Use of Response Functions to Administer Water Rights

AWSE Spring Meeting
Salt Lake City, Utah
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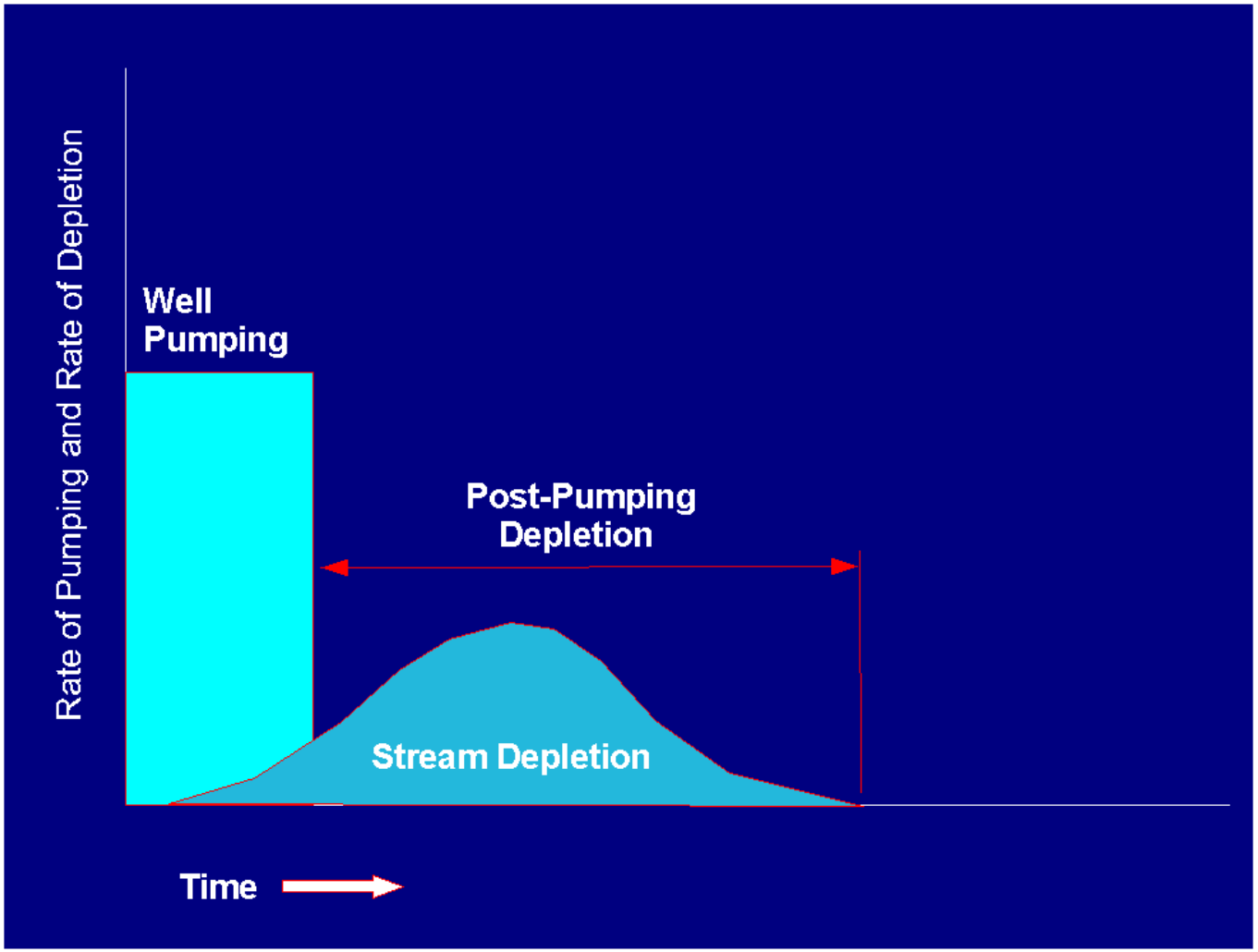
Division of Water Resources
Department of Natural Resources

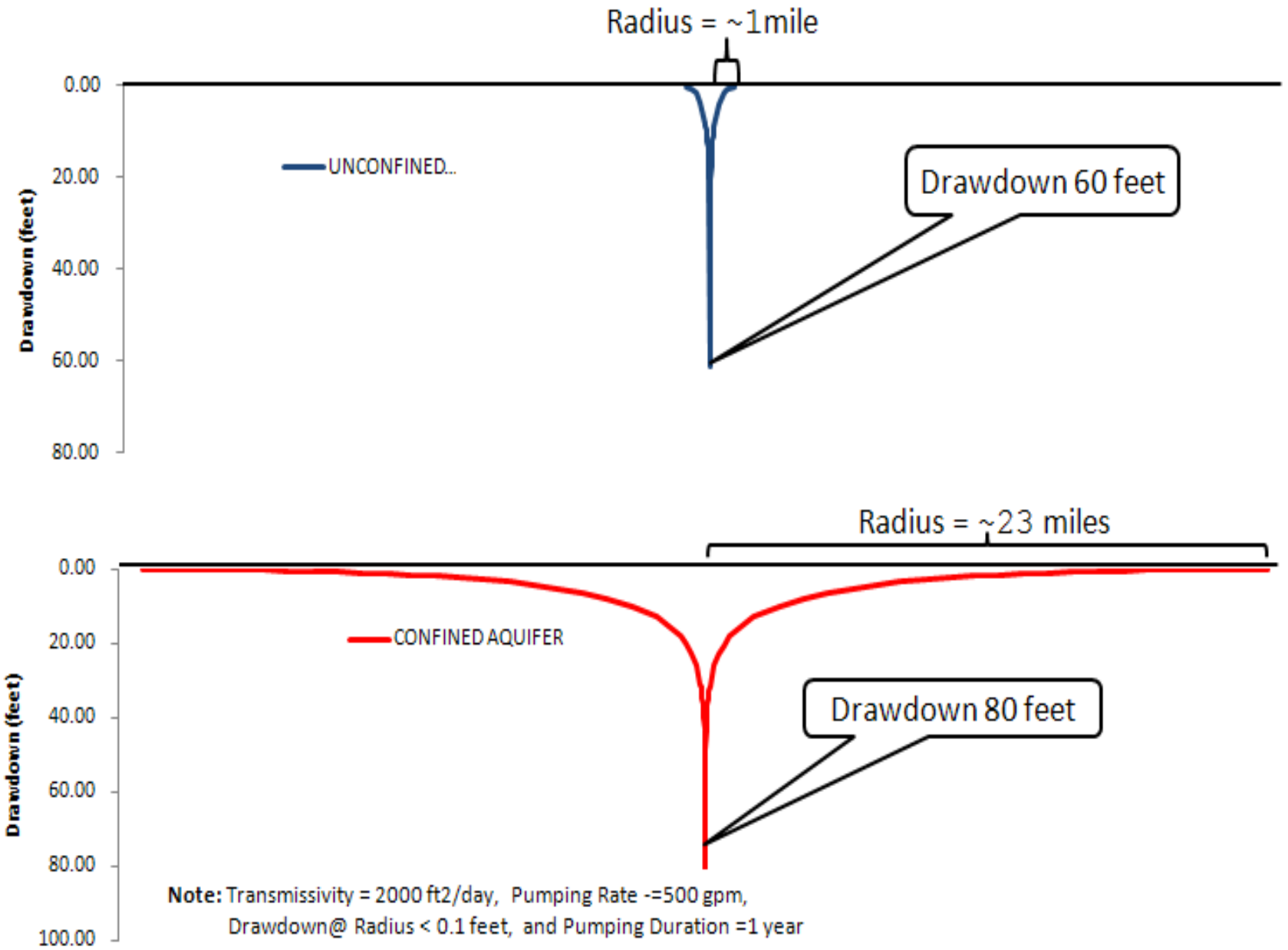
Integrating Groundwater and Surface Water Administration

- Water Admin: Daily on/off of water rights
- Well depletions impact streams
- Can't directly measure depletions so use model to determine impact:
  - Glover/AWAS/Finite Difference Model
- Simple system = simple model
- Complex system = complex model
  - More complex makes prediction difficult.
  - Use RF to distill historic results to predict future

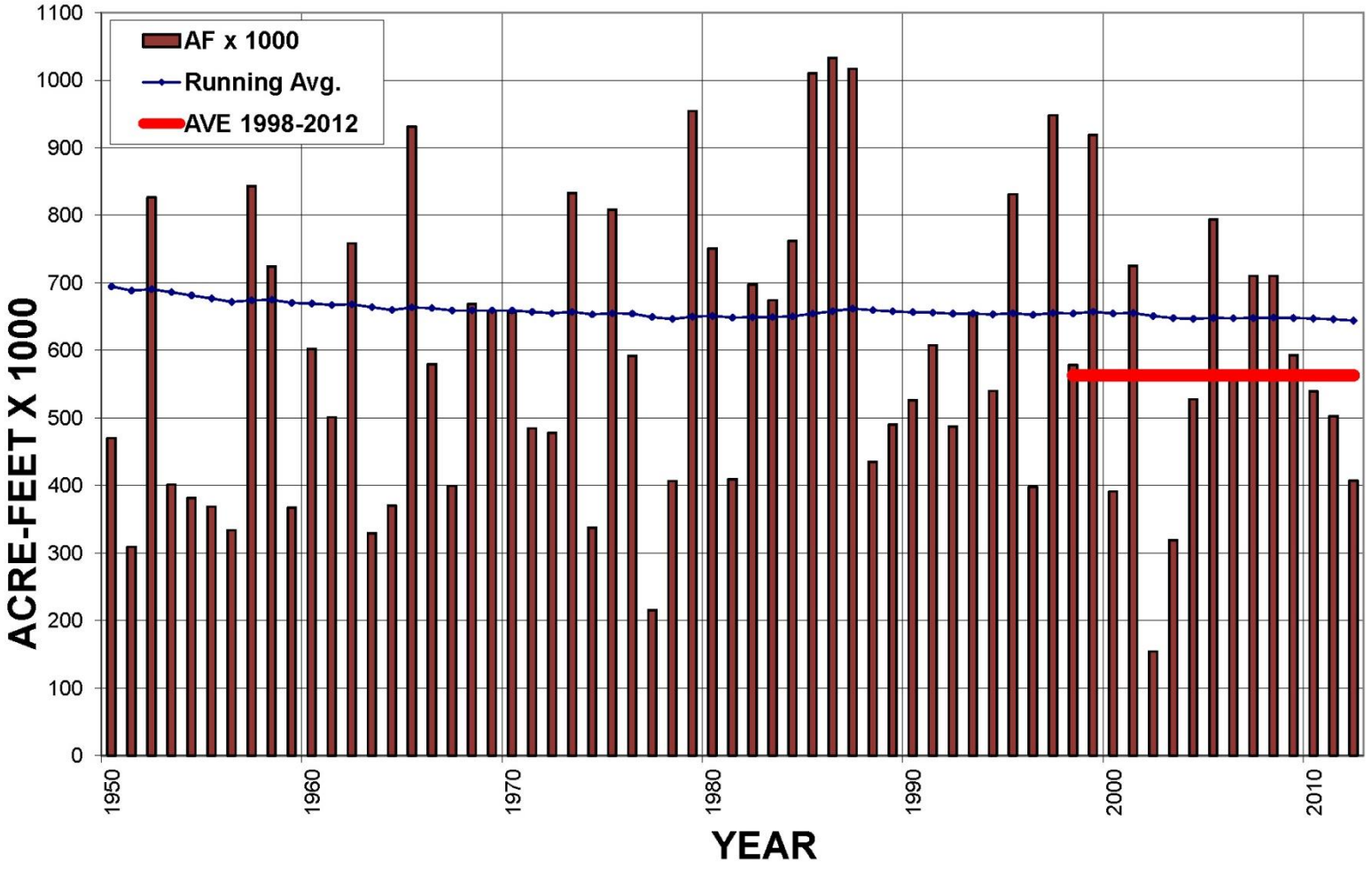
Delayed Depletions



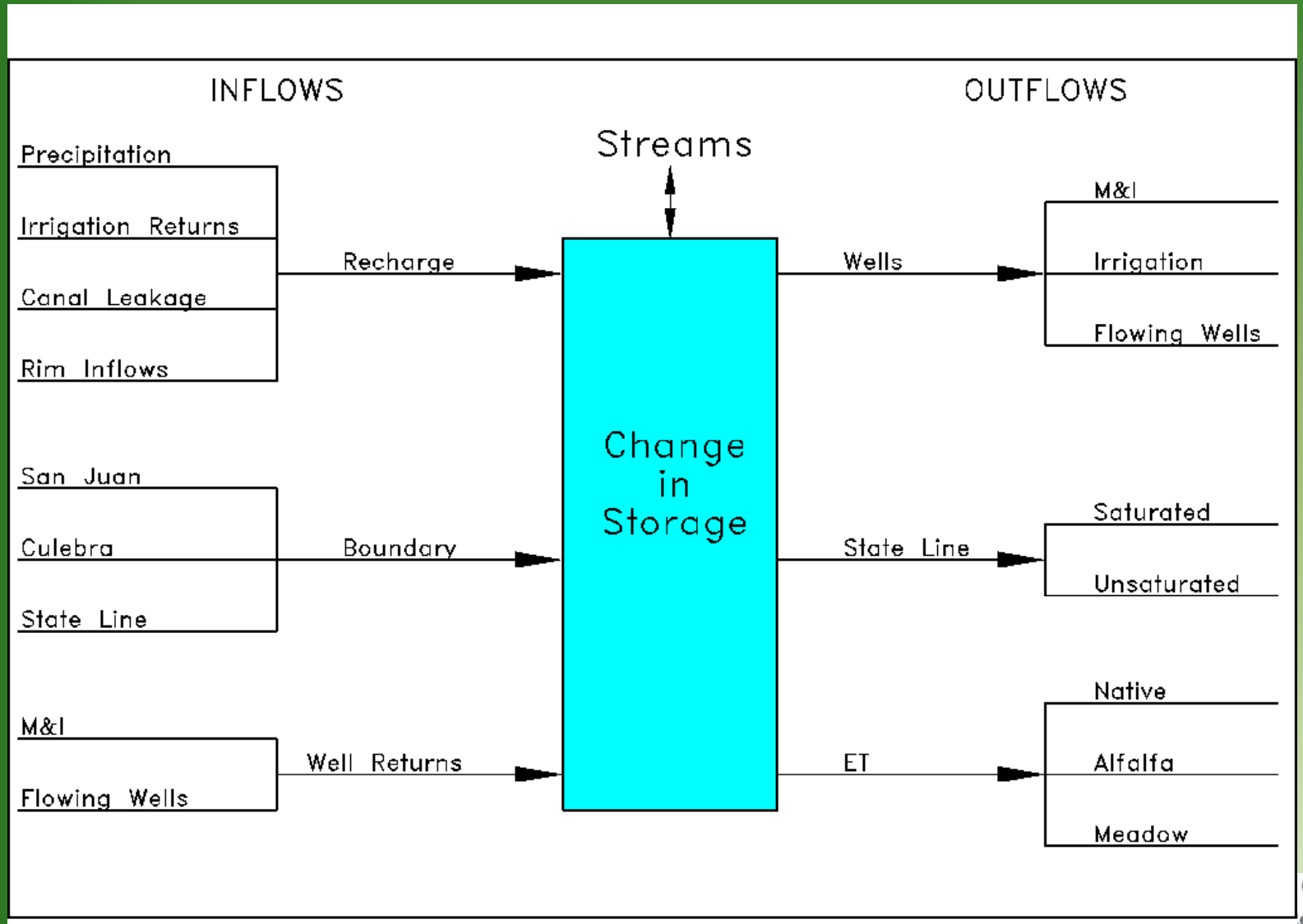
Confined Versus Unconfined Aquifers - Schematic Cones of Depression



Drought


RIO GRANDE NEAR DEL NORTE, CO
ANNUAL CALENDAR YEAR FLOWS
AF x 1000
Running Avg.
AVE 1998-2012
ACRE-FEET X 1000
1100
1000
900
800
700
600
500
400
300
200
100
0
1950
1960
1970
1980
1990
2000
2010
YEAR

Modeling


INFLOWS
OUTFLOWS
Streams
Precipitation
Irrigation Returns
Canal Leakage
Rim Inflows
Recharge
San Juan
Culebra
State Line
Boundary
M&I
Flowing Wells
Well Returns
Change in Storage
Wells
M&I
Irrigation
Flowing Wells
State Line
Saturated
Unsaturated
ET
Native
Alfalfa
Meadow

HydroBase

GIS Data (Spatial Data)

TSTool & StateDMI

CDSS Tool Box & StateDGI

StateCU

MODFLOW

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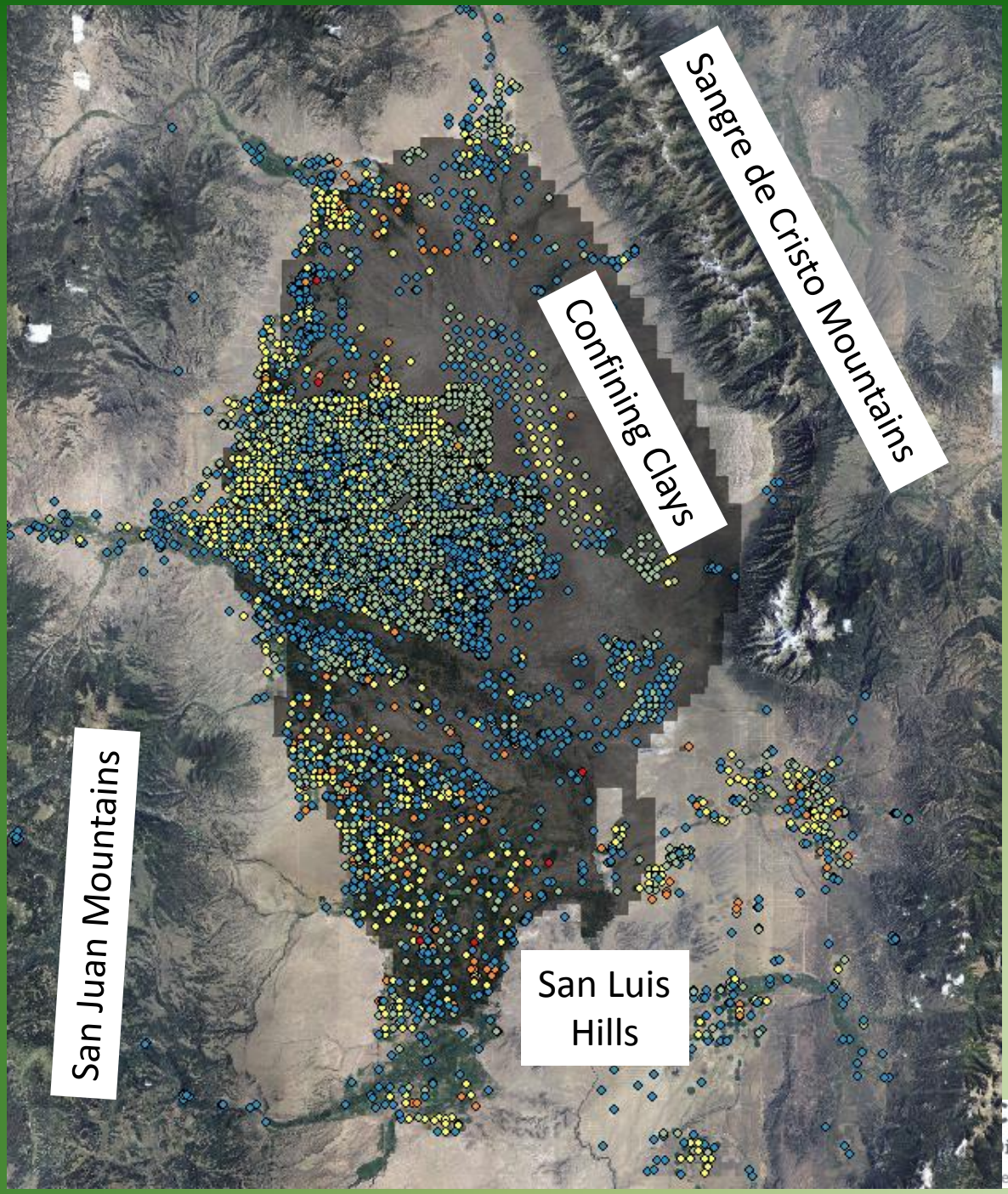
Why RF's

- Complexity of systems, quick analysis of impacts
  - Example: South Platte vs. Rio Grande Basin
- Results model vs. Prediction model
- Ease of use for users
  - Scenarios to build funding case for GWMP
  - Short time frame for ARP



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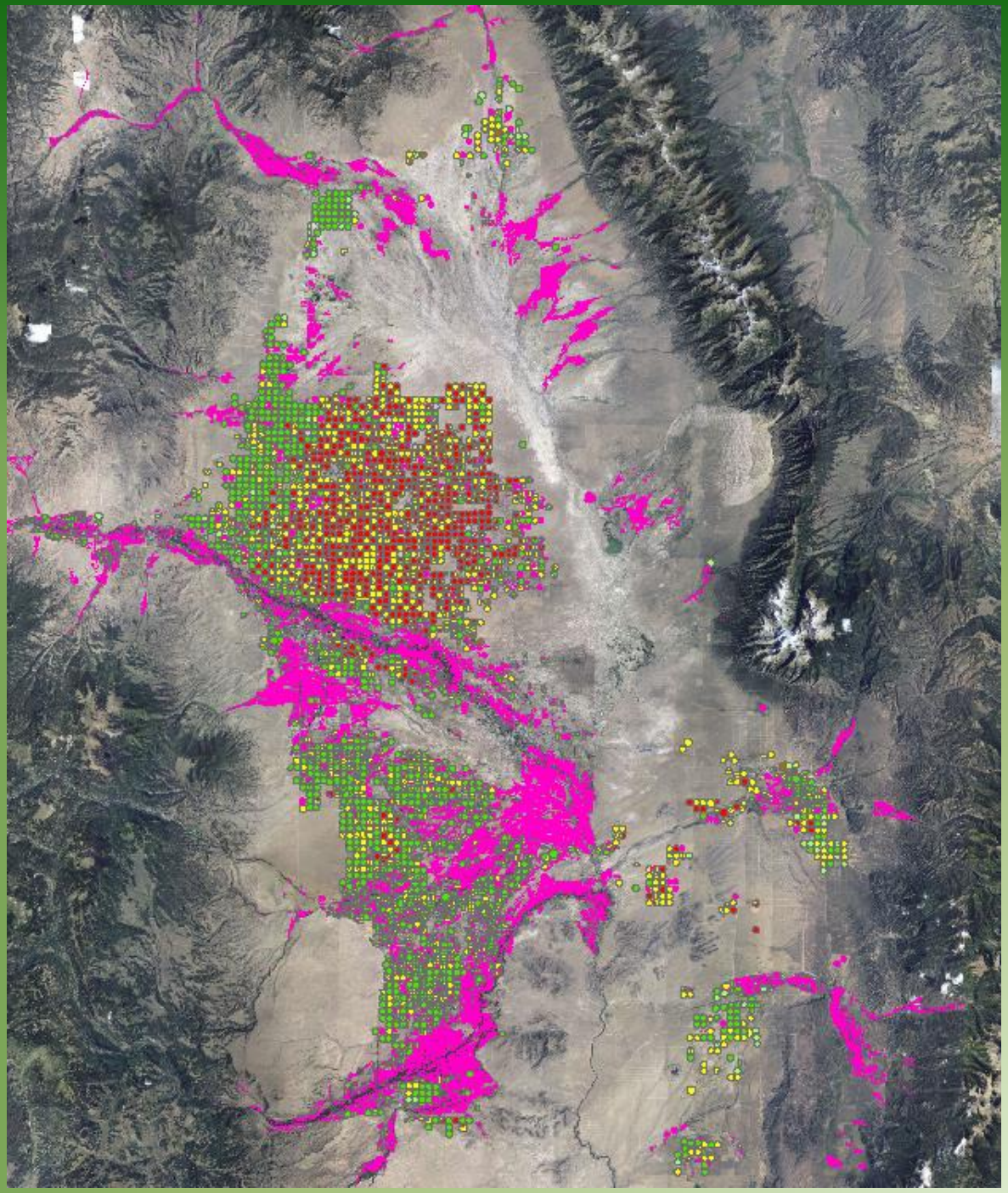
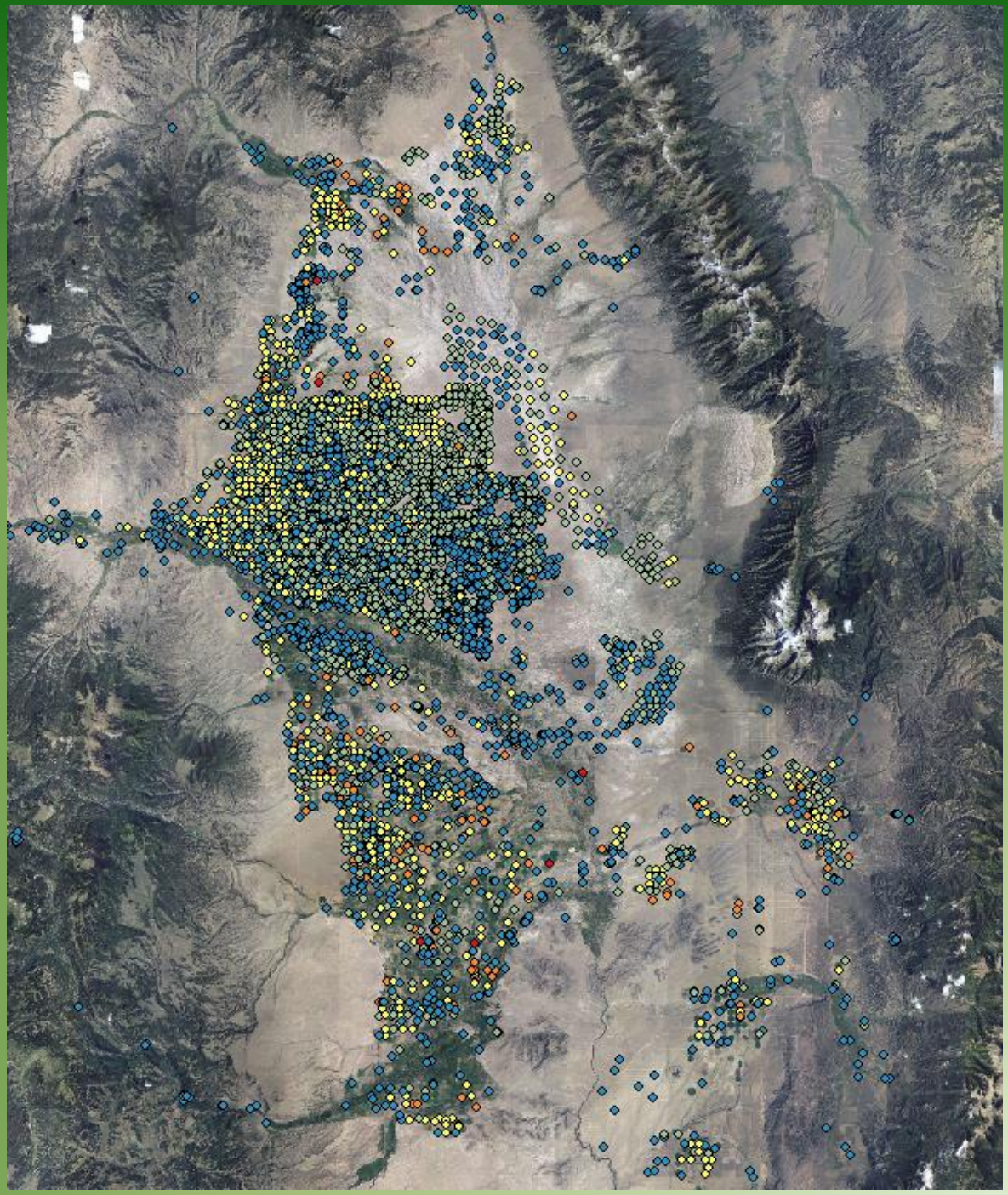
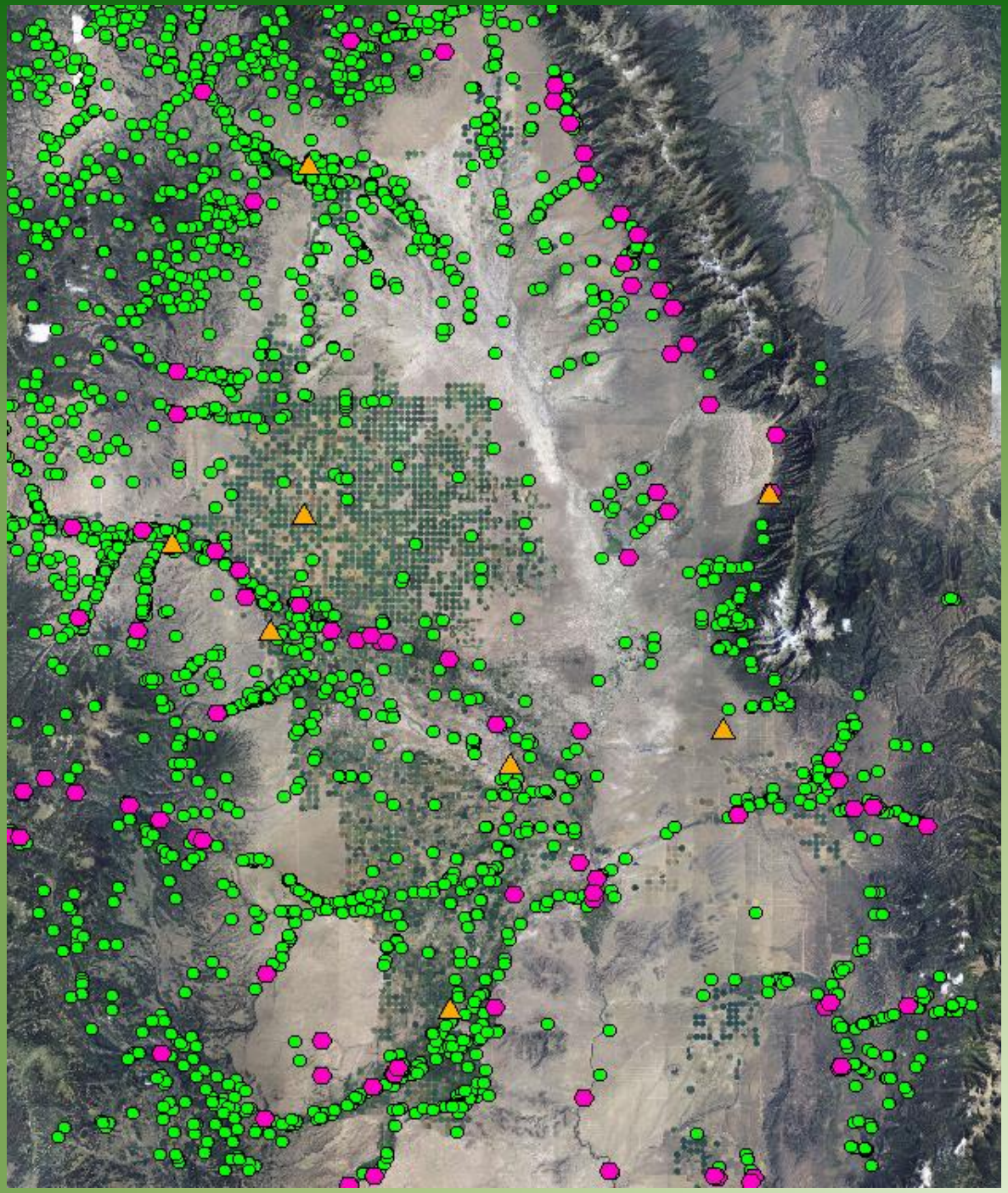
- Irrigated acreage

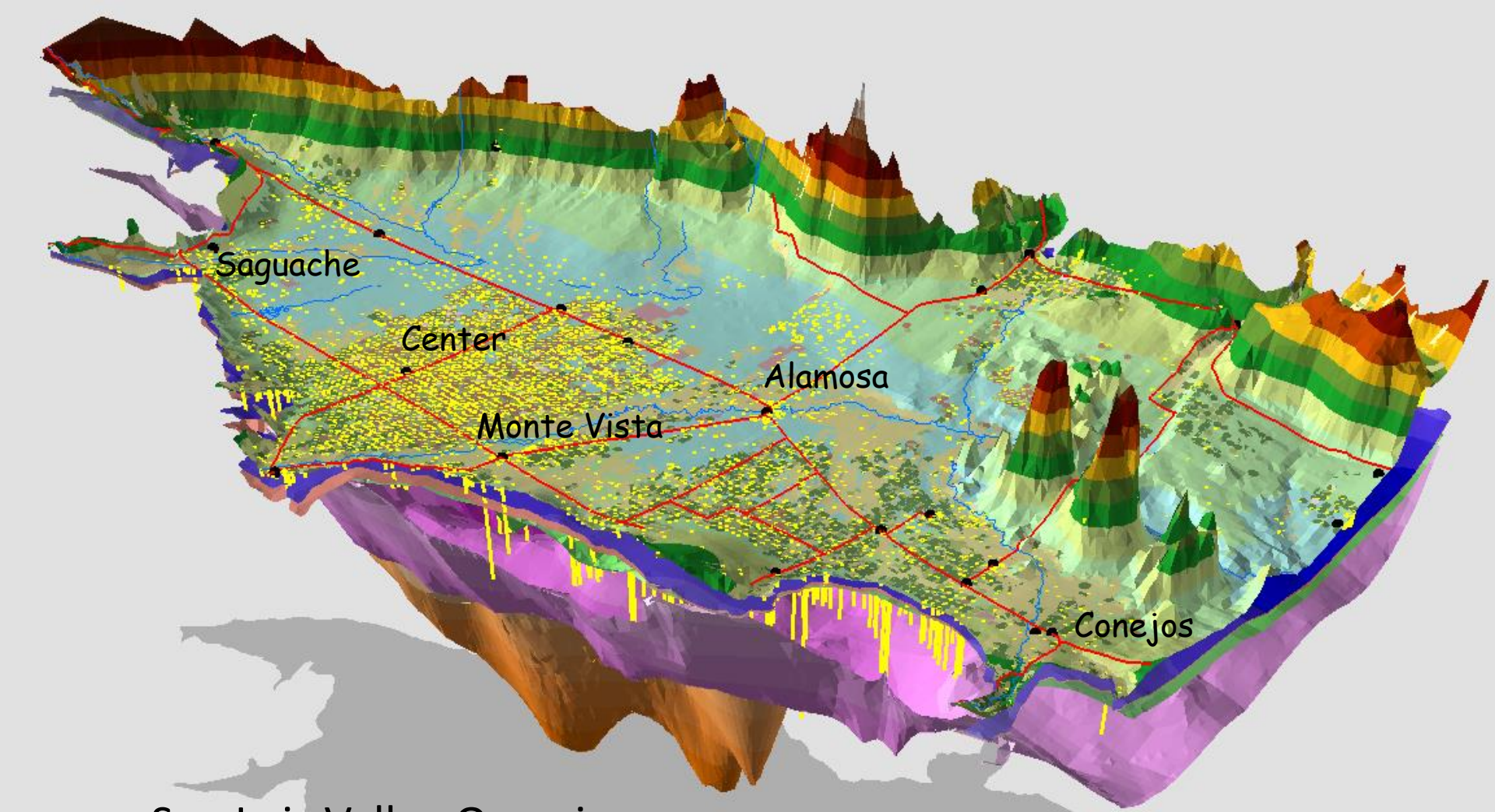


- Location of wells with metered diversion records



- Diversion structures
- Streamflow gages
- Climate stations

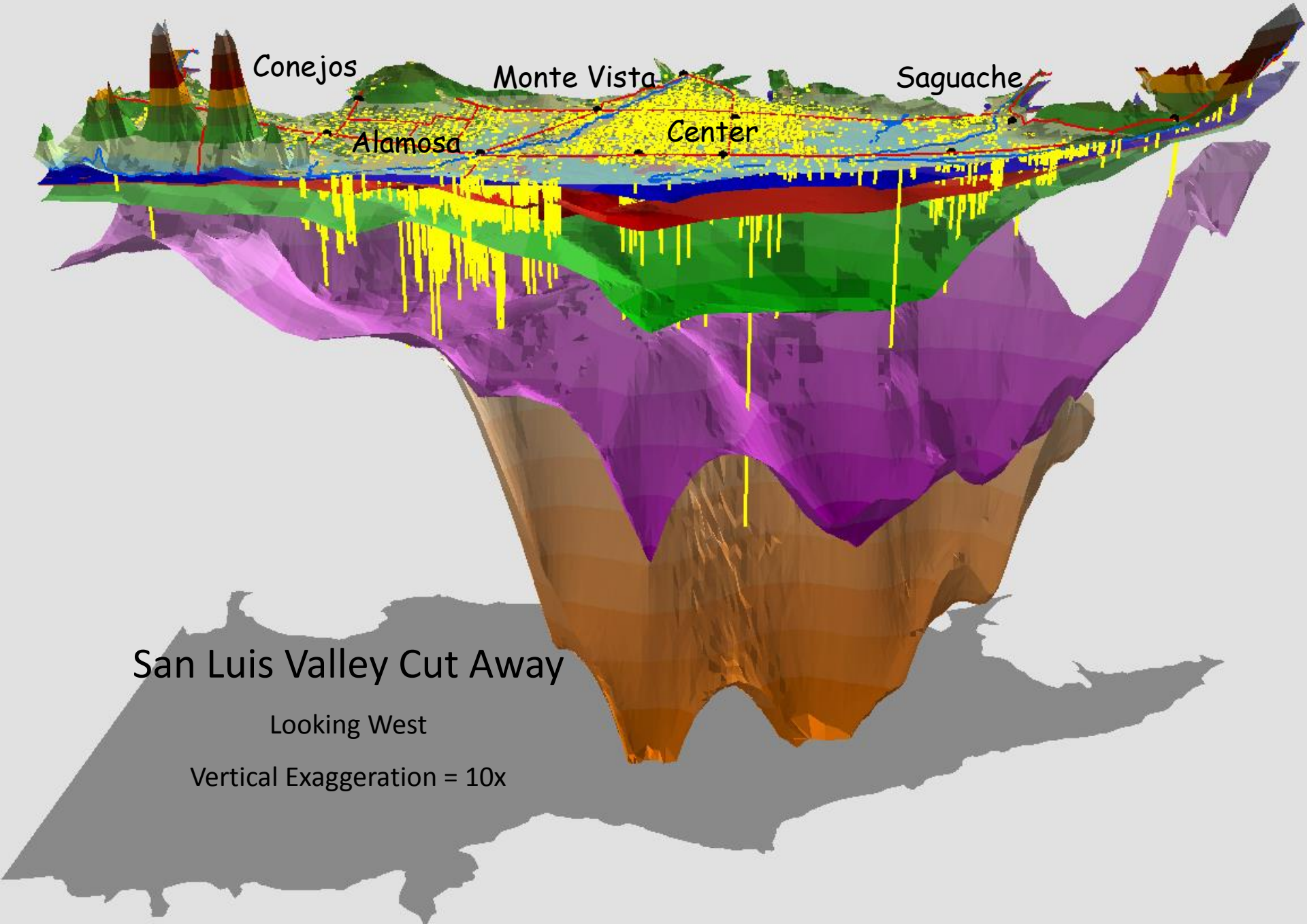




San Luis Valley Overview

Looking Northeast

Vertical Exaggeration = 10x



San Luis Valley Cut Away

Looking West

Vertical Exaggeration = 10x

HydroBase

GIS Data (Spatial Data)

TSTool & StateDMI

CDSS Tool Box & StateDGI

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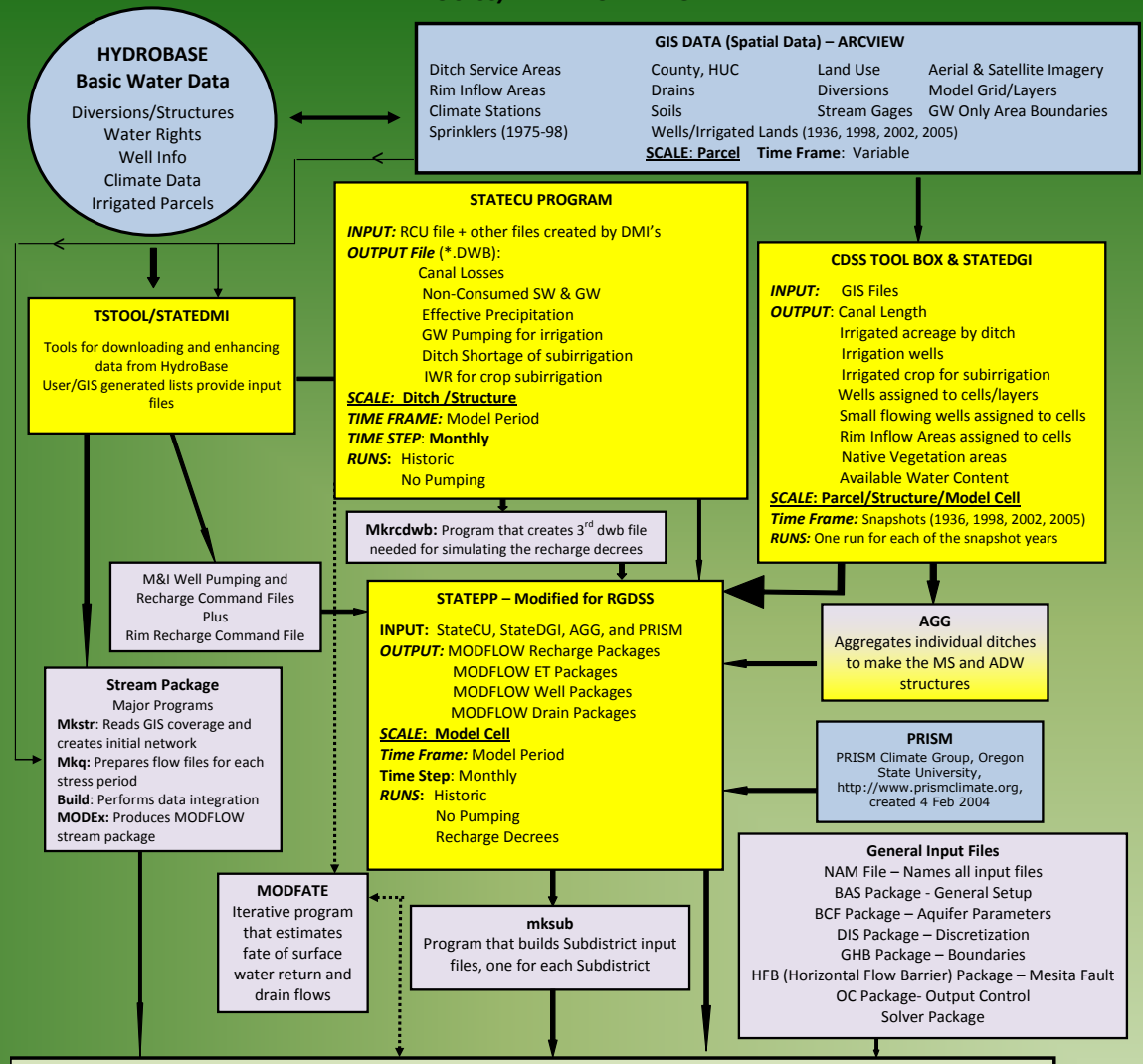
Decision Support Process

RGDSS GROUNDWATER MODEL WORKSHOP
JANUARY 10-12, 2011
PROCESS/DATA FLOW DIAGRAM



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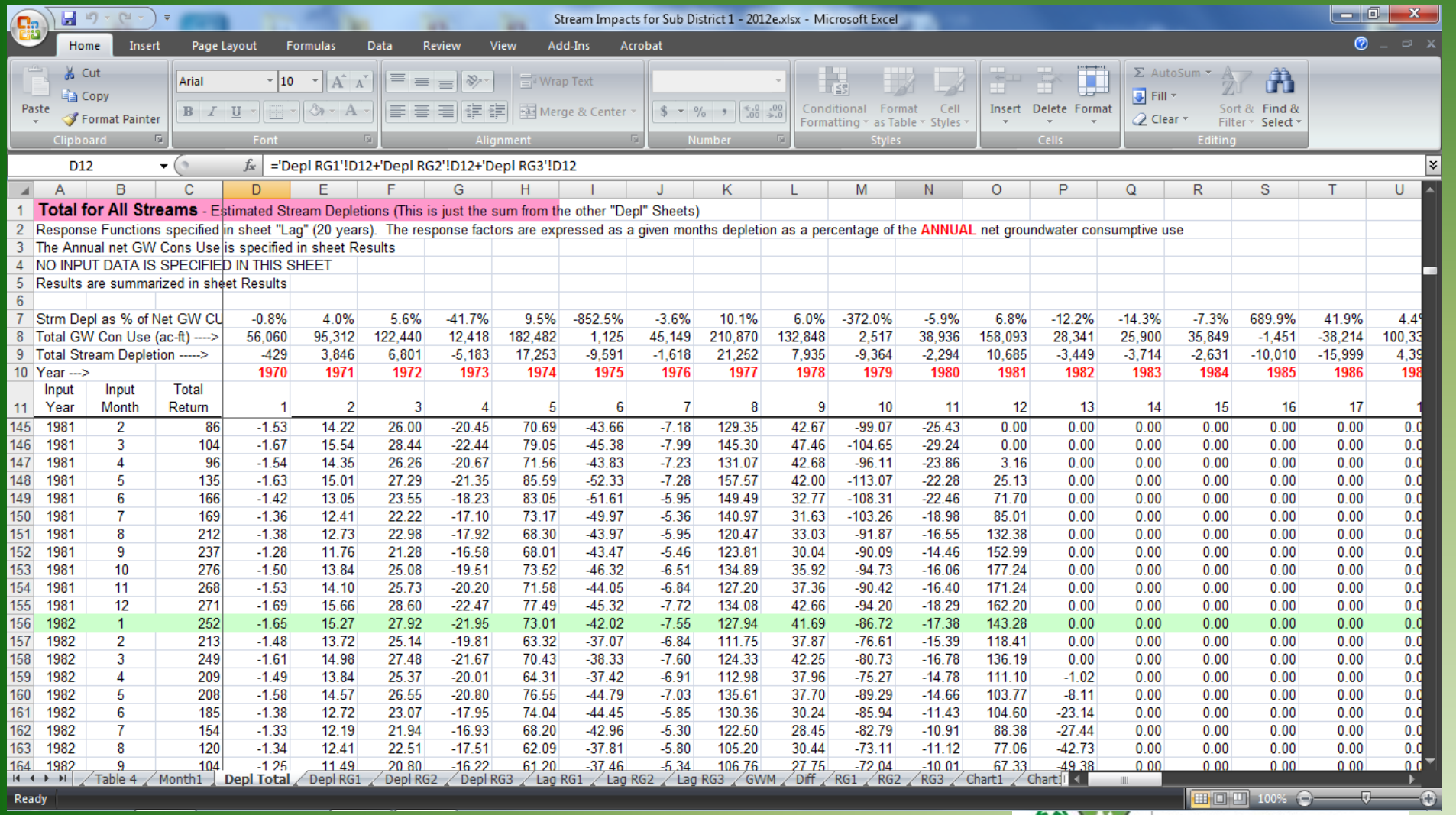
Model output



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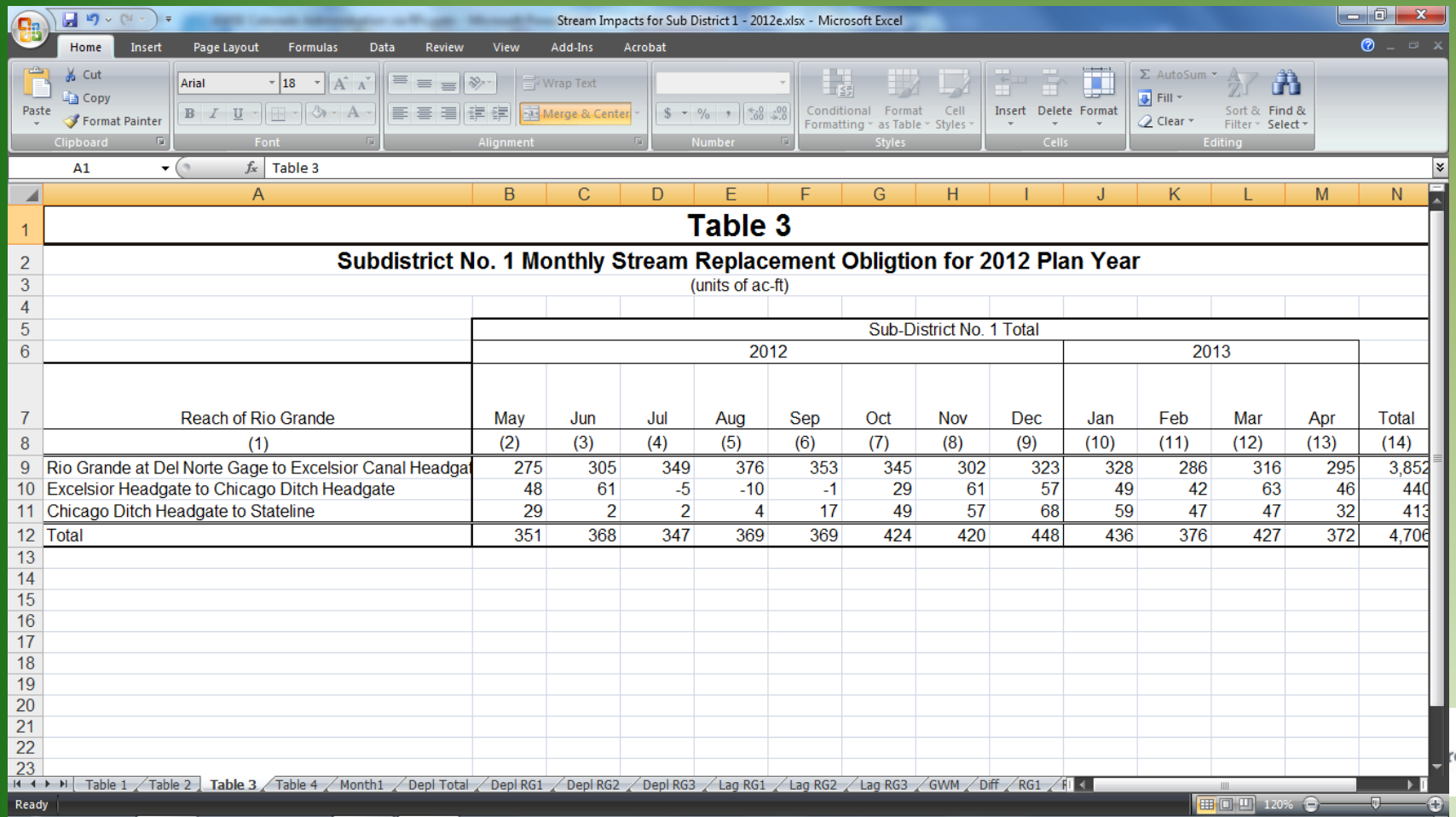
Response Function

- NGWCU, Forecast Streamflow, Year Type



Stream Impacts for Sub District 1 - 2012e.xlsx - Microsoft Excel

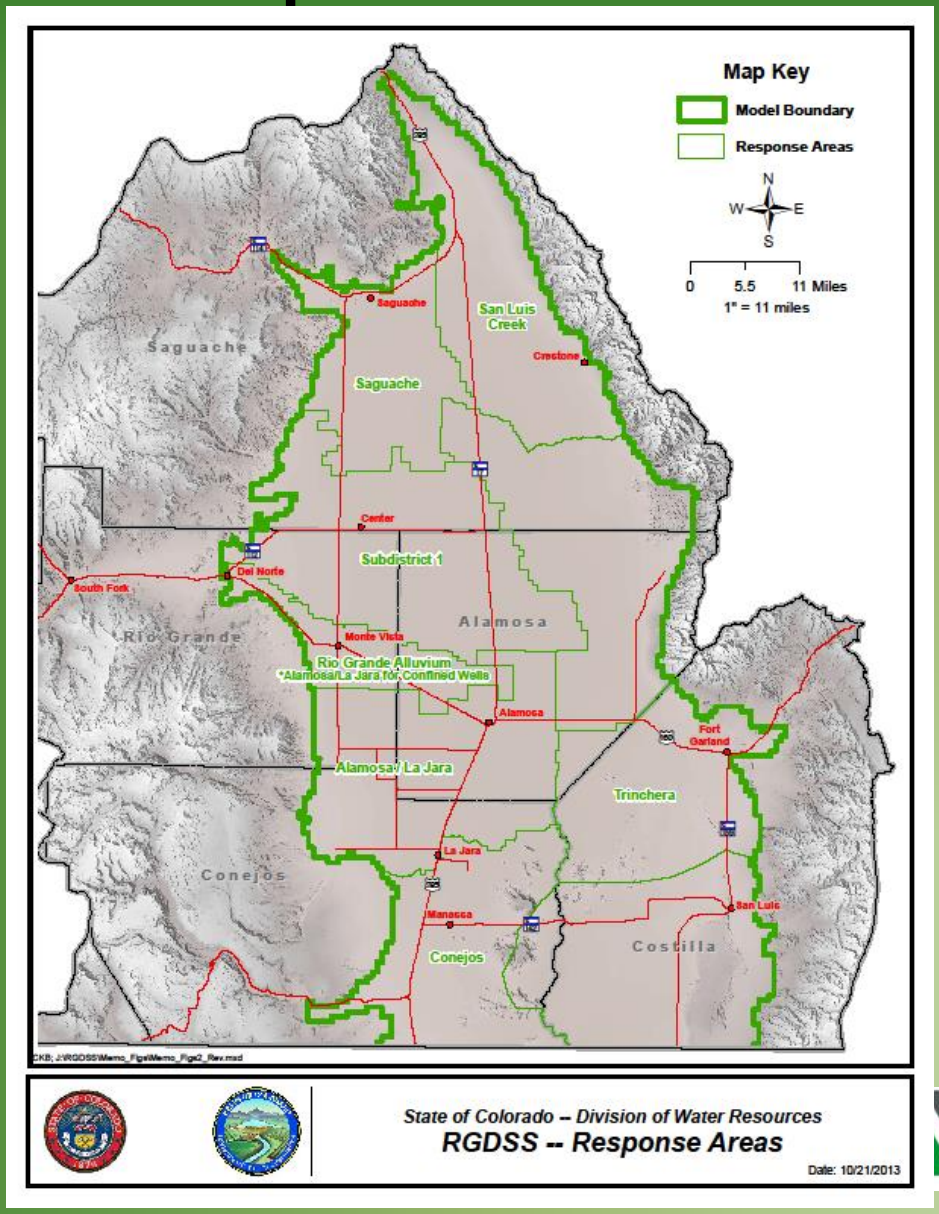
Table 3

Subdistrict No. 1 Monthly Stream Replacement Obligtion for 2012 Plan Year

(units of ac-ft)

		Sub-District No. 1 Total												
		2012								2013				
	Reach of Rio Grande	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
9	Rio Grande at Del Norte Gage to Excelsior Canal Headgat	275	305	349	376	353	345	302	323	328	286	316	295	3,852
10	Excelsior Headgate to Chicago Ditch Headgate	48	61	-5	-10	-1	29	61	57	49	42	63	46	440
11	Chicago Ditch Headgate to Stateline	29	2	2	4	17	49	57	68	59	47	47	32	413
12	Total	351	368	347	369	369	424	420	448	436	376	427	372	4,706

Response Areas



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Annual Replacement Plan

- Projected NGWCU
- Projected year
- RF used
- Water Supply for replacement
- Agreements
- Long term coverage of extended depletions

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Daily Administration

- Table 3 used to determine replacement daily
- Water users tell what source to use each day
- If conditions change (snowpack) may be able to respond with an amendment
- End of year review

Questions???

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