

MINE DEWATERING ISSUES SUMMARY

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LONE TREE PIT LAKE

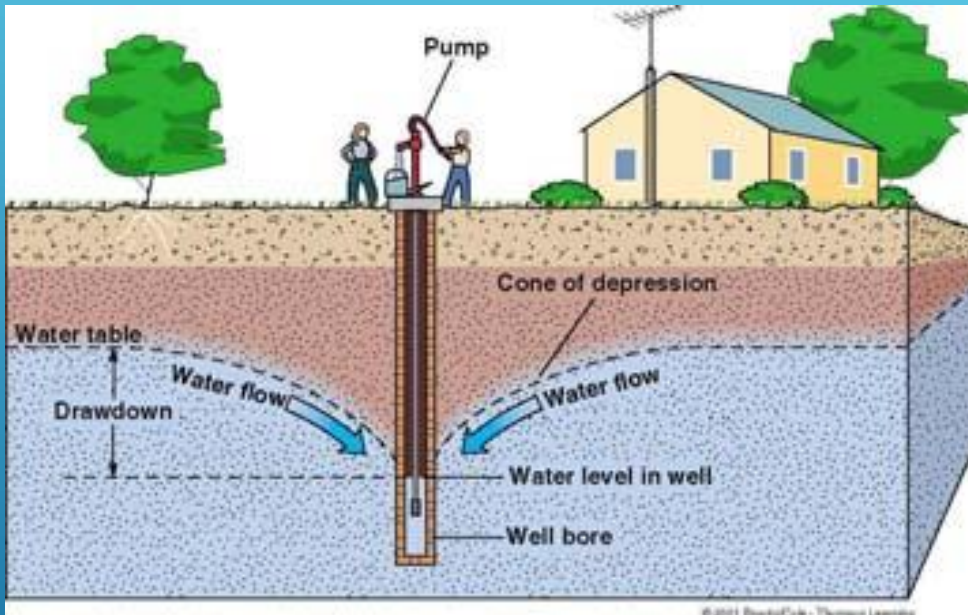
While this pit was being mined, it was kept dry by dewatering.

How did/does the dewatering affect river flows in the nearby Humboldt River?

Where does the water come from to replenish the groundwater deficit created by dewatering and the pit lake?

What about evaporation?

Consider this over seven large open pits in the Humboldt River basin.



DEFINITIONS

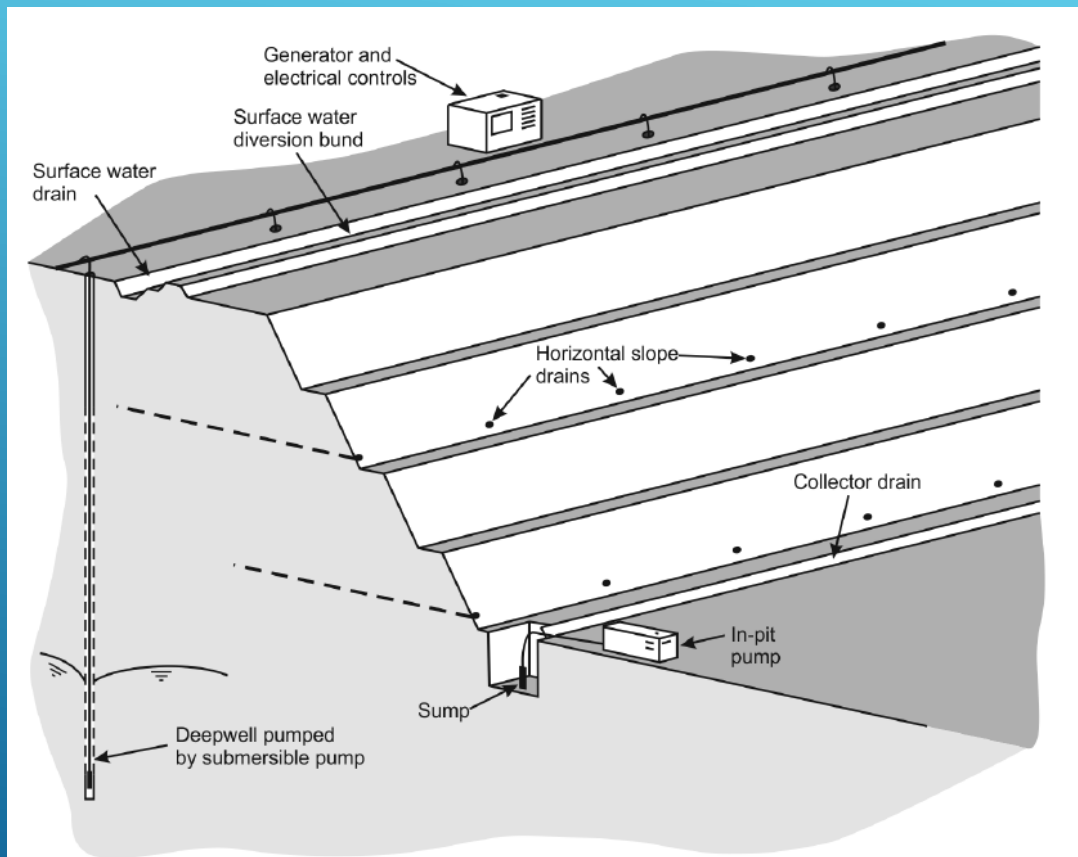
Pumping groundwater causes a drawdown in the water table whether for a small well or large open pit.

Water table: the point at which the ground is saturated

Drawdown: the amount the water is lowered by pumping, or dewatering.

Acre-foot: one foot of water over an acre, or 326,000 gallon.

Enough for one or two families of four.



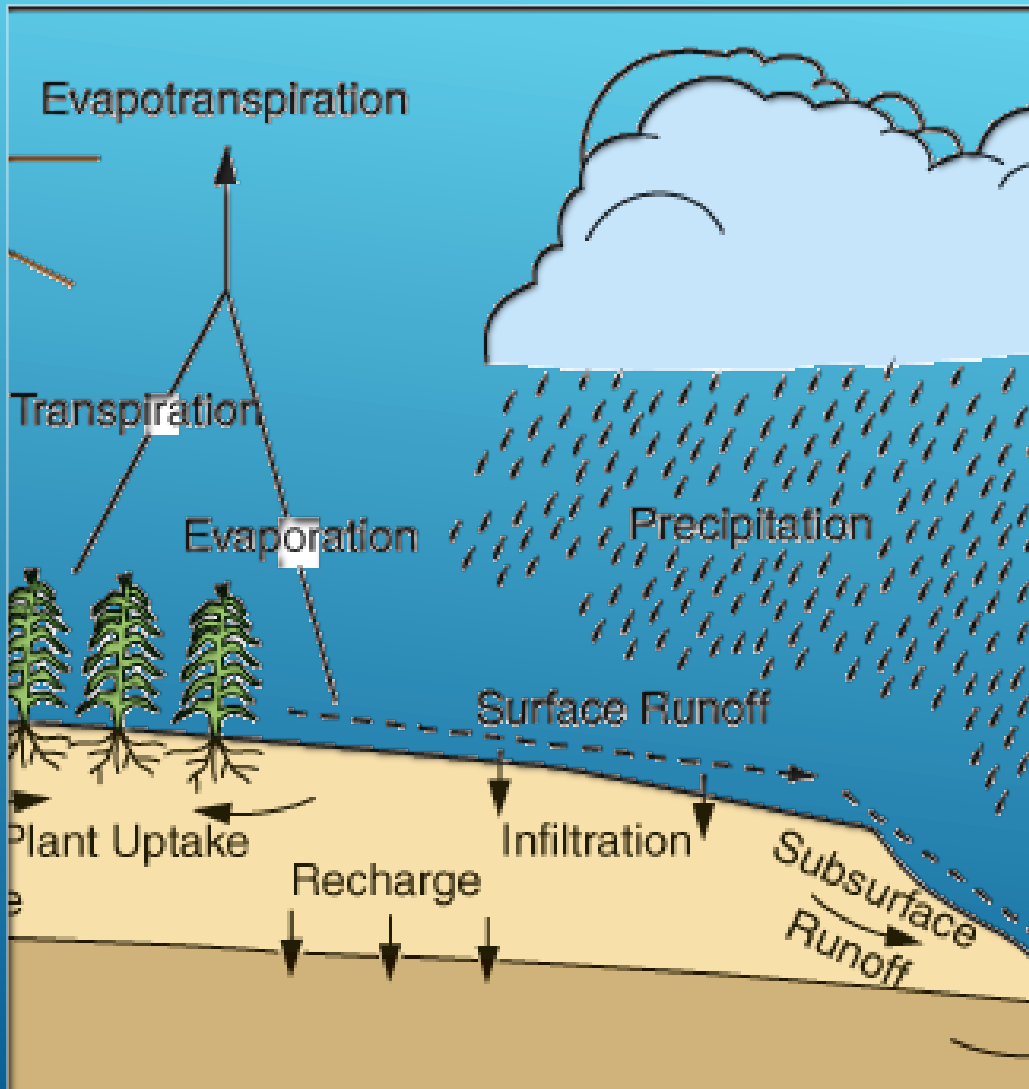
MINE DEWATERING TECHNIQUES

Pump from a sump in the pit

In pit wall drains

In the Humboldt River Basin, most mines used deep wells surrounding the pit.

Volumes measured in acre-feet = 326,000 gallons or 43560 cubic feet.

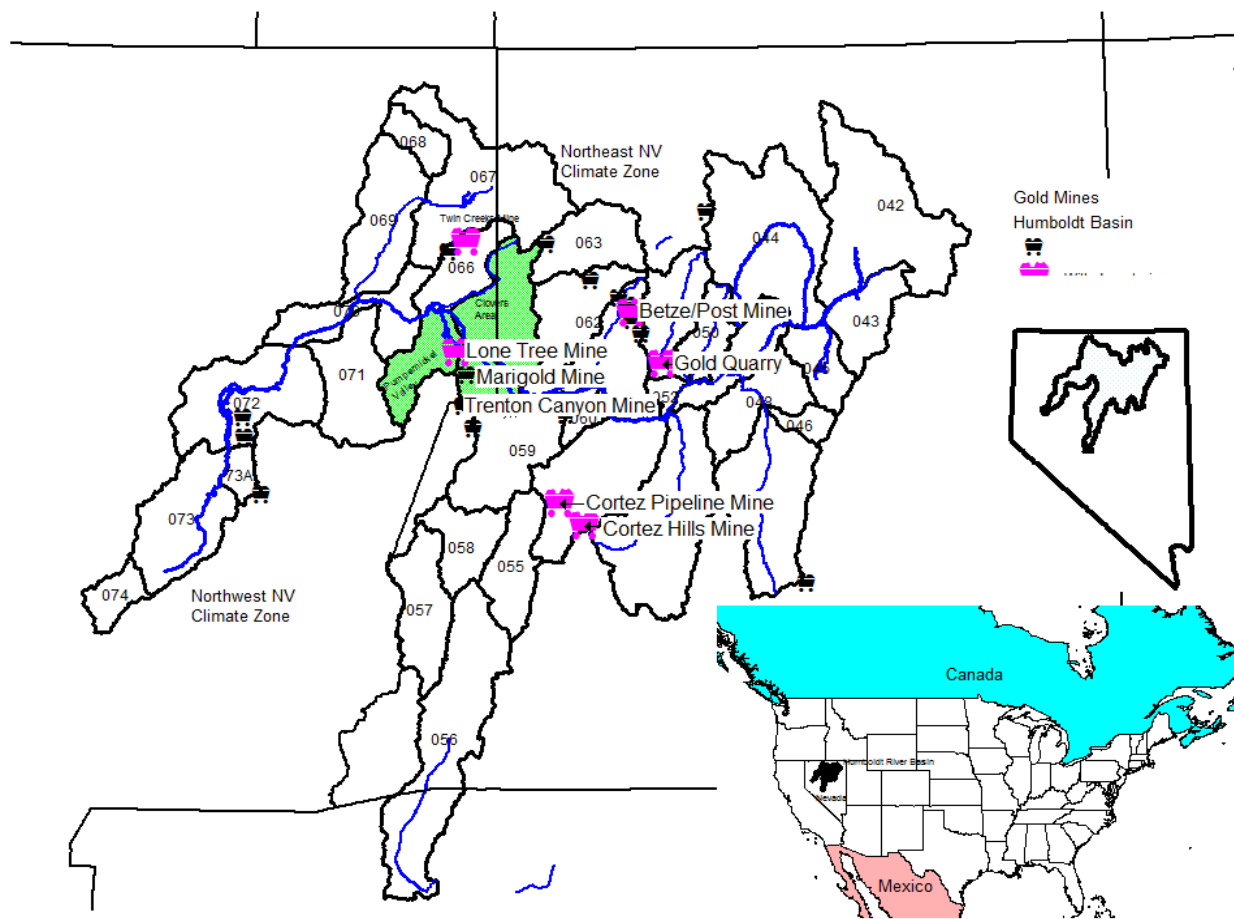


GROUNDWATER RECHARGE

Precipitation that percolates through the soil to the groundwater table

Recharge = Precipitation – runoff – evaporation – transpiration

At steady state, meaning no change in storage.



HUMBOLDT RIVER BASIN, NORTHERN NEVADA

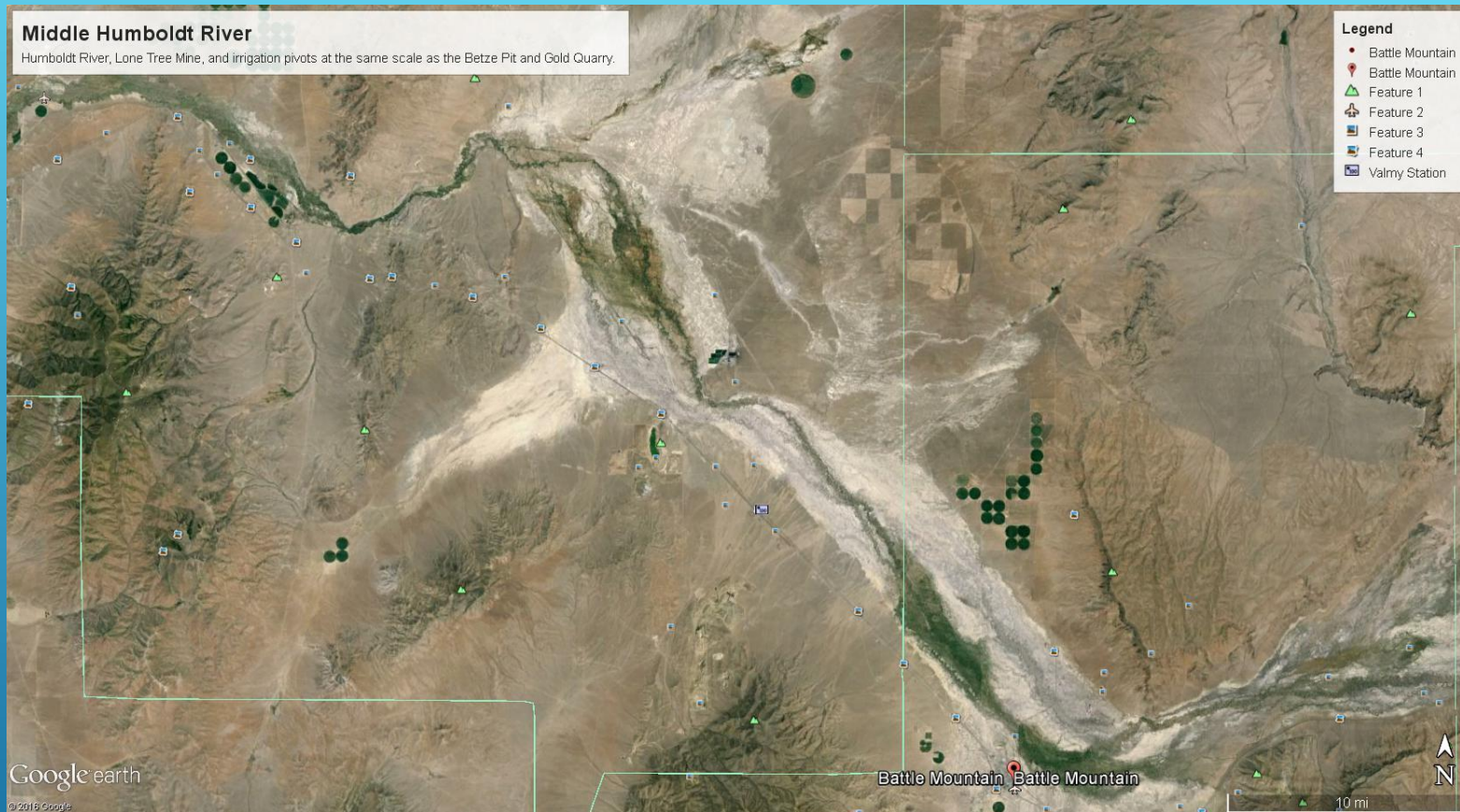
Very arid region

Internal drainage,
with flow east to
west

Avg flow 280,000
af/y

Avg recharge
233,000 af/y

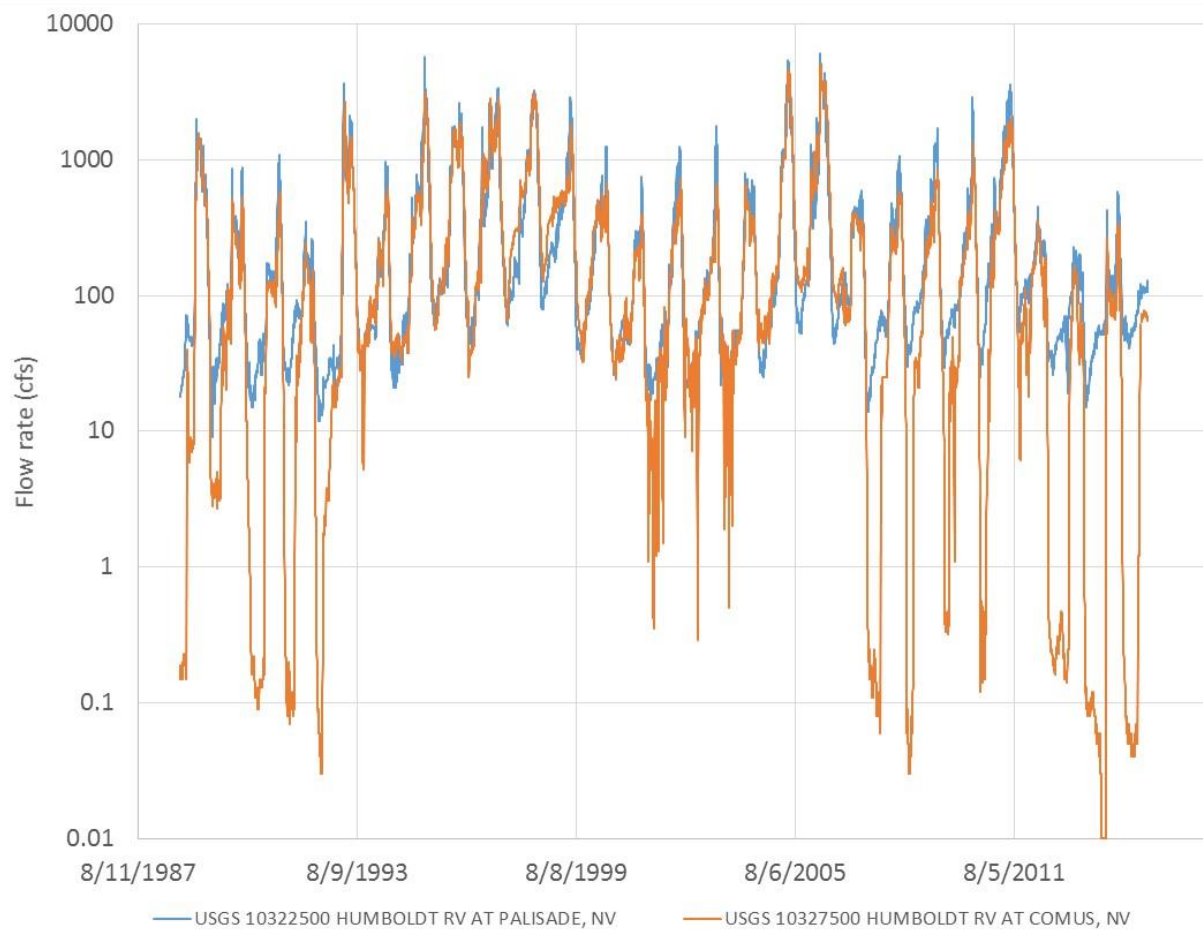
Irrigation is primary
use other than
mining



RIVER REACH FROM BATTLE
MOUNTAIN TO COMUS, 32 MILES

HUMBOLDT RIVER – GROUNDWATER SURFACE WATER INTERACTIONS?





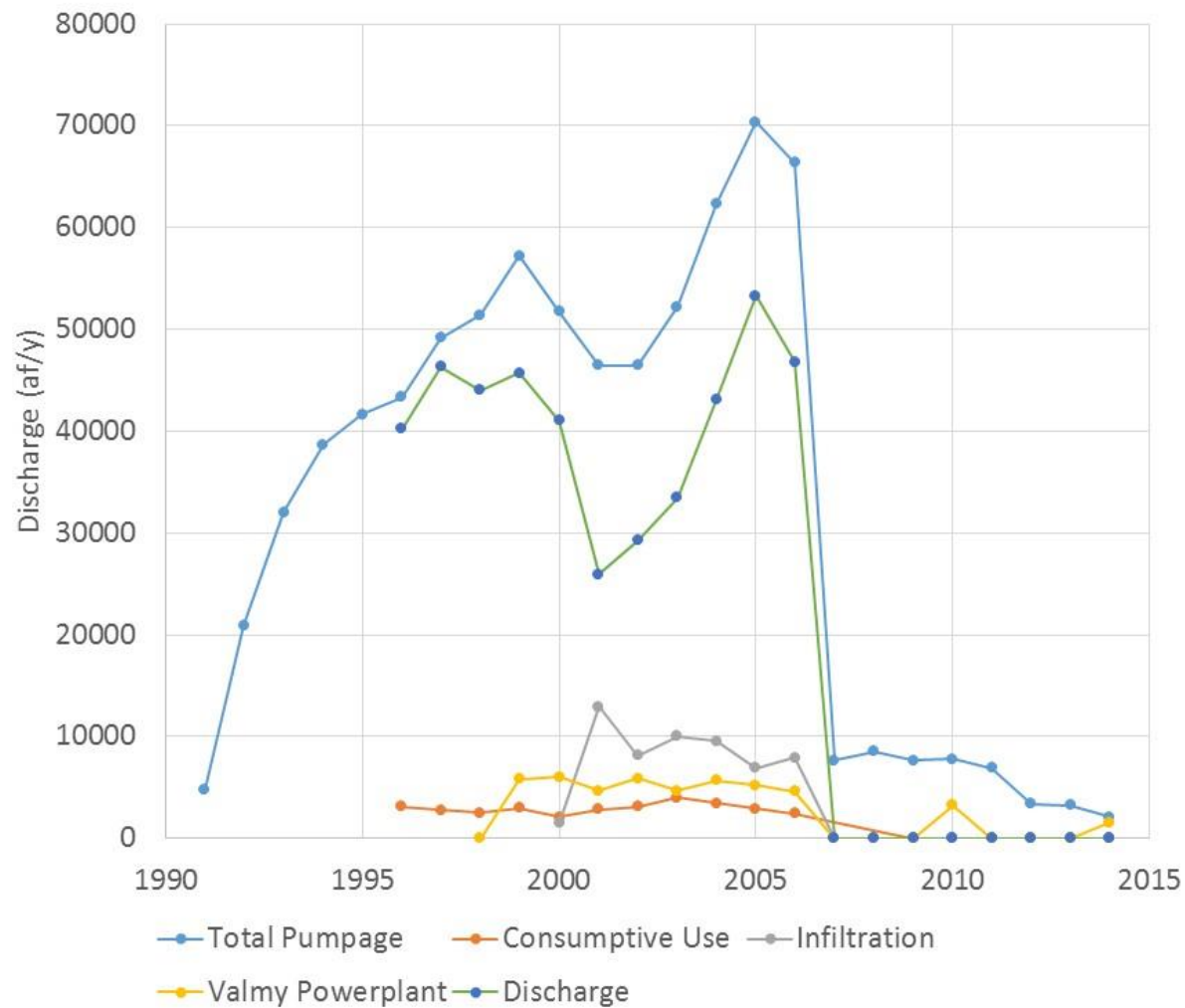
THREE WAYS DEWATERING CAUSES THE RIVER TO LOSE WATER

Dewatering = 3.9 million acre-feet since 1991;
deficit is difference between pumping and water put back into the ground

Pit lake = 1 million acre-feet

Evaporation = 10,000 af/y

Replenished from groundwater storage and by capturing natural discharge to rivers.



LONE TREE DEWATERING

1991-2007

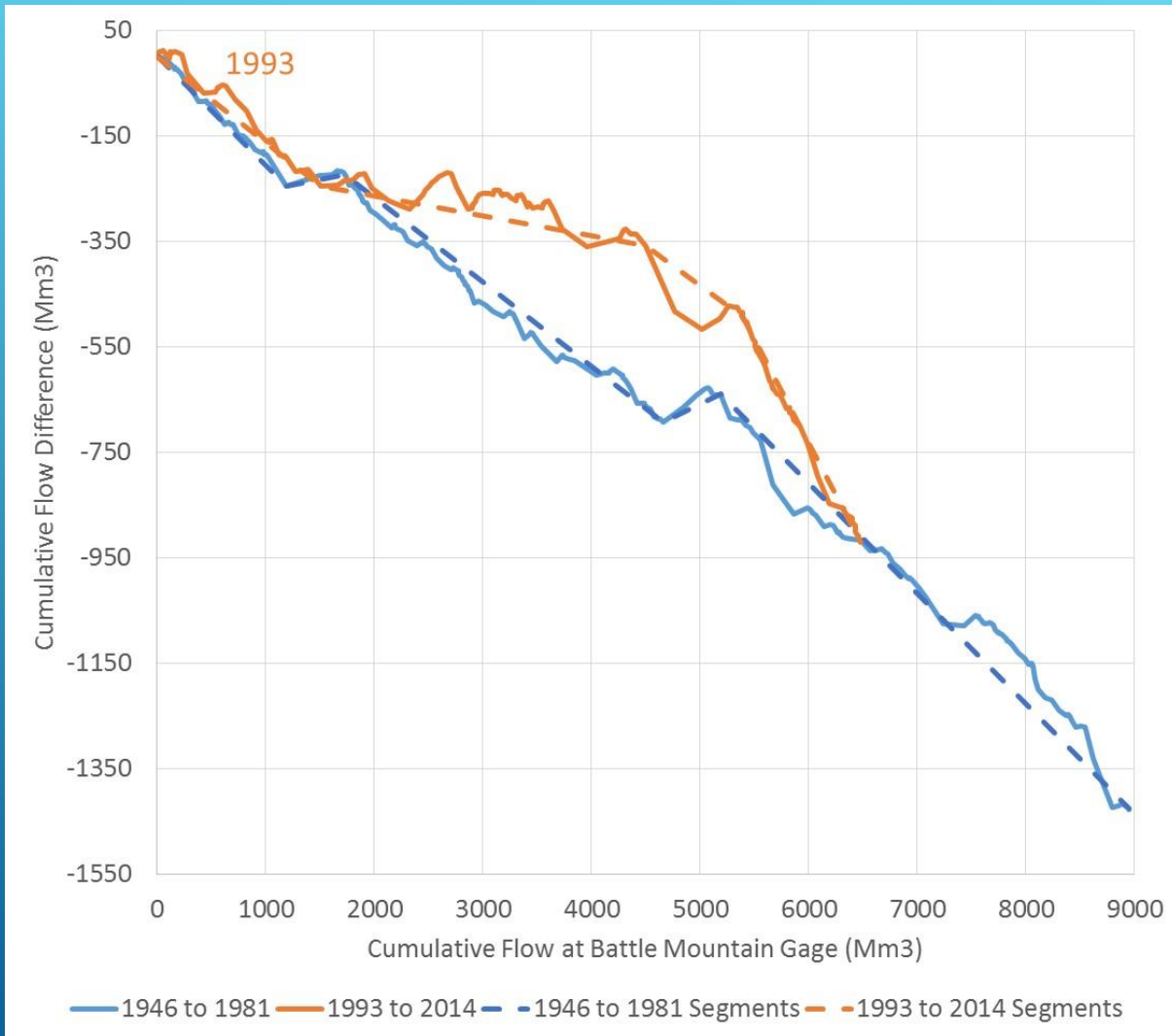
Highest rate about 70,000 af/y in 2005

Total is 780,000 af/y

Approximately 70% discharged to Humboldt River

Other uses at mine and Valmy Powerplant

About 10,000 af/y stored in basin through infiltration for five years



DOUBLE MASS CURVE

Graph of cumulative flow loss through reach versus cumulative flow entering reach.

Changing slope means changing conditions between the gages

Loss rate since 2007: 0.39

Loss rate 1970-81: 0.21

Net Additional Loss: 0.18

176,000 af in 8 years

22,000 af/year

Loss due to mine dewatering recovery is 8% of average annual flow or 18% of baseflow

- ▶ Mine dewatering at six mines has caused a large deficit in the groundwater and developing pit lakes adds an additional deficit.
- ▶ The total deficit equals up to 18 years of the total flow in the river or about 25 years of the total recharge.
- ▶ Replenishing the deficits has caused almost 180,000 af of flow to be lost to the Humboldt River since 2007 in the reach between Battle Mountain and Comus.
- ▶ Impacts to the river from the other mines depend on their distance from the river and the type of bedrock between the pit and river
- ▶ Most of the loss is due to water seeping from surface alluvium into underlying bedrock aquifers, based on water level hydrographs.
- ▶ More questions than answers

SUMMARY