BUREAU OF RECLAMATION

Klamath River Basin Revised Natural Flow Study

November 2 – 3, 2022
Stakeholder Workshop
Upper Klamath Basin Groundwater Flow Model (UKBGFM)
Reclamation slides

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Bureau of Reclamation nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

Estimating applied irrigation and deep percolation

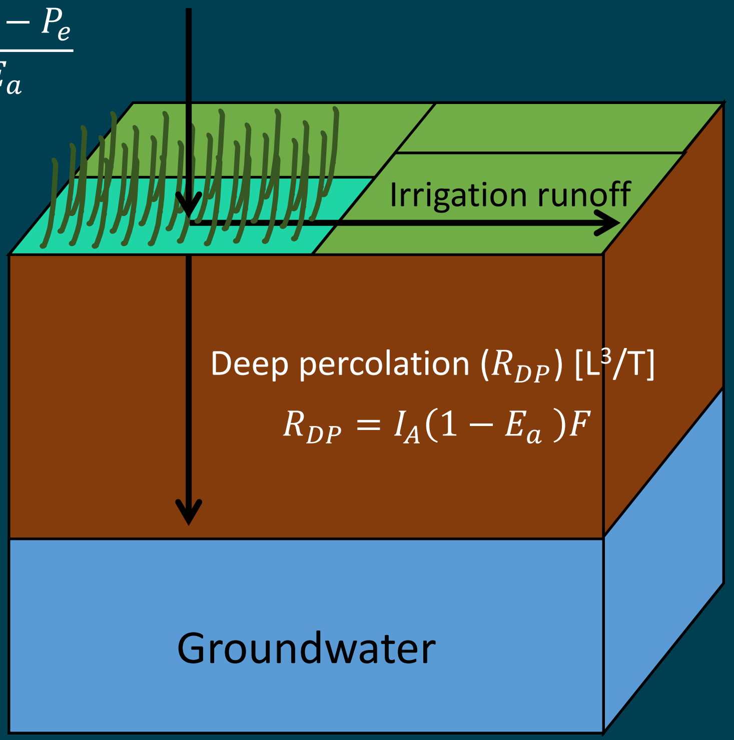
- Applied irrigation and deep percolation are calculated by field
- Assume net consumptive use ($ET_C - P_e$) is met by irrigation
- Applied irrigation accounts for application inefficiencies
- Irrigation efficiencies and fraction to deep percolation are based on irrigation types

Sprinkler pivot:	$E_a = 0.85$; $\mathrm{F} = 0.80$
Sprinkler other:	$E_a = 0.75$; $\mathrm{F} = 0.60$
Flood uncontrolled:	$E_a = 0.50$; $\mathrm{F} = 0.20$
Flood controlled:	$E_a = 0.65$; $\mathrm{F} = 0.40$
Micro irrigation:	$E_a = 0.85$; $\mathrm{F} = 0.90$

Values of E_a come from Howell, 2003. And values of F come from correspondence with Bill Cronin.

Applied irrigation (I_A) [L^3/T]

$$I_A = \frac{ET_C - P_e}{E_a}$$



ET_C Measured crop evapotranspiration [L^3/T]

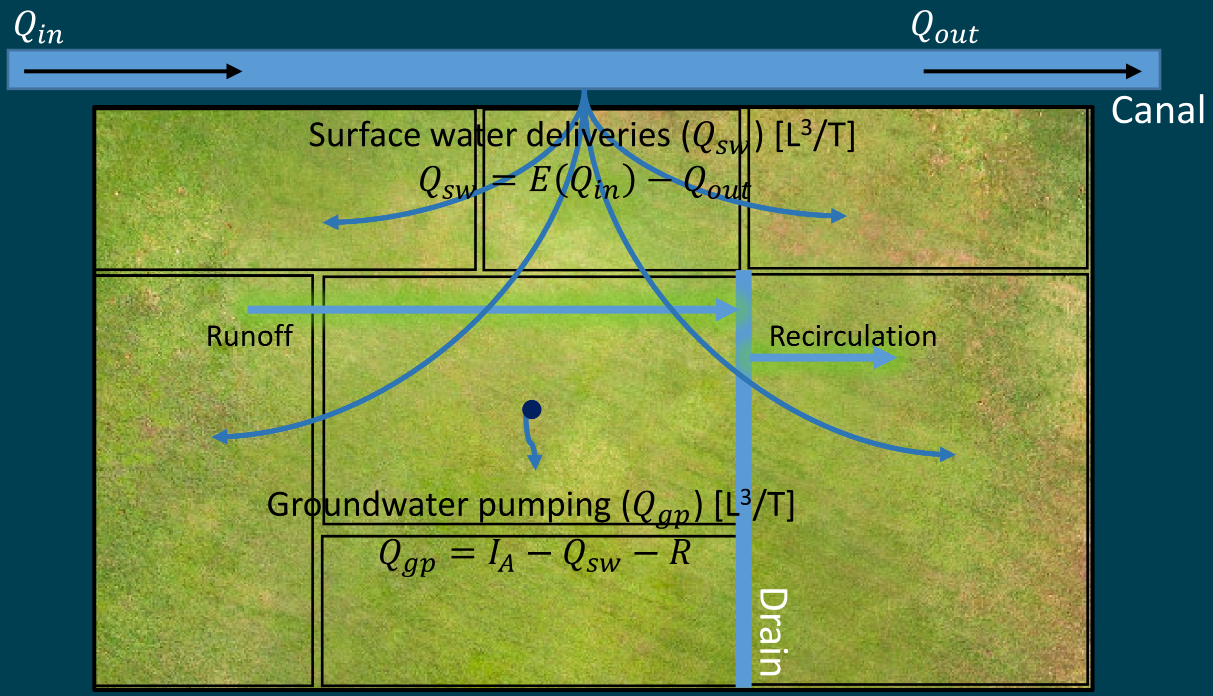
P_e Effective precipitation by field [L^3/T]

E_a Application efficiency [1]

F Fraction of water to deep percolation [1]

Estimating surface water deliveries and groundwater pumping

- Surface water deliveries are based on lumped irrigation districts where diversion inflows and return flows are measured
- Groundwater pumping needs by irrigation district are calculated as the applied irrigation not being met by surface water deliveries
- Because the overall project is very efficient, we use an estimated "reuse" term
  - Accounts for runoff from precipitation and irrigation
  - Accounts for recirculation as a fraction of inflows
  - Assumes pumping needs increased dramatically after 2001



E	Canal efficiency [1]
Q_{in}	Diversion inflows to the irrigation district [L^3/T]
Q_{out}	Return flows out of the district [L^3/T]
I_A	Applied irrigation [L^3/T]
R	Estimated reuse term [L^3/T]

Diversion data comes from various sources including irrigation district operations.

Estimating canal seepage

- Canal seepage is estimated for canals and laterals in the Project

Canal seepage (Q_S) [L^3/T]

$$Q_S = (1 - E)Q_{in}$$

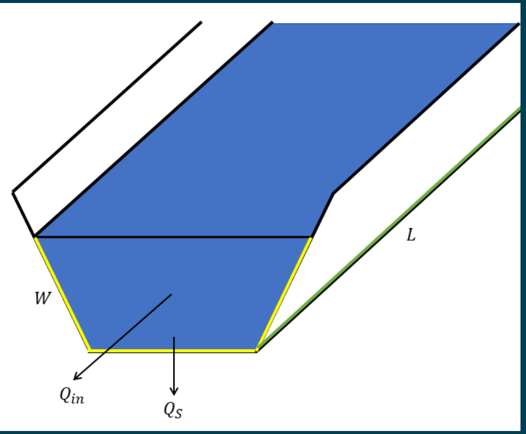
E	Canal efficiency [1]
Q_{in}	Diversion inflows to the irrigation district [L^3/T]

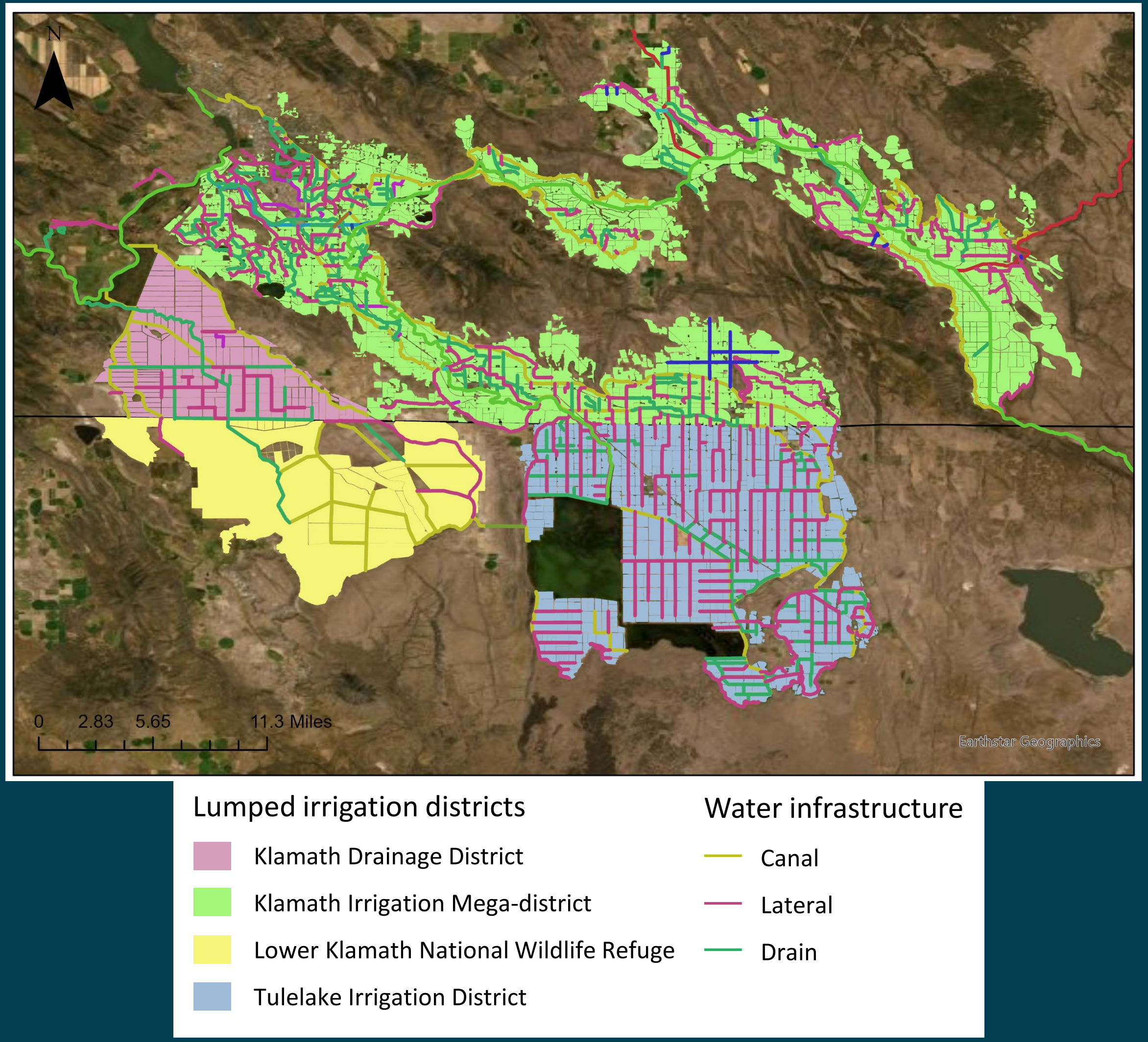
- Seepage rate depends on the canal and lateral geometry

Seepage Rate (S) [L/T]

$$S = \frac{Q_S}{L\,W}$$

Q_S	Canal seepage [L^3/T]
L	Wetted canal length [L]
W	Wetted canal perimeter [L]





Canal and lateral geometries retrieved estimated from Lidar cross sections

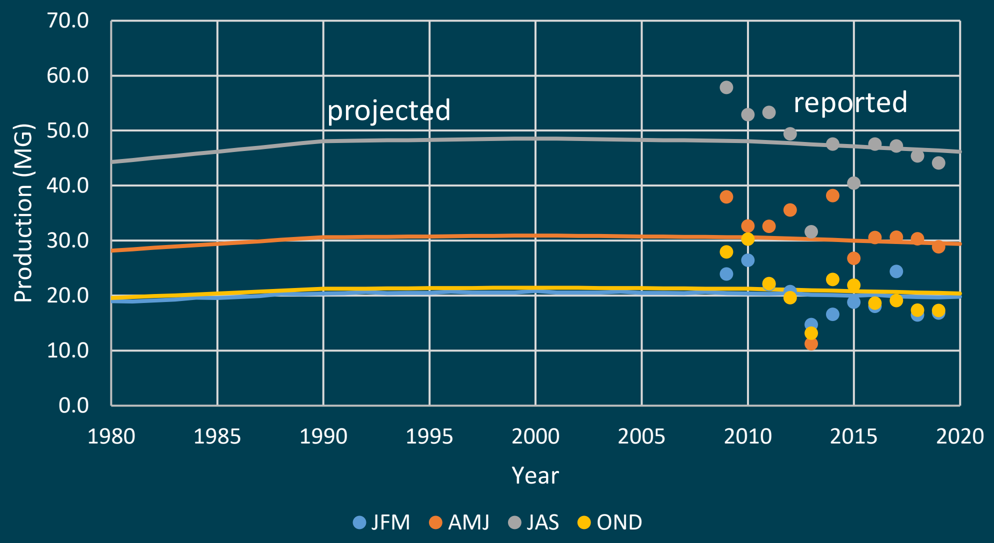
Estimating domestic, community, municipal and industrial pumping

1) Wells with population and monthly production data
- Interpolate population data for every year between census records
- Calculate average annual production
- Calculate average seasonal % of total production
- Calculate average per capita water use
- Calculate average seasonal production using per capita relationship

Example: Tulelake City in CA
- US Census population data from 1970, 1990, 2000, 2010, and 2020
- Production data 2009 – 2019
- Average public supply per capita use in Tulelake, CA is about 327 gal per person per day

Season	CA average seasonal % of total production
JFM	14.5
AMJ	28.9
JAS	41.8
OND	14.8

Example: Tulelake City estimated seasonal production



CA monthly production data retrieved from communication with CA Natural Resource Agency

Estimating Domestic Community Municipal and Industrial Pumping

2) Wells with production data but no population data

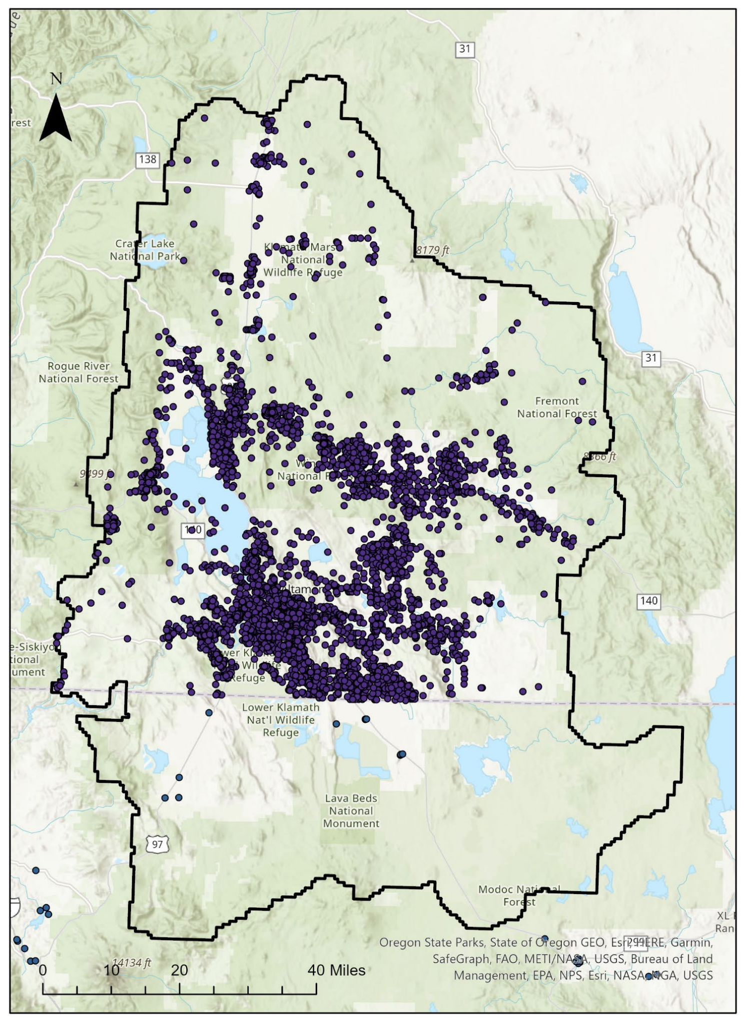
- Calculate average seasonal production

3) Wells with population data but no production data

- Use average per capita water use of known wells of the same type (domestic, community, municipal, or industrial)
- Calculate average annual production using population data and per capita water use relationship
- Calculate average seasonal production using average seasonal % of total production from known wells of the same type

4) Wells with no population or production data

- Use average seasonal production from known wells of the same type



CA public supply well location data comes from CA Natural Resource Agency and SGMA database

OR well location data and production data comes from OWRD Well Report Query Database and Water Use Query by Water User Database

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