Representation of Supplemental Groundwater Pumping for Mixed Source Lands, Wood River Valley Groundwater Flow Model

Preliminary data presented to Modeling Technical Advisory Committee

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OVERVIEW

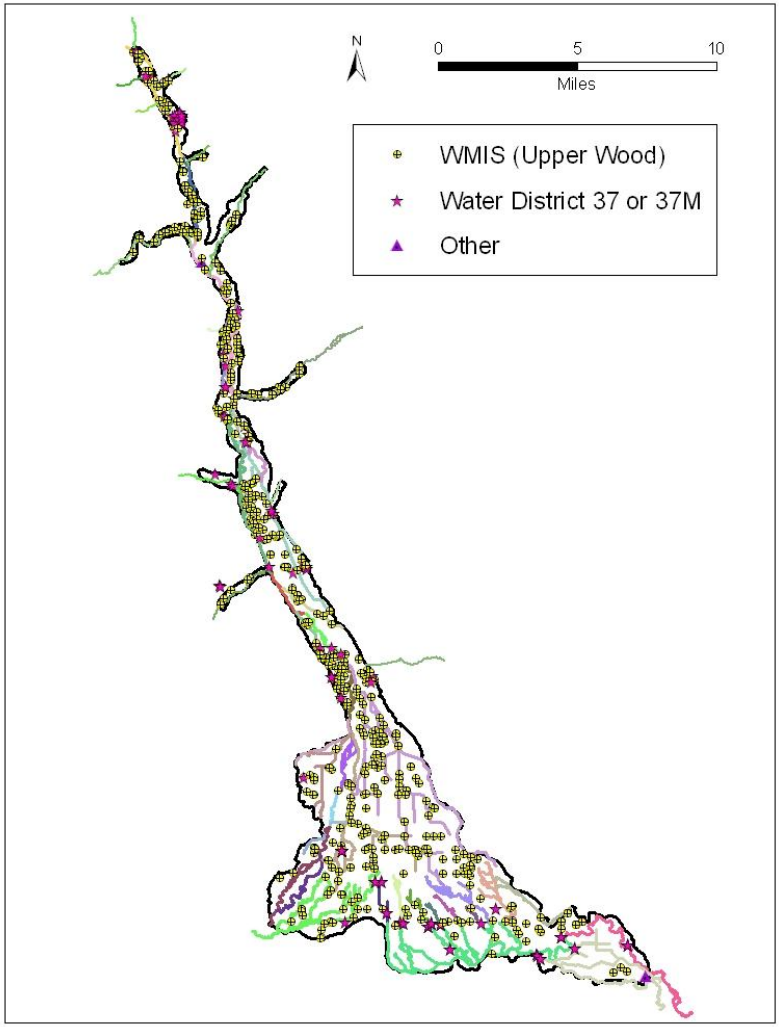
- Data availability
- Water rights on mixed source lands
- Example calculation of supplemental groundwater pumping volume
- Examples of proposed method for distributing supplemental pumping volume to wells
- Comparison with alternative method for distributing supplemental pumping volume to wells

Representation of groundwater pumping

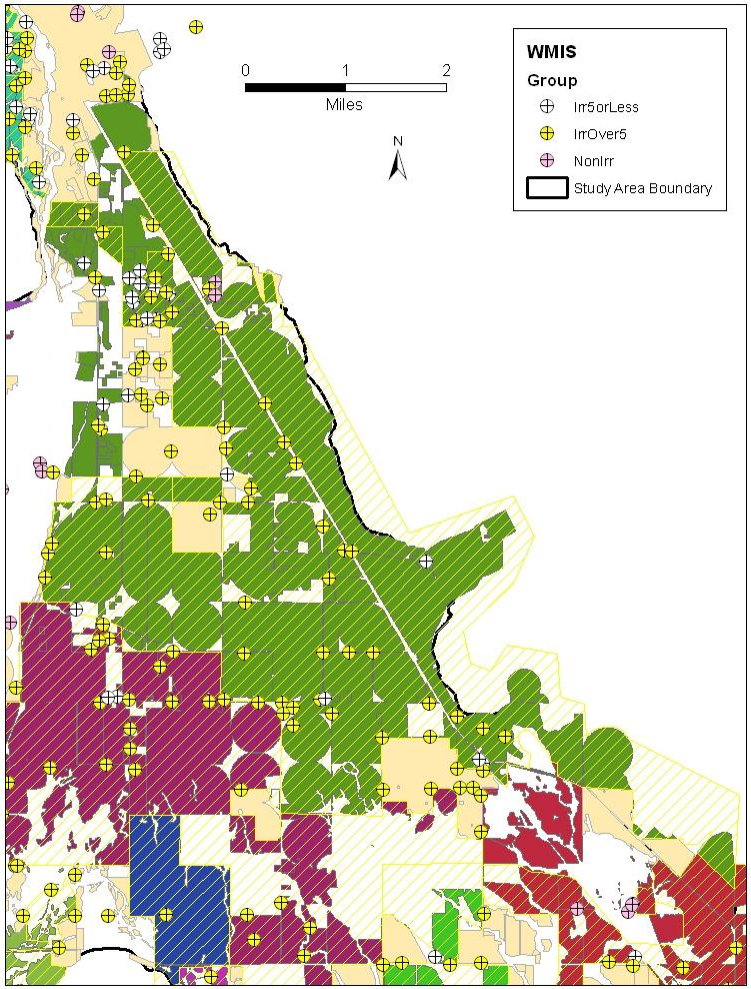
- Available data
  - Crop irrigation requirement (derived from ET, precipitation, and irrigated lands datasets)
  - Well logs (production layer(s))
  - Water rights (mixed source or groundwater only)
  - Surface water supply (for mixed source lands)
  - Watermaster records for exchange wells and a few others
- Future data collection
  - Non-irrigation uses >0.24 cfs ordered to install measuring devices by January 1, 2013
  - Irrigation >5 acres ordered to install measuring devices prior to 2013 irrigation season
  - Irrigation <5 acres ordered to install measuring devices prior to 2014 irrigation season
  - Data collected will likely be totalized irrigation season diversions

Future data collection

- 481 WMIS wells
- 69 wells/PODs in Water District 37/37M; 39 matched to wells with recent records
- 2 other



Estimating irrigation pumping for 1995-2010



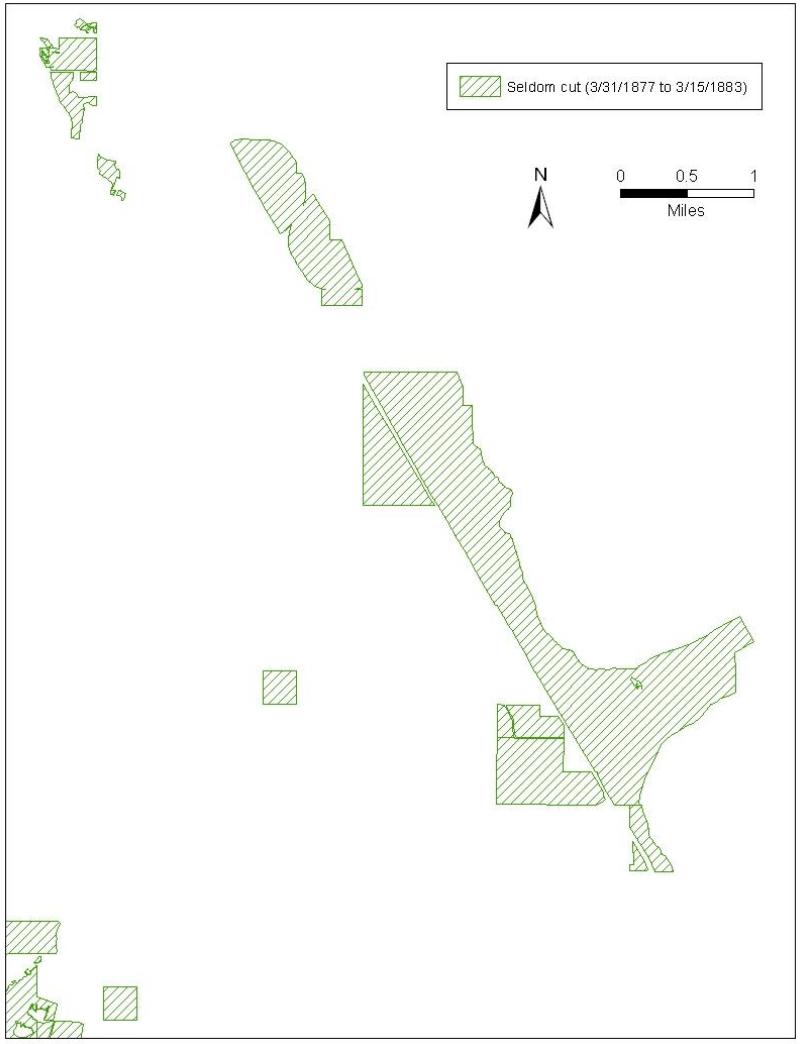
- Calculate primary pumping based on CIR and efficiency
- Calculate supplemental pumping needed based on surface water delivery, CIR, and efficiency
- Surface water delivery data available by entity (canal service area)
- How will calculated supplemental pumping volume for an entity be apportioned to supplemental wells?

Water rights on mixed source lands

- The right holder shall make full beneficial use of all surface water rights available to the right holder for irrigation of the lands authorized to be irrigated under this right. The right holder shall limit the diversion of ground water under this right to those times when the surface water supply is not available or the surface water supply is not reasonably sufficient to irrigate the place of use authorized under this right.
- Right Nos. 37-481B, 37-482G, 37-483B, 37-665K, 37-666J, 37-667N, 37-2625A, 37-2638, 37-2700, 37-21463 and 37-22155 are limited to the irrigation of a combined total of 1435.1 acres in a single irrigation season.
- Total combined delivery at the field headgates (for surface water rights) and diversion at the wellheads (for ground water rights) for this right along with water right nos. 37-481B, 37-482G, 37-483B, 37-665K, 37-666J, 37-667N, 37-2625A, 37-2638, 37-2700, 37-21463, and 37-22155 shall not exceed a total instantaneous rate of 28.7 cfs (which equates to 0.02 cfs per acre over the combined permissible places of use for these water rights totaling 1,435.1 acres).
- Total volume of water delivered to the field from this right along with water right nos. 37-481B, 37-482G, 37-483B, 37-665K, 37-666J, 37-667N, 37-2625A, 37-2638, 37-2700, 37-21463, and 37-22155 shall not exceed 5,022.9 acre-feet per year (which equates to 3.5 acre-feet per acre over the combined permissible places of use for these water rights totaling 1,435.1 acres).

- EXAMPLE: Conditions for groundwater right 37-2625A show that it is supplemental to seven Big Wood River water rights with different priority dates:
  - 8/1/1882
  - 8/1/1884
  - 10/15/1884
  - 6/12/1886
  - 6/15/1891
  - 8/1/1902
  - 4/1/1922

Mixed source lands and surface water right priority

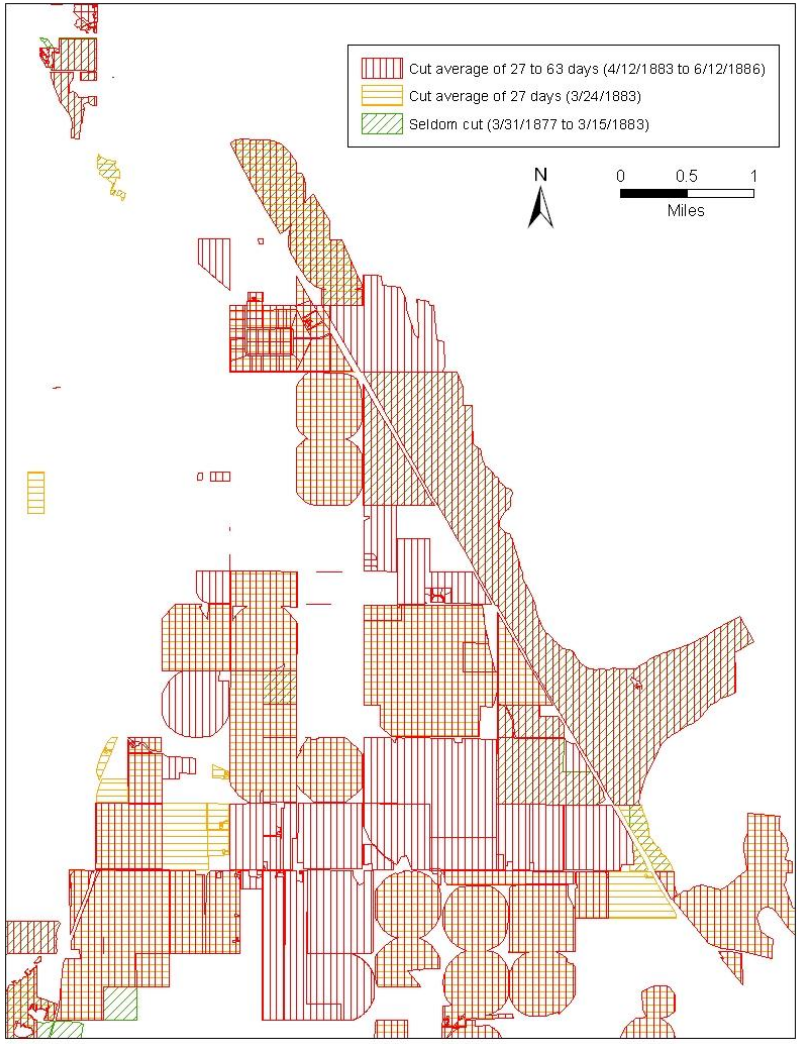


- Multiple surface water rights with range of priority dates are stacked on mixed source lands
- 1877 – 3/15/1883

Mixed source lands and surface water right priority

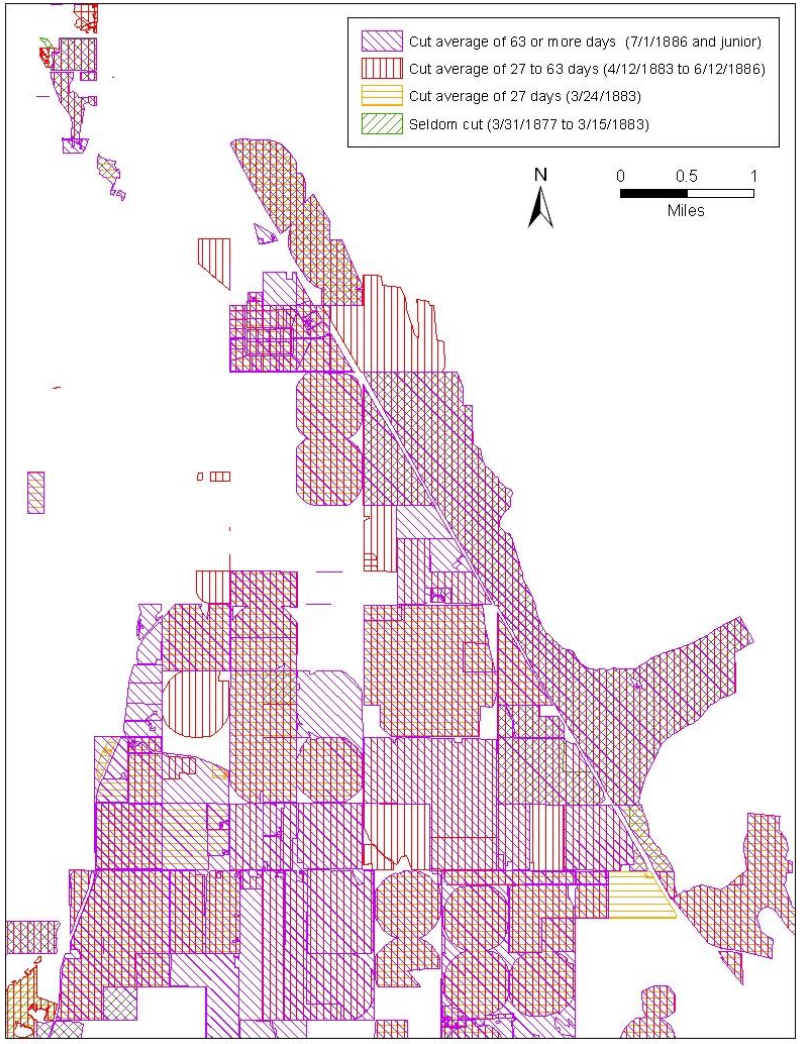
- Multiple surface water rights with range of priority dates are stacked on mixed source lands
- Add 3/24/1883

Mixed source lands and surface water right priority



- Multiple surface water rights with range of priority dates are stacked on mixed source lands
- Add 4/12/1883 – 6/12/1886

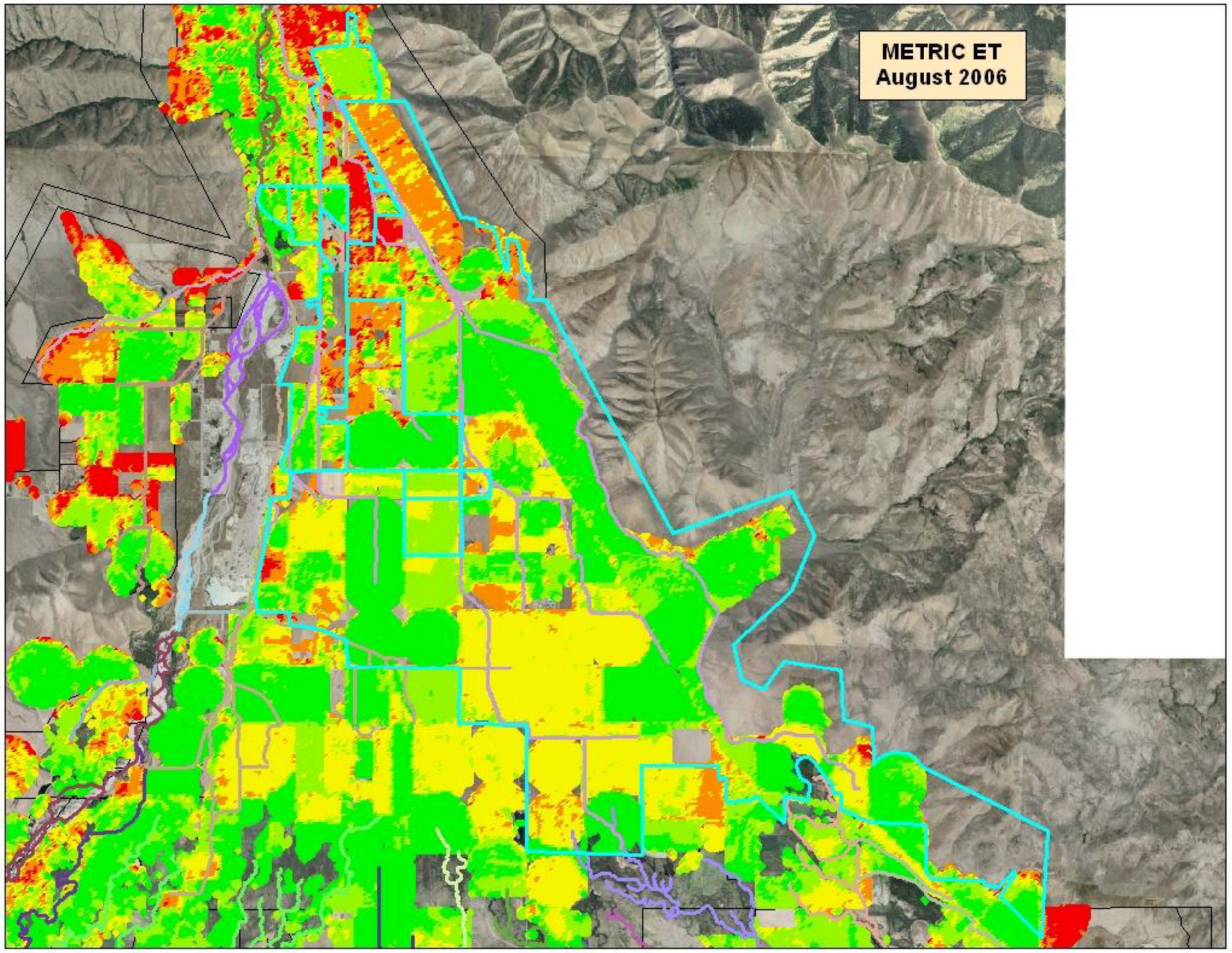
Mixed source lands and surface water right priority



- Multiple surface water rights with range of priority dates are stacked on mixed source lands
- Add 7/1/1886 and junior

Example

- District canal service area
- Stress period August 2006
- METRIC ET gives us ET within service area
- Watermaster records give us surface water diverted at head of canal

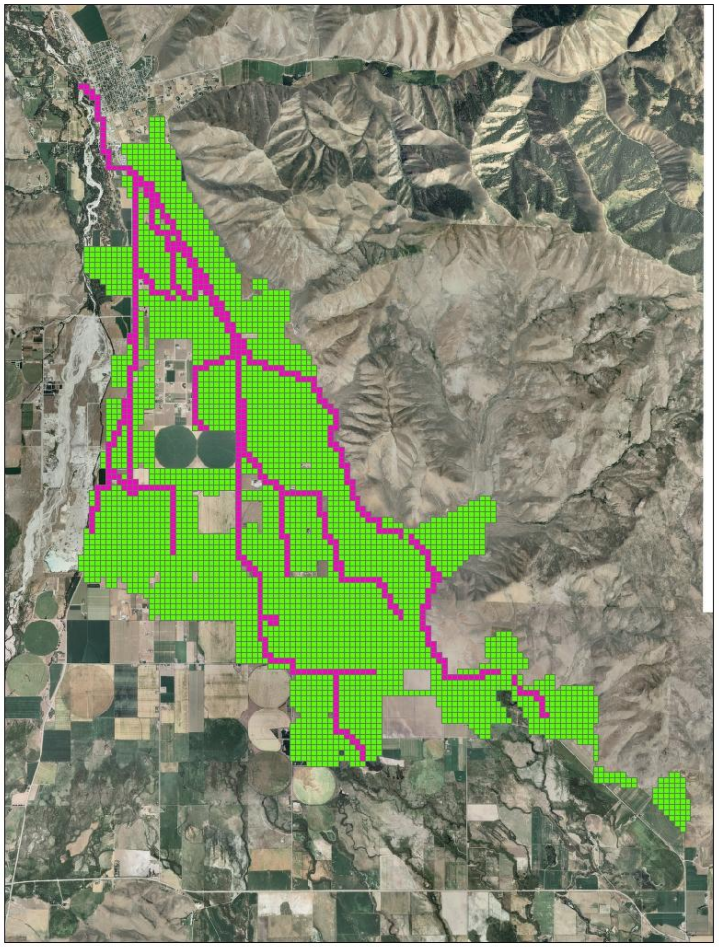


Example: District, August 2006

- ET on SW only lands = 285 AF; CIR = 281 AF
- ET on mixed source lands = 3,736 AF; CIR = 3700 AF
- SW diversion = 8,440 AF
- Canal seepage = 8,440 AF * 0.6 = 5,064 AF
- 3,376 AF delivered to field headgates
- With irrigation efficiency of 0.8, 352 AF needed for SW only lands
- 3,024 AF remaining for mixed source lands will meet 2,419 AF of ET
- 1,601 AF of groundwater pumping needed to meet additional 1,281 AF of ET on mixed source lands

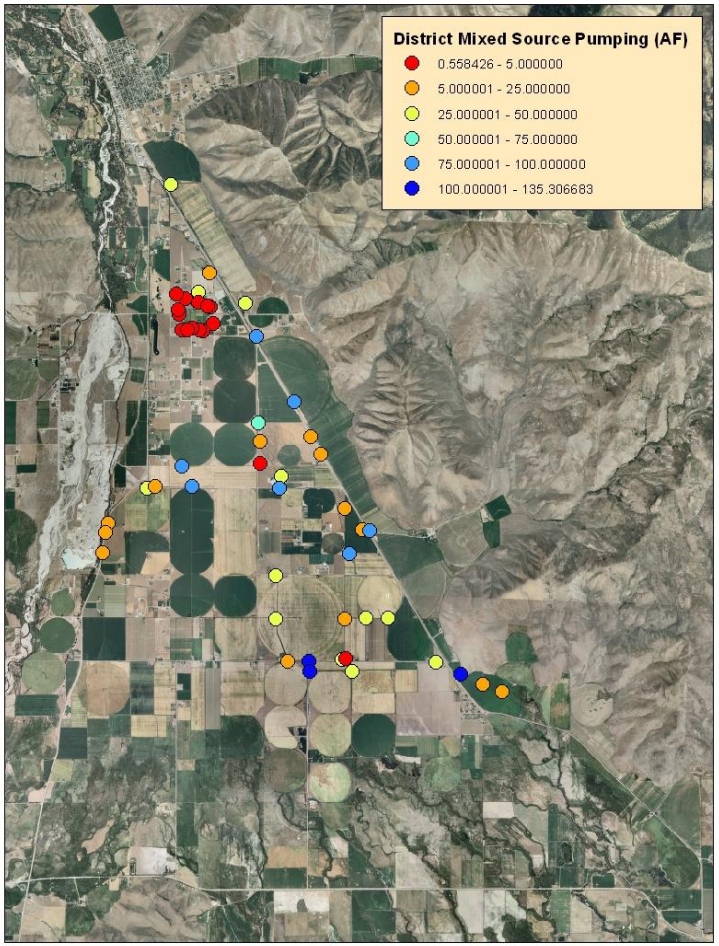
Example: District, August 2006

- 5,064 AF of canal seepage applied to model cells intersected by District canals
- 20% of field headgate delivery & groundwater pumping volume applied as recharge in model cells intersected by irrigated lands (995 AF)
- Recharge applied to model layer 1



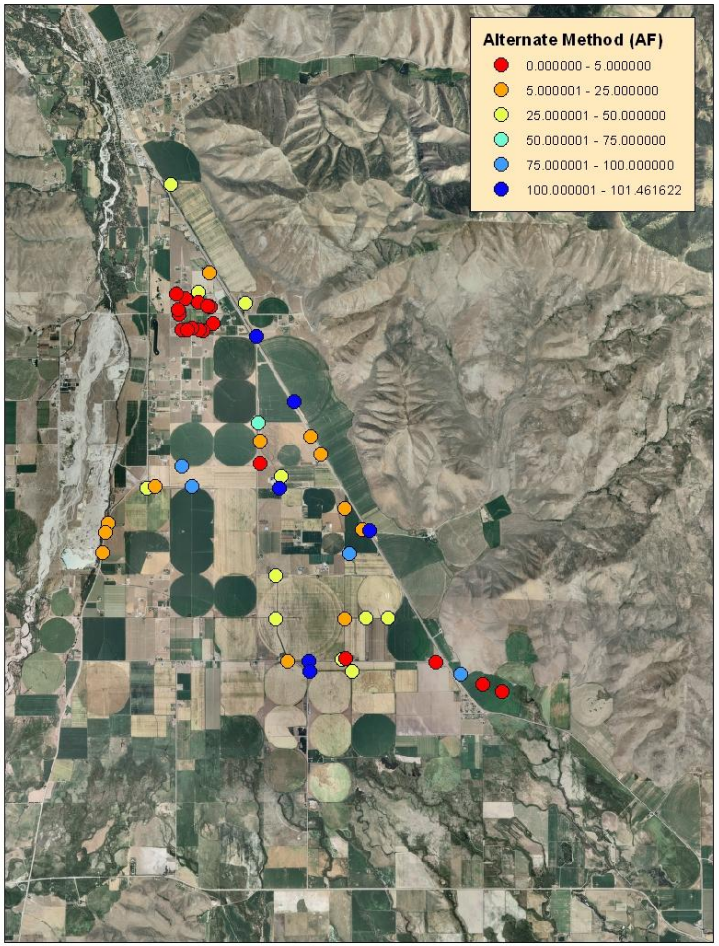
Example: District, August 2006

- 1,601 AF of GW pumping applied at supplemental well PODs
- Well PODs linked to water measurement IDs (WMIS) to facilitate use of future measurements
- Historic pumping distribution estimated from ratio of water right diversion rates x 1,601 AF



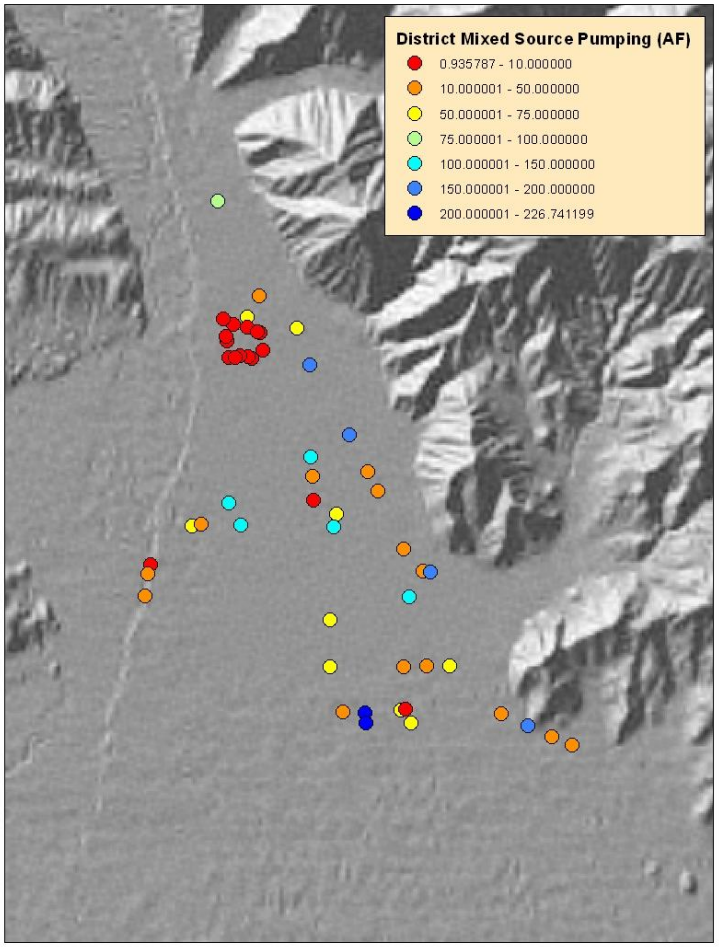
Alternative Example: District, August 2006

- Alternative analysis suggested by Brockway Engineering: apportion pumping based on priority cut date, and priority date and diversion rate of associated surface water rights
  - Query water rights database for combined limits language and tabulate data for each associated surface water right
  - For each month, calculate ratio of surface water right diversion rates junior to priority cut date on 16th of month
  - Multiply ratio calculated for each month by groundwater irrigation diversion rate, then calculate ratio of total pumping within District mixed source lands for each POD
- Results are still an estimate
- Most wells are associated with a wide range of surface water right priority dates
- For August 2006 (4/3/1884 priority cut), this method changes the spatial distribution of approximately 20% of the 1601 AF. Changes at individual wells ranged from -33 AF to +17 AF.
- Priority cut dates between 1884 and 1885 would apply to 12 out of 96 irrigation season stress periods



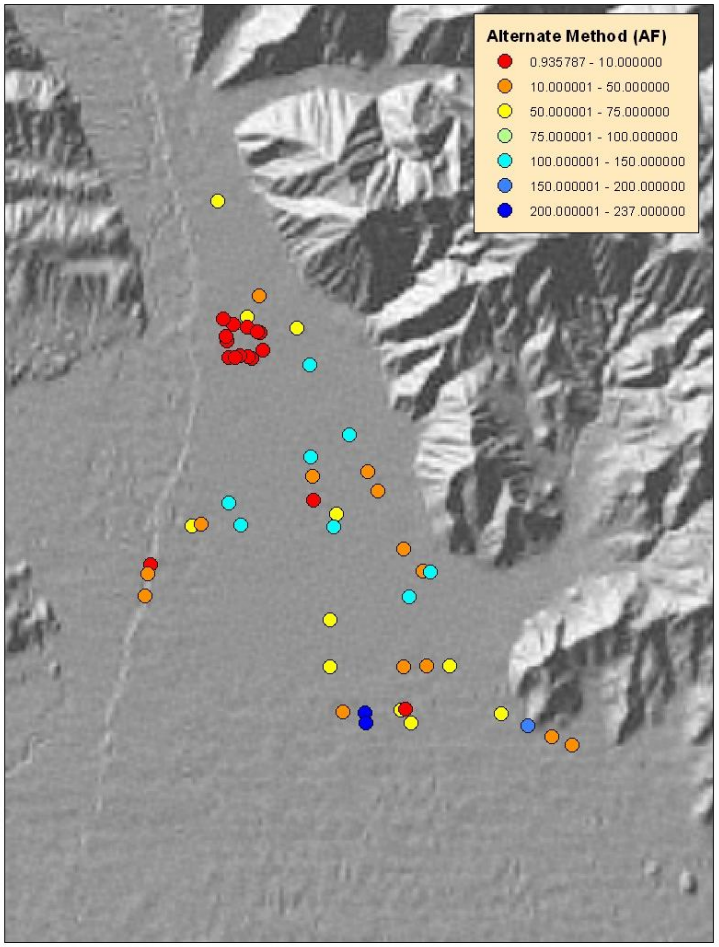
Example: District, August 2000

- 2,608 AF of GW pumping applied at well PODs within mixed source lands
- Well PODs linked to water measurement IDs to facilitate use of future measurements
- Historic pumping distribution estimated from ratio of water right diversion rates x 2,608 AF



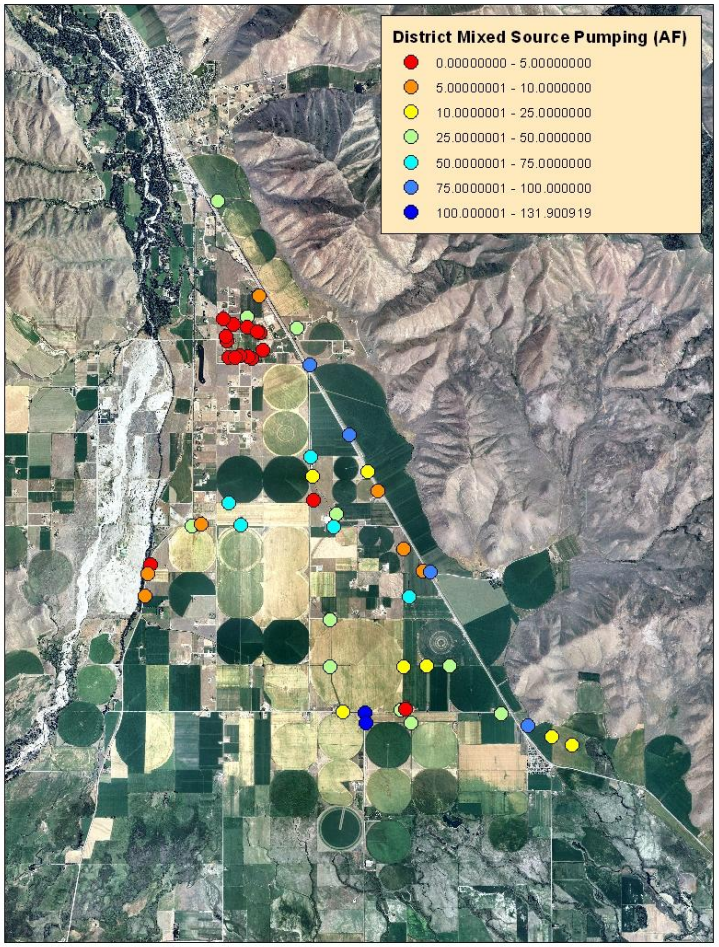
Alternative Example: District, August 2000

- For August 2000 (3/24/1883 priority cut), the alterative method changes the spatial distribution of approximately 5% of the 2608 AF. Changes at individual wells ranged from -15 AF to +8 AF.
- Priority cut dates between 1882 and 1883 would apply to 20 out of 96 irrigation season stress periods
- The largest volumes of groundwater pumping occur during the earliest priority cut dates. At these times, the proposed method and alternative method have a very similar spatial distribution.



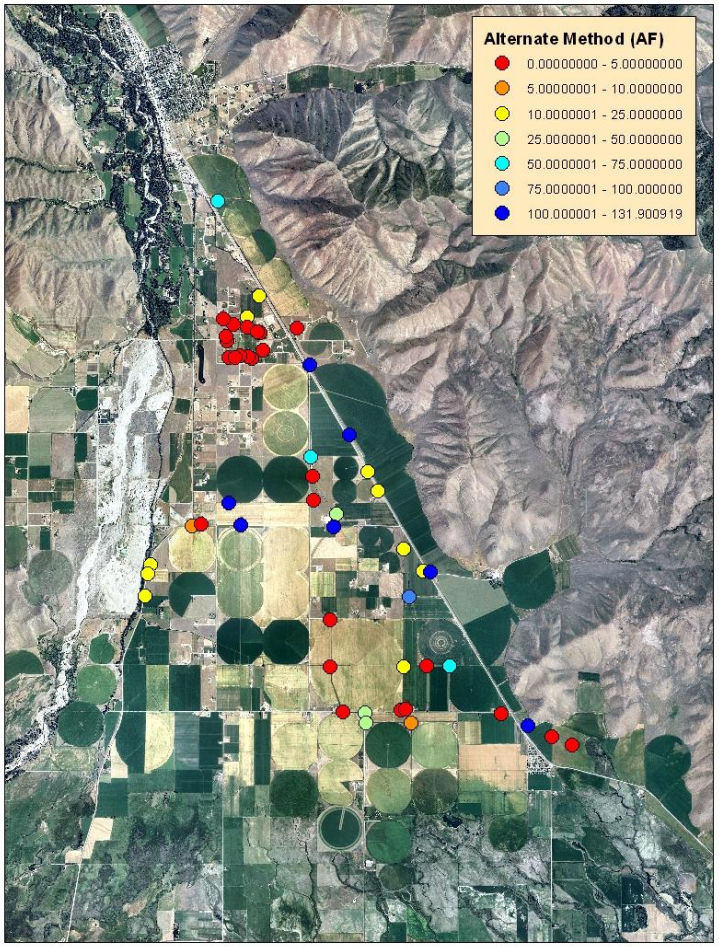
Example: District, July 2008

- 1,418 AF of GW pumping applied at well PODs within mixed source lands
- Well PODs linked to water measurement IDs to facilitate use of future measurements
- Historic pumping distribution estimated from ratio of water right diversion rates x 1,418 AF



Alternative Example: District, July 2008

- For July 2008 (6/12/1886 priority cut), th e alternative method changes the spatial distribution of approximately 69% of the 1418 AF. Changes at individual wells ranged from -90 AF to +56 AF.
- Priority cut dates between 1886 and 1892 would apply to 7 out of 96 irrigation season stress periods.



Comparison of methods for apportioning supplemental pumping

- 192 monthly stress periods, 96 during irrigation season
- No priority cut for 52 stress periods
- Priority cut 1921-1936, 5 stress periods
- Priority cut 1886-1892, 7 stress periods
- Priority cut 1884-1885, 12 stress periods
- Priority cut 1883-1884, 20 stress periods
- Quantity of groundwater applied to lands within irrigation entity is identical for either method
- Apportionment method only results in difference in spatial distribution of pumping for limited number of model stress periods
- Both methods result in very similar spatial distribution for earlier priority cut dates, which are the stress periods with the most supplemental groundwater use
- Largest differences in spatial distribution occur during a limited number of model stress periods
- Both methods are an estimate of pumping, no records of true value

Conclusions

- Use Watermaster records when and where available
- For wells without records, calculate supplemental pumping needed for mixed source lands using monthly surface water diversions and CIR
  - Canal seepage assumed to be 60% for District, Baseline, & Kilpatrick/Iden canal systems; 25% for Hiawatha, 10% for other canals
  - Efficiency assumed to be 80%
  - Headgate deliveries to surface water only lands = CIR_{sw}/80%
  - Supplemental groundwater pumping = CIR_{mixed}/80% -(Diversions*(1-CanalSeepage) - CIR_{sw}/80%) – WM GW Diversions
- Apply incidental recharge (20% of headgate deliveries + 20% of supplemental pumping) at irrigated lands within entity.
- Extract pumping at supplemental groundwater PODs.
- Discuss proposed and alternative methods for apportioning supplemental pumping between PODs.