

INTRODUCTION

Recent data indicate that Idaho is the largest user of groundwater within the northwestern United States (van der Leeden and others, 1975). An estimated two million acre-feet are consumed annually for rural, public, industrial and agricultural uses. Ninety percent of this total, or 1.8 million acre-feet per annum, are used for irrigated agriculture. Remaining groundwater appropriations supply an estimated 80 percent of the rural and public water supplies, and 75 percent of the industrial water needs.

One of the tasks within the department's project to develop a state-managed underground injection control program consists of identifying and describing the aquifers of the State. The aquifers are then to be designated, based on current and future use, as underground sources of drinking water, or exempted from the designation.

After reviewing existing data, it was clear that, because of the complex geologic makeup of the state, identifying and describing each and every aquifer was neither practical nor possible. An alternate approach of identifying and describing the major groundwater flow systems was used. Seventy major groundwater systems, many comprising more than one aquifer, are described herein.

METHODS

Identification and description of the major groundwater systems in Idaho was based on the results of numerous geologic and hydrologic studies conducted by this Department, the U.S. Geological Survey, the University of Idaho and other state and federal agencies. Plates illustrating the general lithologies and potentiometric contours of the groundwater systems were modified from Whitehead and Parlman (1979). Arithmetic means and ranges of values for the physical and chemical constituents of groundwater were developed from existing data. The primary and secondary drinking water standards referred to in the text and presented in Table 4 are taken from U.S. Environmental Protection Agency (1975), U.S. Environmental Protection Agency (1977) and Idaho Dept. of Health and Welfare (1977).

Percentages of populations in each county using groundwater for domestic supplies were developed from municipal and community water use data compiled by the Idaho Department of Health and Welfare and the Idaho Public Utilities Commission. Projected 1980 and 2000 county populations (Meale and Weeks, 1978) were multiplied by these percentages to estimate the number of people in each county relying on groundwater for their domestic supplies. In order to relate the county-wide estimates to individual flow systems, these figures were further broken down as needed into U. S. Bureau of Census county subdivisions using a ratio of subdivision to county population data (U. S. Bureau of Census, 1971)

DESCRIPTION OF THE MAJOR GROUNDWATER SYSTEMS IN IDAHO

Seventy major groundwater flow systems were identified in Idaho (Plate 1). The general lithologies, which usually represent the shallowest component of the regional system, and potentiometric contours and directions of groundwater movement are illustrated in Plates 2 and 3. Additional hydrogeologic characteristics, ranges and arithmetic means of physical and dissolved chemical constituents of groundwater by flow system, and primary and secondary drinking water standards are presented in Tables 1 through 4 (Appendix B). Descriptions of the major groundwater systems follow.

1. Kootenai Valley

The Kootenai Valley groundwater system is within the valley fill material comprised of fine-grained stream and lake sediments, and coarse glacial deposits (Dion and Whitehead, 1973; Parlman and others, 1980). Depth of the system is unknown, but probably extends to a basement formation of either Precambrian metamorphosed sediments or granitic rocks related to the Idaho Batholith. The flow system is recharged primarily by leakage from the Kootenai River and its tributaries, runoff from surrounding uplands, and downward percolation of precipitation and snowmelt.

Most wells observed were shallow (less than 200 feet in depth) and were estimated to yield between 5 and 20 gallons per minute (gpm) (Table 1). The quality of groundwater was reported as generally suitable for domestic use, but nitrate plus nitrite as nitrogen occasionally exceeded the primary drinking water standard of 10 milligrams per liter (mg/L) and dissolved solids sometimes exceeded the secondary standard of 500 mg/L (Tables 2 and 3).

An estimated 3,400 people currently utilize the Kootenai Valley groundwater system for their domestic water supply, and this number is projected to increase to 4,700 by the year 2000.

2. Priest River

The Priest River groundwater system is within the unconsolidated valley fill material comprised of stream and lake sediments and glacial deposits (Parlman and others, 1980). Major sources of recharge are probably leakage from Priest Lake and Priest River, runoff from surrounding uplands and downward percolation of precipitation and snowmelt.

Wells investigated that penetrated the Priest River groundwater system were between 40 and 230 feet in depth and were estimated to yield between 10 and 60 gpm (Table 1). The quality of groundwater was reported as suitable for domestic use (Tables 2 and 3).

An estimated 700 people currently use this groundwater system for their domestic water supply, and this number is projected to increase to 950 by the year 2000.

3. Pend Orielle River

The Pend Orielle River groundwater system is within the valley fill material comprised of stream-deposited sands and gravels, clay, silt and fine-grained sands of lake bottoms, and glacial till (Walker, 1964). Recharge is provided by downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Pend Orielle River, Pend Orielle Lake and tributary streams.

Static water levels in wells investigated were reported to range from 7 to greater than 200 feet below land surface and well yields varied from 6 to 60 gpm (Table 1). The quality of groundwater was reported as generally suitable for domestic use, but pH was occasionally below the lower limit of the secondary drinking water standard, and concentrations of dissolved iron and manganese sometimes exceeded the secondary standards (Tables 2 and 3).

Currently, around 7,500 people utilize this flow system for their domestic water supply and this number is projected to increase to 10,000 by the year 2000.

4. Rathdrum Prairie

The Rathdrum Prairie groundwater system is primarily within glaciofluvial deposits that extend from Pend Orielle Lake to the Idaho-Washington border (Drost and Seitz, 1978). The deposits primarily consist of fine to coarse sands and gravels and are relatively free of fine-grained materials except near land surface. Thickness of the glacial deposits is reported to be approximately 400 feet at the state line, of which 280 feet is saturated. The flow system is thought to overlie the Latah Formation, comprised of fine grained, semi-consolidated sediments. Recharge is by percolation of precipitation and irrigation water from surface sources, underflow from adjoining highlands, and leakage from the Spokane River, tributaries and lakes within the region (Drost and Seitz, 1978; Parlman and others, 1980).

Most wells observed in the Rathdrum Prairie area were between 100 to 500 feet in depth and were reported to yield between 5 to 1500 gpm (Table 1). The quality of groundwater was reported as generally suitable for domestic use, but concentrations of dissolved cadmium occasionally exceeded the primary drinking water standard and levels of dissolved iron sometimes exceeded the secondary standard (Tables 2 and 3).

Currently, an estimated 35,000 people in Idaho utilize this flow system for their domestic water supply, and this number is projected to increase to 61,000 by the year 2000.

5. Coeur d'Alene River - Silver Valley

The Coeur d'Alene River - Silver Valley flow system is primarily within the valley fill material comprised of fine grained lake deposits, stream-deposited silts, sands and gravels, and glacial deposits (Norbeck, 1974; Parlman and others, 1980). Basalt of the Columbia River Group intersects the lower end of the Silver Valley. Within the Silver Valley arm, the sediments grade from poorly sorted gravels mixed with cobbles and boulders near the upper eastern terminus to fine-grained silts, sands and clays within the lower valley. Mine jig tailings have become intermixed with the surficial alluvium over much of the valley (Norbeck, 1974). Thickness of the valley fill material ranges from 30 feet near Wallace, Idaho to over 400 feet at Rose Lake. The flow system is recharged from downward percolation of precipitation and snowmelt, leakage from the Coeur d'Alene River and its tributaries, and underflows from adjoining canyons.

Static water levels in wells investigated ranged from flowing to 199 feet below land surface and yields ranged from 5 to 3000 gpm (Table 1). Concentrations of dissolved cadmium in groundwater from the Silver Valley arm of the flow system were reported to occasionally exceed the primary drinking water standard of 0.01 mg/L (Table 3).

As estimated 12,000 people currently depend on the Coeur d'Alene River - Silver Valley groundwater system for their domestic water supply, and this number is projected to reach 15,000 by the year 2000.

6. Rock Creek

The Rock Creek flow system is within the Columbia River Basalt that flowed from the west into valley lowlands near the southern end of Coeur d'Alene Lake. Although little is known of the specific geologic makeup and hydrologic characteristics of this area, we can assume from studying similar systems that the flow system within the basalt is composed of isolated permeable zones of limited extent. Yields to wells are probably restricted, as indicated in Table 1, and depths to water may be quite variable. The quality of groundwater is apparently suitable for domestic use, but concentrations of dissolved zinc, iron and manganese may occasionally exceed secondary drinking water standards (Tables 2 and 3).

An estimated 700 people currently rely on this system for domestic water and this number is projected to increase to 1300 by the year 2000.

7. Hangman Creek

The Hangman Creek groundwater system is within the fine-grained sediments and underlying Columbia River Basalt that filled the valley lowlands. Little is known about the specific geologic and hydrologic characteristics of this system, but yields to wells are probably restricted. Recharge is likely from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Hangman Creek and its tributaries.

Chemical analyses of groundwater are limited (Tables 2 and 3), but the quality is probably suitable for domestic use. Concentrations of dissolved iron may exceed the secondary drinking water standard of 0.3 mg/L.

An estimated 600 people currently utilize this groundwater system for their domestic water supply and this number is projected to increase to 1,100 by the year 2000.

8. Palouse River

The Palouse River groundwater system is within the fine-grained sediments and Columbia River Basalt that filled the valley lowlands. Little is known about the specific geologic and hydrologic characteristics of this system, but yields to wells are apparently restricted (Table 1). Recharge is probably from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Palouse River and tributaries. The quality of groundwater is apparently suitable for domestic use, but levels of dissolved iron and dissolved solids may exceed the secondary drinking water standards (Tables 2 and 3).

An estimated 3,900 people currently utilize this groundwater system for domestic water and this number is projected to increase to 5,400 by the year 2000.

9. St. Maries - St. Joe River

The St. Maries - St. Joe River groundwater system is within the valley fill material comprising fine to coarse-grained stream deposits and Columbia River Basalt, which flowed into the lowlands. Although little is known of the specific geologic makeup and hydrologic characteristics of the area, the stream deposits apparently yield adequate quantities of water to shallow wells for domestic use (Table 1). Yields to wells penetrating the basalt are probably restricted and depths to water may be quite variable. Recharge to the groundwater system is most likely from downward percolation of precipitation and snowmelt, underflows from adjoining canyons, and leakage from the St. Joe and St. Maries Rivers and their tributaries.

Chemical analyses of groundwater indicate that concentrations of dissolved iron and manganese may exceed the secondary drinking water standards.

An estimated 6,400 people currently utilize this system for their domestic water supply and this number is projected to increase to 10,000 by the year 2000.

10. Moscow Basin

The Moscow Basin groundwater system is within the fine-grained sediments and underlying Columbia River Basalt that filled the valley lowlands. The fine-grained sediments generally yield only low quantities of groundwater to domestic wells, but the underlying basalt yield quantities under artesian pressure of up to 1,500 gpm (Table 1). Water levels in wells penetrating the artesian aquifer have declined for more than 80 years (Stevens, 1960). Recharge to the shallow sedimentary aquifers is by downward percolation of precipitation and snowmelt. Recharge to the deeper artesian aquifers is limited to water that percolates downward through the weathered mantle of crystalline rocks around the perimeter of the basin.

Chemical analyses of groundwater indicated that concentrations of dissolved cadmium and lead might occasionally exceed primary drinking water standards (Tables 2 and 3). Levels of pH were reported to occasionally fall outside the desired range of the secondary standards, dissolved solids and concentrations of dissolved sulfate and manganese sometimes exceeded secondary drinking water standards.

An estimated 17,000 people currently rely on this groundwater system for their domestic supply and this number is projected to increase to 24,000 by the year 2000.

11. Clearwater Uplands

The Clearwater uplands flow system is within the Columbia River Basalt that flowed into the valley lowlands forming the Clearwater Embayment. Although little is known of the specific geologic and hydrologic characteristics of the area, the flow system is likely composed of isolated saturated zones of limited extent. Yields to wells are probably low and depths to groundwater may vary considerably. Recharge is probably from downward percolation of precipitation and snowmelt, and leakage from streams that intersect permeable zones within the basalt.

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of mercury occasionally exceeded the primary drinking water standard and levels of dissolved manganese sometimes exceeded the secondary standard.

An estimated 10,000 people currently utilize this groundwater system for their domestic water supply, and this number is projected to increase to 14,000 by the year 2000.

12. Clearwater Plateau

The Clearwater Plateau groundwater system is within the Columbia River Basalt that flowed into the valley lowlands forming the Clearwater Embayment. Within the uppermost flows of basalt, the flow system is comprised of isolated saturated zones of limited extent (Castelin, 1976). These zones usually yield only low quantities of water to wells and depths to groundwater vary considerably (Table 1). Recharge is from downward percolation of precipitation and snowmelt, and from streams and lakes that intersect permeable zones within the basalt.

Older basalt flows within the groundwater system may yield large quantities of water to wells if an adequate source of recharge is present. The high potential for productivity within these flows is attributed to the lack of soil interbeds within the interflow contact zones (Cohen and Ralston, 1980). One such series of flows comprise the Russell Aquifer, which is both a current and potential source of groundwater for the cities of Lewiston, Idaho and Clarkston, Washington. The aquifer is recharged by the Snake and Clearwater Rivers where the permeable basalt flows are exposed to stream channels (Cohen and Ralston, 1980).

The quality of groundwater within the Clearwater Plateau flow system is reported as generally suitable for domestic use though levels of dissolved cadmium and lead occasionally exceeded primary drinking water standards. Concentrations of dissolved manganese sometimes exceeded the recommended secondary level of .05 mg/L.

An estimated 15,000 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 19,000 by the year 2000.

13. Joseph Plains

The Joseph Plains groundwater system is within that portion of the Clearwater Embayment that lies to the south and west of the Salmon River Canyon. Although little is known of the specific geologic and hydrologic characteristics of the area, the system is likely composed of isolated saturated zones of limited extent. Yields to wells are probably low, and depths to groundwater may vary considerably. Recharge is probably from downward percolation of precipitation and snowmelt, and leakage from streams that intersect permeable zones within the basalt. The quality of groundwater is unknown, but likely similar to that within adjacent basalt systems.

An estimated 240 people currently rely on this system for their domestic water supply, and this number is projected to increase to 300 by the year 2000.

14. Mill Creek

The Mill Creek flow system is probably within unconsolidated stream deposits. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. This system is within national forest boundaries and is likely used only as a seasonal domestic supply for forest service facilities.

15. Little Slate Creek

The Little Slate Creek flow system is probably within stream-deposited sediments. Specific data on the quality of groundwater and hydrologic and geologic characteristics are unavailable. This system is within national forest boundaries and is likely used only as a seasonal domestic supply for forest service facilities.

16. Elk City

The Elk City groundwater system is within the unconsolidated valley fill material. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from overlying streams. The quality of groundwater is reported as suitable for domestic use (Tables 2 and 3).

An estimated 350 people currently utilize the Elk City and Red River (17) flow systems for their domestic water supply, and this number is expected to increase to 450 by the year 2000.

17. Red River

The Red River groundwater system is likely within the unconsolidated valley fill material. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from overlying streams. The quality of groundwater is unknown, but most likely is suitable for domestic use.

An estimated 350 people currently utilize the Elk City (16) and Red River flow systems for domestic water supplies, and this number is expected to increase to 450 by the year 2000.

18. Meadows Valley

The Meadows Valley flow system is within the stream deposited sediments, glacial deposits and Columbia River Basalt that filled the valley lowlands. Little is known about the specific geologic and hydrologic characteristics of this system. Recharge is probably from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Little Salmon River and its tributaries. The quality of groundwater is reported as suitable for domestic use (Tables 2 and 3).

An estimated 1,300 people currently rely on this system for their domestic water supply, and this number is expected to increase to 1,700 by the year 2000.

19. South Fork Salmon River

The South Fork Salmon River groundwater system is likely within the valley fill material composed of glacial and stream deposits. Little is known about the specific geologic and hydrologic characteristics of this system. Recharge is probably from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the South Fork Salmon River and its tributaries. The quality of groundwater is reported as suitable for domestic use (Tables 2 and 3).

An estimated 20 people currently utilize the South Fork Salmon River, Stibnite (20) and Deadwood River (23) flow systems for domestic water supplies, and this number is projected to increase to 30 by the year 2000.

20. Stibnite

The Stibnite groundwater system is likely within the valley fill material composed of glacial and stream deposits. Little is known about the specific geologic and hydrologic characteristics of this system. Recharge is probably from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the East Fork South Fork Salmon River and its tributaries. The quality of groundwater is unknown, but it is likely suitable for domestic use.

21. Long Valley-Round Valley

The Long Valley-Round Valley groundwater system is primarily within the valley fill material comprised of stream and lake sediments and glacial deposits. Little is known of the specific geologic and hydrologic characteristics of this system. Recharge is likely from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Payette Lake, Cascade Reservoir and the North Fork Payette River and its tributaries.

Data describing the quality of groundwater are limited. The only sample documented indicates that the quality of groundwater is probably suitable for domestic use, but dissolved iron may exceed the secondary drinking water standard of 0.30 mg/L.

An estimated 2,200 year-round residents currently rely on this system for their domestic water supply, and this number is expected to increase to 3,200 by the year 2000. These population figures do not include seasonal second-home residents, which would probably double the number of people relying on this system for domestic use during the summer months.

22. Weiser River

The Weiser River groundwater system is within the Columbia River Basalt that underlie the valley lowlands throughout the basin, and sedimentary valley fill material. The sediments generally yield restricted quantities of groundwater to domestic and stock watering wells, while the basalt aquifers generally yield quantities suitable for irrigation and municipal supplies (Young and others, 1977). Recharge to the basalt aquifers is primarily from precipitation and stream leakage that enters fractures and joints in the basalt where exposed in the highlands. The sedimentary aquifers are primarily recharged by downward percolation of precipitation, snowmelt, and irrigation water, and leakage from the Weiser River, its tributaries, and irrigation canals. Some recharge to the sediments may result from upward percolation from the underlying basalt (Young and others, 1977)

Reported groundwater quality data indicate that levels of dissolved arsenic in water from the sedimentary aquifers may exceed the primary drinking water standard of 0.05 mg/L, and concentrations of dissolved iron may exceed the secondary standard (Tables 2 and 3). Levels of iron and manganese and values of pH may not be within the desired ranges of the respective secondary drinking water standards in water from the basalt components of the flow system.

An estimated 4,100 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 5,500 by the year 2000.

23. Deadwood River

The Deadwood River flow system is likely within the unconsolidated valley fill material. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Deadwood River and its tributaries. This system is primarily within national forest boundaries, and, combined with groundwater systems 19 and 20, provides domestic water supplies for an estimated 20 people.

24. Sawtooth Valley - Bear Valley

The Sawtooth Valley - Bear Valley groundwater system is likely within the unconsolidated valley fill material. Specific data on the quality of groundwater and the hydrologic and geologic characteristics are unavailable. Major sources of recharge to the flow system are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Bear Valley Creek, Marsh Creek, Valley Creek, the Salmon River and their tributaries.

An estimated 370 people currently rely on this system for their domestic water supply, and this number is expected to increase to 460 by the year 2000. These population figures do not include seasonal second-home residents, which would increase the number of people relying on the system for domestic water supplies during the summer months.

25. Garden Valley

The Garden Valley flow system is probably within the unconsolidated valley fill material. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Middle and South Forks of the Payette River and their tributaries.

An estimated 530 people currently rely on this groundwater system for their domestic water supply, and this number is expected to increase to 1,000 by the year 2,000. These population figures do not include seasonal second home residents, which would increase the number of people relying on the system for domestic water supplies during the summer months.

26. Scott Creek - Mann Creek

The Scott Creek - Mann Creek groundwater system is primarily within the sedimentary valley fill material comprised of sand, silt and clay (Young and others, 1977). Yields to wells are generally low, but a sand and gravel aquifer near Weiser yields adequate quantities of groundwater for municipal and agricultural production. The groundwater system is recharged by downward percolation of precipitation and snowmelt, leakage from overlying tributaries to the Snake River, and infiltration of imported irrigation water.

The quality of groundwater is generally suitable for domestic use, but dissolved solids and concentrations of dissolved iron and manganese may exceed the secondary drinking water standards.

As estimated 6,500 people currently rely on this groundwater system for their domestic water supply, and this number is expected to increase to 9,000 by the year 2000.

27. Payette Valley

The Payette Valley groundwater system is primarily within the unconsolidated valley fill material comprising of sands, gravels, silts and clays. Sand and gravel aquifers yield quantities of groundwater suitable for agriculture and municipal use (Norvitch, 1966). The groundwater system is recharged by runoff from the surrounding mountains, leakage from the Payette River and its tributaries and infiltration of diverted irrigation water.

The quality of groundwater is reported as generally suitable for domestic use, but nitrate plus nitrite as nitrogen and concentrations of dissolved fluoride occasionally exceeded primary drinking water standards (Tables 2 and 3). Levels of dissolved iron and manganese, and dissolved solids commonly exceeded the secondary standards.

An estimated 27,000 people currently rely on this system for their domestic water supply, and this number is expected to increase to 33,000 by the year 2000.

28. Grimes Creek

The Grimes Creek groundwater system is probably within the unconsolidated valley fill material. Specific data on the quality of groundwater and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation or precipitation and snowmelt, runoff from surrounding uplands, and leakage from Grimes Creek its tributaries.

An estimated 570 people currently rely on the Grimes Creek and Mores Creek (29) groundwater systems for domestic water supplies, and this is expected to increase to 1,100 by the year 2000. These population figures do not include seasonal second-home residents, which would increase the number of people relying on the system for domestic water supplies during the summer months.

29. Mores Creek

The Mores Creek groundwater system is probably within the unconsolidated valley fill material. Specific data on the hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Mores Creek and its tributaries. The quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3).

An estimated 570 people currently rely on the Mores Creek and Grimes Creek (28) groundwater systems for domestic water supplies, and this is expected to increase to 1,100 by the year 2000. These population figures do not include seasonal second-home residents, which would increase the number of people relying on the system for domestic water supplies during the summer months.

30. Boise Valley

The Boise Valley groundwater system is primarily within unconsolidated deposits of silt, sand, clay and fine gravel. Total thickness of the sediments is estimated to be 2500 feet in the Boise-Nampa area (Dion, 1972). In places, Snake River Basalt is intercalated with the sedimentary deposits. The flow system is recharged primarily by leakage from the Boise River, drainage from the mountains to the north of the valley, and infiltration of diverted irrigation water. Yields to wells are reported to be sufficient for municipal and agricultural use throughout most of the valley.

The quality of the groundwater is generally suitable for domestic use (Tables 2 and 3). However, concentrations of nitrate plus nitrite as nitrogen, and dissolved arsenic, cadmium and lead are reported to occasionally exceed primary drinking water standards. Dissolved solids and concentrations of dissolved copper, iron, manganese and zinc may occasionally exceed the secondary standards.

An estimated 240,000 people currently rely on this groundwater system for their domestic water supply, and this number is expected to increase to 400,000 by the year 2000.

31. Mountain Home Plateau

The Mountain Home Plateau groundwater system is primarily within unconsolidated deposits of clay, silt, sand and gravel, Snake River Basalt and, at depth, silicic volcanics of the Idavada Formation. Thickness of the formations overlying the granitic basement complex is estimated to be at least 10,000 feet (Young, 1977). The flow system is primarily recharged from the infiltration of imported irrigation water, leakage from the Boise River between Lucky Peak and Barber Dams, drainage from mountains to the north of the plateau, and direct infiltration of precipitation into the Idavada Volcanics, where exposed.

All wells investigated were finished in either sedimentary or basalt aquifers. Static water levels in wells penetrating unconsolidated formations ranged from 3 to 355 feet, while water levels in wells finished in basalt ranged from 13 to 425 feet below land surface (Table 1). Yields to wells penetrating unconsolidated formations ranged from 20 to 2700 gpm, while wells finished in basalt yielded from 12 to 3600 gpm.

The quality of groundwater was reported as generally suitable for domestic use, but dissolved solids, pH and concentrations of dissolved iron and manganese were occasionally outside of the desired ranges of the secondary drinking water standards (Tables 2 and 3).

An estimated 26,000 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 35,000 by the year 2000.

32. Homedale - Murphy

The Homedale - Murphy groundwater system is primarily within sedimentary sequences of unconsolidated to consolidated clay, silt, sand and gravel, basalt of the Banbury and Bruneau Formations and, at depth, silicic volcanics (Mundorff and others, 1964; Ralston and Chapman, 1969). The system is recharged by drainage from the Owyhee Mountains to the south, and direct infiltration of precipitation into the silicic volcanics where exposed in the highlands.

All wells investigated were finished in either sedimentary or basalt aquifers. Static water levels ranged from 3 to 425 feet below land surface and yields to wells ranged from 3 to 3600 gpm (Table 1). Levels of dissolved fluoride in the groundwater often exceeded the primary drinking water standards and dissolved solids and concentrations of dissolved iron and manganese occasionally exceeded secondary standards (Tables 2 and 3).

An estimated 5,700 people currently rely on this system for their domestic water supply, and this number is expected to increase to 6,500 by the year 2000.

33. South Fork Boise River

The South Fork Boise River flow system is likely within the unconsolidated valley fill material. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the South Fork Boise River and its tributaries.

An estimated 200 people currently rely on this ground water system for their domestic water supply, and this number is expected to increase to 280 by year 2000. These population figures do not include seasonal, second-home residents, which would increase the number of people relying on the system for domestic water supplies during the summer months.

34. Bruneau - Grandview

The Bruneau-Grandview groundwater system is primarily within sedimentary sequences of unconsolidated to consolidated clay, silt, sand and gravel, basalt of the Banbury and Bruneau Formations and, at depth, silicic volcanics (Mundorff and others, 1964; Ralston and Chapman, 1969). The system is recharged by drainage from the Owyhee Mountains to the south, and direct infiltration of precipitation into the silicic volcanics, where exposed in the uplands. The Blue Gulch area, within the eastern portion of this flow system, has been designated as a critical groundwater area in response to recently declining water levels.

All wells investigated were finished in sedimentary aquifers (Table 1). Levels of fluoride and dissolved lead in the groundwater were reported to occasionally exceed the primary drinking water standards, while dissolved solids, pH and dissolved iron were sometimes outside of the desired ranges of the secondary standards (Tables 2 and 3).

An estimated 1,800 people currently rely on this system for their domestic water supply, and this number is expected to increase to 2,100 by the year 2000.

35. Juniper Basin

The Juniper Basin groundwater system is probably within the valley fill materials comprised of stream and lake sediments. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from overlying streams. This system is within a remote area of Idaho and is probably not utilized as a domestic water supply.

36. Duck Valley

The Duck Valley flow system is likely within the valley fill material comprised primarily of stream-deposited sediments. Specific data on the quality of groundwater, and hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from the Owyhee River and its tributaries.

An estimated 160 people currently rely on this flow system for their domestic water supply and this number is expected to increase to 180 by the year 2000.

37. Camas Prairie

The Camas Prairie groundwater system is primarily within the valley fill material comprised of stream and lake sediments, and basalt of the Bruneau Formation (Young, 1978). The system is recharged from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Camas Creek and its tributaries. Static water levels in wells analyzed ranged from flowing to 197 feet below land surface, and reported yields to irrigation wells varied from 400 gpm to greater than 2,000 gpm (Table 1).

The quality of groundwater was reported as generally suitable for domestic use although levels of dissolved fluoride and nitrate plus nitrite as nitrogen occasionally exceeded primary drinking water standards. Concentrations of dissolved iron and manganese in the groundwater usually exceeded the secondary standards (Tables 2 and 3).

An estimated 950 people currently rely on this flow system for their domestic water supply, and this number is projected to decrease to 750 by the year 2000.

38. Big Wood River - Silver Creek

The Big Wood River - Silver Creek groundwater system is primarily within the sedimentary valley fill materials. Estimated thickness of the sediments ranges from 30 feet to greater than 580 feet (Castelin and Winner, 1975). Basalt of the Snake River Group also contain groundwater in the southeast part of the Silver Creek basin (Moreland, 1977). The system is recharged from downward percolation of precipitation and snowmelt, leakage from the Big Wood River and its tributaries, and infiltration of surface water diverted for irrigation (Castelin and Chapman, 1972).

Wells penetrating the sedimentary aquifers are reported to yield from 4 to approximately 5,000 gpm (Table 1), and the quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3).

An estimated 7,000 people currently rely on this groundwater system for their domestic water supply, and this number is expected to increase to 13,000 by the year 2000.

39. Snake Plain

The Snake Plain groundwater system is within the basalt of the Snake River Group, the associated sedimentary and pyroclastic interbeds and the river and lake-deposited sediments that were laid down around the southern, eastern and northern margins of the basalt flows. This flow system is considered one of the most prolific in the world with an estimated total annual recharge of 6,200,000 acre-feet (Mundorff and others, 1964). The system is recharged by downward percolation of precipitation and snowmelt, underflow from tributary basins, leakage from streams entering or crossing the plain and infiltration of surface water diverted for irrigation. Reported static water levels in wells penetrating this groundwater system varied from 4 to 450 feet below land surface, and reported discharges from irrigation wells ranged from 269 to 6,820 gpm (Table 1).

The quality of groundwater was reported as generally suitable for domestic water supplies, but concentrations of dissolved solids, chloride, and iron occasionally exceeded the secondary drinking water standards (Tables 2 and 3). Although not included in the data summary of Table 2, levels of nitrate plus nitrite nitrogen have been reported to exceed the primary drinking water standard of 10.0 mg/L in some domestic groundwater supplies from Minidoka County.

An estimated 200,000 people currently utilize the Snake Plain groundwater system for their domestic water supply, and this number is projected to increase to 280,000 by the year 2000.

40. Salmon Falls Creek - Rock Creek

The Salmon Falls Creek - Rock Creek groundwater system is primarily within basalt of the Banbury Formation and, at depth, silicic volcanics (Crosthwaite, 1969a). Alluvial deposits along stream channels may also contain limited quantities of groundwater. The system is recharged from downward percolation of precipitation and snowmelt, runoff from surrounding uplands, leakage from streams crossing the basin, and infiltration of surface water diverted for irrigation. Reported static water levels in wells penetrating the flow system varied from 72 to 512 feet below land surface and reported discharges ranged from 10 to 3,000 gpm (Table 1).

Reported levels of dissolved fluoride in groundwater often exceeded the primary drinking water standard, and concentrations of dissolved cadmium occasionally exceeded the primary standard of 0.01 mg/L (Tables 2 and 3). Dissolved solids, pH and concentrations of dissolved iron and sulfate were reported as occasionally being outside of the desired ranges of the secondary drinking water standards.

An estimated 53,000 people currently rely on this system for their domestic water supply, and this number is expected to increase to 80,000 by the year 2000.

41. Goose Creek - Golden Valley

The Goose Creek - Golden Valley groundwater system is within the unconsolidated alluvial deposits, basalt of the Snake River Group and, at depth, silicic volcanics (Crosthwaite, 1969b). The system is recharged primarily by drainage from the uplands to the south, direct infiltration of precipitation into the silicic volcanics and related rocks where exposed in the mountains, leakage from streams crossing the basin, and infiltration of surface water diverted for irrigation. Reported static water levels in wells penetrating the flow system ranged from 100 to 500 feet below land surface (Table 1). Three areas within the boundaries of this flow system, Artesian City, Cottonwood and Oakley - Kenyon, have been designated as critical groundwater areas in response to recently declining water levels.

The quality of groundwater was reported as generally suitable for domestic water supplies (Tables 2 and 3). However, levels of dissolved fluoride occasionally exceeded the primary drinking water standard, and pH, dissolved solids and sulfate were reported as occasionally being outside of the desired ranges of the secondary standards.

An estimated 16,000 people currently rely on this groundwater system for their domestic groundwater supply, and this number is expected to increase to 28,000 by the year 2000.

42. Marsh Valley

The Marsh Valley groundwater system is likely within the sedimentary valley fill materials. Specific data on the hydrologic and geologic characteristics are unavailable. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and leakage from Marsh Creek and its tributaries. The quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3).

An estimated 4,300 people currently rely on the Marsh Valley and Raft River (43) groundwater systems for domestic use, and this number is projected to increase to 5,300 by the year 2000.

43. Raft River Valley

The Raft River Valley groundwater system is primarily within the poorly indurated volcanic and sedimentary deposits of the Salt Lake Formation, sediments of the Raft Lake beds, and the shallow alluvium (Walker and others, 1970). Major sources of recharge are runoff from the surrounding uplands, leakage from Raft River and its tributaries and infiltration of surface water diverted for irrigation. Reported static water levels in wells penetrating the flow system ranged from flowing to 276 feet below land surface, and reported yields to irrigation wells varied from 250 to 4,000 gpm (Table 1). A large part of the flow system has been designated as a critical groundwater area in response to recently declining groundwater levels.

The quality of groundwater is reported as generally suitable for domestic use, but dissolved solids, and levels of dissolved sulfate and chloride recently exceeded secondary drinking water standards (Tables 2 and 3). Though not included in the data summary of Table 2, Department records indicate that levels of dissolved fluoride in groundwater may occasionally exceed the primary drinking water standard.

An estimated 4,300 people currently rely on the Raft river Valley and Marsh Valley (42) flow systems for their domestic water supply and this number is projected to increase to 5,300 by the year 2000.

44. Black Pine - Curlew Valley

The Black Pine - Curlew Valley groundwater system is primarily within the stream-deposited alluvium comprised of silt, sand and gravel, and the poorly indurated sediments and volcanics of the Salt Lake Formation (Chapman and Young, 1972). Thickness of the water-bearing sediments is estimated to be 4,000 to 5,000 feet. Major sources of recharge are runoff from the surrounding uplands, leakage from overlying streams and infiltration of surface water diverted for irrigation. Reported static water levels in wells penetrating the groundwater system ranged from flowing to 420 feet below land surface and yields to wells varied from 8 to 2,700 gpm (Table 1). A large part of the flow system has been designated as a critical groundwater area in response to declining groundwater levels.

The quality of groundwater is reported as adequate for domestic use in that primary drinking water standards were not exceeded within the scope of the measured constituents. However, reported levels of dissolved solids, chloride and sulfate often exceeded the secondary standards (Tables 2 and 3).

An estimated 190 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 210 by the year 2000.

45. Rockland Valley

The Rockland Valley groundwater system is primarily within stream and lake-deposited sediments, and the underlying pyroclastic and volcanic rocks (Mundorff, and others, 1964). Specific data on the geologic and hydrologic characteristics are unavailable. Major sources of recharge are runoff from the surrounding uplands and leakage from Rock Creek and its tributaries. The quality of groundwater, based on one sample, is apparently suitable for domestic use (Tables 2 and 3).

An estimated 4,000 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 5,400 by the year 2000.

46. Arbon Valley

The Arbon Valley groundwater system is primarily within the stream-deposited alluvium that filled the valley lowlands (Chapman and Young, 1972). Near the mouth of the valley, underlying volcanic and pyroclastic rocks may yield substantial quantities of groundwater to deep wells (Mundorff and others, 1964). Thickness of the water-bearing sediments may exceed 3,000 feet in places. Major sources of recharge are runoff from the surrounding uplands and leakage from Bannock Creek and its tributaries. Reported static water levels in wells penetrating the flow system ranged from flowing to 28 feet below land surface and reported yields to irrigation wells varied from 450 to 3,400 gpm (Table 1).

The quality of groundwater was reported as generally suitable for domestic use. However, concentrations of nitrate plus nitrite as nitrogen may occasionally exceed the primary drinking water standard of 10 mg/L, and dissolved solids may exceed the secondary standard (Table 2). Data describing concentrations of trace constituents in groundwater were unavailable.

An estimated 680 people currently rely on this flow system for their domestic water supply, and this number is expected to increase to 920 by the year 2000.

47. Pocatello Valley

The Pocatello Valley flow system is primarily within the valley fill materials comprised of fine-grained lake deposits (Chapman and Young, 1972). Specific hydrologic and water quality data are unavailable, but yields to wells are probably low. The major source of recharge is runoff from the surrounding uplands.

An estimated 2,300 people currently utilize the Pocatello Valley and Malad Valley (48) flow systems for their domestic water supply, and this number is projected to increase to 2,400 by the year 2000.

48. Malad Valley

The Malad Valley groundwater system is primarily within the unconsolidated alluvial deposits of clay, silt, sand and gravel (Burnham and others, 1969; Pluhowski, 1970). A shallow 170 to 200 feet thick sand and gravel deposit containing interbedded lenses of clay is considered the principal aquifer of the flow system and, where penetrated, can yield substantial quantities of artesian water to irrigation wells. Static water levels are reported to range from flowing to 20 feet below land surface (Table 1). The groundwater system is primarily recharged by downward percolation of precipitation and snowmelt, infiltration of surface runoff from the surrounding uplands into alluvial fans, leakage from overlying streams and irrigation canals, and infiltration of excess irrigation water.

Data describing the quality of groundwater are unavailable, but it is likely similar to that of the Black Pine - Curlew Valley (44) and Cache Valley (50) systems. Generally, the quality of groundwater is probably suitable for domestic use, but levels of dissolved solids may exceed the secondary standard of 500 mg/L.

An estimated 2,300 people currently utilize the Malad Valley and Pocatello Valley (47) groundwater systems for their domestic groundwater supply, and this number is projected to increase to 2,400 by the year 2000.

49. Marsh Creek - Lower Portneuf River

The Marsh Creek - Lower Portneuf River groundwater system is primarily within the unconsolidated valley fill materials and underlying poorly indurated sediments and volcanics of the Salt Lake Formation (Norvitch and Larsen, 1970). Basalt of the Snake River Group have filled part of the lower Portneuf Valley between the towns of McCammon and Inkom, Idaho, and may also contain substantial quantities of groundwater. The major sources of recharge are downward percolation of precipitation and snowmelt, leakage from tributaries to the Portneuf River and Marsh Creek, and infiltration of surface water diverted for irrigation. Reported yields to wells penetrating the flow system varied from 20 to 2,600 gpm (Table 1).

The quality of groundwater is reported as suitable for domestic use, though concentrations of nitrate plus nitrite as nitrogen occasionally exceeded the primary drinking water standard of 10.0 mg/L (Tables 2 and 3). Levels of dissolved solids, pH, iron and manganese were reported as sometimes being outside of the desired ranges of the secondary standards.

An estimated 55,000 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 83,000 by the year 2000.

50. Cache Valley

The Cache Valley groundwater system is primarily within the unconsolidated valley fill materials and the underlying poorly indurated sediments and volcanics of the Salt Lake Formation (Dion, 1969). Reported static water levels in wells penetrating the flow system ranged from flowing to 116 feet below land surface, and reported yields to wells varied from 3 to 2,500 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, leakage from surface streams along the margins of the valleys, and infiltration of surface water diverted for irrigation.

The quality of groundwater is reported as generally suitable for domestic use, but levels of dissolved cadmium occasionally exceeded the primary drinking water standard of 0.01 mg/L, and dissolved solids and concentrations of dissolved iron frequently exceeded secondary standards (Tables 2 and 3).

An estimated 8,100 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 9,300 by the year 2000.

51. Portneuf Valley - Gem Valley

The Portneuf Valley - Gem Valley groundwater system is primarily within the valley fill materials comprised of unconsolidated alluvium, canyon-filling Blackfoot Basalt and, at depth, poorly indurated sediments and volcanics of the Salt Lake Formation (Norvitch and Larson, 1970). Thickness of the valley fill materials may exceed 8,000 feet in places. Reported static water levels in wells penetrating the flow system ranged from flowing to 198 feet below land surface; and reported yields to wells varied from 40 to 3000 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, leakage from surface streams and impoundments overlying the system, infiltration of surface water diverted for irrigation, and possibly, some underflow from the adjoining Gem Valley - Gentile Valley groundwater system (52).

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of dissolved silver at times exceeded the primary drinking water standard of 0.05 mg/L (Tables 2 and 3). Dissolved solids and iron occasionally exceeded the desired levels of the secondary standards.

An estimated 2,500 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 4,000 by the year 2000.

52. Gem Valley - Gentile Valley

The Gem Valley - Gentile Valley groundwater system is primarily within the valley fill materials comprised of canyon-filling Blackfoot Basalt, unconsolidated alluvium and, at depth, poorly indurated sediments and volcanics of the Salt Lake Formation (Dion, 1970). Reported static water levels ranged from 1 to 174 feet below land surface, and reported yields to wells varied from 30 to 2,700 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, leakage from surface streams along the margins of the valleys, infiltration of surface water diverted for irrigation, and underflow from the Soda Springs groundwater system (53).

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of nitrate plus nitrite as nitrogen occasionally exceeded the primary drinking water standard of 10.0 mg/L (Tables 2 and 3). Dissolved solids and pH were reported as occasionally being outside of the desired ranges of the secondary standards.

An estimated 3,900 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 6,000 by the year 2000.

53. Soda Springs

The Soda Springs groundwater system is primarily within the valley fill materials comprised of canyon-filling Blackfoot Basalt, unconsolidated alluvium and, at depth, poorly indurated sediments and volcanics of the Salt Lake Formation (Dion, 1970; Seitz and Norvitch, 1979). Reported static water levels ranged from flowing to 265 feet below land surface and reported yields to wells varied from 10 to 3,400 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, leakage from surface streams along the margins of the basin, seepage from Blackfoot Reservoir and possible underflow from the Bear River-Dingle Swamp groundwater system (54).

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of nitrate plus nitrite as nitrogen occasionally exceeded the primary drinking water standard of 10.0 mg/L (Tables 2 and 3). Levels of dissolved solids and dissolved iron, and values of pH were reported as occasionally being outside of the desired ranges of the secondary standards.

An estimated 6,200 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 10,000 by the year 2000.

54. Upper Blackfoot River

The Upper Blackfoot River groundwater system is primarily within the unconsolidated valley fill materials and the underlying Dinwoody and Wells Formations comprised of limestone, sandstone and other marine sediments (Ralston and others, 1977). Although the structural geology of the area has been studied in great detail, specific hydrologic and water quality data are limited to phosphate mining sites and are of little use in defining the nature and extent of the overall groundwater system.

Major sources of recharge to the flow system are downward percolation of precipitation and snowmelt into the alluvium, infiltration into the Dinwoody and Wells Formations where exposed in the uplands, and leakage from tributaries to the Blackfoot River. The alluvial aquifers are, in places, recharged by the sedimentary rock aquifers, while in other areas the saturated alluvium may lose water to the underlying sedimentary formations. The quality of groundwater in this system is most likely suitable for domestic use.

An estimated 400 people currently rely on the Upper Blackfoot River and Star Valley-Sage Valley (59) groundwater systems for their domestic water supply, and this number is projected to increase to 660 by the year 2000.

55. Bear River - Dingle Swamp

The Bear River - Dingle Swamp groundwater system is primarily within the unconsolidated valley fill materials and the underlying poorly indurated sediments and volcanics of the Salt Lake Formation (Dion, 1969). Reported static water levels in wells penetrating the flow system ranged from flowing to 56 feet below land surface, and reported yields to wells varied from 5 to 1,800 gpm (Table 1). In central Bear Lake Valley, the water table is at or near land surface forming a large marshy area known as Dingle Swamp. Major sources of recharge are downward percolation of precipitation and snowmelt, and leakage from surface streams along the margins of the valleys.

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of nitrate plus nitrite as nitrogen sometimes exceeded the primary drinking water standard of 10.0 mg/L (Tables 2 and 3). Dissolved solids and sulfate were also reported to occasionally exceed the desired levels of the secondary drinking water standards.

An estimated 5,200 people currently rely on this system for their domestic water supply, and this number is projected to increase to 6,100 by the year 2000.

56. Blackfoot Reservoir

The Blackfoot Reservoir groundwater system is likely within the valley-fill materials comprised of unconsolidated alluvium and the canyon filling Blackfoot Basalt. Sedimentary deposits of pre-Tertiary origin may also yield groundwater in limited quantities where fractured or weathered. Major sources of recharge are probably downward percolation of precipitation and snowmelt, runoff from the adjacent uplands and leakage from the Blackfoot reservoir and overlying streams.

Hydrologic and water quality data were available for only one well, which penetrates the pre-Tertiary sediments. The static water level was reported at 15 feet below land surface and the quality was reported as generally suitable for domestic use (Tables 1 to 3).

The number of people utilizing this system for domestic water supplies is unknown, but probably less than 50.

57. Willow Creek - Grays Lake

The Willow Creek - Grays Lake groundwater system is primarily within the valley-filling sediments and volcanics, and sedimentary rocks of the Wayan and related pre-Tertiary formations (Parlman, personal communication). Reported static water levels in wells ranged from flowing to 120 feet below land surface (Table 1). Major sources of recharge are likely downward percolation of precipitation and snowmelt, direct infiltration into permeable sedimentary rock formations where exposed, and runoff from surrounding uplands.

With the exception of total dissolved solids, the quality of groundwater is reported as generally suitable for domestic use, but data describing trace constituents are lacking (Tables 2 and 3).

An estimated 500 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 800 by the year 2000.

58. South Fork Snake River

The South Fork Snake River groundwater system is within the valley-filling sediments and volcanics, and sedimentary rocks of the Wayan and related pre-Tertiary formations (Parlman, personal communication). Reported static water levels in wells ranged from flowing to 500 feet below land surface, and reported yields to wells varied from 3 to 75 gpm (Table 1). The flow system is recharged primarily by downward percolation of precipitation and snowmelt, direct infiltration into sedimentary rock formations where exposed, and runoff from the surrounding uplands.

The quality of groundwater is reported as generally suitable for domestic use. However, water obtained from the unconsolidated to poorly indurated sediments may occasionally contain dissolved fluoride levels in excess of the primary drinking water standard, and dissolved solids and concentrations of sulfate and chloride frequently exceeded the recommended levels of the secondary standards (Table 2). Water obtained from the basalts occasionally was reported to contain dissolved solids in excess of the secondary drinking water standard of 500 mg/L. Data describing concentrations of trace elements in groundwater were unavailable.

An estimated 1,000 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 1,300 by the year 2000.

59. Star Valley - Sage Valley

The Star Valley - Sage Valley groundwater system is likely within the unconsolidated valley fill material and the underlying pre-Tertiary sedimentary rocks. This flow system is probably recharged by downward percolation of precipitation and snowmelt, direct infiltration into permeable sedimentary rock formations where exposed, and runoff from the surrounding uplands.

Specific hydrogeologic characteristics and water quality data are limited to one well. The reported static water level was 20 feet, the discharge was 15 gpm and the quality was suitable for domestic use (Tables 1 to 3).

An estimated 400 people currently rely on the Star Valley - Sage Valley and Upper Blackfoot River (54) groundwater systems for their domestic water supply, and this number is expected to increase to 660 by the year 2000.

60. Teton Valley

The Teton Valley groundwater system is primarily within glacial and stream deposited sediments, silicic volcanics and pre-Tertiary sedimentary rocks (Kilburn, 1964). Major sources of recharge are downward percolation of precipitation and snowmelt, runoff from the surrounding uplands, direct infiltration into permeable sedimentary rock formations where exposed, and downward migration of surface water diverted for irrigation. Static water levels in wells were reported to range from flowing to 375 feet below land surface, and reported yields varied from 2 to 1,400 gpm (Table 1).

The quality of groundwater is reported generally suitable for domestic use, but pH and levels of dissolved iron were occasionally outside of the desired ranges of the secondary drinking water standards (Tables 2 and 3).

An estimated 5,500 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 7,500 by the year 2000.

61. Island Park

The Island Park groundwater system is primarily within the valley-filling stream and glacial deposits, rhyolitic ash flows and basalt (Whitehead, 1978). Thickness of the alluvium near Henrys Lake is reported to exceed 3,600 feet. Reported static water levels in wells penetrating the flow system varied from 1 to 225 feet, and reported specific capacities ranged from 1.7 to 113 gpm/foot (Table 1). The flow system is recharged primarily by downward percolation of precipitation and snowmelt that falls within the basin.

The quality of groundwater is reported as generally suitable for domestic use (Table 2). However, levels of dissolved fluoride occasionally exceeded the primary drinking water standard, and pH and dissolved solids were sometimes outside of the desired ranges of the secondary standards. Concentrations of trace constituents in the groundwater are unknown.

An estimated 420 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 520 by the year 2000. These population figures do not include seasonal second-home residents, which would increase the number of people relying on the system for domestic water during the summer months.

62. Birch Creek Valley

The Birch Creek Valley groundwater system is primarily within the valley fill materials comprised of stream, lake and glacial deposits (Parlman, 1982). Specific hydrologic and water quality data are unavailable due to a lack of development in the valley. The flow system is likely recharged by downward percolation of precipitation and snowmelt, infiltration of runoff from the surrounding uplands and leakage from Birch Creek.

The number of people relying on this groundwater system for domestic water supplies is unknown, but probably less than 50.

63. Lemhi Valley

The Lemhi Valley groundwater system is primarily within the valley fill materials comprised of stream, lake and glacial deposits (Parlman, 1982). Marine sediments may also yield limited quantities of groundwater to wells along the eastern flank of the valley. Reported static water levels in wells penetrating the flow system ranged from 2 to 78 feet below land surface and reported yields varied from 1 to 2,240 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, runoff from the surrounding uplands, and infiltration of surface water diverted for irrigation.

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of dissolved fluoride occasionally exceeded the primary drinking water standard (Table 2). Levels of dissolved sulfate, chloride, iron and dissolved solids sometimes exceeded the secondary drinking water standards (Table 3).

An estimated 1,800 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 2,200 by the year 2000.

64. Little Lost River Valley

The Little Lost River Valley groundwater system is primarily within the valley fill materials comprised of stream, lake and glacial deposits (Parlman, unpublished data). Basalt of the Snake River Group underlay the sediments in the southern part of the valley near Howe and yield substantial quantities of groundwater to irrigation wells (Clebsch and others, 1974). Reported static water levels in wells penetrating the flow system ranged from 46 to 278 feet below land surface and reported yields to wells varied from 10 to 2,475 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, runoff from surrounding uplands, and infiltration of surface water diverted for irrigation.

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of dissolved iron occasionally exceeded the desired limit of the secondary drinking water standards (Tables 2 and 3).

An estimated 280 people currently rely on this groundwater system for their domestic water supply, and this number is projected to remain constant over the next 20 years.

65. Pahsimeroi Valley

The Pahsimeroi Valley groundwater system is primarily within the valley fill materials comprised of stream, lake and glacial deposits (Parlman, 1982). Reported static water levels in wells penetrating the flow system ranged from flowing to 165 feet below land surface, and reported yields to wells varied from 50 to 3,850 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, runoff from the surrounding uplands, and infiltration of surface water diverted for irrigation.

The quality of groundwater is reported as generally suitable for domestic use, but concentrations of trace elements are unknown (Tables 2 and 3).

An estimated 150 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 200 by the year 2000.

66. Big Lost River Valley

The Big Lost River Valley groundwater system is primarily within the valley fill materials comprised of stream, lake and glacial deposits (Parlman, 1982). Thickness of the valley fill is reported to range from 150 feet at the northern end near Chilly to over 2,500 feet at the southern end near Arco. Basalt of the Snake River Group, interbedded in the alluvium within the lower end of the valley, and carbonate rocks along the northeast flank, may also transmit large quantities of groundwater (Crosthwaite and others, 1970). Reported static water levels in wells penetrating the flow system ranged from 4 to 600 feet below land surface, and reported yields to wells varied from 10 to 4,000 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, underflow from the Copper Basin flow system, runoff from surrounding uplands and infiltration of surface water diverted for irrigation.

The quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3). However, the concentration of nitrate plus nitrite as nitrogen may exceed the primary drinking water standard and the level of dissolved iron may exceed the desired limit of the secondary standard.

An estimated 4,400 people currently rely on this groundwater system for their domestic water supply, and this number is projected to increase to 4,800 by the year 2000.

67. Copper Basin

The Copper Basin groundwater system is primarily within unconsolidated glacial deposits (Crosthwaite and others, 1970). Specific data on the quality of groundwater and hydrologic and geologic characteristics are unavailable. Sources of recharge are likely runoff from the surrounding mountains and leakage from overlying streams. This groundwater system is within national forest boundaries and is likely used only as a seasonal domestic supply for forest service facilities.

68. Round Valley

The Round Valley groundwater system is primarily within the valley fill materials comprised of stream and glacial deposits (Parlman, 1982). Reported static water levels in wells penetrating the flow system ranged from 6 to 120 feet below land surface, and reported yields to wells varied from 1 to 200 gpm (Table 1). Major sources of recharge are downward percolation of precipitation and snowmelt, runoff from the surrounding uplands and possibly leakage from overlying streams. The quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3).

An estimated 970 people currently rely on this flow system for their domestic water supply, and this number is projected to increase to 1,200 by the year 2000.

69. Upper Salmon River

The Upper Salmon River groundwater system is primarily within the valley fill materials comprised of stream and glacial deposits (Parlman, 1982). Reported static water levels in wells penetrating the flow system ranged from 10 to 65 feet below land surface, and reported yields varied from 1 to 22 gpm (Table 1). Major sources of recharge are underflow from adjoining groundwater systems, downward percolation of precipitation and snowmelt, runoff from surrounding uplands and possible leakage from overlying streams. The quality of groundwater is reported as generally suitable for domestic use (Tables 2 and 3).

An estimated 1,600 people currently rely on the Upper Salmon River and North Fork Salmon River (70) groundwater systems for their domestic water supply, and this number is projected to increase to 2,000 by the year 2000.

70. North Fork Salmon River

The North Fork Salmon River groundwater system is primarily within the valley fill materials comprised of stream and glacial deposits (Parlman, 1982). Specific data on the quality of groundwater and hydrologic characteristics are unavailable. Sources of recharge are likely downward percolation of precipitation and snowmelt, runoff from surrounding uplands and leakage from overlying streams.

An estimated 1,600 people currently rely on the North Fork River and Upper Salmon River (69) groundwater systems for their domestic groundwater supply, and this number is projected to increase to 2,000 by the year 2000.

SUMMARY

The quality of groundwater available to wells within a given flow system is dependent on:

1. precipitation within the basin of the groundwater system,
2. groundwater underflow from one flow system into another,
3. the capacity of exposed or shallow unsaturated formations to conduct infiltrating surface water into the groundwater system, and
4. the lithology and continuity of the saturated zones.

Within North and Central Idaho (flow systems 1-17), precipitation is adequate to maintain most groundwater systems at or near maximum capacity. However, because of either limited infiltration, or restricted permeability, flow systems within fine-grained lake deposits or the Columbia River basalt generally yield only limited quantities of groundwater to wells. The most productive groundwater systems, such as Rathdrum Prairie (4) or Coeur d'Alene River - Silver Valley (5), are within the coarse stream and glacial deposited materials. Older basalt components, which lack soil buildup within the interflow zones, may also yield large quantities of groundwater when adequate recharge to the system is available.

Capacities of several major groundwater systems in Southwest and South Central Idaho are limited by a lack of water available as recharge, in addition to unfavorable geologic characteristics. Large areas within the Bruneau - Grandview (34), Goose Creek - Golden Valley (41) and Raft River Valley (43) flow systems have been designated as critical groundwater areas in response to declining groundwater surface elevations. These systems are all located south of the Snake River (Plate 1).

Generally, the most productive groundwater systems in these regions of the state are within basalt, silicic volcanics and coarse-grained sediments. Adequate water for recharge is supplied by precipitation in nearby mountains, primarily to the north of the Snake River Plain, and infiltration of surface water, often diverted for irrigation. One of these systems, the Snake Plain (39), underlies a large part of South Central and Southeast Idaho, and is considered one of the most prolific groundwater systems in the world.

Within Southeast Idaho (systems 44-61, plus the eastern half of 39), several groundwater systems contain large areas where yields to wells are low, or static water levels are declining. A large part of the Black Pine - Curlew Valley (44) flow system has been designated as a critical groundwater area, and the Pocatello Valley (47) and parts of the Malad Valley (48) groundwater systems yield only limited quantities to wells.

Adequate water for recharge combined with suitable aquifer formations have resulted in generally productive flow systems along the eastern margin of the State (systems 49-61). The most productive lithologic zones are comprised of coarse-grained alluvium and stream sediments, poorly indurated sediments and volcanics, fractured or porous sedimentary rocks of marine origin, basalt, and silicic volcanics.

Groundwater systems underlying the mountain valleys of East Central Idaho (systems 62-70) are primarily within valley-filling stream, lake and glacial sediments, and, near the northern boundary of the Snake River Plain, basalt of the Snake River Group. Recharge, primarily from precipitation falling within the respective basins, is adequate and yields to wells are generally suitable to meet agricultural and domestic needs.

The quality of groundwater is primarily dependent upon sources of recharge, physical and chemical interactions within the geologic environment, time of retention within the subsurface settings, and the effects of man's activities. Current groundwater conditions in Idaho are primarily attributed to influence of the natural phenomena.

Generally, the quality of groundwater in Idaho is reported as suitable for domestic use. The only constituent observed to consistently exceed primary drinking water standards within a major flow system was fluoride. Levels in excess of 4 mg/L were usually observed in samples collected from the Homedale - Murphy (32) and Salmon Falls Creek - Rock Creek (40) groundwater systems. Concentrations of fluoride were reported to occasionally exceed the primary standard in groundwater from seven additional systems in Southwest, South Central, Southeast, and East Central Idaho. The high-fluoride groundwaters are thought to be of natural origin.

Levels of nitrate-nitrogen were reported to exceed primary drinking water standards in samples collected from eleven major groundwater systems. However, the high nitrate groundwaters were found only in small areas or individual wells, and were usually associated with relatively shallow alluvial flow systems underlying agricultural or residential areas. Principal sources of nitrate contamination of groundwater are nitrogen fertilizer applications and septic tank effluent.

Trace elements in concentrations exceeding primary drinking water standards were occasionally observed in groundwater from eleven major flow systems. The principal sources of trace element contamination in the Coeur d'Alene River - Silver Valley groundwater system (5) are thought to be related to nearby mining and smelting activities. Most other cases where concentrations of trace elements were reported to exceed the primary standards are attributed to natural sources.

Level of iron and/or manganese were reported to commonly exceed secondary drinking water standards in three major groundwater systems in southern Idaho, and excessive concentrations were occasionally observed in 24 additional systems. In most areas, the high levels of iron and manganese can be attributed to natural sources.

Levels of dissolved solids were reported to commonly exceed the secondary drinking water standard of 500 mg/L in five major groundwater systems in Southwest, South Central and Southeast Idaho. Levels occasionally exceeded the secondary standard in samples from 19 additional flow systems.

Concentrations of chloride, sulfate, zinc and copper in samples of groundwater were occasionally reported to exceed the secondary drinking water standards, and pH levels were sometimes reported as outside of the desired range of the secondary standard.

Groundwater systems with known water shortages, or that contain water that does not meet the primary drinking water standards on a widespread basis are primarily situated in Southern Idaho, south of the Snake River. The quality and quantity of groundwater throughout the rest of the State is generally adequate to meet current domestic, industrial and agricultural needs. However, careful management is imperative to insure sufficient supplies of good-quality groundwater to meet future demands.

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**APPENDIX B: Hydrogeologic Characteristics and Physical
and Chemical Quality of Groundwater for the Major Flow
Systems in Idaho.**

TABLE 1. HYDROGEOLOGIC CHARACTERISTICS OF THE MAJOR GROUNDWATER FLOW SYSTEMS IN IDAHO

| Flow System | Number of Wells Analyzed | Lithology of Production Zone | Groundwater Surface Elev. (ft. above msl) Range of Values | Depths to Standing Water (ft. below LSD) Range of Values | Discharge (gpm) Range of Values | Specific Capacity (gpm/ft. of drawdown) Range of Values |
|-------------|--------------------------|------------------------------|--|---|------------------------------------|--|
| 1 | 84 | Qs | 1742-1772 | 15-59 | 5-20 | |
| 2 | 6 | Qs | 2057-2496 | 24-203 | 10-60 | |
| 3 | 20 | Qs | 2066-2341 | 7-214 | 6-60 | |
| 3 | 1 | pCm | 2184 | 16 | | 15 |
| 4 | 50 | Qs | 1950-2295 | 70-515 | 5-1500 | |
| 4 | 1 | pCm | 2291 | 124 | | 5 |
| 5 | 12 | Qs | 1971-2451 | Flowing-199 | 5-3000 | |
| 5 | | Tcr | | | | |
| 6 | 2 | Tcr | 1582-2748 | 28-52 | 10-15 | |
| 7 | 1 | Tcr | | 2560 | Flowing | 15 |
| 8 | 2 | Qs | 2532-2624 | | 16-68 | 10 |
| 8 | 3 | Tcr | 2471-2498 | | 22-149 | 10-20 |
| 9 | 4 | Qs | 2143-2815 | | 15-67 | 5-15 |
| 10 | 40 | Tcr | | 669-716 | | 2-240 |
| 11 | | Tcr | | | | |
| 12 | 152 | Tcr | | 766-4351 | Flowing-399 | 1-110 |
| 13 | ND | | | | | |
| 14 | ND | | | | | |
| 15 | ND | | | | | |
| 16 | | Qs | | | | |

TABLE 1. HYDROGEOLOGIC CHARACTERISTICS OF THE MAJOR GROUNDWATER FLOW SYSTEMS IN IDAHO

| Flow System | Number of Wells Analyzed | Lithology of Production Zone | Groundwater Surface Elev. (ft. above msl) Range of Values | Depths to Standing Water (ft. below LSD) Range of Values | Discharge (gpm) Range of Values | Specific Capacity (gpm/ft. of drawdown) Range of Values |
|-------------|--------------------------|------------------------------|--|---|------------------------------------|--|
| 17 | ND | | | | | |
| 18 | | Qs | | | | |
| 18 | | Tcr | | | | |
| 19 | | Qs | | | | |
| 20 | ND | | | | | |
| 21 | | Qs | | | | |
| 22 | 21 | Tcr | | 10-164 | 3-2200 | |
| 22 | 11 | Qs | | 14-55 | 1-200 | .06-59.4 |
| 23 | | QTs | | | | |
| 24 | ND | | | | | |
| 25 | ND | | | | | |
| 26 | 10 | QTs | <1-38 | 8-24 | .01-61.2 | |
| 27 | | QTs | | | | |
| 28 | ND | | | | | |
| 29 | | Qs | | | | |
| 30 | 86 | QTs | 2215-2807 | 2-159 | | |
| 31 | 42 | QTs | | 3-355 | 20-2700 | 1-1050 |
| 31 | 34 | Qsr | | 13-425 | 12-3600 | 2-325 |
| 32 | 63 | QTs | 2235-2807 | | | |
| 33 | ND | | | | | |
| 34 | 139 | QTs | 2320-3256 | | | |

TABLE 1. HYDROGEOLOGIC CHARACTERISTICS OF THE MAJOR GROUNDWATER FLOW SYSTEMS IN IDAHO

| Flow System | Number of Wells Analyzed | Lithology of Production Zone | Groundwater Surface Elev. (ft. above msl) Range of Values | Depths to Standing Water (ft. below LSD) Range of Values | Discharge (gpm) Range of Values | Specific Capacity (gpm/ft. of drawdown) Range of Values |
|-------------|--------------------------|------------------------------|--|---|------------------------------------|--|
| 34 | | Qs | | | | |
| 35 | ND | | | | | |
| 36 | ND | | | | | |
| 37 | 146 | Qs | 4810-5102 | Flowing-197 | | |
| 37 | 48 | Qsr | 4747-5131 | Flowing-119 | | |
| 37 | 36 | QTsv | 5072-5412 | Flowing-143 | | |
| 37 | 43 | TKi | 5056-5310 | Flowing-33 | | |
| 38 | | Qs | | | 4-5000 | 0.3-200 |
| 39 | 270 | Qsr | | 4-450 | | 259-6820 |
| 39 | 31 | Qs | | 39-323 | | 580-4600 |
| 40 | 42 | Qsr | 320-5100 | 72-512 | 10-3000 | 1.2-420 |
| 41 | | Qsr | 3700-4450 | 100-500 | | |
| 42 | | Qs | | | | |
| 43 | 193 | Qs | 4150-5700 | Flowing-276 | 250-4000 | 72 |
| 44 | 11 | Qs | 4546-4792 | Flowing-420 | 8-2700 | 1.6-100 |
| 45 | | QTs | | | | |
| 46 | 3 | QTs | 5025-5136 | Flowing-28 | 450-3400 | 5.6-26.2 |
| 47 | | Qs | | | | |
| 48 | 3 | QTs | | | Flowing-20 | |
| 49 | 21 | QTs | 450B-4998 | | 20-2500 | |
| 49 | | QTb | | | | |

TABLE 1. HYDROGEOLOGIC CHARACTERISTICS OF THE MAJOR GROUNDWATER FLOW SYSTEMS IN IDAHO

| Flow System | Number of Wells Analyzed | Lithology of Production Zone | Groundwater Surface Elev. (ft. above msl) Range of Values | Depths to Standing Water (ft. below LSD) Range of Values | Discharge (gpm) Range of Values | Specific Capacity (gpm/ft. of drawdown) Range of Values |
|-------------|--------------------------|------------------------------|--|---|------------------------------------|--|
| 50 | 37 | QTs | 4473-5033 | Flowing-104 | 90-1350 | |
| 50 | 75 | TsI | 4464-5040 | Flowing-116 | 3-2500 | |
| 51 | 1 | QTs | 5504 | 21.0 | 20 | 4 |
| 51 | 5 | QTb | 5303-5433 | 17.1-186.8 | 20-1350 | 150-1760 |
| 52 | 2 | QTs | 5260-5425 | 9.8-65.0 | 10-? | |
| 52 | 4 | QTb | 5116-5400 | 77.0-166.0 | 17-1680 | 8-? |
| 52 | 1 | pTs | | 5242 | 38.0 | 15 |
| 53 | 1 | Qs | | 5791.5 | 33.5 | 20 |
| 53 | 12 | QTb | 5116-6081 | 17.0-175.5 | | |
| 53 | 1 | TsI | 5816 | 34.0 | 9-100 | <1 |
| 53 | 2 | pTs | 5779.5-6215 | 45.5-360.0 | 10 | 1-? |
| 54 | ND | | | | | |
| 55 | 16 | Qs | 5912-6120 | 1.7-98*5 | 15-1300 | 0-43 |
| 55 | 3 | TsI | 5950-6139.5 | Flowing-40.5 | 20-30 | <1: |
| 55 | 3 | pTs | 5999-6256 | 11-34 | 15-20 | I-2 |
| 56 | 1 | pTs | 6415 | 15.0 | | |
| 57 | 9 | Qs | 6160-6560 | Flowing-120 | | |
| 57 | 1 | TsI | 5750 | 25 | | |
| 57 | | Qsr | | | | |
| 57 | 2 | QTb | | | 30 | |
| 58 | 22 | Qs | 5231-6402 | 5-380 | 3-75 | |
| 58 | 3 | QTb | 5263-5630 | 7-20 | | |
| 58 | 2 | pTs | 5220-5230 | 470-500 | | |
| 58 | 1 | QTs | 5221 | 12D | | |
| 58 | 2 | TsI | 5530-5640 | Flowing-80 | | |
| 59 | 1 | pTs | 622D | 20.0 | 5 | 1 |
| 60 | 26 | QTsv | 5794-6297 | Flowing-375 | 2-100 | |

TABLE 1. HYDROGEOLOGIC CHARACTERISTICS OF THE MAJOR GROUNDWATER FLOW SYSTEMS IN IDAHO

| Flow System | Number of Wells Analyzed | Lithology of Production Zone | Groundwater Surface Elev. (ft. above msl) Range of Values | Depths to Standing Water (ft. below LSD) Range of Values | Discharge (gpm) Range of Values | Specific Capacity (gpm/ft. of drawdown) Range of Values |
|-------------|--------------------------|------------------------------|--|---|------------------------------------|--|
| 60 | 113 | Qs | 5951-6373 | Flowing-242 | 3-1400 | |
| 60 | 1 | pTs | 6110 | 130 | | |
| 61 | 35 | QTsv | 5939-6397 | 2-205 | | 1.7-50 |
| 61 | 87 | Qs | 6203-7699 | 1-225 | | 3.2-113 |
| 62 | ND | | | | | |
| 63 | 1 | pTs | | 2 | 20 | |
| 63 | 22 | QTas | | 6-78 | 1-2240 | 1-29 |
| 64 | | pTs | | | | |
| 64 | 14 | QTas | | 46-278 | 10-2475 | 12-236 |
| 65 | 54 | QTas | 4618-6234 | Flowing-165 | 50-3850 | 15-203 |
| 66 | | pTs | | | | |
| 66 | 47 | QTas | | 4-600 | 10-4000 | 1.2-663 |
| 67 | ND | | | | | |
| 68 | 10 | QTas | | 6-120 | 1-200 | 2-22 |
| 69 | 19 | QTas | | 10-65 | 1-22 | 1-15 |
| 70 | ND | | | | | |

ND: No Data Available

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM Page 1

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|-------------------|-------------------|------------|-------------------------|---------------------------------|-------------------|---------------------|--------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|---------------------|--------------------|-----------------------------------|
| 1 | Qs | 10 | 6.9-7.6 | 309 35-773 | 472 43-1050 | 21.1 1.9-58.0 | 2.6 8-4.1 | 63.4 4.9-180.0 | 17.0 8-38.0 | 272 19-530 | 0 * | 33.0 1.0-100.0 | 8.3 8-60.0 | .26 .10-.60 | 2.6 .01-5.0 |
| 2 | Qs | 6 | 6.2-7.4 | 106 47-206 | 145 41-312 | 4.6 1.5-12.0 | 1.5 8-2.8 | 18.3 4.4-41.0 | 5.3 8-12.0 | 91 24-190 | 0 * | 10.6 2.1-28.0 | .57 .10-.90 | .13 .00-.30 | .13 .01-.41 |
| 3 | Qs | 21 | 6.1-8.2 | 133 128-361 | 210 32-639 | 4.6 1.2-17.0 | 1.3 .4-2.3 | 27.2 4.5-81.0 | 8.4 .7-39.0 | 124 16-430 | 0 * | 9.1 .7-29.0 | .9 .2-3.9 | .15 .1-5 | .18 .01-1.60 |
| 4 | Qs | 50 | 6.5-8.2 | 152 42-220 | 241 43-495 | 3.7 1.8-15.0 | 1.7 .5-4.0 | 31.1 5.0-54.0 | 12.1 .8-22.0 | 153 29-350 | 0 * | 9.9 2.1-41.0 | 1.1 .3-8.8 | .1 .0-5 | .74 .01-2.90 |
| 5 | Qs | 19 | 6.0-8.2 | 98 55-199 | 150 46-968 | 5.3 1.1-24.0 | 1.2 .5-2.9 | 14.3 4.5-27.0 | 6.1 1.2-26.0 | 59 11-220 | 0 * | 18.8 2.2-73.0 | 2.9 2-40.0 | .09 .0-40 | .39 .01-1.30 |
| 6 | Tcr | 6 | 7.4-7.5 | 200 165-245 | 240 * | 21.0 8.0-30.0 | 2.0 1.2-3.1 | 23.8 22.0-27.0 | 11.8 7.0-17.0 | | | 5.3 1.0-10.0 | 4.7 2.0-7.0 | .39 .32-.47 | .17 .002-.49 |
| 7 | Tcr | 1 | 7.7 | 143 | 191 | 13 | 2.3 | 14 | 9.6 | 120 | 0 | 2.7 | 1.6 | .3 | 0 |
| 8 | Tcr | 5 | 7.1-8.1 | 273 106-565 | 431 129-968 | 45.5 5.6-110.0 | 2.7 1.7-4.9 | 34.8 14.0-78.0 | 7.9 4.6-16.0 | 172 79-220 | 0 * | 33.7 2.1-140.0 | 24.9 1.4-100.0 | .44 1-1.4 | .03 .002-.04 |
| 9 | Qs | 4 | 6.9-7.6 | 172 103-208 | 241 133-313 | 8.9 6.2-11.0 | 3.9 1.3-10.0 | 26.8 12.0-36.0 | 11.0 4.5-15.0 | 158 70-200 | 0 * | 4.6 2.8-8.5 | 1.2 1.0-1.3 | .23 .10-.40 | .06 .00-.09 |
| 10 | Qs | 31 | 6.0-8.2 | 333 70-680 | | 30.8 * | 2.8 * | 24.0 * | 11.2 * | | | 65.6 8.0-260.0 | 13.8 2.0-82.0 | .72 .06-1.41 | .06 .002-.44 |
| 11 | Tcr | 14 | 7.0-8.4 | 125 51-224 | | 10.7 1.0-26.0 | 1.6 .2-4.0 | 9.7 2.0-21.0 | 9.2 1.0-31.0 | | | 14.4 .2-35.5 | 2.9 1.0-9.0 | .14 .01-.34 | .06 .002-.18 |
| 12 | Tcr | 18 | 6.5-8.1 | 283 144-460 | | 30.4 6.0-76.0 | 2.7 .4-4.8 | 29.5 11.0-58.0 | 12.0 5.0-19.0 | | | 9.7 1.0-62.0 | 9.2 1.0-26.0 | .59 .24-1.24 | 1.04 .02-9.40 |
| 13 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 14 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 15 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 16 | Qs | 5 | 7.1-7.9 | 107 58-213 | | 5.1 1.9-14.0 | 1.0 .5-1.2 | 14.2 8.0-29.0 | 2.9 9-8.0 | | | 16.8 2.0-48.0 | 11.2 4.0-38.0 | .29 .05-.42 | 2.8 <.02-.64 |
| 17 | NO DATA AVAILABLE | | | | | | | | | | | | | | |

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM Page 2

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|-------------------|-------------------|------------|-------------------------|---------------------------------|--------------------|---------------------|--------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|---------------------|--------------------|-----------------------------------|
| 18 | Qs | 6 | 7.1-8.2 | 253 148-368 | | 47.5 7.1-68.0 | 4.1 1.6-5.5 | 16.4 14.0-20.0 | 6.9 2.8-18.0 | | | 76.5 10.0-116.0 | 17.2 <2.0-52.0 | .60 <.01-1.25 | .01 .002-.02 |
| 19 | Qs | 3 | 6.8-7.0 | 48 32-70 | | 2.2 2.0-2.5 | .43 .4-5 | 5.7 5.0-6.0 | .53 .40-.80 | | | 9.3 8.0-10.0 | 3.3 <2.0-6.0 | .07 <.01-.14 | .008 .002-.01 |
| 20 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 21 | Qs | 1 | | 52 | | 6.5 | 1.1 | 6.0 | 1.0 | | | <10.0 | 2.0 | <.01 | .04 |
| 22 | Tcr | 21 | 6.8-8.7 | 197 136-323 | 240 145-440 | 25.4 5.6-75.0 | 6.2 1.5-13.0 | 15.2 4.1-31.0 | 6.6 .2-19.0 | 149 83-283 | 1.2 0.0-16.0 | 8.2 6-19.0 | 2.1 .5-4.5 | .3 .1-1.0 | .74 .01-4.90 |
| 22 | QTs | 10 | 6.6-8.2 | 235 165-499 | 316 168-700 | 29.4 9.7-89.0 | 6.0 1.1-9.0 | 20.4 2.6-66.0 | 9.1 1.1-26.0 | 154 59-266 | 0 * | 29.6 4.3-240.0 | 5.2 .6-17.0 | .25 .10-.30 | 2.1 .01-9.0 |
| 23 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 24 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 25 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 26 | QTs | 10 | 6.3-8.3 | 523 216-1150 | 649 271-1810 | 67.6 13.0-250.0 | 8.01 3.90-14.00 | 52.5 20.0-110.0 | 13.9 3.6-34.0 | 301 129-910 | 0 * | 70.6 13.0-180.0 | 17.7 3.3-45.0 | .63 .40-1.80 | 2.40 .02-6.30 |
| 27 | QTs | 46 | 6.5-8.3 | 432 54-719 | 223 166-280 | 45.5 5.0-109.0 | 3.9 .7-11.2 | 35.4 10.0-86.0 | 13.9 1.0-37.2 | | | 25.5 .1-82.0 | 5.3 2.0-20.0 | .7 .2-3.0 | 1.9 .002-18.2 |
| 28 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 29 | Qs | 2 | | 56 54-58 | | 3.5 3.4-3.6 | .75 .70-.80 | 10.5 10.0-11.0 | 1.3 * | | | <10.0 * | <2.0 * | <.01 * | .03 .002-.050 |
| 30 | QTs | 86 | 6.7-8.4 | 323 98-667 | 596 104-1210 | 43.8 6.6-96.0 | 3.1 1.0-5.5 | 47.0 17.0-93.0 | 9.7 2.5-28.0 | 195 83-275 | | 67.2 2.0-148.0 | 16.0 0.0-63.0 | .34 .30-.50 | 2.7 0.0-12.9 |
| 31 | Qsr | 34 | 7.0-8.1 | 209 52-571 | 288 40-844 | 26.6 2.9-130.0 | 3.9 1.2-7.3 | 22.2 2.5-77.0 | 7.4 .3-31.0 | 134 14-398 | | 22.6 1.9-100.0 | 8.5 .8-43.0 | .43 .10-1.00 | 1.7 .08-8.6 |
| 31 | QTs | 13 | 5.9-8.4 | 309 136-904 | 467 193-1428 | 45.0 12.0-190.0 | 4.1 1.1-9.1 | 36.2 15.0-67.0 | 10.8 1.0-37.0 | 171 75-381 | | 58.5 7.6-200.0 | 18.4 4.6-67.0 | .52 .20-1.20 | 2.78 .15-8.90 |
| 32 | QTs | 48 | 6.7-8.3 | 299 132-920 | 430 426-437 | 72.0 8.0-278.0 | ** | 18.1 1.0-69.0 | 3.9 .2-23.0 | 145 61-258 | ** * | 42.7 1.9-230.0 | 9.6 2.0-21.0 | 7.87 .01-24.0 | .35 .01-2.20 |
| 33 | NO DATA AVAILABLE | | | | | | | | | | | | | | |

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM Page 3

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|-------------------|-------------------|------------|-------------------------|---------------------------------|---------------------|---------------------|--------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|----------------------|--------------------|-----------------------------------|
| 34 | QTs | 16 | 8.1-8.9 | 315 270-544 | 390 270-950 | 58.6 20.0-106.0 | 7.4 2.5-12.2 | 31.2 16.0-66.0 | 17.1 1.0-51.0 | | | 48.6 17.0-210.0 | 52.4 40.0-67.0 | 1.4 .6-6.4 | 1.9 .6-3.5 |
| 35 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 36 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 37 | Qs | 29 | 6.8-8.5 | 156 82-284 | 217 107-416 | 24.4 7.2-78.0 | 2.3 .5-8.0 | 13.6 3.0-33.0 | 4.4 .0-10.0 | 112 44-240 | .14 .00-3.00 | 4.4 .60-36.0 | 3.7 .9-10.0 | .92 .10-4.60 | 1.5 0.0-18.0 |
| 38 | Qs | 36 | 7.5-7.7 | 232 162-368 | 388 247-605 | 7.7 4.0-23.0 | 1.2 .0-3.1 | 41.9 16.0-77.0 | 13.6 2.8-34.0 | 199 52-355 | | 14.3 4.0-26.0 | 3.0 1.0-15.0 | .24 .00-1.00 | .87 .00-2.90 |
| 39 | Qsr | 301 | 7.2-8.0 | 359 172-679 | 595 260-1560 | 33.1 13.0-87.0 | 5.3 3.0-10.0 | 57.1 21.0-118.0 | 21.0 8.0-43.0 | 225 144-394 | 0 * | 57.3 7.0-171.0 | 41.6 7.0-325.0 | .53 .20-1.00 | 1.3 .44-7.1 |
| 40 | Qsr | 42 | 7.7-8.2 | 486 121-804 | 556 416-780 | 96.7 66.0-128.0 | 4.8 1.0-8.6 | 78.6 36.8-104.0 | 22.2 4.8-36.0 | 204 135-300 | | 142.6 49.8-252.0 | 73.7 39.0-92.0 | 4.8 .8-6.9 | 1.8 .02-5.7 |
| 41 | Qsr | 31 | 6.2-9.4 | 319 81-854 | 495 39-1230 | 38.1 2.5-137.0 | 6.2 1.5-12.0 | 42.1 1.8-149.0 | 10.5 6.0-36.0 | 148 15-426 | | 44.6 .6-270.0 | 33.5 1.0-144.0 | .81 .10-6.80 | .76 .00-4.40 |
| 42 | Qs | 4 | 7.2-7.5 | 266 254-280 | | 17.0 15.0-21.3 | 4.8 4.7-5.6 | 37.0 30.0-41.0 | 20.7 13.9-24.0 | | | 24.9 24.0-25.7 | 11.0 2.0-29.0 | .52 .43-.69 | .03 .01-.08 |
| 43 | Qs | 19 | 7.1-7.9 | | 1017 * | 77.4 17.0-271.0 | 8.5 4.0-12.0 | 91.3 40.0-423.0 | 18.8 9.0-49.0 | 208 133-282 | | 59.7 16.0-347.0 | 188.9 32.0-988.0 | .52 .20-1.60 | .64 .00-9.80 |
| 44 | QTs | 14 | 7.1-7.9 | 1090 308-3352 | 1668 587-4392 | 146.7 17.0-454.0 | 12.7 3.0-36.7 | 96.7 29.0-255.0 | 72.3 18.0-154.0 | 270 203-391 | ** * | 175.4 21.0-994.0 | 296.4 54.0-1029.0 | .34 .10-.97 | 1.62 .14-2.89 |
| 45 | QTs | 1 | 7.0 | 318 | | 23.0 | 9.6 | 48.0 | 18.6 | | | 16.0 | 2.0 | .16 | .73 |
| 46 | QTs | 3 | 7.4-7.8 | 559 316-744 | 861 483-1197 | 47.7 14.0-90.0 | 4.9 1.6-10.9 | 95.7 67.0-119.0 | 22.0 10.0-41.0 | 315 200-455 | ** * | 29.0 10.0-43.0 | 86.7 43.0-128.0 | .20 .07-.35 | 6.8 .4-13.9 |
| 47 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 48 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 49 | QTb | 49 | 6.8-8.5 | 392 232-489 | 708 756-1200 | 39.6 24.0-47.0 | 6.7 1.2-9.7 | 89.7 48.0-120.0 | 43.7 13.0-84.0 | 515 332-820 | 2 0-10 | 47.0 10.0-75.0 | 34.7 13.0-59.0 | .2 .0-.7 | .69 .02-1.50 |
| 49 | QTs | 39 | | 452 193-1440 | 745 334-2300 | 42.8 7.1-200.0 | 6.1 .7-41.0 | 72.5 34.0-200.0 | 26.6 6.1-60.0 | 309 143-833 | 0 * | 44.6 1.6-230.0 | 61.7 16.0-360.0 | .25 .10-.80 | 2.53 .02-29.00 |
| 50 | QTs | 14 | 7.4-7.9 | 430 286-632 | 709 472-1020 | 45.3 9.2-110.0 | 6.4 1.9-19.0 | 61.6 27.0-95.0 | 32.4 14.0-59.0 | 351 277-496 | | 29.6 5.0-91.0 | 43.9 13.0-95.0 | .53 .20-1.30 | 1.3 .11-3.8 |

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM Page 4

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|-------------------|-------------------|------------|-------------------------|---------------------------------|-------------------|---------------------|--------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|---------------------|--------------------|-----------------------------------|
| 51 | QTs | 2 | 7.4-7.5 | 294 291-297 | 518 513-522 | 14.0 * | 2.3 1.2-3.4 | 57.5 54.0-61.0 | 18.0 17.0-19.0 | 260 258-262 | 0 * | 15.5 13.0-18.0 | 20.0 18.0-22.0 | .35 .30-.40 | 1.18 .35-2.00 |
| 51 | QTb | 5 | 7.1-7.5 | 623 475-823 | 1033 777-1350 | 40.4 27.0-68.0 | 8.2 3.4-13.0 | 97.6 79.0-120.0 | 59.4 26.0-94.0 | 523 369-781 | 0 * | 78.2 55.0-120.0 | 39.8 23.0-54.0 | .3 .2-.3 | 1.60 .04-3.10 |
| 52 | QTs | 2 | 7.5 * | 417 301-533 | 668 482-854 | 28.2 5.3-51.0 | 1.9 1.2-2.5 | 89.0 80.0-98.0 | 22.5 17.0-28.0 | 365 337-392 | 0 * | 43.1 8.1-78.0 | 22.5 3.0-42.0 | .15 .1-.2 | 1.79 .17-3.40 |
| 52 | QTb | 4 | 7.2-7.6 | 679 559-909 | 1117 927-1440 | 58.3 52.0-68.0 | 11.4 6.8-21.0 | 70.8 66.0-76.0 | 75.3 49.0-130.0 | 549 359-855 | 0 * | 81.5 71.0-90.0 | 51.3 45.0-56.0 | .33 .20-.40 | 8.8 2.4-15.0 |
| 52 | pTs | 1 | 5.4 | 190 | 338 | 1.8 | .4 | 56.0 | 12.0 | 217 | 0 | 5.4 | 1.9 | .1 | .03 |
| 53 | Qs | 1 | 7.4 | 272 | 489 | 6.7 | 2.3 | 88.0 | 20.0 | 254 | 0 | 11.0 | 8.8 | .1 | .92 |
| 53 | QTb | 12 | 6.4-7.8 | 599 237-1690 | 985 404-2730 | 21.7 6.1-49.0 | 4.2 2.6-9.5 | 82.3 13.0-150.0 | 78.2 15.0-320.0 | 586 210-1930 | 0 * | 59.3 8.8-150.0 | 21.9 5.3-63.0 | .4 .1-2.0 | 3.80 .04-19.00 |
| 53 | Tsl | 1 | 7.1 | 458 | 769 | 9.2 | 3.5 | 80.0 | 22.0 | 312 | 0 | 28.0 | 38.0 | .2 | 5.4 |
| 53 | pTs | 2 | 7.3-7.5 | 365 362-368 | 597 564-630 | 10.9 5.8-16.0 | 3.4 1.1-5.7 | 85.5 76.0-95.0 | 22.0 19.0-25.0 | 359 305-412 | 0 * | 21.5 16.0-27.0 | 13.5 6.0-21.0 | .45 .20-.70 | .37 .21-.53 |
| 54 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 55 | Qs | 16 | 7.2-7.8 | 409 260-592 | 703 409-1040 | 33.7 6.8-110.0 | 3.2 1.0-8.9 | 72.1 38.0-110.0 | 29.3 17.0-53.0 | 303 209-594 | 0 * | 70.2 1.6-300.0 | 29.2 3.1-110.0 | .24 .10-.80 | 1.9 .0-7.9 |
| 55 | Tsl | 3 | 7.2-7.6 | 405 356-475 | 671 561-754 | 28.0 10.0-59.0 | 9.0 .7-25.0 | 72.7 34.0-110.0 | 26.0 23.0-31.0 | 307 273-329 | 0 * | 62.7 14.0-140.0 | 25.9 8.0-60.0 | .5 .2-.8 | 1.55 .08-4.00 |
| 55 | pTs | 3 | 7.2-7.5 | 439 320-518 | 744 536-867 | 27.3 15.0-47.0 | 2.0 .8-3.3 | 84.0 76.0-95.0 | 29.7 15.0-38.0 | 262 224-314 | 0 * | 108.0 24.0-180.0 | 32.4 9.1-45.0 | .3 .1-.5 | 6.7 .25-19.00 |
| 56 | pTs | 1 | 7.7 | 345 | 597 | 53.0 | 2.7 | 52.0 | 19.0 | 371 | 0 | 10.0 | 15.0 | .2 | .02 |
| 57 | Qs | 18 | 7.1-8.3 | 307 125-545 | 547 230-1150 | 27.7 4.2-110.0 | 2.5 .5-11.0 | 58.9 13.0-110.0 | 17.3 3.6-44.0 | 322 130-570 | 0 * | 18.2 4.3-90.0 | 15.5 9-79.0 | .3 .1-.7 | .88 0.00-5.10 |
| 57 | Tsl | 1 | 7.6 | 349 | 497 | 12.0 | 4.6 | 70.0 | 16.0 | 250 | 0 | 57.0 | 10.0 | .6 | 0.02 |
| 57 | Qsr | 3 | 7.8 * | 340 321-359 | 570 526-598 | 26.0 22.0-30.0 | 4.1 3.8-4.4 | 65.5 64.0-67.0 | 17.0 15.0-19.0 | 266 242-290 | 0 * | 44.5 40.0-49.0 | 25.7 18.0-57.0 | .3 .2-.4 | 1.5 * |
| 57 | QTb | 2 | 7.6-8.1 | 235 210-259 | 415 349-480 | 14.8 9.5-20.0 | 2.1 1.4-2.7 | 43.5 42.0-45.0 | 13.0 12.0-14.0 | 250 210-290 | 0 * | 14.9 6.9-23.0 | 8.3 5.5-11.0 | .4 * | |

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|-------------------|-------------------|------------|-------------------------|---------------------------------|--------------------|---------------------|---------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|---------------------|--------------------|-----------------------------------|
| 58 | Qs | 16 | 6.3-8.3 | 1059 119-6620 | 1656 206-10500 | 185.6 9-1500.0 | 21.8 4-180.0 | 133.4 12.0-560.0 | 34.8 14.0-100.0 | 411 200-1200 | 0 * | 125.3 2.2-1000.0 | 305.7 1.2-2800.0 | .57 .10-2.70 | 1.1 .05-4.90 |
| 58 | QTb | 3 | 7.2-7.7 | 334 219-485 | 640 345-1113 | 4.0 2.9-5.5 | 3.2 .9-7.3 | 92.0 59.0-140.0 | 23.3 13.0-39.0 | 327 220-430 | 0 * | 79.3 14.0-200.0 | 15.3 1.6-79.0 | .77 .10-.50 | .34 .29-.37 |
| 58 | pTs | 3 | 7.2-7.6 | 390 266-585 | 616 447-898 | 23.0 7.0-41.0 | 3.5 2.2-5.3 | 71.3 46.0-100.0 | 25.3 11.0-37.0 | 293 240-390 | 0 * | 64.0 11.0-140.0 | 30.6 6.7-52.0 | .2 .1-.3 | .94 .32-1.40 |
| 58 | QTs | 1 | 7.2 | 615 | 1010 | 68.0 | 7.8 | 98.0 | 35.0 | | | 46.0 | 120.0 | .3 | .42 |
| 58 | Tsl | 2 | 7.4 * | 226 213-238 | 315 280-350 | 8.7 8.4-8.9 | 3.5 3.5-3.6 | 39.5 36.0-43.0 | 11.0 9.9-12.0 | 165 150-180 | 0 * | 12.0 11.0-13.0 | 14.5 13.0-16.0 | .2 * | |
| 59 | pTs | 1 | 7.4 | 328 | 587 | 39.0 | 2.1 | 55.0 | 20.0 | 290 | 0 | 13.0 | 39.0 | .2 | 1.1 |
| 60 | Qs | 36 | 7.1-8.9 | 225 47-352 | 371 48-604 | 6.0 0.0-76.0 | 1.1 0.0-3.3 | 52.5 5.4-85.0 | 14.8 0.1-28.0 | 220 21-390 | 0 * | 22.6 1.0-159.0 | 4.3 .0-45.0 | .2 .0-.4 | .72 .03-2.20 |
| 60 | QTsv | 7 | 7.1-8.9 | 122 69-221 | 204 111-384 | 4.9 2.9-6.9 | .53 0.00-1.30 | 24.4 12.0-52.0 | 7.6 2.3-16.0 | 121 63-243 | 2 0-12 | 5.9 1.4-7.7 | 4.7 1.9-11.0 | .23 .10-.40 | .80 .03-2.20 |
| 60 | pTs | 1 | 7.0 | 103 | 164 | 2.1 | .8 | 19.0 | 6.4 | 100 | 0 | 9.0 | 1.4 | .1 | .46 |
| 61 | QTsv | 46 | 6.3-8.3 | 183 14-506 | 187 19-830 | 7.5 .5-36.0 | 2.5 .2-4.0 | 23.8 1.1-95.0 | 8.5 .1-39.0 | 121 * | 0 * | 5.2 .8-34.0 | 3.5 .1-36.0 | .62 .0-4.60 | 1.7 .0-2.4 |
| 62 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 63 | QTas | 26 | 6.8-8.9 | 624 124-2660 | 1065 137-4068 | 114.3 5.2-390.0 | 6.5 .7-37.0 | 76.2 1.7-480.0 | 18.2 .0-96.0 | 310 73-990 | | 155.3 3.8-1000.0 | 73.1 3.0-730.0 | .75 .0-3.70 | .89 .0-6.90 |
| 64 | QTas | 15 | 7.2-8.0 | 240 151-446 | 407 243-733 | 15.1 2.7-62.0 | 1.5 .9-3.4 | 45.2 24.0-70.0 | 17.8 11.0-27.0 | 209 130-330 | | 22.3 9.6-61.0 | 14.1 3.3-41.0 | .11 .1-2 | 1.2 .11-4.50 |
| 65 | QTas | 7 | 7.1-8.0 | 219 92-345 | 369 159-562 | 17.3 5.5-64.0 | 2.2 .9-6.3 | 38.9 12.0-68.0 | 13.8 8.9-20.0 | 211 88-317 | 0 * | 18.4 8.8-31.0 | 6.2 1.6-8.9 | .3 .0-.9 | .47 .17-.79 |
| 66 | QTas | 47 | 7.3-8.0 | 195 110-288 | 396 183-738 | 8.0 3.2-14.5 | ** | 48.6 25.0-67.0 | 11.8 5.3-18.0 | 221 98-422 | 0 * | 17.9 11.0-29.0 | 7.9 .5-22.0 | .27 .20-.40 | 2.6 .0-11.0 |
| 67 | NO DATA AVAILABLE | | | | | | | | | | | | | | |
| 68 | QTas | 3 | 6.9-8.9 | 278 267-289 | 447 432-461 | 74.0 70.5-78.5 | .5 .3-.8 | 16.3 15.2-17.6 | 3.7 3.0-4.3 | | | 50.9 46.0-54.2 | 10.0 2.0-17.0 | .56 .51-.59 | 1.0 .002-.24 |
| 69 | QTas | 20 | | 251 58-665 | 408 76-1092 | 32.1 4.3-120.0 | 3.3 .4-12.0 | 37.9 3.8-110.0 | 14.0 .9-44.0 | 179 50-350 | | 48.0 2.5-200.0 | 9.9 1.0-40.0 | 1.1 .1-11.0 | 1.5 .03-3.8 |

TABLE 2. ARITHMETIC MEANS AND RANGES OF PHYSICAL AND DISSOLVED CHEMICAL CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Numbers | Aquifer | Number of Samples | pH (range) | Dissolved Solids (mg/l) | Specific Conductance (µmhos/cm) | Sodium (Na, mg/l) | Potassium (K, mg/l) | Calcium (Ca, mg/l) | Magnesium (Mg, mg/l) | Bicarbonate (HCO ₃ , mg/l) | Carbonate (CO ₃ , mg/l) | Sulfate (SO ₄ , mg/l) | Chloride (Cl, mg/l) | Fluoride (F, mg/l) | Nitrate plus Nitrite (as N, mg/l) |
|---------------------------|---------|-------------------|------------|-------------------------|---------------------------------|-------------------|---------------------|--------------------|----------------------|---------------------------------------|------------------------------------|----------------------------------|---------------------|--------------------|-----------------------------------|
| 70 | | NO DATA AVAILABLE | | | | | | | | | | | | | |

- * No Range
- ** Potassium Combined with Sodium
- *** CO₃ Combined with HCO₃

TABLE 3. ARITHMETIC MEANS AND RANGES OF DISSOLVED TRACE CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Number | Aquifer | Number of Samples | Arsenic (As, mg/l) | Barium (Ba, mg/l) | Cadmium (Cd, mg/l) | Chromium (Cr, mg/l) | Copper (Cu, mg/l) | Iron (Fe, mg/l) | Lead (Pb, mg/l) | Manganese (Mn, mg/l) | Mercury (Hg, mg/l) | Silver (Ag, mg/l) | Zinc (Zn, mg/l) |
|--------------------------|-------------------|-------------------|--------------------|-------------------|--------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|-------------------|--------------------|
| 1 | Qs | 2 | | | <.001 | | .011 * | .04 .02-.05 | <.01 * | .01 <.01-.02 | <.005 * | | <.001 |
| 2 | Qs | | | | | | | | | | | | |
| 3 | Qs | 4 | | | <.001 * | | .003 <.001-.009 | .97 .06-2.18 | <.01 * | .08 <.01-.15 | <.005 * | | .50 .081-1.29 |
| 4 | Qs | 39 | <.01 * | <.1 * | .001 <.001-.022 | .01 * | .007 .010-.090 | .06 .01-.31 | <.01 * | .01 <.01-.04 | <.005 * | <.001 * | .040 .001-.580 |
| 5 | Qs | 7 | .001 .000-.008 | | .006 .002-.023 | 0 * | .03 .03-.08 | .08 .00-.13 | .008 .005-.015 | | 0 * | | .81 .11-3.60 |
| 6 | Tcr | 4 | | | .01 * | | .008 <.001-.016 | .19 .06-.42 | .01 * | .04 <.01-.08 | <.001 * | | 1.79 .175-5.14 |
| 7 | Tcr | 1 | | | | | | | | 3.5 | | | |
| 8 | Qs | 6 | .01 <.01-.01 | <.1 * | .002 .001-.005 | <.01 * | .03 .001-.06 | 3.1 .0-14.0 | .01 <.01-.01 | .03 <.01-.05 | <.005 * | <.001 * | .05 .001-.149 |
| 9 | Qs | 8 | <.01 * | <.1 * | .003 <.001-.018 | <.01 * | .006 <.001-.017 | 1.20 .03-5.75 | <.01 * | .06 <.01-.16 | <.005 * | .001 * | .35 .03-1.19 |
| 10 | Tcr | 16 | <.01 * | <.1 * | .006 <.001-.02 | <.01 * | .06 * | 4.5 * | .01 <.01-.08 | .72 * | <.005 * | <.001 * | .4 * |
| 11 | Tcr | 14 | <.01 * | <.1 * | <.005 * | <.01 * | .03 .001-.18 | .30 <.01-1.70 | .01 <.01-.01 | .03 .01-.08 | .02 .0005-.16 | <.001 * | .040 <.001-.081 |
| 12 | Tcr | 18 | <.01 * | <.1 * | .008 .001-.019 | <.01 * | .003 .001-.010 | .13 .01-.27 | .025 .010-.120 | .02 .01-.06 | <.005 * | <.001 * | .08 .002-.109 |
| 13 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 14 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 15 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 16 | Qs | 1 | <.01 | <.1 | <.001 | <.01 | .016 | .03 | <.01 | <.01 | <.0005 | <.001 | .63 |
| 17 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 18 | Qs | 4 | <.01 * | <.1 * | <.001 * | <.01 * | .006 <.001-.013 | .10 .01-.30 | .01 <.01-.01 | .01 <.01-.01 | <.005 * | <.001 * | .20 .001-.583 |
| 19 | Qs | 1 | <.01 | <.1 | <.001 | <.01 | <.001 | <.01 | <.01 | .01 | <.005 | <.001 | .28 |

TABLE 3. ARITHMETIC MEANS AND RANGES OF DISSOLVED TRACE CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Number | Aquifer | Number of Samples | Arsenic (As, mg/l) | Barium (Ba, mg/l) | Cadmium (Cd, mg/l) | Chromium (Cr, mg/l) | Copper (Cu, mg/l) | Iron (Fe, mg/l) | Lead (Pb, mg/l) | Manganese (Mn, mg/l) | Mercury (Hg, mg/l) | Silver (Ag, mg/l) | Zinc (Zn, mg/l) |
|--------------------------|-------------------|-------------------|--------------------|-------------------|--------------------|---------------------|--------------------|-----------------|-------------------|----------------------|--------------------|---------------------|-------------------|
| 20 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 21 | Qs | 1 | <.01 | <.1 | <.001 | <.01 | <.01 | .44 | <.01 | .04 | <.005 | <.001 | .04 |
| 22 | Tcr | 8 | .003 .001-.006 | .07 .05-.10 | <.001 * | <.01 * | .003 .001-.005 | .90 .00-1.2 | .012 .010-.016 | .02 .00-.06 | <.005 * | .001 * | .04 .002-.13 |
| 22 | QTs | 7 | .09 .003-.17 | .07 .05-.10 | .002 .001-.004 | <.01 * | .006 .001-.013 | .30 .01-2.80 | .014 .010-.017 | 0 * | <.005 * | .001 .001-.002 | .009 .003-.029 |
| 23 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 24 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 25 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 26 | QTs | 4 | .017 .004-.041 | <.1 * | <.001 * | <.01 * | .033 .001-.072 | .26 .00-1.50 | .03 .01-.05 | .03 .00-.09 | <.005 * | .001 * | .012 .001-.029 |
| 27 | QTs | 33 | .009 .010-.027 | <.1 * | <.005 * | <.01 * | .006 <.001-.034 | .30 .01-6.43 | <.01 * | .09 .01-.69 | <.005 * | <.001 * | .07 .001-2.46 |
| 28 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 29 | Qs | 3 | <.01 * | <.1 * | <.001 * | <.01 * | <.001 * | .11 .09-.12 | <.01 * | .01 <.01-.02 | <.005 * | <.001 * | .006 .004-.007 |
| 30 | QTs | 116 | .01 .005-.052 | .10 .05-.80 | .001 <.001-.130 | .01 <.01-.04 | .03 .001-1.28 | .42 .20-.76 | .01 .01-.18 | .04 .01-.63 | <.005 | <.001 <.001-.005 | .19 <.001-5.96 |
| 31 | Qsr | | | | | | | | | | | | |
| 31 | QTs | 17 | <.01 * | <.1 * | <.005 * | <.01 * | .010 .001-.055 | .14 .01-1.05 | <.01 * | .05 .01-.56 | <.005 * | <.001 * | .22 .001-2.24 |
| 32 | QTs | 48 | .01 .005-.01 | <.1 * | <.001 * | <.01 * | .020 .001-.046 | .89 .01-2.70 | <.01 * | .10 .02-.30 | <.005 * | <.001 * | .03 .002-.086 |
| 33 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 34 | QTs | 5 | .02 .01-.02 | .15 .10-.20 | <.001 * | <.01 * | .003 .001-.005 | .23 .14-.58 | .02 .01-.19 | .01 .01-.03 | <.005 * | <.001 * | .29 .04-.53 |
| 35 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 36 | NO DATA AVAILABLE | | | | | | | | | | | | |

TABLE 3. ARITHMETIC MEANS AND RANGES OF DISSOLVED TRACE CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Number | Aquifer | Number of Samples | Arsenic (As, mg/l) | Barium (Ba, mg/l) | Cadmium (Cd, mg/l) | Chromium (Cr, mg/l) | Copper (Cu, mg/l) | Iron (Fe, mg/l) | Lead (Pb, mg/l) | Manganese (Mn, mg/l) | Mercury (Hg, mg/l) | Silver (Ag, mg/l) | Zinc (Zn, mg/l) |
|--------------------------|-------------------|-------------------|--------------------|-------------------|---------------------|---------------------|--------------------|-------------------|-----------------|----------------------|--------------------|---------------------|-------------------|
| 37 | Qs | 4 | <.01 * | <.1 * | <.001 * | <.01 * | .009 <.001-.014 | 1.56 .01-18.00 | <.01 * | .14 .00-.70 | <.005 * | <.001 * | .05 .01-.14 |
| 38 | Qs | 4 | <.01 * | <.1 * | <.001 * | <.01 * | <.001 * | .12 <.01-.27 | <.01 * | <.01 * | <.005 * | <.001 * | .060 017-.134 |
| 39 | Qsr | 200 | .01 <.01-.025 | <.1 * | .001 <.001-.002 | <.01 * | .03 .001-.22 | .48 .01-3.82 | <.01 * | .01 <.001-.03 | <.005 * | <.001 * | .06 .001-.58 |
| 40 | Qsr | 19 | .01 <.01-.02 | .1 <.1-.4 | .001 .001-.023 | .01 <.01-.01 | .01 .01-.12 | .07 .01-.90 | .01 <.01-.02 | .01 <.001-.03 | <.005 * | <.001 <.001-.010 | .03 .001-.15 |
| 41 | Qsr | 12 | <.01 * | <.1 * | .001 <.001-.003 | <.01 * | .001 <.001-.006 | .04 .01-.15 | <.01 * | .01 * | <.001 * | <.001 * | .084 .001-.296 |
| 42 | Qs | 4 | <.01 * | <.1 * | <.001 * | <.01 * | .003 * | .02 * | <.01 * | <.01 * | <.005 * | <.001 * | .07 * |
| 43 | Qs | 1 | | | | | .03 | | | | | | |
| 44 | QTs | 14 | .002 .000-.020 | | | | | | | | | | |
| 45 | QTs | 1 | <.01 | <.1 | .003 | <.01 | .005 | .01 | <.01 | <.01 | <.005 | <.001 | .05 |
| 46 | QTs | 3 | 0 * | | | | | | | | | | |
| 47 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 48 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 49 | QTb | 35 | <.01 * | .1 <.1-.2 | <.001 <.001-.003 | <.01 * | .22 .00-.44 | .07 <.01-2.24 | .01 <.01-.03 | .02 .01-.12 | <.005 * | <.001 .001-.01 | .20 .003-1.17 |
| 49 | QTs | | | | | | | | | | | | |
| 50 | Qs | 10 | <.01 * | .1 .1-1.0 | .001 <.001-.03 | <.01 * | .02 .001-.25 | .8 <.01-10.0 | <.01 * | <.01 * | <.005 * | <.001 * | .07 .007-.25 |
| 51 | QTs | | | | | | | | | | | | |
| 51 | QTb | | | | | | | | | | | | |
| 52 | QTs | | | | | | | | | | | | |
| 52 | QTb | 2 | <.01 * | <.1 * | <.001 * | <.01 * | .011 * | .08 * | <.01 * | <.01 * | <.005 * | <.001 * | 2.9 * |

TABLE 3. ARITHMETIC MEANS AND RANGES OF DISSOLVED TRACE CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Number | Aquifer | Number of Samples | Arsenic (As, mg/l) | Barium (Ba, mg/l) | Cadmium (Cd, mg/l) | Chromium (Cr, mg/l) | Copper (Cu, mg/l) | Iron (Fe, mg/l) | Lead (Pb, mg/l) | Manganese (Mn, mg/l) | Mercury (Hg, mg/l) | Silver (Ag, mg/l) | Zinc (Zn, mg/l) |
|--------------------------|-------------------|-------------------|----------------------|-------------------|--------------------|---------------------|--------------------|-----------------|-----------------|----------------------|--------------------|-------------------|-----------------|
| 52 | pTs | | | | | | | | | | | | |
| 53 | Qs | | | | | | | | | | | | |
| 53 | QTb | 8 | <.01 * | <.1 * | <.01 * | <.01 * | .007 <.001-.031 | .07 <.01-.33 | <.01 * | .01 <.01-.03 | <.005 * | <.001 * | .16 .001-.89 |
| 53 | Tsl | | | | | | | | | | | | |
| 53 | pTs | | | | | | | | | | | | |
| 54 | NO DATA AVAILABLE | | | | | | | | | | | | |
| 55 | Qs | 3 | <.01 * | <.1 * | .003 * | <.01 * | <.001 * | .02 .01-.02 | <.01 * | <.01 * | <.0002 * | <.001 * | .118 * |
| 55 | Tsl | | | | | | | | | | | | |
| 55 | pTs | | | | | | | | | | | | |
| 56 | pTs | | | | | | | | | | | | |
| 57 | Qs | | | | | | | | | | | | |
| 57 | Qsr | | | | | | | | | | | | |
| 57 | Tsl | | | | | | | | | | | | |
| 57 | QTb | | | | | | | | | | | | |
| 58 | Qs | | | | | | | | | | | | |
| 58 | QTb | | | | | | | | | | | | |
| 58 | pTs | | | | | | | | | | | | |
| 58 | QTs | | | | | | | | | | | | |
| 58 | Tsl | | | | | | | | | | | | |
| 59 | pTs | | | | | | | | | | | | |
| 60 | Qs | 5 | .0004 0.000-0.002 | .016 0.00-0.05 | .005 .002-.01 | | | | | | | | |
| 60 | QTsv | | <.01 * | <.1 * | <.001 * | <.01 * | .005 .0005-.007 | .79 .03-2.70 | <.01 * | <.01 * | <.005 * | <.001 * | .26 .08-.69 |

TABLE 3. ARITHMETIC MEANS AND RANGES OF DISSOLVED TRACE CONSTITUENTS IN GROUNDWATER BY FLOW SYSTEM

| Flow System Index Number | Aquifer | Number of Samples | Arsenic (As, mg/l) | Barium (Ba, mg/l) | Cadmium (Cd, mg/l) | Chromium (Cr, mg/l) | Copper (Cu, mg/l) | Iron (Fe, mg/l) | Lead (Pb, mg/l) | Manganese (Mn, mg/l) | Mercury (Hg, mg/l) | Silver (Ag, mg/l) | Zinc (Zn, mg/l) |
|--------------------------|---------|-------------------|--------------------|-------------------|--------------------|---------------------|-------------------|-----------------|-----------------|----------------------|--------------------|-------------------|-----------------|
| 60 | pTs | | | | | | | | | | | | |
| 61 | QTsv | | | | | | | | | | | | |
| 62 | | NO DATA AVAILABLE | | | | | | | | | | | |
| 63 | QTas | 2 | <.01 * | <.1 * | <.001 * | <.01 * | .017 .015-.019 | 1.04 * | <.01 * | .01 <.01-.02 | <.005 * | <.001 * | .11 .03-.178 |
| 64 | QTas | 1 | | | | | | .95 | | | | | |
| 65 | QTas | | | | | | | | | | | | |
| 66 | QTas | 47 | | | | | | 27 .02-.73 | .01 * | | | | |
| 67 | | NO DATA AVAILABLE | | | | | | | | | | | |
| 68 | QTas | 2 | <.01 * | <.1 * | <.001 * | <.01 * | .004 .002-.006 | .21 .14-.30 | <.01 * | .01 .01-.02 | <.005 * | <.001 * | .57 .35-.80 |
| 69 | QTas | 1 | | | | | | .28 | | | | | |
| 70 | | NO DATA AVAILABLE | | | | | | | | | | | |

* No Range

TABLE 4. QUALITY STANDARDS FOR DRINKING WATER

| Constituent | Maximum Contaminant Levels for Inorganic Chemicals (USEPA, 1975 & IDHW, 1977) | Secondary Quality Standards (USEPA, 1975 & IDHW, 1977) |
|-----------------------|---|---|
| Iron | -- | 0.3 mg/L |
| Manganese | -- | 0.05 mg/L |
| Sulfate | -- | 250 mg/L |
| Chloride | -- | 250 mg/L |
| Fluoride ¹ | 2.0 mg/L | -- |
| Nitrate | 10.0 mg/L | -- |
| Dissolved solids | -- | 500 mg/L |
| pH | -- | <6.5 or >8.5 |
| Arsenic | 0.05 mg/L | -- |
| Barium | 1.0 mg/L | -- |
| Cadmium | 0.01 mg/L | -- |
| Chromium | 0.05 mg/L | -- |
| Copper | -- | 1.0 mg/L |
| Lead | 0.05 mg/L | -- |
| Mercury | 0.002 mg/L | -- |
| Silver | 0.05 mg/L | -- |
| Zinc | -- | 5.0 mg/L |

¹ The maximum contaminant level (MCL) for fluoride is dependent upon the annual average of the maximum daily air temperatures for the location in which the water-supply system is situated; from 1.4 mg/l (26.3 to 32.5°C) to 2.4 mg/l (<12.0°C).