated materials of lacustrine or lake materials. Wells developed in the deeper rocks exhibit or have exhibited artesian pressures or piezometric pressures sufficient to cause these wells to flow at the ground surface or to have very low depths to water in the well. These formations within the aquifer system, particularly the deeper silicic rocks, are faulted in a general southeast to northwest direction with the downthrust to the north. The faulting, much of which has been mapped in the hard—rock areas where scarps are evident, results in compartmentalization of the aquifer system, differences in aquifer properties within various parts of the system and abrupt changes in the flow system within the aquifer. Within each compartment or aquifer section, the recharge may be from different sources, the water movement between compartments may be restricted and the response in various areas of the aquifer from pumping in one specific area may be very different. The result of this structural control of water movement within the aquifer is very complex hydraulic system.

Natural surface discharge from the aquifer system is from springs which are located primarily along fault zones. Flow from specific springs is conveyed from the underlying silicic volcanic rocks through fractures or vents in the less permeable overlying rock and flow magnitude is related to the piezometric pressure at the spring orifice. Most of the springs are along or adjacent to the incised Bruneau River.
channel or tributary channels. However, several springs are evident in the alluvium of the flood plain of the Bruneau River. The various vents or springs serving the Indian Bathtub are evident from water erosion patterns, present discharge locations, and photographs from as early as 1922. Based on the photographs and current geological indicators, the historical flow from these springs probably issued from vents as much as 10–15 feet above the currently flowing springs. This indicates that the piezometric surface in the bathtub vicinity could historically have been 10–15 feet above the current levels.

Measurements of piezometric heads (well head pressures or depth to water) in some production wells and observation wells have shown declines of up to one (1) foot per year over the last 35 years; however the number of observation wells is small and the response trends are not uniform throughout the aquifer system. The non-uniformity in piezometric head response indicates possible non-uniform local draft, compartmentalization within the aquifer, or non-uniform recharge.

Geothermal water from flowing or pumped wells is used for irrigation of crops and to a limited extent for heating and aquaculture. Well drilling has increased since the 1950’s, however, the magnitude and trends in geothermal water use have not been adequately documented. It is known that larger wells with higher yields have been drilled most recently while smaller low-yield wells were prevalent in the early development periods. Many artesian wells formerly flowed year round and may or may not have been beneficially used during the non-irrigation season. Recent attempts by the Idaho Department of Water Resources to restrict diversions to permitted uses and periods has been successful and it is believed that non-irrigation season diversions have decreased.

SNAIL HABITAT ENHANCEMENT OR PRESERVATION

Bruneau Hot Springs snail habitat has been discovered at or in the vicinity of the Indian Bathtub and in at least two small springs in the Hot Creek drainage above the confluence with the Bruneau River. Preservation and enhancement of the existing habitat in the Indian Bathtub area by natural processes requires an increase in the spring flow from strategic vents above and within the vertical rock surfaces. Both short-term and long term technical alternatives for achieving this goal are desired.

Short Term Alternatives
It is likely that the existing habitat (estimated at 50 square inches) which now exists on the rock face above the sediment level may be eliminated this season (1989) due to zero or near zero spring flow in September or earlier. Whether or not the snails are capable of burrowing and could effectively survive within the sediments is not known. In any case, two possible short-term alternatives are offered, both of which are structural remedies and costly.

A production well could be drilled near the Indian Bathtub to produce up to 50 gpm of geothermal water which could be conveyed to strategic locations above the vertical rock surfaces and dispersed to maintain wet surfaces. This well would not flow and would require either an electric, gasoline or diesel, or solar powered pump. The flow required to maintain sufficient wet surface would depend on the area of surface required and the efficiency in dispersion of the flow over the surfaces. It is likely that considerably less than 50 gpm would be required and a solar powered pump might be feasible. Pumping of a well in the vicinity of the bathtub might theoretically intercept the flow to the bathtub, however it is unlikely that the impact of this magnitude of flow on the actual spring flow would be discernible. Temperatures and chemical quality of the well water should be similar to the existing spring water. A production
well in this vicinity may have to be drilled 600 to 700 feet to effectively penetrate the artesian system. It is possible that, as an interim measure, one of the planned observation wells for the USGS study might be drilled earlier than the second year of the study and serve as a production well. No costs for the alternative have been developed.

A second structural alternative for short-term preservation or enhancement of the habitat in the bathtub area is to circulate geothermal water from existing springs downstream of the bathtub area. At least two small springs, approximately 1/4 mile downstream of the area now provide some snail habitat. Water from one or more of these springs could be collected immediately after it flows over the snail habitat and pumped back up the canyon to be dispersed over the Indian Bathtub habitat. The quality of this water would be proven, in that this water already supports habitat. The only unknown would be the effect of slightly decreased temperatures due to exposure to the atmosphere and detention time in the pipeline. There could be a problem with easements for the collectors and pipeline since this land is in private ownership. Pumping requirements would depend on the effective lift and pipeline head loss and the necessary discharge rate. Energy sources for pumping could include electricity, gasoline or diesel or solar power depending on total pumping head and discharge requirements. No costs for this alternative have been developed.

No other short term remedies are evident to maintain the natural habitat in the immediate area of the Indian Bathtub since no other alternative water supplies are available.

One alternative which would be less costly than either a well source or recirculation of spring water, would be to provide artificial habitat by diverting flow from existing springs by gravity downstream of the bathtub, conveying by ditch to artificial media consisting of collected or naturally occurring large rock with vertical surfaces, and strategically dispersing the water. This alternative would require subsequent transplanting of snails either to a restored habitat in the Indian Bathtub area or to other suitable environments. There is certainly a research component in this alternative and it may not be allowable or feasible under the endangered species act.

Long Term Alternatives

It is likely that, by shutting off or severely curtailing the pumping or flow of all wells in the vicinity of the Indian Bathtub, i.e. the Bruneau River drainage and Little Valley, the flow of the springs would be sustained at levels above the current discharge. However, this is not feasible either legally or politically as a short term or long term alternative.

There is no technical justification for shutting off any particular well or group of wells in hopes of beneficially affecting the flow of the Indian Bathtub springs. No one knows the complex flow systems in this aquifer well enough to predict the response of any spring to changes in pumping of any well or group of wells and it premature to speculate on long term aquifer management strategies to increase spring flows.

Observed changes in spring flow in an aquifer system may be a response to any or all of four possible conditions. The first is a change in recharge to the aquifer system as a result of climatic change or changes in land use if the recharge area is in an irrigated region or where recharge can be manipulated by man. The recharge area for this aquifer system is believed to be the Owyhee mountains and plateau to the south of the area with deep circulation patterns, any changes in piezometric head or spring
flow due to recharge changes would be the result of changes in weather patterns or precipitation and subsequent percolation on these areas and not local precipitation patterns. In a confined aquifer system, such as the geothermal system underlying the Bruneau—Little Valley area, the response to recharge changes is likely rapid, even though the water physically travels a long distance from the recharge point to the discharge area.

A second possibility is that the observed response of the piezometric head or spring flow is due to changes in patterns or magnitude of local or near—by pumping from the aquifer. This likely accounts for a part of the response of springs in the Bruneau—Little Valley aquifer since the measured decreases of the Indian Bathtub springs appears to coincide with irrigation season water demands.

A third possibility is that the conduit system through which water is conveyed from deeper formations to a surface spring is disrupted by catastrophic events such as earthquakes or slippage along fault plains. Both geothermal and cold water springs in parts of Idaho are known to have been severely affected by the October 1983 earthquake near Challis, Idaho.

A fourth possibility is that flow through conduit systems may be restricted by deposition of dissolved minerals from the flowing water as it reaches the surface or areas of pressure relief in the aquifer. This phenomenon is common in waters high in carbonates or silica which can readily precipitate upon release of pressure or temperature decrease. This possibility is not likely in the Bruneau—Little Valley aquifer. For these reasons, a determination of whether or not the spring discharge could ever be increased to pre—development levels is not possible.

CURRENT AND PROPOSED STUDIES

The studies currently under way by the U.S. Geological Survey and the Idaho Department of Water Resources are designed to help determine the aquifer characteristics and assist in determining spatial variations in piezometric head and spring flow response. The results of these studies are essential to an understanding of the system and for rational decision making regarding possible management strategies. The studies will evaluate water level or piezometric heads throughout the aquifer and by utilizing geological, geochemical, and isotopic data will allow better interpretations of the structural control, compartmentalization, and flow systems with the aquifer. This data, coupled with the geologic mapping proposed by the Idaho Department of Water Resources and water use data will allow the development of a mathematical flow model of the system. This model can provide insight into regional differences in the system, anomalous piezometric head responses, errors or poor estimates in water balance components, and will be a significant tool in understanding the aquifer system. It will not provide quantitative answers to all questions of concern in this aquifer. Because of the complex nature of this aquifer, and the apparent sensitivity of spring flows to piezometric head changes, this proposed model may not be capable of determining the specific quantitative effect on the flow of springs at Indian Bathtub due to changes in pumping of specific wells or groups of wells. It will likely be able to provide indications of the effect on piezometric head in the vicinity of the springs from which estimates of flow changes could be made, providing the relationships between discharge and piezometric head can be determined. At this time that relationship is unknown.

The study and model development by the USGS should be pursued and possibly expanded to include the use of geophysical techniques to assist in defining the
lithology and structural control features within the aquifer. It may be advantageous to utilize either seismic or resistivity techniques in areas where other data analysis does not adequately define the system. These procedures are costly but many times are cost—effective.

SEDIMENT CONTROL

The accumulation of sediment in the Indian Bathtub and downstream channel is a result of unusual runoff events, probably overgrazing of the watershed, and alteration of the flow regime through the system. A cursory examination of the watershed area contributing to Hot Creek above the Indian Bathtub shows areas of high erosion potential, probably due to overgrazing. The magnitude of the runoff events which caused the accumulation of sediment were not measured, however, the discharges were reported to be extremely high as a result of at least one rain—on—snow runoff. These events are expected; however the amount and size of sediment carried into the channel would have been increased because of the condition of the watershed. Historically the base flows in the channel from the springs have been sufficient to flush out normal sediment accumulation as indicated in earlier photographs. The diminished spring flows are now inadequate to carry out the sediments and establishment of a flow regime similar to the historical regime will be required to maintain a relatively sediment—free reach. Mechanical removal of the accumulated sediment is not a recommended solution. Sediment would have to be removed from the bathtub area and for a significant distance downstream to effect a reasonable stream gradient. The potential for disruption of existing snail habitat from use of earth moving equipment in the area is probably greater than the likelihood of improving the habitat. Some hand work along the vertical rock faces to remove sediment and expose more of the rock at lower elevations could be effective. This would require additional hand work to provide drainage away from the exposed lower areas. No permanent solution is evident without increases in base spring and stream flows.