Potential for Aquifer Storage in the Yakima River Basin

Tom Ring

Hydrogeologist, YN Water Res.

For YRBWEP 2009 Discussion

Disclaimer

- This staff-level technical presentation does not represent the policy or legal position of the Yakama Nation

Concept

- Store water in aquifers pre-storage control
- Use water post-storage control in lieu of reservoir releases
- Benefit is increased carry-over storage
  - Hedges against drought following year
  - Optimizes
    - Juvenile passage from reservoirs
    - Spring outmigration conditions
  - Reduces unnaturally high summer flows
- Aquifer storage is same year (from pre- to post-storage control)
- Year to year storage is in the form of carryover storage in reservoirs

Contrast with Other Presentations

- Differentiate between this concept and the municipal type ASR projects, which will never be cost effective for the hundreds of thousands of acre feet we are discussing
- Differs in timing and locations from regional ASR presentation

Recharge Concept

- Store water in aquifers pre-storage control
  - When flow greater than fish and ecosystem needs
    - Same determination needed for surface storage
- Use existing irrigation delivery systems to convey water to locations distant from the river
- Recharge through constructed facilities
- Not using treated drinking water

Recovery Concept

- Use water post-storage control in lieu of reservoir releases
- Recover by means of (as appropriate)
  - Wells
  - Drains
  - Passive recovery (let it discharge to streams)

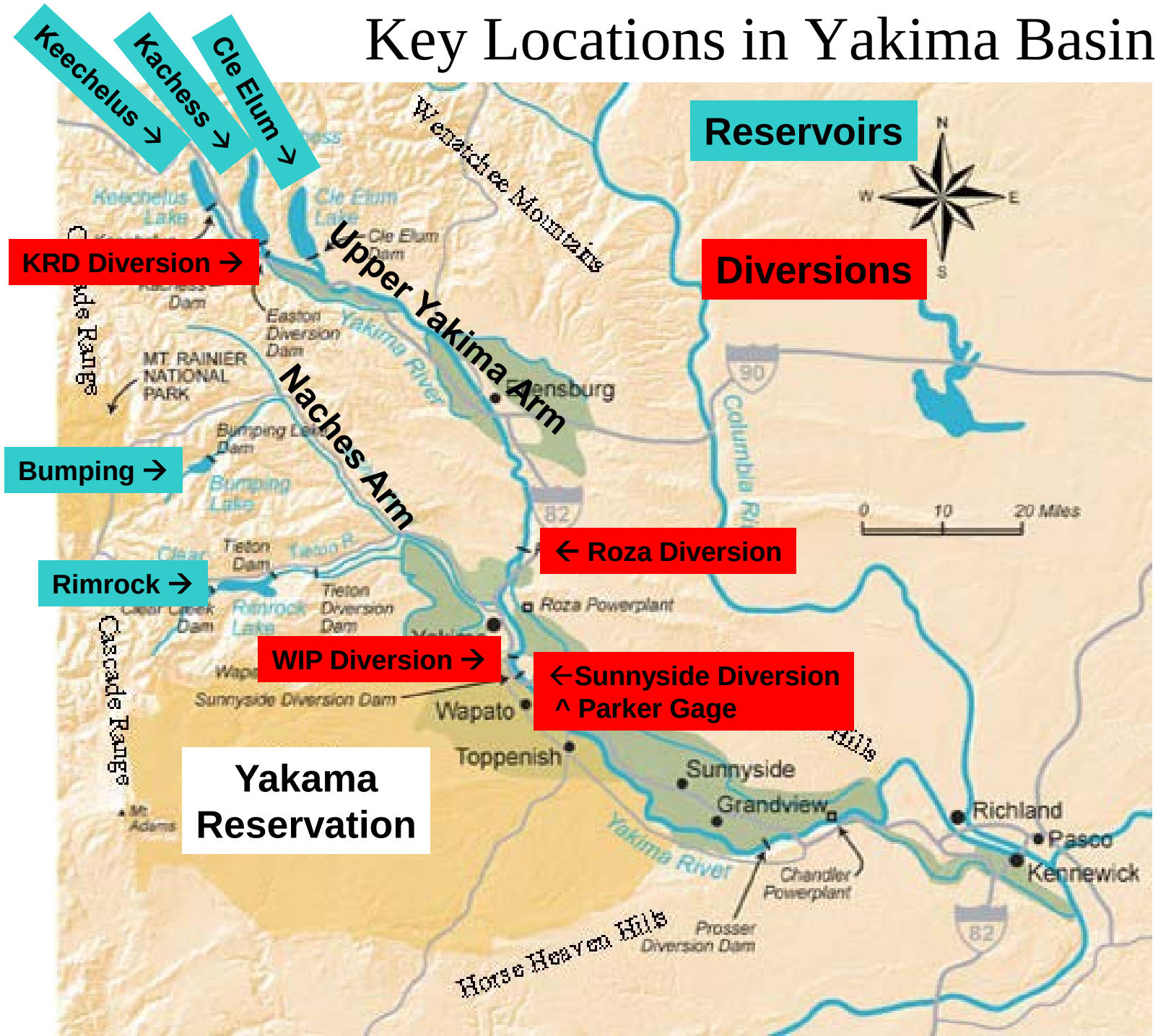
Benefits

- Potential to increase carry-over storage
- Irrigation
  - Increased carry-over is hedge against drought the following year
- Aquatic resources:
  - Increased carry-over increases effectiveness of juvenile passage out of reservoirs and
  - Better spring outmigration conditions
  - Reduced high late summer flows
- Relatively low cost
  - Utilizes existing reservoir and conveyance facilities as much as possible

How to Quantify

- The Reclamation surface water models would be used (with fisheries input) to determine how much storable water would be available for recharge for a variety of years
- The USGS groundwater model (soon to be completed) would be used
  - To simulate the behavior of the recharge mound
  - To determine favorable locations for recharge and recovery facilities
  - In tandem with Reclamation models to estimate effectiveness in terms of carryover, drought abatement, and flow augmentation

Key Locations in Yakima Basin



Changing hydrograph

Effects of storage and diversion

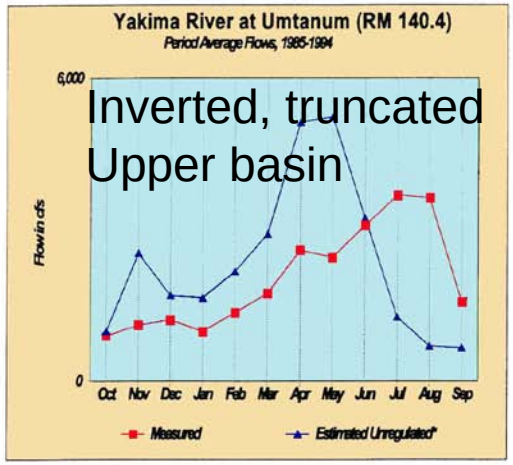


Figure III-1a

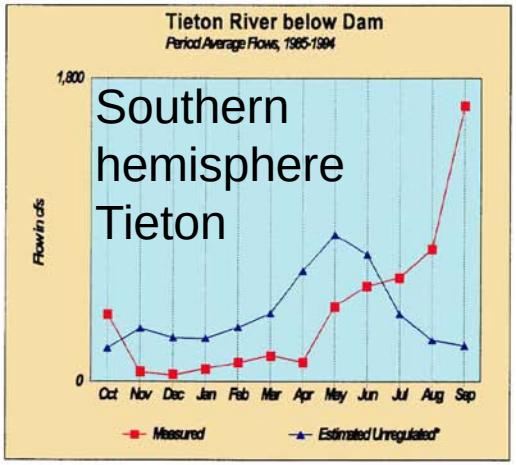


Figure III-1b

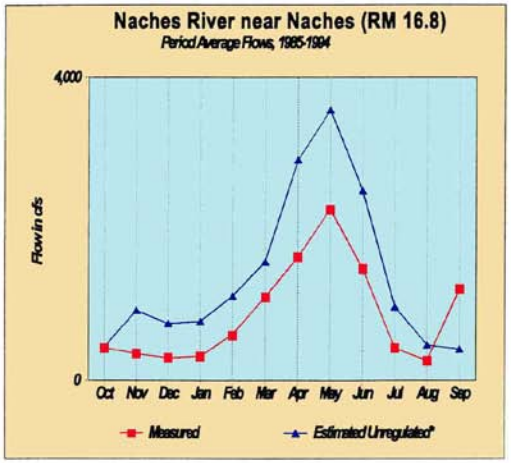


Figure III-1c

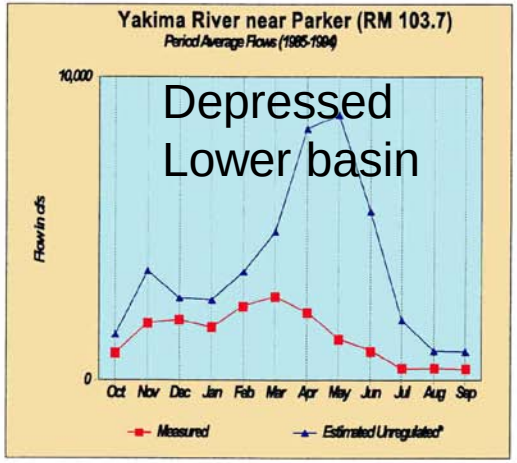


Figure III-1d

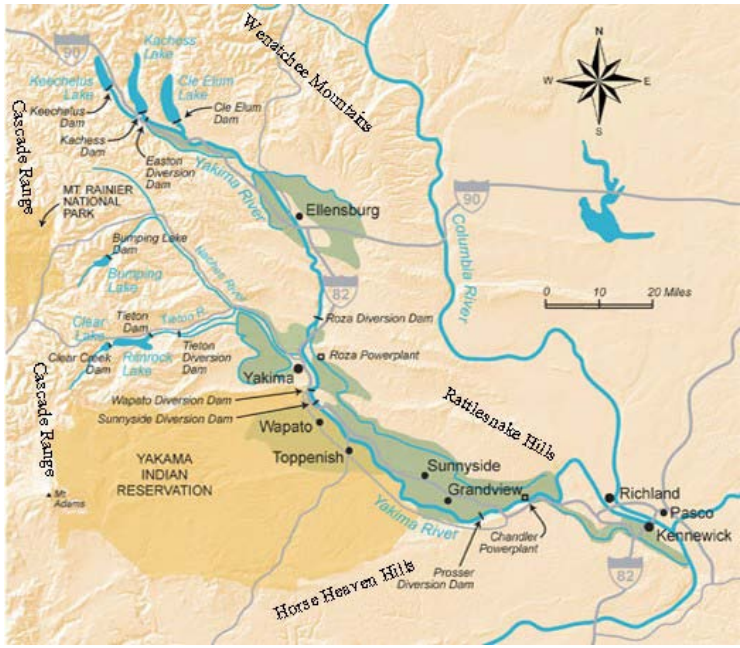
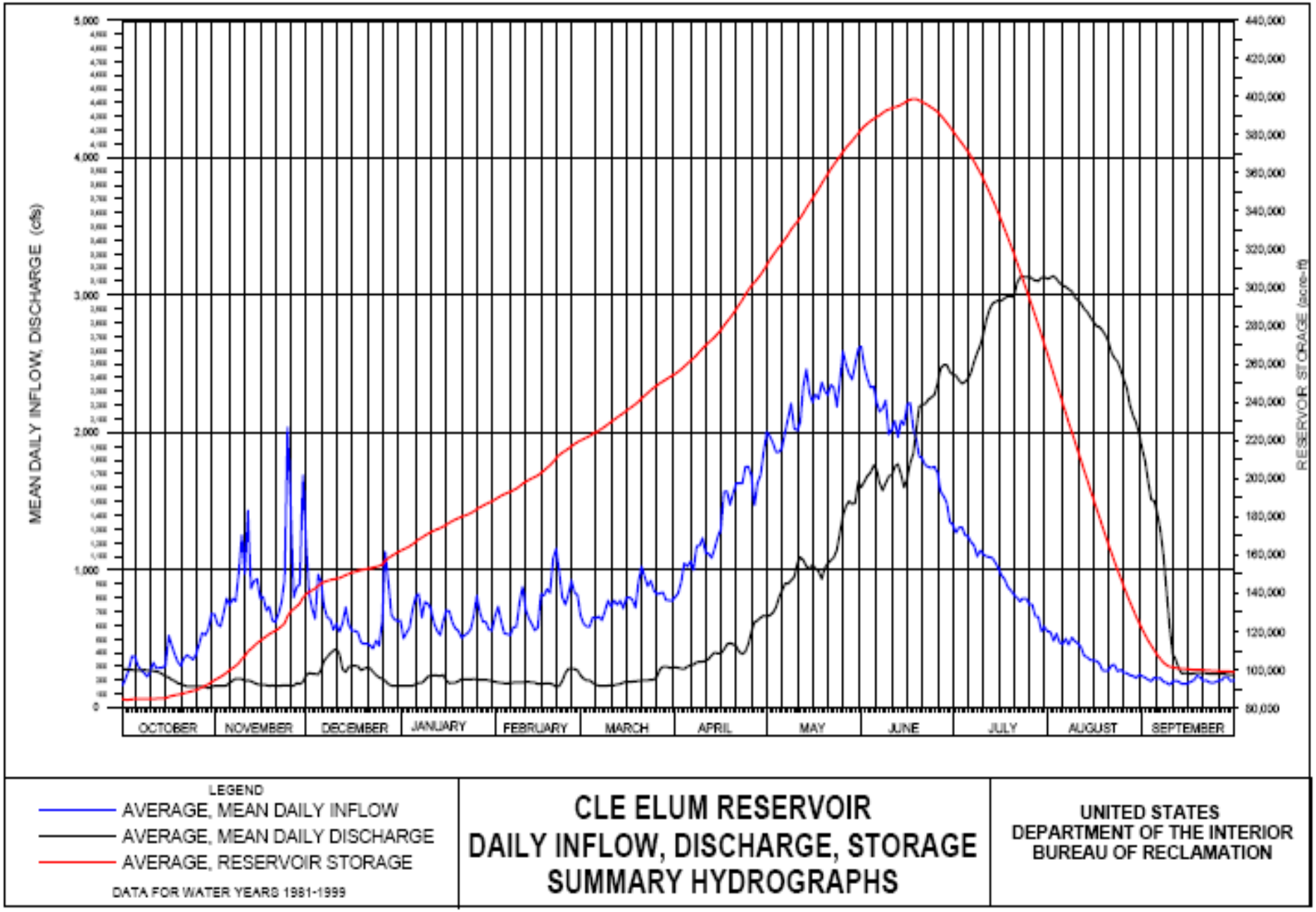


Figure III-1.—Conceptual comparison of measured flow and estimated unregulated flow (measured flow corrected for storage, estimated diversions, and estimated return flows).

From YRBWEP Draft Programmatic Environmental Impact Statement

Cle Elum


MEAN DAILY INFLOW, DISCHARGE (cfs)
RESERVOIR STORAGE (acre-ft)
5,000
4,000
3,000
2,000
1,000
0
440,000
420,000
400,000
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
LEGEND
AVERAGE, MEAN DAILY INFLOW
AVERAGE, MEAN DAILY DISCHARGE
AVERAGE, RESERVOIR STORAGE
DATA FOR WATER YEARS 1981-1999
CLE ELUM RESERVOIR
DAILY INFLOW, DISCHARGE, STORAGE
SUMMARY HYDROGRAPHS
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

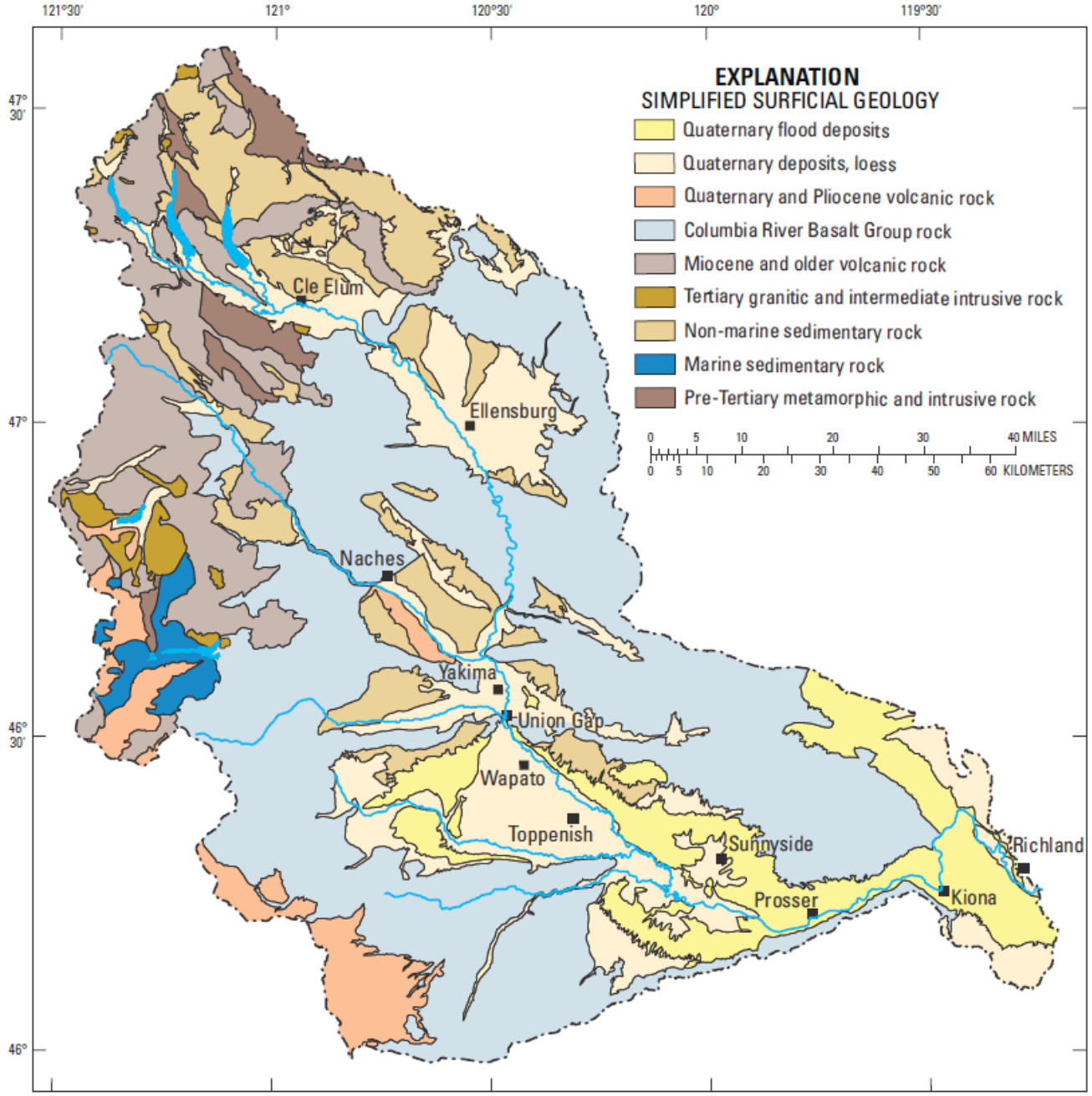
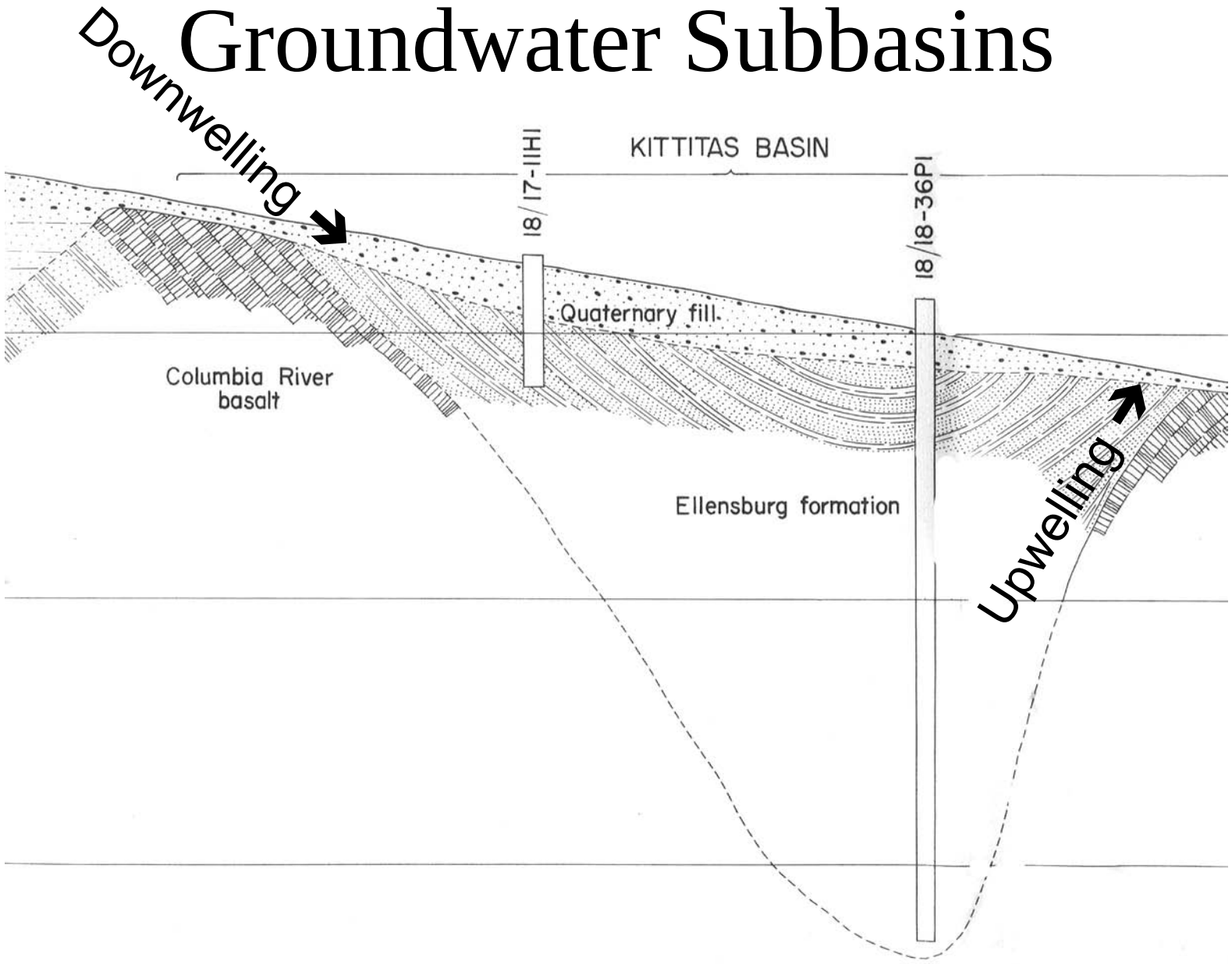
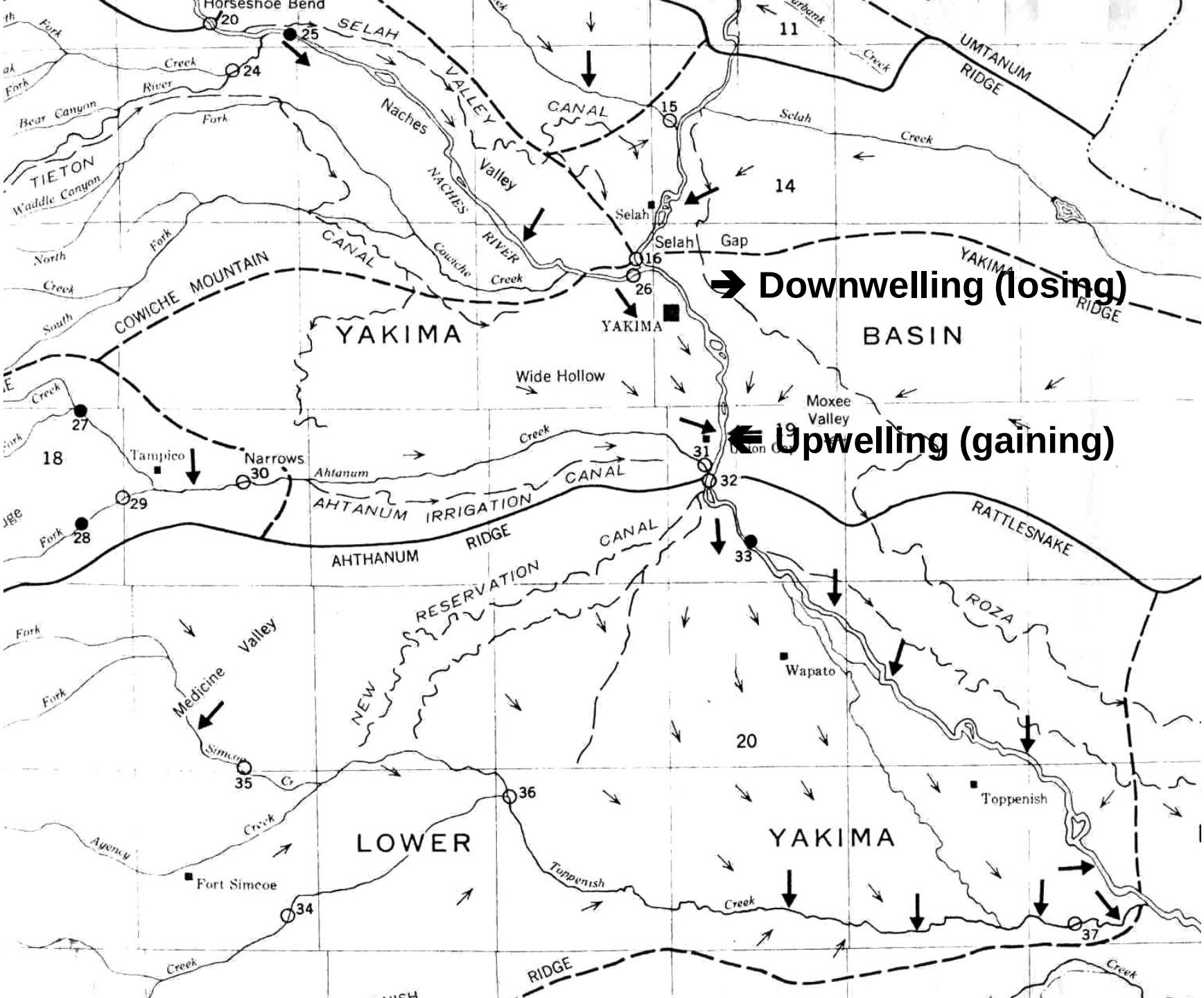


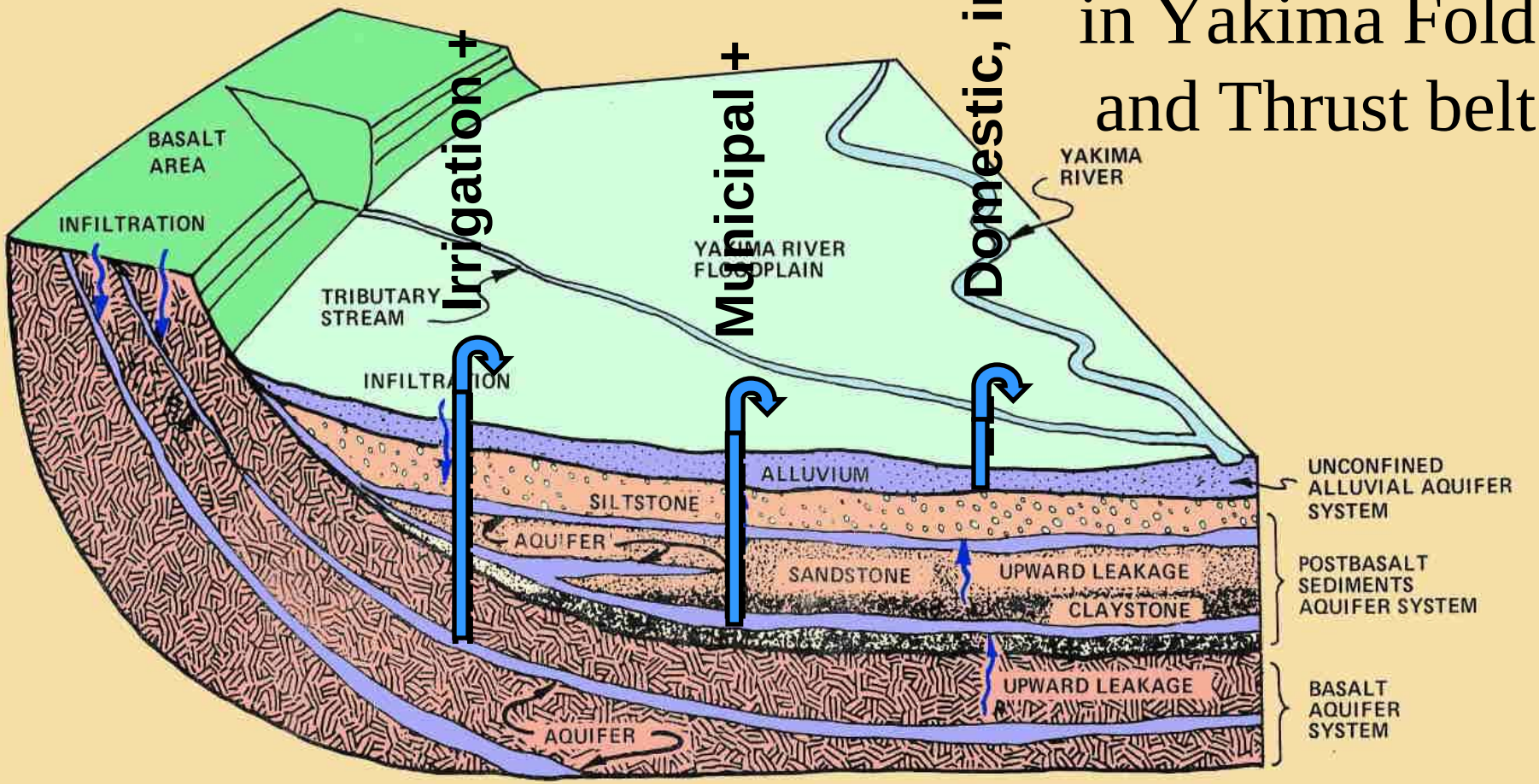
Figure 4. Simplified surficial geology of the Yakima River Basin, Washington. From Fuhrer and others, 1994.

Groundwater Subbasins




➔ Downwelling (losing)
⇐ Upwelling (gaining)
Horseshoe Bend
SELAH VALLEY
Naches
Valley
NACHES RIVER
CANAL
UMTANUM RIDGE
Selah
Selah Gap
YAKIMA RIDGE
TIETON
Waddle Canyon
Bear Canyon
North Fork
South Fork
Creek
River
COWICHE MOUNTAIN
Cowiche Creek
YAKIMA
BASIN
Wide Hollow
Moxee Valley
Tampico
Narrows
Ahtanum
AHTANUM IRRIGATION CANAL
AHTHANUM RIDGE
RESERVATION CANAL
RATTLESNAKE
ROZA
NEW
Medicine Valley
Simcoe
Wapato
Toppenish
LOWER
YAKIMA
Fort Simcoe
Agency
Toppenish Creek
11
14
15
16
18
19
20
24
25
26
27
28
29
30
31
32
33
34
35
36
37

Synclinal Basin in Yakima Fold and Thrust belt



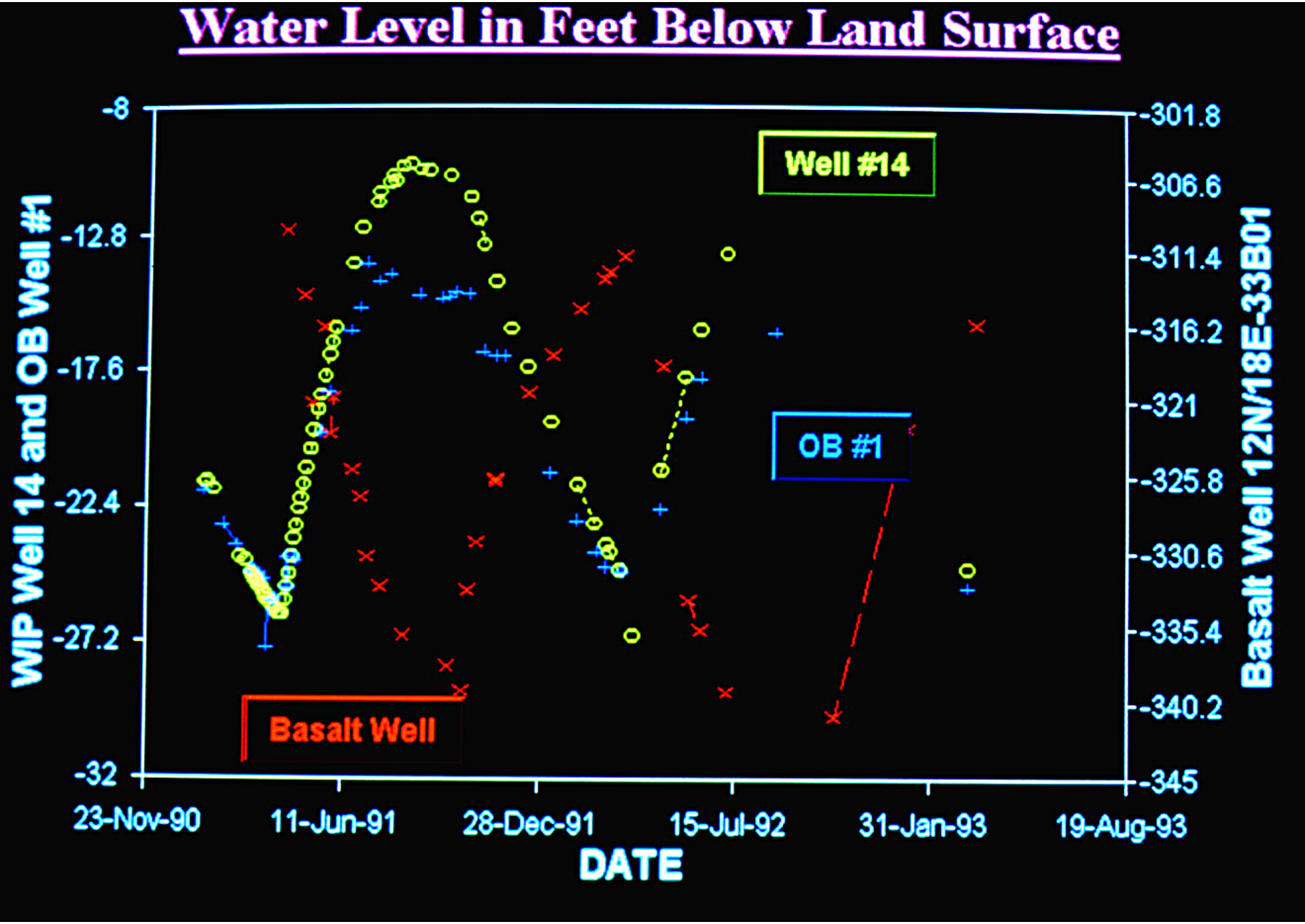
Not rivers, but leaky sheets of folded layer cake geology

In basalts, interflow zones most permeable

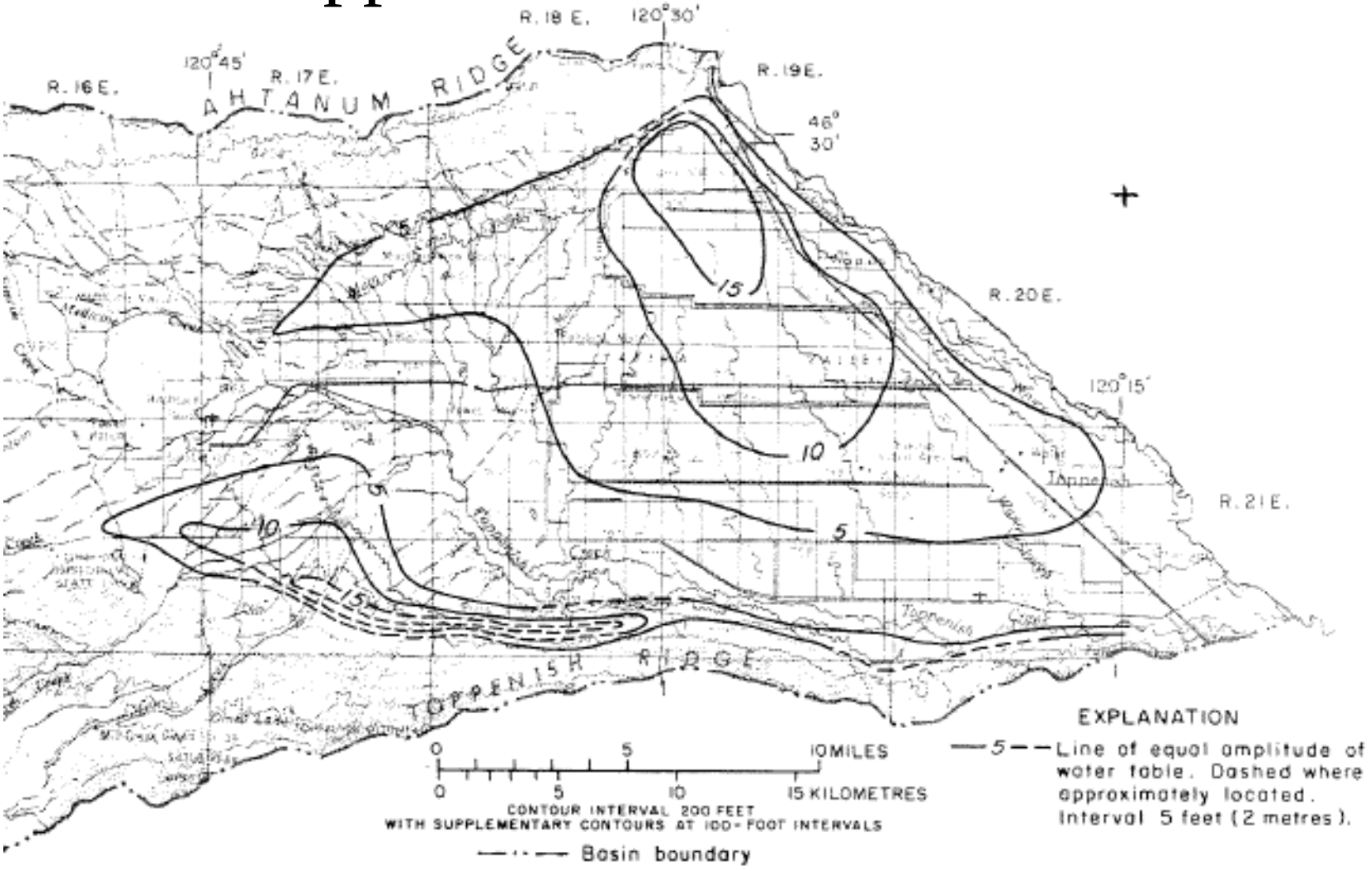
Alluvial aquifer water young like me, basalts old

Figure 3. The Three Principal Aquifer Systems in the Yakima River Basin

From U.S. Army Corps of Engineers, 1978,
Yakima Valley Regional Water Management Study


Water Level in Feet Below Land Surface
WIP Well 14 and OB Well #1
-8
-12.8
-17.6
-22.4
-27.2
-32
Basalt Well 12N/18E-33B01
-301.8
-306.6
-311.4
-316.2
-321
-325.8
-330.6
-335.4
-340.2
-345
Well #14
OB #1
Basalt Well
23-Nov-90
11-Jun-91
28-Dec-91
15-Jul-92
31-Jan-93
19-Aug-93
DATE

Annual Change in Groundwater Storage in Toppenish Subbasin = 125 kaf



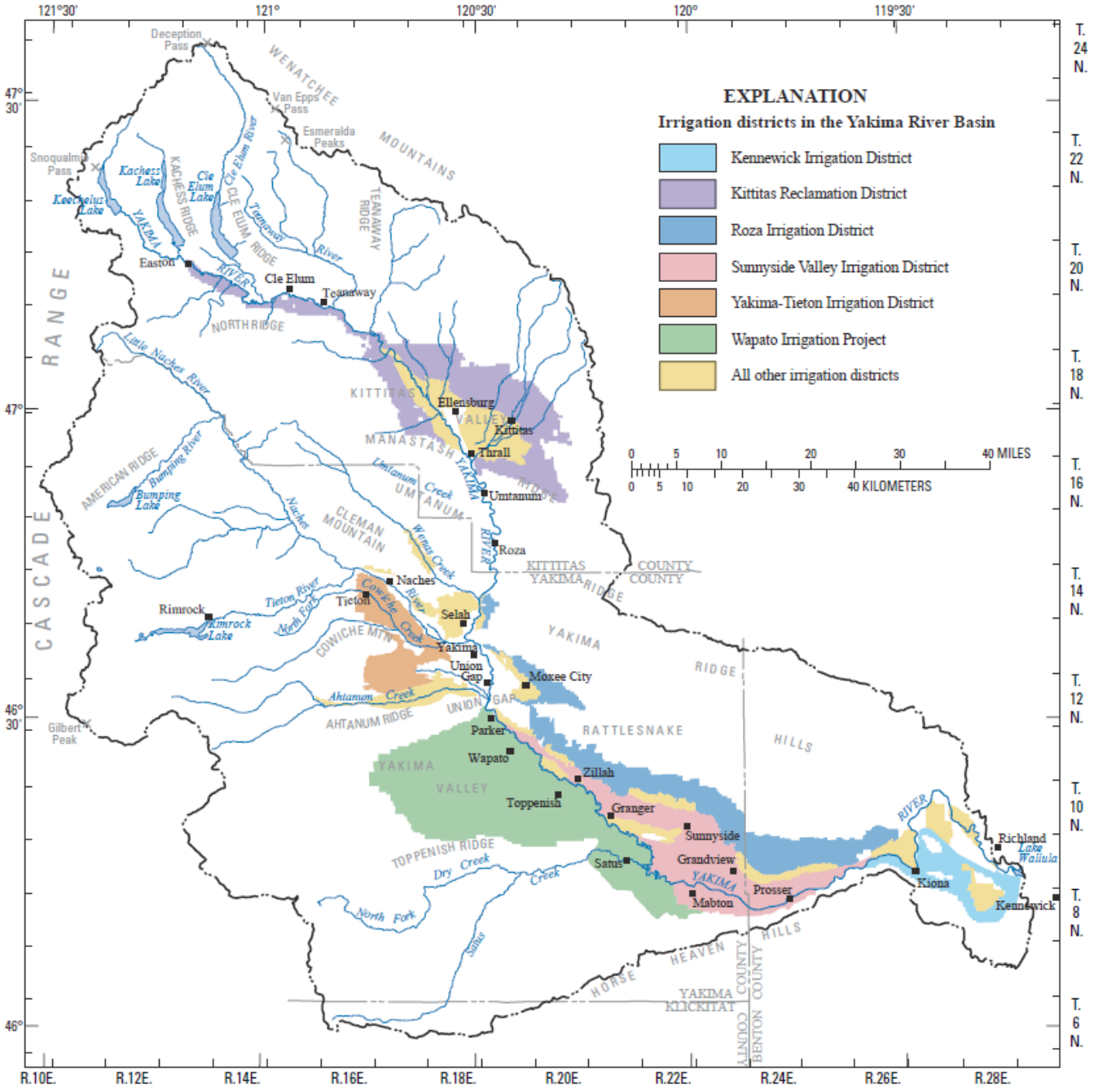


Figure 6. Surface-water irrigation districts, Yakima River Basin, Washington.

Summary

- Build the mound pre-storage control
- Use the stored groundwater post-storage control in lieu of reservoir releases
- Increase carryover storage