Expansion and Update of the SAJB Groundwater Flow Model

Spokane Valley – Rathdrum Prairie Aquifer

Prepared by

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Groundwater Model Improvement Project

- Funded by SAJB and the WA Department of Health
- Project focused on model expansion and update, and the 2010 Special Wellhead Protection Areas (SWPAs)
- Three project tasks
  - Study effects of stormwater recharge facilities on 2010 SWPAs
  - Verify the method for delineating SWPAs
  - Model expansion and update
    - Expansion: Create a high-resolution aquifer-wide model
    - Update: Pumping and information from the Bi-State study

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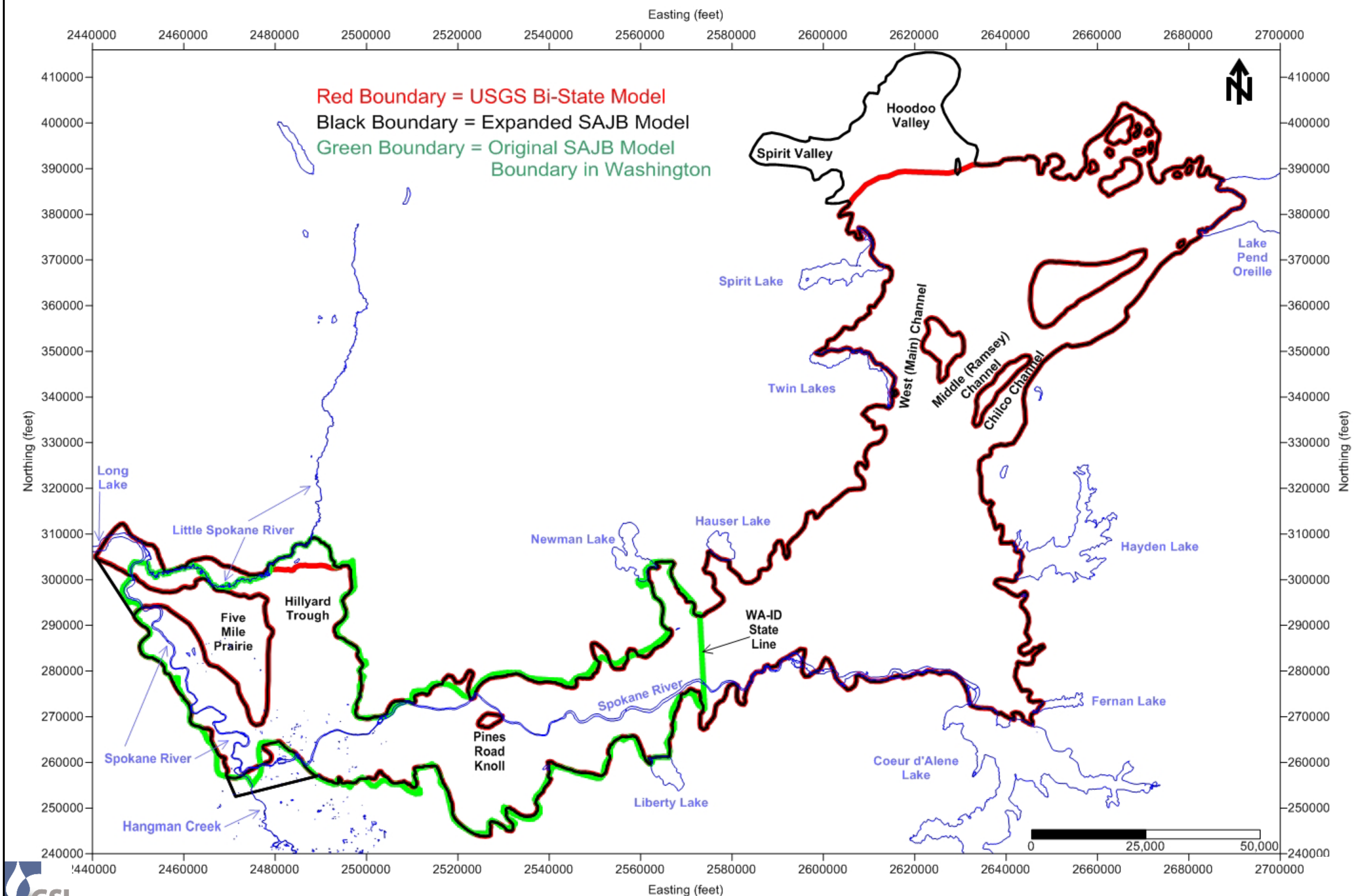
SAJB and Bi-State Model Areas



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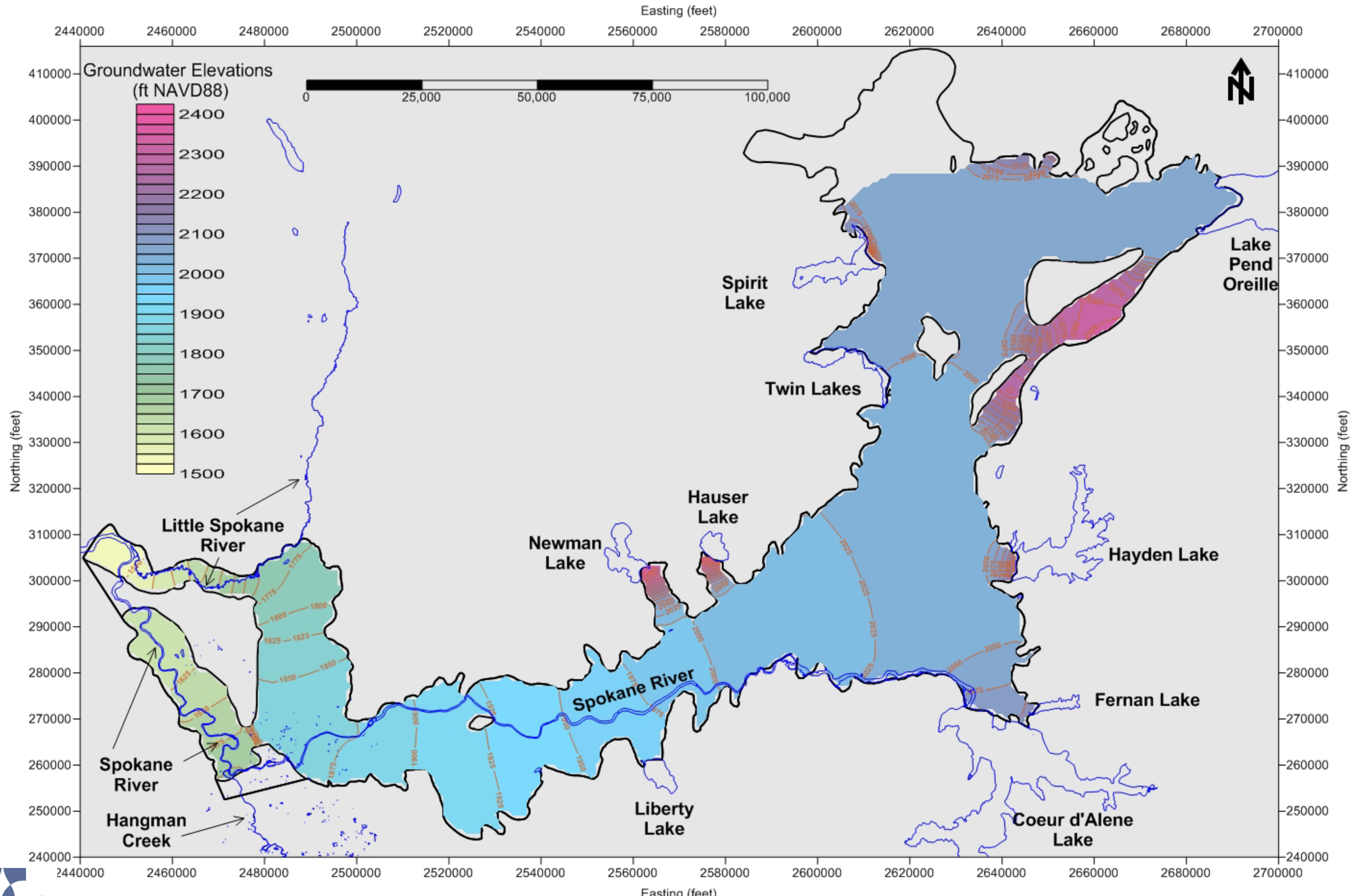
SAJB Model - Groundwater Elevations



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Groundwater Model Improvement Project

Objectives for the Expansion and Updated Model

1. Support wellhead protection planning
   (a) Avoid truncation of capture zones at state line
2. Provide a high-resolution, up-to-date tool for
   (a) Wellfield-scale analyses
   (b) Groundwater resource management at other scales

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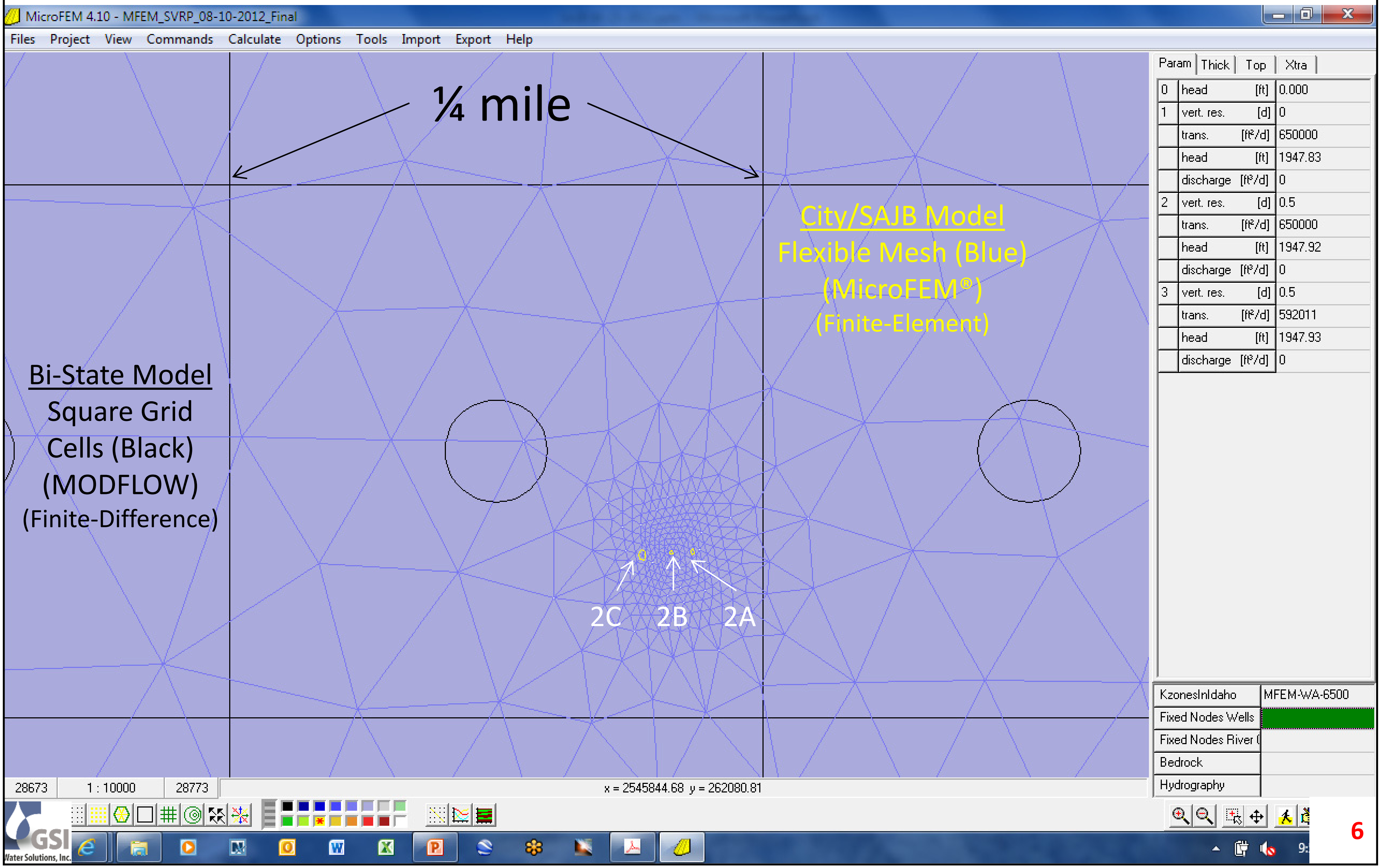
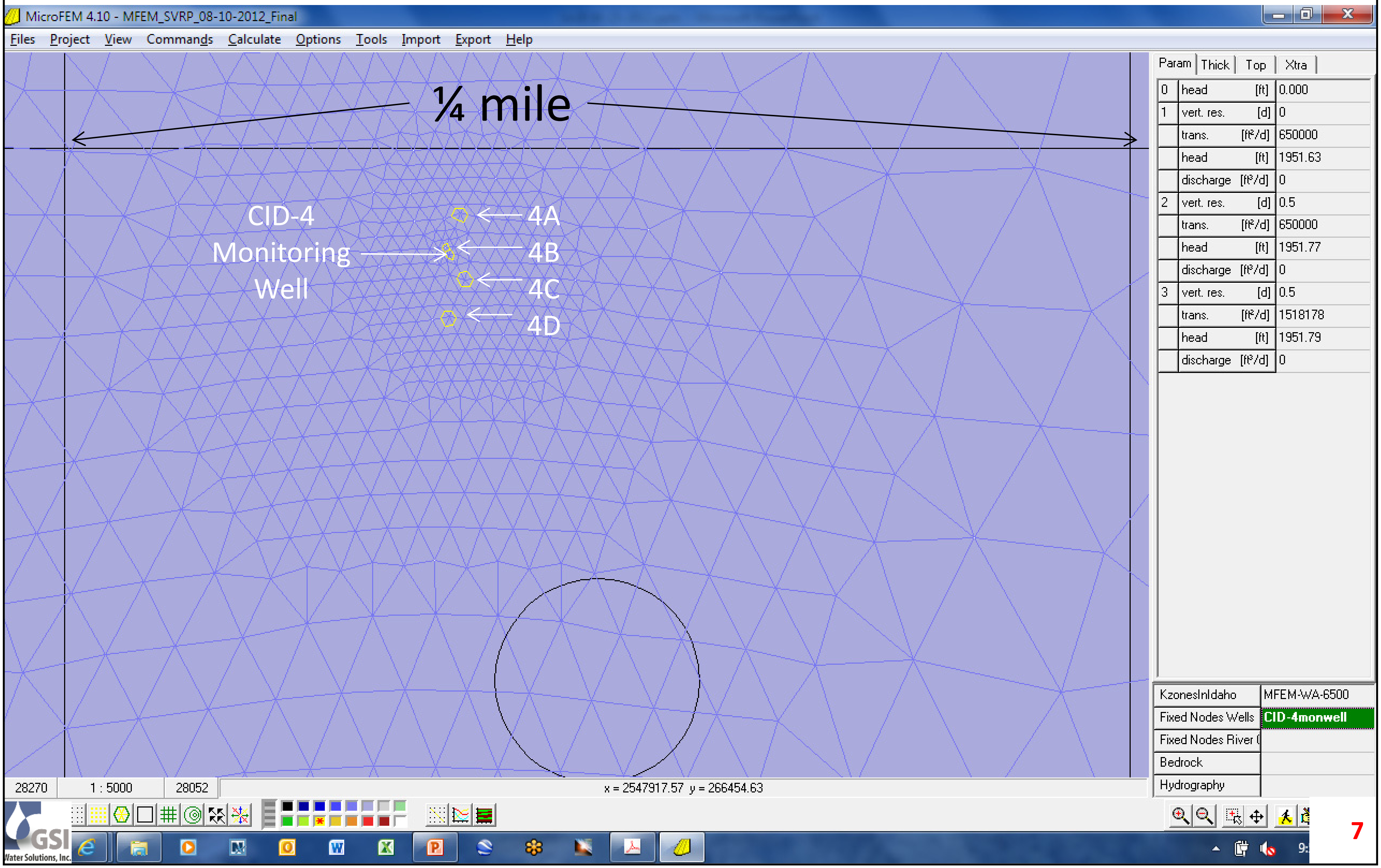
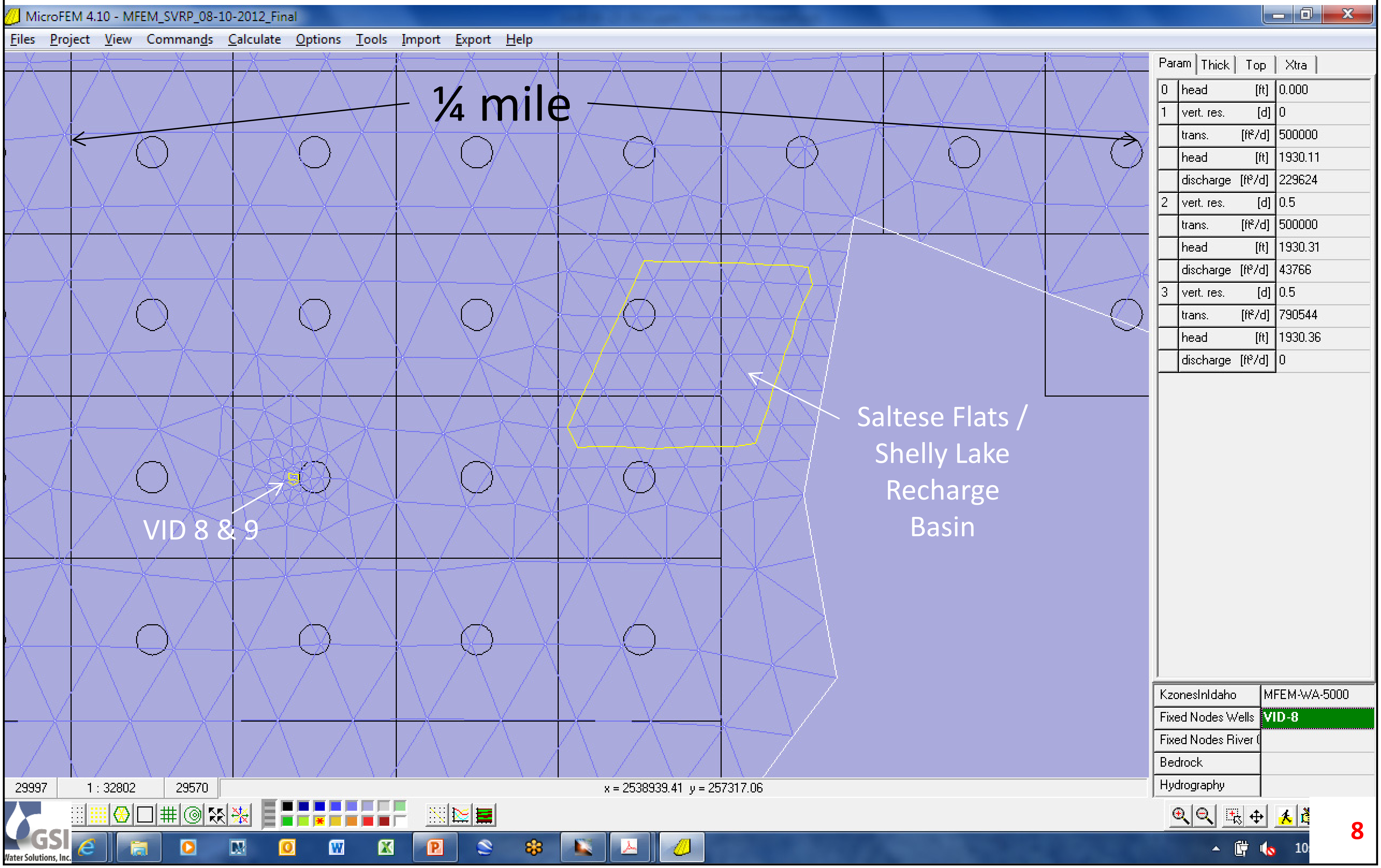
SAJB and Bi-State Model Grids at CID-2



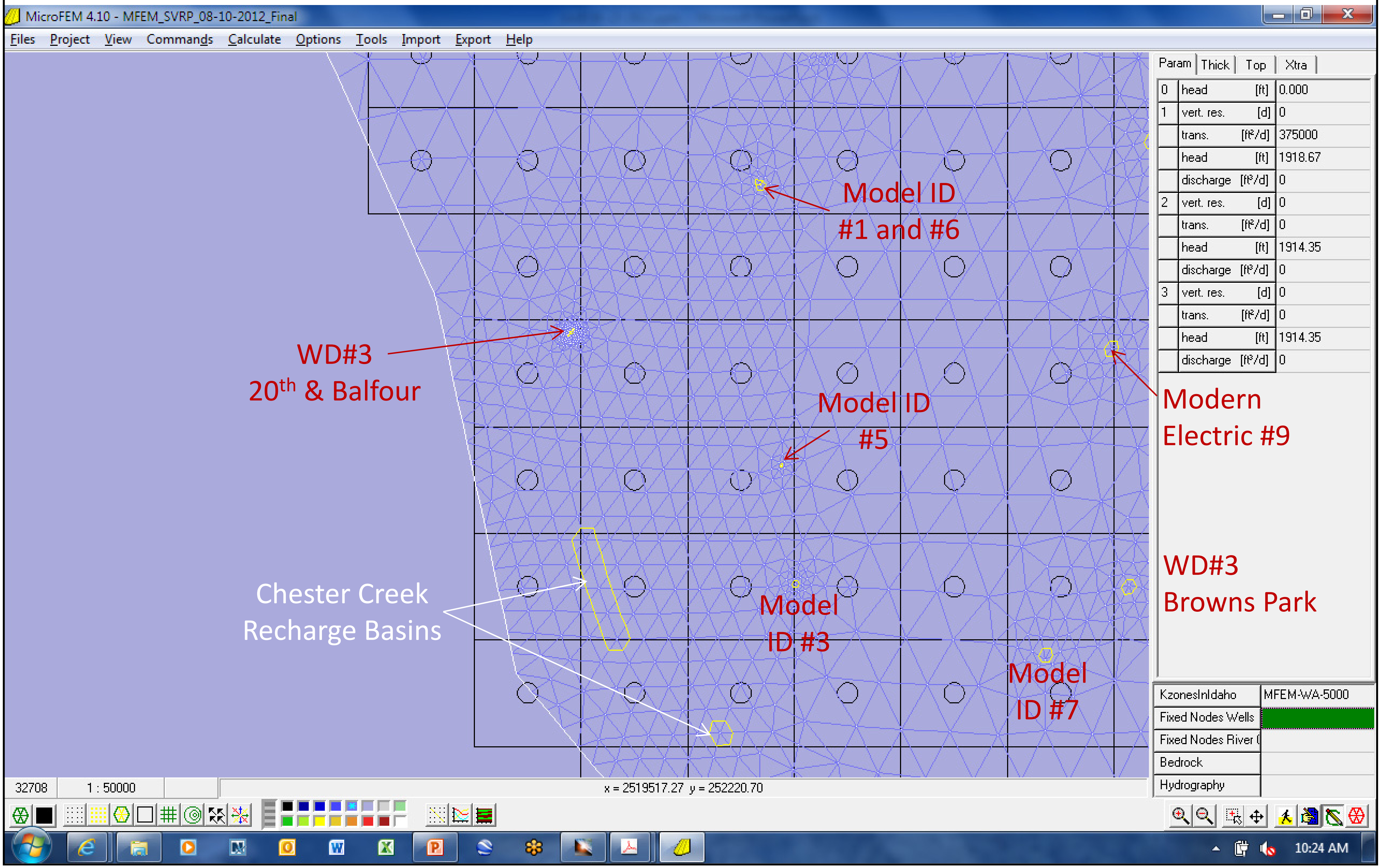
SAJB and Bi-State Model Grids at CID-4



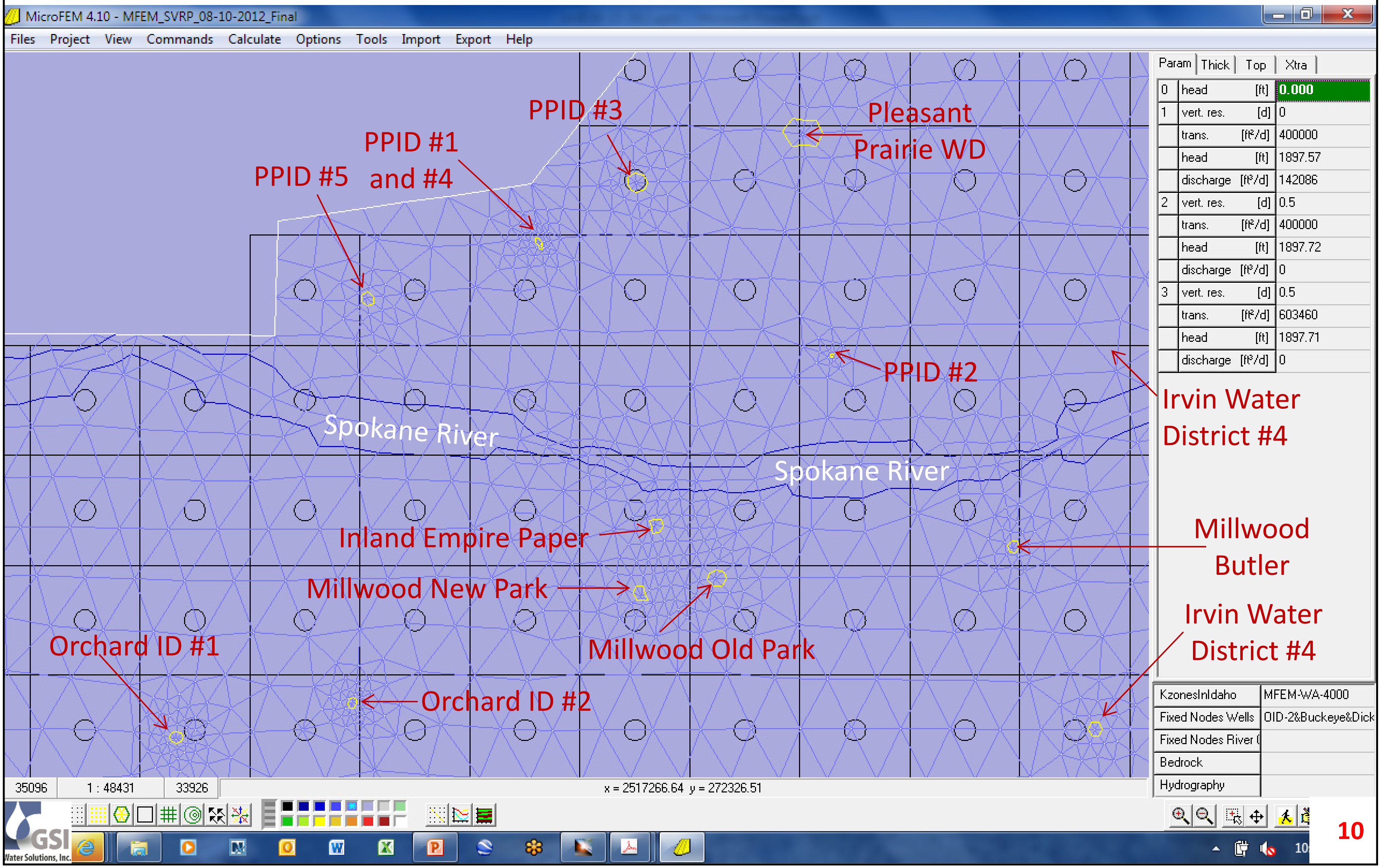
SAJB and Bi-State Model Grids at Recharge Basin



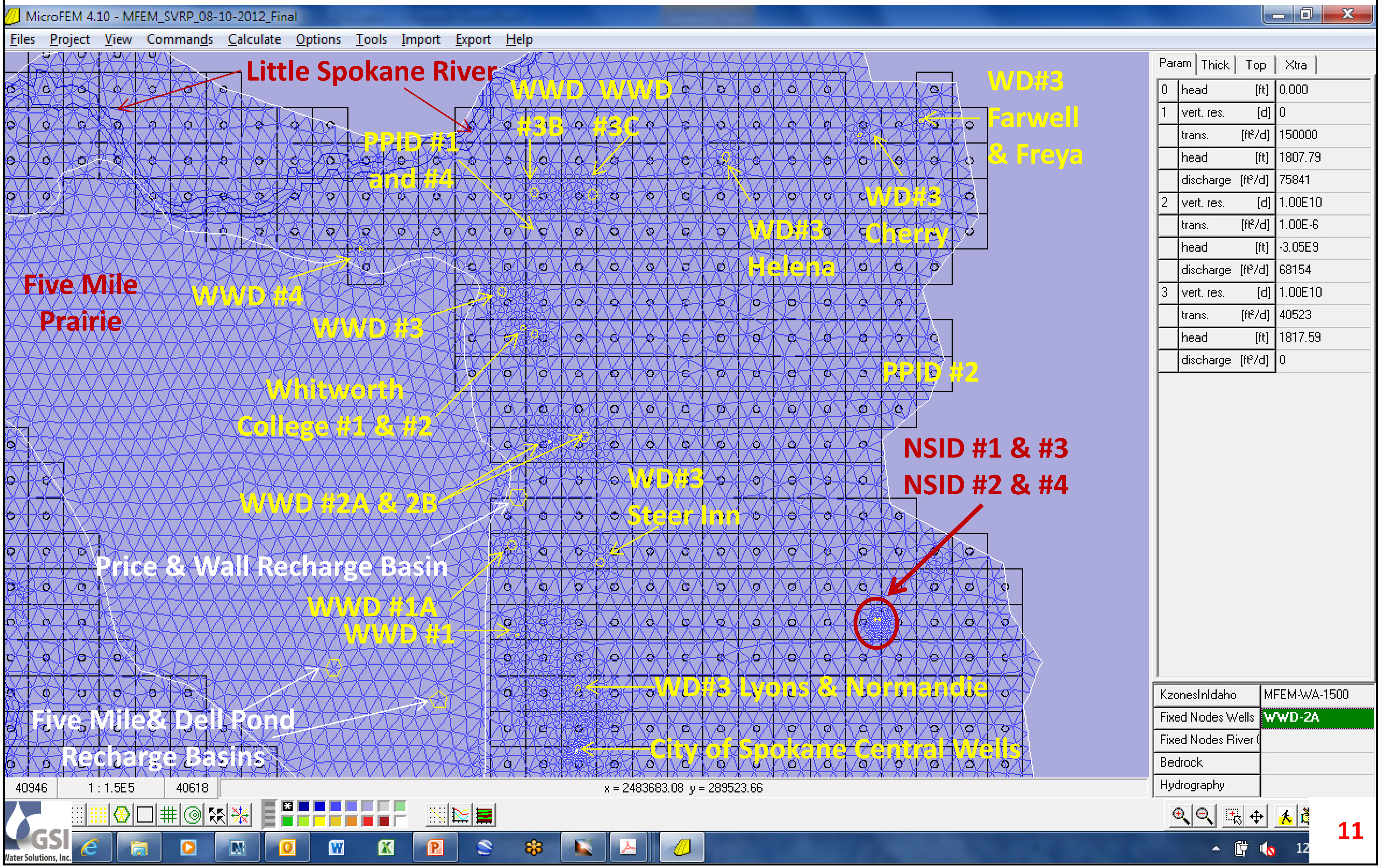
SAJB and Bi-State Model Grids at Chester Creek



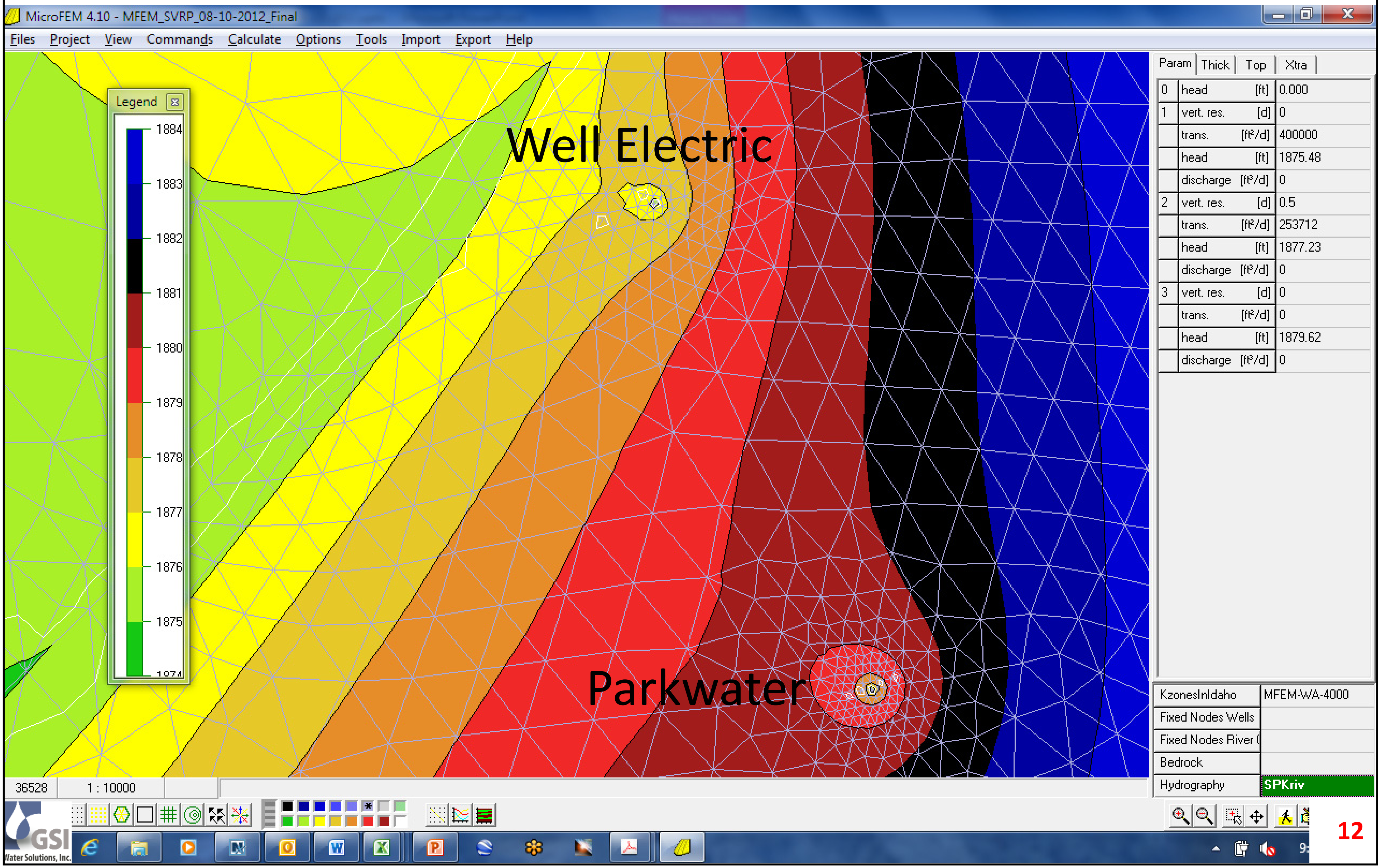
SAJB and Bi-State Model Grids at PPID, OID, Millwood



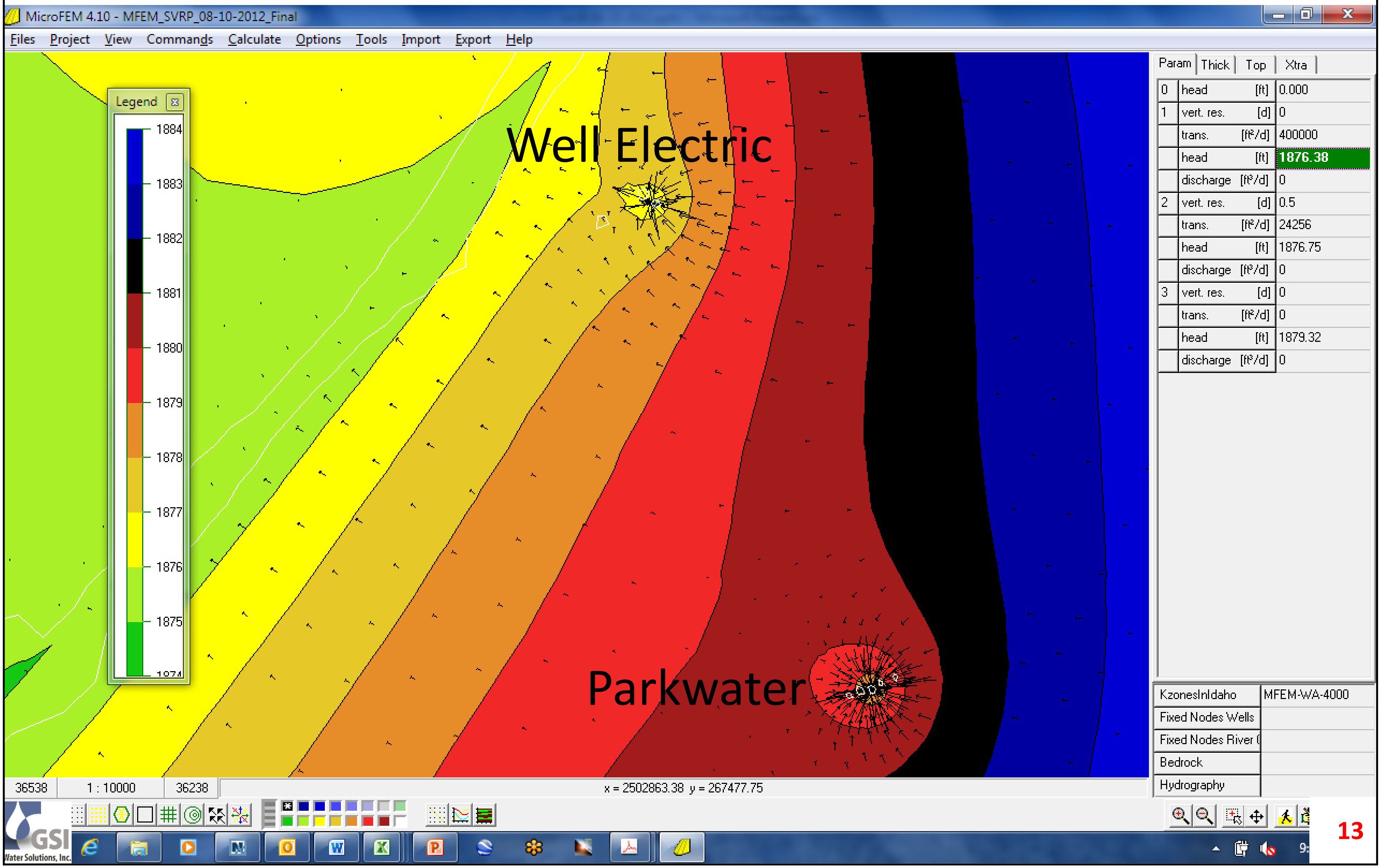
SAJB and Bi-State Model Grids in Hillyard Trough



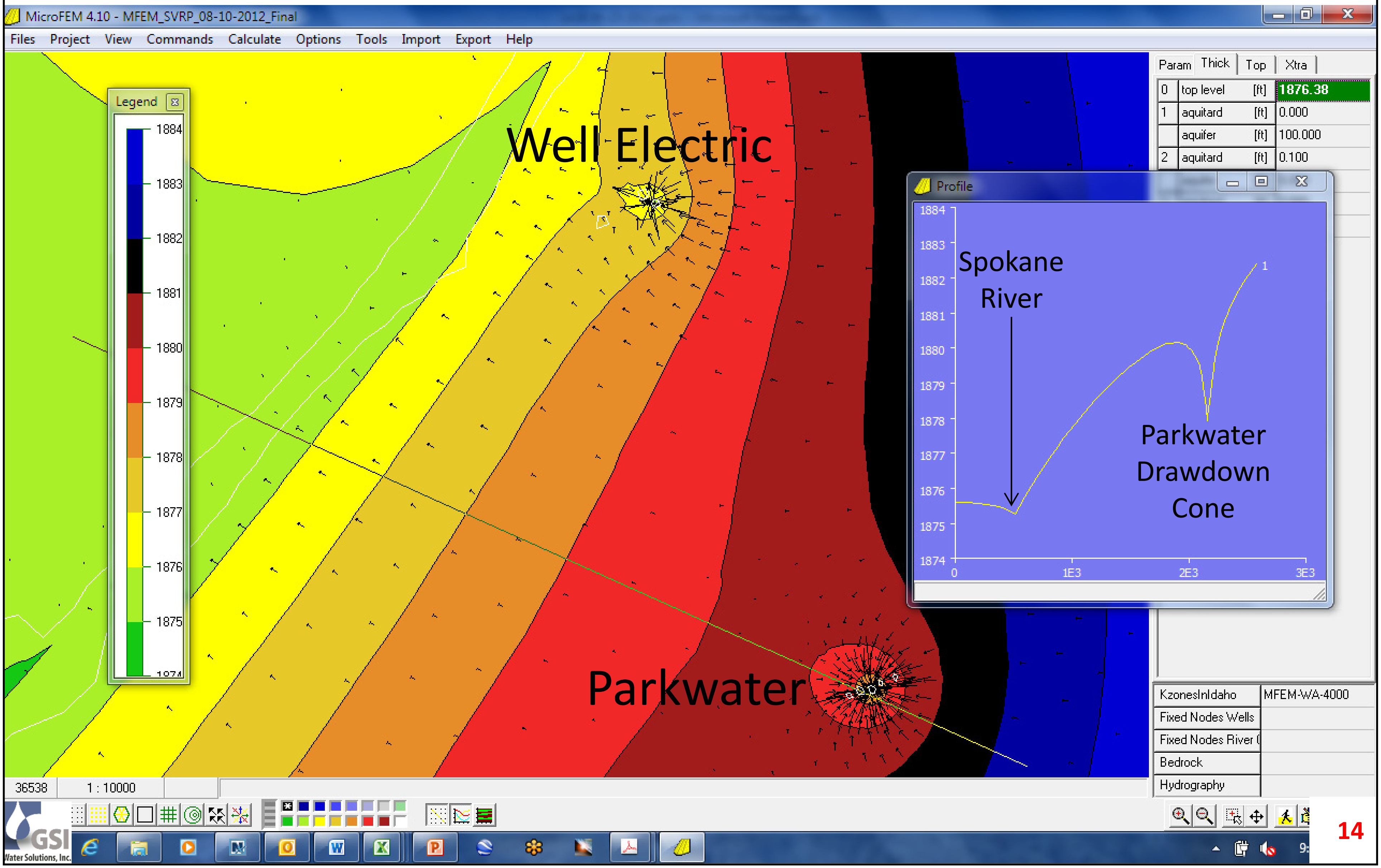
Drawdown Cones at Parkwater and Well Electric



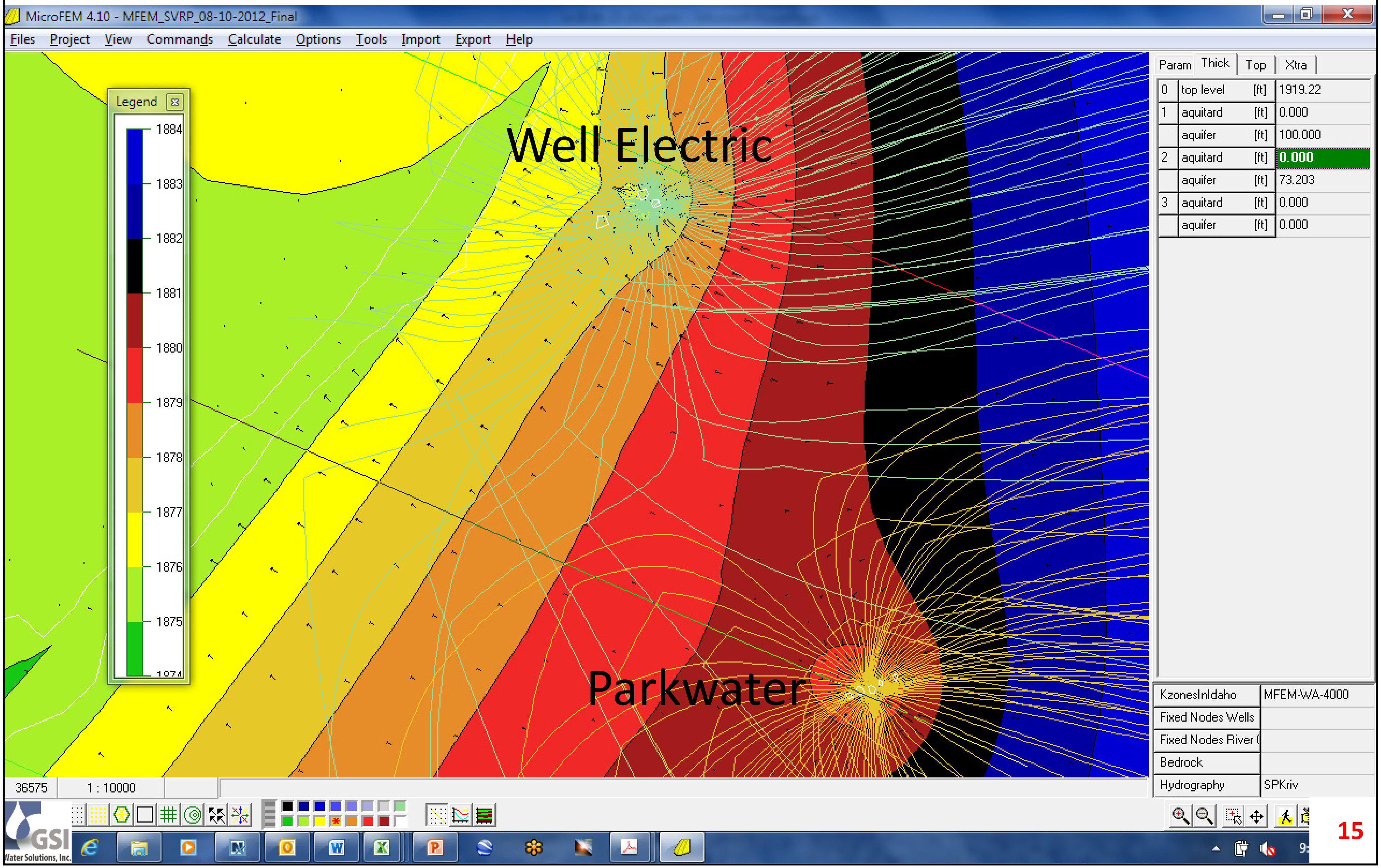
Flow Patterns at Parkwater and Well Electric



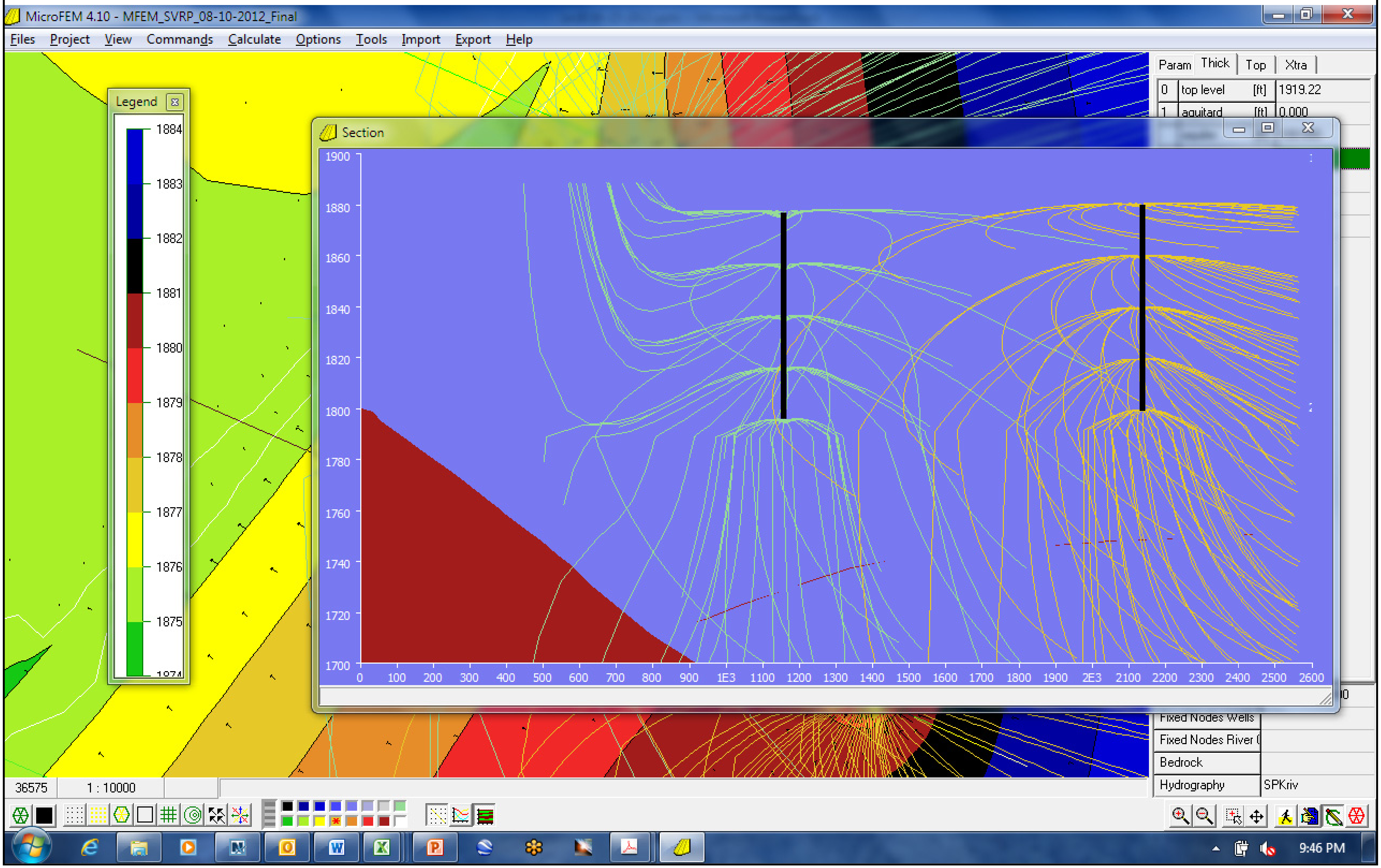
Water Table Profile in Cross-Sectional View



Three-Dimensional Groundwater Flow Paths (Projected onto Plan View)



Capture In Cross-Sectional View



Other Aspects of Expanded Model

1. Grid includes some adjoining areas with alluvial deposits that might be of interest in the future
   - Mouth of Hangman Creek
   - Spirit and Hoodoo valleys in Idaho
2. Uses three layers to simulate groundwater flow
   - The USGS Bi-State model used just one layer, except in Hillyard Trough (3 layers north of Spokane city limits)
   - Pain-staking effort to resolve issues with Bi-State model files
     - Electronic files: Too thick just east of state line, and too thin between state line and City of Spokane
     - Published maps: Found internal inconsistencies (saturated thickness did not match water table and basement)
     - Localized change to USGS representation of basement bedrock and SVRP thickness near downtown Spokane (per City and Ecology)

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Other Aspects of Expanded Model

3. Inflows from tributary drainages and lakes
   – 37 areas in Washington and 38 areas in Idaho
   – Same representation as in USGS Bi-State model
4. Multiple stage profiles for the Spokane River
   – Summer conditions (low-stage / low-flow)
   – Spring conditions (high-stage / high-flow)
   – Annual average conditions

Other Aspects of Expanded Model

5. Updated well list and pumping rates
   – Annual average rates, as compiled by City of Spokane
6. Areal recharge from Bi-State model
7. Pumping and areal recharge are now separated!
   – Lumped together into single term in Bi-State model

     Bi-State model pumping =
     (1) Actual pumping minus
     (2) Septic system infiltration minus
     (3) 40% of outdoor-applied water in urban areas minus
     (4) 40% of outdoor-applied water on irrigated fields

   – Difficult to change pumping in Bi-State model: requires decisions about whether (and how) to change recharge
   – Difficult and time-consuming to separate, but we did it!

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Other Aspects of Expanded Model

8. All input data are stored in the model software!
   - Facilitates visual display
   - Allows mathematical analysis of input data, facilitates QC
   - Includes labels of key features
   - Facilitates future adjustments to the model grid (i.e., the data values at existing nodes won't get lost)

Param | Thick | Top | Xtra

x6	Final BaseElev (ft	1326.868
x7	L1 Aq Thickness	100
x8	L2 Aq Thickness	100
x9	L3 Aq Thickness	372.23
x10	Precipitation rech	0.002325
x11	Sewer density	0.25
x12	Irrigation density	0
x13	K1 (ft/day)	4500
x14	K2 (ft/day)	4500
x15	K3 (ft/day)	4500
x16	c2 (days)	0.5
x17	c3 (days)	0.5
x18	mt1 (ft)	100
x19	mt2 (ft)	100
x20	mt3 (ft)	372.23
x21	RiverReachNo.W	0
x22	Leakage(Kr/Dr)(s	0
x23	River Width (w)	0
x24	River Node Lengt	0
x25	River Node Area (	0
x26	a/(LW)	0
x27	Resistance(Dr/Kr)	0
x28	wc1 (days)	0
x29	RiverReachNo.ID	0
x30	USGS KVSR (ft/d	0
x31	Stage Fall94 (ft Ci	0

KzonesInIdaho	MFEM-WA-4500
Fixed Nodes Wells	**HID-2**
Fixed Nodes River (	
Bedrock	
Hydrography	

Param | Thick | Top | Xtra

x32	Stage Spring95 (ft	0
x33	Stage Fall94 (ft U	0
x34	Stage Spring95 (ft	0
x35	Stage Spring95-F.	0
x36	SepticPercolation	0.002273
x37	IrrigationPercolati	0.000219
x38	City of SPK Irr ove	0
x39	City of SPK Valley	0.001815
x40	LLSWD Irr over S	0
x41	City of Millwood Ir	0
x42	SPK County East	0
x43	PPID Irr over SVF	0
x44	NSID Irr over SVF	0
x45	WWD Irr over SV	0
x46	WD3-North Irr ove	0
x47	WD3-West Irr ove	0
x48	City of Post Falls I	0
x49	Rosspoint Irr over	0
x50	City of CDA Irr ove	0
x51	City of Hayden Irr	0
x52	City of Rathdrum I	0
x53	City of Spirit Lake	0
x54	City of Athol Irr ov	0
x55	Septic Perc Adjus	0
x56	IrrigationPercolati	0.001815
x57	Total PPN (ft/d)	0.00414

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Other Work and Findings

- Review of SWPA delineation methodology
  - Can we replicate the 2010 Special Wellhead Protection Areas?
- Regional stormwater recharge facilities
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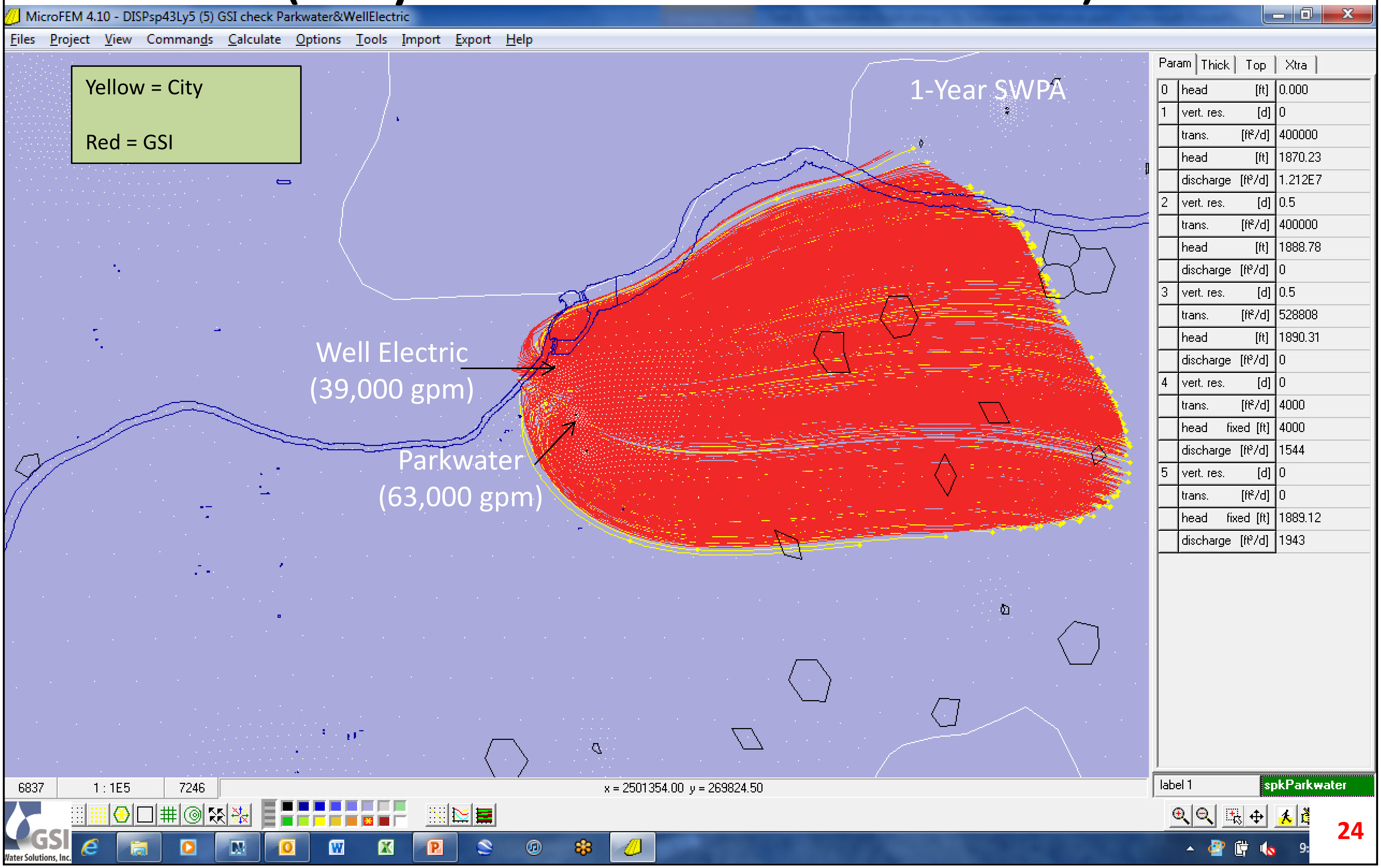
Wells Selected, And Rationale

- CID #4
  - Crosses underneath losing reach of Spokane River
- Fairchild #5
  - City found SWPA was sensitive to how river is modeled
- Pinecroft
  - In complex area (near bedrock knoll), and crosses river
- City of Spokane's Parkwater and Well Electric wells
  - Huge pumpers, near river

Parkwater and Well Electric (City and GSI Delineations)



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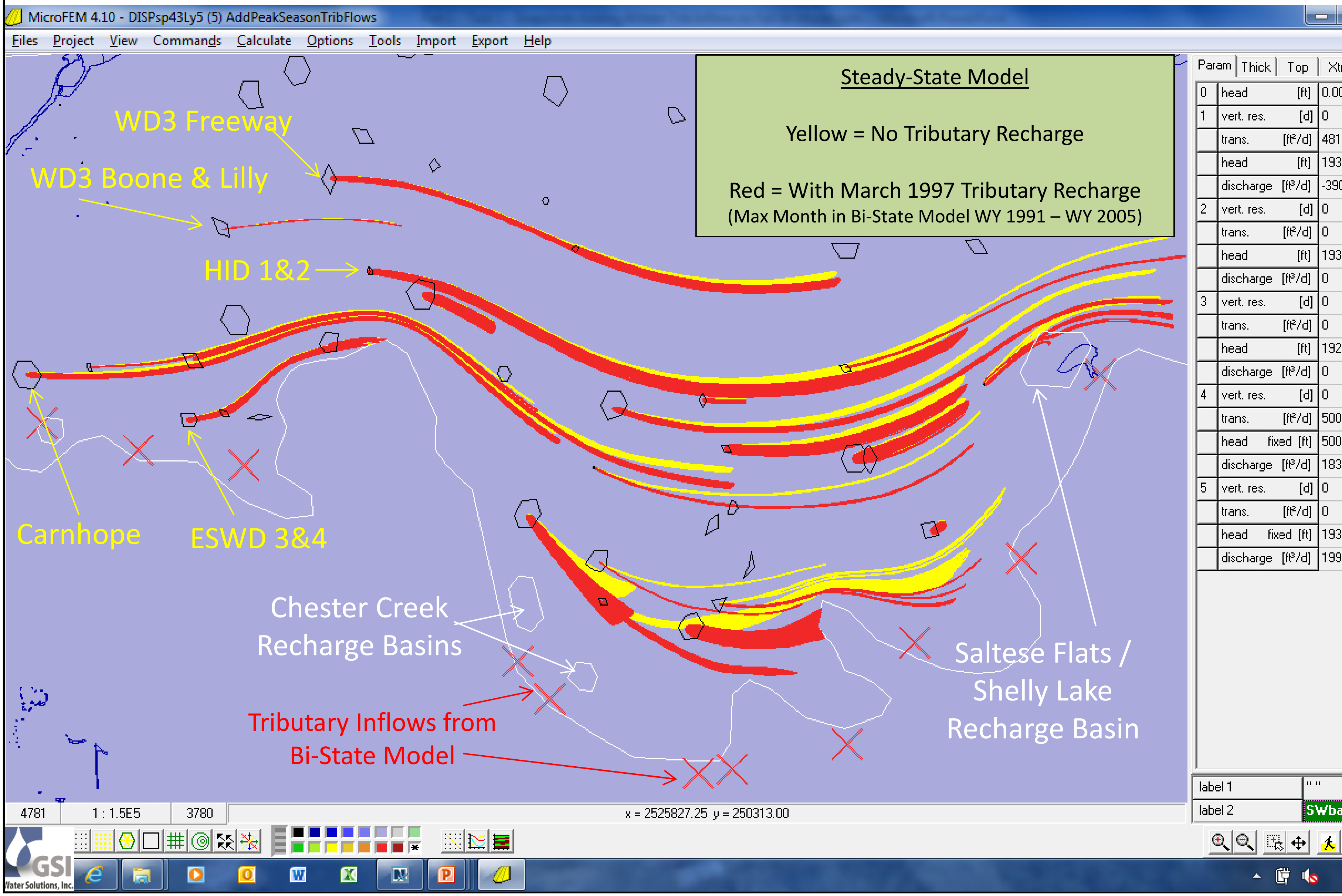
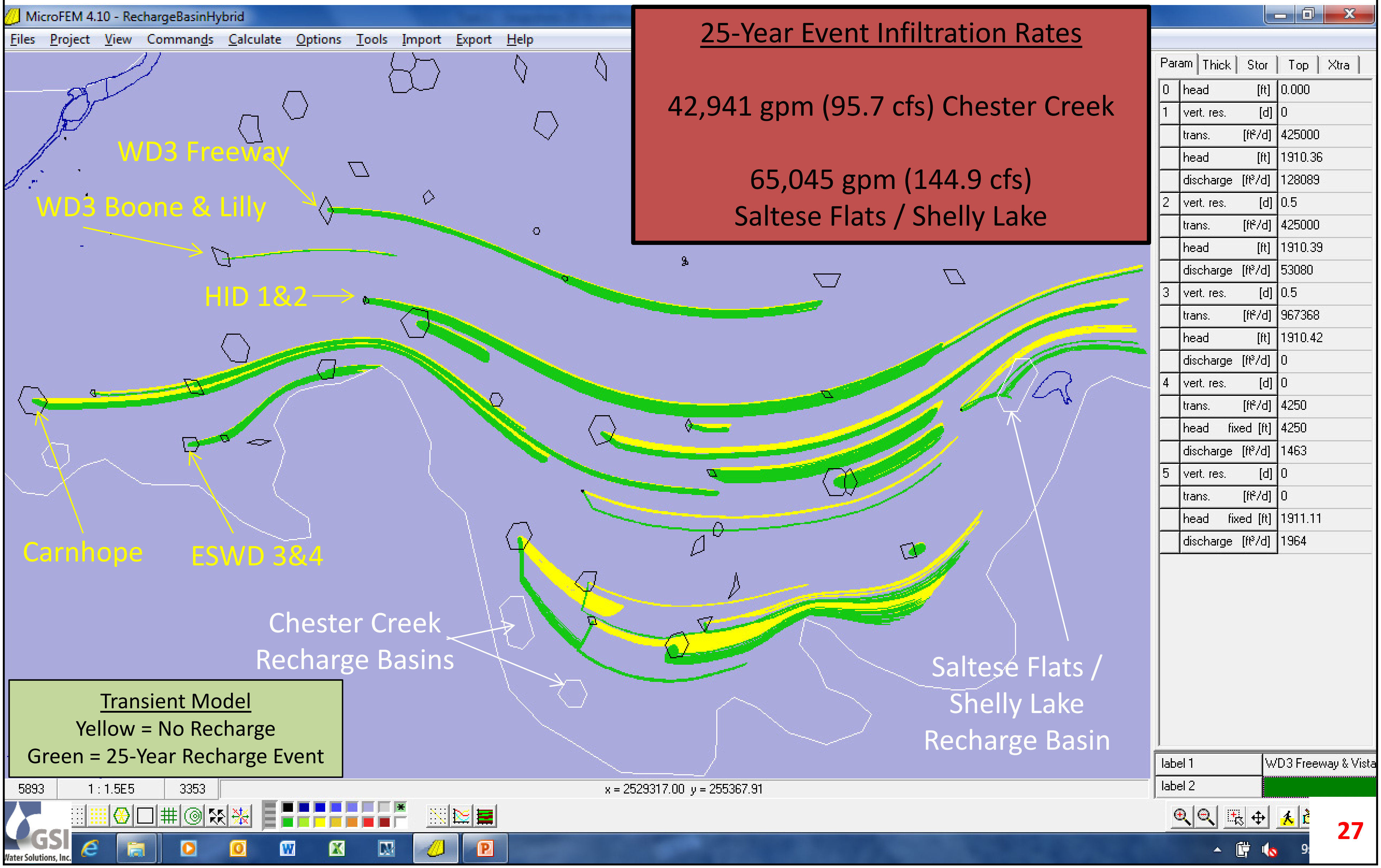
Bi-State Tributary Recharge Effects on Wells Near Chester Cr. And Saltese Recharge Basins



Influence of 25-Year Infiltration Events at the Chester Creek And Saltese Recharge Basins



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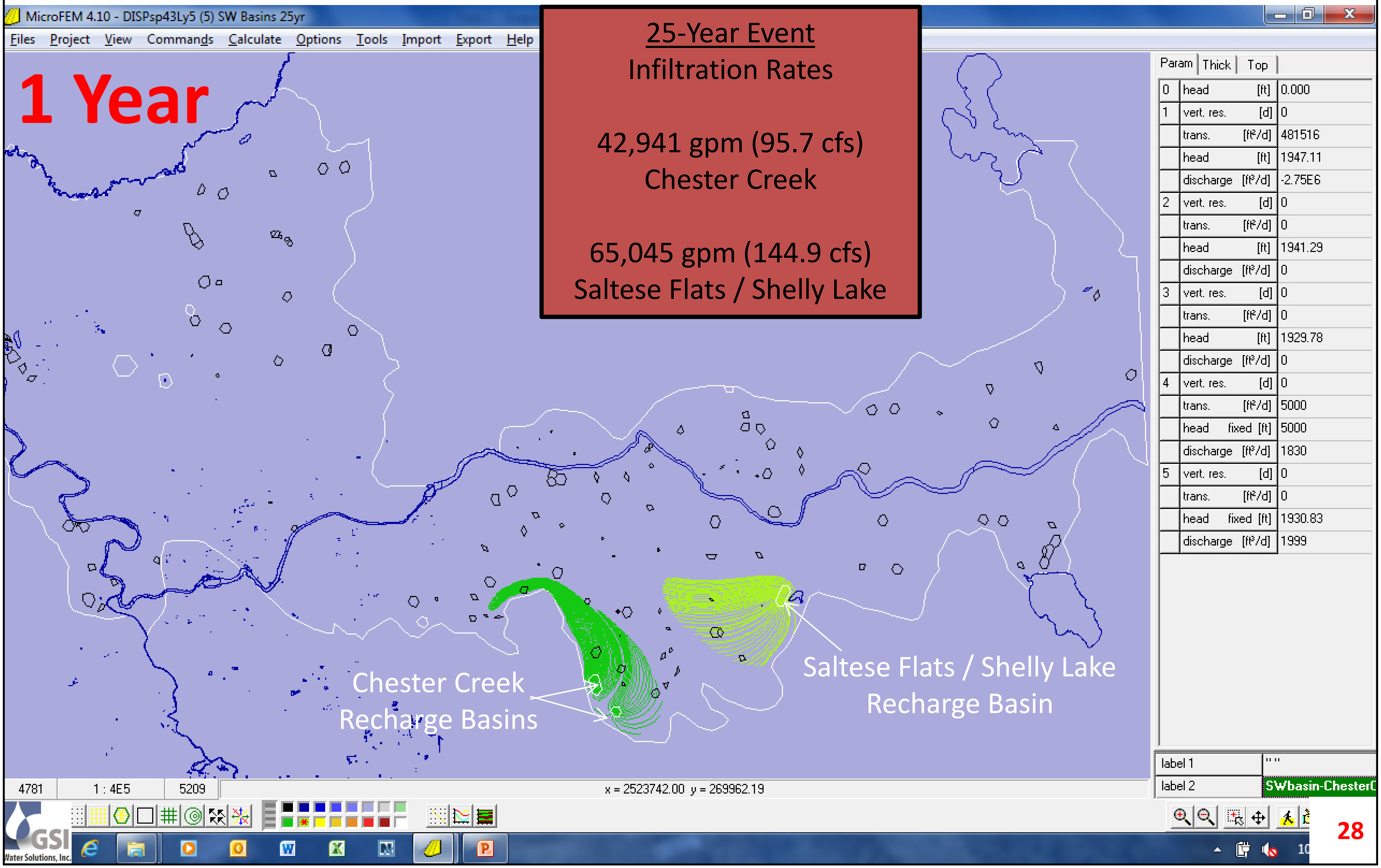

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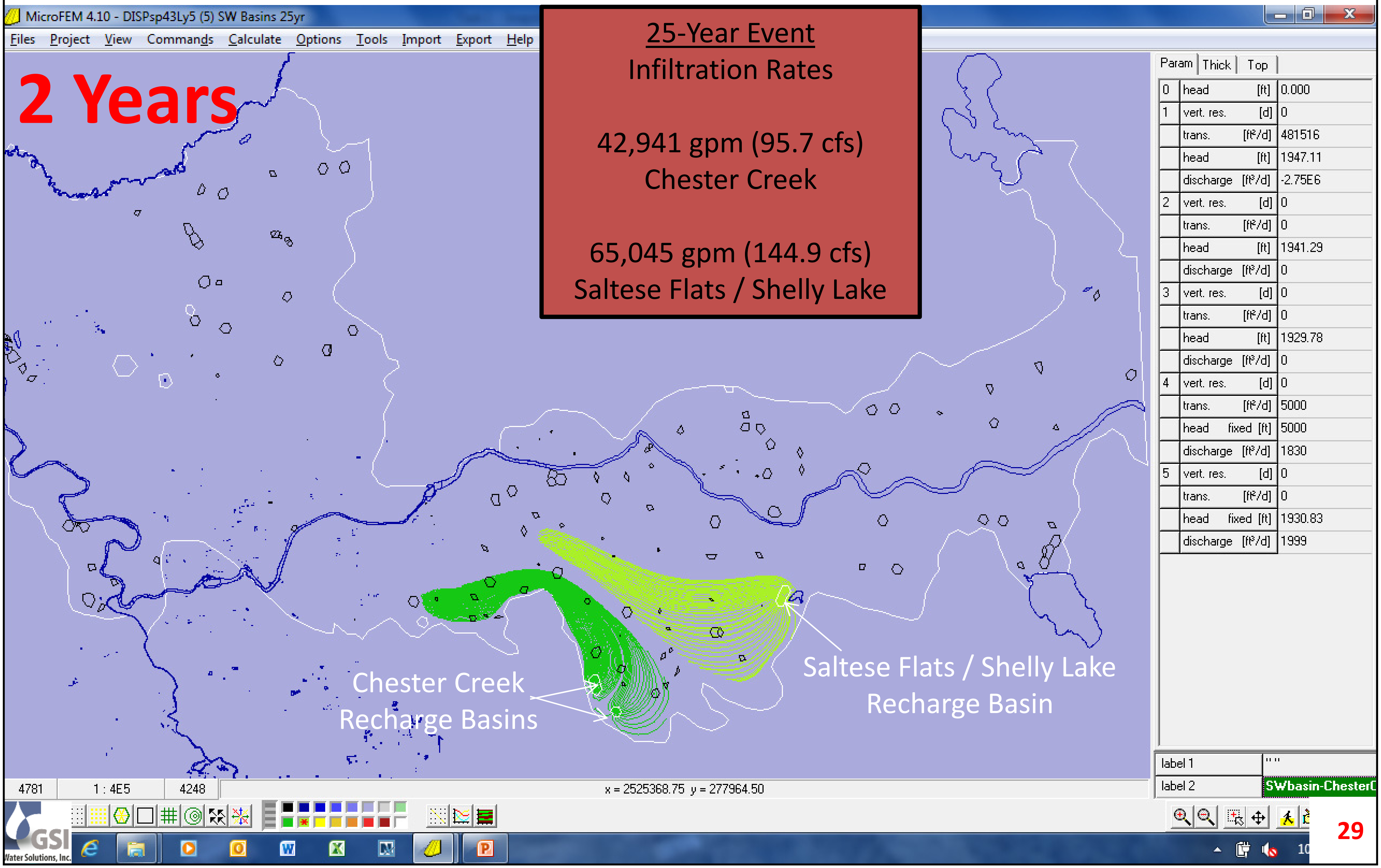

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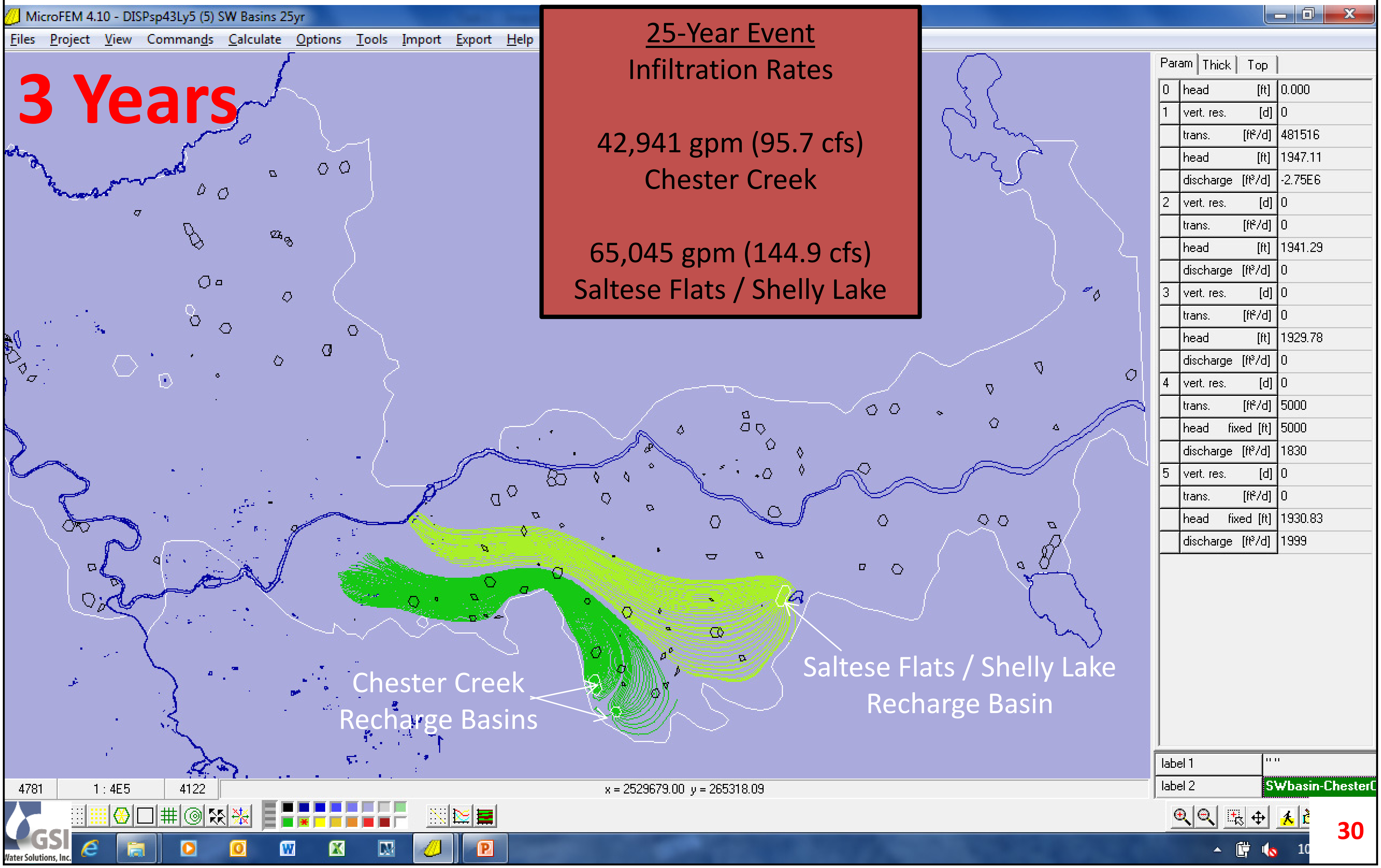

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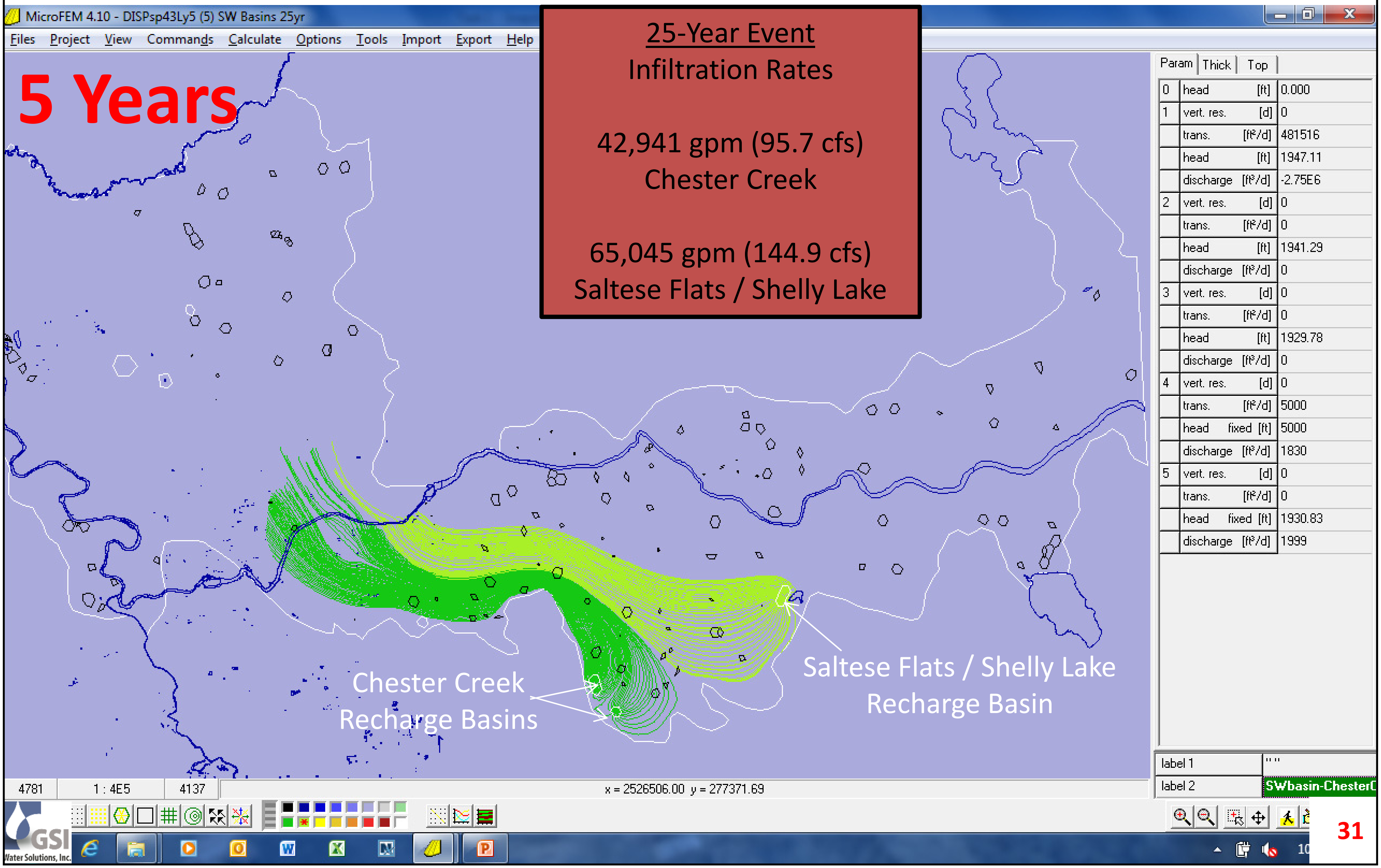

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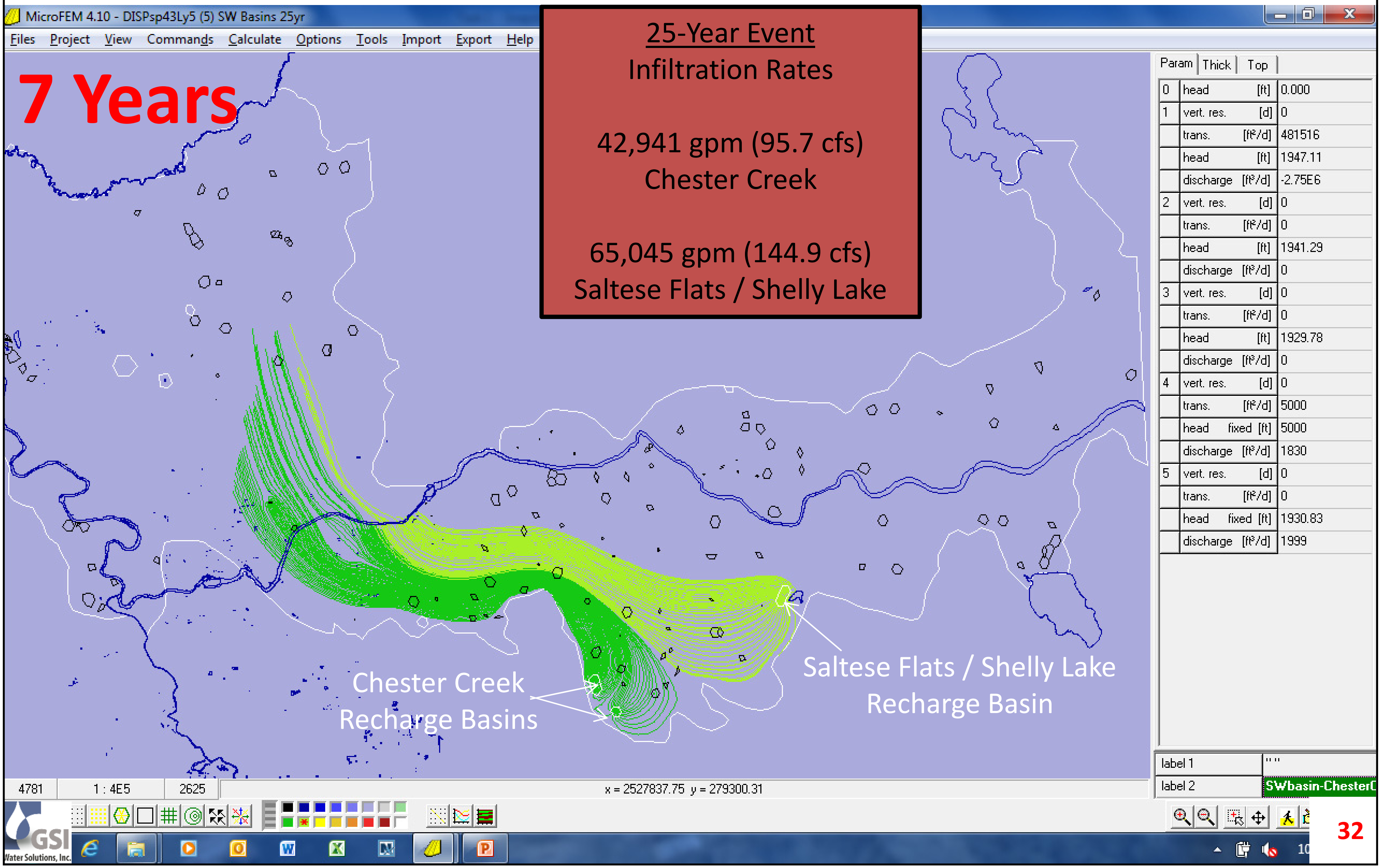

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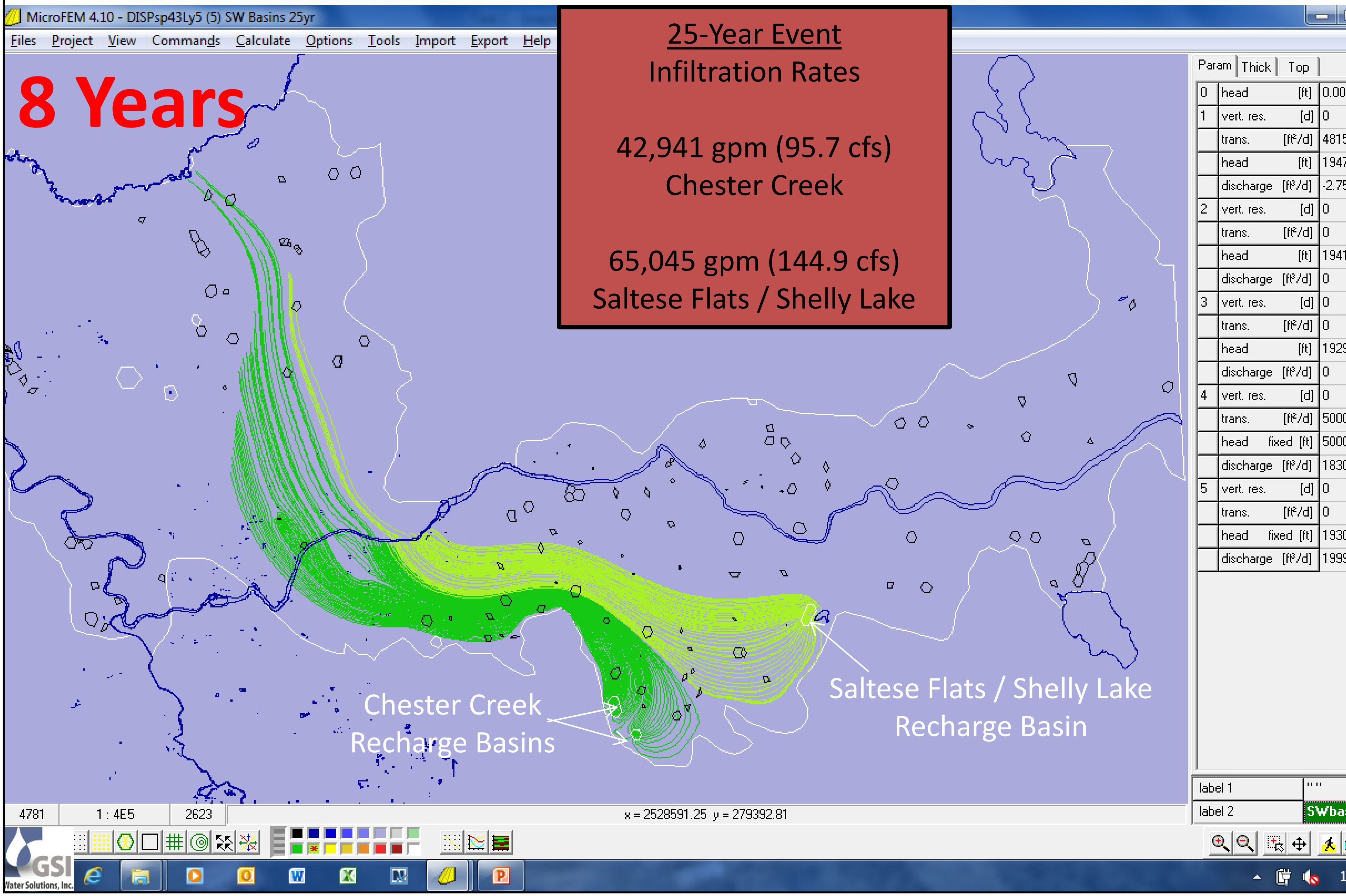

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