Hydrogeologic Framework of the Yakima River Basin Aquifer System

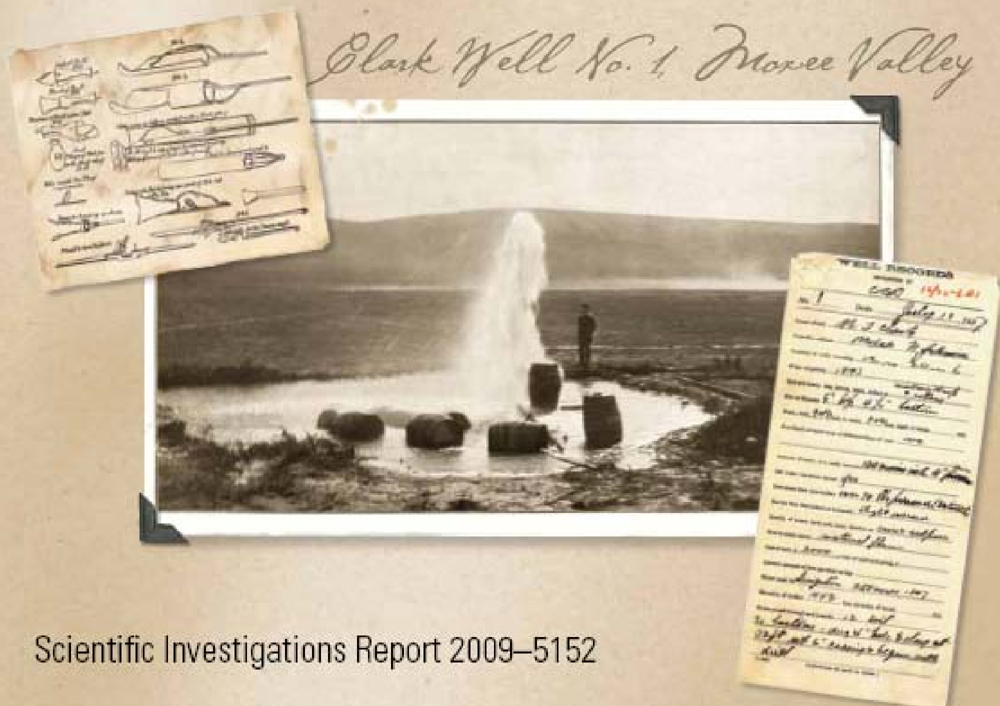
USGS

Washington Water Science Center

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
Bureau of Reclamation,
Washington State Department of Ecology, and the
Yakama Nation

Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington



Scientific Investigations Report 2009–5152

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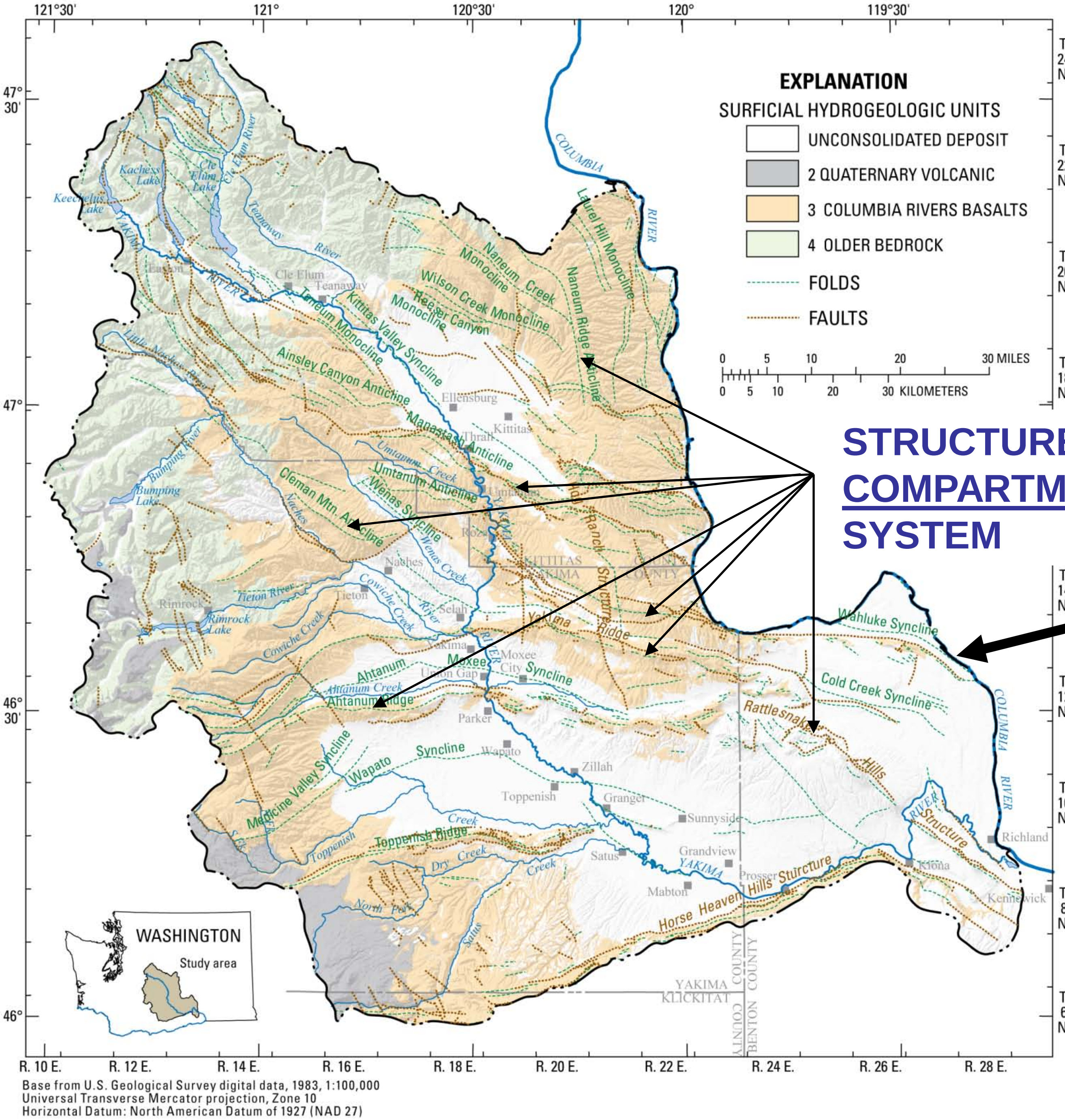
HYDROGEOLOGIC UNITS



STRUCTURE ➔ <u>COMPARTMENTALIZES</u> FLOW SYSTEM

<u>Extended study area</u>

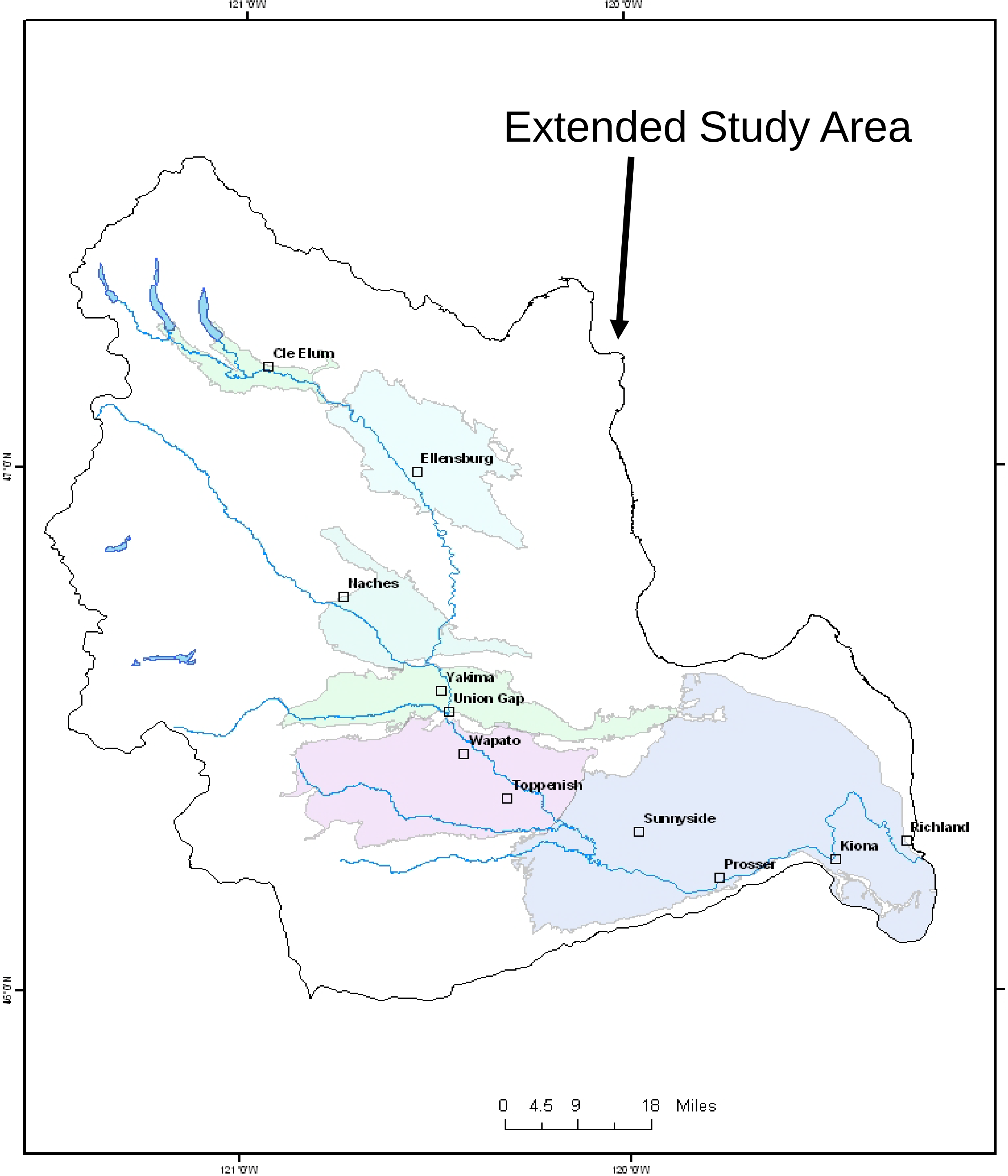
BASIN-FILL DEPOSITS

- MAPPED HYDROGEOLOGIC UNITS AND TOTAL THICKNESS

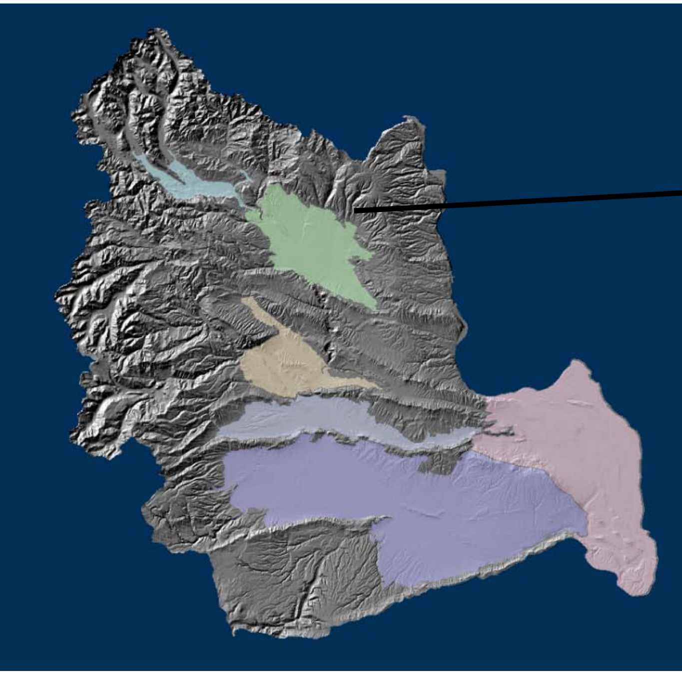
Six Structurally controlled Basins that contain basin-fill deposits

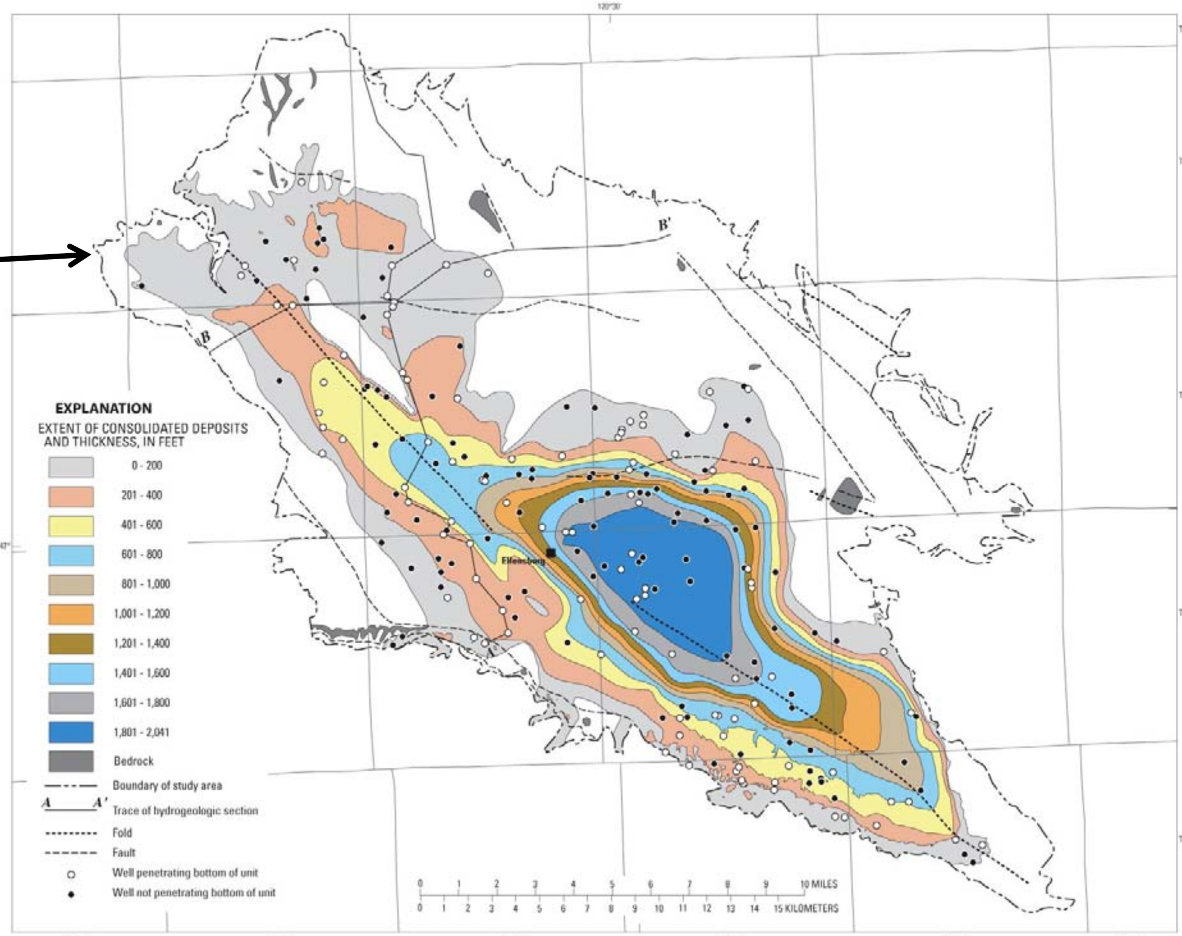
2,200 mi²

70 – 1,020 mi²



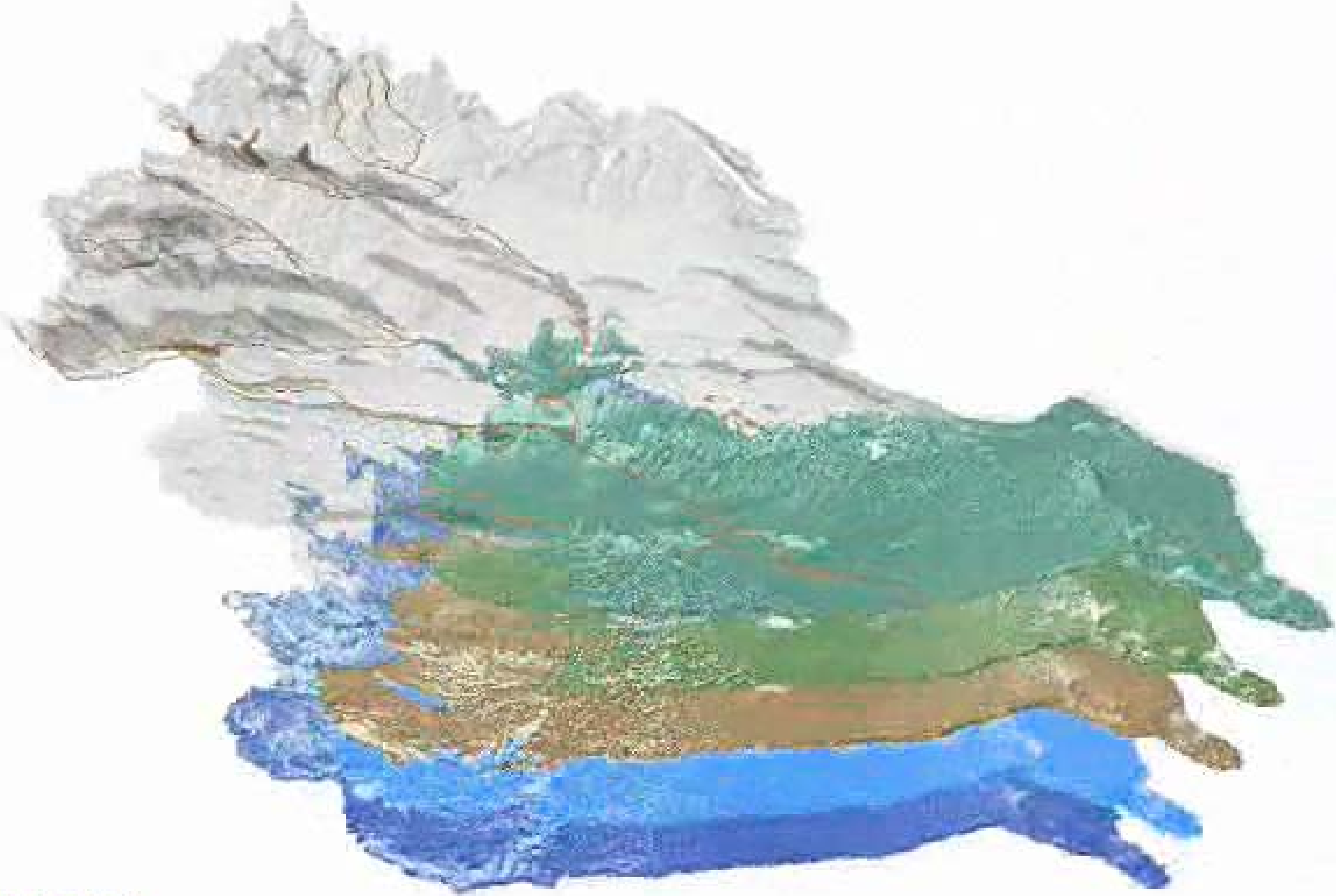
Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins





COLUMBIA RIVER BASALT GROUP

- MAPPED LATERAL EXTENT AND DEPTH TO TOP OF UNIT of: Saddle Mountains, Wanapum, and Grande Ronde Units (basalts) and Mabton and Vantage Units (interbeds)



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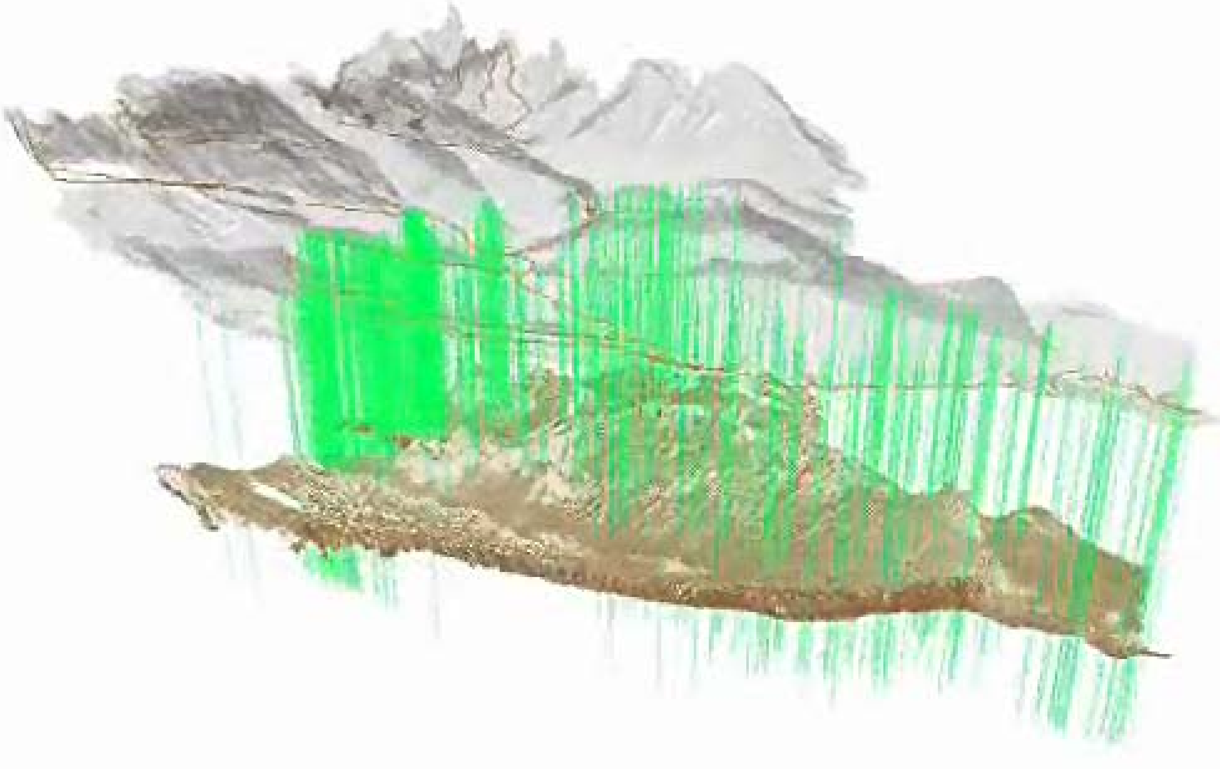
science for a changing world



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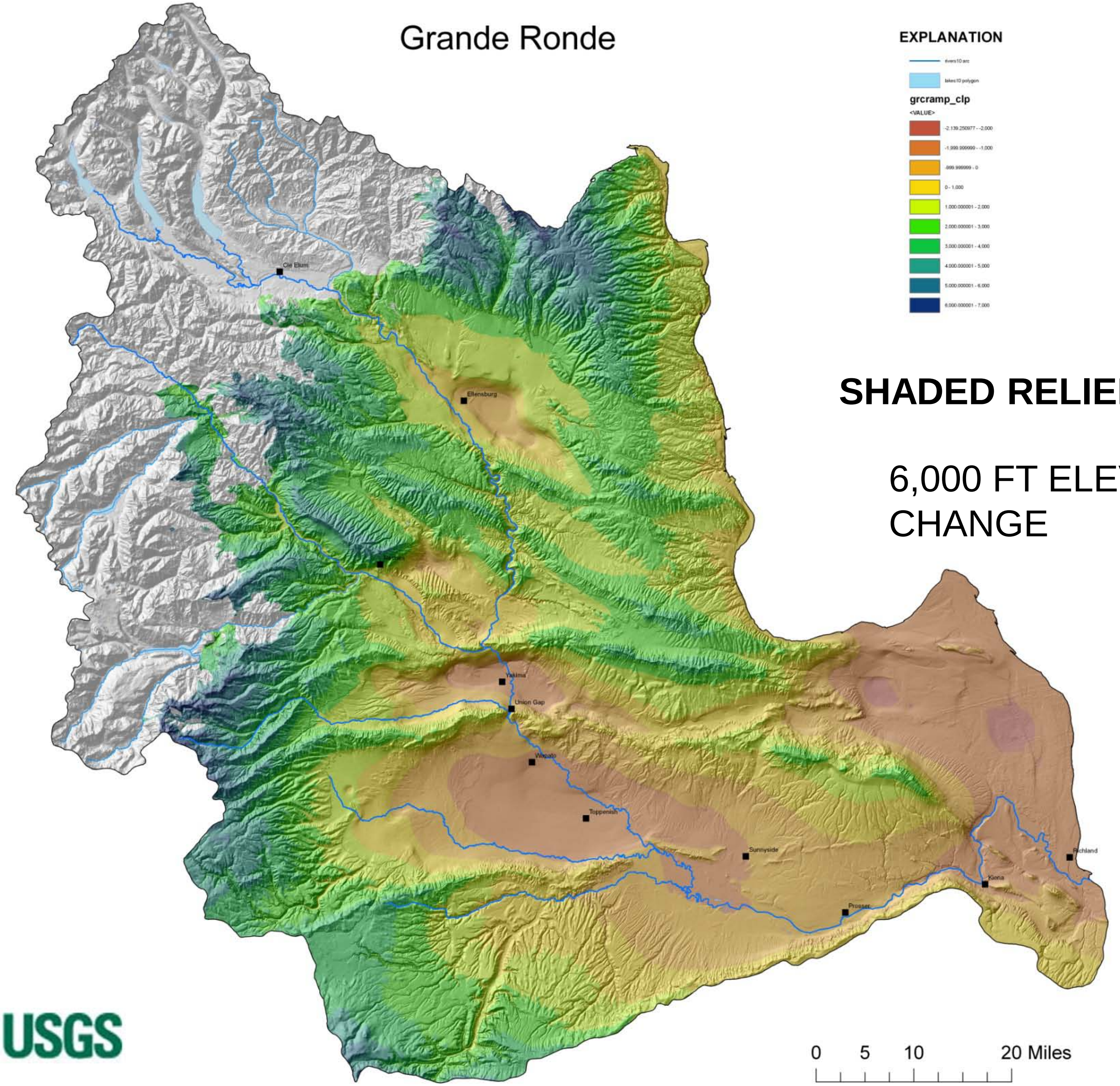

SHADED RELIEF OF TOP

6,000 FT ELEVATION CHANGE

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BASIN-FILL AND COLUMBIA RIVER BASALT GROUP UNITS				
ERA	PERIOD	EPOCH	SIMPLIFIED GEOLOGIC UNITS	HYDROGEOLOGIC UNIT
CENOZOIC	Quaternary	Holocene	Alluvium, alpine glaciation, alluvial fan, dune sand, artificial fill, and peat deposits	Unit 1 (R, K, S, Y, T, B)
		Pleistocene	Alluvium, alpine glacial drift, alluvial fan, Palouse Fm., Lakedale Drift, Lookout Mountain Ranch Drift, Hayden Creek Drift, Kittitas Drift, Evans Creek Drift, unknown continental sedimentary deposits, dune sand, Missoula glacial lake deposits	Unit 1 (R, K, S, Y, T, B), Unit 2 (R, K, S, Y, T)
	Tertiary	Pliocene	Alluvial fan, Ringold Fm., Ellensburg Fm., Dalles Fm., Thorpe Gravel, and unknown continental sedimentary deposits	Unit 1 (B), Unit 2 (R, K, S, Y, T), Unit 3 (R, K, S, Y)
		Miocene	Ellensburg Fm., Ringold Fm., Dalles Fm., Snipes Mountain deposits, and unknown continental sedimentary deposits	Unit 2 (B), Unit 3 (R, K, S, Y, T), Unit 4 (T), Unit 5 (T)
			Columbia River Basalt Group: Saddle Mountains Basalt flow members and interbeds	Saddle Mountains unit (SM)
			Mabton interbed	Mabton unit
			Wanapum Basalt flow members and interbeds	Wanapum unit (WN)
			Vantage interbed	Vantage unit
			Grande Ronde Basalt flow members and interbeds	Grande Ronde unit (GR)

BEDROCK UNITS				
ERA	PERIOD	EPOCH	SIMPLIFIED GEOLOGIC UNITS	HYDROGEOLOGIC UNIT
CENOZOIC	Quaternary	Holocene to Pleistocene	Old Snowy Mtn. andesite, Mount Rainier andesite, Tieton andesite, Russel Ridge andesite, Round Mtn. andesite, Pear Lake andesite, Jess Lake compplex andesite, Deep Creek andesite, Deer Lake Mtn. andesite, Swampy Meadow andesite, Signal Peak andesite, South Butte andesite, Hellroaring and Big Muddy Creek complex andesite, Mt. Adams volcanics, Tumac Mtn. basalt, Rimrock Lake basalt, Lava Creek basalt, Kincaid Lake basalt, Hogback Mtn. basalt, Canyon Creek basalt, Paradise Falls basalt, Outlaw Creek basalt, McClellan Meadows basalt, White Chuck cinder cone basalt, Walupt Lake basalt, Two Lakes Basalt, Trout Lake Creek basalt, Thomas Lake basalt, Tillicum Creek basalt, Twin Buttes basalt,Sleeping Beauty basalt, Sawtooth Mtn. basalt, Red Lake basalt, Riley Creek basalt, Rush Creek basalt, Red Butte basalt, Mosquito Creek basalt, Lakeview Mtn. basalt, Little Goose Creek basalt, Loaf basalt, Lake Comcomly basalt, Lone Butte basalt, Indian Viewpoint basalt, Indian Heaven basalt, Ice Cave basalt, Hidden Lake basalt, Goat Butte basalt, Green Canyon basalt, Gotchen Creek basalt, Glaciate Butte basalt, Flattop Mtn. basalt, East Canyon Creek basalt, Dead Horse Creek basalt, Deep Lake basalt, Camas Prairie basalt, County Park basalt, Chenamus Lake basalt, Burnt Peak basalt, Bunnell Butte basalt, Bird Mountain basalt, Blue Lake basalt, Badger Peak basalt, Placid Lake basalt, Spiral Butte dacite, Clear Fork dacite, Snyder Mtn. dacite, Olallie Lake dacite	QB Quaternary Bedrock unit (for area that overlays the older bedrock deposits and lies outside the Grande Ronde Basalt extent)
		Pliocene	Simcoe Mtn. volcanics, Devils Horns volcanics, Goat Rocks andesite, Bee Flat andesite, Lincoln Plateau basalt, Hogback Mtn. basalt, Devils Washbasin basalt, Dalles Ridge basalt, Bald Mtn., pluton, and Bethel Ridge basalt	TB Tertiary Bedrock unit
	Tertiary	Miocene	Conglomerate Point breccia, Howson andesite, Council Bluff volcanics, Clear West rhyolite, Silver Creek tonalite, Skyscraper Mtn. volcanics, Eagle tuff, Palisades tuff, Ellensburg Fm. volcanics, Cooper Pass volcaniclastics, Stevens Ridge Fm. volcanics, Fife's Peak Fm. volcanics, Tatoosh pluton, Bumping Lake pluton, Box Canyon gabbro, Carbon River stock, Nisqually diorite, Jug Lake sills, Snoqualmie Batholith, Snipes Peak Fm. sediments, White River pluton, Box Canyon volcanics	
		Oligocene	Wenatchee Fm. sediments, Chumstick Fm. andesite, Grotto Batholith, Mount Daniel volcanics, Index Batholith, Mount Aix volcanics, Eagle Gorge volcanics, Ohanapecosh Fm. volcanics, Mill Creek basalt, Wildcat Creek volcaniclastics, Spencer Creek volcaniclastics, Rattlesnake Creek tuff, Bumping River tuff, and Burnt River tuff	
		Eocene	Tukwila Fm. volcanics, Tiger Mtn. Fm., sediments, Roslyn Fm. sediments, Renton Fm. sediments, Naches Fm. sediments and volcanics, Barlow Pass volcanics, Swauk Fm. sediments and volcanics, Manatash Fm. sediments, Lookout Creek sandstone, Tenaway Basalt, Camas Land diabase, Goat Mtn. dacite, Banks Lake dacite, Fuller Mount polug, Cooper Mtn. Bartholith Raging River Fm. sediment, Mt. Persis volcanics, Taneum andesite, Summer Creek basalt, Peoh Point andesite, Frost Mtn. basalt, Chumstick Fm. volcanics, and Spencer Creek tuff, Tieton Pass basalt, Discovery Creek basalt	
		Paleocene	Swawilla Basin granite, Coffee Lake granite	
MESOZOIC	Cretaceous	Early to Late	Nason Ridge Gneiss, Mount Stuart Batholith, Bald Mtn. pluton, Arbuckle Mtn. tonalite, Russell Branch Fm. sediments, Ten Peak pluton, Sloan Creek pluton	MB Mesozoic Bedrock unit
	Jurassic	Early to Late	Lookout Mountain Fm. metamorphics and metavolcanics, Alta Lake metamorphics, Ingalls tectonic complex metamorphics and metavolcanics, eastern and western melange elt metavolcanics, Indian Creek complex diorite, Sarrington phyllite, Shuksan greenschist, Quartz Mtn. stock tonalite	
	Triassic	Early to Lake	Tonga Fm. metamorphics and metavolcanics, Gibraltar Rock migmatite, Chiwaukim schist	
PALEOZOIC	Permian	Early to Late	North Peak metavolcanics	PB Paleozoic Bedrock unit

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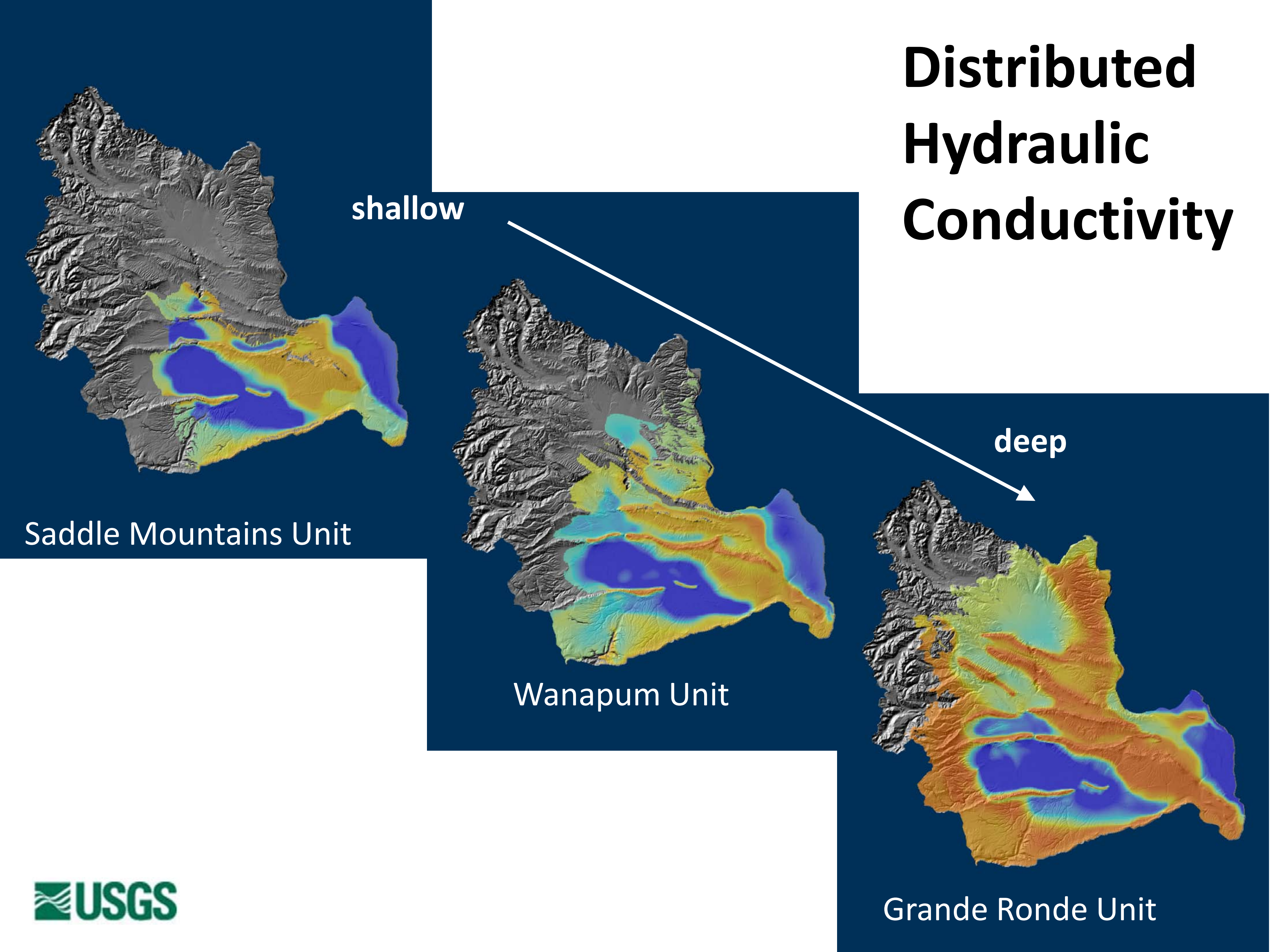
HYDRAULIC CHARACTERISTICS OF UNITS

The ability of sediments and rocks to store and transmit groundwater (their hydraulic characteristics) determines how a groundwater-flow system functions. Knowledge of the hydraulic characteristics also is necessary to evaluate how the flow system responds to stresses such as pumpage.

Distributed Hydraulic Conductivity



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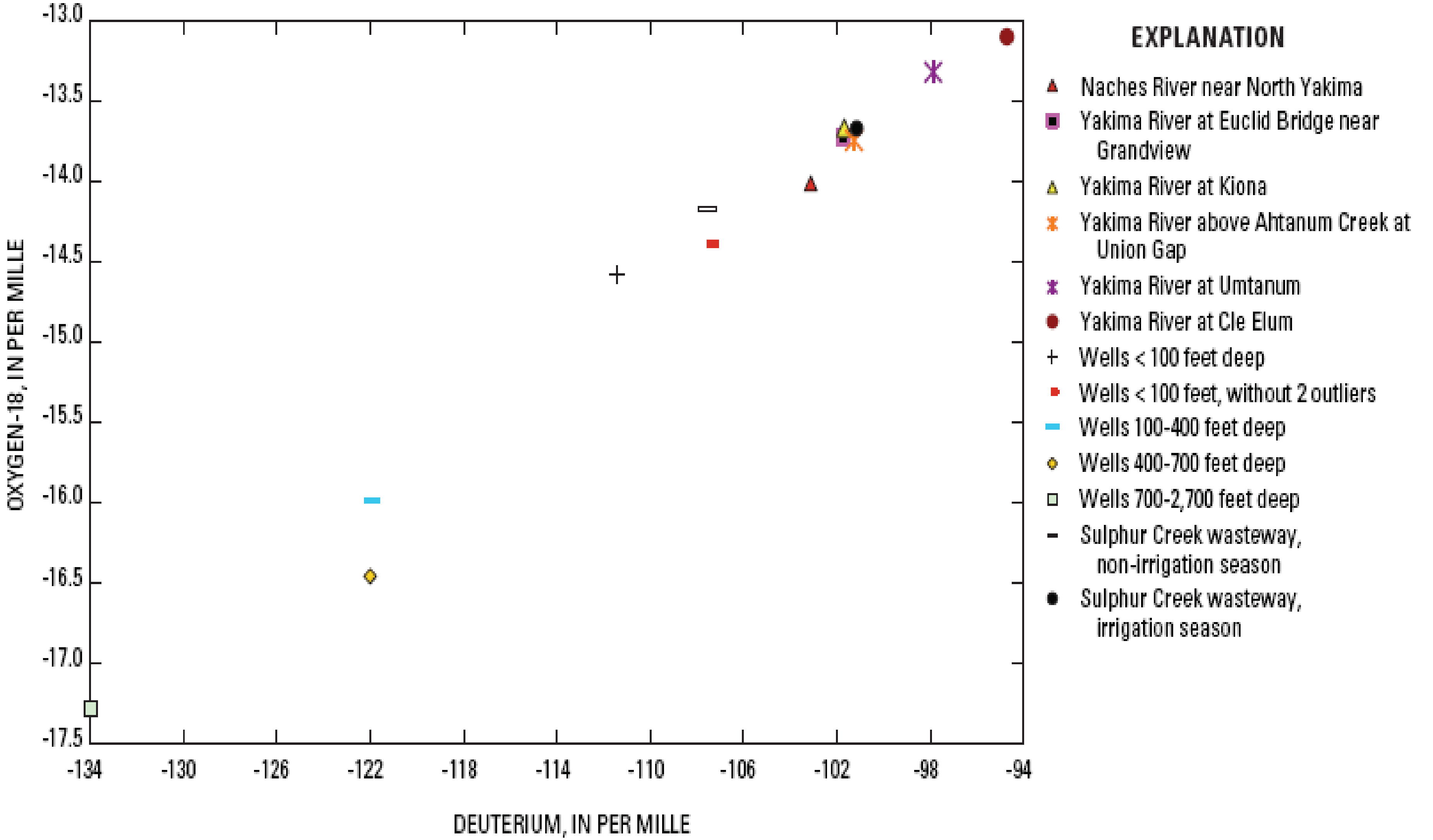
Hydraulic conductivity of the basalts can range several orders of magnitude.

Hydraulic conductivity of the productive zones in the basin-fill deposits are as much as 2 orders of magnitude larger than the basalts.

HYDROCHEMISTRY



-13.0
-13.5
-14.0
-14.5
-15.0
-15.5
-16.0
-16.5
-17.0
-17.5
OXYGEN-18, IN PER MILLE
-134
-130
-126
-122
-118
-114
-110
-106
-102
-98
-94
DEUTERIUM, IN PER MILLE
EXPLANATION
Naches River near North Yakima
Yakima River at Euclid Bridge near Grandview
Yakima River at Kiona
Yakima River above Ahtanum Creek at Union Gap
Yakima River at Umtanum
Yakima River at Cle Elum
Wells < 100 feet deep
Wells < 100 feet, without 2 outliers
Wells 100-400 feet deep
Wells 400-700 feet deep
Wells 700-2,700 feet deep
Sulphur Creek wasteway, non-irrigation season
Sulphur Creek wasteway, irrigation season

Dissolved Methane and its Stable Carbon Isotope

Most of the occurrences of methane measured in groundwater samples from wells outside of the Hanford Site were found at locations several miles distant from mapped structural fault features, indicating upward vertical movement of predominantly thermogenic methane from the underlying bedrock may be more widespread than previously thought and (or) the more general occurrence of unmapped fault structures. In either case, upward migration of methane through the CRBG from the underlying bedrock units is indicated by the data.

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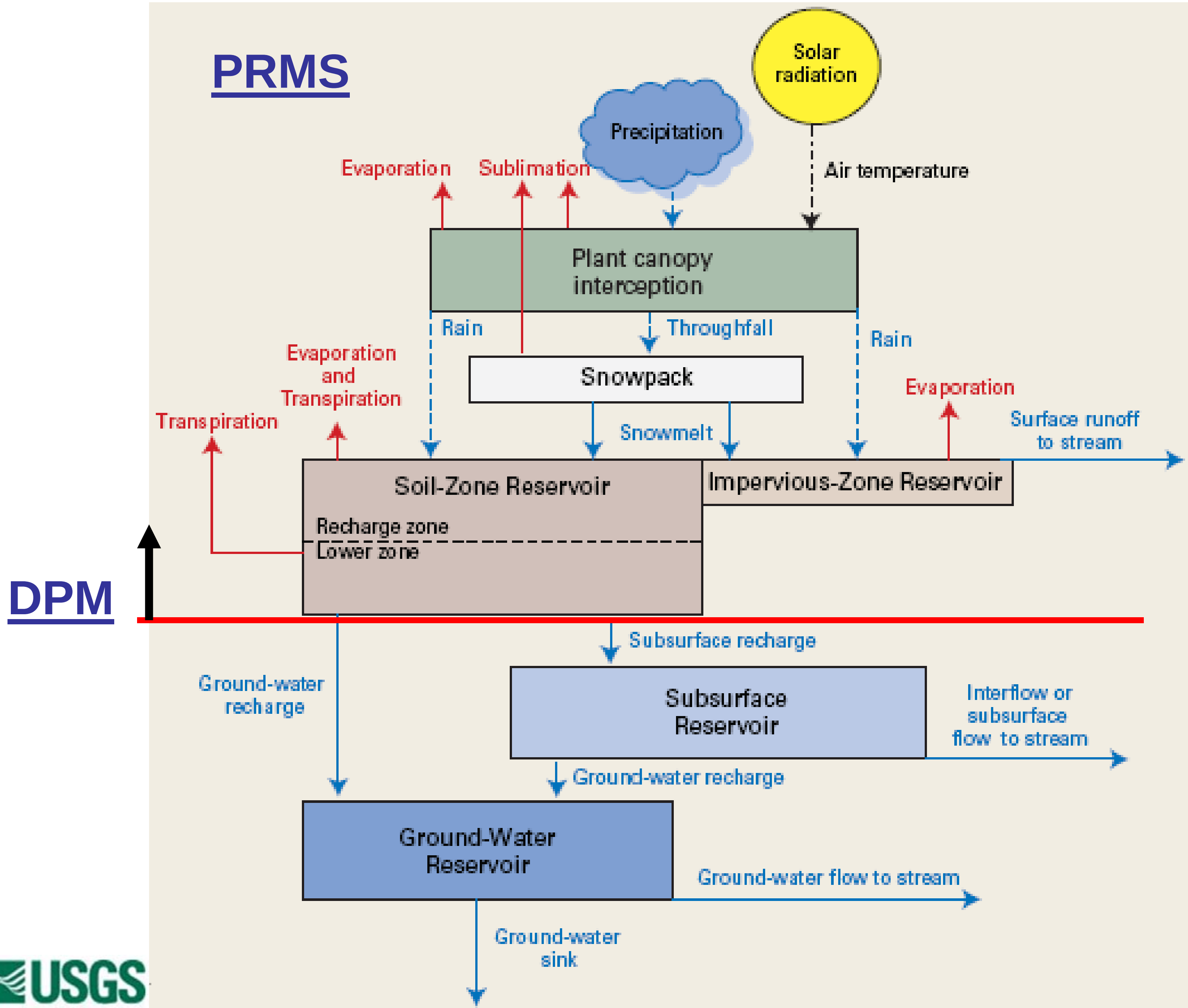
Helium - A noble gas

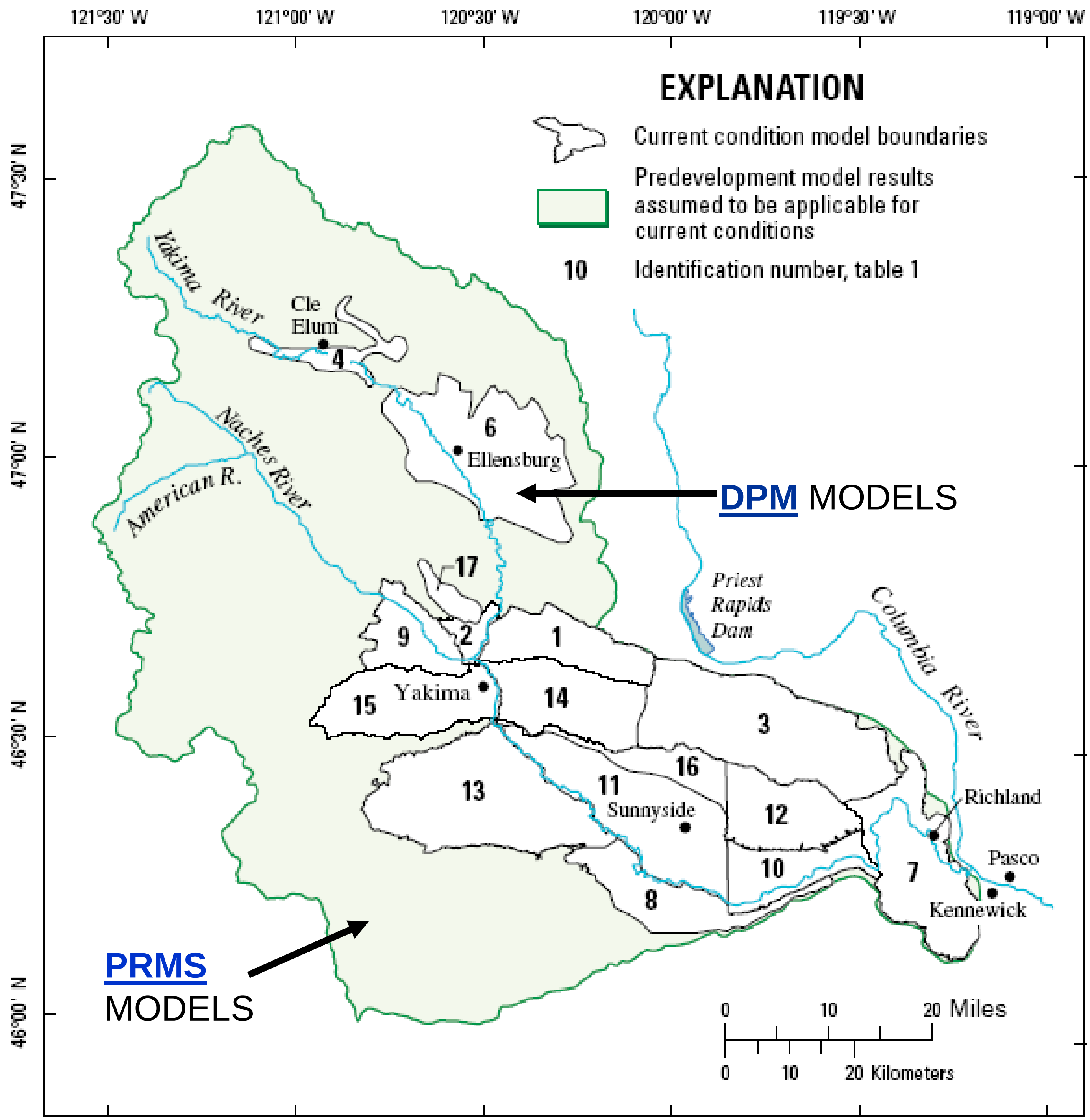
One cannot explicitly determine if part of the helium is from a mantle source, only that the predominant source is radiogenic helium. But mantle helium is so enriched with ^{3}He that the likely source is mantle derived.

GROUNDWATER OCCURENCE

Groundwater Occurring in the Hydrogeologic Units was Derived From:

- Rainfall
- Snowmelt
- Irrigation starting in the late 1800’s


PRMS
DPM
Solar radiation
Precipitation
Air temperature
Evaporation
Sublimation
Plant canopy interception
Rain
Throughfall
Rain
Snowpack
Evaporation and Transpiration
Transpiration
Snowmelt
Evaporation
Surface runoff to stream
Soil-Zone Reservoir
Recharge zone
Lower zone
Impervious-Zone Reservoir
Subsurface recharge
Ground-water recharge
Subsurface Reservoir
Interflow or subsurface flow to stream
Ground-water recharge
Ground-Water Reservoir
Ground-water flow to stream
Ground-water sink



[DPM](#) MODELS

[PRMS](#) MODELS

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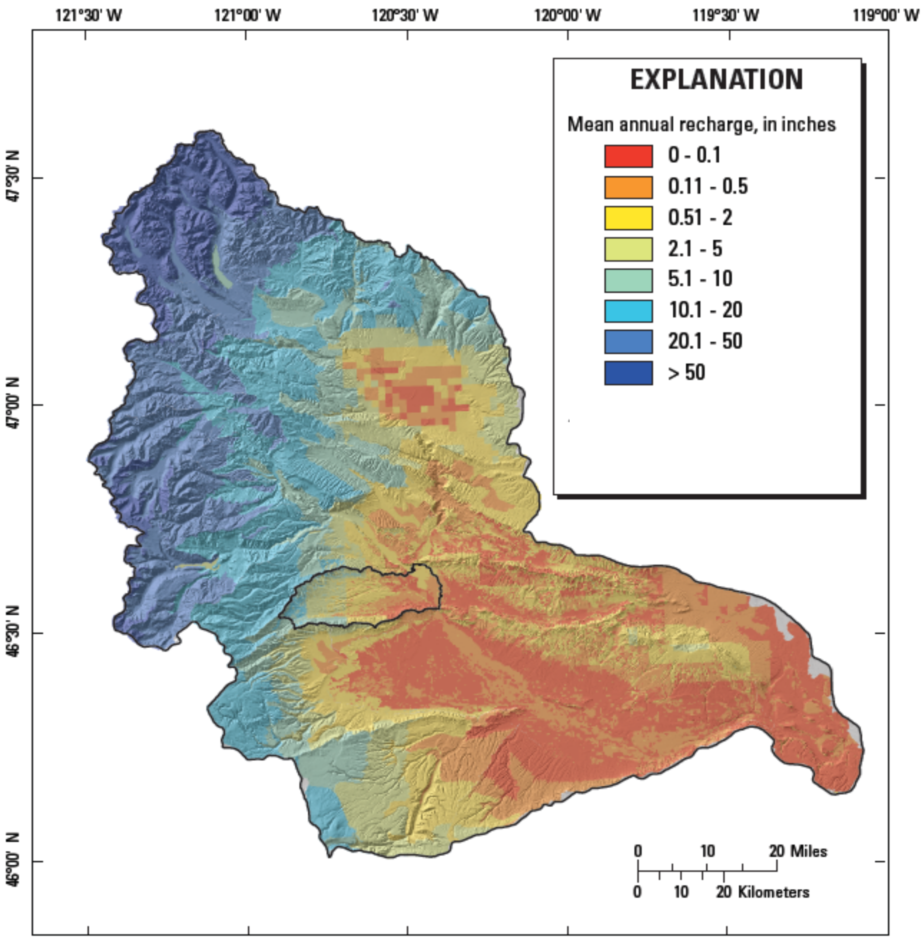
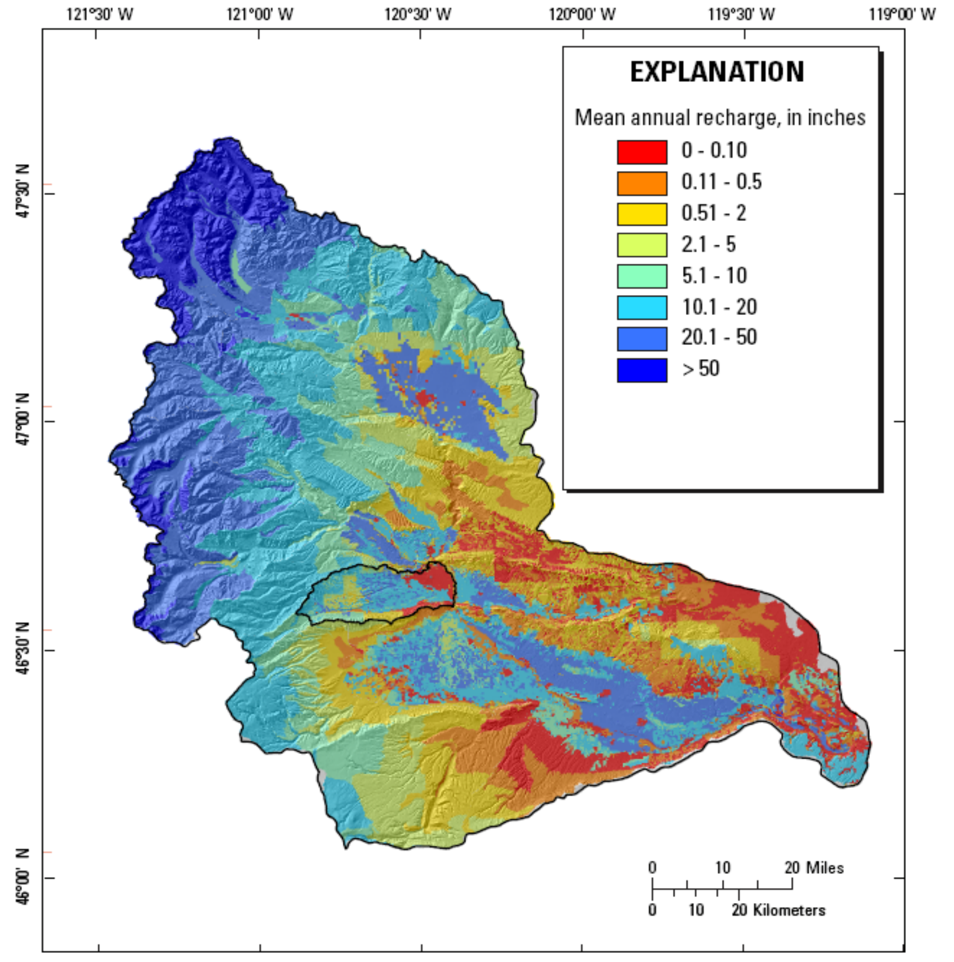
Derived Estimates of Potential Recharge





Predevelopment Recharge

- 11.9 in
- 5,540 ft^3/s
- 3.9 million acre-feet

Current Recharge

- 15.6 in
- 7,149 ft^3/s
- 5.2 million acre-feet

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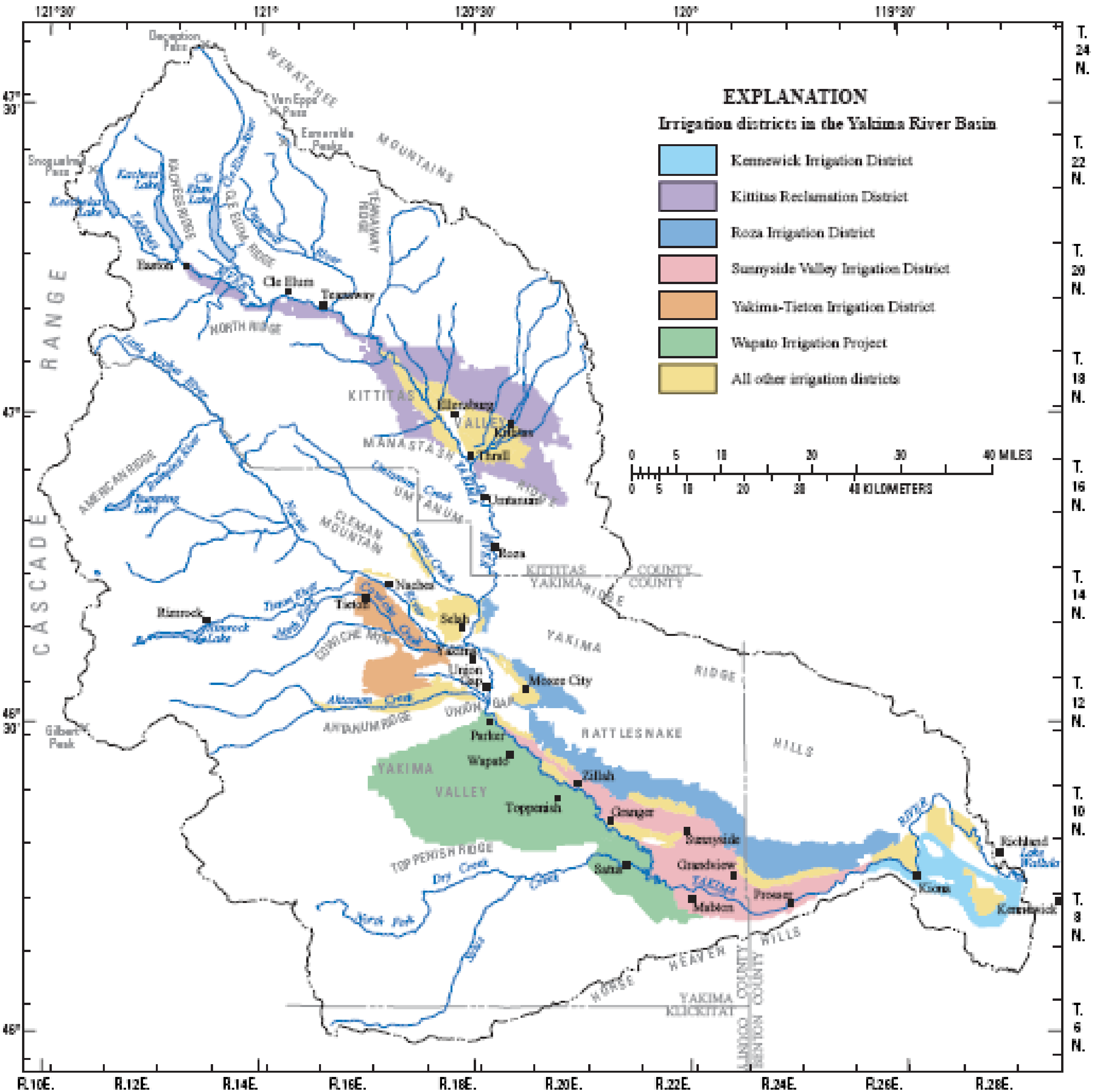
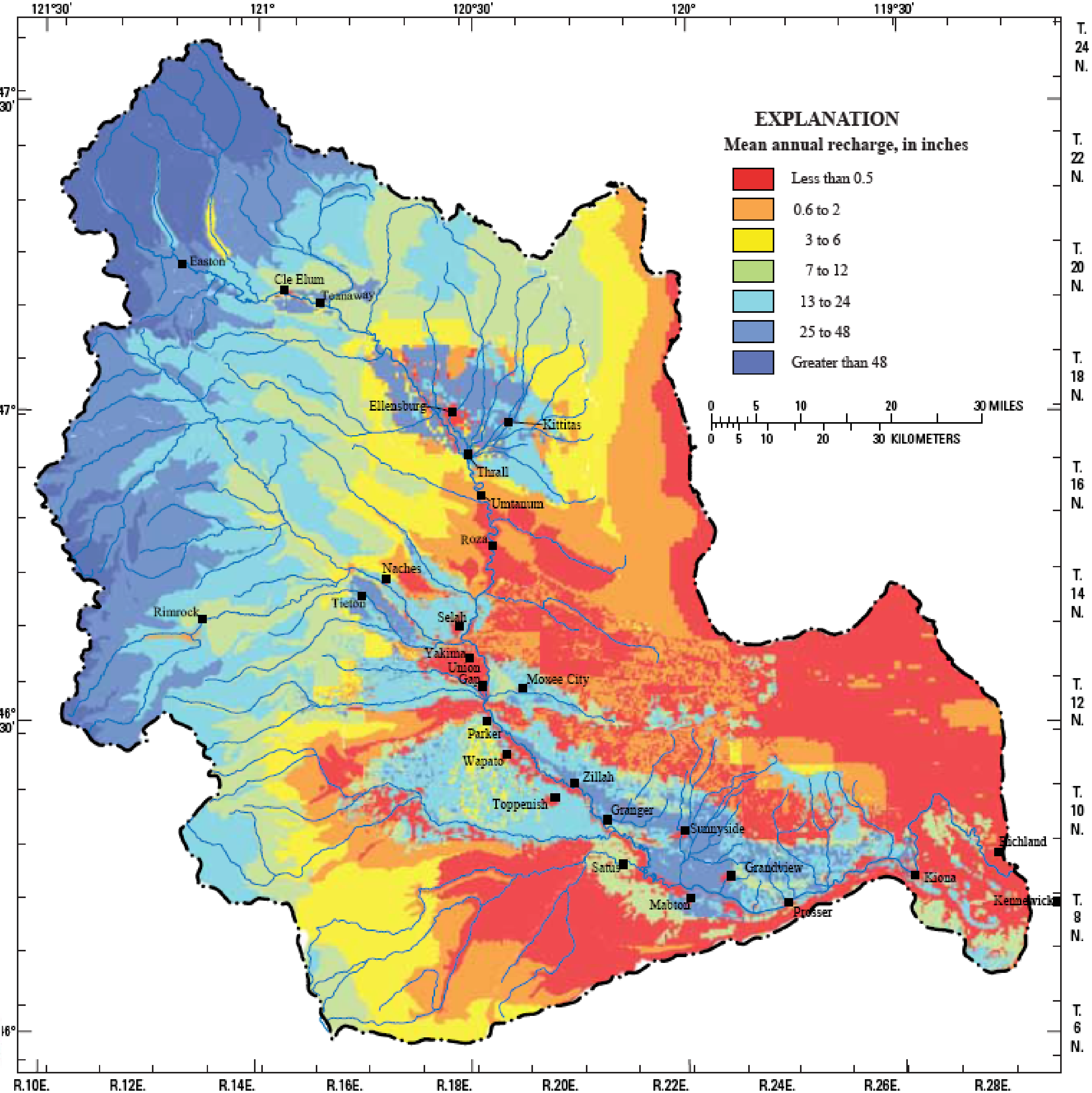

EXPLANATION
Irrigation districts in the Yakima River Basin
Kennewick Irrigation District
Kittitas Reclamation District
Roza Irrigation District
Sunnyside Valley Irrigation District
Yakima-Tieton Irrigation District
Wapato Irrigation Project
All other irrigation districts
0 5 10 20 30 40 MILES
0 5 10 20 30 40 KILOMETERS
CASCADE RANGE
WENATCHEE MOUNTAINS
KITTITAS VALLEY
YAKIMA VALLEY
Ellensburg
Kittitas
Thrall
Cle Elum
Easton
Naches
Tieton
Rimrock
Selah
Yakima
Union Gap
Moxee City
Parker
Wapato
Zillah
Toppenish
Granger
Sunnyside
Grandview
Satus
Mabton
Prosser
Kiona
Richland
Kennewick
RATTLESNAKE HILLS
YAKIMA RIDGE
TOPPENISH RIDGE
HORSE HEAVEN HILLS
AHTANUM RIDGE
UMTANUM
MANASTASH
KITTITAS COUNTY
YAKIMA COUNTY
BENTON COUNTY
KLICKITAT
R.10E. R.12E. R.14E. R.16E. R.18E. R.20E. R.22E. R.24E. R.26E. R.28E.
T. 24 N. T. 22 N. T. 20 N. T. 18 N. T. 16 N. T. 14 N. T. 12 N. T. 10 N. T. 8 N. T. 6 N.
121°30' 121° 120°30' 120° 119°30'
47°30' 47° 46°30' 46°



EXPLANATION
Mean annual recharge, in inches
Less than 0.5
0.6 to 2
3 to 6
7 to 12
13 to 24
25 to 48
Greater than 48
0 5 10 20 30 MILES
0 5 10 20 30 KILOMETERS
121°30'
121°
120°30'
120°
119°30'
47° 30'
47°
46° 30'
T. 24 N.
T. 22 N.
T. 20 N.
T. 18 N.
T. 16 N.
T. 14 N.
T. 12 N.
T. 10 N.
T. 8 N.
T. 6 N.
R.10E.
R.12E.
R.14E.
R.16E.
R.18E.
R.20E.
R.22E.
R.24E.
R.26E.
R.28E.
Easton
Cle Elum
Teanaway
Ellensburg
Kittitas
Thrall
Umtanum
Roza
Naches
Tieton
Rimrock
Selah
Yakima
Union Gap
Moxee City
Parker
Wapato
Zillah
Toppenish
Granger
Sunnyside
Satus
Grandview
Mabton
Prosser
Kiona
Kennewick

Most of the recharge in the bedrock-floored, humid, forested-upland slopes of the Cascade geologic province (where the bedrock units occur) discharges as shallow subsurface groundwater flow to upland streams and thus is not available to recharge the deeper parts of the aquifer system. Recharge in some of these upland areas, especially in Kittitas County, is limited because the bedrock generally has a much lower hydraulic conductivity and infiltration capacity than the overlying soils and (or) unconsolidated deposits, which also are generally thin or missing.

On a long-term basis, only about 34 percent of the potential mean annual recharge (percentage varies on an interannual basis) was estimated to have entered the regional groundwater flow system in the bedrock units in the upper Yakima River basin in Kittitas County.

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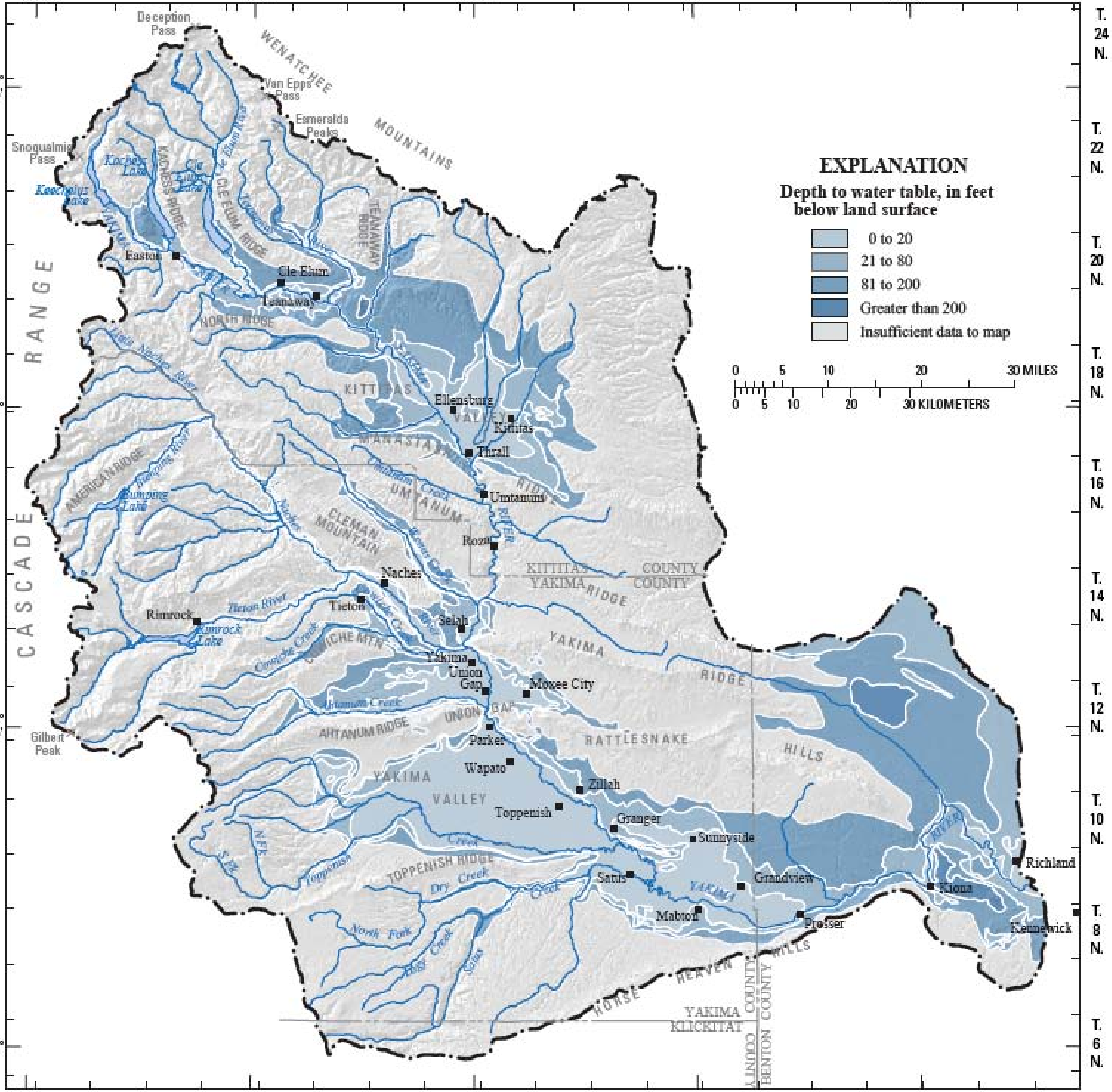
Within the Yakima River basin, the percentage (rounded) of recharge that occurs in the outcrop areas of the hydrogeologic units is about 0.29 percent for the basin-fill units, 0.007 percent for the Saddle Mountains, 0.008 percent for the Wanapum, 0.13 percent for the Grande Ronde, and 0.57 percent for the bedrock units

Flow paths range from a few feet to about 50 miles, and groundwater ages range from very recent to more than 10,000 years in the deeply buried units near regional discharge locations.

CONDITIONS OF OCCURENCE

- Water table
- Semi-confined
- Confined
- Perched


EXPLANATION
Depth to water table, in feet below land surface
0 to 20
21 to 80
81 to 200
Greater than 200
Insufficient data to map
0 5 10 20 30 MILES
0 5 10 20 30 KILOMETERS
121°30'
121°
120°30'
120°
119°30'
47° 30'
47°
46° 30'
T. 24 N.
T. 22 N.
T. 20 N.
T. 18 N.
T. 16 N.
T. 14 N.
T. 12 N.
T. 10 N.
T. 8 N.
T. 6 N.
R.10E.
R.12E.
R.14E.
R.16E.
R.18E.
R.20E.
R.22E.
R.24E.
R.26E.
R.28E.
Deception Pass
Van Epps Pass
Esmeralda Peaks
WENATCHEE MOUNTAINS
Snoqualmie Pass
Keechelus Lake
Kachess Lake
KACHESS RIDGE
Cle Elum Lake
CLE ELUM RIDGE
TEANAWAY RIDGE
Easton
Cle Elum
Teanaway
NORTH RIDGE
CASCADE RANGE
Little Naches River
KITTITAS VALLEY
Ellensburg
Kittitas
Thrall
MANASTASH RIDGE
UMTANUM RIDGE
Umtanum
AMERICAN RIDGE
Bumping River
Bumping Lake
CLEMAN MOUNTAIN
Roza
Naches
Tieton
Tieton River
Rimrock
Rimrock Lake
Selah
KITTITAS COUNTY
YAKIMA COUNTY
YAKIMA RIDGE
Yakima
Union Gap
Moxee City
UNION GAP
Ahtanum Creek
AHTANUM RIDGE
Parker
Gilbert Peak
RATTLESNAKE HILLS
Wapato
Zillah
YAKIMA VALLEY
Toppenish
Granger
Sunnyside
TOPPENISH RIDGE
Toppenish Creek
Satus
Grandview
Mabton
Prosser
Kiona
Richland
Kennewick
Dry Creek
Satus Creek
North Fork
HORSE HEAVEN HILLS
YAKIMA COUNTY
KLICKITAT COUNTY
BENTON COUNTY
YAKIMA RIVER

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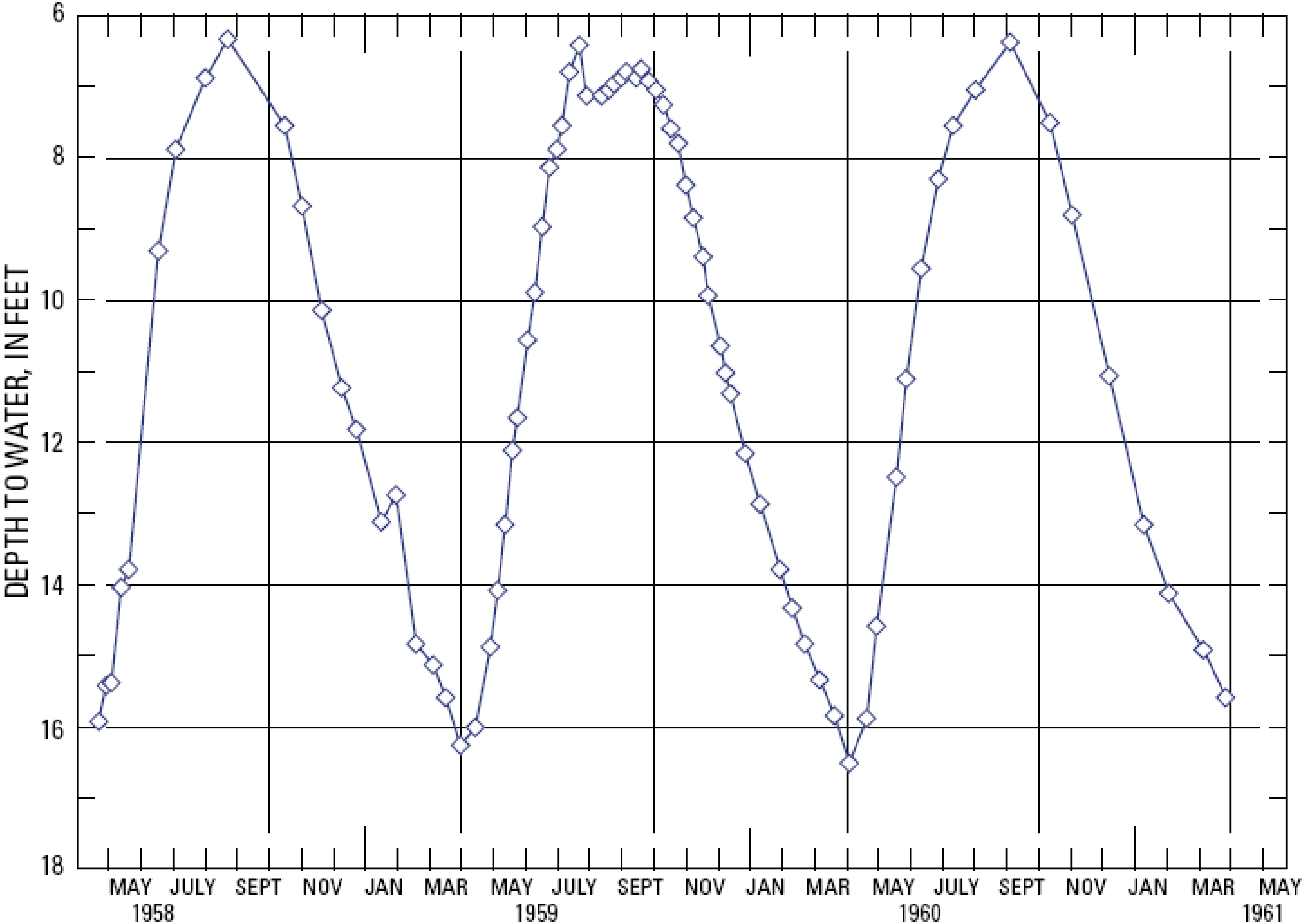

DEPTH TO WATER, IN FEET
6
8
10
12
14
16
18
MAY
JULY
SEPT
NOV
JAN
MAR
MAY
JULY
SEPT
NOV
JAN
MAR
MAY
JULY
SEPT
NOV
JAN
MAR
MAY
1958
1959
1960
1961

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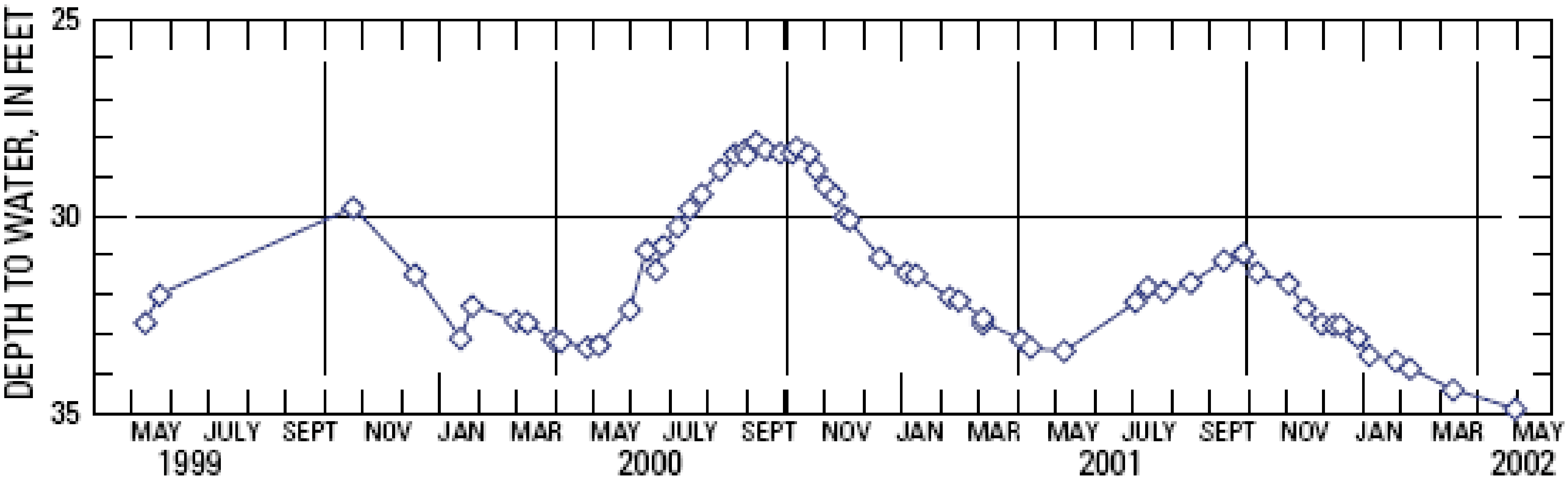

Smaller Rise in Drought Years

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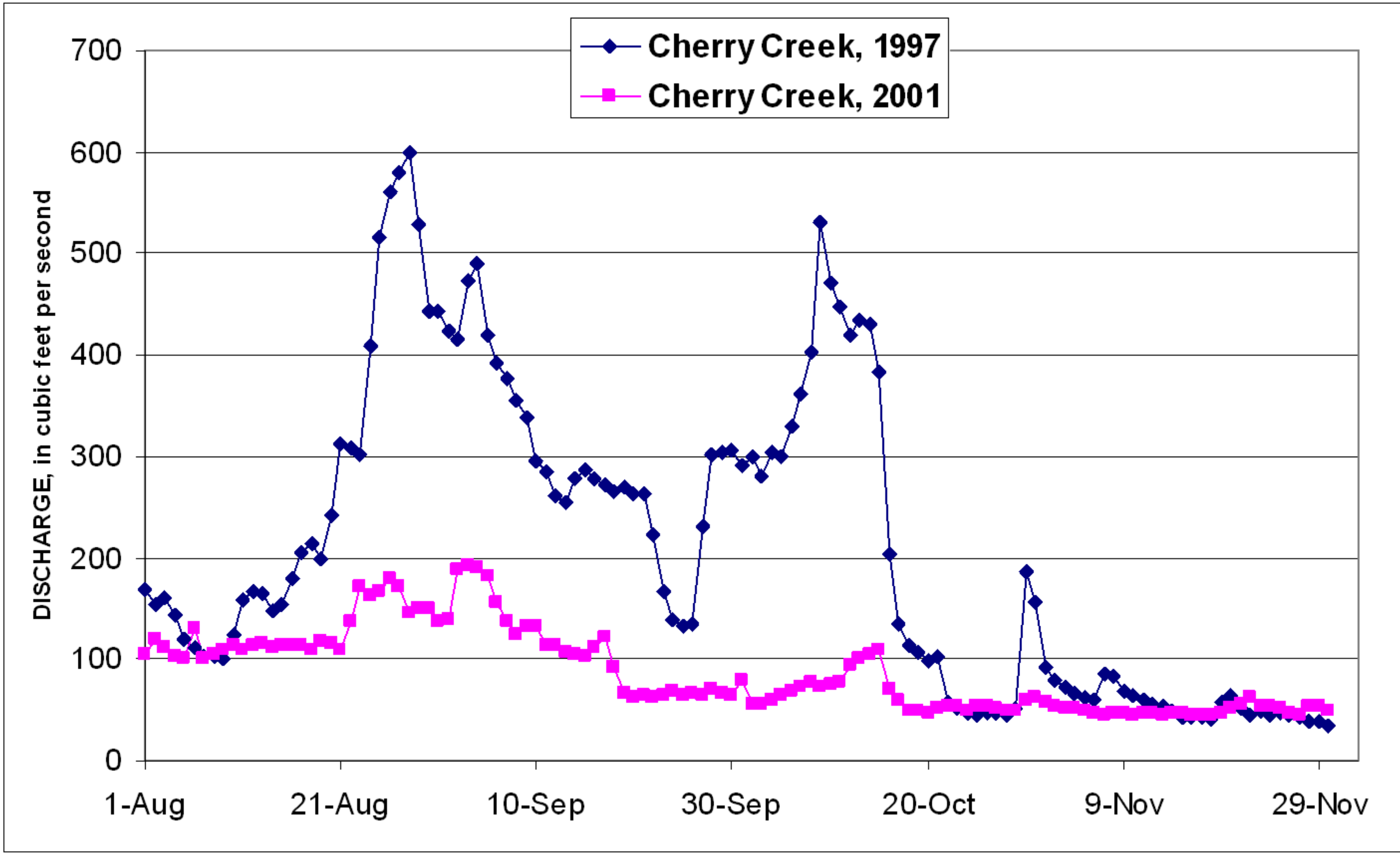
Why-What shallow water table in basins

In describing the relation between irrigation and drainage, Jayne (1907) presents information for nine wells in the Sunnyside area dug between 1890–1900 that shows that by 1902 there were water-level rises from 14 to 75 ft.

The shallow water table in the structural basins suggests a readily available supply of groundwater, but much of this irrigation-derived water in the shallow system discharges to drains and streams and is relied on to meet downstream uses (both in-stream flows and diversions with entitlements). Areas with high water tables (shallow groundwater) also are more susceptible to contamination from sources at the land surface.


Cherry Creek, 1997
Cherry Creek, 2001
DISCHARGE, in cubic feet per second
700
600
500
400
300
200
100
0
1-Aug
21-Aug
10-Sep
30-Sep
20-Oct
9-Nov
29-Nov

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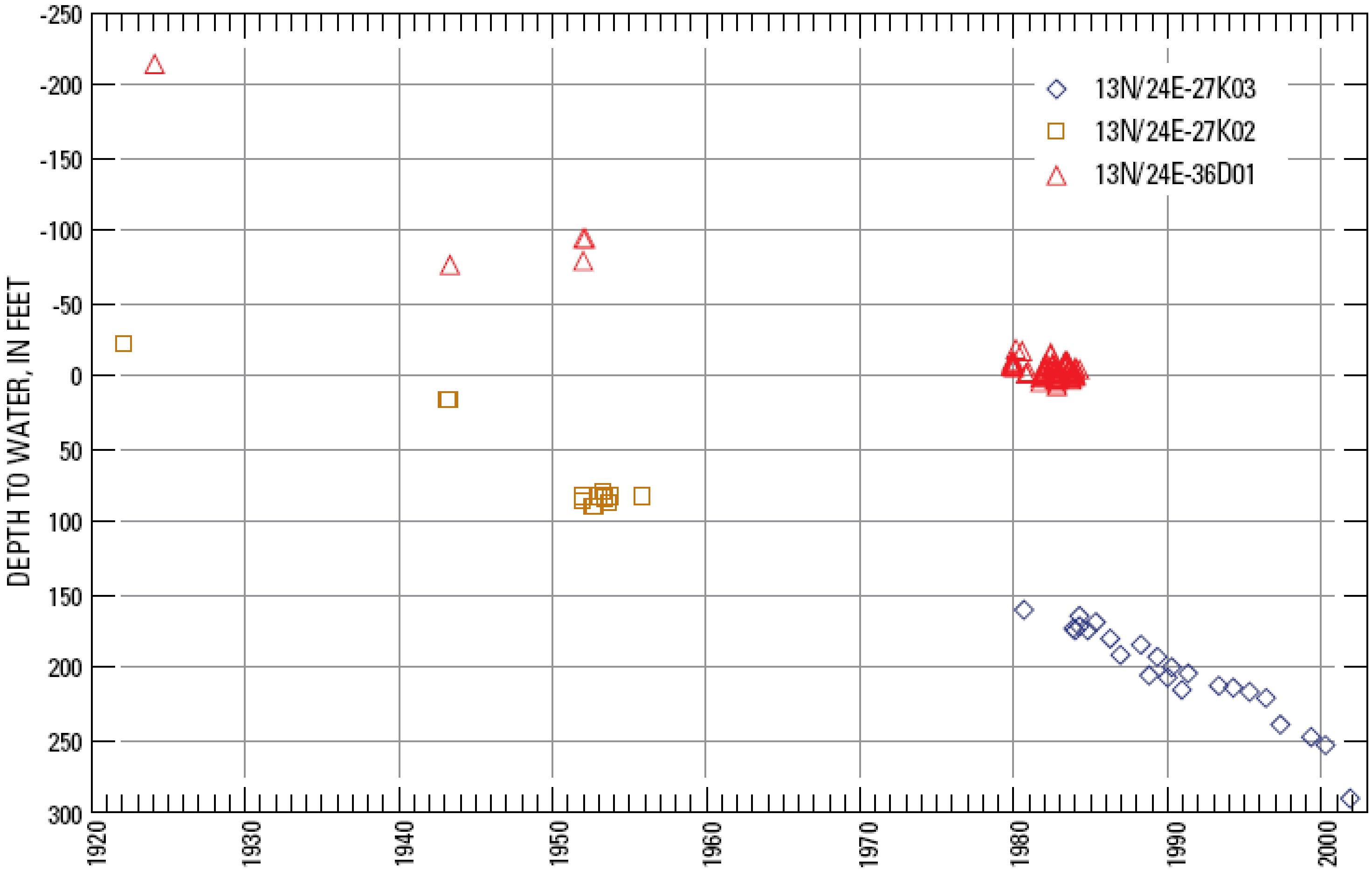
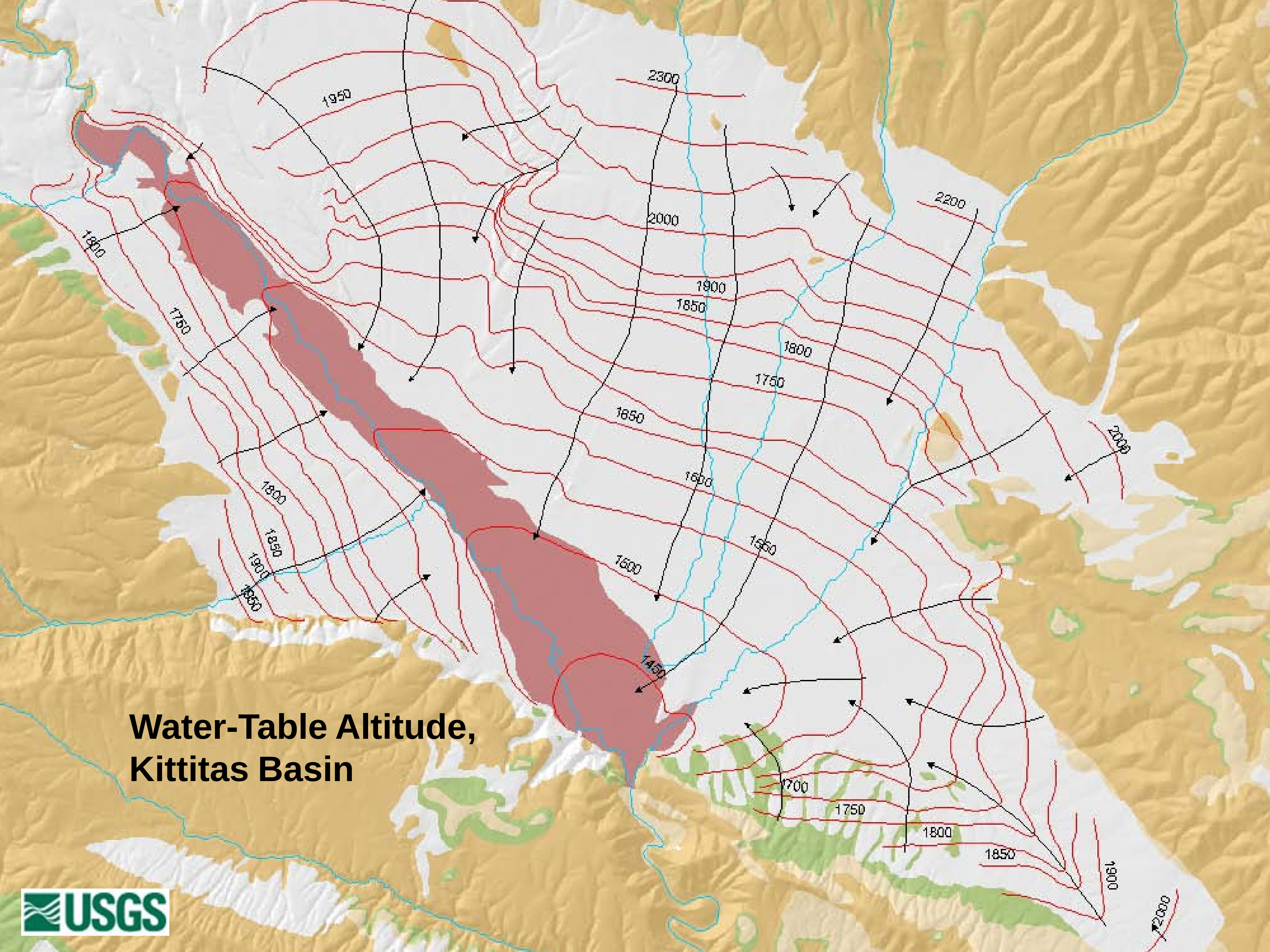


A. **Wanapum unit**

FLOW SYSTEM

Groundwater moves through the aquifer system from the uplands (high land-surface altitude—topographic highs) to surface drainage features in the lowlands, principally to the Naches and Yakima Rivers and to the Columbia River in the eastern part of the extended study area.



Water-Table Altitude, Kittitas Basin

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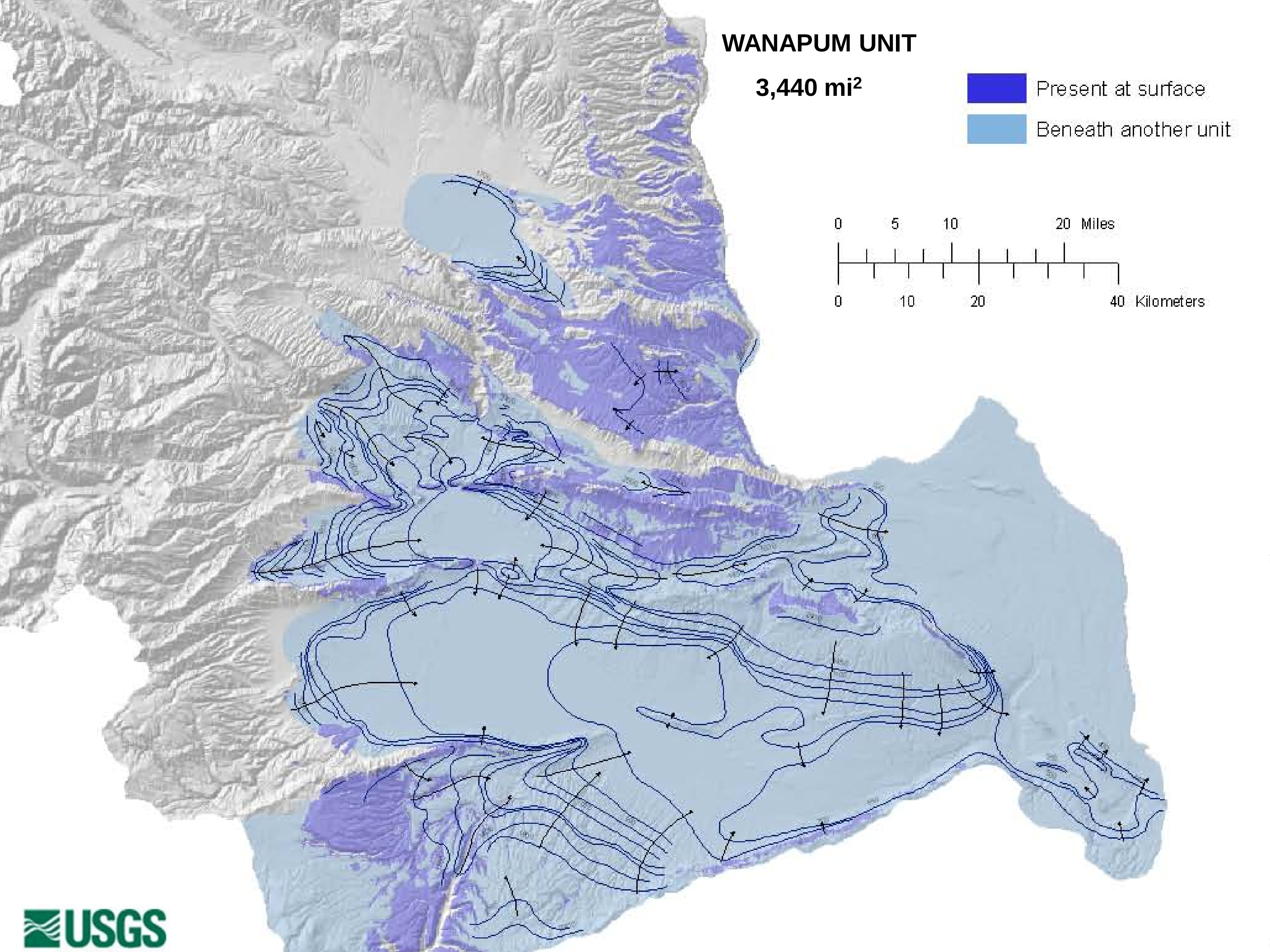
WANAPUM UNIT

3,440 mi^2



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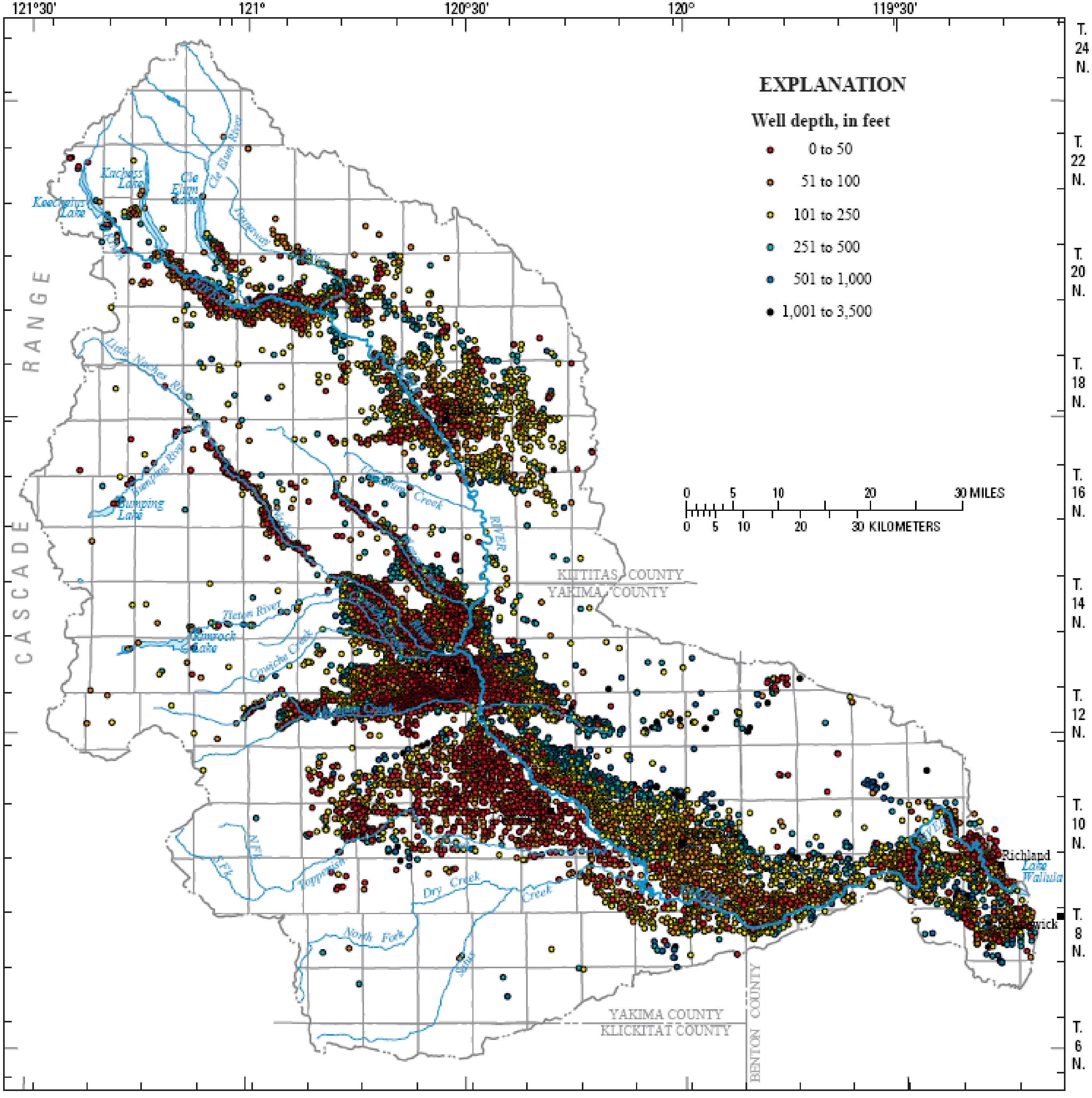
GROUNDWATER USE



121°30'
121°
120°30'
120°
119°30'
47° 30'
47°
46° 30'
46°
EXPLANATION
Well depth, in feet
0 to 50
51 to 100
101 to 250
251 to 500
501 to 1,000
1,001 to 3,500
0 5 10 20 30 MILES
0 5 10 20 30 KILOMETERS
T. 24 N.
T. 22 N.
T. 20 N.
T. 18 N.
T. 16 N.
T. 14 N.
T. 12 N.
T. 10 N.
T. 8 N.
T. 6 N.
R.10E.
R.12E.
R.14E.
R.16E.
R.18E.
R.20E.
R.22E.
R.24E.
R.26E.
R.28E.
CASCADE RANGE
Kachess Lake
Cle Elum Lake
Keechelus Lake
Cle Elum River
Little Naches River
Bumping River
Bumping Lake
Tieton River
Rimrock Lake
Cowiche Creek
Ahtanum Creek
Toppenish
Dry Creek
Creek
North Fork
KITTITAS COUNTY
YAKIMA COUNTY
RIVER
YAKIMA COUNTY
KLICKITAT COUNTY
BENTON COUNTY
Richland
Lake Wallula

USGS

Groundwater Rights

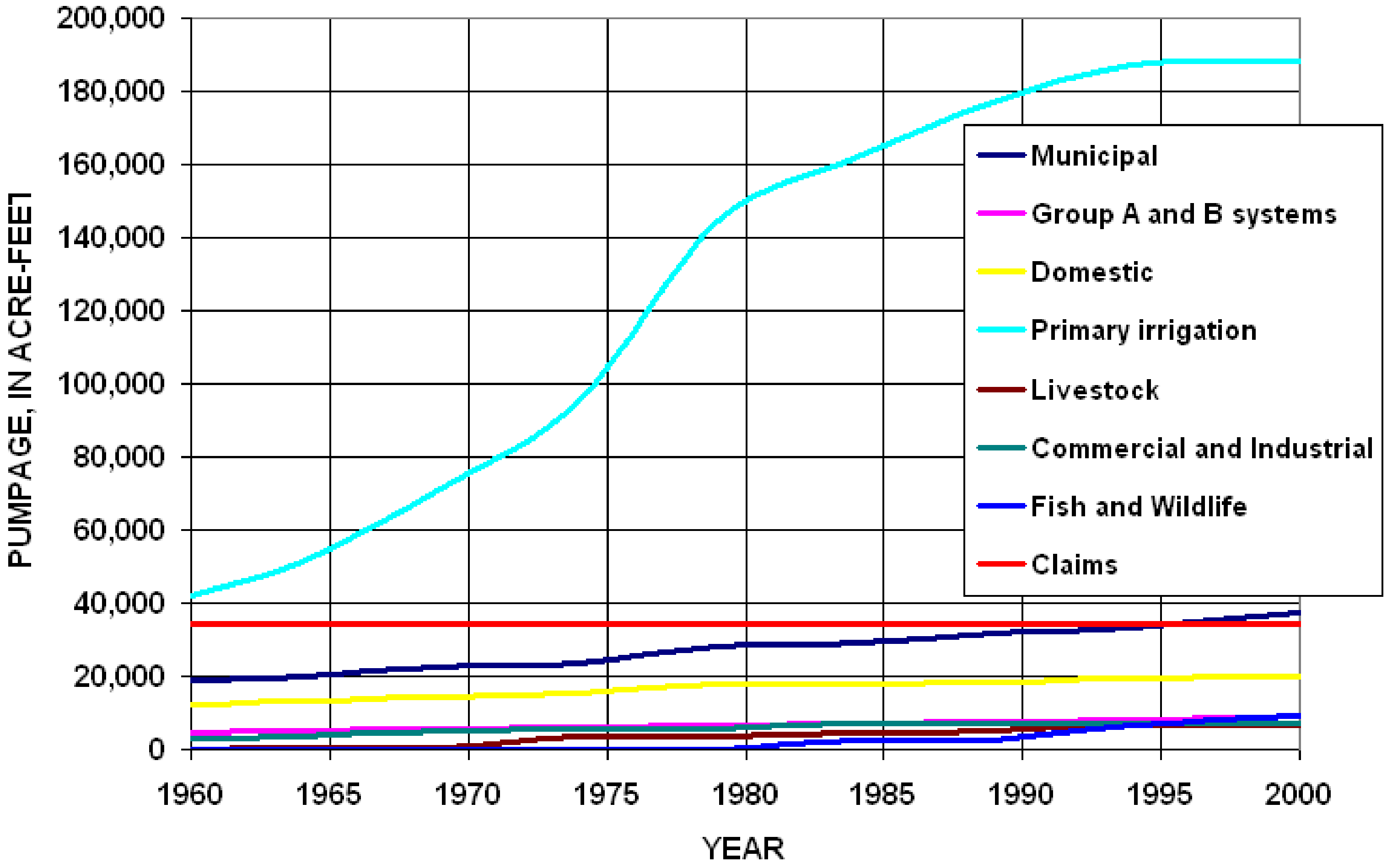
Number	Instantaneous (GPM)	Annual (Acre-FT)	Irrigated Area (Acres)
2,874	950,000	530,000	130,000

Instantaneous	=	**1.4** Billion gallons per day
Annual	=	**730** Cubic feet per second
Streamflow leaving the Basin	=	**3,600** Cubic feet per second

Note: about 25% of Irrigation Rights
are Standby/Reserve Rights

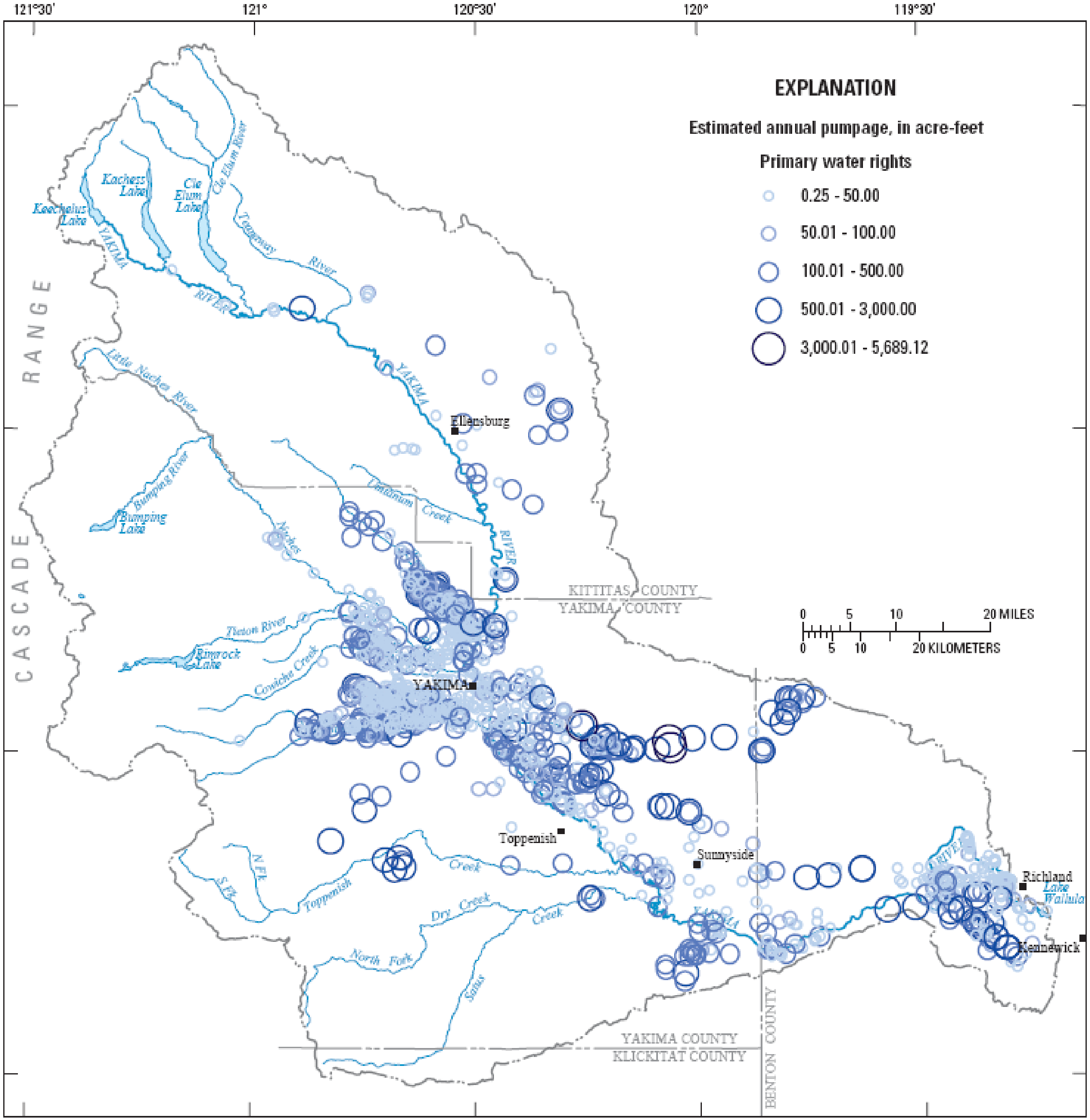
USGS

1960 116,000 ACRE-FT **2001 400,000 ACRE-FT**

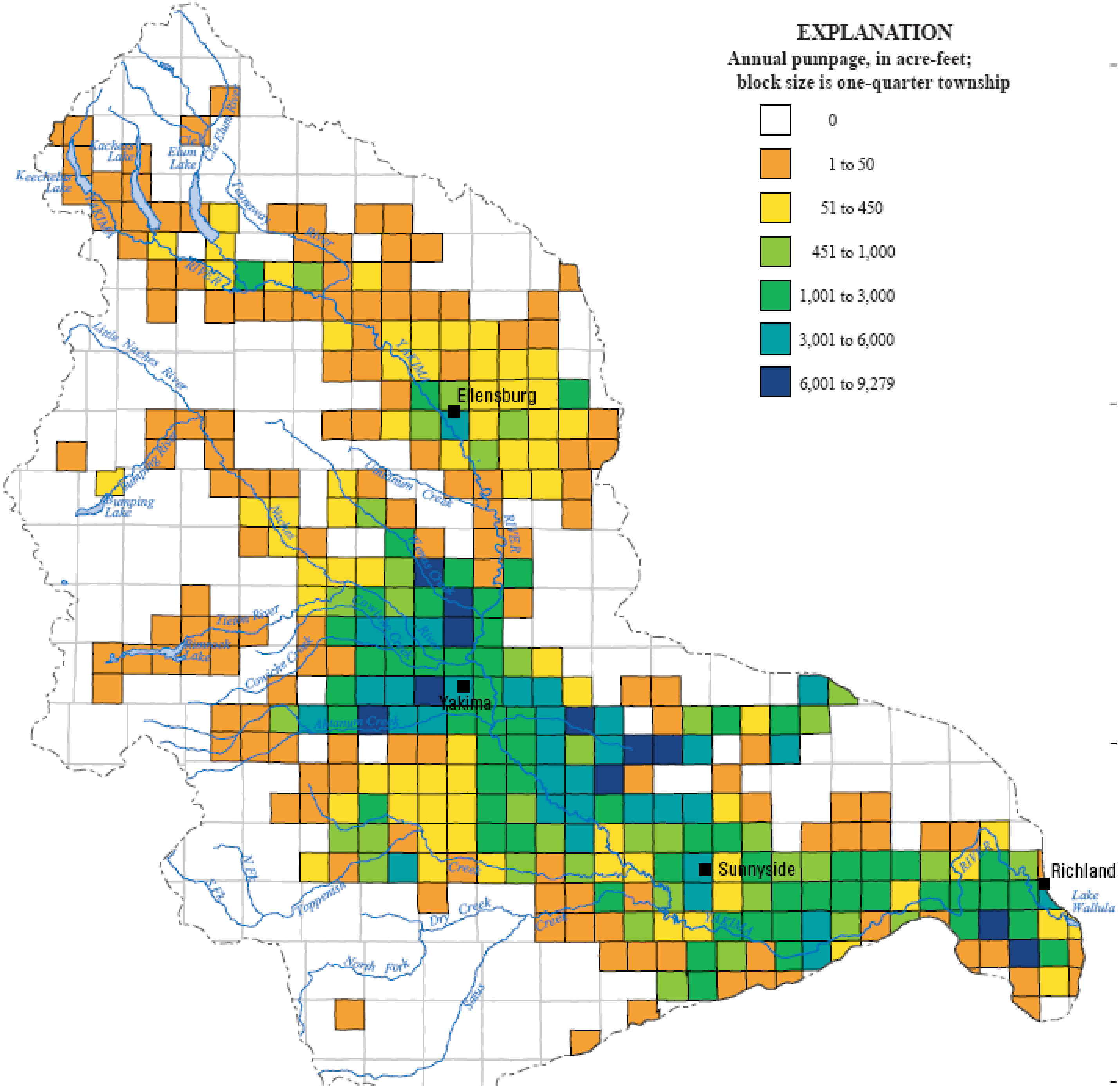


IRRIGATION PUMPAGE

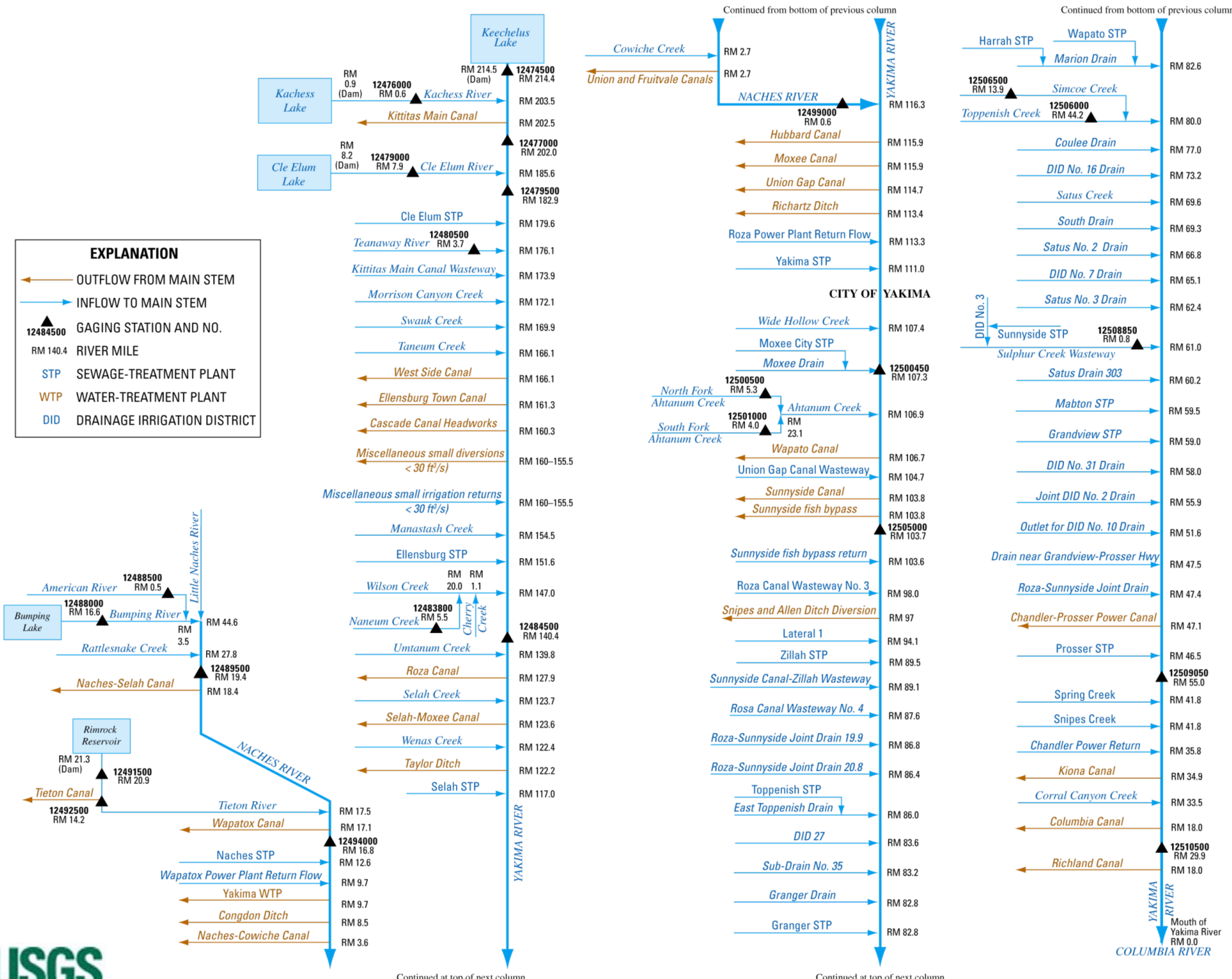
2000

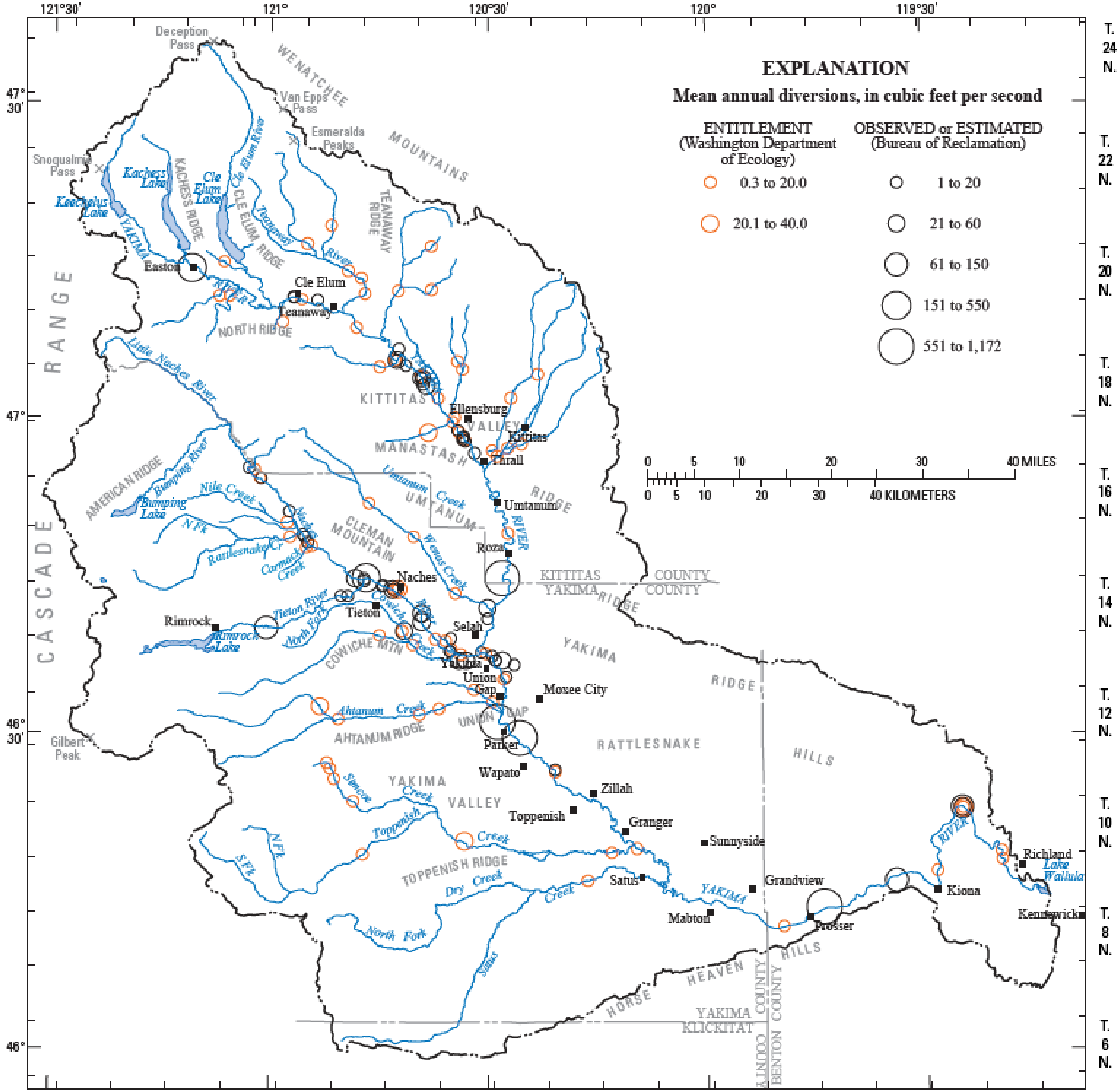


USGS



EXPLANATION
Annual pumpage, in acre-feet; block size is one-quarter township
0
1 to 50
51 to 450
451 to 1,000
1,001 to 3,000
3,001 to 6,000
6,001 to 9,279
Ellensburg
Yakima
Sunnyside
Richland
Lake Wallula
Keechelus Lake
Kachess Lake
Cle Elum Lake
Cle Elum River
Teanaway River
YAKIMA RIVER
Little Naches River
Bumping River
Bumping Lake
Naches River
Umtanum Creek
Tieton River
Rimrock Lake
Cowiche Creek
Ahtanum Creek
Toppenish Creek
Dry Creek
North Fork
Satus


EXPLANATION
OUTFLOW FROM MAIN STEM
INFLOW TO MAIN STEM
12484500 GAGING STATION AND NO.
RM 140.4 RIVER MILE
STP SEWAGE-TREATMENT PLANT
WTP WATER-TREATMENT PLANT
DID DRAINAGE IRRIGATION DISTRICT
Keechelus Lake
RM 214.5 (Dam)
12474500 RM 214.4
Kachess Lake
RM 0.9 (Dam)
12476000 RM 0.6
Kachess River
RM 203.5
Kittitas Main Canal
RM 202.5
12477000 RM 202.0
Cle Elum Lake
RM 8.2 (Dam)
12479000 RM 7.9
Cle Elum River
RM 185.6
12479500 RM 182.9
Cle Elum STP
RM 179.6
Teanaway River
12480500 RM 3.7
RM 176.1
Kittitas Main Canal Wasteway
RM 173.9
Morrison Canyon Creek
RM 172.1
Swauk Creek
RM 169.9
Taneum Creek
RM 166.1
West Side Canal
RM 166.1
Ellensburg Town Canal
RM 161.3
Cascade Canal Headworks
RM 160.3
Miscellaneous small diversions < 30 ft³/s)
RM 160–155.5
Miscellaneous small irrigation returns < 30 ft³/s)
RM 160–155.5
Manastash Creek
RM 154.5
Ellensburg STP
RM 151.6
Wilson Creek
RM 20.0
RM 1.1
RM 147.0
Naneum Creek
12483800 RM 5.5
Cherry Creek
12484500 RM 140.4
Umtanum Creek
RM 139.8
Roza Canal
RM 127.9
Selah Creek
RM 123.7
Selah-Moxee Canal
RM 123.6
Wenas Creek
RM 122.4
Taylor Ditch
RM 122.2
Selah STP
RM 117.0
YAKIMA RIVER
Continued at top of next column
Little Naches River
American River
12488500 RM 0.5
Bumping Lake
12488000 RM 16.6
Bumping River
RM 3.5
RM 44.6
Rattlesnake Creek
RM 27.8
12489500 RM 19.4
Naches-Selah Canal
RM 18.4
Rimrock Reservoir
RM 21.3 (Dam)
12491500 RM 20.9
Tieton Canal
12492500 RM 14.2
NACHES RIVER
Tieton River
RM 17.5
Wapatox Canal
RM 17.1
12494000 RM 16.8
Naches STP
RM 12.6
Wapatox Power Plant Return Flow
RM 9.7
Yakima WTP
RM 9.7
Congdon Ditch
RM 8.5
Naches-Cowiche Canal
RM 3.6
Continued from bottom of previous column
Cowiche Creek
RM 2.7
Union and Fruitvale Canals
RM 2.7
NACHES RIVER
12499000 RM 0.6
YAKIMA RIVER
RM 116.3
Hubbard Canal
RM 115.9
Moxee Canal
RM 115.9
Union Gap Canal
RM 114.7
Richartz Ditch
RM 113.4
Roza Power Plant Return Flow
RM 113.3
Yakima STP
RM 111.0
CITY OF YAKIMA
Wide Hollow Creek
RM 107.4
Moxee City STP
Moxee Drain
12500450 RM 107.3
North Fork Ahtanum Creek
12500500 RM 5.3
Ahtanum Creek
South Fork Ahtanum Creek
12501000 RM 4.0
RM 23.1
RM 106.9
Wapato Canal
RM 106.7
Union Gap Canal Wasteway
RM 104.7
Sunnyside Canal
RM 103.8
Sunnyside fish bypass
RM 103.8
12505000 RM 103.7
Sunnyside fish bypass return
RM 103.6
Roza Canal Wasteway No. 3
RM 98.0
Snipes and Allen Ditch Diversion
RM 97
Lateral 1
RM 94.1
Zillah STP
RM 89.5
Sunnyside Canal-Zillah Wasteway
RM 89.1
Rosa Canal Wasteway No. 4
RM 87.6
Roza-Sunnyside Joint Drain 19.9
RM 86.8
Roza-Sunnyside Joint Drain 20.8
RM 86.4
Toppenish STP
East Toppenish Drain
RM 86.0
DID 27
RM 83.6
Sub-Drain No. 35
RM 83.2
Granger Drain
RM 82.8
Granger STP
RM 82.8
Continued at top of next column
Continued from bottom of previous column
Harrah STP
Wapato STP
Marion Drain
RM 82.6
12506500 RM 13.9
Simcoe Creek
Toppenish Creek
12506000 RM 44.2
RM 80.0
Coulee Drain
RM 77.0
DID No. 16 Drain
RM 73.2
Satus Creek
RM 69.6
South Drain
RM 69.3
Satus No. 2 Drain
RM 66.8
DID No. 7 Drain
RM 65.1
Satus No. 3 Drain
RM 62.4
DID No. 3
Sunnyside STP
12508850 RM 0.8
Sulphur Creek Wasteway
RM 61.0
Satus Drain 303
RM 60.2
Mabton STP
RM 59.5
Grandview STP
RM 59.0
DID No. 31 Drain
RM 58.0
Joint DID No. 2 Drain
RM 55.9
Outlet for DID No. 10 Drain
RM 51.6
Drain near Grandview-Prosser Hwy
RM 47.5
Roza-Sunnyside Joint Drain
RM 47.4
Chandler-Prosser Power Canal
RM 47.1
Prosser STP
RM 46.5
12509050 RM 55.0
Spring Creek
RM 41.8
Snipes Creek
RM 41.8
Chandler Power Return
RM 35.8
Kiona Canal
RM 34.9
Corral Canyon Creek
RM 33.5
Columbia Canal
RM 18.0
12510500 RM 29.9
Richland Canal
RM 18.0
YAKIMA RIVER
Mouth of Yakima River RM 0.0
COLUMBIA RIVER


EXPLANATION
Mean annual diversions, in cubic feet per second
ENTITLEMENT (Washington Department of Ecology)
0.3 to 20.0
20.1 to 40.0
OBSERVED or ESTIMATED (Bureau of Reclamation)
1 to 20
21 to 60
61 to 150
151 to 550
551 to 1,172
0 5 10 20 30 40 MILES
0 5 10 20 30 40 KILOMETERS
121°30'
121°
120°30'
120°
119°30'
47° 30'
47°
46° 30'
46°
T. 24 N.
T. 22 N.
T. 20 N.
T. 18 N.
T. 16 N.
T. 14 N.
T. 12 N.
T. 10 N.
T. 8 N.
T. 6 N.
R.10E.
R.12E.
R.14E.
R.16E.
R.18E.
R.20E.
R.22E.
R.24E.
R.26E.
R.28E.
CASCADE RANGE
WENATCHEE MOUNTAINS
Deception Pass
Van Epps Pass
Esmeralda Peaks
Snoqualmie Pass
Gilbert Peak
Keechelus Lake
Kachess Lake
Cle Elum Lake
Bumping Lake
Rimrock Lake
Lake Wallula
Easton
Cle Elum
Teanaway
Ellensburg
Kittitas
Thrall
Umtanum
Roza
Naches
Tieton
Rimrock
Selah
Yakima
Union Gap
Moxee City
Parker
Wapato
Zillah
Toppenish
Granger
Sunnyside
Satus
Mabton
Grandview
Prosser
Kiona
Richland
Kennewick
KITTITAS VALLEY
YAKIMA VALLEY
KITTITAS COUNTY
YAKIMA COUNTY
BENTON COUNTY
KLICKITAT
HORSE HEAVEN HILLS
RATTLESNAKE HILLS
YAKIMA RIDGE
UMTANUM RIDGE
MANASTASH RIDGE
CLEMAN MOUNTAIN
COWICHE MTN
AHTANUM RIDGE
TOPPENISH RIDGE
AMERICAN RIDGE
NORTH RIDGE
KACHESS RIDGE
CLE ELUM RIDGE
TEANAWAY RIDGE
YAKIMA RIVER
Cle Elum River
Teanaway River
Little Naches River
Bumping River
Nile Creek
Rattlesnake Cr
Carmack Creek
Tieton River
North Fork
Cowiche Creek
Wenas Creek
Umtanum Creek
Ahtanum Creek
Simcoe Creek
Toppenish Creek
Dry Creek
Satus Creek
North Fork
NFk
SFk

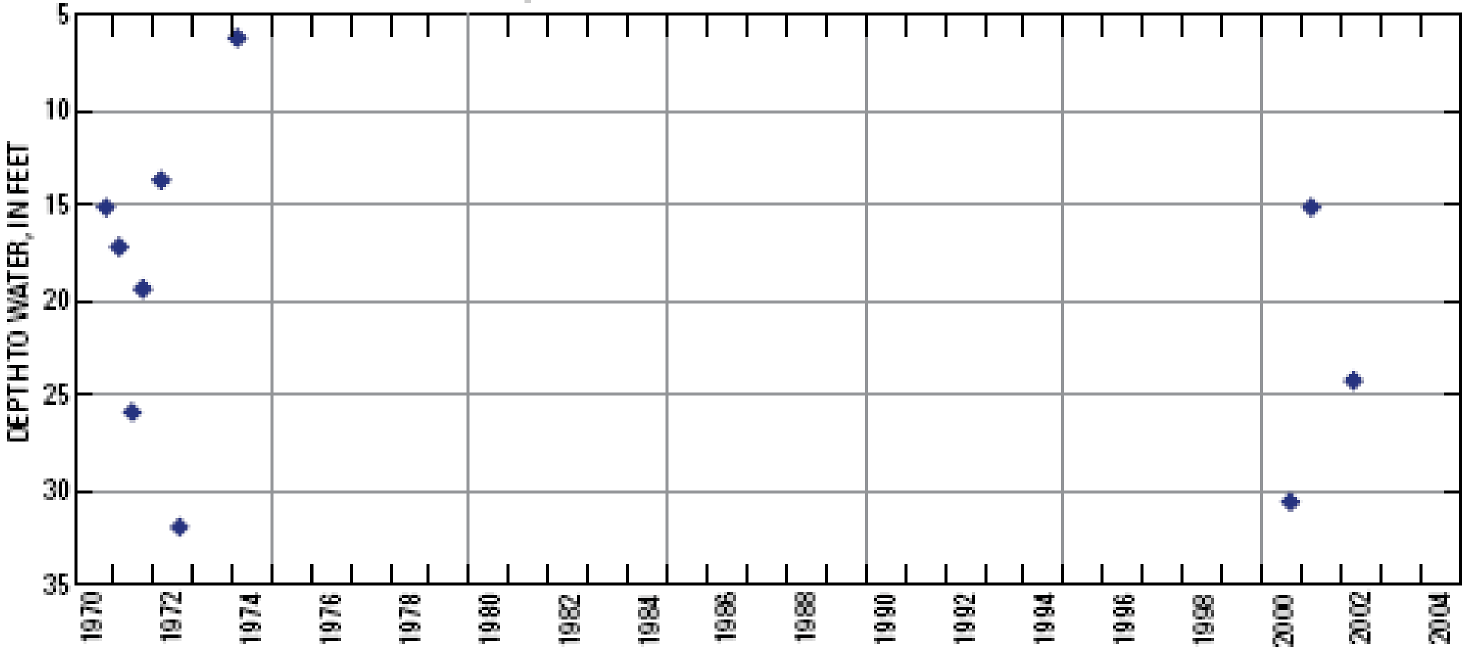
WATER-LEVEL TRENDS

Trends, and absence of trends, when analyzed in conjunction with groundwater pumpage, streamflow, and recharge, can indicate areas where there have been: (1) changes in groundwater storage, (2) potential capture of recharge, and (3) changes in groundwater discharge to streams, springs, or wetlands. Pumpage (discharge by wells) must be balanced by one or a combination of the above three changes (Theis, 1940).

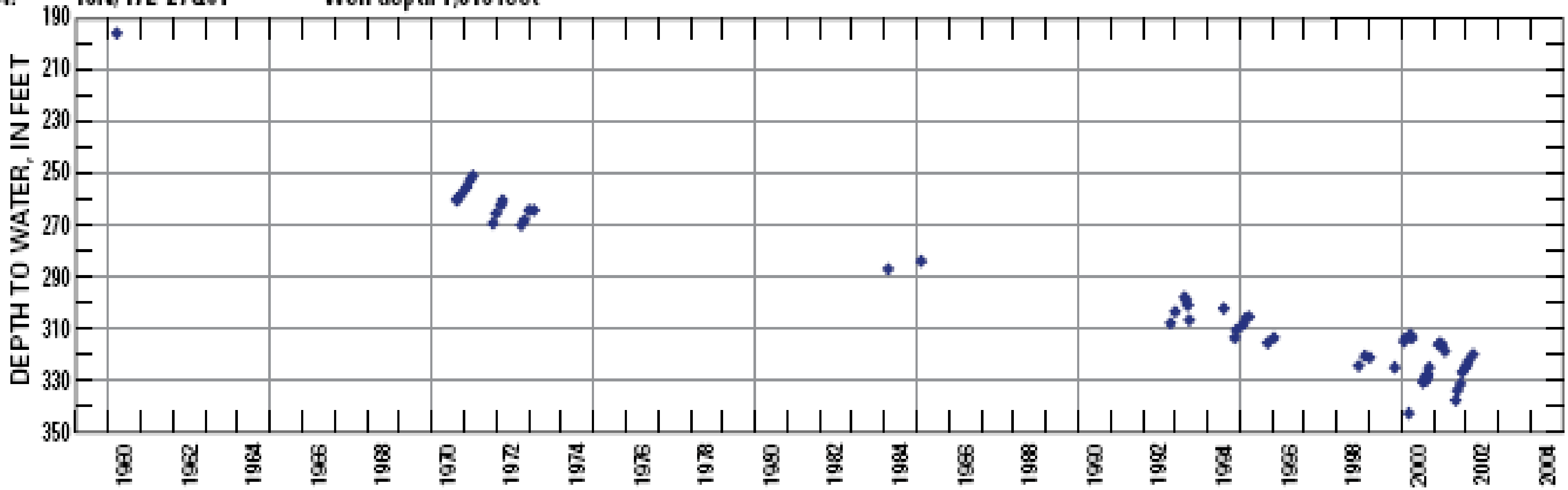
USGS

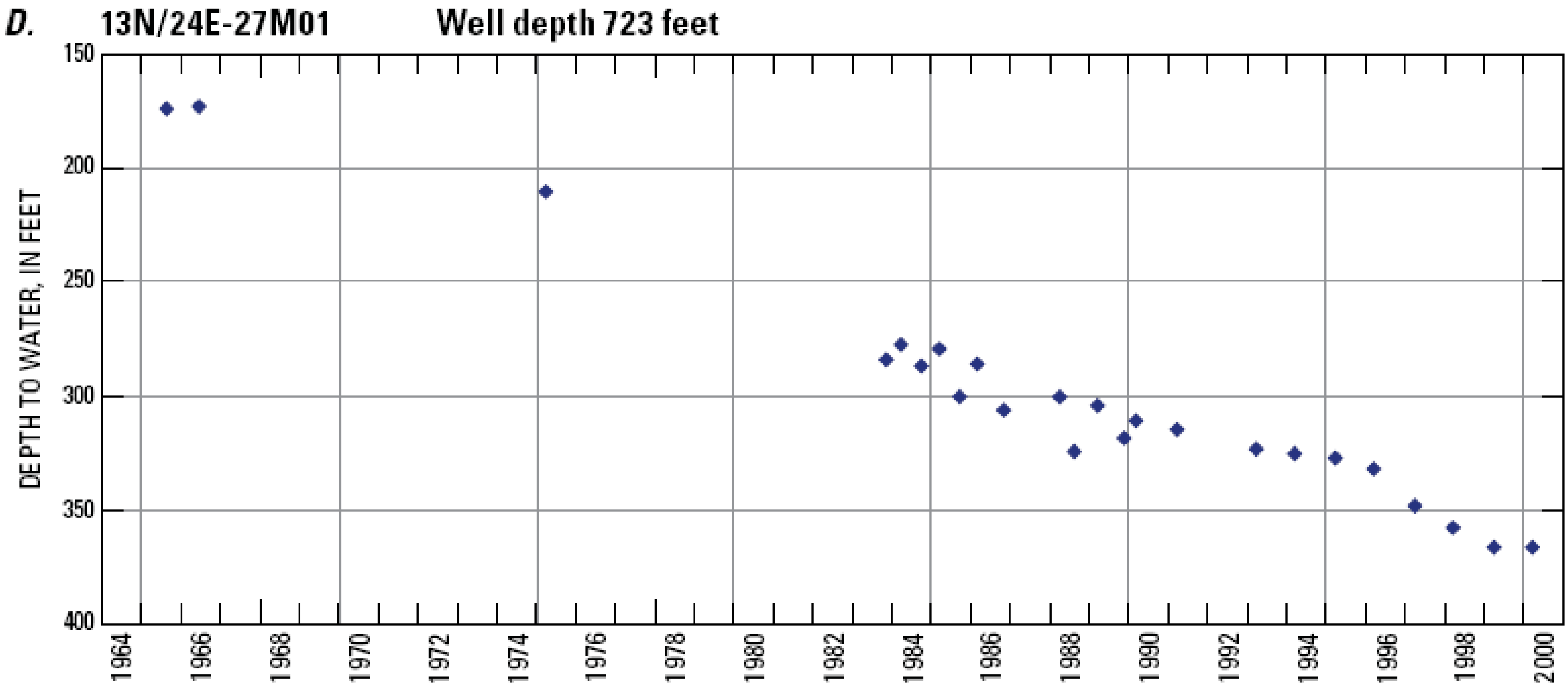
Groundwater-level trends were categorized as: stable to small water-level declines (0–20 ft), moderate declines (21–75 ft), large declines (76–150 ft), and very large declines (greater than 150 ft).

C. **11N/19E-10A02** **Well depth 765 feet**

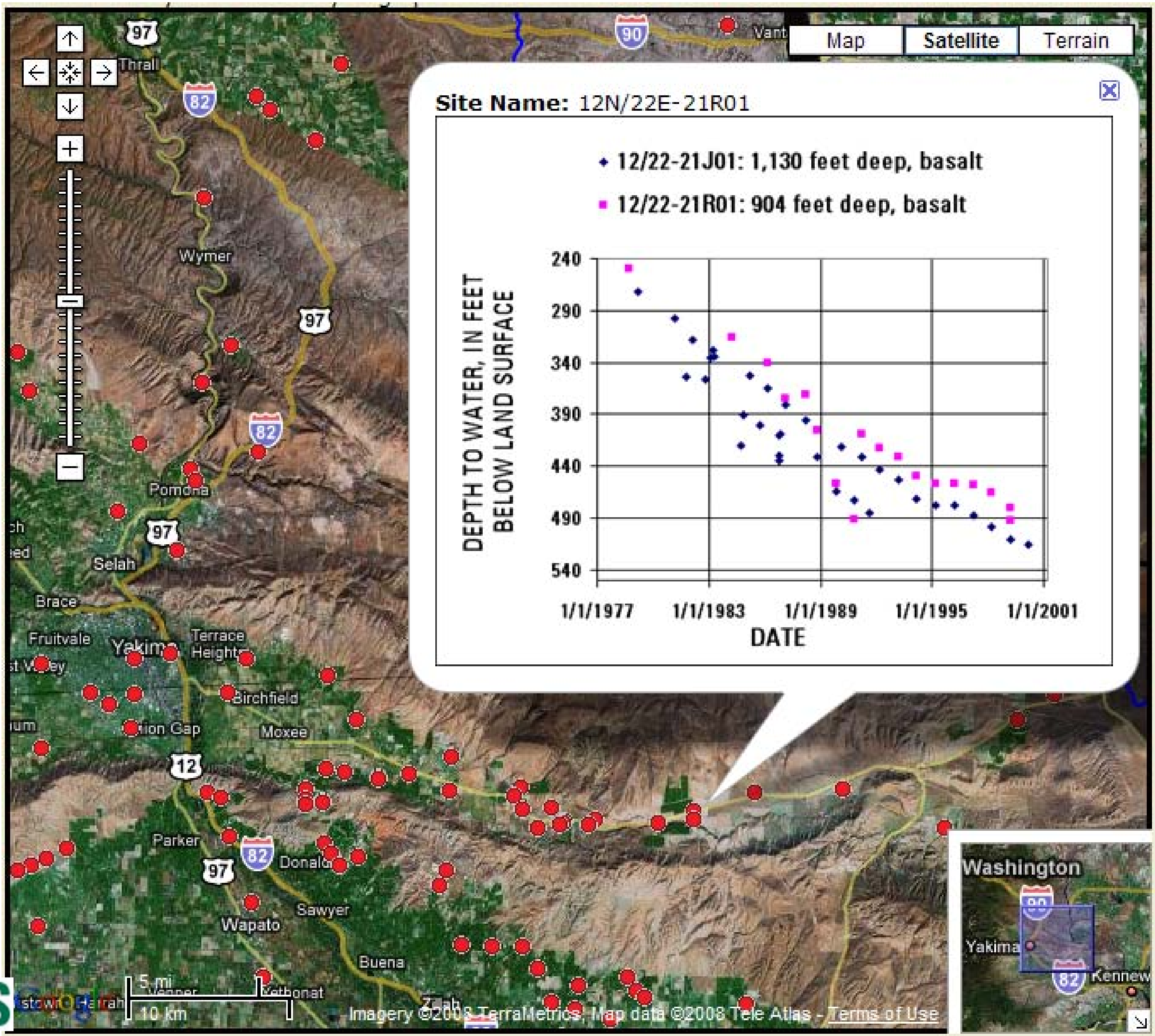


A. **10N/17E-27Q01** **Well depth 1,510 feet**



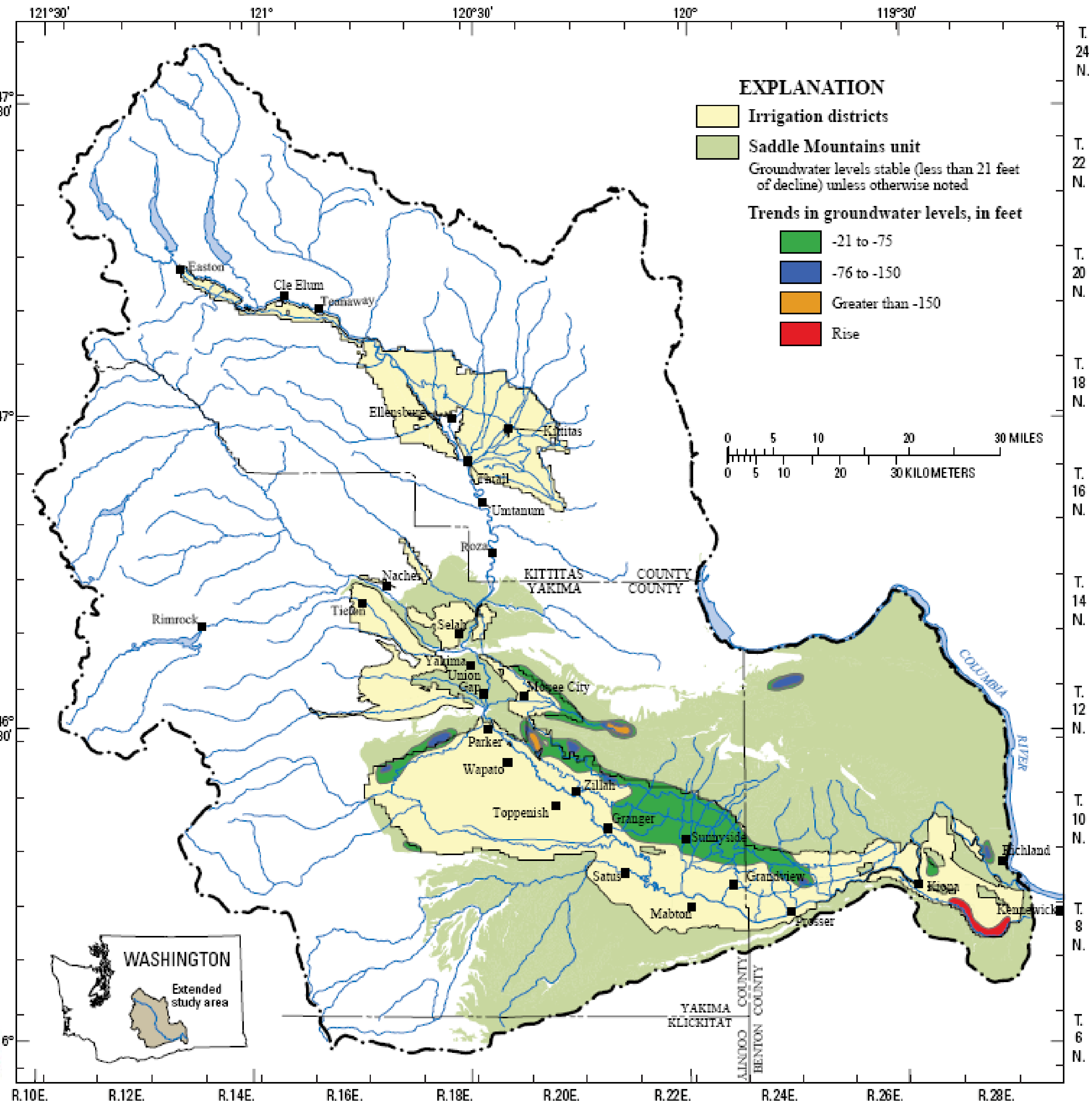


D.
13N/24E-27M01
Well depth 723 feet
DEPTH TO WATER, IN FEET
150
200
250
300
350
400
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000



Map
Satellite
Terrain
Site Name: 12N/22E-21R01
12/22-21J01: 1,130 feet deep, basalt
12/22-21R01: 904 feet deep, basalt
DEPTH TO WATER, IN FEET BELOW LAND SURFACE
240
290
340
390
440
490
540
1/1/1977
1/1/1983
1/1/1989
1/1/1995
1/1/2001
DATE
Thrall
Wymer
Pomona
Selah
Brace
Fruitvale
Yakima
Terrace Heights
Birchfield
Moxee
Parker
Donald
Sawyer
Wapato
Buena
Washington
Yakima
5 mi
10 km
Imagery ©2008 TerraMetrics, Map data ©2008 Tele Atlas - Terms of Use

USGS



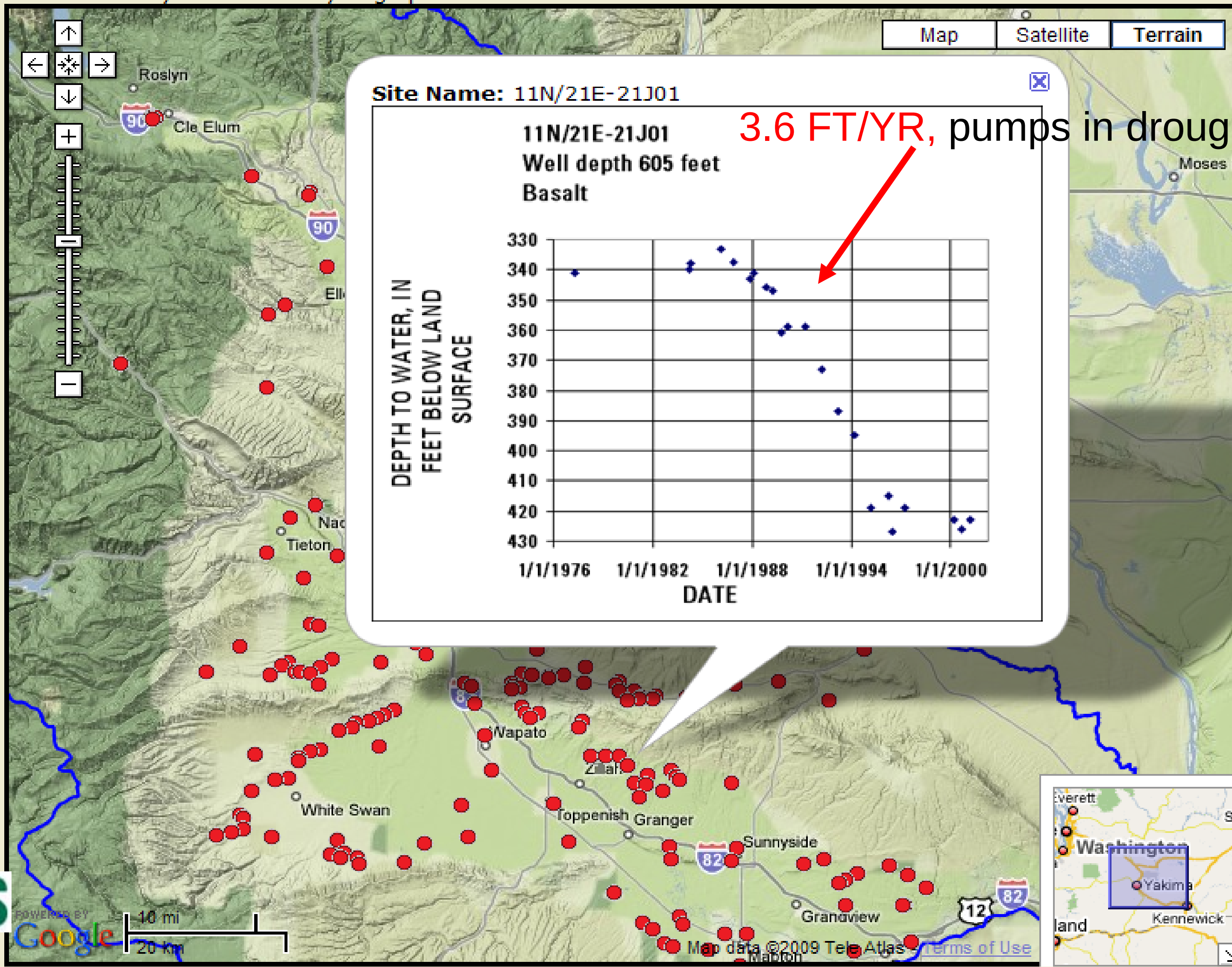
EXPLANATION
Irrigation districts
Saddle Mountains unit
Groundwater levels stable (less than 21 feet of decline) unless otherwise noted
Trends in groundwater levels, in feet
-21 to -75
-76 to -150
Greater than -150
Rise
0 5 10 20 30 MILES
0 5 10 20 30 KILOMETERS
121°30'
121°
120°30'
120°
119°30'
47° 30'
47°
46° 30'
46°
T. 24 N.
T. 22 N.
T. 20 N.
T. 18 N.
T. 16 N.
T. 14 N.
T. 12 N.
T. 10 N.
T. 8 N.
T. 6 N.
R.10E.
R.12E.
R.14E.
R.16E.
R.18E.
R.20E.
R.22E.
R.24E.
R.26E.
R.28E.
Easton
Cle Elum
Teanaway
Ellensburg
Kittitas
Thrall
Umtanum
Roza
Naches
Tieton
Rimrock
Selah
Yakima
Union Gap
Moxee City
Parker
Wapato
Zillah
Toppenish
Granger
Sunnyside
Satus
Grandview
Mabton
Prosser
Kiona
Richland
Kennewick
KITTITAS COUNTY
YAKIMA COUNTY
YAKIMA COUNTY
KLICKITAT COUNTY
BENTON COUNTY
COLUMBIA RIVER
WASHINGTON
Extended study area

USGS

Yakima Ground Water Sites - Hydrographs

Back to DS 343

Click on well symbol to see hydrograph.



WATER BUDGET FOR THE YAKIMA RIVER BASIN

Water budget component	Predevelopment conditions	Current conditions
Precipitation	8.6	8.6
Streamflow	4.1	2.5
Evapotranspiration	5.1	6.1
Recharge[1]	3.8	5.0
Pumpage	.0	.24
Reservoir storage	.0	1.1
Diversions[2]	.0	3.1

Values in Millions of Acre-Feet

USGS

The product is available online at:

http://pubs.usgs.gov/sir/2009/5152/

Yakima Groundwater Project Web Site:

http://wa.water.usgs.gov/projects/yakimagw/

Cooperators

WASHINGTON STATE DEPARTMENT OF ECOLOGY

CONFEDERATED TRIBES AND BANDS
YAKAMA NATION
TREATY OF 1855

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION